# WHY DO TEMPORARY HELP FIRMS PROVIDE FREE GENERAL SKILLS TRAINING?*

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The majority of U. S. temporary help supply (THS) firms offer nominally free, unrestricted computer skills training, a practice inconsistent with the competitive model of training. I propose and test a model in which firms offer general training to induce self-selection and perform screening of worker ability. The model implies, and the data confirm, that firms providing training attract higher ability workers yet pay them lower wages *after* training. Thus, beyond providing spot market labor, THS firms sell information about worker quality to their clients. The rapid growth of THS employment suggests that demand for worker screening is rising.

## Introduction

Open the help wanted pages of a local newspaper, and you are likely to find prominent advertisements from temporary help supply (THS) firms offering free skills training in subjects such as word processing, data entry, and in some cases computer programming. Manpower, Inc., the nation's largest THS employer, estimates that it trains more than 100,000 temporaries per year in the use of office automation software. The Bureau of Labor Statistics's (BLS) 1994 Occupational Compensation Survey (OCS) of Temporary Help Supply Services found that 89 percent of temporary workers are employed by establishments that provide some form of nominally free skills training. While not all workers train, a 1994 survey by the National Association of Temporary and Staffing Services (NATSS) found that almost one quarter of current THS workers had received skills training as temporaries [Steinberg 1994]. Training stints are normally brief but not uniformly so. Close to half of those trained received eleven plus hours of training, and a third received more than twenty hours. As Krueger [1993] reported and recent BLS analysis confirms [U. S. Department of Labor 1996], training is almost uni-

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versally given "up-front" with no explicit charge and no contractual requirement of past or continued employment.

While skills training expenditures by THS establishments are modest—estimated at 4 percent of the wages paid to trainees in 1995 and 8 percent in 1997—the puzzle they present to the competitive model of training merits investigation.[1] The Human Capital model of Becker [1964] predicts that firms will never bear the up-front cost of general skills training due to the threat of poaching or holdup. Recent theoretical work challenges this notion, however, and several empirical studies find that workers who receive general training from their employers do not appear to pay the costs through lower training wages as the Becker model predicts.[2] Yet this evidence is far from definitive. Most employer-sponsored training consists of both general and specific components. Additionally, because workers with unobservably greater earnings potential are typically more likely to receive training, this will bias empirical analyses against finding that trainees earn less than their marginal product during training.[3]

By contrast, the training provided by temporary help employers—primarily end user computer skills—is inherently general. Furthermore, because workers typically receive training up-front during unpaid hours prior to taking any paid assignments, productivity is inherently zero during the training period. It is therefore clear that that the direct, up-front costs of skills training, which include computer equipment, instructional materials, and training staff, are borne by THS firms.

This paper asks why temporary help firms provide free general skills training. The answer it provides is that in addition to fostering human capital, training serves two complementary in-

1. Industry estimates place training expenditures at $75 million in 1995 and $146 million in 1997 with an average cost per trainee of of $118 and $150, respectively [NATSS 1996b, 1998]. Wage-bill share calculations assume that 24 percent of temporary workers receive training [Steinberg 1994].

2. Models advanced by Acemoglu and Pischke [1998, 1999], Chang and Wang [1996], and Katz and Ziderman [1990] indicate that if employers hold private information about worker ability or skills, they may fund general skills training up front and capture the returns ex post. Studies that present evidence consistent with these models include Bishop [1996] and Baron, Berger, and Black [1997]. In a similar vein, Loewenstein and Spletzer [1998] show that training in off-site vocational courses, which typically provide general skills training, increases wages with the current employer less than it increases wages with future employers.

3. Acemoglu and Pischke [1998], Altonji and Spletzer [1991] and Bartel and Sicherman [1998] report that workers with higher skills as measured by standardized test scores are more likely to receive training, even conditional on education.

formational functions. One is to induce self-selection. Firms that offer training are able to differentially attract workers of greater unobserved ability. A second role is to facilitate worker screening. By tightly coupling worker training with worker skills testing, temporary help firms use training to privately screen the ability of workers whom they train. As the model below demonstrates, these dual purposes—self-selection and screening—are complementary. Without the ability to privately screen worker ability, firms would be unable to retain the high ability workers that they train and hence unable to capture the benefits of training.

The key premise of the theoretical model is that training is more productive and therefore more valuable to high ability workers. Workers are assumed to have imperfect prior knowledge of their ability while employers cannot initially perceive ability but observe it through training. Because of the learning advantage possessed by high ability workers, firms are able to offer a package of training and initially lower wages that induces self-selection. Workers of high perceived ability choose firms offering training in expectation of wage gains in permanent employment, while low ability workers are deterred by lower wages and limited expected gains. Firms profit from their training investment ex post via their short-run informational advantage about ability and thereby limited monopsony power.

The model further explores how firms will adjust wages and training to accommodate competitive pressure that dissipates these monopsony profits. At the imperfectly competitive equilibrium of the model, firms maximize profits by providing socially suboptimal quantities of training—where marginal social benefits exceed marginal private costs. Accordingly, as competitive conditions tighten, firms optimally dissipate profits into additional training. And because competition tends to pin wages down ex post, wages and training rise in tandem. Since trainees earn less on average than nontrainees, the implication is that competition narrows the wedge between training and nontraining wages.

To test these precepts, the paper exploits a restricted access Bureau of Labor Statistics study of wages and training in the THS industry encompassing an estimated 19 percent of all THS establishments and 36 percent of all THS workers as of 1994. The model's three implications find strong support. Wages are lower at firms offering training by a modest but statistically significant magnitude; heightened market competition, as measured by a Herfindahl index, substantially increases firms' propensity to offer free training; and, although training increases with market competition, the wage gap between training and nontraining firms contracts significantly.

The paper draws two conclusions. First, the presence of private information in the labor market appears a viable explanation for why firms fund workers' general human capital investments. Second, the emerging role of THS as a labor market information broker appears something more than an outgrowth of employers' desire for flexibility; it suggests that the demand for worker screening is rising.[4]

## I. The Temporary Help Supply Industry: Context and Training

The THS industry supplies its workers to client sites on an as-needed basis, charging the client an hourly fee that typically exceeds the wage paid to the THS worker by 35 to 65 percent [Autor, Levy, and Murnane 1999; ALM hereinafter]. Starting from a small base, THS employment grew rapidly throughout the 1990s, accounting for fully 10 percent of net U. S. employment growth over the decade. As of 2001, approximately 1 in 35 U. S. workers was an employee of Help Supply Services [SIC 7363], which is primarily composed of THS. Further, given turnover rates exceeding 350 percent [NATSS 1996a], the industry's point in time employment is likely to substantially understate the number of workers who have contact with it annually.

### A. Skills Training

Job skills required by THS firms (primarily clerical) were essentially static and training negligible until the proliferation of workplace computing technology generated demand for new and rapidly shifting expertise that could be mastered quickly [Oberle 1990]. As is documented in Table I, training is now a pervasive industry feature. Of 1002 U. S. THS establishments surveyed by

4. Autor [2000a] and Miles [2001] provide evidence that the development of unjust dismissal doctrine during the 1980s, which raised employer risks in terminating workers, contributed substantially to increased demand for employment screening through THS. Recent changes in the organization of production may have also increased the returns to selectivity in hiring [Acemoglu 1999; Cappelli and Wilk 1997; Levy and Murnane 1996].

TABLE I
SKILLS TRAINING: PREVALENCE AND POLICIES AT U. S. TEMPORARY HELP SUPPLY ESTABLISHMENTS, 1994

| Training provided | | Training policies | |
|---|---|---|---|
| All skills training | | *(multiple policies possible)* | |
| Any | 78% | "Up-front": All/Volunteers trained | 66% |
| White-collar workers | 56% | Establishment selects trainees | 34% |
| Clerical/sales workers | 81% | Client requests and pays | 36% |
| Blue-collar workers | 59% | No training | 22% |
| Computer skills training | | Training methods used (if training given) | |
| Any | 65% | *(multiple methods possible)* | |
| White-collar workers | 27% | Computer-based tutorials | 82% |
| Clerical/sales workers | 74% | Classroom work, lectures | 45% |
| Blue-collar workers | 14% | Written self-study materials | 52% |
| "Soft" skills training | | Audiovisual presentations | 47% |
| Any | 70% | Other | 14% |
| White-collar workers | 52% | | |
| Clerical/sales workers | 70% | | |
| Blue-collar workers | 58% | | |

Detailed training subject frequencies by major occupation group

| | Any | White-collar | Clerical/sales | Blue-collar |
|---|---|---|---|---|
| Word processing | 63% | 23% | 75% | 13% |
| Data entry | 58% | 19% | 69% | 11% |
| Computer programming languages | 22% | 12% | 23% | 1% |
| Customer service | 41% | 27% | 47% | 12% |
| Workplace rules/on-job conduct | 66% | 55% | 68% | 60% |
| Interview and resume development skills | 30% | 31% | 32% | 13% |
| Communications skills | 14% | 15% | 14% | 10% |

White-collar occupations are professional specialty, technical, and executive and managerial. Clerical/sales occupations are marketing, sales, and clerical and administrative support. Blue-collar occupations are precision production, craft and repair, machine operators, assemblers, and inspectors, transportation and material movement occupations, and handlers, equipment cleaners, and laborers. The sample includes 1002 temporary establishments supplying white-collar, clerical, or blue-collar temporary workers (establishments may supply more than one type of worker). Training statistics by collar include only the subsample of firms supplying workers in collar (n = 630, 859, and 755 for establishments supplying white-collar, clerical, and blue-collar workers, respectively). All frequencies are weighted by BLS national establishment sampling weights.

the Bureau of Labor Statistics (BLS) in 1994, 78 percent offered some form of skills training, and 65 percent provided computer skills training.[5]

5. Computerized tutorials are the most common form of instruction (82 percent), while 52 percent of establishments provide workbook exercises and 45 percent provide classroom-based training. As documented in Table I, firms employ

Almost without exception, training is given prior to or between assignments during unpaid hours with all fixed and marginal costs paid by the THS firm. ALM report that 44 percent of all skills training is given "up front" to allow workers to qualify for their first assignments. Trainees are not contractually bound to take or retain a job assignment afterwards, nor would such a contract be enforceable. While THS firms are prone to overstate the efficacy and depth of their training, evidence of its value is found in the fact that several leading firms sell the same training software and courses to corporate customers that they provide for free to their workers. For example, Manpower, Inc. charged $150 per worker per day to provide on-site training to approximately 35,000 of its clients' nontemporary workers in both 1996 and 1997.[6]

These facts run counter to the Human Capital model of training [Becker 1964]. In the competitive case analyzed by Becker, workers pay for general skills training by accepting a wage below their marginal product *during* training. The threat of poaching or holdup ensures that workers earn their full post-training marginal product, and hence up-front general skills training is not provided. By contrast, THS firms routinely provide training up front during unpaid hours, and hence the opportunity for workers to defray costs through a contemporaneously lower training wage is essentially nonexistent.

While several alternative explanations for these facts are conceivable within the standard framework—including skill-specificity, labor market monopsony, and low rates of worker turnover—none appears relevant. On the first point, if skills provided are firm-specific and hence (by definition) have no outside market value, firms may invest in training up front and reap returns ex post. Yet, logically, THS firms must (and do) train in general skills broadly demanded by their many clients. Limited worker mobility after

several training policies: managers select trainees (44 percent), clients request and fund training (46 percent), and, most prevalently, all volunteers are trained (85 percent). Since policies are not mutually exclusive, one might assume that more restrictive policies are applied to more valuable forms of training (e.g., computer skills training). Yet, among establishments that provide computer training exclusively and report only one training policy, 62 percent provide strictly up-front training. Nor is up-front computer training exclusively provided using the lowest cost methods. Among firms that offer exclusively up-front computer skills training, 25 percent provide classroom training. Hence, it appears that the bulk of computer training (both classroom and self-paced) is given on an up-front basis.

6. Personal communication, Sharon Canter, Director of Strategic Communications, Manpower, Inc., 1998.

training might also make up-front training profitable, for example, if THS firms effectively operated "company towns." Yet THS markets are generally not concentrated in a conventional sense, with most localities served by multiple firms. Finally, it is a common assumption in the literature that low employee turnover facilitates employer-sponsored general skills training since workers are unlikely to depart after training [Blinder and Krueger 1996; OECD 1993]. If this argument is correct, then THS establishments—where annual turnover averages several hundred percent—are an improbable venue for training.

### *B. Skills Training: Industry Motivations*

THS managers interviewed for this research primarily cited three motivations for providing skills training: worker recruitment, worker screening, and skill development. I discuss these in turn.[7]

Because turnover is high, recruiting at THS establishments is ongoing. Applicants to THS firms are heterogeneous, often having short work histories, limited credentials, and recent spells of unemployment [Houseman and Polivka 2000; Segal and Sullivan 1997a]. While THS firms offer a variety of benefits to attract workers, training is distinct among them because it is thought to differentially attract desirable workers. For example, a Manpower, Inc. advertisement to customers reads, "Manpower offers our employees many ongoing training opportunities—at no charge. This helps them increase their marketability and wage earning potential. Plus, it helps Manpower and Manpower Technical continue to attract and retain the best workers." The view embodied here that training is more valuable to higher ability workers concords with numerous findings cited earlier that suggest that training and worker ability are complements.

Closely related to the recruiting function is the idea that skills training facilitates worker assessment. For example, the industry trade association's guide *How to Buy Temporary Help/ Staffing Services* [NATSS undated] offers this advice to client firms, "How are potential temporary employees screened and tested? Does the company offer any training programs? This may help you determine the "quality" of workers you receive." This

7. Interviews were conducted with approximately two dozen THS executives. Additional fieldwork included performing site visits to THS firms, undergoing skills training and testing with software and materials provided by various firms, registering as a THS worker, and conducting a national survey of THS establishments (analyzed in Autor, Levy, and Murnane [1999]).

screening role has three components: pretraining exams measure the skills that workers possess; tests before and after training permit firms to gauge workers' ability to acquire new skills; and workers' motivation to take training is itself considered an emblem of skill or desirability.[8]

A final motivation for training is of course skill development. While in theory training could serve only a signaling role as in Spence [1973], the evidence cited above suggests that workers do gain marketable skills from the training experience.[9]

*C. Salient Institutional Features*

In addition to skills training, several institutional features of the THS industry bear emphasis. A first is labor supply. Survey data reveal that a large majority of THS workers would prefer a traditional (non-THS) employment relationship and hence use THS to search for permanent work or to supplement income during job search [Cohany 1996, 1998; Steinberg 1994, 1998]. Consistent with these motivations, 58 percent of workers exit the sector within a single calendar quarter, and 83 percent within two quarters [Segal and Sullivan 1997b].

Since most THS workers are job seekers, a second salient institutional feature is that THS firms hold a comparative advantage in facilitating arm's length worker screening. Because the availability and duration of THS assignments is inherently uncertain, THS arrangements provide clients with a means to audition workers for permanent employment at low cost and minimal legal risk [Autor 2000a]. THS firms rarely need to fire workers on behalf of their clients. Instead, THS firms simply do not provide additional assignments to workers who fail initial screens or perform poorly at client sites.

While employers have historically used THS to meet short-term labor needs, the importance of employment screening has grown. Houseman [1997] reports that among employers increasing their use of THS, 37 percent cite difficulty finding qualified workers, and

8. In all cases the author observed, training began and ended with assessment. Firms can of course test without training, and some do. This is unlikely to be as informative, however, because testing will not normally gauge motivation or learning ability.

9. It is also important to observe that the THS market is characterized by vertical (quality) differentiation, with competing firms offering differing packages of cost and service. For example, an article in *Purchasing* states [Evans-Correia 1991]: "most buyers agree that testing and training do make a more reliable worker . . . Businesses will have to pay a premium for temporaries with extensive testing and training. But . . .'it's worth it.' "

24 percent cite screening candidates for permanent employment as important motivations. Consistent with these facts, direct flows from THS into permanent employment are substantial. ALM find that between 11 and 18 percent of THS workers placed on assignment in a calendar month are directly hired by clients.

The model below reflects each of these institutional features. In the model, workers supply labor inelastically to the THS sector for a brief period during which time they are screened and subsequently hired by clients.

## II. Model

### A. Environment

This section offers a model of training provision in which firms offer general skills training to induce self-selection and perform subsequent screening of worker ability. The model builds on Salop and Salop [1976], Greenwald [1986], and Acemoglu and Pischke [1998, 1999; AP hereinafter]. Similarities with these models are discussed below. For the reader's convenience, I follow the notation and exposition in AP where possible. Each of the three empirical implications derived and tested below is unique to the current model.

The model has three periods. There are a large number of THS firms, some of which offer skills training, and some of which do not. I refer to these as training and nontraining firms. All firms and workers are risk neutral, and there is no discounting between periods. In the first period, workers may select to work at either a training or nontraining firm. Training firms provide general skills training $\tau$ to the workers whom they hire during the first period. Nontraining firms do not.

At the end of the first period, a fraction $\lambda$ of the workers at each THS firm quits for exogenous reasons to enter the secondhand market. In addition, workers may quit their first period THS firms voluntarily to enter the secondhand market. Workers in the secondhand market are hired by other THS firms. At the beginning of the third period, all workers are hired by clients into the permanent sector.

Workers produce nothing during the first period. In the second period and third period, each worker produces

$$f(\eta|\tau) = \eta(1 + \tau), \tag{1}$$

where $\eta$ is the general ability of the worker. This multiplicative specification embeds a key assumption of the model: ability and general skills training are complements.[10]

The cost for each worker trained is $c(\tau)$, which is incurred by the firm. The cost function is assumed to be everywhere strictly increasing, convex and differentiable with $c(0) = 0$, $c'(\cdot) > 0$, $c''(\cdot) > 0$, and $\lim_{\tau \to \infty} c'(\tau) = \infty$. This cost structure ensures that some training is socially optimal for high ability workers.

Workers may be of either two abilities, $\eta \in \{H, L\}$, where without loss of generality, I normalize $H = 1$ and $L = 0$. The distribution of worker ability is given by the parameter $\rho$ which is the fraction of low ability workers in the population.

The distribution from which worker ability is drawn is common knowledge, but neither firms nor workers know the ability of any individual in the first period. At the start of the first period, however, each worker receives an imperfectly informative signal of his or her ability, $\beta$, which I refer to as the worker's beliefs. This signal may be either high or low. The probability that a worker is of a given ability conditional on his beliefs is $P(\eta = H|\beta = h) = \delta_h$ and $P(\eta = H|\beta = l) = \delta_l$. The following inequality indicates that workers' beliefs are informative: $1 > \delta_h > 1 - \rho > \delta_l > 0$. A worker with high beliefs is more likely than the average worker to be of high ability, and vice versa for low belief workers.

Although firms cannot initially distinguish worker ability, they are able to observe it during training. If a firm trains in period 1, it privately observes the ability of each trainee; otherwise, not. The amount of training given to each worker is public knowledge. However, information acquired by firms about worker ability is held privately through the second period. At the end of the second period, each worker's ability becomes common knowledge.

The exact sequence of events in the model is as follows:

1. At the start of period 1, workers form beliefs about their ability based on the signal, $\beta$, that they privately receive. Each firm offers a package of training, $\tau$, and a first-period wage, $w_1 \geq 0$. Each worker then selects to apply to either a training or nontraining firm.
2. Firms hire all workers who apply. At this point, firms do not know the ability of any worker they have hired.
3. During training, firms learn the ability of each worker

10. Any concave function with positive cross-partial derivatives between training and ability would work equally well.

whom they have trained. Firms that do not train do not learn the ability of any worker.

4. At the end of the first period, a fraction $\lambda$ of each firm's workforce separates for exogenous reasons to enter the secondhand market. Incumbent firms offer remaining workers a second period wage $w_2$. At training firms, this wage may differ between high and low ability workers. The wage will not be contingent upon output, however; if a worker stays with the incumbent firm, the worker receives the specified wage in the second period.[11] After receiving the incumbent firm's wage offer, workers may quit to enter the secondhand market.
5. At the start of the second period, outside THS firms may make wage offers $v(\tau)$ to workers in the secondhand market. Because training provided is public knowledge, the secondhand wage may depend upon training received.[12]
6. Workers are deployed to client sites in period 2 where they produce output according to (1). At the end of the second period, each worker's ability becomes public knowledge.
7. At the start of the third period, all workers are hired by clients into the permanent sector and again produce output according to (1).

Depending on parameter values, the model can generate several equilibria. The equilibrium of empirical relevance, analyzed below, is a separating equilibrium in which workers with high ability beliefs self-select to receive training while those with low beliefs do not. To simplify the exposition, I first explore a setting in which training and nontraining firms do not earn equal profits. After deriving the conditions for a separating equilibrium, I generalize the model to explore how free entry and hence equalized profits impact training and wages.

### *B. Equilibrium with Restricted Entry*

To obtain the necessary conditions for the separating equilibrium, I work backward from the final (third) period. It is immediate that because worker ability and training provided are

11. In the case of contingent output contracts, the model would be trivial. Firms would simply offer output contracts of epsilon length to measure worker ability. Private information would be irrelevant.

12. For simplicity, I rule out the possibility of raids in which firms attempt to bid away workers who are not in the secondhand market. It is straightforward to show that the equilibrium is robust to this generalization.

common knowledge in the third period, third period wages will be set competitively: $w_3 = \eta_i(1 + \tau_i)$.

To retain workers in the second period, incumbent firms must pay them at least what they can earn in the secondhand market. Period 2 wages will accordingly be set by wages offered to separators. Denote the expected productivity of separators as $v(\tau)$, equal to the product of their expected ability and the training they have received:

$$v(\tau) = E[\eta|\text{separator}]\cdot(1 + \tau). \tag{2}$$

The value of (2) will differ by firm type (training or nontraining).

At the separating equilibrium, the worker pool of training firms is composed exclusively of high belief workers. Although as noted above, a fraction of the high belief pool, $(1 - \delta_h)$, is of low ability, each worker is offered the same training since firms cannot initially distinguish ability. At the end of period 1, training firms lose a fraction $\lambda$ of their workers to exogenous turnover. Training firms will then use their private information about ability acquired during training to set period 2 wages. Workers of low ability are offered a wage of zero, their revealed productivity. Because some high ability workers have turned over exogenously, all low ability workers will also separate to pool with the exogenous departures. Substituting into (2), the expected productivity and hence the outside wage for separators from training firms is

$$v(\tau) = \left(\frac{\lambda\delta_h}{\lambda\delta_h + (1 - \delta_h)}\right)\cdot(1 + \tau). \tag{3}$$

This equation has four implications. First, because the secondhand pool is a mixture of exogenous departures of expected ability $\delta_h$ and endogenous departures of low ability ($\eta = 0$), the expected productivity of trainees in the secondhand market is strictly below the expected productivity of the average trainee. Hence, the secondhand pool is characterized by adverse selection.

Second, although some separators from training firms are of high ability, all workers in the secondhand market command a wage of only $v(\tau)$. This follows because outside buyers cannot distinguish individual ability and individual workers cannot credibly communicate the reason they separated from their first period firm (i.e., all would claim to be exogenous separators). Accordingly, firms in the secondhand market offer each worker the expected productivity of the entire pool, $v(\tau)$.

A third implication of (3) is that to retain high ability workers trained during period 1, incumbent firms need only pay them a wage of $w_2(\tau) = v(\tau)$, strictly below their actual productivity. This result is due to the private information that training firms hold about worker ability and hence limited monopsony power. Although training firms recognize which of their workers are high ability, firms in the secondhand market do not. The opportunity wage of high ability workers trained during the first period is therefore $v(\tau)$. This result exploits Greenwald's [1986] insight that incumbent employers' informational advantage about worker ability generates adverse selection in the secondhand market, thereby depressing outside wages.

A final implication of (3) is that training provided during the first period increases trainees' productivity by more than it increases their period 2 wages. This can be seen by observing that $E[f'(\tau|\beta = h)] = \delta_h$ whereas $v'(\tau) < \delta_h$. Although all training firm separators in the secondhand market have received training, a disproportionate share are low ability workers who do not benefit from training. By contrast, all workers retained by training firms are of high ability. Equation (3) therefore implies that firms are able to increase the gap between retained workers' productivity and their outside wage through training.

Solving for training firms' optimal period 1 training level given this wage structure is straightforward. A client's willingness to pay for workers supplied by a given firm during period 2 is simply the expected productivity of workers who are retained: $(1 + \tau)$. Training firms choose wages and training $\tau^*$ to maximize profits, and the first-order condition is

$$c'(\tau^*) = (1 - \lambda)\delta_h[1 - v'(\tau)],\ w_1 = 0. \tag{4}$$

This condition will be satisfied at $\tau^* > 0$. Although firms incur training costs up front in the first period, they are able to earn positive profits in the second period by capitalizing on their informational advantage about ability developed through training. Hence, as AP explore in greater detail, because training increases workers' productivity by more than it raises their outside wages, firms find it profitable to pay for general skills training.

At the separating equilibrium, the worker pool of nontraining firms is comprised exclusively of low belief workers. Given that a fraction $\delta_l$ of these workers is of high ability, it is possible that nontraining firms would also find it profitable to train. To simplify the analysis, I assume that the marginal cost of the first unit of training is strictly positive such that $c'(0) > (1 - \lambda)\delta_l(1 - v'(0))$. This structure implies that the gains to training the small fraction of high ability workers in the low belief pool does not offset the losses incurred by training the remainder.[13]

At the end of period 1, a fraction $\lambda$ of the workers at nontraining firms turns over exogenously and enters the secondhand market. Because these workers are a representative subset of the initial pool and have not received training, it follows that their secondhand wage is $v(0) = \delta_l$. Hence, incumbent nontraining firms pay their workers $w_2(0) = v(0)$ to retain them.

### C. Separating Condition

A key result of the information structure visible from (3) is that high ability trainees receive less than their marginal product during period 2. How much less? A comparison of $v(\tau^*)$ and $v(0)$ reveals that period 2 wages at training firms may well be *lower* than at nontraining firms, even though ability and training are both higher. This result follows from the fact that it is *not* productivity that sets wages at training firms but rather the degree of adverse selection in the outside market as seen in (3).

Since period 1 wages are identically zero for trainees and nontrainees and expected period 3 wages are higher for trainees, all workers would self-select to receive training unless $v(\tau^*) < v(0)$. Observe, however, that although all workers would forgo some earnings to receive training, workers with high beliefs will forgo *more* because their expected period 3 gains are larger ($\delta_h > \delta_l$). Accordingly, the necessary and sufficient condition for worker separation is simply

$$\delta_h\tau^* > v(0) - v(\tau^*) > \delta_l\tau^*. \tag{5}$$

At a separating equilibrium, the expected period 3 wage gain for high belief workers offsets at a minimum their training wage penalty in period 2, while for low ability belief workers it does not. Note that this equation is not satisfied at all parameter values.[14] I focus here on the case where (5) is satisfied; a separating equilibrium holds. A necessary implication of (5), tested below, is

13. In this expression, $v'(0) = \lambda\delta/(\lambda\delta_l + (1 - \delta_l))$. This expression is comparable to (3) except that $\delta_l$ replaces $\delta_h$ to reflect the expected ability of low belief workers.

14. When it is not satisfied, the model generally yields a pooling equilibrium, discussed further in Autor [2000b].

that $v(0) - v(\tau^*) > 0$. At a separating equilibrium, wages at training firms are *lower* than at nontraining firms.[15]

The separating equilibrium given by (5) depends critically upon two features of the model. A first is the complementarity between training and ability. Because training and ability are complements, high belief workers apply to training firms, and low belief workers apply to nontraining firms. Training therefore serves as a self-selection device as in Salop and Salop [1976]. If training and ability were not complements, either all workers or no workers would choose training. A separating equilibrium would be infeasible.

The second critical feature of the model is that training elicits private information about worker ability. If training firms did not acquire private information about worker ability, competitive markets would ensure, as Becker [1964] observed, that each trainee received his marginal product after training. And since trainees are on average more productive than nontrainees, (5) could not be satisfied, and training would not be provided.[16] Hence, the dual roles played by training in the model—self-selection and information acquisition—are complementary. By inducing self-selection of high ability workers, training improves the firm's worker pool. By revealing private information about worker ability, training then allows the firm to profit from this pool.

While the model is of course stylized, these private-information-based results appear consistent with the personnel policies of THS firms. After initial training and testing, THS workers are normally first placed at lower wage, lower skill assignments and subsequently given better placements as they demonstrate success. Workers who test and train successfully and perform well at assignments advance more rapidly while workers who perform poorly are rarely offered placements. Consequently, poor workers

15. Note that this equilibrium satisfies the intuitive criterion of Cho and Kreps [1987]. A question not addressed explicitly by the model is whether workers could apply to multiple temporary help firms, receive training from each, and then conditional on being high ability, induce a bidding war among firms to raise their wages to their actual productivity. Implicitly, the timing of the model rules out this case since workers must remain at one firm to receive training during period 1. In practice, the case of multiple temporary help firm registrations does not appear particularly important. Segal and Sullivan [1997b, Table 3] report that only one in eight THS workers holds positions from more than one THS firm. THS managers interviewed explained that because workers receive superior assignments as they demonstrate success, it behooves them to take assignments primarily from a single firm.

16. Note that satisfaction of (5) is sufficient but not necessary for training. A necessary condition for training is that trainees do not receive their marginal product after training. See Autor [2000b].

disproportionately turn over while good workers frequently remain. Hence, there is little question that incumbent THS employers develop a better informational position regarding worker ability than do outside buyers.

*D. Equilibrium: The Impact of Competition on Training and Wages*

At present, these results are a partial equilibrium inasmuch as training firms earn monopsony profits while nontraining firms do not. Here, I briefly explore how firms may adjust wages and training to accommodate competitive pressure that equalize and dissipate these monopsony profits.

Let the parameter $\pi \geq 0$ equal the minimum per-worker profit or "markup" demanded by each incumbent or entrant THS firm.[17] Assume as above that there are a large number of training and nontraining firms and that (5) is satisfied; i.e., the separating equilibrium holds. Competition will ensure that per-worker profits are reduced to $\pi$ at each firm and further that all firms of a given type employ the same wage and training policies. An important maintained assumption is that while competition dissipates rents arising from asymmetric information, it does not dispel asymmetric information directly since firms must continue to test and train to observe ability.[18]

Define $V(\tau,\pi)$ as the maximum wage a firm is willing to pay as a function of a worker's training and the firm's reservation profit. At nontraining firms, the minimum profit requirement is simply reflected in a debit to the wage:

$$V(0,\pi) = \delta_l - \pi. \tag{6}$$

This wage, equal to the expected productivity of separators in the secondhand market minus the markup, generates profits equal to the profit floor.

17. This reservation profit parameter may arise in several contexts, for example from a fixed cost of market entry that serves as a profit floor as in Salop [1979] or from Cournot competition among market incumbents (cf. Tirole [1988, section 5.5]). In the empirical work ahead, I use a Herfindahl index to proxy market conditions and hence either interpretation is natural. More generally, firms facing a constant elasticity of labor supply will optimally set wages at a productivity-cost markdown inversely proportional to this elasticity. If, plausibly, added market competition increases the elasticity of labor supply, firms will reduce their markdowns accordingly.

18. Since firms compete for both workers and clients, competition could arise in the product or labor market or both. I maintain the assumption that clients pay expected productivity and hence the locus of competition is the labor market.

The wage for workers at training firms is similarly determined by the expected productivity of training firm separators minus the markup:

$$V(\tau(\pi), \pi) = \frac{\lambda\delta_h(1 + \tau(\pi))}{\lambda\delta_h + (1 - \delta_h)} - \pi. \tag{7}$$

Notice that the profit parameter enters the wage function twice: directly because, in equilibrium, firms hiring separators must receive the reservation profit; and indirectly, because the training level $\tau(\pi)$ will optimally depend upon $\pi$. Whereas training firms previously chose the training level via an unconstrained profit maximization, they now choose training to maximize *worker utility* (i.e., the sum of workers' wages over three periods) subject to the minimum profit constraint $\pi$.[19]

Substituting (7) into the worker's utility function gives the firm's maximization:

(8)

$$\max_{w_1,\tau} E[w_1 + w_2 + w_3|\beta = h] = w_1 + V(\tau(\pi), \pi) + \delta_h\tau \quad \text{subject to}$$

$$(1 - \lambda)\delta_h[(1 + \tau) - V(\tau(\pi), \pi)] - c(\tau) - w_1 \geq \pi, \quad w_1 \geq 0.$$

Solving for $\tau(\pi)$, the firm's optimal training choice given $\pi$, yields the following expression for training as a function of reservation profits and worker ability:[20]

$$c(\tau(\pi)) = (1 + \tau(\pi))(1 - \lambda)\delta_h\left[1 - \frac{\lambda\delta_h}{\lambda\delta_h + (1 - \delta_h)}\right] - \pi[1 - (1 - \lambda)\delta_h]. \tag{9}$$

This equation provides two key empirical implications. The first is that competition *increases* training. This can be seen by taking the derivative of training with respect to the profit parameter,

19. Observe that if a firm failed to maximize worker utility for a given profit level, a competitor—also making profits $\pi$ but offering a preferred combination of wages and training—would attract all high ability belief workers.

20. The working paper version of this manuscript [Autor 2000b] derives a more complicated expression for $c(\tau(\pi))$, equal to the minimum of (9) and the socially optimal level of training, $\tau^{**}$. Because the case in which (9) *exceeds* the socially optimal level of training is unlikely, I suppress it in the exposition. Equations (9)–(11) assume that $c(\tau(\pi)) \leq \tau^{**}$.

$$(10)\qquad \frac{d\tau(\pi)}{d\pi} = -\frac{(1-(1-\lambda)\delta_h)}{c'(\tau(\pi)) - c'(\tau^*)} < 0,$$

where $c'(\tau^*)$ is given by (4). This derivative is negative; a fall in $\pi$ (i.e., more competition) raises training.

The second empirical implication is that competition increases wages at training firms by *more* than at nontraining firms. At nontraining firms, competition increases wages one-for-one; a reduction in the markup yields an equivalent increase in the wage ($\partial V(0,\pi)/\partial\pi = -1$). At training firms, however, competition increases wages through two channels: directly through a fall in $\pi$, and indirectly through an increase in $\tau(\pi)$. Hence, competition increases wages at training firms by *more* than one-for-one:

$$(11)\qquad \frac{dV(\tau(\pi),\pi)}{d\pi} = -1 + \frac{d\tau(\pi)}{d\pi}\left[\frac{\lambda\delta_h}{\lambda\delta_h + (1-\delta_h)}\right] < -1.$$

Recall, however, that in the separating equilibrium, wages at training firms are below those of nontraining firms. The predicted effect of competition is therefore to narrow the wedge between training and nontraining wages.

The intuition for these two comparative static results is visible in Figure I which plots the marginal cost of skills training against the marginal gain to revenue. This gain is apportioned between worker wages and firm profits according to the adverse selection condition set by (3). At the imperfectly competitive equilibrium of the model, firms maximize profits by providing socially suboptimal training, where marginal social benefits exceed marginal private costs. This is depicted as point $\tau^*$ in the figure. Now consider a case where in response to competition, a training firm wishes to increase workers' earnings by the area A-B-C-D. One response is to pay A-B-C-D out of profits. Alternatively, the firm can increase training from $\tau^*$ to $\tau^{**}$, thereby raising earnings equivalently but at cost A-C-D, which is strictly less than A-B-C-D. Accordingly, as competitive conditions tighten, firms will optimally dissipate profits into additional training.[21] And because competition in the secondhand market pins down the wage ex post, wages and training rise in tandem.

21. It can be shown by an application of the envelope theorem that at $\tau^*$, the net cost of increasing wages slightly through additional training is zero.

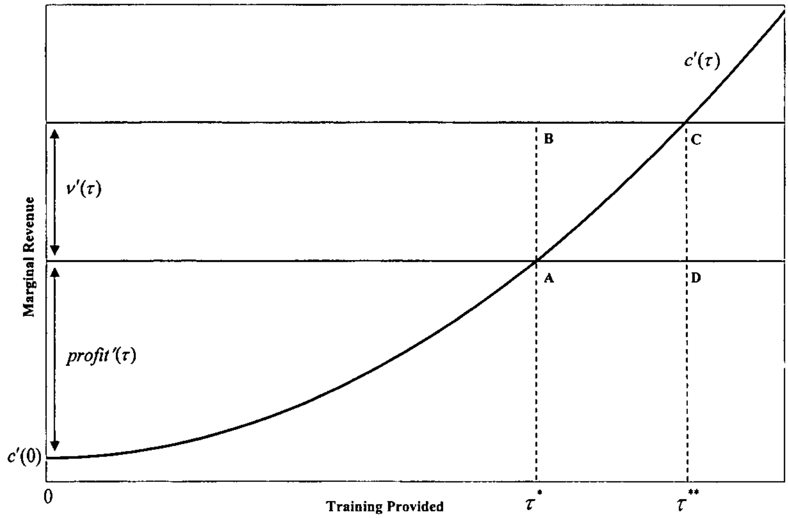


FIGURE I
Why Additional Training Is an Efficient Means to Raise Wages

To close the model, note finally that first period wages at training firms will generally be equal to zero. Although training firms could elect to pass profits through into first period wages rather than into training, Figure I indicates why this case is unlikely to occur.[22]

## E. Empirical Implications

In the subsequent sections, I test the three key predictions of the model: 1) that wages (for comparable jobs) are lower at training firms than at nontraining firms, a necessary condition for training to generate self-selection by worker ability; 2) that firms provide more free skills training as market competition increases; and 3) that wage gains spurred by competition are comparatively larger for workers at training than at nontraining firms. Each of these theoretical predictions receives empirical support. I also discuss alternative interpretations and provide supplementary evidence using survey data from ALM.

22. Autor [2000b] derives the conditions under which first period wages will be positive. Interestingly, the ALM survey captured a small number of examples of THS establishments that paid positive wages during training, typically at the rate of $1 per hour.

## III. Data Sources

The BLS Occupational Compensation Survey of Temporary Help Supply Services (OCS hereafter) provides a unique data source for analyzing the relationships among wages, training, and competition at temporary help establishments. Conducted in 1994, the survey enumerates employment, wages, training offerings, and training policies at 1033 temporary help establishments in 104 Metropolitan Statistical Areas (MSAs), Primary Metropolitan Statistical Areas (PMSAs), or nonmetropolitan counties throughout the United States (which, for brevity, are referred to as MSAs). An establishment is defined as all outlets of a firm in an MSA and may encompass multiple offices. Thirty-eight percent of establishments belong to firms residing in multiple regions. The sample comprises an estimated 19 percent of all THS establishments employing twenty or more temporary workers in 1994 and 34 percent of all THS employment.[23]

Surveyed establishments provided data for a payroll reference month on the hourly wage of assigned THS workers classified into 47 detailed technical, clerical, blue-collar, and service occupations. For brevity, I refer to the first three of these groups as white-collar, clerical/sales, and blue-collar, respectively. Service occupations (3.9 percent of the sample) were excluded from the analysis because they do not normally receive training, as were observations where occupation was unspecified, leaving 333,888 observations at 1002 establishments.[24]

In addition to wages and job titles, the primary component of the survey used below is detailed information collected on skills training subjects and policies summarized in Table I. Respondents reported whether they offer skills training to each "collar" in eight subject categories: word processing, data entry, computer programming languages, workplace rules and on-the-job conduct, customer service skills, interview and resume development skills, communications skills, and other. I focus here on computer skills

23. Franchises of a firm are counted as independent establishments. The mean number of establishments owned by multiregion firms is 7.9 with a standard deviation of 14.2. Confidentiality requirements prevent disclosure of the range of establishments owned by multiregion firms. The survey universe includes only establishments with twenty plus workers. It is likely that establishments with fewer workers provide a negligible share of THS employment.

24. Inclusion of service occupations changes none of the substantive results. White-collar occupations include professional specialty, technical occupations, accountants and executive, administrative, and managerial occupations. Clerical occupations include marketing, sales, and clerical and administrative support occupations. Blue-collar occupations include precision production, craft and repair, machine operators, assemblers, and inspectors, transportation and material movement occupations, and helpers, handlers, and equipment cleaners. See BLS (1996) for corresponding SIC codes and job descriptions.

because they are well defined, hold market value, and clearly constitute general skills training.

Training policies were categorized as follows: all workers receive some training; workers volunteer; establishment selects workers for training; and clients request and pay for training. Multiple responses were permitted. Unlike the training subject data, these policies refer to the entire establishment rather than workers in a collar. If a firm specifies multiple training policies, it cannot normally be determined which policy applies to what subjects or worker groups. For purposes of the empirical work, I combine the "all workers trained" category with the "workers volunteer" category into an "all/volunteers" category because it is apparent that many establishments that report training *all* workers actually train *all workers who volunteer.* Since the majority (62 percent) of firms that checked the "all" category also checked the "volunteers" category, this decision had little impact on the substantive results. Firms that did not report any training subjects (or only reported "other") were coded as nontraining firms, and firms that offered training only to a specific collar(s) were coded as nontraining firms for the collar(s) that they do not train.[25] The data do not enumerate which workers receive what training or what fraction is trained. To account for the pairing of individual worker wage data with establishment level training data, I use Huber-White standard errors with a clustering correction throughout. For further discussion of the OCS survey, see U. S. Department of Labor [1996].[26]

## IV. Are Wages Lower at Establishments That Offer Training?

### *A. Wage Differentials between Training and Nontraining Establishments*

For up-front skills training to induce self-selection by ability, wages at training firms must be lower than at nontraining firms.

25. Hence, for example, if a firm had a "client requests/pays" policy and offered exclusively word processing skills to clerical workers, it would be coded as having a "no training" policy for white- and blue-collar workers.

26. Two sets of BLS supplied probability sampling weights, national and area (MSA), are used for the analysis. Wage models use national weights to approximate the U. S. THS wage distribution while models of the relationship between THS market concentration and skills training or wages use area weights since the MSA is hypothesized as the relevant market. For some analyses, I also employ regional and occupational employment data from the 1994 Current Population Survey (CPS) Outgoing Rotation Group files and the Census 1990 IPUMS 1 percent sample [Ruggles and Sobeck et al. 1997]. All CPS and Census data are weighted by sampling weights.

Before turning to regression estimates, Table II provides a bivariate comparison of mean log wages at training and nontraining establishments in the nine major occupational groups in the sample (three in white-collar, two in clerical/sales, four in blue-collar). The comparison is striking. In eight of nine occupations, mean wages are *lower* at training establishments, with an average occupational wage difference of minus 6.4 log points.

To make a more formal comparison, I estimate the following equation:

$$W_{ij} = \alpha + \delta T_j + \gamma E_j + O_i + R_j + \varepsilon_{ij}, \tag{12}$$

where $W_{ij}$ is the natural logarithm of hourly wages of individual $(i)$ at establishment $(j)$. $T_j$ is a vector of establishment training variables, $E_j$ is a vector of establishment characteristics, $O_i$ is a vector of major occupation indicators corresponding to the categories in Table II, $R_j$ is a vector of 103 MSA indicators, and $\varepsilon_{ij}$ is a random error term assumed to be composed of a person-specific and establishment-specific component. Given this error structure, (12) is estimated with Huber-White standard errors that allow for clustering at establishments. The parameter of interest is $\delta$, the wage differential at training establishments. Due to the inclusion of narrow MSA and occupation indicators, $\delta$ effectively measures wage differentials among local THS establishments potentially competing for the same workers and supplying labor to the same customers.

The first three columns of Table III presents wage models for the full sample. The initial specification estimates the training wage differential with an indicator variable that is equal to one if the establishment provides computer skills training. The coefficient on this variable indicates that wages at training establishments are on average 2.0 log points lower, which is significant at the 5 percent level.

To probe alternative explanations for this wage differential, the second column introduces two additional controls. The first is the log of establishment size. Because large establishments typically provide more consistent THS assignments, workers at these establishments may accept lower hourly wages. And since large establishments are substantially more likely to offer training, it is plausible that the observed training-wage relationship in part reflects a size-wage differential. The second control introduced is the log of THS employment in the major occupation ("collar") in the MSA. This variable may proxy for market scale effects that

TABLE II
COMPARISON OF LOG HOURLY WAGES OF THS WORKERS AT TRAINING AND NONTRAINING ESTABLISHMENTS BY MAJOR OCCUPATION

| | Log hourly wages | | | Training | Nontraining |
|---|---|---|---|---|---|
| | Free training | No training | Difference | No. workers No. estabs | No. workers No. estabs |
| White-collar | | | | | |
| *All* | 2.66 | 2.79 | −0.13 | 10,497 | 13,034 |
| | (0.04) | (0.05) | (0.06) | 360 | 270 |
| *Professional specialty* | 3.05 | 3.17 | −0.13 | 2,918 | 5,016 |
| | (0.02) | (0.03) | (0.04) | 200 | 170 |
| *Technical* | 2.41 | 2.45 | −0.05 | 5,805 | 6,554 |
| | (0.04) | (0.05) | (0.06) | 274 | 213 |
| *Accountants and* | 2.72 | 2.77 | −0.06 | 1,774 | 1,464 |
| *auditors* | (0.04) | (0.06) | (0.07) | 187 | 134 |
| Clerical/sales | | | | | |
| *All* | 2.01 | 2.09 | −0.09 | 156,419 | 17,925 |
| | (0.01) | (0.03) | (0.03) | 693 | 166 |
| *Clerical and* | 2.02 | 2.10 | −0.08 | 145,997 | 16,957 |
| *administrative support* | (0.01) | (0.02) | (0.03) | 690 | 164 |
| *Marketing and sales* | 1.84 | 1.97 | −0.13 | 10,422 | 1,328 |
| | (0.03) | (0.08) | (0.09) | 435 | 42 |
| Blue-collar | | | | | |
| *All* | 1.76 | 1.78 | −0.02 | 85,756 | 50,257 |
| | (0.01) | (0.01) | (0.02) | 461 | 294 |
| *Precision production,* | 1.89 | 1.97 | −0.08 | 8,193 | 6,142 |
| *craft, and repair* | (0.04) | (0.04) | (0.06) | 216 | 162 |
| *Operators, assemblers,* | 1.79 | 1.82 | −0.03 | 19,867 | 12,851 |
| *and inspectors* | (0.02) | (0.02) | (0.03) | 310 | 187 |
| *Transport, material* | 1.89 | 1.92 | −0.03 | 1,884 | 1,809 |
| *movement* | (0.06) | (0.05) | (0.08) | 186 | 126 |
| *Handlers, equipment* | 1.72 | 1.71 | 0.01 | 55,812 | 29,445 |
| *cleaners, and laborers* | (0.01) | (0.01) | (0.02) | 445 | 252 |

All estimates are weighted by BLS national probability sampling weights. Standard errors in parentheses are corrected for clustering of observations at the establishment level. Sample includes 1002 establishments, which may employ workers in multiple occupations.

are correlated with both wages and skills training.[27] As column (2) indicates, wages are relatively lower at larger THS establishments and are significantly higher in MSAs where the scale of

27. Establishment size is measured by survey reference month employment within-collar at each establishment. An establishment is coded as supplying labor in a collar if workers were employed in that collar during the survey reference month. It is likely that some establishments provide workers in collars not present during the survey month. Market size is measured by survey reference month MSA-collar THS employment.

TABLE III
OLS ESTIMATES OF THE RELATIONSHIP BETWEEN ESTABLISHMENT TRAINING POLICIES AND WORKER WAGES, POOLED AND FIXED EFFECTS MODELS
DEPENDENT VARIABLE IS THE LOG HOURLY WAGE OF THS WORKERS

| | *A. Pooled estimates* | | | *B. Fixed effect estimates* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Any training provided | −0.020<br>(0.010) | −0.019<br>(0.010) | | −0.035<br>(0.0179) | −0.034<br>(0.0176) | |
| Up-front training provided | | | −0.025<br>(0.010) | | | −0.049<br>(0.019) |
| Firm selects trainees | | | 0.005<br>(0.013) | | | −0.026<br>(0.040) |
| Client requests/pays for training | | | 0.003<br>(0.012) | | | 0.061<br>(0.039) |
| Log of establishment size | | −0.026<br>(0.004) | −0.025<br>(0.004) | | −0.020<br>(0.007) | −0.022<br>(0.007) |
| Log of THS employment in MSA-collar | | 0.051<br>(0.012) | 0.050<br>(0.011) | | 0.023<br>(0.013) | 0.024<br>(0.013) |
| Firm fixed effects | No | No | No | Yes | Yes | Yes |
| $R^2$ | 0.62 | 0.62 | 0.62 | 0.54 | 0.54 | 0.54 |
| n | 333,888 | 333,888 | 333,888 | 201,314 | 201,314 | 201,314 |

All models are weighted by OCS national establishment probability weights and include 103 metropolitan statistical area (MSA) dummies and 8 major occupation dummies. Huber-White standard errors in parentheses are corrected for clustering at the establishment level (1002 establishments). Fixed effect models are limited to workers employed at multiregion firms (50 firms and 395 establishments). Training policies are not mutually exclusive.

THS employment is relatively greater. Notably, inclusion of these measures has little impact on the training wage differential.

The final specification in Panel A allows the establishment wage differentials to vary by training policy. The wage differential for the up-front training policy is estimated at −2.5 log points, which is highly significant. By contrast, the "client requests" and "firm selects" policy coefficients are close to zero and insignificant. Hence, the negative wage impact of employment at a training establishment is exclusively accounted for by the up-front training policy.

Since workers receive training during nonwork hours, the wage differentials estimated above do not reflect "training wages" in the conventional sense of Becker [1964]. Rather, they indicate that workers at establishments providing up-front training receive lower wages while assigned to client sites, either before or after they have received training (or both).

### B. Fixed Effects Estimates

A potential concern with these estimates is that establishments providing up-front training might pay lower wages in part because of other amenities offered or due to unobserved (negative) quality differences that are correlated with training provision. One can partially explore this concern by exploiting an unusual feature of the OCS data. As noted above, 38 percent of sampled establishments belong to multiregion firms, many of which do not offer uniform training across establishments. This within-firm variation permits inclusion of fixed effects that remove each firm's mean wage "policy," thereby controlling for differences in quality or amenities prevailing firmwide. Accordingly, the fixed effects models identify average occupational pay differentials across training and nontraining establishments belonging to the same firm.

To perform these estimates, I limit the sample to workers of multiregion establishments, leaving 50 firms, 395 establishments, and 201,314 worker observations. Panel B of Table III presents the fixed effects estimates. In the single training indicator specification augmented with firm fixed effects, the point estimate for the training wage differential is −3.5 log points. Adding controls for establishment size and MSA-collar THS employment does not appreciably change this coefficient. When the wage impact of training is allowed to vary by training policy in column (3), it is again the up-front training policy that accounts for the negative training-wage relationship. Conditional on firm fixed effects and detailed MSA and occupational controls, the up-front policy remains significantly negative at −4.9 log points. Apparently, even within individual firms, only those establishments offering unrestricted skills training pay lower wages than their local competitors.[28]

Although unobserved negative selection on ability at training establishments could give rise to similar wage patterns, this does not appear likely. For example, ALM (Table 12) report that establishments offering skills training are *substantially more selective* in hiring THS workers than nontraining establishments. In

28. Wage differentials were also estimated separately by collar and by major occupation (nine total) using both pooled and fixed effects models. These disaggregated results confirm that the negative training wage relationship is pervasive among blue-collar and clerical occupations, is driven by up-front training policies, and is comparable in magnitude to the pooled occupation results above. White-collar estimates generally find an insignificantly negative training-wage relationship. When training subject dummies (corresponding to the seven training areas) were included in the models, they were not as a group significant. Policy variables were robust to their inclusion. Further details and specification tests are available in Autor [2000b].

particular, holding occupation constant, training establishments are significantly more likely than nontraining establishments in the same MSAs to require a high school diploma (19 percent), previous experience (14 percent), previous training or skills certification (25 percent), and good English or verbal skills (15 percent). These facts suggest that unobserved selection works against a finding of a negative training-wage relationship.

### *C. The Costs and Benefits of Training*

It is important to ask whether these modest differentials are of an appropriate economic magnitude. According to sources cited above, industry training expenditures equaled 1.0 percent of the wage-bill in 1995, and 73 percent of workers were employed at establishments offering training. Together, these figures imply that training establishments would need to charge workers a wage differential of 1.4 percentage points to recover costs. This figure comports closely to estimated overall training wage differential of −2.0 log points in column (1) Table III. While this calculation is crude, it suggests that the wage differential workers receive at training establishments is at least roughly in line with the cost of training and hence may plausibly be compensated by subsequent wage gains.

To complete this argument, it would be valuable to directly estimate the wage gains that trainees receive upon leaving THS. While the OCS data do not permit such a test, survey data from ALM provide evidence on a closely related question: do workers at training establishments find permanent placements with greater frequency than other THS workers? Since wages for THS workers typically increase by 10 to 20 percent upon entering permanent employment [Segal and Sullivan 1998], a greater hiring rate out of training establishments would indicate greater expected wage gains for trainees.

THS establishments surveyed by ALM were asked the following question, "Of the workers [within the establishment's largest occupation category] who worked at an assignment last month, about what percentage were hired by a customer last month?" A regression of establishment responses on occupation main effects, MSA dummies, an indicator variable for whether or not the firm provides free training and an intercept yields the following estimate (standard errors are in parentheses):

$$\text{(13)}\quad \text{Percent Hired} = \underset{(2.42)}{8.34} + \underset{(2.00)}{6.07} \times \text{Skills-Training} - \underset{(2.21)}{0.49} \times \text{Clerical/Sales} - \underset{(2.49)}{1.51} \times \text{White-Collar}$$

$$(\text{n} = 381, R^2 = 0.05).$$

Given a base placement frequency of 10.5 percent at nontraining establishments, this estimate indicates that workers at training establishments are substantially (approximately 60 percent) more likely to find a permanent placement through their THS employer in a given month. Hence, these data support the model's central implication that the wage profile of workers at training firms is, on average, steeper.[29]

## V. The Impact of Market Concentration on the Prevalence of Skills Training

At the imperfectly competitive equilibrium of the model, firms maximize profits by providing training at socially suboptimal levels. The model therefore implies that as competitive conditions tighten, firms optimally dissipate profits into additional training. This implication contrasts with the Becker [1964] model where training levels are invariant to competitive conditions (because they are always at the social optimum).

The OCS data are well suited to testing how training provision responds to market conditions. The sample includes data on approximately 20 percent of the 1994 U. S. universe of THS establishments, with much greater coverage in larger MSAs. Additionally, the sampling weights implicitly provide complete information on the count and size distribution of firms not directly surveyed. Using the weights, one may calculate a Herfindahl concentration measure for each of the three major occupational collars (white-collar, clerical/sales, and blue-collar) in each MSA:

$$\text{(14)}\qquad H_{jk} = \sum_{i=1}^{n_k} \omega_{ik} \cdot \left( E_{ijk} \Big/ \sum_{i=1}^{n_k} E_{ijk}\omega_{ik} \right)^2,$$

29. Note that these differences in exit probabilities imply a 3.5 month shorter mean time to permanent employment at training establishments (9.5 months at nontraining establishments versus 6.0 months at training establishments). Assuming that non-THS wages average 10 percent above THS wages [Segal and Sullivan 1998], workers at training establishments can expect 2 percent greater total earnings over 9.5 months (including both THS and non-THS wages) than workers at nontraining establishments.

where $(j)$ indexes occupational collars, $(k)$ indexes MSAs, $(i)$ indexes establishments within a region, $E_{ijk}$ is establishment occupational employment, $\omega_{ik}$ is the BLS area sampling probability weight for the establishment, and $n_k$ is the number of establishments in the MSA.[30]

The calculation assumes that "collar" distributions at nonsampled establishments are comparable to those of sampled establishments and that MSAs constitute distinct THS markets. This latter assumption is clearly an approximation but is reasonable given that THS markets are by nature local, circumscribed by the distance THS workers are willing to commute to assignments. A complete measure of competition in the THS industry would also include factors such as the concentration of customers and the opportunity for direct hire of temporary workers by non-THS firms. While these measures are unfortunately not available, it is not obvious that their omission will introduce bias.

Summary characteristics of regional markets both overall and by collar are provided in Table IV. THS market concentration in sampled MSAs is on average moderate but varies significantly. Some of the smallest nonmetropolitan markets contain only a single establishment while the least concentrated MSAs have a Herfindahl of under 0.05.

### A. Estimation

Using a cross-section regression to estimate the concentration-training relationship may be problematic since many local market factors may affect training such as the distribution of worker skills and preferences, demand by clients, regional price levels, etc. While one might locate proxies for some of these factors, this approach is unlikely to be convincing. An alternative strategy pursued here is to identify the concentration-training relationship using *within*-market variation in the relative concentration of white-collar, clerical/sales, and blue-collar occupations. Specifically, I estimate the following model:

$$T_{ijk} = \alpha + \sigma H_{jk} + C_j + \phi S_{ij} + \zeta E_{ij} + \gamma M_{jk} + R_k + \varepsilon_{ijk}, \tag{15}$$

30. This equation is analogous to the textbook Herfindahl except that each sampled establishment's market share is deflated by the employment count at nonsampled establishments while the sum of squared market shares is inflated by the imputed shares of nonsampled establishments. An establishment's area weight is the ratio of sampled to unsampled establishments in the establishment's size class in an MSA.

TABLE IV
MEANS AND STANDARD DEVIATIONS OF REGIONAL THS MARKETS IN 103 METROPOLITAN STATISTICAL AREAS BY MAJOR OCCUPATION GROUP

| | All | White-collar | Clerical/sales | Blue-collar |
|---|---|---|---|---|
| Total establishments | 30.5 | 20.1 | 24.8 | 19.7 |
| | (32.0) | (20.6) | (24.8) | (17.8) |
| Mean establishment size | 333.2 | 37.4 | 203.0 | 180.1 |
| | (462.1) | (64.6) | (312.2) | (266.3) |
| Total THS employment | 6,471 | 681 | 3,317 | 2,476 |
| | (7,968) | (935) | (4,656) | (3,281) |
| Herfindahl index | 0.21 | 0.29 | 0.23 | 0.24 |
| | (0.27) | (0.28) | (0.25) | (0.25) |
| Total MSA employment (1000s) | 801.1 | 264.1 | 227.7 | 184.0 |
| | (812.3) | (271.5) | (232.4) | (188.8) |
| THS employment share | 1.0% | 0.3% | 1.6% | 2.0% |
| | (0.5%) | (0.3%) | (0.8%) | (1.1%) |

Standard deviations are in parentheses. All statistics are unweighted means of OCS regional data except for MSA employment data obtained from the 1994 Current Population Survey Outgoing Rotation Group files. Columns 1 through 4 contain 104, 97, 103, and 102 regions respectively. CPS data are used for 83 of 103 regions (the smallest 20 are not identified in CPS public use files).

where $(i)$ denotes establishments, $(j)$ denotes occupational collars, and $(k)$ denotes regions. $T_{ijk}$ is an indicator variable equal to one if an establishment offers training to workers in a given collar, $H_{jk}$ is the MSA-collar Herfindahl index from (14), $C_j$ is a vector of collar main effects, $S_{ij}$ is a vector of establishment occupation share variables within collars, $E_{ij}$ is establishment-collar employment, $M_{jk}$ is MSA-collar THS employment, $\alpha$ is a common intercept, and $\varepsilon_{ijk}$ is a random error term composed of establishment, MSA, and occupation-specific components.[31] In addition, I include a vector of 103 MSA dummies, $R_k$, to absorb unobserved factors common to occupations in each market that affect the overall propensity to train. The parameter $\sigma$ measures the direct impact of competition on training propensity. Because the Herfindahl measure increases with concentration, the predicted sign of $\sigma$ is negative.

Four computer skills training variables are used for the estimates: word processing, data entry, computer programming

31. Occupational share variables correspond to the nine major occupation groups. Two share variables are included for white-collar, one for clerical/sales, and three for blue-collar (where one share variable is omitted in each of the three collars). Variables sum to one within a collar.

languages, and an any-computer-training aggregate. Since the dependent variable is dichotomous, a nonlinear model would be appropriate but is impractical due to the large number of indicator variables in the equation. Accordingly, I estimate a linear probability model with Huber-White standard errors that account for clustering within MSA-collar cells and are robust to arbitrary forms of heteroskedasticity. While the earlier results focused on training *policies* and not on training *subjects,* I focus on training subjects here for two reasons. First, the model's prediction is that firms vary their training provision in response to market competition while the policies that complement this training are invariant. Second and more pragmatically, the identification strategy requires an outcome variable that varies by collar, as do the training subject dummies.[32]

Panel A of Table V presents estimates of (15) for the four training outcomes. In each case, the concentration measure is negatively related to computer skills provision and, in three of four cases, significantly so. The most substantial relationships are found for word processing and data entry training (the most prevalent computer skills offerings). As would be expected, larger establishments are more likely to offer skills training. Interestingly, despite the substantial (negative) correlation between concentration and market size ($\rho \approx -.80$ in each collar), MSA-collar THS employment is estimated to have no significant impact on training propensity in these models.[33]

Paralleling the wage estimates, Panel B of Table V presents fixed effects estimates of the training probability models. Because these models control for each firm's average propensity to train, they provide a check on the possibility that the pooled results are driven by the differential presence of multiregion, high training-propensity firms in large competitive markets. These fixed effects estimates prove quite comparable to the pooled results in Panel A. Appar-

32. The empirical strategy differs from the theory in one dimension. While the model predicts that added competition will shift the intensive margin of training, the empirical work explores its impact on the extensive margin. A practical explanation for the substitution is that the data speak only to the prevalence of training and not its depth. More substantively, the model's prediction of movement along only one margin is an artifact of the simplifying assumption of two discrete skill groups, implying a constant "take-up" rate. If one posits a continuous ability distribution, it is readily seen that greater depth of training implies that the participation constraint (5) is satisfied for workers lower in the distribution, leading a greater fraction to prefer training.

33. Models that exclude the Herfindahl find a significant positive impact of MSA-collar THS employment on training prevalence.

TABLE V

LINEAR PROBABILITY ESTIMATES OF THE IMPACT OF THS MARKET CONCENTRATION ON COMPUTER SKILLS TRAINING, POOLED AND FIXED EFFECTS MODELS

DEPENDENT VARIABLE EQUAL TO ONE IF ESTABLISHMENT PROVIDES COMPUTER SKILLS TRAINING TO WORKERS IN COLLAR (WHITE/CLERICAL-SALES/BLUE)

| | *A. Pooled estimates* | | | | *B. Fixed effect estimates* | | | |
|---|---|---|---|---|---|---|---|---|
| | Word processing | Data entry | Computer programming | Any computer training | Word processing | Data entry | Computer programming | Any computer training |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Herfindahl in MSA-collar | −0.379 | −0.525 | −0.111 | −0.254 | −0.362 | −0.332 | 0.036 | −0.401 |
| | (0.122) | (0.120) | (0.115) | (0.123) | (0.131) | (0.104) | (0.113) | (0.121) |
| Log estab size | 0.082 | 0.082 | 0.027 | 0.080 | 0.033 | 0.049 | 0.013 | 0.048 |
| | (0.009) | (0.009) | (0.007) | (0.010) | (0.022) | (0.020) | (0.020) | (0.021) |
| Log MSA-collar THS employment | 0.019 | −0.005 | 0.008 | 0.018 | 0.022 | 0.030 | 0.034 | 0.025 |
| | (0.013) | (0.015) | (0.013) | (0.014) | (0.019) | (0.018) | (0.019) | (0.020) |
| Intercept | 0.065 | 0.260 | −0.080 | 0.096 | 0.193 | 0.220 | −0.096 | 0.145 |
| | (0.133) | (0.160) | (0.131) | (0.145) | (0.265) | (0.254) | (0.251) | (0.284) |
| Firm fixed effects | No | No | No | No | Yes | Yes | Yes | Yes |
| $R^2$ | 0.34 | 0.32 | 0.13 | 0.32 | 0.70 | 0.70 | 0.49 | 0.68 |
| n | 2,244 | 2,244 | 2,244 | 2,244 | 1,020 | 1,020 | 1,020 | 1,020 |

Huber-White standard errors in parentheses account for correlation of errors within region-collar cells. Models are weighted by BLS area probability sampling weights. All models include 102 MSA indicators, collar main effects, and establishment occupational share measures within collars: 2 in white-collar, 1 in clerical/sales, and 3 in blue-collar. Each establishment may supply (and train) workers in 1, 2, or 3 collars. Pooled estimates include 1002 establishments, 630 supplying white-collar, 859 supplying clerical/sales, and 755 supplying blue-collar workers. Fixed effects estimates are limited to 50 multiregion firms comprising 395 establishments, 285 supplying white-collar, 379 supplying clerical/sales, and 356 supplying blue-collar workers.

ently, even among establishments belonging to the same firm, training provision is quite sensitive to local market conditions.

### *B. Magnitudes and Specification Tests*

The estimated impact of concentration on training is of meaningful economic magnitude. Taking the example of word-processing training, a one standard deviation increase in market competition is predicted to increase training prevalence by nine percentage points. A movement from the most to the least concentrated market would increase training prevalence by a sizable 38 percentage points. Using the overall training frequencies found in Table I, this impact translates into an elasticity at the sample mean of −0.15. The comparable elasticity for data entry training is −0.23 and for any computer skills training is −0.09.

Because the "difference-in-difference" estimates above are necessarily somewhat restrictive, I also provide in Appendix 1 estimates of the impact of concentration on training propensity performed separately by collar and excluding (by necessity) MSA fixed effects. Unlike the earlier models, these "difference" estimates identify the concentration-training relationship using exclusively *inter*market variation in concentration. Although their precision is substantially reduced by exclusion of MSA fixed effects, these estimates confirm that a negative training-concentration relationship obtains for all training outcomes and collars.

OLS models were also estimated using the log of the Herfindahl measure, yielding smaller elasticities and weaker while still significant $t$-statistics. A quadratic Herfindahl term was never significant. Models that include the local MSA-collar unemployment rate as an alternative measure of the degree of competition in the local labor market generally find a positive but insignificant impact of local unemployment on firms' training propensity.[34] Along with further detailed specification tests, Autor [2000b] also provides instrumental variables estimates of equation (15) that employ as instruments for THS market concentration the relative occupational employment of *non*temporary help workers in each MSA (a proxy for the scale of the target market to which

34. A table of estimates is available on request.

THS firms supply labor).[35] These IV models provide comparable estimates to those above.

To summarize, THS establishments are more likely to provide skills training in markets where competition is more strenuous. These facts are consistent with the model. An alternative reading, however, is that skills training is primarily a nonwage benefit like paid vacation that firms offer as competitive conditions demand. To distinguish the paper's monopsony model from this alternative hypothesis, it is necessary to ask whether training and nontraining firms respond differentially to competition. The final empirical section performs this test.

## VI. The Impact of Market Concentration on Wages

A distinct prediction of the present model is that because competition induces firms to provide additional productive training, competition yields larger wage gains for workers at training than at nontraining establishments. To examine this implication, I estimate wage equations similar to (12) augmented with the MSA-collar Herfindahl measure. These estimates explore first, whether earnings of THS workers rise with competition in the THS marketplace, and second, whether earnings gains are greater for workers at training establishments.

### *A. Estimation*

Estimates of these models are found in Table VI. The estimate in column (1) indicates that wages at THS establishments are on average higher in more competitive THS markets. This differential is not statistically significant, however. Column (2) replaces the Herfindahl main effect with two interactions: Herfindahl times training-provided and Herfindahl times no-training-provided. Consistent with the theoretical model, the point estimates for the wage-concentration elasticity appear substantially greater at training than at nontraining establishments. The data do not reject the null hypothesis of equality between the two coefficients, however. The subsequent column adds additional controls for THS establishment size and MSA-occupation market size. These controls do not change the

35. If there is a minimum efficient scale to operating a THS establishment, markets with greater potential demand for THS services will also intrinsically have lower THS concentration. Figure 2 of Autor [2000b] demonstrates that this relationship is quite apparent in the data.

TABLE VI

OLS ESTIMATES OF THE RELATIONSHIP BETWEEN THS MARKET CONCENTRATION AND THS WORKER WAGES, POOLED AND FIXED EFFECTS MODELS
DEPENDENT VARIABLE IS THE LOG HOURLY WAGE OF THS WORKERS

| | A. Pooled estimates | | | B. Fixed effect estimates | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Herfindahl in MSA-collar | −0.116 | | | −0.328 | | |
| | (0.141) | | | (0.159) | | |
| Herfindahl × Training provided | | −0.390 | −0.154 | | −0.408 | −0.393 |
| | | (0.129) | (0.147) | | (0.150) | (0.163) |
| Herfindahl × No training provided | | −0.251 | −0.049 | | −0.183 | −0.147 |
| | | (0.148) | (0.164) | | (0.164) | (0.165) |
| Training provided | −0.021 | −0.013 | −0.012 | −0.019 | −0.003 | 0.003 |
| | (0.013) | (0.019) | (0.018) | (0.022) | (0.025) | (0.025) |
| Log of establishment size | −0.026 | | −0.026 | −0.022 | | −0.022 |
| | (0.004) | | (0.004) | (0.008) | | (0.008) |
| Log of THS employment in MSA-collar | 0.041 | | 0.040 | −0.001 | | −0.004 |
| | (0.020) | | (0.020) | (0.016) | | (0.016) |
| Firm fixed effects | No | No | No | Yes | Yes | Yes |
| $R^2$ | 0.63 | 0.62 | 0.63 | 0.54 | 0.54 | 0.55 |
| n | 333,888 | 333,888 | 333,888 | 201,314 | 201,314 | 201,314 |
| $H_1$: Herfindahl × Training = Herfindahl × No training | | 0.26 | 0.40 | | 0.03 | 0.02 |

Huber-White standard errors in parentheses account for correlation of errors within MSA-collar cells. All models are weighted by OCS regional establishment probability sampling weights and include 103 MSA dummies and 8 occupation dummies. Pooled estimates include workers at 1002 establishments. Fixed-effects estimates are limited to workers employed by multiregion firms (50 firms, 395 establishments).

qualitative pattern of results but do leave the Herfindahl-training interactions insignificant.

Fixed effects estimates of these models prove substantially more robust. The noninteracted specification, column (4), finds a substantial direct impact of market concentration on wages. A standard deviation increase in competition is predicted to raise wages by 8.9 log points. The subsequent two specifications, which interact the Herfindahl measure with training and nontraining policies, demonstrate that this impact is significantly larger at training establishments.

To gauge the magnitudes of these impacts, note first that the "training provided" dummy in the regression models is approximately equal to zero. Hence, the estimates imply that in a fully nonconcentrated market (Herfindahl equal to zero), there would be no wage differential between training and nontraining establishments. At the sample mean of the Herfindahl, however, training establishments will pay approximately five percentage points less than nontraining establishments. A standard deviation increase in concentration causes this gap to grow by an additional 6.6 log points.

To ensure that the estimates are not driven by functional form or white-collar/nonwhite-collar differences, models were also estimated using a log Herfindahl measure and excluding white-collar observations. These specification tests yielded comparable results. Instrumental variables estimates found in Autor [2000b] also confirm these patterns. Models were also estimated including the MSA-collar unemployment rate as an additional measure of market competition. While imprecise, these estimates find that a decline in the local unemployment rate appears to increase wages for THS workers at training establishments by more than at nontraining establishments.[36]

The survey conducted by ALM provides a final source of confirmatory evidence. THS managers were asked, "Hypothetically, let's say that conditions in your local temporary market got tougher because several competing offices opened nearby. How likely are you to take the following steps?" A large majority of respondents was likely to "increase wages" (68 percent) or "offer more attractive

36. A table of results is available on request. Since the up-front training policy is at the core of the monopsony model, Autor [2000b] also presents augmented wage models in which the Herfindahl measure is interacted with each of the training policy variables. The pattern of coefficients demonstrates that firms offering an up-front policy exclusively account for the concentration-wage effect. A supplementary table containing policy-interacted specifications is also available.

training opportunities" (62 percent). By contrast, only a minority was likely to "increase vacation, holiday or sick benefits" (33 percent) or to "reduce qualifications required for hire" (15 percent). Notably, the fraction likely to increase wages was 23 percent greater ($p < .05$) at training establishments than at nontraining establishments.

While these results are consistent with the theoretical model's monopsony framework, perhaps a more direct test is simply to ask whether the wage markup that training establishments command is higher than that at nontraining establishments.[37] Establishments surveyed by ALM were asked to report their typical wage markup on assignments within their major occupation. A regression of their responses on occupation and MSA main effects and a variable indicating whether or not the establishment provides up-front skills training yields the following estimate (standard errors are in parentheses):

$$\text{(16)} \quad \text{Percent Markup} = \underset{(2.00)}{46.57} + \underset{(1.88)}{5.54} \times \text{Skills-Training} - \underset{(2.00)}{7.74} \times \text{Clerical/Sales} - \underset{(2.17)}{2.82} \times \text{White-Collar}$$

$$(n = 293, R^2 = 0.28).$$

Apparently, within the same occupations and MSAs, training establishments command a wage markup that exceeds that at nontraining by 5.5 percentage points (12 percent). Given the earlier evidence that training establishments pay lower wages yet screen for workers of higher quality, this finding does suggest that training establishments hold some degree of monopsony power.

## VII. Conclusions

This paper makes two contributions. The first is to propose and test a model in which firms offer skills training to induce self-selection and perform screening of high ability workers. The idea advanced by the model that skills training may serve as an information elicitation mechanism is not at odds with the canonical view of training as a human capital investment. In fact, the proposed model relies on the assumption that training *is* productive, and

37. This markup should be distinguished from the parameter $\pi$ in the model. In the model, $\pi$ does not differ between training and nontraining firms. However, the difference between wages and the client bill rate is strictly higher at training firms. See equation (8).

differentially so with workers of higher ability. The key distinction is that in the competitive human capital model, workers pay ex ante or contemporaneously for general training, whereas in the framework explored here, training is given up front while training costs and returns are shared ex post by worker and firm.

While the notion that private information may induce employers to pay for general skills training has received considerable theoretical attention, empirical evidence has proved elusive. In part, this is because information-based models, which intrinsically depend on unobservable quantities, are notoriously difficult to test. This problem is compounded in the training context because, as the human capital model underscores, it is typically not feasible to discern how the costs and benefits of on-the-job skills training are allocated between worker and firm. This paper resolves this set of ambiguities by studying training in a setting in which it is demonstrably clear that employers do pay the up-front costs of general skills training. Hence, the question explored here is not whether firms pay for general skills training but *why* they pay for general skills training. The evidence above suggests that private information is indeed a central explanation, at least in the case of temporary help firms.

The second contribution of the paper is to suggest an answer to a puzzle raised by many analysts of U. S. and European labor markets: what specifically is the service that THS firms provide for which demand is growing so rapidly?[38] The model and empirical analysis above demonstrate that beyond providing flexible spot market labor, THS firms gather and sell information about worker quality to their clients. Consistent with this view, recent survey data indicate that employers increasingly use THS arrangements to screen workers for permanent employment. Indeed, in some sectors, THS firms have become the primary conduit for auditioning and hiring new workers.[39] While numerous researchers have attributed the dramatic growth of THS employment to increasing employer desire for flexibility, this appears not to be the entire explanation. The growing role of THS as a labor market information broker implies that the demand for worker screening is rising.

38. See, for example, Katz and Krueger [1999], OECD [1999], Segal and Sullivan [1997a], and U. S. Department of Labor [1995, 1999].

39. See, for example, Ballantine and Ferguson [1999], Houseman [1997], and U. S. Department of Labor [1999].

APPENDIX 1: LINEAR PROBABILITY ESTIMATES OF THE IMPACT OF THS MARKET CONCENTRATION ON COMPUTER SKILLS TRAINING, PERFORMED SEPARATELY BY COLLAR DEPENDENT VARIABLE EQUAL TO ONE IF ESTABLISHMENT PROVIDES COMPUTER SKILLS TRAINING TO WORKERS IN COLLAR

| | Word processing | Data entry | Computer programming | Any computer skill |
|---|---|---|---|---|
| | *A. Technical/Professional Workers* | | | |
| Herfindahl in MSA-collar | −0.178 | −0.222 | −0.013 | −0.101 |
| | (0.145) | (0.147) | (0.145) | (0.170) |
| Log establishment size | 0.085 | 0.069 | 0.016 | 0.075 |
| | (0.017) | (0.016) | (0.016) | (0.018) |
| Log MSA-collar THS | −0.004 | −0.016 | 0.005 | 0.000 |
| employment | (0.016) | (0.016) | (0.012) | (0.016) |
| $R^2$ | 0.07 | 0.07 | 0.03 | 0.05 |
| n | 630 | 630 | 630 | 630 |
| | *B. Clerical/Sales Workers* | | | |
| Herfindahl in MSA-collar | −0.434 | −0.344 | −0.147 | −0.261 |
| | (0.209) | (0.216) | (0.196) | (0.244) |
| Log establishment size | 0.091 | 0.112 | 0.053 | 0.089 |
| | (0.015) | (0.015) | (0.012) | (0.015) |
| Log MSA-collar THS | −0.056 | −0.091 | −0.039 | −0.047 |
| employment | (0.019) | (0.022) | (0.016) | (0.021) |
| $R^2$ | 0.06 | 0.10 | 0.03 | 0.06 |
| n | 859 | 859 | 859 | 859 |
| | *C. Blue-Collar Workers* | | | |
| Herfindahl in MSA-collar | −0.251 | −0.142 | −0.022 | −0.174 |
| | (0.163) | (0.145) | (0.027) | (0.168) |
| Log establishment size | 0.050 | 0.038 | −0.006 | 0.052 |
| | (0.014) | (0.014) | (0.004) | (0.015) |
| Log MSA-collar THS | −0.017 | −0.014 | −0.002 | −0.007 |
| employment | (0.020) | (0.017) | (0.002) | (0.021) |
| $R^2$ | 0.04 | 0.02 | 0.01 | 0.04 |
| n | 755 | 755 | 755 | 755 |

Huber-White standard errors in parentheses account for correlation of errors within MSAs (103). Models are weighted by OCS national establishment probability weights and include establishment occupational share measures within collars: 2 in white-collar, 1 in clerical/sales, and 3 in blue-collar.

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