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WAGES, EMPLOYER COSTS, AND EMPLOYEE PERFORMANCE IN THE FIRM

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ABSTRACT

In this paper I use data from a survey of firms to estimate the effects of a firm's wage level on several measures of its hiring costs and the characteristics and performance of its employees. These measures include the previous experience and current tenure of its employees; subjective productivity scores for these employees; job vacancy rates; perceived ease of hiring qualified workers for the firm; and hours spent hiring and training new workers. In doing so, I distinguish the case of high wages imposed on a firm by unions from that in which the firm might be choosing its wage level in order to maximize its profits. I also provide some rough measures of the extent to which firms offset their high wage costs in each case.

The results show generally positive effects of firm wages on employee experience and tenure as well as on subjective productivity scores. The firm's wages generally have negative effects on job vacancy rates and positive effects on the perceived ease of hiring qualified workers. Training time is also reduced. While the magnitude of each individual effect may not always be large or even significant, their combined effects suggest that firms offset a good deal of their higher wage costs through improved productivity and lower hiring and turnover costs among their employees.

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I. Introduction

It has long been recognized that firms which are forced to pay above market-clearing wages will respond by altering their hiring behavior. If, for instance, unions raise the wages of unskilled workers for a firm or industry, firms should respond by substituting capital for labor and more highly skilled workers for those less skilled.[1] Thus, we would expect to find higher skill levels and higher productivity observed among workers at unionized firms, in order to prevent workers from fully extracting their monopoly rents. The amount of training provided to these workers once hired might be affected as well.[2]

Of course, these labor demand-side explanations often assume that the skills of workers are perfectly observable, that workers within skill categories are homogenous, and that supplies of workers in each category are limitless (i.e., perfectly elastic).[3] If, however, these conditions are not met, profit-maximizing firms might themselves choose to pay higher wages even in the absence of unions.[4] The recently burgeoning "Efficiency Wage" literature stresses these difficulties which firms may have in hiring, monitoring, and/or retaining high productivity workers.[5] Because of these difficulties, firms might choose to pay higher wages in order to raise the quality and/or quantity of job applicants, reduce supervision costs and reduce turnover. Employer search and matching models also suggest that firms might choose high wages in order to lower the foregone profits associated with lengthy job vacancies and perhaps to lower hiring costs as well.[6] Finally, firms might change the structure and method of pay in addition to its average level in order to create greater incentives for worker performance.[7]

A great deal of empirical evidence has also been produced on these general topics, but surprisingly little considers the direct effects of firm-

level wages on employee characteristics and performance. For instance, the effects of unions on worker productivity, profits, training and turnover have received widespread attention, though few studies focus on the direct effects of wages as opposed to the institution of unionism on these outcomes.[8] More generally, wage effects on turnover and absenteeism have been studied.[9] But a much broader range of employee costs and productive characteristics or outcomes among workers must be considered in order to correctly measure the firm's ability to offset the costs of higher wages. The magnitudes of the effects must be considered as well in any reasonable attempt to gauge the overall effects of wages on the firm.[10]

In this paper I use data from a survey of firms to estimate the effects of a firm's wages on its hiring costs and on the characteristics and performance of its workers. The focus on wages at the level of the firm (as opposed to the industry or individual worker) will distinguish this work from most previous studies on related issues. This focus is consistent with the evidence of wage differentials between firms for comparable workers of which economists have long been aware (e.g. Dunlop (1957)) but which remain poorly understood to date.

Several measures of worker quality and performance are used as outcomes here. These include: the previous experience of the worker and his/her tenure with the current employer; as well as subjective productivity scores as gauged by the employer. In addition, I will consider job vacancy rates and the perceived ease of hiring qualified workers to measure firm hiring difficulties and how wages affect them. Finally, I will consider the number of hours spent hiring and training these new employees by the employer. This fairly comprehensive list of responses to firm wages will enable us to approximately measure the degree to which high wage costs are offset by firms, in a manner which has not been attempted to date.

In estimating firm-level wage effects on these outcomes, we will distinguish between the effects of unions on wages, which are generally imposed exogenously on the firm;[11] and other determinants of wage levels which might conceivably reflect firm choices. These other determinants will include industry and firm size, both of which have clearly been show to be associated with long-run wage differences between firms.[12] While this analysis is not an explicit test of "Efficiency Wages" or any other theory of wage determination, it should shed some light on the general notion of whether firms might ever find it in their interest to pay high (relative to the market) wages.

The data which are used here to measure firm effects are from the 1982 wave of the Employment Opportunity Pilot Project (EOPP) Survey of Firms.[13] This wave of the survey was administered to approximately 3400 firms in 28 local areas. The survey is discussed in greater detail below.

The results of the estimation can be briefly summarized here. We generally find positive effects of firm wages on employee experience and tenure as well as on subjective productivity scores. The firm's wages also have negative effects on job vacancy rates and positive effects on the perceived ease of hiring qualified workers as well as negative effects on hours of training. While the magnitude and/or significance levels of many of the individual effects are not large, taken together they suggest that firms offset a good deal of their higher wage costs through improved productivity and lower hiring and turnover costs among their employees.

The rest of the paper is laid out as follows: Section II describes the data and the equations estimated in greater detail, while Section III presents the results of estimated equations. Section IV presents a summing up of the various effects to estimate an overall effect of wages on profits, while Section V contains the conclusion and implications of this work.

II. Data and Equations

In order to consider the effects of a firm's wage level on its cost and profits, we must distinguish between its effects on fixed hiring costs and on its variable costs and revenues of operating. For a given period of time, a firm's profits can be written as follows:

$$1) \qquad \Pi = P \cdot Q(W, (1-V)J) - W \cdot (1-V) \cdot J - F_H C_H$$

where F_H and C_H reflect the frequency of hiring and direct cost per hire respectively; V reflects the rate at the firm; J is the number of jobs currently available in the firm; and P, Q and W reflect prices, output and wages at the firm. Both output and labor costs therefore depend on non-vacant jobs (i.e., employment in the firm) as well as on wages in this formulation, though employment above the specified job level does not add to output or revenue here.

The frequency of hiring should reflect employee turnover as well as net employment growth at the firm. The cost per hire should reflect both the duration and intensity of hiring activity, which in turn should influence the number of hours spent by company personnel in recruiting, screening, and training new employees. The wages of company personnel and other direct hiring expenditures (such as advertising, etc.) are included as well in this term. Finally, the vacancy rate also depends on both the frequency and duration of new hiring activity, as well as the fractions of each in which the positions being filled are actually vacant.

The firm's wage level might raise output levels by inducing the firm to hire more qualified workers. This should be easier to do if the quantity

and/or quality of job applicants attracted by the firm rises with the wage. The wage level might also affect direct hiring costs in a variety of ways. By reducing employee turnover (or, equivalently, raising employee tenure with the firm), higher wages will reduce the frequency with which new employees must be hired. Costs per hire might also be reduced if a larger and better applicant pool leads to fewer hours spent recruiting and training by company personnel. Monetary costs of recruiting should be reduced as well. Finally, reductions in the frequency and duration of hiring will also reduce vacancy rates and thus the costs of foregone output associated with vacant jobs. Of course, large offsets of wage costs in terms of training or expected productivity should imply smaller ones in terms of vacancy rates and/or turnover, as the net attractiveness of high-wage jobs for workers becomes diminished.

Assuming that the price level and number of jobs are fixed, the effects of wages on firm profits can be seen by differentiating Equation 1) as follows:

$$2) \quad \frac{d\Pi}{dW} = P \cdot \frac{\partial Q}{\partial W} - P \cdot \frac{\partial Q}{\partial (1-V)J} \frac{\partial V}{\partial W} \cdot J - (1-V)J$$

$$+ W \cdot J \cdot \frac{\partial V}{\partial W} - \frac{\partial F_H}{\partial W} \cdot C_H - \frac{\partial C_H}{\partial W} F_H$$

where the costs of higher wages must be balanced against the potential benefits of higher output, lower vacancies and lower direct hiring costs. If the firm is free to choose its wage level, it will do so in the usual manner of equating these marginal costs and benefits. If, however, the wage is exogenously determined (by unions or otherwise), Equation 2) simply enables us to measure the degree to which these higher costs can be offset by the firm.

The data with which we will analyze these issues are from the EOPP Survey of firms in 1980 and 1982. This survey was administered in 28 local areas that were sites for the EOPP labor market experiments in the late 1970's. The sites are heavily concentrated in the South and mid-West, and about half are SMSA's. Large and/or low-wage firms were oversampled within each site.

The 1982 survey, which we use below, asked two general types of questions of employers: one type covering firm-wide characteristics (e.g., number of employees, fraction unionized, number of vacancies, perceived hiring difficulties etc.) and the other covering the last worker hired during the previous year. Among the latter questions in the 1982 Survey were the occupation, sex, age and years of education of the worker, as well as his or her wages - both starting and current (or most recent if the employee was no longer with the firm).

One measure of employee performance that is available for these workers is a subjective performance rating. Employers were asked to score the most recent employee's productivity on a scale from 0 to 100, where the former would reflect no productivity and the latter the maximum feasible output on the job. The question was asked for different points in the employee's tenure at the firm: the first two weeks, the third through twelfth weeks, and currently/most recently. Separate questions were asked for "typical" employees on the same job so that relative comparisons could be made within the firm.

As for more objective employee characteristics which might be performance-related, a few different measures of employee experience are available in these data. One question asked how many months of previous experience the employee had that has some application to the current job.

Presumably, this question gauges occupation and/or industry-specific experience. From the question on the employee's age and years of education, we can also calculate a standard measure of total labor market experience (i.e., age minus years of education minus 6).

For a measure of turnover and therefore of hiring frequency, tenure within the firm was specifically asked from those employees who were no longer with the firm. For those still present, tenure can be calculated from the date of hiring and the survey date. In addition to the tenure measures, several questions were asked about the amount of time explicitly invested in training by the new employee. Total hours of formal and informal training provided by management, supervisors, or trained personnel as well as time spent with co-workers are available. The hours spent recruiting and screening workers for this position are available as well.

Using these data, we can estimate the effects of firm-level wages on a variety of labor outcomes. We note that an individual employee's wages and quality (or productivity) can be decomposed into firm-wide and individual-specific components:

$$3) \qquad W_{ij} = W_j + w_{ij}(Q_{ij})$$

$$4) \qquad Q_{ij} = Q_j(W_j) + q_{ij}$$

where W and Q reflect wages and quality respectively while the subscripts i and j denote the individual and firm respectively. Thus an individual's wage is some function $w_{ij}(Q_{ij})$ of his/her perceived quality in addition to a firm-wide premium W_j, which in turn influences the quality of worker attracted and/or retained by the firm. Other equations comparable to 4) could be

specified for employee tenure or for time spent training the employee. In addition, some firm-wide outcomes (such as vacancy rates or ease of hiring) can be denoted as follows:

$$4') \quad V_j = V(W_j) + v_j$$

with both wage-determined and random components.

If direct observations on the firm wage premium W_j were available, these equations could be estimated recursively. But given that only individual employee's wages are available in the data, we estimate the following simultaneous equations:

$$5) \quad W_{ij} = a_w + b_w X_{ij} + c_w Z_{ij} + d_w Y_j + \varepsilon_{w,ij}$$

$$6) \quad X_{ij} = a_x + b_x W_{ij} + c_x Z_{ij} + \varepsilon_{x,ij}$$

$$6') \quad V_j = a_v + b_v W_{ij} + c_v Z_{ij} + \varepsilon_{v,ij}$$

where the X_{ij} are the observed individual characteristics or outcomes described above, (such as experience and productivity ratings), the Z_{ij} are exogenous worker and job characteristics, and the Y_j are exogenous characteristics of the firm.[14]

The Z_{ij} variables used here include sex, occupation and education (i.e. high school or college) dummies. The Y_j include 2-digit industry dummies as well as fraction unionized and a group of firm size variables. The latter include a continuous measure of firm size within the site as well as a set of dummies for total firm size (i.e., 0-99, 100-249, 250-499, 500-1999, 2000+).

The crucial assumption of this model is that the Y_j can be excluded from and thereby used to identify equations 6) and 6'). This is tantamount to

assuming that these variables affect the various labor outcomes strictly through the wage and not directly. This assumption is no doubt questionable, especially for industry (where technological differences independent of the wage may determine differences in hiring). Even firm size might directly affect the quality of job applicants independently of the wage.[15]

Furthermore, the exogeneity of industry and size with respect to the wage as well as the observed outcomes might also be in doubt, as wage differentials with regards to each might reflect maximizing behavior and therefore self-selection. Indeed, the "Efficiency Wage" theories noted above predict such self-selection, which may cause biases (though mostly towards zero) in estimated wage effects.[16]

For those reasons, we estimate different specifications of Equations 6) and 6'). In some, the fraction unionized and/or plant and firm size will be used to identify the outcome equations; while in others, industry dummies will be used as well. In all cases, statistical tests will be discussed for the validity of the exclusions used.

An additional concern in some cases below involves the subjective nature of certain outcome variables - i.e., the productivity ratings and perceived ease of hiring. The former, in particular, are known to contain a good deal of measurement error (Bishop, 1987) and may also contain firm - specific components that are correlated with our instruments for firm-level wages, thereby causing biased estimates.[17] Of course, the additional use of objective outcomes (i.e., experience/tenure instead of productivity scores and vacancy rates instead of ease of hiring) provides a check on any results obtained with the subjective outcomes. Furthermore, evidence will be provided below on the relationships between experience, productivity scores, and wages that will underscore the validity of both. In partaicular, we will note that

fixed-effects estimates of these relationships are fairly comparable to cross-sectional ones, thereby suggesting that biases from firm-specific effects are not severe.

We note a few other econometric issues before moving on to the results. We estimate the various outcome equations independently of one another, thus abstracting from cross-equation effects and error correlations.[18] Thus, the outcome equations are of a reduced-form nature.

A few other aspects of the estimation below are noted as well. For one thing, certain limited dependent variable functions will be estimated where appropriate, using predicted firm wages as the independent variable.[19] Finally, continuous hazard models of the Weibull form will be estimated in order to gauge the effect of the firm's wages on tenure outcomes.

III. Empirical Results

In Table 1 we find means and standard deviations of several key variables for the sample used here. Two types of variables are considered: those which reflect the characteristics and performance of the last worker hired as well as those of the firm itself.

Several characteristics of workers and firms in the sample are noteworthy. The starting wages are relatively low, reflecting a sample which is predominantly comprised of high school workers in clerical, sales, and service jobs. It is also a fairly young sample, averaging 8-9 total years of experience in the labor market. Average tenure on the job is just under 1 year. These characteristics of workers reflect the fact that low-wage firms were oversampled and also that the last-hired workers will over-represent high-turnover, low-wage jobs and low-tenure workers within firms.

Table 1

Means (and Standard Deviations) of Key Variables

Last Worker Hired:	
Starting Wage	$5.02
	(1.88)
Education:	
High School	.782
College	.087
Occupation:	
Professional/Technical	.042
Managerial	.040
Clerical	.154
Sales	.190
Crafts	.005
Operatives	.020
Laborer	.002
Service	.192
Missing	.355
Prior Experience (Years):	
General	8.581
	(8.925)
Related	2.446
	(4.420)
Tenure (Months):	
	11.380
	(7.152)
Hours of Training:	
Formal	8.991
	(38.779)
Informal	45.118
(Management)	(73.716)
Informal	38.768
(Co-workers)	(129.283)
Hours spent Hiring:	
Total	12.225
	(28.865)
Per Applicant	2.155
	(4.647)
Productivity Score	80.057
	(17.598)
Firm:	
Fraction Unionized	.113
	(.288)
Local Firm Size	68.185
	(227.933)
Vacancy Rate	.018
	(.059)
Perceived Ease of Hiring Qualified Workers:	
Very Easy	.315
Not Very Difficult	.267
Somewhat Difficult	.248
Very Difficult	.170

The vast majority of training hours reported here are for informal training by both co-workers and management. Hours spent hiring by management are lower than those spent training. Current or most recent productivity scores average about 80, which is significantly higher than those attributed to workers at the time of hiring.

As for the firms themselves, we find that they are relatively large but less unionized relative to random national samples.[20] Vacancy rates are fairly low, and a majority of firms do not report difficulties in hiring qualified workers.

Fixed Costs: Hiring Time, Training Time

In Tables 2 and 3 we present estimates of the effects of the firm's wage levels on its hours spent hiring and training respectively. These estimates are from versions of Equation 6) above in which hours spent hiring or training are the dependent variables. A similar set of equations are estimated for other outcomes and reported below.

The equations reported here and below are estimated using two-stage least squares. Several specifications are presented in which industry, fraction unionized and firm size variables are used to identify the two stages and provide estimates of the firm wage. To test whether high wages caused by unions have different effects from those chosen by the firm, we present separate estimates of the union wage effect (column 3) and the size-wage premium effect (Column 4). Coefficients on these variables when they appear as controls are presented as well. We use the individual's starting wage to calculate this premium, and we control for a variety of personal characteristics (i.e., education, sex, occupation, site, and year hired) in the outcome equation.[21]

Table 2

Firm Wage Effects on Hours Spent Hiring - 2SLS

A. Total Hours Spent Hiring

	1	2	3	4
Firm Wage	13.434	21.970	-6.940	143.204
	(5.361)	(14.911)	(13.906)	(75.099)
Fraction Unionized	---	---	---	-.344
				(.205)
Local Firm Size	---	---	3.444	---
			(.814)	
Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.055	.087	.103	.034

B. Hours Spent Hiring per Applicant

	1	2	3	4
Firm Wage	.104	-1.095	-.965	-3.459
	(.859)	(1.919)	(2.242)	(7.424)
Fraction Unionized	---	---	---	.007
				(.020)
Local Firm Size	---	---	.041	---
			(.131)	
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.069	.099	.101	.092

NOTE: Education, sex, occupation, site, and year dummies are included in these and all subsequent equations. Sample size for this and all subsequent tables is 1278. Industry dummies are 2-digit unless otherwise indicated. Hours spent hiring include hours spent recruiting, screening and interviewing job applicants. Standard errors are presented in parentheses in this and all other tables below.

Table 3

Firm Wage Effects on Hours Spent Training - 2SLS

A. Formal Training by Management

	1	2	3	4
Firm Wage	-3.397	-10.878	-12.701	2.239
	(7.308)	(15.993)	(18.738)	(59.210)
Fraction Unionized	---	---	---	-.037
				(.162)
Local Firm Size	---	---	.458	---
			(1.096)	
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R2	.035	.088	.089	.088

B. Informal Training by Management

	1	2	3	4
Firm Wage	-13.085	-50.603	-28.982	-158.590
	(13.759)	(30.004)	(35.507)	(130.113)
Fraction Unionized	---	---	---	.306
				(.355)
Local Firm Size	---	---	-2.762	---
			(2.077)	
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R2	.049	.084	.087	.066

C. Informal Training by Co-Workers

	1	2	3	4
Firm Wage	-45.258	-26.412	-13.877	82.412
	(24.384)	(53.911)	(62.686)	(204.606)
Fraction Unionized	---	---	---	-.308
				(.558)
Local Firm Size	---	---	-2.558	---
			(3.667)	
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R2	.035	.068	.074	.005

Table 2 contains results for hours spent hiring. Because high-wage and large firms receive more job applicants which, in turn, should require more time spent screening and interviewing applicants, we present estimates of equations for total hours spent as well as hours spent per applicant.[22]

The results show that high-wage firms generally must spend more total time on their hiring activities than do other firms. Only when a strict union wage premium is considered (i.e., when we control for industry and firm size) does this result not appear. However, hours spent per applicant show no such effect. If anything, these effects are generally negative (though not significant). Thus, the larger quantity (and perhaps quality) of job applicants received by high-wage firms requires them to spend more time on screening, though some small economies of scale may emerge.[23]

The effects of firm wages on hours spent training new employees appear in Table 3. Separate equations appear for the three types of training considered: formal, informal provided by management, and informal provided by co-workers.

The results show generally negative effects of firm wages on all three types of training, though most effects are not significant. Only the effects on hours of informal training provided by management are marginally significant when we control for industry but not firm size.[24] We also note that the results here conflict somewhat with those presented by Barron et. al. using the same data.[25]

Comparing Tables 2 and 3, we find that the magnitudes of the combined negative training effects are generally larger than the positive effects on total time spent hiring. While the costs associated with the different kinds of time presumably differ, the results suggest that total time spent and costs per new employee might be lower in high wage firms.

Hiring Frequency: Tenure

Of course, the question remains as to how frequently these new employees must be hired, which depends on turnover. Previous research (cited above) has shown lower turnover among high-wage employees and industries as well as unionized firms. In Table 4 we consider whether this holds more generally for employees of high-wage firms. The table presents estimates of hazard functions in which the dependent variable is months of job tenure. Estimates are presented using the Weibull functional form.

The results show that higher firm wages generally lead to higher tenure with the firm.[26] The effect of high wages in large firms is particularly strong, while that in union firms is negative but not significant.[27]

Overall, then, we find that high wages in a firm generally enable it to reduce turnover and thus the number of new employees it must hire, as well as the total time associated with each new employee. Fixed hiring costs thus appear to be lower in high-wage firms.

Vacancies and Ease of Hiring

As noted above, a firm's output and labor costs reflect its vacancies as well as its direct wage costs, and vacancy rates can give us some indication about the frequency and duration of hiring activities. In Table 5 we present estimates of vacancy rate equations. Given the large fraction of firms (i.e., about 85%) which report no vacancies, we estimate those equations using Tobit as well as OLS. In both cases, the firm-level wage is the predicted wage based on virtually the same instruments as were used in the previous tables.[28] Control variables are comparable as well.

Table 4

Firm Wage Effect on Months of Job Tenure - Weibull Hazard Functions

	1	2	3	4
Firm Wage	.048 (.050)	.180 (.085)	-.048 (.103)	.540 (.192)
Fraction Unionized	---	---	---	-.0013 (.0006)
Local Firm Size	---	---	.033 (.008)	---
Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
Log L	-174.68	-146.78	-154.30	-164.21

Table 5

Firm Wage Effects on Job Vacancy Rates

A. 2SLS

	1	2	3	4
Firm Wage	-.020	-.056	-.014	-.069
	(.011)	(.019)	(.023)	(.038)
Fraction Unionized	---	---	---	.0001
				(.0001)
Local Firm Size	---	---	-.006	---
			(.002)	
Total Firm Size Dummies	no	---	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.052	.059	.072	.059

B. Tobit

	1	2	3	4
Firm Wage	-.023	-.028	-.158	.388
	(.048)	(.084)	(.104)	(.165)
Fraction Unionized	---	---	---	-.0017
				(.0006)
Local Firm Size	---	---	.014	---
			(.007)	
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
Log L	-547.7	-253.9	-250.3	-249.2

NOTE: In these equations, firm wage is a predicted variable based on the regressors used in all of the previous tables. Industry dummies are 1-digit here.

The results show that higher wages are usually associated with lower vacancy rates, though once again the exact magnitudes are difficult to pin down. Comparing Tobit estimates to those from OLS equations we find coefficient magnitudes among the former which are much more unstable, varying in both sign and magnitude. We also find standard errors which are always larger among the former. The largest and most significant negative effect is the one associated with union wages in the Tobit equations, while the Tobit effect of large firm size has the opposite sign.

An alternative method of testing for hiring effects of wages can be found by analyzing the firm's perceived ease of hiring qualified workers. As noted above, this subjective variable may refer to any or all components of hiring costs and may also reflect firm-specific factors that could cause biases if correlated with regressors. Still, it provides us with an additional measure of hiring costs with which to the estimate the effects of a firm's wages.

Equations for the effects of wages on perceived ease of hiring appear in Table 6. In these equations, the dependent variable takes on a value of one if firms report that the hiring of qualified workers is "very easy" or "not very difficult" and zero if such hiring is "somewhat difficult" or "very difficult". Other specifications not reported here provided relatively similar estimates. [29] Equations are estimated using two-stage least squares.

The results of Table 6 show that higher wages generally cause the perceived ease of hiring qualified workers to rise as well. Only the union wage effect is not significant here, while the wage effect associated with firm size is quite large.

Overall, then, we find firm wage levels to be negatively associated with hiring costs and difficulties. Though hours spent recruiting and

Table 6

Firm Wage Effects On Ease of Hiring - 2SLS

	1	2	3	4
Firm Wage	.468 (.093)	.563 (.209)	.186 (.232)	2.687 (1.423)
Fraction Unionized	---	---	---	.006 (.004)
Local Firm Size	---	---	.042 (.014)	---
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.095	.116	.135	.040

NOTE: Dependent variable is equal to one if employer finds it very easy on not very difficult to hire qualified workers and zero otherwise.

Table 7

Firm Wage Effects On Years of Prior Experience

A. General Experience - 2SLS

	1	2	3	4
Firm Wage	4.713 (1.630)	2.627 (3.621)	4.468 (4.199)	7.572 (14.912)
Fraction Unionized	---	---	---	.029 (.041)
Plant Size	---	---	-.012 (.245)	---
Firm Size Dummies	no	yes	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.048	.082	.087	.068

B. Related Experience - 2SLS

	1	2	3	4
Firm Wage	3.024 (.775)	1.837 (1.739)	1.912 (2.032)	4.172 (6.297)
Fraction Unionized	---	---	---	-.007 (.017)
Plant Size	---	---	.017 (.119)	---
Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.079	.108	.110	.113

C. Related Experience - Tobit

	1	2	3	4
Firm Wage	4.430 (1.153)	1.795 (2.007)	1.139 (2.392)	2.521 (4.094)
Fraction Unionized	---	---	---	-.003 (.014)
Plant Size	---	---	.142 (.171)	---
Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
Log L	-2907.1	-2902.1	-2901.1	-2902.1

NOTE: The tobit equations use 1-digit industry dummies rather than 2-digit for computational reasons.

Table 8

Firm Wage Effects On Current Productivity Scores - 2SLS

	1	2	3	4
Firm Wage	7.053 (3.308)	16.056 (7.461)	15.487 (8.719)	16.773 (27.788)
Fraction Unionized	---	---	---	-.002 (.076)
Local Firm Size	---	---	.270 (.570)	---
Total Firm Size Dummies	no	no	yes	no
Industry Dummies	no	yes	yes	yes
R^2	.044	.076	.077	.075

screening rise for high wage firms, hours spent training per new fall by even larger amounts. The frequency of new hiring apparently reduced and employee tenure rises while the costs associated with vacant are probably reduced as well.

Employee Characteristics and Performance

For employees of relatively long tenure, the variable costs of higher wages per hour or week of work will likely swamp any reductions in fixed hiring costs which they might cause. These variable costs must therefore be compared to improvements in the characteristics and/or performance of employees hired in these firms.

Without direct evidence on worker output, we use two different proxies for the performance of workers in the firm. One is the number of years of prior experience which the employee has had, either general or related to the (described above) job at the firm. The other is the productivity score assigned to the worker either currently or at the end of his/her tenure with the firm. The experience measures have the advantage of being objective, thus avoiding the problems associated with subjective variables. However, there may be some doubt as to whether prior experience is truly productivity-enhancing.[30]

In order to consider more carefully the nature of these proxies for worker productivity, the Appendix contains estimates of OLS equations for wages and productivity scores of workers. The wage equations correspond to Equation 5) above. They appear with and without the productivity score included as an additional independent variable.

These equations show that both experience and productivity scores are positively associated with individuals wages. Related experience has effects

which are several times larger than those of general experience. Furthermore, the effects of productivity scores on wages seem to be largely (though not totally) explained by prior experience. The productivity score equations also show particularly large effects of related experience.

Furthermore, a variety of wage-change and productivity-change equations presented in Holzer (1988) show results which are fairly comparable to those presented in the Appendix.[31] Since these change equations omit fixed effects of firms in the performance ratings (which should capture some of the subjective differencess across managers of different firms in how they rate employees), we may conclude that both prior experience measures as well as subjective productivity scores are reasonable proxies for worker performance at the firm.

In Tables 7 and 8 we move on to consider the effects of firm-level wages on our various proxies for worker preference. Table 7 contains equations for years of prior experience while Table 8 contains the firm productivity scores.

Table 7 provides separate estimates for general and related experience. Because of the large fraction (i.e., about 40%) of workers with no related experience reported, we provide Tobit estimates as well for this latter measure.[32] The results show generally positive effects of firm wages on years of prior experience. However, these estimates are generally not significant once we have controlled for industry. Furthermore, it generally appears as though industry effects exist independently of firm wages (according to F-tests on the industry dummies).

The results of productivity score equations in Table 8 provide strong support for the notion that worker productivity rises with the firm wage level. Effects of wages are positive and significant in all cases except for

Table 9

Summary of Firm Wage Effects on Hiring Costs and Employee Performance

Outcomes:	Industry, Union, Size Effects	Union, Size Effects	Union Effect	Size Effect
Hours Spent Hiring				
Total	+++	++	-	+++
Per Applicant	+	-	-	-
Hours Spent Training				
Formal	-	-	-	+
Informal: Management	-	---	-	-
Informal: Coworkers	---	-	-	+
Months of Tenure	+	+++	-	+++
Job Vacancy Rates	---	---	-	---
Ease of Hiring	+++	+++	+	+++
Prior Experience				
General	+++	+	+	+
Related	+++	+	+	+
Productivity Scores	+++	+++	+++	+

NOTE: Three plus or minus signs reflect statistical significance at the 10% level (2-tailed test); two reflect it at the 20% level, and one reflects the higher levels. The four columns here correspond to columns 1-4 in Tables 2 through 8. Job vacancy rate and experience level estimates reflect 2SLS with linear (rather than Tobit) second stage here.

the firm-size-wage effect. In contrast, coefficients on the control variables for unionism and local firm size show little direct effects of these factors.

Before moving on, we present a summary of all of these estimated effects of firm wages on hiring costs and employee characteristics or performance in Table 9. For each outcome variable in Tables 2 through 8, we present the sign (i.e., plus or minus) of the wage effect under each of the four different exclusion restrictions. Results which are significant at the 20% level in a 2-tailed test are represented by 2 signs, which significance at or better than 10% is represented by three signs.

The table shows that the firm's wage level generally has positive and negative effects respectively on total hours spent hiring and training new workers. Effects on vacancy rates are also generally negative while those on employee tenure, perceived ease of hiring, experience and perceived productivity are positive. The vacancy, ease of hiring, and productivity scare effects are significant in three of the four specifications presented and the tenure effect is significant in two of the four. In general, the wage premia associated with firm size are more likely to be significant than are those associated with unionism. This is true despite the fact that selection biases are more likely to bias estimated coefficients towards zero for the former.

IV. A Summing Up of Wage Effects

Given the variety of firm wage effects which we have estimated for hiring and training, vacancy rates, and worker quality/performance, we now must sum up these magnitudes to determine the extent to which wage costs can be offset for high-wage firms. While this effort requires some fairly heroic assumptions and therefore must be viewed as being only suggestive, it does

shed light on the relative magnitudes of the estimated effects and therefore on how these effects net out for firms.

To do this computation, we consider Equation (2) from page 5 above, which decomposes wage effects on profits into components based on output (directly and through vacancy rates), wage costs, and fixed hiring costs. In order to make Equation (2) tractable for this effort, we must transform it into the following:

$$7) \qquad \frac{d\ln\Pi}{d\ln W} = \frac{d\ln PQ}{d\ln W} - \gamma_w \frac{d\ln WC}{d\ln W} - \gamma_H \frac{d\ln HC}{d\ln W}$$

where the revenue (PQ) and wage cost (WC) elasticities include the direct effects of wages (first and third terms of Equation 2) respectively) as well as their indirect effects through the vacancy rate (second and fourth terms of Equation 2) respectively). The hiring cost (HC) elasticity includes wage effects on both frequency and cost per hire (fifth and sixth terms of Equation 2)), while the γ's represent the shares of revenue accounted for by direct wage costs and hiring costs respectively.

We obtain Equation (7) by dividing Equation (2) by PQJ/W. The estimated effect of wages on profits can then be calculated from our estimated means and coefficients in previous tables.[33] To perform the calculation, we make the assumption that labor accounts for about 70% of the total value of output and that 10% of this goes to specifically personnel-related activity, so we can approximate γ_w and γ_H with the fractions .6 and .1 respectively.

In order to obtain estimates of the elasticity of revenue with respect to wages, we also make the following assumptions: 1) proportional changes in performance ratings equal proportional changes in output per worker and therefore in revenue (since we are treating prices as constant); and 2) the

Table 10

Effects of a 10% Wage Increase on Profits

	Industry, Union, Size Effects	Union Size Effect	Union Effect	Size Effect
1. Output Effect				
Direct Wage Effect	.0088	.0201	.0193	.0210
Vacancy Effect	.0020	.0056	.0014	.0069
Total	.0108	.0257	.0207	.0279
2. Labor Cost Effect				
Direct Effect	-.0982	-.0982	-.0982	-.0982
Vacancy Effect	.0020	.0056	.0014	.0069
Total	-.0962	-.0926	-.0968	-.0913
Weighted by Share	-.0577	-.0556	-.0581	-.0548
3. Hiring Cost Effect				
Cost per Hire Effect	.0295	.0582	.0606	-.0332
Weighted by Share	.0030	.0058	.0061	-.0033
Frequency Effect	.0048	.0180	-.0048	.0540
Weighted by Share	.0005	.0018	-.0005	.0054
4. TOTAL EFFECT	-.0318	-.0223	-.0248	-.0434

NOTE: These four columns correspond directly to colums 1-4 in Tables 2 through 8. Job vacancy rate estimates reflect 2SLS with linear (rather than Tobit) second stage here.

effect of a percentage point change in the vacancy rate (and therefore of occupied jobs) on output is 1% - i.e., constant returns to scale.

As for the elasticity of profit with respect to hiring costs, we assume that the hiring frequency is the inverse of expected job tenure and then use our estimated wage effects on duration (Table 4) to calculate the effects of wages on this frequency.[34] We use hours spent recruiting and training each each new employee as a measure of the cost per hire.[35] But since an hour spent by co-workers is presumably not as costly to the firm as an hour spent by management personnel, we value each of the latter at twice the value of each of the former.[36] We also adjust time spent in formal training to account for the fact that each hour of management time usually accommodates multiple employees.[37] The elasticity of total hiring costs is then obtained by aggregating these effects and dividing by appropriately weighted means.

In Table 10 we present calculations of how a 10% rise in the firm's wages will effect profits. We present separate estimates based on wage effects from each of the four specifications used in Tables 2 through 8. Table 10 also presents estimates of each of the three terms of Equation (7), which are appropriately weighted and summed to produce estimates of total effects as well.

The results show that a 10% rise in wages will lower profits by 2.2% to 4.3%. More specifically, the increase caused by unions will lower profits by 3.3% while such a wage increase associated with firm size reduce profits by about 2.5%. Comparing the total reduction in profits to that which would be caused without any adjustment by the firm, these results suggest that about 46% of the higher wage costs associated with unions and about 58% of that associated with firm size is offset by firms.

The results are, of course, driven primarily by the relatively large weight attached to the revenue effect and to the magnitude of the wage effect on revenue (output), which is comparable between the union and firm size cases. While the crucial assumption that observed wage effects on performance rating effects equal those on output is indeed questionable, we also note that the estimated magnitudes of the offset are consistent with various estimates of the fraction of the union wage differential that is accounted for by personal characteristics (e.g., Mincer (1983), Freeman (1984)). The evidence of lower profits in the union sector despite higher experience and/or productivity (Becker and Olson (1987)) is also consistent with the finding here of a partial wage offset for unionized firms. Finally, we note once again that problems such as self-selection noted above are likely, if anything, to bias these results in downward direction.

V. Conclusion

In this paper I provide estimates of how the wage level of a firm affects its hiring and training costs as well as the observed characteristics and performance of its employees. This is done using data from a nationwide survey of firms on the number of hours spent hiring and training their most recent employee; the characteristics (i.e., experience and job tenure) and performance (subjective ratings) of that employee; and vacancy rates as well as other measures of hiring difficulties. Separate estimates are provided for union wage premia as opposed to those associated with firm size and/or industry.

The results generally show that high-wage firms have lower hiring and training costs as well as better employee performance. More specifically, we find fewer hours spent on informal training, longer tenure with the firm, more

years of previous job experience, higher performance ratings, lower vacancy rates, and higher perceived ease in hiring for higher wage firms. However, the exact magnitudes and significance levels (as well as the signs in a few cases) are quite sensitive to whether identification is achieved through fraction unionized or employee size.

Furthermore, we make some attempt to crudely measure the overall costs and benefits to the firm of these higher wages. These calculations are quite incomplete and require some heroic assumptions to which the results are quite sensitive. Nevertheless, the calculations suggest that about 46% of the higher wage premia unions and about 58% of those for of large firms are offset by reduced costs and improved performance.

Future research on these wage effects require better measures of outcomes, especially those measuring worker output and performance. Financial data on the profits and capital values of firms might be preferable. More careful specifications of how various outcomes are related to each other and to wage measures would also be useful.

FOOTNOTES

[1]References to employer substitution in response to union wages date back as far as Lewis (1963) and were also stressed by Johnson(1975). Discussions of union effects on productivity and profits appear in Slichter et. al. (1960), though they focus on institutional factors rather than direct wage effects. It should be noted that the predicted effects of union wages within a labor demand framework contrast with those of the "efficient contracts" approach, which stresses union control over employment as well as wages (Farber, 1986). Union effects may also be present for non-union workers due to "insider" power (Lindbeck and Snower, 1986) or the threat of unionization (Dickens, 1985).

[2]The effects of unions on hours of training are theoretically ambiguous. If unions have a larger effect on starting wages than on subsequent ones, we might expect unions to reduce on-the-job training in the same manner as the minimum wage appears to do (Hashimoto, 1981). But if unions raise wages independently of (or more than proportionately with) job tenure, it may pay for firms to invest more training in the new hires. On the other hand, employee incentives to invest in such training may be reduced (Mincer, 1983). The specificity of the training involved and the expected tenure of the employee should also affect the firm's training choices.

[3]Simple labor-demand models of wage-taking firms assume infinitely elastic supplies of labor in each category of workers. If, instead, firms face upward-sloping labor supply curves (especially in the short-run), the market-clearing wage would clearly rise as well. Firms might still prefer to pay an above-market wage to generate a queue of highly skilled workers from which to choose.

[4]This possibility has, of course, long been recognized in the personnel/human resources literature. See, for example, Milkovich and Newman (1987).

[5]The different versions of efficiency wage theory are summarized in Yellen (1984) and Katz (1987).

[6]Employer search models include Barron et. al. (1985), Jackman et. al. (1985), and Albrecht and Axell (1985). These models frequently posit that employees choose wages and/or search intensities to maximize profits which, in turn, depend on efficient matching of jobs and workers. Models in which wages depend on bargaining solutions once a match has occurred include Pissarides (1985) and Davidson et. al. (1987). Evidence on employer search intensity also appears in Barron et. al..

[7]See Brown (1988) and Ehrenberg and Milkovich (1987) for discussions of these issues.

[8]Union effects on productivity are reviewed in Addison and Hirsch (1986) while those on firm profits are discussed in Becker and Olson (1987). For union effects on turnover see Mincer (1983) and Freeman and Medoff (1984). The turnover studies generally sort out wage and union effects. An alternative approach to this issue is to use panel data in determining the extent to which the cross-sectional union wage effect is an actual wage premium as opposed to a return for higher quality workers. Mincer (1983) and Freeman (1984) conclude that half or more of the observed effect is a union premium.

[9]See Pencavel (1970), Viscusi (1980) and Allen (1981) for evidence on turnover and absenteeism effects of wages.

[10]For recent papers which consider the effects of wages on several employee outcomes and then compare potential benefits with the costs of higher wages see Raff and Summers (1987) or Leonard (1987). The former considers data on the Ford Motor Company before and after the introduction of the "Five-Dollar Day" in 1914. The latter analyzes effects of wages on supervisory personnel and turnover in six occupations for a sample of high-technology firms.

[11]This assumes, of course, that estimated union wage effects are not fully explained by differential union organizing success among highly-skilled workers.

[12]Industry wage effects (and their relative constancy over time) are described in Krueger and Summers (1987) and Dickens and Katz (1986). Intra-industry wage differences are also considered in Groshen (1985). Evidence of firm size effects on wages is provided in Mellow (1980) and Brown and Medoff (1987) as well.

[13]The 1982 wave of the EOPP Survey was designed at the National Center for Research on Vocational Education (Ohio State University) and administered by Gallup, Inc.

[14]It would be possible to use individual instead of firm-level wages in Equations 4'). However, we continue to use firm-level wages, as the focus of this steady is on wage differentials at that level. The firm-wide wages also lessen the problem of unobserved heterogeneity which would plague wages at the individual level.

[15]Evidence presented in Holzer et. al. (1988) shows that firm size affects the quantity of job applicants received per opening by firms independently of wages paid. Assuming that the quantity and quality of the best applicants are positively correlated, firm size might have independent effects on the quality of hires as well.

[16]If, for instance, all firms need workers of a c
level and all choose the wages needed to attain such worker
no relationship between wage levels and performance. Only to
firms vary in their need for high performance (because output and
more dependent on such performance for some than for others) will th
effect be observed.

[17]Purely random measurement error in the dependent variable would result in inefficiency but no biases. Fixed effects can cause biases in either direction, depending on the correlation of these effects with the relevant independent variables.

[18]Seemingly Unrelated Regression estimates might have been appropriate here, but the identical specifications of right-hand side variables eliminated this possihility.

[19]Tobit models will be used for vacancy rates, since most firms (about 80%) report no vacancies. They will also be used for applicable experience, where about 40% of the sample reports move. The use of predicted wage variables in these equations is an approximation to a fuller treatment of simultaneity in limited dependent variable models.

[20]Average private sector unionism in the Unite States in 1982 was approximately 18%.

[21]We use starting wages rather than current/most recent wages for calculation of the firm wage premia because the latter is strongly affected by job tenure, which is an outcome variable in this study. However, the correlation here between starting and current wages is about .9, and estimated results using both variables are quite similar.

[22]See Footnote 15.

[23]These results are generally consistent with those of Barron, Bishop and Dunkelberg (1985).

[24]Industry controls appear to affect training independently of the wage, as F-statistics on these dummies are highly significant in all of the training equations.

[25]Barron et. al use log-odds specifications for the probabilities of workers receiving each type of training. Using continuous as opposed to discrete training variables, as well as the use of firm-level rather than individual wages, appear to cause the conflicting results.

[26]Industry dummies are again significant in these outcome equations.

[27]It is important to remember while interpreting the coefficient on unions that this is a partial effect, controlling for the effects of firm wages which, in turn, already capture industry, size and union effects.

[28]For computational reasons, we use 1-digit rather than 2-digit industry dummies here. All other instruments and controls are comparable.

[29]For instance, defining the dependent variable as one if hiring is very easy and zero otherwise produces quite comparable results.

[30]See, for instance, Medoff and Abraham (1981) for evidence that tenure with the firm may not enhance worker productivity.

[31]In those equations, I interpret employee tenure at the firm as the change in total experience for that worker. Experience effects on productivity scores and on wages as well as productivity scores effects on wages continue to be positive and significant in those equations, with most magnitudes remaining quite comparable to those of cross-section estimates.

[32]As in the case of vacancy rate equations, the predicted wage variable is based on the same set of instruments as in all other equations except for the use of 1-digit dummies. Controls are comparable as well.

[33]We divide by J for this and all other terms of the equation since our estimated effects apply only to the last worker hired. The estimated effect of lnW on performance ratings is then divided by mean performance and added to the vacancy rate effect of lnW to obtain the elasticity estimate. We use the OLS rather than tobit estimates of vacancy effects, since the former are more stable and plausible in magnitude.

[34]If $F_H = 1/T$ then $d\&nF_H/d\&nW = -d\&nT/d\&nW$, which is simply the additive inverse of any of the Weibull hazard function coefficients presented in Table 4.

[35]We thus abstract from direct monetary costs of recruiting.

[36]Mean weekly wages in May, 1978 for managers was $322 compared to 231, 175, and 152 for sales, clericals, and service workers respectively who are paid weekly. Hourly rates are 4.66, 2.93, 3.72, and 2.93 respectively. (BLS Bulletin 2096, September 1982). The two-to-one ratio of managerial to non-managerial wages is thus a reasonable approximation here.

[37]See Bishop (1988), who assumes an average class-size of two at formal training sessions.

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Appendix

Experience, Productivity Scores, and Wages of Individuals

	Wage Levels		
	1	2	3
General Experience	.0113 (.0027)	---	.0112 (.0026)
General Experience^2	-.0003 (.0001)	---	-.0003 (.0001)
Related Experience	.0411 (.0044)	---	.0393 (.0045)
Related Experience^2	-.0010 (.0002)	---	-.0009 (.0002)
Productivity Score	---	.0019 (.0004)	.0009 (.0003)
R^2	.511	.423	.514

	Productivity Score Levels
General Experience	.1604 (.2181)
General Experience^2	-.0007 (.0060)
Related Experience	2.0327 (.3655)
Related Experience^2	-.0545 (.0151)
R^2	.150

NOTE: In addition to the variables listed, the wage equations contain the following controls: sex, education, occupation, year, and site dummies, as well as hours of training. All but the year dummies also appear in the productivity score equations.