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FIRM AGE AND WAGES

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ABSTRACT

In this paper, we analyze the relationship between how long an employer has been in business (firm age) and wages. Using data from special supplements to the Survey Research Center's monthly Survey of Consumers, we find that firms that have been in business longer pay higher wages (as previous studies have found), but pay if anything lower wages after controlling for worker characteristics. There is some evidence that the relationship is not monotonic, with wages falling and then rising with years in business. Older firms provide better fringe benefits and more stable employment, but these differences do not appear very important in understanding the age-wage relationship. Established employers do appear to make greater use of back-loaded compensation, consistent with their higher probability of remaining in business.

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We know a great deal about how the characteristics of individuals are related to labor market outcomes—which types of workers earn higher wages, who is more likely to quit or be laid off, who is more likely to work part-time or not at all. We know less about the relationship between firm characteristics and various labor-market phenomena, except for a few such characteristics that have been the focus of much recent research. Prominent examples include unionization (Lewis, 1986; Freeman and Medoff, 1984), employer size (Oi, 1983; Brown, Hamilton, and Medoff, 1990; Oi and Idson, 1999), and industry (Dickens and Katz, 1987; Krueger and Summers, 1988).

A fourth key characteristic of firms is their age. Beneath the relatively gradual changes in aggregate employment lies a far less tranquil picture at the firm level (Leonard, 1987 and 1994; Davis and Haltiwanger, 1992). This finding has led to considerable interest in the determinants of firm birth, growth, and death rates (Jovanovic, 1982; Dunne, Roberts and Samuelson, 1988 and 1989), and, more broadly, to interest in differences between old and young firms. Dunne, Roberts, and Samuelson (1989) report that manufacturing plants that have been in business longer are less likely to close, and Brock and Evans (1986) show that older firms are less likely to fail (controlling for plant and firm size, respectively).

An emerging literature suggests that older firms pay higher wages, even after other relevant firm characteristics are held constant. Dunne and Roberts (1990a, 1990b) find that older manufacturing plants pay higher wages to their production workers, controlling for size, industry, and region, whether or not one controls for the probability the plant will close. Davis and Haltiwanger (1991) also find that older manufacturing plants pay higher wages, and age remains

a statistically significant determinant of wages once industry and size are held constant. Troske (1998, Table 11.11) reports similar results: controlling for employer size and location, workers in plants that are less than five years old earn nearly 20 percent less than workers in plants that have been in business 15 years or more. Blanchflower and Oswald (1988) find no significant relationship between wages and years in operation in British data;[1] Winter-Ebmer finds a positive relationship in Austria.

While differences in wages (and other outcomes) by age of firm may well be important, limitations of available data make analysis of such differences difficult. Establishment data used in previous studies do not allow one to control for worker characteristics,[2] which have been found to account for some but not all of the wage differentials associated with other employer characteristics. Moreover, previous research offers few clues as to why differences by age are present in the data, and whether non-wage features of the employment contract are related to age (as is true for union, employer size, and industry).

The purpose of this paper is to provide a careful analysis of wages by age of firm. In Section I, we present reasons why old and young firms might be expected to pay different wages. In Section II, we describe a household-based survey that includes information on wages, worker characteristics, employer characteristics including age of firm, and related non-wage characteristics. In Section III, we examine the relationship between firm age and wages.

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1. The lack of an age effect may reflect US-UK differences. It may also be due to differences in control variables (in particular, Blanchflower and Oswald control for the financial condition of the firm, which may be correlated with firm age).

2. Winter-Ebmer's Austrian data does include some information about worker characteristics.

Because we were concerned about the accuracy of worker reports of firm characteristics, we also located Dun and Bradstreet's records for a subset of the employers of our respondents; section IV examines whether wage equations differ significantly when D&B data on employer characteristics replace the workers' own reports. We ask in in Section V whether differences in non-wage characteristics can help us understand the firm age-wage relationship, and in Section VI whether the wage-tenure profile differs between newer and established firms. We summarize our main findings and their implications in Section VII.

I. Theoretical Links Between Firm Age and Wages

The standard competitive model of heterogeneous firms and workers suggests that the wages firms pay reflect the quality of the workers they hire and the working conditions they offer. It thus provides a natural framework for thinking about wage differences by age of firm.

Worker Quality

Among observable indicators of worker quality, experience and tenure with the firm are the most obviously related to firm age. Those working for newly-established firms cannot have high levels of tenure. Older firms thus have longer-tenure workers, and they are likely to have workers with more overall experience as well. While there is much inter-firm mobility, many workers eventually stay with one firm for much of their work life (Hall, 1982; Farber, 1998). Age-related differences might lead to other, cohort-related differences at one point in time; e.g., with secular increases in workers' education, the older workers employed by established firms may have less education than the younger workers at newly-created firms.

For most analytical purposes, older firms paying higher wages because their workers are more experienced and have higher tenure (or lower wages because they have less education)

would not be regarded as "true" firm-age differentials. Nevertheless, it is important to explore this possibility, because the establishment-based data used in earlier studies do not allow analysts to control for such differences.

Firm Age, Survival, and Employment Stability

If experience and tenure are the worker characteristics most likely to differ by age of firm, probability of survival is perhaps the most obvious non-wage job characteristic to explore. As noted in the introduction, younger firms are much more likely to expire than older ones. As one might expect, having one's place of employment close has negative effects not only on employment but also on wages. Gibbons and Katz (1991) report that workers displaced by plant closings averaged 20 weeks of joblessness following displacement, and their wages (typically about two years later) were about 16 percent below pre-displacement levels. Even six years after displacement, wages are reduced by about nine percent , and subsequent job loss is more likely (Stevens, 1997); food consumption remains below pre-displacement levels (Stephens, 2001). It is reasonable to view the higher probability that younger firms will close as an important negative job characteristic, which implies that such firms would have to offer higher wages in order to attract a given quality of worker.[3]

The fact that established firms are more likely to survive has other implications, both for wage levels and for the slope of the wage-tenure profile. Idson (1996, pp. 279-281) argues that

3. The existing literature provides mixed evidence on whether the prospect of layoff or plant closing leads to higher wages. Dunne and Roberts (1990a, Table 2) find that U.S. manufacturing plants with high probability of closing pay higher wages. Blanchflower (1991) however finds that workers receive higher wages when they expect employment at their workplace to increase.

firms whose likelihood of survival is high offer more firm-specific training, which would make wages rise more rapidly with tenure and raise the average level of wages. Baker, Gibbons, and Murphy (1994) suggest that firms encourage worker effort by promising higher future wages to workers who work harder now, but that these implicit contracts are compromised if the firm has a high discount rate (which tempts the firm to renege). Milgrom and Roberts (1992, p. 266) argue that, while implicit contracts can be enforced by the firm's reputation, "[a] major constraint on reputational enforcement mechanisms is that the horizon over which the relationship is expected to continue must be relatively long if the value of reputation is to exceed the gain from cheating." Established firms, with more secure survival prospects, would be more likely to honor—and so be able to make greater use of—these implicit contracts. Once again, this would make the wage-tenure relationship steeper, and average wages higher (since these contracts lead to greater effort by workers).

Fringe Benefits

Older firms are more likely to offer fringe benefits like pensions or health insurance. One reason is that, as noted above, they tend to pay higher wages, and such fringe benefits are tax-advantaged, making them particularly attractive to higher-paid workers. A more mechanical "explanation" is that firms tend not to have pension or health insurance plans when they start in business, and gradually adopt them afterwards. One reason for such behavior is that the cost of such fringes includes a relatively fixed set-up cost. Uncertainly about survival probability (and the need for the entrepreneur to focus first on more basic production and marketing decisions) encourage new firms to postpone such decisions.

Empirically we (Brown and Medoff, 1996, pp. 285-286) find that established firms are more likely to offer pension plans and health insurance, though the latter difference is only marginally significant when we control for worker characteristics. Offering pensions or health insurance should allow older firms to attract workers of given quality at lower wages.

Ability to Pay

The relationships between firm age and wages outlined so far are those that one would expect in competitive markets, in which workers care about features of the job and their compensation, but not about the profitability of the firm per se. An alternative hypothesis is that firms find it costly to pay wages below those seen as fair by workers (Akerlof and Yellen, 1990) in light of the firm's ability to pay (Kahneman, Knetsch, and Thaler, 1986, p. 733; Blinder and Choi, 1990, pp. 1008-1009). If—as passive learning models suggest (Pakes and Ericson, 1998)—firms that have survived longest are on average those with the greatest underlying potential profitability,[4] the wage regarded by workers as fair (and hence, in equilibrium, the wage chosen

4. Peterson and Rajan (1995, p. 435) find that established firms pay significantly lower interest rates than newer ones, holding size (book value of assets) and indebtedness constant, and note that their finding is consistent with the hypothesis that survival is a signal about the borrower's true quality. Bartel (1994, Table 1) finds positive effects of age of the business on labor productivity, controlling for size. The estimated effects are sizeable (a one standard deviation increase in firm age increasing ln (output/worker) by .09) but imprecisely estimated (t=1.2). She argues that "young businesses have low levels of labor productivity because their technology has not yet been well defined and their employees devote a significant amount of their time to designing and redesigning an appropriate production technology" (p. 416).

by the firm) is likely to be higher at established firms. The claim of inability to pay higher wages is much more credible when made by a new firm whose long-run existence is in doubt than (absent very special circumstances) when made by a long-surviving firm.[5]

An alternative path to the same result is to imagine firms and (even non-union) workers bargain over the rents from the employment relationship. Hildreth and Oswald (1997) present such a model and find profitability is positively related to wages even in the long run.

II. Data

In order to investigate the relationship between firm age and wages, we added supplementary questions to the regular Survey of Consumers, which is conducted by the Survey Research Center at the University of Michigan. Each month, a sample of 500 adults is interviewed by telephone, collecting basic demographic information (schooling, age, race, sex, and marital status) as part of its mission of monitoring consumer attitudes and expectations. From September 1991 through March 1992 the supplement asked whether the respondent was currently employed and if so whether s/he was an employee of a private business or non-profit organization. Each private wage and salary worker was asked a standard set of questions about labor market status —years of full-time work experience, years of tenure with current employer, usual workweek, coverage by collective bargaining, occupation, industry, and employer size (employment at the worker's establishment and the company/organization as a whole).

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5. Age may also contribute more directly to potential profitability. Firms that have been in business longer are likely to produce better-known products, providing a brand loyalty that newer entrants are hard-pressed to match even with equal advertizing budgets (Scherer, 1980, p. 260), and a less elastic demand for their product.

Three additional types of information were added in order to investigate the importance of age of firm. First, respondents were asked "how long has this (company/organization) been in (business/operation)?" Second, we asked each respondent for the name and address of his/her workplace, and added Dun and Bradstreet data on industry, establishment and company employment, and years in business for that employer to the data file. Third, we asked respondents about job characteristics that the previous section suggested would be related to age of firm and to wages, such as the probability of losing the job to layoff or plant closing, the availability of employer-provided pension and health insurance plans, and the financial condition of the firm (whether the firm could afford a 10 percent wage increase).[6]

During the months of our supplement, Survey of Consumers respondents included 1410 currently employed private wage and salary workers, which is in line with expected "losses" of those who are not employed, self-employed, and government workers. Sample means, standard deviations, and sample sizes for individual variables are presented in the first three columns of Table 1. The demographic variables are unsurprising, except perhaps for women comprising half

6. The layoff question was "In the next few years, if you remain with your current employer, how likely is it that you would lose your job due to a layoff or your workplace closing down altogether?" with responses recoded so that "almost certain"=1.0, "probable"=.75, "50-50 chance"=.5, "unlikely"=.25, "extremely unlikely"=0.0. The ability to pay question was "Without going out of business, do you think your employer could afford to increase the pay of all its workers by 10 percent?" with responses recoded so that "definitely"=1.0, "probably"=.75, "50-50 chance"=.5, "probably not"=.25, and "definitely not"=0.0.

of our sample. Roughly 10 percent of the sample did not report a wage[7] or employment at the company where they work; other variables, including establishment size and age of business, posed fewer problems. The fourth column of the table gives mean values of the variables in the sample (N=1067) with complete data for all of the variables. The complete-data sample looks very much like the larger sample.

The final column of Table 1 gives mean values for the sample for which we have complete data and matching information from Dun and Bradstreet's. We discuss the D&B data in greater detail in Section IV. For now, we note that we were more likely to match larger and more established employers, but differences in worker characteristics between the matched and larger sample are again very small.

III. Evidence on Firm Age and Wages

Evidence that established firms pay higher wages is largely based on establishment data from manufacturing. We therefore begin my asking whether, controlling for employer characteristics typically available in establishment surveys, there is evidence that older firms pay higher wages in our (household-based) data (not limited to manufacturing). The first two columns of Table 2 show that we, too, find higher wages at larger establishments and firms, and (controlling for these) at older firms as well.[8] The relationship between firm age and wages is

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7. We treated ln wage (in cents per hour) < 5 or >10 (i.e., hourly wages <$1.48 or >$220) as missing.

8. The union coefficients are negative because most unionized workers are in blue-collar occupations, and we are not controlling for personal characteristics correlated with occupation. Analyses of union wage effects using establishment data usually focus on blue-collar workers.

economically significant—a one standard deviation increase in age increases wages by 7 percent when age is entered linearly and 4.6 percent using ln-age.

The next two columns underline the importance of controlling for differences in worker characteristics when measuring the impact of firm age. The firm age effect is eliminated (col. 3) or becomes significantly negative (col. 4) by the addition of controls for worker characteristics. While personal characteristics are obviously correlated with the employer variables, they do not lead to collinearity problems—in fact, the standard errors of the employer variables are reduced when we control for worker characteristics (because they reduce residual variance). While firm age is positively related to union coverage and to employer size, these links are weak enough that controlling for age of firm has little effect on our estimates of these more traditional variables.[9]

Comparisons among the specifications in columns 1-4 of Table 2 raise two questions. First, which control variables are responsible for the dramatic change in the estimated effect of firm age? Thinking of the personal characteristics included in columns 3-4 but not in columns 1-2 as omitted variables, we can write

$$\ln w = b_1 \text{ (age of business)} + \Sigma b_{2,j} X_j + \text{error}$$

$$\ln w = c_1 \text{ (age of business)} + \Sigma c_{2,j} X_j + \Sigma c_{3,k} Z_k + \text{error}$$

$$Z_k = a_k \text{ (age of business)} + \Sigma a_{k,j} X_j + \text{error},$$

where X = establishment variables (besides age of business) held constant in columns 1-2, and Z = worker characteristics added in columns 3-4. The change in the coefficient of age of business, b_1-c_1, due to controlling for Z is equal to $\Sigma a_k c_{3,k}$. Values of $\Sigma a_k c_{3,k}$ for the added personal

9. When we do not control for firm age, the union and employer size coefficients are the same (to three decimal places) as those in column 3.

characteristics are given in Table 3. As expected, the experience and tenure variables are most important. The surprise in Table 3 is the small but consistent contributions of the other variables whose connection to age of business was much less clear a priori. Across the board, older firms are hiring workers with characteristics associated with higher wages. This uniformity leads us to expect that controlling for unmeasured worker characteristics would make the age-of-firm coefficients more negative.

While controlling for worker characteristics when measuring the effect of age of business is not possible with the establishment data that previous researchers used when they found a positive relationship, it is possible with the Worker Establishment Characteristic Database (WECD) recently created at the U.S. Census Bureau (Troske, 1998).[10] Ken Troske has generously provided results of regressions similar to Table 2, based on the WECD. Several differences are worth noting: WECD includes only manufacturing workers, has age of plant rather than age of the business, has more detailed industry, occupation, and geographic controls but no measure of tenure or union status. With age of plant entered linearly, adding worker controls changes its coefficient from .007 (s.e.=.0006) to .0008 (.0005); with the logarithmic

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10. The long form of the U.S. Census included detailed information on the location of the respondent's workplace. The WECD then matches those employed in manufacturing to Census Bureau establishment data based on that detailed location information. Matched workers tend to be found in plants that are larger than average, and earn about 10 percent more per hour, than is true of manufacturing workers in general. Despite these concerns, Troske (1999) concludes that estimates of the size-wage relationship are are very similar to those found in other data.

variable, the coefficient falls from .021 (.005) to .008 (.001). So, in Troske's WECD equations, the worker controls reduce the effect of age of plant from positive (though smaller than in Table 2) to zero.[11]

A second question raised by Table 2 is why the estimated effects of years in business differ so much between linear and logarithmic specifications. While the difference is dramatic in columns 3-4 (implied elasticity of -.004 in column 3 vs. -.035 in column 4), it is also significant in columns 1-2 (.088 vs .042). To resolve this puzzle, we allowed a more flexible relationship between firm age and wages, using a spline with kinks at firm ages of 15, 30, and 60 years (roughly the quartiles of the distribution). The results are summarized in Table 4. The individual spline segments are not very precisely estimate—we are asking a lot of 1000 observations—but they are jointly significant, and they have very similar implications for the linear and logarithmic specifications. These are shown in the bottom half of the table, where the predicted wage at various points of the firm-age distribution (the quartile points, and age=90, which is near the 10th percentile) are calculated, and normalized to zero at the median age of 30 years. When worker characteristics are not held constant, the wage-age relationship is U-shaped, with the increasing segment dominating. With worker characteristics held constant, the U-shape

11. In a slightly different specification with controls for worker characteristics, Troske (1999) reports a coefficient of ln(plant age) of .002 (.005). Doms, Dunne, and Troske (1997) match WECD data to establishments in five industries (for which they also have unusual data on adoption of technology). In these five industries, older plants pay higher wages; this difference becomes negative but insignificant when controls for worker education and age are added. They control throughout for capital intensity and number of technologies adopted.

remains, but the initial decreasing segment is more dominant. Once the splines' flexibility is introduced, it matters little whether the splines are based on a linear or logarithmic age variable, so they do effectively account for the difference between the linear and logarithmic results in Table 2.

IV. Dun and Bradstreet Data

Because we were concerned about the accuracy of worker reports of employer characteristics, we asked respondents for the name, address, and telephone number of the place where they worked, and added Dun and Bradstreet data for those employers we could match. We were able to match about half of the sample, with losses due to respondents' reluctance to tell us where they worked (17 percent), inability to locate the employer in Dun and Bradstreet's (22 percent), and a residual category of matches we questioned (11 percent), most often because respondents had provided seriously incomplete information about their employers (see Brown and Medoff, 1996, p. 278).[12] As we noted in discussing Table 1, the employers we could match were larger and had been in business somewhat longer (based on respondent reports) than the ones we could not match; wages and personal characteristics were not very different.

A comparison of worker reports and D&B data shows encouraging agreement on establishment and firm size ($r>.8$) and less on firm age ($r=.5$). For firm age, however, part of the discrepancy appears related to changes in ownership. When a business is sold to a new owner,

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12. Decisions about questionable matches were based only on the name, address, and telephone number of the employer as given by the worker with the same information from the D&B match candidate. We did not evaluate matches based on comparing worker and D&B data on employer size, age, or industry.

Dun and Bradstreet's years in business variable often measures years in business under current ownership. We strongly suspect that our respondents did not treat such changes of ownership as a rebirth. On this issue, it is not clear what the ideal convention would be (Oi and Idson, 1999, p. 2210), and so these discrepancies are not necessarily "errors" in the workers' reports.

In Table 5, we present regressions using this smaller sample, with employer variables based on worker reports (columns 1-4) and D&B data (columns 5-8). Compare first the worker reports in Table 5 with the analogous columns in Table 2, which are based on worker reports but use the full sample. Establishment size is less important and firm size more important in Table 5 than in Table 2 but the effect of proportionally increasing both is nearly equal in the two tables. Age of business coefficients are a bit less positive/more negative among the matched employers, but the general patterns of the two tables are quite similar. Standard errors are, of course, larger in the smaller sample.

Comparisons of the D&B-based results in columns 5-8 with those using worker reports in the first four columns show weaker effects of age of business, though these results are not large once we control for personal characteristics.

Given Dun and Bradstreet's handling of changes of ownership, it possible for workers tenure with employer to exceed the age of that employer in the D&B file. Excluding cases where this happens from Table 5's regressions increases the correlation between worker reports and D&B reports of firm age to .6, and raises the absolute value of the D&B-based age coefficients in Table 5, so that they are even more similar to those based on worker reports.

V. Non-Wage Job Characteristics and Wages

The evidence in Tables 2-5 suggests that, after controlling for worker characteristics,

wages fall with age of firm at least initially, before perhaps increasing. Can differences in non-wage job characteristics account for this pattern?

As noted in the introduction, established employers tend to offer better fringe benefits and more stable employment (which should lead to lower wages, all else constant) and might be seen as having greater ability to pay above-market wages (which would lead to higher wages). Differences in fringe benefits and job stability might account for the generally downward-sloping age-wage relationship, and ability to pay might help explain the eventually increasing relationship.

The simplest test of these links is to enter measures of fringe benefit availability, job (instability, and perceived ability to pay higher wages into the wage equations of Table 2. This is done in the first column of Table 6. Comparing this column to column 4 of Table 2 shows that the additional variables account for none of the observed relationship—if anything, they intensify the puzzle. The same conclusion holds for the more complicated U-shaped form—column 4 of Table 4 vs column 2 of Table 6.

Inspection of the coefficients of the four additional variables reveals why they cannot account for the age-wage relationship—none has the sign predicted by the theory. At least for the two fringe benefit variables and the instability measure, this reflects the difficulty of finding evidence of compensating differentials in cross-section wage equations. If, for example, workers with greater (unmeasured) ability receive higher wages and are more likely to be in pension plans, the omitted ability biases the pension-plan variable upward.[13]

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13. Workers with more tenure should place greater value on employment stability (since they have more invested in the relationship) and pensions (since pension values often jump

Our ability to pay measure turns out to be only weakly related to firm age or to wages. If anything, we would have expected that those who work for successful firms would be above average on unmeasured characteristics, so omitted variables are an unlikely explanation for the weak relationship with wages. (We also asked respondents whether their employer was in better or worse financial condition than its competitors, but "better" so dominated the responses that there was little useful variation in this measure.)

For the two fringe benefit measures, there is a way around the problem of estimating the effect of fringes on wages. At least as an approximation, we might expect workers to "pay" for $1 of pensions or health insurance with a $1 reduction in wages. On average, establishments that offered pension plans spent about 7.2 percent of wage costs on pensions; establishments that offered health insurance spent about 9.5 percent of wage costs on such insurance.[14] We can

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discontinuously at eligibility for early retirement). In a spot-market model of compensating differentials, the interaction of tenure and employment instability should be positive, and the interaction of tenure and pensions should be negative. Neither of these predictions is supported by the data.

14. For pensions, we calculated the ratio of employer costs for retirement plans to wages (including holiday and vacation pay) in private industry, which was .041 in 1988 according to Employment Cost Index data. We divided this by the proportion of workers whose employers offer retirement plans, .57 in the 1988 Current Population Survey. Thus, we estimate that, for employers offering such plans, they account for about .041/.57=7.2 percent of wage costs. For health insurance, we took the ratio of insurance costs to wages (.071), and divided by the fraction of workers whose employers offer health plans (.75); thus, for employers offering health

impose the belief that such benefits reduce wages dollar for dollar, or, equivalently, focus on the logarithm of "total compensation" defined as

ln (wage + pension cost + health insurance cost) =

ln (wage) +ln (1 + pension/wage + health insurance/wage) ≈

ln wage + .072 * has pension + .095 * has health insurance.

In columns 3 and 4 of Table 6, we replace ln (wage) with ln (total compensation) as our dependent variable.

Comparing column 3 of Table 6 with column 4 of Table 2 reveals that these two benefits account for about 30 percent of the negative effect of firm age on wages. In column 4 of Table 6, we see that the spline in age of business continues to suggest a U-shaped relationship. Given that we have imposed a 1-for-1 tradeoff between fringes and wages, we think this approach if anything overestimates the ability of fringes to explain the link between firm age and wages.[15] It is possible, however, that among firms that offer pensions or health insurance, older firms offer more generous plans[16] (which would lead even our constrained estimates to understate the

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insurance, its cost amounts to about .071/.75=9.5 percent of wages. All data are from Piacentini and Foley, 1992, Tables 2.6 and 2.15.

This procedure in effect assumes that firms offering these benefits pay average wages (while in fact they pay higher wages), and so the ratio of benefit costs to wages is overstated.

15. As explained in the previous note, our procedure also tends to overstate the ratio of pension or health insurance costs to wage payments.

16. Carroll and Hannan (2000, p. 434) conjecture that firms founded before the rise of government-provided benefits offered—and continue to offer—more generous fringe benefits,

relationship between fringe benefits and age of firm). Lacking data on generosity of fringe benefit plans by age of firm, we cannot pursue this possibility.

VI. Firm Age and Wage-Tenure Profiles

We noted earlier that both human capital theory and some models of labor contracts to motivate worker effort predict that wages should increase with tenure, and that this relationship is likely to be more pronounced where the employment relationship itself is more secure. Since new firms have higher failure rates, workers have less incentive to invest in firm-specific human capital, and firms have more incentive to renege on (and so can make less use of) promises of higher future wages in return for greater current effort. Yet no study in the emerging literature on firm age and wages has looked at the relationship between firm age and the slope of the wage-tenure profile.

In the first two columns of Table 7, we add an interaction between tenure and firm age (or ln firm age) when the worker started with the firm to the wage equations of Table 2. The coefficients of these interaction terms are positive, as expected, and suggest differences in wage growth at large and small firms may be practically important. On average, one year of tenure increases wages by 1.7 percent, and a year of tenure and experience by 2.7 percent; a one standard deviation increase in age of firm increases this by about .25 percentage points.

The point estimates in columns 1-2 are, however, only marginally significant. Moreover, if one adds the age*tenure interaction to specifications with age splines (as in Table 4), the interaction term is essentially zero.

In columns 3 and 4, we difference the wage equation in columns 1-2, so that the change

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but they acknowledge that reliable data are not available.

in ln real wage (i.e., ln wage - ln starting wage in $1992, using the personal consumption deflator) is the dependent variable. Fixed personal characteristics drop out when we difference, as do employer characteristics—assuming, as we must given the data, that these are relatively stable. The remaining explanatory variables are the change in tenure = the change in experience (= tenure at survey date), (the change in) tenure squared, the change in experience squared, and the age of firm*tenure interaction.

With this specification, the evidence that wages grow faster at established firms is quite strong—the interaction coefficients are nearly twice as large as in the "levels" specification and are highly significant statistically.[17]

The stronger results in columns 3 and 4 are "explained" by the fact that initial wages are negatively related to firm age*tenure, and so subtracting initial wage from current wage makes the age*tenure interaction larger (more positive). One interpretation of this negative relationship is that (unmeasured) quality of those hired by established firms has grown more positive over time, but specification error correlated with firm age*tenure obviously includes other possibilities. The differenced equations in columns 3-4 correct for such specification errors, and

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17. Starting wages are no doubt measured less accurately than current wages, and the wage-change measure has a few striking outliers. Nevertheless, eliminating observations in the top and bottom five percent of the distribution of wage changes per year had essentially no effect on the estimated age*tenure interaction. Alternatively, one might argue that wages should grow faster in larger firms. Adding an interaction between tenure and ln firm size reduces the age*tenure interaction by only 20-30 percent, and so leaves the story line unchanged.

have somewhat smaller standard errors. On balance, they seem more reliable.[18]

If established firms are able to offer more firm-specific training and make greater use of implicit contracts with deferred compensation (and so induce greater worker effort), we would expect wages to be lower initially but higher eventually (and, since workers are investing more and working harder, on average). This makes the generally negative estimates in the previous tables more striking.

VII. Conclusions

We began with a number of hypotheses linking firm age and wages, ranging from the relatively mechanical tendency for established firms to have older, longer-tenure workers to subtler relationships based on established firms offering more stable employment and better fringe benefits and perhaps being seen as having greater ability to pay high wages.

Unlike employer characteristics such as size, industry, and union coverage, the higher wages paid by established firms are completely explained by the observable characteristics of their workers. Indeed, after controlling for these characteristics, the relationship between firm age and wages is negative, at least over much of the firm-age distribution. Moreover, it is not just experience and tenure, but also education, occupation, and other demographic characteristics associated with higher wages that are positively related to age of firm. We therefore expect that, if our measured worker characteristics were more extensive, the relationship between age of firm and wages would be more negative still.

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18. The usual argument against differencing is that it increases the noise to signal ratio. But in our equation the variable of interest (firm age*tenure) is the same in the cross-section and differenced specification, because the initial value of firm age*tenure is identically zero.

Established firms are more likely to offer pensions and health insurance, and these should allow them to obtain workers of given quality at lower wages. However, even assuming a one-for-one tradeoff between benefit costs and wages leaves most of the negative relationship between firm age and wages unexplained. Established firms also provide more stable employment. The usual difficulties of estimating compensating differentials models—with incomplete controls for worker quality, estimated effects of amenities on wages are likely to be less negative or even positive—make it difficult for us to conclude how important such differences in employment stability are for wages.

The hypothesis that firms with greater ability to pay end up paying higher wages leads to the prediction that established firms should pay higher wages. As we noted earlier, once we control for worker characteristics, there is no longer a positive differential to explain. Our measure of ability to pay was only weakly related to age of firm, and was not associated with higher wages. Our tentative conclusion is that variation in ability to pay is not an important part of the relationship between firm age and wages, though it would be worthwhile to repeat this analysis with objective measures of ability to pay based on profits (which do seem related to wages—Hildreth and Oswald, 1997).

Finally, we investigated the relationship between age of firm and the slope of workers' wage-tenure profiles. While such second-order effects are hard to detect in modest-sized samples such as ours, it does appear that established firms offer steeper wage-tenure profiles.

Another interesting (though, given the size of our sample, somewhat tentative) conclusion is that the relationship between firm age and wages is not monotonic. Wages fall as firm age increases, but this relationship appears to be reversed among older firms.

What might account for such a pattern? We suspect that no one factor can do so. Working backwards from data to theory, we should be looking for relationship that can account for new firms' paying higher wages that becomes much less important as firms age, and/or a positive wage-age relationship that is muted among young firms. Compensating differentials for the risk of the firm closing is an example of the first sort of relationship—firm failures (Evans, 1987, Table 1) and plant closings (Dunne, Roberts, and Samuelson, 1989, Table I) decline sharply over the first decade or so of their existence, and then much more gradually. The link between firm age and the ability to use reputation to enforce implicit contracts may be an example of the second. For example, in Baker, Gibbs, and Murphy's (1994) model, firms with high discount rates (in our framework, young firms) cannot use implicit contracts because workers realize the incentive to renege is too large. Reductions in the discount rate (increases in firm age) have no effect, until a critical threshold is reached, at which point not only do implicit contracts become viable but they become increasingly important over some range as the discount rate continues to fall (firm age continues to increase). If, as in their model, worker effort parallels the use of implicit contracts, wages will eventually increase with firm age.

Our findings suggest three directions for future research. First, two of our more intriguing findings—a U-shaped relationship between firm age and wages, and a tendency for older firms to offer steeper wage-tenure profiles—need to be replicated with other (hopefully larger) data sets. Longitudinal data could be particularly valuable, providing better controls for unmeasured worker ability and a much clearer picture of how wages vary with worker tenure at younger and older firms. Second, there may be a positive relationship between the age of a business and the age of the capital it uses; it is not clear which age concept is more appropriate. It may, for

example, be that older firms use older capital, which requires less skill and so employ less-skilled workers. Doms, Dunne, and Troske (1997) find that wages are higher in plants that use new technologies. However, Doms (1994) finds that age of plant and use of new technologies are nearly uncorrelated—which suggests that any correlation between wages and plant age must be due to other factors besides technology. It seems unlikely that the merits of different measures of firm or plant age can be assessed empirically without a data set that includes both measures. Third, if wages fall with age of firm, or trace out a U-shaped pattern once worker characteristics are held constant, explaining this differential will require better understanding of the relationship between age of firm and other features of the work environment.

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Table 1

Sample Means and Standard Deviations

Variable	All Cases			Complete Data N=1067	Clean D&B Matches N=533
	Mean	Std. Dev.	N	Mean	Mean
Years of Schooling	13.7	2.1	1408	13.8	13.7
Years of Experience	15.4	11.0	1398	15.0	15.6
Years of Tenure	6.74	7.82	1397	6.72	6.95
Female	0.50	0.50	1410	0.49	0.47
Married	0.60	0.49	1409	0.60	0.61
Widowed or Divorced	0.18	0.39	1409	0.18	0.19
Black	0.07	0.26	1400	0.06	0.05
Hispanic	0.04	0.18	1400	0.03	0.03
ln (Wage/Hour)	6.92	0.59	1255	6.96	6.97
ln (Site Employment)	4.07	2.18	1390	4.05	4.33
ln (Firm Employment)	5.76	3.10	1245	5.83	5.86
Age of Business (years)	40.1	32.0	1332	39.7	41.8
ln (Age of Business)	3.29	1.09	1332	3.27	3.37
Union Contract	0.11	0.31	1402	0.10	0.11

Table 2

Wages, Age of Firm, and Other Employer Characteristics
Complete Data Sample, N=1067
Dependent Variable = ln (Wage/Hour)

Variable	(1)	(2)	(3)	(4)
Union Contract	-.014 (.058)	-.007 (.058)	.053 (.051)	.057 (.051)
ln (Site Employment)	049 (.011)	.050 (.011)	.035 (.010)	.037 (.009)
ln (Firm Employment)	.012 (.008)	.015 (.008)	.009 (.007)	.013 (.007)
Age of Business/10	.022 (.006)		-.001 (.005)	
ln (Age of Business)		.042 (.019)		-.035 (.016)
Weighted Standard Deviation of Industry Effects	.193	.196	.125	.126
Worker Characteristics	No	No	Yes	Yes

Notes:

Standard errors in parentheses below coefficients.

Worker characteristics in columns 3 and 4: education, years of full-time experience (2), tenure (2), race, Hispanic, sex, marital status (2), marital status x sex (2), occupation (12).

All regressions include dummy variables for region (3) and a constant.

Table 3

Effects of Added Worker Characteristics
on Age of Business Coefficients
(based on Table 2)

	Effect on Age	Coefficient
	col(1)-col(3)	col(2)-col(4)
Education	.003	.006
Experience + Experience^2	.004	.018
Tenure + Tenure^2	.008	.034
Race + Hispanic	.000	.001
Sex	.002	.004
Marital Status	.002	.002
Sex * Marital Status	.001	.002
Occupation	.002	.005
Sum	.023	.077

Table 4

Wages and Age-of-Business Splines

	(1)	(2)	(3)	(4)
Spline Coefficients:				
Age of Business/10	-.080 (.063)		-.119 (.052)	
Max[(Age-15)/10,0]	082 (.097)		.086 (.080)	
Max[(Age-30)/10,0]	.044 (.062)		.039 (.051)	
Max[(Age-60)/10,0]	-.025 (.033)		.012 (.027)	
ln (Age of Business)		-.030 (.043)		-.066 (.036)
Max[ln(Age)-ln(15),0]		-.008 (.120)		-.041 (.099)
Max[ln(Age)-ln(30),0]		.232 (.175)		.124 (.144)
Max[ln(Age)-ln(60),0]		.009 (.199)		.141 (.164)
ln-wage differential, relative to Age = 30:				
Age of Business = 1	.108	.108	.216	.250
Age of Business = 15	-.003	.026	.049	.074
Age of Business = 30	.000	.000	.000	.000
Age of Business = 60	.140	.134	.017	.012
Age of Business = 90	.204	.217	.070	.076
F(3,n-k) for three spline variables	2.01 P≈.10	4.66 P<.01	5.42 P≈.001	3.27 P<.05
F(4,n-k) for all four age variables	5.09 P<.001	4.78 P<.001	4.07 P<.01	3.62 P<.01

Notes:

Control variables are the same as those in corresponding column of Table 2.

F(3,n-k) tests the hypothesis that the coefficients of the three spline variables are all zero. F(4,n-k) tests the hypothesis that the coefficients of all four age of business variables are zero.

Table 5

Wages, Age of Firm, and Other Employer Characteristics
Sample with Matching D&B Data, N=533
Dependent Variable = ln (Wage/Hour)

Employer Variables From	Worker Reports				D&B Data			
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Union Contract	.017	.028	.100	.101	.061	.051	.108	.106
	(.080)	(.080)	(.069)	(.069)	(.079)	(.079)	(.069)	(.068)
ln (Site Employment)	.028	.029	.016	.017	.041	.041	.034	.035
	(.018)	(.018)	(.014)	(.104)	(.018)	(.018)	(.014)	(.014)
ln (Firm Employment)	.032	.035	.027	.029	.030	.032	.019	.017
	(.013)	(.013)	(.010)	(.010)	(.012)	(.012)	(.010)	(.009)
Age of Business/10	.016		-.006		.003		-.010	
	(.008)		(.007)		(.007)		(.006)	
ln (Age of Business)		.027		-.044		.004		-.032
		(.028)		(.023)		(.021)		(.017)
Weighted Standard Deviation of Industry Effects	.167	.170	.114	.114	.150	.151	.092	.091
Worker Characteristics	No	No	Yes	Yes	No	No	Yes	Yes

Notes:

See Table 2.

Table 6

Wages, Age of Firm, and Non-wage Job Characteristics
Dependent Variable = ln(Wage/Hour)

	N = 1052		N = 1060	
Variable	(1)	(2)	(3)	(4)
ln (Age of Business)	-.042 (.016)	-.071 (.036)	-.030 (.017)	-.058 (.037)
Max[ln(age)-ln(15),0]		-.054 (.098)		-.043 (.101)
Max[ln(age)-ln(30),0]		.141 (.143)		.126 (.147)
Max[ln(age)-ln(60),0]		.149 (.163)		.129 (.168)
Pension Plan Offered	.139 (.039)	.141 (.039)	-.072	-.072
Health Insurance Offered	.014 (.042)	.021 (.042)	-.095	-.095
Probability of Job Loss	-.054 (.054)	-.049 (.054)		
Ability to Afford 10% Wage Increase	-.057 (.038)	-.050 (.038)		
Worker Characteristics	Yes	Yes	Yes	Yes

Notes:

Control variables are the same as those in Table 2, column 4.

Coefficients of Pension Plan and Health Insurance variables in columns 3 and 4 are constrained to equal minus the ratio of pension and health costs to wage bill costs in establishments offering these benefits.

Table 7

Age of Firm and the Wage-Tenure Profile

Variable	(1)	(2)	(3)	(4)
Age of Business/10	-.0034			
	(.0063)			
(Age of Business$_0$/10)	.0009		.0017	
* Tenure	(.0006)		(.0004)	
ln(Age of Business)		-.0399		
		(.0180)		
[ln(Age of Business$_0$)]		.0023		.0039
* Tenure		(.0013)		(.0011)

Notes:

Age of business$_0$ is the age of the business when the worker joined; i.e., age of business at survey date - tenure.

In columns 1 and 2, the dependent variable is ln(Wage/Hour). Control variables are the same as those in Table 2, column 4. N=1036 (a few cases with calculated age of business$_0$<0 were deleted).

In columns 3 and 4, the dependent variable is the ln(Wage/Hour) minus ln(Starting Wage/Hour), with the starting wage adjusted for inflation. Control variables are tenure, tenure squared, and the change in (experience squared). N=971, due to deletion of cases that did not report starting wage.