THE SURVEY OF INCOME AND
PROGRAM PARTICIPATION

TRAINING, WAGE GROWTH, FIRM SIZE

No. 68

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Training, Wage Growth, and Firm Size*

A growing body of economic literature indicates that the labor market operates to match workers with particular skills to firms in which those skills are needed. Because of the importance of monitoring costs and of efficiencies that result from the routinization of production when producing large standardized volumes of output, large firms tend to provide firm-specific training. Small firms, on the other hand, can more easily adjust output between product lines and the volume of output itself; the skills required to facilitate such adjustments tend to be learned through general training. Thus the question of whether workers receive more on-the-job training at large firms or at small ones can only be resolved by analyses of empirical data. It is this question that is the subject matter of our study.

1. The Theoretical Background

Theoretical models including Williamson (1967), Lucas (1978), Rosen (1982), and Oi (1983 a, b) explain how market equilibrium occurs with firms of different size. The work of Oi which is summarized below is particularly relevant for its insights into firm heterogenity, the organization of production, and their implications for training.

According to Oi differences in firm size arise out of an unequal distribution of entrepreneurial ability. The special ability of some entrepreneurs that enables their firms to reach large size is that they are able to coordinate the production of large volumes of standardized goods. This ability however does not extend to monitoring the performance of workers. As a result more

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able entrepreneurs who employ a larger work force will incur greater monitoring costs in hiring an additional worker than those faced by less able entrepreneurs who employ fewer workers. Insofar as workers differ in the amount of monitoring, large firms will find it advantageous to hire relatively high-productivity workers. Small firms, on the other hand, will expand output by hiring relatively low-productivity workers even though they require more intensive monitoring. The outcome of this matching process is that, all else being the same, better educated workers and workers with greater labor force attachment, i.e., characteristics associated with high-quality labor, are employed in large firms vis-a-vis small ones (Barth, Cordes, and Haber, 1987).

Large firms also limit monitoring costs in the way they organize production. Production is arranged around teams and managers are layered in a hierarchical structure. Capital is used intensively and is specialized to simplify the tasks performed by labor. Job descriptions and work assignments are described in detail, limiting what workers would like to do and proscribing what they should do. One implication of the organization of production in large firms is that workers in these firms receive relatively large amounts of specific training. Specific training includes not only training on how to operate a unique piece of equipment, but also learning to modify one's behavior to further the objectives of the firm. Specific training of the latter type may be just as important as the former, since it molds workers into more homogeneous labor units allowing substitutability between workers and reduces the costs of supervision.

At the other end of the scale, small firms do best by choosing technologies that are not capital intensive. This alone reduces their need to engage in specific training. By relying on general purpose equipment small firms can

more easily adjust the volume of output as well as its mix. well. In the adjustment process, workers at all experience levels may be expected to receive general training.

From the discussion it is seen that small and large firms tend to occupy different niches in the production spectrum, employ different kinds of workers, and provide different types of training. While it is not possible to say with confidence that one firm size group provides more training than another, the following argument might be made to support the proposition that large firms do more training: Since increases in worker output per unit of training tend to be positively related to a worker's initial productivity level, it may be that large firms provide general training, as well as specific training, to their well-educated employees. On the other hand, although similar individuals undertaking general training in small firms may also want to invest in specific training, ample opportunities for such training may be lacking. Whether this is indeed the case, however, can only be resolved by examining empirical data.

As noted the high monitoring casts faced by large firms imply that they find it more efficient to hire high-productivity workers. It is plausible to assume that the characteristics of workers receiving training in large firms are the same as those of the workers they are most likely to hire. But although small firms hire disproportionately fewer high-productivity workers, it would not be surprising if in these firms, too, high-productivity workers also received the most training. Not so clear however is whether workers with given characteristics receive different amounts of training in firms of different size.

2. The Measurement of Training

Direct evidence of the extent to which training is provided by firms can be

obtained by asking employees and/or employers about company training programs. While Lillard and Tan (1986) do not consider firm size, based on their analysis of Current Population Survey (CPS) and National Longitudinal Survey data they suggest that there is a complementarity between formal schooling and participation in a company training program. They conclude that except for persons with more than 16 years of schooling, the probability of participating in a company training program rises with educational attainment. In separate studies of American and Canadian firms based on employer surveys, where firm size is taken into account, Barren, Black and Lowenstein (1984) and Simpson (1984), respectively, have found that training programs are more prevalent among large firms than small ones. In the former study prevalency is based, in part, on the probability of a firm's most recently hired worker receiving formal training by management.[1] In the latter study prevalency is measured by the duration in months of industrial nonapprenticeship training programs.

The bulk of on-the-job training probably occurs through more informal ways than participation in a training program. Informal training is typically obtained through instruction offered by experienced workers to inexperienced ones. It also occurs when workers simply observe how others perform their job or when they learn by doing through trial and error. Whatever the mode of training, to the extent that training occurs and increases a worker's productivity, one would expect that higher productivity to be reflected in increased earnings. Thus, a measure that captures all aspects of the training process, albeit indirect, is wage growth.

The proposition that wage growth is due to the accumulation of human capital is central to the human capital theory of life cycle earnings. However, wages may increase for reasons that are independent of the training received

by a worker while in the employ of a given firm. Lazear (1981), for example, suggests that the promise and reality of continually higher wages for most workers is an inducement offered by firms to discourage malfeasance. Initially low wages followed by higher wages, on the other hand, is seen by Salop and Salop (1976) as a means of discouraging workers who have marginal attachment to the labor force or who are "job changers" from seeking employment at firms because this is one way of reducing costs, e.g., hiring costs. Despite the different reasons why an individual's wage increases over time, we assume in this study that wage growth is related to human capital investment and that employers who pay a higher wage in the absence of a corresponding increase in worker productivity will not survive for long in a competitive market. To the extent that this is not the case, it is assumed that the proportional contribution of other factors to wage growth remains constant over time. Some empirical evidence that there is a very little discernable wage growth in the absence of training, and of the wage growth that is observed upon completion of training only a relatively small portion is attributable to factors other than training, has been provided by Brown (1983).

Because of the stringency of the data requirements, analyses of wage growth to study productivity gains achieved via on-the-job training are not common. Data sets that permit the examiniation of firm size as a factor influencing wage growth are even rarer, since firm size is lacking in most household surveys. In a study by Keeley (1984), data for hourly workers in 14 cities from the Employment Opportunity Pilot Project surveys were matched with employer data to obtain information on firm size. Keeley found that workers paid by the hour in small and large firms experienced the same relative wage growth, and concluded that the specific training such workers obtain in the latter is offset by general training in the former. However, hourly workers are less

likely to participate in company training programs than salaried workers, particularly in large firms (Haber, 1988), and this may also be true for informal training. Since salaried workers comprise approximately 40 percent of private sector workers, it is unclear whether Keeley's finding for hourly workers also holds for all workers.

Relative wage growth is also considered by Barron, Black, and Lowenstein (1985) but they conclude that it is higher for small firms than large ones. Based on 1960-70 data from the Social Security Administration Longitudinal Employee-Employer Data file, a similar conclusion is reached by Schiller (1982) for young males on their first full-time job lasting at least 6 months.

While no control for firm size was included in Leighton and Mincer (1981), their study of the relationship between the minimum wage and human capital formation, proxied by absolute wage growth, is consistent with the hypothesis that less training is provided by small firms than large ones. Under the minimum wage low-paying firms that would otherwise offer a wage that is less than the minimum and, additionally, also provide employer-paid firm-specific training might find that they can only offer the higher minimum wage. Workers who are the most likely to find training opportunities curtailed by the minimum wage are those whose productivity is low, i.e., whose earnings are low. Leighton and Mincer's study indicates that the minimum wage does, indeed, inhibit human capital formation among low-productivity workers. To the extent that low-productivity workers are employed in low-wage firms and low-wage firms are small firms, it is plausible to surmise that wage growth in small firms is lower than in large ones, again subject to the caveat that little is known about the amount of general training received by workers in small firms.

Leighton and Mincer measure wage growth in absolute terms on the grounds that it is the dollar amount by which the wage rates increases that measures the amount of training received by an individual. In this study we also use absolute wage growth to measure the degree to which skills are augmented via on-the-job training.

3. The Data

The data that we utilize are from Waves 1 through 4 of the 1984 panel of the Bureau of Census Survey of Income and Program Participation (SIPP). A distinguishing feature of SIPP is that it is a longitudinal survey. Each SIPP panel is dividied into four rotation groups. One rotation group is interviewed during the first two weeks of each month. One cycle or wave of interviewing of the four rotation groups required four months; thus each household is interviewed three times a year. The reference period for an interview is the four month period preceding the interview month.

As we use data from Waves 1 through 4, they cover a period of 16 months, spanning calendar year 1984 and early 1985. Of importance for this study SIPP Wave 3 included the size of firm at which individuals worked. Since the analysis is restricted to individuals who worked for the same employer throughout the 16 month period, this information is sufficient to determine whether wage growth occurred at a small or large firm.

In performing the analysis a number of screens have been utilized to increase the homogeneity of the sample. As indicated, all individuals in the sample worked at least 16 months for their employer. Only individuals age 21 years and over are included because work experience information was not collected for younger persons. Even in the absence of this data constraint, one might wish to exclude younger workers because some members of the 16-20 age group

may be disinclined to invest in human capital in the form of on-the-job training at this early stage of their work life. Likewise, persons age 65 years or over and those who indicated they had retired from a job are excluded on the grounds that they may be less inclined to invest in human capital then other workers.

The sample is further limited to individuals who both usually worked full-time at their job and actually worked 35 hours or more per week[2] in all weeks (excluding weeks not worked but for which they were paid, e.g., because of holidays, vacation, etc.) during the 16 months defining the reference periods of Wave 1 through Wave 4. These criteria are more restrictive than those defining full-time, full-year workers in the CPS and ensure greater homogeneity of the sample. Moreover, because of the four-month recall period in SIPP (rather than the 15-month recall period in the CPS), the earnings, hours, and weeks worked information are likely to be more accurate. The intent here is to focus on full-time workers who had uninterrupted attachment to their employer and, therefore, had the same exposure to training. Approximately 2,450 respondents satistied the criteria just described plus the additional criterion that they be private wage and salary workers, excluding private household workers, employed in nonagricultural industries.

4. The Empirical Model

The SIPP data are particularly well suited for assessing the relationship between wage growth and firm size. This assessment is undertaken below utilizing a regression model incorporating individual and firm characteristics, and observing how wage growth varies with firm size when all other independent variables are held constant.

The relationship between training and firm size is assessed by estimating the empirical wage growth model

$$\Delta w = a + b_1x_1 + b_2x_2 + \ldots + c_1y_1 + c_2y_2 + \ldots + e$$

where Δw measures absolute wage growth over a 16 month period. The x_i and y_i represent individual and firm related characteristics, respectively;[3] the coefficients indicate how particular individual or firm characteristics influence wage growth; and e is an error term assumed to be normally distributed with constant variance.

Of particular interest for this study is how wage growth is related to firm size on the grounds that if one observes differential rates of growth for two individuals who are otherwise alike except that one works for a small firm and the other for a large one, the differential wage growth between firm size groups measures differences in the amount of training that they provide.

It is important to note that what is being assessed is not whether large firms provide greater amounts or lesser amounts of training than small ones considering the entire work force of each, but rather whether the amount of industrial training that <u>similar</u> individuals receive is affected by firm size. The amount of training received by workers in a firm depends not only on how much training is offered to individuals with the same characteristics but also on the mix of workers in the firm. As mentioned earlier the mix of workers is different in small and large firms.

Among the individual characteristics variables that can be controlled for in SIPP is educational attainment which is here defined in terms of degree earned rather than years of school completed. Defining educational attainment in this manner has the advantage of affording a more precise measure of the amount

of formal knowledge a person has accumulated while attending school than the amount of time spent in school. All else the same, individuals with more formal education may be expected to acquire more on-the-job training than those with less formal training.

Human capital is acquired not only by attending school but also by working at a succession of jobs, hence, the need to control for differences among individuals in the length of time they have spent in the labor force. At the same time the rate at which new skills are acquired in the labor market may be expected to diminish over time and this, too, should be taken into account. In SIPP work experience can be measured by the number of years an individual has worked six months or more since the year he or she first worked six straight months or longer. This measure of work experience provides a more accurate estimate of an individual's job related investments in human capital than the conventional measure of potential years of work experience (i.e., age-education-6), since the latter can yield erroneous results when applied to women.

Labor force attachment is stronger for married than nonmarried men but the converse is true among women. A parallel relationship might be expected between marital status and wage growth, namely, married men may experience greater wage growth than divorced or single men whereas married women may experience less wage growth than divorced or single women.

It is well known that persons in poor health earn less than those in good health. It may also be that poor health impedes the acquisition of new skills. From the SIPP data health status can be measured by whether an individual has a health condition that limits the kind or amount of work that he or she can do.

Workers covered under a union contract typically earn more than their non-union counterparts, all else being the same. It appears, however, that the wage profile of union workers is not as steep as that of nonunionized workers. If the tasks performed by union workers are more routinized then those performed by other workers, wage growth for the former may be no greater than that for the latter even though the level of wages is higher for union workers.[4]

Wage profiles are also invariably flatter for women than for men. Thus, all else the same, it would not be surprising if wage growth were less for women than for men. Less evident, however, is the relationship between gender and wage growth among firms of different size. In particular, does wage growth among women (relative to men) depend on firm size? Because of the work history data available in SIPP, it is possible to address this question.[5]

Relatively flat wage profiles are characteristic of minorities, i.e., blacks and Hispanics, and these groups, too, may also experience low rates of human capital accumulation through training.

Still another variable that may be related to wage growth is occupation. Three occupational dummy variables are used to control for differences in occupation among workers. A characteristic pertaining more to employers than employees is industry. Three industry dummy variables are used to control for industry effects.

In this study a firm is defined to include all of its establishments. A small firm is defined as having less than 100 employees; large ones are those with 100 or more employees. As indicated by the brief review of the literature, the relationship between firm size and wage growth has been measured in different ways by different investigators. The findings are likewise mixed; strong

evidence is lacking that either large or small employers afford workers greater opportunities for training.

As noted our proxy for training is absolute wage growth denoted by $\Delta w = w_1 - w_0$ where w_1 and w_0 are, respectively, wage rates at the end and beginning dates of a time interval spanning 16 months. For the dependent variable measured in this manner, the coefficients in the regression equation measure the change in an individual's wage for a small change in an independent variable, everything else the same. In particular, the coefficient of the firm size variable shows how firm size affects wage growth when other factors are held constant.

5. The Empirical Results

The empirical regression models are designed to examine two issues. The first is central to this study, namely, whether individuals who are otherwise alike receive different amounts of training depending on whether they work for a large or small firm. The second issue is whethe there are groups of workers who receive more training in one firm size or another. For example, do married workers receive more training than unmarried ones in large firms? Based on differential monitoring costs between large and small firms, an argument for the affirmative can be made on the assumption that married workers have more stable work traits. But if such training is firm-specific, this line of reasoning still leaves unanswered the question of whether married persons in small firms receive an equal amount of training in the form of general training. It should be noted that this second issue is independent of the relationship between training and firm size.

The results of the regression analysis are shown in Tables 1 and 2. The dependent variable in model 1 is wage growth measured in absolute terms. The dependent variable in Model 2 is the natural log of the wage rate. The latter

model can be compared with the first to see how the results of the wage rate regressions differ from those of the wage growth regressions.

As can be seen from Model 1A in Table 1, the regression results conform for the most part with what is known about wage profiles. The conclusions that can be drawn from this table are: Wage growth increases with work experience, mirroring gains in productivity associated with investment in human capital, but then moderates as investment in human capital tapers off in the later stages of the life cycle. Wage growth is also found to be less among women than men, reflecting the less steep wage profile for the former found in studies based on cross-sectional data. Additionally, growth is positively related to education, being greater among individuals with a Bachelor's degree than among those who have not completed college. Individuals with a Master's or higher degree, however, do not appear to experience greater wage growth than those who have not completed college. One possible explanation for this is the finding of Lillard and Tan that individuals with an advanced degree tend not to participate in training programs at work. Another reason, noted below, pertains to the way the data are constructed.

Although the signs of the independent variables are in general agreement with what one would expect, except for the variables just cited and the three occupational variables the coefficients of all other variables in Model 1A are found to be not significantly different from zero at the .10 significance level.

For this study the most important conclusion that emerges given the results of Model 1A is that wage growth is independent of firm size, implying that, all else being equal, individuals acquire as much training working in small firms as they do in large ones. Despite the fact that in large firms a higher fraction

Table 1

Regression Results: Wage Growth
Over 16 Months, SIPP Waves 1-4,
1984 Panel (Including Imputations)

		Regression Equations[a]		
	Mean	Model 1A	Model 1B	Model 2A
Intercept	-	0.621	1.223*	1.552*
Large Firm	.73	-.198	-.134	.190*
Fem	.40	-.479**		-.285*
Black	.08	.409		-.097*
Span	.04	-.585		-.151*
Mar	.71	-.080		.051*
Health	.04	-.616		-.075***
BA	.15	1.022*		.241*
MA	.06	.430		.287*
Union	.19	-.090		.139*
SMSA	.57	.207		.083*
South	.29	-.203		-.050*
Man	.19	.017		.034***
Tran	.04	.019		.163*
RetPers	.14	-.258		-.133*
Prof	.30	.659**		.360*
Cler	.31	.590**		.225*
Mech	.15	.596***		.233*
Yrs Worked	18.21	.060***		.025*
Yrs Worked^2	446.23	-.002**		-.0004*
R^2		.03	.0002	.39
F Ratio		3.99	.43	83.12
Prob > F		.0001	.5128	.0001

[a] Dependent variable is Δw in Models 1A and 1B and ln w in Model 2A.

* Significant at 1% level.
** Significant at 5% level.
*** Significant at 10% level.

Sample size 2,459.

of workers participate in training programs (Haber, 1988) that for the most part are firm-specific, it appears that full-time, full-year workers in small firms obtain general training in amounts sufficient to raise their productivity to the same extent as their counterparts in large firms.

It may be, of course, that the absence of a statistically significant relationship between wage growth and firm size is due to firm size being correlated with the independent variables included in the model. To check this possibility, wage growth is regressed soley against firm size in Model 1B with the same outcome--the two variables are found to be unrelated.

The finding that wage growth is the same in small firms and large ones is in sharp contrast to what is observed regarding wage levels for the two firm size groups. Utilizing the same data in Model 2A, the natural logarithm of the wage rate is regressed against the independent variables included in Model 1A. Most of the variables in Model 2A are statistically different from zero at the .01 level of significance and the remainder are statistically significant at the .10 level. In particular, it is found that ceteris paribus wage rates are 19.0 percent higher for workers in large firms than workers in small firms. Since the longitudinal data fail to indicate a difference in on-the-job human capital accumulation between small and large firms, the higher wages found for the latter in cross-sectional data suggest that these firms hire higher-quality workers--and that the wage differential is due to the wage premium that large firms pay such workers. In particular, the higher wage paid to workers in large firms, evidenced in Model 2A, reflects individual attributes that are difficult to measure in cross-sectional data but are controlled for in longitudinal data in that if they are present at one point of time they are typically present at other points of time.

Another possible explanation of the lack of association between wage growth and firm size is that it is due to imputation errors in the data. When information is missing for a respondent, the Census Bureau utilizes what is known as a "hot-deck" procedure whereby the missing data element is imputed using the same value as that of the preceding respondent with the same characteristics. Thus, for example, if an individual's wage rate is imputed in both the first and last months of Waves 1 and 4, the error in measured wage growth is likely to be greater than the difference between the imputed and true values for each wave. Hence, the hot-deck procedure introduces larger errors in regressions based on longitudinal data than regressions based on cross-sectional data.[6] To check whether the Census Bureau's imputation method accounts for the lack of statistical significance in the firm-size coefficient in Model 1A, it was rerun as Model 1C using only observations for which no imputations were made in computing wage rates or the assignment of workers to small or large firms. The results for Model 1C based on the nonimputed data are shown in Table 2.[7]

As can be seen the coefficients of threee additional variables are found to be statistically significant. Wage growth for individuals with a Master's or higher degree is now greater than for individuals who lack a Bachelor's degree. Individuals who are limited in the amount or kind of work they can do are found to experience less wage growth than those without a work limitation. And wage growth is found to be positively related to residence in a metropolitan area, perhaps because of externalities associated with urbanization. Other variables, e.g., union status, still remain unrelated to wage growth. And of importance for this study, once again no association is found between firm size and wage growth. [8]

Table 2

Regression Results: Wage Growth
Over 16 Months, SIPP Waves 1-4,
1984 Panel (Excluding Imputations)

	Regression Equations[a]			
	Mean	Model 1C	Model 1D	Model 2B
Intercept	-	.493	.526	1.506*
Large Firm	.74	-.161	-.294	.212*
Fem	.41	-.567*	-.771***	-.194*
Black	.07	-.267	-.853	.105
Span	.03	-.315	-.307	-.066
Mar	.70	-.063	-1.310	.084***
Health	.04	-.738***	-.761***	-.103**
BA	.16	1.248*	2.287*	.246*
MA	.07	1.110*	.634	.241*
Union	.18	-.315	-.335	.126*
SMSA	.57	.468**	.478**	.076*
South	.29	.005	.032	-.052*
Man	.18	.231	.251	.061**
Tran	.03	-.383	-.379	.120**
Ret	.14	-.320	-.328	-.132*
Prof	.32	.540***	.560***	.351*
Cler	.32	.669**	.680***	.223*
Mech	.14	.124	.137	.249*
Yrs Worked	17.69	.062***	.061***	.026*
Yrs Worked^2	423.40	-.002**	-.002**	-.0004*
Fem x Large Firm			.422	-.026
BA x Large Firm			-1.406**	-.011
MA x Large Firm			.639	.039
Black x Large Firm			.593	-.128
Span x Large Firm			-1.003	-.202***
Mar x Large Firm			.217	.026
Mar x Fem			-.188	-.112
R^2		.051	.058	.41
F Ratio		5.51	4.44	50.20
Prob > F		.0001	.0001	.0001

[a] Dependent variable is Δ w in Models 1C and 1D and ln w in Model 2B.

* Significant at 1% level.
** Significant at 5% level.
*** Significant at 19% level.

Sample size 1,891.

In order to determine whether firm size indirectly affects wage growth, Model 1C was expanded to include several interaction effects. Even though no direct link betweeen firm size and wage growth has been found, it is possible that the relationship between, say, gender and wage growth indirectly depends on whether individuals are employed in a small or large firm. For example, it might be argued that women have more opportunities for advancement in large firms beacuse of the diversified occupational structure of such firms.

To test whether particular groups of workers experience greater wage growth in firms of different size the education, race, Spanish origin, gender, and marital status variables were interacted with the firm size variable. Based on the results of Model 1D the only indirect effect on wage growth that is statistically significant is the one between firm size and having a Bachelor's degree. Relative to those who did not complete college, individuals with a Bachelor's degree increased their wage rate by an additional $1.41 an hour over the 16 month period if they worked in a small firm rather than a large one. A plausible explanation for this outcome is that in small firms less educated persons may not be able to translate general training into greater productivity and better educated persons may have such specialized knowledge that specific training offers them the most rewarding channel, but not necessarily the most remunerative one, for expanding on skills learned in a formal educational setting.

From Model 1D it is also appears that women, blacks, Hispanics, and married persons experience the same wage growth whether they work in a small firm or large firm. Of some interest the last interaction terms in Models 2B and 1D indicate the although married persons, relative to nonmarried persons, earn less if they are women, there is no relationship between wage growth and the

gender of married persons, suggesting that women receive less training than men because of their gender rather then their marital status.

It should be noted that while no relationship is found between firm size and wage growth, this can not be taken to imply that Leighton and Mincer's finding, i.e., that the minimum wage adversely impacts on training, is put in question. Training may be inhibited in low wage, small firms but not all small firms pay low wages. Our findings only indicate that for workers with the same characteristic wage growth is no less in the average small firm than in the average large firm. SIPP does not provide information on the average wage paid by the firms in which respondents are employed and hence this aspect of human capital formation, i.e., whether wage growth is less in low wage, small firms than in high wage, small firms, could not be examined. As mentioned no firm size effect on wage growth is apparent when low and high wage firms are grouped together within firm size classes.

The reader is cautioned that in assessing these results the historical context of the U.S. economy at the time the survey data were collected should not be ignored. The economy was just beginning to recover from the 1982 recession. The effect of that recession on subsequent wage growth in small and large firms is not self-evident. Nonetheless the SIPP data do provide a basis for at least a tentative conclusion regarding the relationship between firm size and industrial training.

Still another caveat that should be borne in mind is that the data pertain to money earnings rather than compensation and, hence, omit employer contributions to health insurance, life insurance, private pension plans, and other nonwage compensation which may be related to firm size. Due to lack of information about employer costs for fringe benefits further refinement of the data is not possible.

6. Conclusion

In this study absolute wage growth is used to proxy all forms of on-the-job training whether specific or general and whether informal or formal. Empirical regression models are estimated to determine how firm size affects wage growth. As expected holding firm size and other variables constant wage growth was found to depend on a worker's level of education, gender, and amount of work experience.

The major conclusion of the study is that workers who are otherwise alike experience the same wage growth whether they work for a small firm or large one. While large firms do more specific training, small firms do more general training; on balance the total amount of training is the same in both groups of firms. It also appears that workers with given characteristics receive the same amount of training irrespective of the size of the firm at which they work. The one exception pertains to individuals who have a Bachelor's degree (but not a higher degree). Relative to workers without a college degree, those with only a Bachelor's degree have higher wage growth if they work at a small firm than if they work at a large one.

Of methodological interest our study indicates that the imputation of missing values in longitudinal household surveys can introduce errors into the data which lead to results that differ from expectations. Fortunately the data of this study permit one to distinguish between reported and imputed data.

FOOTNOTES

1 Training was found to be more prevalent among large firms than small ones when prevalency was also measured by the probability of a firm's most recent hire receiving informal training by management, informal training by co-workers, and training involving watching others do their job.

2 The criterion of actually working 35 hours or more per week covers all jobs. Hence, some individuals are included who may have worked more than 35 hours a week as a result of having moonlighted at a second job. Such individuals would have also had to usually work 35 hours or more at their primary job for inclusion in the analysis.

3 The independent variables utilized in the model are listed in the Appendix Table.

4 An alternative explanation is suggested by Mincer (1981), namely, that a larger proportion of union workers' compensation is in the form of fringe benefits, including pension benefits, which reduces their propensity to leave an employer and, hence, inhibits the incentive for undertaking general training.

5 Leighton and Mincer and Schiller include only men in their study and neither Barron, Black, and Lowenstein or Keeley report how gender affects wage growth.

6 For a related discussion see Lillard, Smith, and Welch (1986).

7 The remaining models in Table 2 are also estimated using the nonimputed data.

8 A similar finding is obtained when wage growth is measured in relative terms by $\ln (w_1/w_0)$, using the imputed observations and excluding them. In both instances the t-values for the firm size variable fell short of statistical significance at the .10 significance level.

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Appendix Table

Independent Variables in the Wage Growth Regression Equations

Variable Name	Description
Large Firm	Equals 1 if number of employees is over 100; 0 otherwise
Fem	Equals 1 if female; 0 otherwise
Black	Equals 1 if black; 0 otherwise
Span	Equals 1 if Hispanic; 0 otherwise
Mar	Equals 1 if married, spouse present; 0 otherwise
Health	Equals 1 if disability which limits the kind of amount of work that can be done; 0 otherwise
BA	Equals 1 if Bachelor's degree; 0 otherwise[a]
MA	Equals 1 if Master's degree, Ph.D., or professional degree; 0 otherwise[a]
Union	Equals 1 if covered by a union contract; 0 otherwise
SMSA	Equals 1 if metropolitan area; 0 otherwise
South	Equals 1 if state in the South; 0 otherwise

[a] Degree attained base group -- less than a Bachelor's degree.

Appendix Table (cont'd)

Independent Variables in the Wage Growth Regression Equations

Variable Name	Description
Man	Equals 1 if mining; construction; and manufacturing; 0 otherwise[b]
Tran	Equals 1 if transportation, communications, and other public utilities; 0 otherwise[b]
Ret Pers	Equals 1 if retail trade; personal service, entertainment, and recreation services; 0 otherwise[b]
Prof	Equals 1 if executive, administrative, managerial; professional specialty; and technical and related support occupations; 0 otherwise[c]
Cler	Equals 1 if sales and administrative support, including clerical occupations; 0 otherwise[c]
Mech	Equals 1 if mechanics and repairers, construction and extractive; precision production occupations; 0 otherwise[c]
Yrs Worked	Number of years worked six months or more since first year worked six straight months or longer

[b] Industry base group -- wholesale trade; finance, insurance, real estate; business and repair services; and professional and related services.

[c] Occupation base group -- machine operators, assemblers and inspectors; service occupations, except household; transportation and material moving; handlers, equipment cleaners, helpers, laborers; and farming, forestry, and fishing occupations (excluding those in agriculture).