PERSISTENCE
OF FIRM AND INDIVIDUAL WAGE COMPONENTS

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Abstract

Using longitudinal matched employer-employee data, we show that a standard wage equation ignoring firm and individual effects yields a baseline explaining 36 percent of wage variation. Firm specific wage components, including common firm-wide omitted human capital, accounts for an additional 22 percent. Firm pay differentials are large and persistent. Most of these firm differentials reflect omitted general human capital. We also show the importance of asymmetric information and unobserved heterogeneity in wage setting mechanisms.

Résumé:

Nous utilisons une banque de données regroupant de l'information à la fois sur les employeurs et les employés. Nous montrons qu'une équation de capital humain standard qui ignore les effets individuels et les effets de firme explique environ 36% de la variance observée des salaires. Les effets de firme permettent d'expliquer 22% additionnels de cette variance. Les différences de salaires entre firmes sont importants et persistants. Nous montrons que la plus grande partie de ces différences de salaires sont causées par l'omission de certaines variables de capital humain. Par contre, nous montrons que l'asymétrie d'information et l'hétérogénéité non observée jouent également un rôle important dans la détermination des salaires.

Introduction

In classical economic theory, wages, properly considered, are equal within competitive homogeneous markets. In empirical observations, wages are rarely equal across observationally similar employers and employees. An exceedingly long list of potential explanations has been offered to help account for this disparity. In this paper, we use matched employer-employee longitudinal data to provide evidence on why wages differ across firms and employees. This question is central to labor economics, and its answer will help to identify the power and limits of different types of labor market and institutional theories.

The debate between competitive and non-competitive theories is largely one over unobserved factors. Consider the meaning of differences in pay across employees. In market models, these necessarily represent omitted human capital (clustered within firm or industry); omitted job characteristics (compensating differentials) or mismeasured compensation. In other words, to maintain the market model's predictions, it must be the case that pay differences across firms are explained variously by the assertions that employees are not homogeneous (omitted human capital), that employers are not homogeneous (compensating differentials), or that pay is simply mismeasured. The alternative is that labor markets are not perfectly competitive. Failures of the assumptions required for competitive markets may involve: 1) imperfect information concerning employers and employees, or 2) imperfect mobility of employers and employees (including barriers to entry.)

Equilibrium Models

The classical economic model of the labor market assumes perfect information and costless mobility with neither employers nor employees enjoying market power. With homogeneous workers and firms, it predicts wage equality across both workers and firms. This model provides the background for other economic models that relax its assumptions.

Wage differences can be made to fit within this simple model by positing heterogeneous firms (requiring compensating differentials),

heterogeneous workers (requiring compensation for unmeasured human capital), or measurement-error (implying that compensation, properly measured, is equal). The compensating differential and measurement error models both make a testable ancillary prediction: turnover rates should not differ as a function of measured wages. The data reject these models, showing instead that turnover is a decreasing function of wage differentials (Leonard and Van Audenrode, 1994a). The simplest measurement error model also predicts a particular decay pattern over time, which the data also firmly rejects (Leonard and Van Audenrode, 1994a).

The omitted human capital model comes in two main varieties that differ in their prediction on persistence across employers. Omitted general human capital, by definition, persists perfectly as the employee moves across firms. Specific human capital, or match-specific capital, does not persist across employers. The classic models of investments in firm specific human capital do not predict differences in the present value of earnings across other-wise comparable workers. Rather, with shared investments and returns, they predict steeper tenure - earnings profile. Among a sub-sample of larger manufacturing firms, Leonard and Van Audenrode (1994a) observe that steeper profiles are associated with lower initial pay, a combination that tends to equalize career earnings and so reduce the firm effects apparent at early or late career stages.

Imperfect Information

The match-specific models are as well suited to accommodating heterogeneity on both sides of the market as they are unsuited to forming broadly applicable and testable predictions for the labor market. To say that the match specific component dominates wages is to say that the labor markets are highly fragmented. These models tend to be quite flexible, and without further assumptions, can accommodate a wide variety of behavior. With the assumption that the firm's technology and labor pool do not change over time, firms' positions in the wage distribution do not change over time. Whether or not a wage premium paid generally or individually to workers at one firm persists as these workers move to another employer depends on whether the

match components are common across firms. If there are many firms that offer the same match for each worker then we could expect to see persistence. But this very condition implies that the variance of wages is influenced little by match specific idiosyncrasy, and so undercuts the importance of matching models at the level of the individual firm. Match components that are idiosyncratic to a firm do not, by definition, persist as the workers moves across firms. Match components that are idiosyncratic to the worker are unlikely to yield strong common firm effects.

Matching models predict that the persistence of wage components will increase with tenure on the previous job. Mismatches are more likely to be found among low than among high tenure employees. Over time, firms and workers discover they have made a bad match. Once this known match value falls below the expected match value elsewhere less the cost of moving, a separation ensues. The highest tenure workers have survived such winnowing longer, and so are more likely to be better matched.

Let M_{ij} be the match specific component of wages for employee i in firm j. Wages are then given by:

$$W_{ij} = BX + M_{ij},$$

Mobility ensues if:

$$M_{ij} < E(M_i^*) - K$$

Where K is the cost of moving and $E(M_i^*)$ is the expected match component at other firms. Because workers and firms know less about each other early in a relationship, M_{ij} is lower early in the relationship and the mobility condition is more easily satisfied. But this implies low persistence. Low tenure workers are more likely than are high tenure to move because of mismatch. Moving because of mismatching implies low persistence. Individuals who learn of better matches will have little persistence in individual wage components. Workers coming from firms that invest little in selection or

that do a poor job of matching will also show little persistence of firm wage effects.

Less complex models of imperfect information also attempt to explain pay differences across homogeneous firms and workers (see Stigler). Firms that accidentally pay too generously in a competitive market correct their mistake or exit. Firms that accidentally pay too little cannot attract or keep employees. Even with imperfect information, the competitive model predicts regression to the mean in the distribution of firm wages.

The outcome of this search depends not only on the distribution of other wages, but also on reservation wages. Among workers facing the same distribution of offer wages, those with lower reservation wages will have less persistent wage components. They will be reemployed over a larger portion of the offer wage distribution. The resulting higher variance in reemployment wages reduces the correlation of past and future wages.[1]

At the other end of the spectrum are non-market clearing models in which firm and individual wage differences are not transient but chronic. Rent sharing models predict that firms will maintain their position in the wage distribution. However, there is no reasons for any subsequent employer to pay a similar premium to exiles from a rent-sharing firm, so rent sharing models predict no persistence of the pure firm component of a previous employer's wage premium at a new employer.

In short and rough form, that covers much of what theoretical labor economics has to say about the distribution of wages across employers. Theory of course, has had a great deal more to say, but with the striking exception of Abowd, Kramarz and Margolis's pathbreaking work, theory in this area has been able to proceed largely unencumbered by evidence derived from following employees across identified employers. These foundation models of wage determination make distinctive predictions about the persistence of wage

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[1] Actually, the relationship between reservation wage, unemployment duration and wage persistence is slightly more complicated. The key to wage persistence is not the reservation wage by itself, but whether this reservation wage is reasonable or not (i.e. the worker is not trying to hold on to non-transferable rents). (Leonard and Van Audenrode, 1995)

components across employees and employers. If firm effects represent omitted general human capital, movers should retain their premium. Wage differentials should survive intact the transition to a new employer. Such unmeasured human capital would account both for clustered mobility and for persistent wage premiums.

Firm differentials that represent the firm's sharing of economic rent should not survive a transition. More precisely, such rents follow the firm irrespective of the workers, rather than following the worker, irrespective of the firm. If indeed we observed workers moving from one high rent firm to another - (mobility concentrated within rent classes) we could see persistence, but we would then have to question the pure rent interpretation, because there is no reason why any subsequent firm should prefer workers lucky enough to enjoy rents on a previous job.

The first type of tests follow workers and asks whether they maintain their previous firm's wage component as they change employers. We also employ a conceptually distinct test of the persistence of firm wage components. This second type of test follows firms and asks whether each firm's wage differential remains unchanged over time as it slowly changes its workforce, and as market conditions change. Firm wage differentials that represent measurement error will quickly decay. Firm wage differentials that represent omitted human capital not actively selected for will decay with the rate of workforce turnover (generally about 9 percent per year (Leonard and Van Audenrode, 1994a)). In search models, the rate of decay depends on both the cost of search, and on the benefits as given by the distribution of firm wages. Belgium has suffered double-digit unemployment for much of the past two decades. It offers unemployment benefits without time limit, that formally require active search. More important than what the regulations say is what people do. Empirically, the job finding rate is similar in the first and in the fifth and subsequent quarters of unemployment (Leonard and Van Audenrode, 1995). Even when the distribution of firm differentials remains unchanged, search models predict the decay of individual firm effects.

The core of this paper is then the use of measures of persistence in wage components across employers to differentiate competitive from non-competitive models of the labor market. Underlying productivity differences predict persistence. Market imperfections such as imperfect information or imperfect mobility predict transience.

Data

We use a longitudinal matched employer-employee data set for the population of private sector employees in Belgium in 1983, 1984 and 1985. This allows us to follow employees across employers. If mobility were a random event, firm and individual wage components could be identified using movers. In practice, movers may not be random reallocations of workers across firms. Moves that are endogenous may yield biased estimates of wage components. To see this consider the model:

$$W_{ij} = B\,X_i + F_j + I + e_{ij} \quad .$$

The I and F_j components are unobserved individual and firm fixed wage components, but can be identified (up to a normalization) using movers:

$$(W_{ik} - W_{ij}) = (F_k - F_j) + (e_{ik} - e_{ij}).$$

The individual component is differenced out, leaving the difference in firm effects and the change in errors. The latter term is mean zero and uncorrelated with $(F_k - F_j)$ if moves are random reallocations. This restriction is unlikely to hold in practice. Workers who receive a negative error in their current job and a positive error on an offered job are more likely to move. In this case, DW will theoretically overestimate $(F_k - F_j)$ among movers from one firm to another.

The point is that unbiased estimates of firm effects are more likely to be obtained from job changes that are exogenous rather than endogenous to the wage distribution. Easier said than done. To reduce this type of potential bias,

we select a subset of workers who are more likely to have lost their job for reasons independent of their current and offered wages.

Of the 2,680,344 employees of Belgian private firms in 1983, 88,869 left firms that reduced employment by at least 25 positions between 1983 and 1984, including firms that ceased to report any employees by 1984. We concentrate our analysis on these job losses due to mass or total layoff. We take a 1 in 5 random sample of these, and identify the firms they first find reemployment in by 1986. We then augment our sample of movers (not of firms) by including all other displaced workers who were reemployed in these same firms. So movers here are displaced from dead or dying firms. The origin firms are a random sample of those in the private sector displacing workers (by our definition). The destination firms are a random sample of those first reemploying workers displaced in 1983 within the subsequent three years. Within these firms we include the population of movers between any of the firms in the origin set and any of the firms in the destination set, so as to increase the within firm precision of our estimates. This yields the population of workers moving among a random sample of declining private firms and the private firms that reemploy the random sample of displaced workers within three years.

The data used here are firm-based and not establishment based. A common problem with such data is the possibility of labeling as a transition what is only a legal change- a company disappearing to reappear under a new name, mergers, etc.. Although Belgian Social Security and Employment contract laws are quite restrictive with regard to these legal changes[2], we excluded from our sample any suspicious transition.[3]

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[2] A change in employer identifier number implies a change in legal liability for the payment of past and present social security taxes. This cannot happen solely as a result of a merger, acquisition or change in ownership. Even bankruptcy and the death of the employer are not sufficient conditions to generate a change in employer identifier.

[3] We excluded from the sample any transitions where more than 50% of the exiles from a dying firm ended up at the same new employer after a spell of unemployment of less than 100 days. This restriction reduces estimated persistence but does not fundamentally alter our conclusions.

Methodology

We first estimate a pre-displacement wage equation of the type:

$$W_{io} = B\ X_i + F_o + (I^*_o + e_{ij})$$

where the subscript **i** refers to the I'th worker, the subscript **o** refers to the old job, the subscript **n** refers to the new job, **F** is the firm effect, and **I** the individual effect. We estimate this cross-section equation amongst the 419,441 workers who were employed in the 931 firms which laid off one of the workers included in our sample. In Abowd, Kramarz and Margolis' terminology, our firm effect F_o is the sum of a pure idiosyncratic difference in average firm wages (not justified by any observed or unobserved individual differences) and of the firm average of individual effects; while our individual effect is the sum of within firm pure individual unobserved heterogeneity and of a random error term: $I_o = (I^*_o + e_{ij})$. F_o and I_o represent respectively these firm and individual effects in the old job.

We then estimate the same cross-section specification among all the workers employed at any firm which rehired one of the workers in our sample during the year this worker was hired. F_n and I_n represent respectively the firm and individual effects in the new job.

Persistence is tested by looking at movements by workers in the distribution of individual and firm effects across jobs, and by formally testing how F_o and I_o affect W_{in}. Finally, another original contribution of this paper will be to look at the symmetry in persistence. In addition to formally testing how F_o and I_o affect W_{in}, we will examine how F_n and I_n affect W_{io}.

Clustering and Transitions Across Employers

Mobility or its threat drive markets toward equilibrium. Within a competitive labor market, wages can move toward equilibrium by regression to

the mean in the distribution of firm wages, and by the individual mobility from low wage and higher wage firms.

Here we present the first analysis of mobility across employers. In terms of position in the distribution of firm and individual wages, existing economic theories model mobility as a function of the present value of earnings (utility), irrespective of its components.

We classify movers into quartiles of the previous and new job firm effects. Conditional on firm effects, age, sex, and broad occupation, we also classify movers into quartiles of the within firm wage residual distribution.

If these firm and individual wage differences were nothing but measurement error, transitions across states classified solely on this basis should be random. Origin state and destination state would be independent. Noise does not persist across employers.

If the wage components represent compensating differentials, mobility should not be a function of wage, and wage components need not be similar across employees. In hedonic wage models, compensation differentials depend on the distribution across firms of the marginal cost of reducing unpleasant working conditions as well as on the distribution across employees of the marginal disutilities of such unpleasant conditions. The same process that matches a high marginal disutility worker with a low cost of mitigation firm could lead to transitions across firms with similar firm wage components. However, this mechanism is doubtful because in other work (Leonard and Van Audenrode,1996) we see that turnover is a function of firm wage premia, which would not occur if these premia were just compensating differentials.

If the wage components represented pure economic rent, we would not expect them to affect mobility across the distribution. An exile from one high wage firm would not be preferentially selected into another high wage firm if the firm wage component is indeed a pure rent. Of course, if high wage firms select higher quality workers, the premium is no longer a pure rent.

Even if the wage components represent omitted human capital, current models predict only random moves in the firm of individual wage distributions as long as the total wage change exceeds the cost of moving. In addition, the

omitted human capital theory predicts that mobility within the distribution of firm effects will be negatively corrected with mobility within the distribution of individual wage effects.

The second channel of wage equilibration, outlier firms in the wage distribution moving toward the mean, is active in muted form. In a sample of 312 large Belgian manufacturing firms, we find that firm effects are correlated .97 one year apart, and .83 seven years apart. This slow 3 percent annual decay rate is inconsistent with simple measurement error stories, and does not suggest intensive search whittling away differentials based on poor information. Nor is it entirely compatible with centralized collective-bargaining setting uniform industry wide wages. In other contexts going back at least as far as Dunlop, such persistent firm wage differentials have been taken as evidence of imperfectly competitive labor or product markets. They may also indicate persistent differences in unmeasured human capital.

Because firm effect do decay over time, a fixed-effect model fitted to such data will yield smaller fixed effects when estimated over longer spans of time. Clearly, the usefulness of the fixed effect approximation declines in longer time-spans.

A Model of Clustering

Clustering occurs when the distribution of human capital within firms is truncated. In production function terms, the elasticity of substitution in productions across different levels or types of human capital is low. If human capital is partly unobserved, then two predictions follow. First, firm wage components will account for much wage variation, and individual components for relatively little. The firm component will reflect the common omitted human capital among (like) individuals within firms. Second, clustering distinctively predicts few moves across the firm wage distribution. Skills that are particularly valuable in one part of the firm wage distribution reduce the incidence of moves of high wage workers at lower-wage firms to relatively (compared to the new firm mean) poorly paid positions at high-wage firms, even though such moves could otherwise satisfy the mobility conditions.

For displaced workers, as shown in Table 1, most transitions are between different employers in the same quartile of the firm wage distribution. In addition, most mobility leaves the individual in the same quartile of the within-firm wage distribution -- even though the individual changes firms.

This result rejects theories of wage differentials as measurement error, or as pure economic rents shared by the firm. It is consistent with the clustering model: omitted human capital with limited elasticities of substitution across human capital classes within firms. This clustering will yield evidence of persistent firm effects even as employees move across firms.

Wage Results

The first generation of empirical labor economics has enjoyed great success in explaining one-third of the cross-sectional variance in wages, largely by reference to the highly significant human capital proxies of age, education and experience. That leaves only two-thirds of wages to be explained. Of course, we can soak up all wage variance without greatly increasing understanding by the liberal use of individual dummies. Our aim is different: to establish the nature of heterogeneity, partition it into firm and individual components, and by the systematic analysis of these components discover general patterns that we use to test the basic models of the labor market.

Table 2 presents descriptive statistics for four sub-groups: employees who stayed at the old firm, displaced movers, hires at the new firm who did not come from the displacing firms, and incumbents at the new firms. In this table, old firm refers to employers who displaced workers [but not dead firms who cannot have stayers]. New firm refers to the firms that first reemployed the displaced workers. Displaced workers who find reemployment within 3 years are younger, have less tenure, are more likely to be women and blue-collar, and are paid 16 percent less than are the workers who remain in declining firms.

If movers were randomly selected and randomly reallocated across firms, they would be indistinguishable from stayers, importing and exporting firms would be indistinguishable, and on average wages would not change with movement. Unsurprisingly, none of these hold true. Movers in fact enjoy

nominal wage increases of 7.6 percent. Under the simplest models' restrictions, (exogenous mobility, human capital held fixed, zero mean independent error in the wage change equation), this would be translated as importing firms paying more than exporting firms. The average mover goes from a firm in which he is paid 1.3 percent below the firm mean, adjusted for age, sex, broad occupation and tenure; to one in which he is paid 4.3 above the firm mean. The importing firms, (those which reemploy displaced workers) employ a younger workforce, with less tenure, in more white-collar positions. So the 7.6 percent wage gain of movers can be decomposed into a 2.0 percent gain due to moving to higher wage firms, and a 5.6 percent gain by moving up within the firm distribution of wages. About these means, the correlation of change in firm wage component with change in individual wage component is negative. This result is consistent with sorting models of movements across firms. Poor performers in the big leagues tend to move down the firm distribution. Minor league successes show some upward movement.

Using only information on the movers' sex, age, and broad occupation (blue-collar or white-collar) we can account for 36 percent of wage variation in the previous job (see Table 3, eq. 13). Contemporaneous firm components account for an additional 22 percent of wage variation (of which about half is an industry effect), with individual components accounting for the remaining 42 percent. By themselves, firm effects account for slightly more wage variation (37 percent) than do the standard individual characteristics.

Longitudinal matched employee-employer data allows us to analyze the persistent effects of these firm and individual wage components. Table 3 presents baseline equations for the reemployment or new job wage (equations 5 to 8). We want to know whether the firm-wide and individual factors that led to wage differences on the old job cause the same differences in the new job. Equations 1 to 4 of Table 3 answer this question by estimating the effect on new job wages of F_o and I_o - the firm and individual wage components in the old job.

We see persistent effects. Those who were employed in firms paying high wages, or who were paid above average within the old firm, tend to be paid

more in the new firm. This persistence would not be predicted by rent-sharing, by measurement error or by firm specific human capital models. In addition, we would expect rents or compensating differentials to affect workers broadly within each firm, and so load onto the firm rather than the individual wage component. Persistent effects of past wage components are consistent with omitted general human capital. While this may seem plausible for individual effects, it may not be readily apparent why a successor firm should pay employees more because they are exiting from a high wage firm. In terms of the human capital model, the firm component as measured here includes, in addition to the firm effect that is independent of the workers, the component of omitted human capital common to workers within the firm. In terms of Abowd, Kramarz and Margolis's specifications, F_o is the sum of a pure idiosyncratic difference in average firm wages not justified by any observed or unobserved individual differences and of the firm average of individual effects. Because the first component has no value to other employers, the persistence we observe indicates that the firm-wide common component of general human capital is larger. Note also that the proportion of the last job's wage premium left behind is greater for the individual than for the firm components. Workers are more likely to carry forward wage premiums due to having been at a high-pay firm than those due to having been well paid within the firm, (although the former effect is muted in the sub-sample that controls for industry). This may reflect the better information employers have of each other than of each other's employees, because each transfer increases the precision of firm estimates while leaving that of individual estimates unchanged. Or, it may be that individual wage variation within firms is less due to general human capital than is the firm-wide common component.

That said, it is also true that new and old employers partition human capital differently. An example helps to explain this. Consider two classes of firms and two classes of workers. If class I firms always and only employ Class I workers (perfect matching or segregation), then the new firm's wage carries no information beyond that already contained in the old firm's wage. Firms do not segregate to that extent, or value different parts of human capital differently.

Controlling for Fn, the new job's firm effect, Fo (the old jobs firm effect) is still significant, although greatly reduced in magnitude.

The Use of Movers to Identify Firm Effects

Movers could help to partition our firm effect into pure firm differences and systematic individual differences within firms. As we have shown, for movers

$(W_{ik}-W_{ij}) = (F_k-F_j) + (e_{ik}-e_{ij})$. The assumptions needed to identify relative firm effects are that the reallocation of workers across firms is random, i.e. 1) $E(e_{ik}-e_{ij})=0$, and 2) the change in errors is independent of the change in firm effects.

In fact the necessary identifying assumptions are violated in practice. Movers are not a random draw of employees, nor does the reallocation of workers across jobs resemble a random process. Nor would standard migration models predict them to be. We have purposely selected a sample of movers from declining or dying firms precisely to increase the chances of observing mobility exogenous to individual wage offers. The death or decline of the firm takes the role of the proverbial helicopter drop of employees onto the labor market. Despite this sample selection, we observe wage changes consistent with voluntary mobility models and inconsistent with the identifying assumptions.

In standard mobility models, workers who receive a positive external wage offer or a negative internal wage offer are more likely to move. In Table 4, we show wage changes for bilateral flows. These are three pairs of firms in which at least 10 workers moved each way between 1983 and 1984. Unlike the rest of this paper, the initial sample is drawn from a sample of large manufacturing firms, rather than from the population of declining firms, and so is more likely to include voluntary movers.

In each case, the movers experience substantial wage gains in <u>both</u> directions of the bilateral flows. In all cases, the average wage gains exceed the 4.3 percent wage growth enjoyed by the average Belgian between 1983 and 1984. The simplest and strongest evidence that the identifying assumption is violated is that in practice movers from firm A to Firm B, and from Firm B to

Firm A, both gain, and gain relative to stayers. Simply put, it cannot be that Firm A pays more than Firm B, and that Firm B pays more than Firm A. The obvious interpretation is that (ε_{ik}-e_{ij}) dominates (F_k-F_j). While compatible with mobility models, this undercuts the use of movers to identify firm effects.

Note also that the existence of these simultaneous bilateral flows suggests the importance of matching in labor market across firms. Pure scale effects (undifferentiated product demand shocks affecting firms with homogeneous workers) cannot account for the simultaneous exchange of workers between firms. It is not unusual for firms to exchange employees. Finally, as previous work has established (Freeman), wage changes are notoriously noisy.

Matching in the Labor Market

The matching model of the labor market predicts that mismatched employees will leave their pasts behind, and that such mismatches are most likely to be found early in an employment spell. At longer tenure levels, workers are less likely to separate because of the (late) discovery of mismatches.

As the matching model predicts, tenure on the previous job strongly affects the persistence of the individual wage component. (See Table 5). Among workers separating during their first year with an employer, only 39 percent of the individual wage component carries over into the new job's wage. This rises to 70 percent among those who left their previous employer after 6 or more years on the job.

Wages from short employment spells carry less information about persistent productivity. At longer tenure, more productivity information has been revealed, and workers are more likely to be displaced exogenously than displaced because of mismatch. The greater persistence of individual effects among longer tenure workers is also consistent with higher reservation wages, conditional on human capital, and on the high-tenure displaced being better informed of the labor market. The sharp difference in persistence between low and high tenure workers in Table 5 indicates that, as in matching models, the

individual component of wages from short duration matches carries relatively little information of use to subsequent employers.

Fixed Effects?

Even more crucial to the identification of pure firm and individual effects is the assumption that these effects are fixed.

Fixed effects do not respect history. The past and the future are treated identically and symmetrically in these ahistorical models. If firm and individual effects are imperfectly observed by employers, individual effects cannot be fixed and cannot be treated symmetrically in the old and the new jobs, even though a specification that starts with the restriction of fixed effects is likely to find some average persistence to label as a fixed effect. Here we test whether the individual wage component is a fixed effect by examining whether it is symmetrical when time is reversed. The same argument holds for the part of the firm effect that reflects common omitted worker quality.

In equation 9 to 16 of Table 3 we see the effects of the future on the past are not symmetric with those of the past on the future. The future firm component has less of an "impact" on the past wage, than the past firm component has on the future. The relative size of the individual effects is reversed. The degree to which the firm and individual wage components would load onto firm and individual fixed effects would differ between past and future wages components. In other words, the firm and individual components identified here are not just fixed effects.

Firm Effects

The past firm component has a coefficient in the future wage equation that is about .77, implying that it carries 77 percent of its impact on contemporaneous wages. This is a striking result. It suggests that only about 23 percent of the variation in firm wages is due to rents, with the remainder presumably reflecting unmeasured human capital. The exact ratio here is sensitive to specification, and would be expected to fall with the inclusion of additional direct controls for human capital. Nevertheless, this suggests the

Belgian labor market is subject to competitive forces, and that firm wage differentials need not be entirely incompatible with this competition.

Alternatively, the ratio of cross to contemporaneous effects may be taken to reflect Bayesian information processing by subsequent employers. In terms of a simple measurement error model, subsequent employers are acting as though the noise to signal ratio in the variance of past firm wages was about 0.23.

We would expect this error variance to be a larger component of the individual effect, because the individual effect absorbs the residual. The individual effect here includes anything and everything that affects wages other than common firm components and sample-wide returns to age, sex, broad occupation and tenure. Even with this all-encompassing definition, 42 percent of the past job's individual effect carries over to the new job. In terms of the measurement error model, this implies that the variance of errors is 38% greater than that of true individual effects. Information on position within the past firm‘s wage distribution is discounted, but it is used by subsequent employers.

The fact that firm effects carry over into new jobs in such a large proportion indicates that they act as a quality signal. Prospective employers imperfectly informed of a potential employees productivity may take average pay levels at the previous employer as a signal of productivity rather than as a sign of rents.

The distinctive feature of signals is that they operate unidirectionally in time: signals can be sent only from the past to the future. The data do not accept this restriction. Future firm wages “cause” previous wages. This is consistent with the future and previous firm wage components representing dimensions of general human capital omitted by the econometrician -- but observed by employers.

Bayesian Information Processing

In any country, the distribution of firms ranges from a few large and well known to a multitude of small and largely unknown. A prospective employer’s task in interpreting past wages is to isolate that portion due to

persistent productivity differences from factors extraneous to the next job such as the past job's rents, compensating differentials, mismatches or accidents. The employer learns much of the distinguishing information from experience. In previous work (Leonard and Van Audenrode 1994) we used the age and size of the previous employer as proxies for the precision of information others were likely to have of it. Here we improve on those proxies by measuring experience directly.

We measure the gross flow of employees from one firm to another. The larger this flow, the better able will be the subsequent employer to distinguish productivity from extraneous wage components. In Bayesian theory, each employer starts with an uninformed, flat prior concerning all others. As firm A samples (hires) more of firm B's exiles, the precision of firm A's estimate of the rent and productivity components of firm B's pay increases.

Table 6 offers strong support of this type of Bayesian updating. In this table, movers are stratified by the gross flow from origin to destination firms. As the Bayesian updating model predicts, both prior firm and individual wage components are sharply discounted if the importing firm has hired few people from the exporting firm. The persistence of past individual components increases from .21 with less than 5 hires, to more than .84 with 50 or more hires. The persistence of past firm components increases from .37 to .95 with more than 100 hires. Clearly, a methodology that looks for a common individual component across employers will be able to load more of the variance onto such individual fixed effects in cases with greater gross flows. At the other end, the fixed-effect methodology will report greater idiosyncratic variation (pure firm and error components) among smaller, younger and lower turnover firms. The degree to which "fixed" individual effects will be found is, as Table 6 demonstrates, a function of the gross flow from one firm to another.

The second column of this table is a specification test. The information processing story is unidirectional. If, however, the gross flow rate acts in part as a proxy for some other omitted variable (size, turnover rate, etc.) then new firm individual and firm wage components would show similarly distinct correlations with past wage when movers were stratified by the gross flow from old to new

firm. In both cases the stratification yields a much muted form of the persistence differentials observed running time forward.

The information content of past wages will differ for exiles from dead firms compared to those from ongoing firms. The former are more likely to have been released onto the market for reasons exogenous to their individual productivity. In other work, we confirm this distinction (Leonard and Van Audenrode, 1994a).

Further Specification Tests

Our persistence tests partition residual wage variance. This section examines the potential sensitivity of our results to heterogeneity in omitted human capital. To test the impact of this unobservable, we use the following maintained assumptions: 1) education is general human capital, and 2) the education of white-collar workers is more dispersed and has a greater impact on their wages than that of blue-collar workers.

Omitted general human capital, by definition, has wage effects that persist across employees. Under the maintained assumptions, if omitted education drove our persistence results, we would expect to see greater persistence among white than blue-collar workers. Table 7 shows that this pattern does not hold. Under the maintained assumptions, this suggests omitted education does not drive the persistence results. That leaves the question of why persistence of both firm and individual wage components is greater for blue-collar. This persistence may reflect omitted human capital independent of education.

Skill requirements are typically thought to be more common within than across industry. Other studies have shown that displaced workers who are reemployed outside their original industry suffer more severe wage losses. Table 8 confirms a human capital explanation of firm wage effects that is consistent with previous accounts. The persistence of firm effect is about half as large when workers change industry as when they change firms within an industry.

AKM vs. LVA Technology

Here we present direct comparisons of the AKM fixed-effect estimates with our more flexible specification. Both sets of estimates are based on the population of workers who ever touched any of 312 large Belgian manufacturing firms between 1978 and 1985. Table 9 presents the AKM specification imposing both fixed individual and fixed firm effects. The important result here is the strong evidence of clustering. There are highly significant firm effects (eq. 2), and highly significant individual effects (eq. 3), but these are almost entirely joint effects. Equation 4 shows that the marginal contribution of either firm or individual effects is small once the other is controlled for, as we would expect with human capital clustering. These large joint effects are not an artifact of small firm size: the average firm in this sample has more than 800 employees.

The second important result is that cross-section and pooled cross-section estimates of the returns to experience (age) severely underestimate the life-cycle or within cohort effects. Controlling for individual, the returns to experience are nearly triple those found in the pooled cross-sections without individual controls. This occurs because entry wages have been bid up over time (over successive cohorts), and successive cohorts are not perfect substitutes (or equivalently, wage levels at entry have long-term effects over the working life). Note also that workers who move between blue-collar and white-collar jobs are unusual, and do not share in the average occupation effects. As we have observed before, a substantial part of the female wage penalty occurs through segregation into low wage firms.

Our specification that does not impose the fixed-effects restriction is shown in Table 10. Among the employees of these 312 firms are 13,859 who moved between any two of these 312 firms in successive years between 1978 and 1985. We estimate a version of our standard regressions of new wage on old wage components (eq.2) and of old wage on new wage components (eq.1). for movers pooled across years.

We see that our previous attempts to isolate moves exogenous to the wage distributions was at least partly successful. The 312 firm sample is not

limited to declining or dying firms, and so includes many more mis-matched workers who quit or are individually fired. Wage differences due to mismatch, by definition, do not persist. The importance of such mismatch can be seen in the dramatically lower persistence of both individual and firm wage components in this sample.

In addition, even though the individual and firm effects that persist over time are highly correlated with each other, we can clearly estimate separate (similar) coefficients.

Table 10 also confirms a number of results that are well-known from the displaced worker literature. Differencing the returns on the new job and the old job while controlling for heterogeneity, we see that older workers lose from a move, that white-collar movers gain more than blue-collar movers, and that male movers gain more than female movers. Movers are substantially different than stayers. In particular the movers in Table 10 sacrifice most of the returns to experience enjoyed by the average worker in these same firms (Table 9).

Conclusion

Using longitudinal matched employer-employee data, we have shown the following:

1. A standard wage equation ignoring firm and individual effects yields a baseline explaining 36 percent of wage variation.
2. Firm specific wage components, including common firm-wide omitted human capital, accounts for an additional 22 percent. Firm pay differentials are large, persistent, and can account (incrementally!) for about two-thirds as much of the variation in wages as do the standard (human capital) measures of age, tenure, sex and broad occupation. By themselves, firm effects account for slightly more wage variation than do the standard individual characteristics.
3. Most of these firm differentials reflect omitted general human capital. About 77 percent of a firm premium paid at a prior firm is carried forward to a subsequent employer. This suggests a limited role for compensating differentials, rent sharing, pay errors, measurement

errors, or firm specific institutional factors in explaining wage differences across firms.

4. Imperfect information is an important constraint in the labor market. We directly measure labor market contacts between employers and find that familiarity breeds wage persistence. Hiring firms act as Bayesians, updating their priors with each hire from another firm. In consequence, an alternative methodology that looks for fixed individual effects will find them more important when the gross flow between firms is greater.
5. Mismatch models are useful in explaining the lack of persistent firm and individual wage components among low tenure movers.
6. The attempt to identify firm effects using movers depends on an identifying assumption at odds with standard mobility models, and at odds with observed patterns. The wage changes of movers are dominated not by the difference in firm effects between origin and destination firms, but by the difference in error components. This occurs because people receiving a positive surprise in this error difference are more likely to move. Methods that ignore this may fall prey to identifying as relative firm effects a difference in noise, weighted by interfirm net flows.
7. Human capital clusters within firms as would be expected if there were little elasticity of substitution between skill classes in production. The component of omitted human capital common within the firm is large. Most mobility occurs among firms in the same part of the distribution of firm wages.
8. About 40 percent of the individual wage residual appears to represent human capital that earns a return at subsequent employers.

There is no doubt that the next generation of innovations in empirical labor economics will exploit this type of rich matched European employer - employee data. Nor that the chief challenge of this work will be finding systematic patterns in heterogeneous behavior.

Bibliography

Abowd, John, Francis Kramarz and David Margolis, "High Wage Workers and High Wage Firms," CREST/ENSAE Working Paper (1995).

Dunlop, John, "The Task of Contemporary Wage Theory," in G. Taylor and F. Pierson (eds.), *New Concepts in Wage Determination* (New York: McGraw-Hill, 1957), pp. 117-139.

Freeman, Richard, "Longitudinal Analyses of the Effects of Trade Unions," *Journal of Labor Economics*, Vol. 2, No. 1 (1984).

Leonard, Jonathan and Marc Ban Audenrode, "Corporatism Run Amok: Industrial Policy and Unemployment in Belgium," *Economic Policy*, Vol. 17, (1994a)

Leonard, Jonathan and Marc Van Audenrode, "Worker Limited Liability, Turnover, and Employment Contracts," Annales d'Economie et de Statistique. Forthcoming. (1996).

Leonard, Jonathan and Marc Van Audenrode, "Wages and Asymmetric Information in the Labor Market," CEPR Conference paper, (1995).

Stigler, George, "Information in the Labor Market," *Journal of Political Economy* 70 (October 1962): 92-104.

Table 1: Transition Matrices of Individual Effects and Firm Effects

Individual Effect:

Job Lost	New Job		
	Low	Average	High
Low	4567	2020	691
	(.628)	(.277)	(.095)
Average	2250	10294	1983
	(.155)	(.709)	(.137)
High	482	2245	4601
	(.066)	(.306)	(.628)

Low effect is an effect in the lowest quartile, while high effect is an effect in the upper quartile.

Firm Effect:

Job Lost	New Job		
	Low	Average	High
Low	4965	2022	474
	(.666)	(.271)	(.064)
Average	2052	10040	2704
	(.139)	(.679)	(.183)
High	269	2176	4431
	(.039)	(.317)	(.644)

Low effect is an effect in the lowest quartile. High is an effect in the upper quartile.

Joint Effects:

Job Lost	New Job			
	Low Firm Low Individual	Low Firm High Individual	High Firm Low Individual	High Firm High Individual
Low Firm Low Individual	3806	1014	1173	431
	(.593)	(.158)	(.183)	(.067)
Low Firm High Individual	1356	4531	586	1373
	(.173)	(.578)	(.075)	(.175)
High Firm Low Individual	1449	671	4531	1482
	(.178)	(.083)	(.557)	(.182)
High Firm High Individual	461	1312	1179	3778
	(.069)	(.195)	(.175)	(.561)

Low is an effect below median value. Value in parentheses are the proportion of rows.

Table 2: Descriptive Statistics

	Old Firm Stayers	Movers	Other Hires New Firm	Stayers New Firm
Age	38.06	35.51	27.15	35.55
Tenure Old Job	5.77	5.13	NA	NA
Tenure New Job	NA	0	0	4.33
Prop. Men	.729	.632	.550	.604
Prop White Collars	.462	.423	.544	.631
Prop. From Dying Firm	0	.503	NA	NA
Log(Wage Old Job)	7.647	7.484	NA	NA
	(.438)	(.445)		
Log(Wage New Job)		7.560	7.314	7.599
		(.440)	(.414)	(.487)
Individual Effect O J		-.0125		
		(.292)		
Individual Effect N J	NA	.0432		
		(.277)		

Table 3: Impact of Individual and Firm Components on Other Job Wages

Eq.	Dependent Variable	Firm Effect	Individual Effect	Tenure Control	Industry Control	R2
1.	New Wage	.770 (.008)	.547 (.006)	Yes	No	.649
2.		.774 (.008)	.546 (.006)	No	No	.644
3.		.616 (.014)	.569 (.009)	Yes	Yes	.683
4.		.629 (.014)	.571 (.009)	No	Yes	.677
5.		--	--	Yes	No	.386
6.		--	--	No	No	.377
7.		--	--	Yes	Yes	.490
8.		--	--	No	Yes	.483
9.	Old Wage	.576 (.008)	.655 (.006)	Yes	No	.600
10.		.581 (.008)	.661 (.006)	No	No	.595
11.		.425 (.014)	.687 (.010)	Yes	Yes	.665
12.		.432 (.014)	.698 (.010)	No	Yes	.658
13.		--	--	Yes	No	.357
14.		--	--	No	No	.345
15.		--	--	Yes	Yes	.478
16.		--	--	No	Yes	.461

The rows labeled New Wage report the coefficients of old wage firm and individual components in a regression of the form:
Ln(Wage New Job)= $X\beta$ +β Individual Effect Old Job +β Firm Effect Old Job.
The rows labeled Old Wage report the coefficients from regressions of the form:
Ln(Wage Old Job)= $X\beta$ +β Individual Effect New Job +β Firm Effect New Job

X always include age, age squared, a dummy variable for sex and a dummy variable for occupation. Others controls are added as reported. Tenure consists of a variable for tenure, one for tenure squared and a dummy variable equal to 1 when tenure is censored., on the old job. Industry consists of a set of nine dummy variables controlling for 1-digit SEC classification. 25,670 movers are observed when industry is not controlled for. Industry is identified for 9,794 movers.

Table 4: Labor Power Parity: Wage Gains of Identical Workers in Pairs of Firms.

Variable: Log(Average Daily Wage 84) - Log (Average Daily Wage 83) for workers reporting a 1983 wage in the origin firm and a 1984 wage in the destination firm among firm pairs with at least 10 worker moves in both directions.

	1984					
1983	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Firm 1		.159 (.142) N=56				
Firm 2	.085 (.420) N=65					
Firm 3				.146 (.136) N=31		
Firm 4			.113 (.200) N=10			
Firm 5						.094 (.111) N=37
Firm 6					.165 (.146) N=125	

Note: Log(Average Daily Wage 84) - Log (Average Daily Wage 83) in the full population = .043

The sample is of workers observed in pairs of firms with bilateral flows of at least 10 workers in each direction between 1983 and 1984. All workers, including multiple job holders, who report a 1983 wage in the origin firm and a 1984 wage in the destination firm are included.

Table 5: Persistence of Individual Effects by Tenure on Old Job

	Control for Tenure		No Control for Tenure	
	New wage	Old wage	New wage	Old wage
Individual Effect when Tenure on Lost Job is:				
1 year	.392	.595	.396	.586
2 years	.498	.636	.503	.628
3 years	.443	.669	.443	.665
4 years	.628	.685	.625	.687
5 years	.579	.627	.578	.662
6 years and more	.697	.683	.693	.699
Firm effect	.776	.576	.781	.581
Adj. R. Squared	.656	.600	.650	.596

All standard errors are below .026

The columns headed New Wage report the coefficients on old wage individual components in a regression of the form:

Ln(Wage New Job)= $X\beta$ +β Individual Effect Old Job +β Firm Effect Old Job, for the new wage, and
Ln(Wage Old Job)= $X\beta$ +β Individual Effect New Job +β Firm Effect New Job, for the old wage. X always include age, age squared, a dummy variable for sex and a dummy variable for occupation. Others controls are added as reported. Tenure consists of a variable for tenure, one for tenure squared and a dummy variable equal to 1 when tenure is censored., on the old job.

Table 6: Persistence of Effects by Number of Contacts between Old and New Employers

	New Wage	Old wage
Individual Effect by Number of Contacts Between Old and New Employers		
Less than 5	.209	.336
5 to 10	.188	.454
10 to 25	.322	.560
25 to 50	.511	.780
50 to 100	.880	.812
more than 100	.841	.752
Firm Effect by Number of Contacts Between Old and New Employers		
Less than 5	.372	.405
5 to 10	.635	.502
10 to 25	.836	.541
25 to 50	.821	.650
50 to 100	.836	.682
more than 100	.953	.600
Adjusted R-Squared	.705	.615

All standard errors are below .035.

These equations control for age, age squared, sex, broad occupation, tenure, tenure squared, and truncated tenure on the old job.

The variable 'number of contacts' is defined as the number of workers laid off by employer i who are rehired by employer j. This variable is calculated for each mover. In the regressions estimated on the sample of 25,670 movers and reported above, we report the coefficients on individual and firm wage components interacted with dichotomous variables categorizing these gross flows between employers.

Table 7: Firm Persistence for Blue and White Collar Workers

Dependent Variable: Log(New Wage)

	Coefficient	Standard Error
Age	.0177	.0012
Age Squared	-.00016	.0000
Tenure	.0564	.0078
Tenure Squared	-.0083	.0014
Permanent	.0937	.0123
Male	.3039	.0037
White Collar	.3398	.0047
Individual Effect Old Job:		
Blue Collar	.7395	.0066
White Collar	.4632	.0102
Firm Effect Old Job:		
Blue Collar	.7829	.0110
White Collar	.7706	.0099
Adjusted R-Squared	.655	

Permanent refers to a worker with at least 6 years tenure with the previous employer.

Table 8: Firm Persistence for Workers Changing Industry

Dependent Variable: Log(New Wage)

	Control For Industry
Age	.0148 (.0019)
Age Squared	-.00015 (.0000)
Tenure	.0491 (.0118)
Tenure Squared	-.0081 (.0020)
Perm	.1316 (.0187)
Male	.2880 (.0064)
White Collar	.2990 (.0066)
Individual Effect Old Job	.5607 (.0084)
Firm Effect Old Job:	
Same Industry	.8029 (.0167)
Different Industry	.4333 (.0166)
Adjusted R-Squared	.695
N	9,794

9 Dummy variables controlling for industry of new job added and not shown.

Table 9: Firm and Individual Effects in Belgium

Abowd, Kramarz, Margolis specification on 312 manufacturing firms, 1978 1985.

Age	.0338 (.0001)	.0269 (.0001)	.0786 (.0001)	.0785 (.0001)
Age Squared	-.0004 (.0000)	-.0003 (.0000)	-.0021 (.0000)	-.0021 (.0001)
Male	.3010 (.0004)	.2445 (.0004)	.0004 (.0003)	-.0002 (.0002)
White Collar	.2303 (.0004)	.2226 (.0003)	-.0297 (.0033)	-.0294 (.0034)
Firm Effect	No	Yes	No	Yes
Individual Effect	No	Nos	Yes	Yes
Adjusted R-Squared	.5416	.6439	.6732	.6734

7 Dummy variables included to control for year.

Table 10: Firm and Individual Effects in Belgium

Leonard and Van Audenrode specification on 312 manufacturing firms, 1978-1985.

N=13,859

	Old Wage	New Wage
Age	.0523 (.0016)	.0154 (.0014)
Age Squared	-.0006 (.0000)	-.0001 (.0000)
Male	.2637 (.0074)	.3025 (.0068)
White Collar	.1202 (.0052)	.2549 (.0048)
Firm Effect Old Job		.3435 (.0152)
Individual Effect Old Job		.3654 (.0083)
Firm Effect New Job	.3925 (.0176)	
Individual Effect New Job	.4090 (.0102)	
Adjusted R-Squared	.5368	.5569

6 Dummy variables included to control for year.