Firm-Specific Human Capital: A Skill-Weights Approach

Edward P. Lazear

Hoover Institution
and
Graduate School of Business

Stanford University

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Abstract

One problem with the theory of firm-specific human capital is that it is difficult to generate convincing examples of investment that yield the sometimes observed large and continuing effects on earnings. Another approach, called the "skill-weights" view, allows all skills to be general in that there are other firms that use each of the skills. But firms use them in different combinations and with different weights attached to them. The skill-weights view not only has aesthetic appeal, but is consistent with frequently observed large wage loss from involuntary turnover. All of the implications of the traditional view are produced by this approach, and there are a number of other implications that distinguish the new view from the traditional one. The extant empirical evidence already contains some support for the skill-weights view.

Most professors of labor economics teach their students the difference between general and firm-specific human capital. Firm-specific human capital makes workers more productive in their current firm, but not elsewhere. General human capital augments productivity in the same way at multiple firms. But when searching for examples of firm-specific human capital, many of us fall back on the same clichés. "Knowing how to find the restrooms," "learning who does what at the firm and to whom to go to get something done," "learning to use equipment or methods that are only used in the worker's current firm ," are ones that come to mind. The problem is that it is difficult to generate convincing examples where the firm-specific component approaches the importance of the general component. If we think of our own jobs as academics, there is surely some value to knowing the specifics of the university at which we are employed, but does that capital come close to the amount of general economic knowledge that we have acquired on the job through seminars, reading and writing papers, and talking with colleagues? The answers is almost certainly no, and this is true for virtually every job that one considers. Yet involuntary job loss, especially for older workers, often results in significant earnings loss, which is often interpreted as a reflection of firm specific human capital that is valueless in the new job[1]

Another view of firm-specific human capital is offered here that is based solely on general

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[1] The first strong evidence of at least the possibility of firm-specific human capital was provided by Parsons (1972), which was inferred from a comparison of stayers' and leavers' earnings. Topel (1991) finds significant tenure effects even after accounting for endogeneity, as does Neal (1995), table 4. But Altonji and Shakotko (1987) argue that much of the earlier findings on tenure effects are biased upward as a result of heterogeneity and again, Altonji and Williams (1997) argue that the ten-year tenure effect is only .11. The point of the argument here is not to weigh in on the size of the tenure coefficient, but rather to provide a believable explanation of why some workers suffer large wage reductions after involuntary separation.

skills, but generates the findings observed in the literature on earnings functions. The approach is this. Suppose that there are a variety of skills used on each job and suppose that each of these skills is general in the sense that it is used at other firms as well. The difference, however, is that firms vary in their weighting of the different skills. A real-world example of which I have some personal knowledge may be helpful. A small Silicon Valley start-up provides enterprise software that does tax optimization. The typical managerial employee in this firm must know something about tax laws, something about economics, and something about software and java programming. None of these skills, taken alone, is firm-specific. There are many other firms in the economy that make use of knowledge on taxes. Other firms use economic reasoning to produce their products. Java is a language used commonly throughout the Valley. But the combination of these skills, especially in the quantities used at the start-up in question, are unlikely to be replicated in many, if any, other firms. A manager who leaves the start-up will have a difficult time finding a firm that can make use of all the skills he acquired at the first firm. The second job might use some of the economics and some of the tax, but little of the programming expertise. Or it might use tax and programming, but little economics.

In part, the loss from going to a new job depends on the thickness of the labor market and on search costs. When markets are very thick and search costs are low, a laid-off worker is more likely to find a job where weights favor his skills. When markets are thin and search costs are high, the worker might have to settle for a firm that makes little use of all the skills acquired at the prior firm, even though each of those skills is “general” in the sense that there are other employers who make use of the same skill. As a result, separation, especially in thin markets, results in a wage loss associated with involuntary job loss. In very thick markets, where another identical job can be found, there is no wage loss associated with layoff.[2]

Why bother with another story for specific human capital? The traditional view seems to have generated many predictions that are consistent with the data. The advantage of this new "skill-weights" view of human capital is that it provides a more reasonable story, is more consistent with wage loss sometimes associated with involuntary turnover, and yields all of the implications for earnings functions that are documented in the empirical human capital literature. Furthermore, a number of additional testable implications, some of which have already received the support of existing empirical work, come from this view, thereby distinguishing it from the traditional view of firm-specific human capital. In short, this skill-weights view is likely to be closer to reality.

The Model

Let there be two skills, A and B, which the individual can acquire at cost C(A,B) with C_A, $C_B > 0$ and C_{AA}, $C_{BB} > 0$. Two skills and two periods are sufficient to derive all of the propositions. Think of workers as making their investments during period 1 and receiving the payoff from work in period 2.

A worker with skill set (A,B) has output at firm i given by

[2] There are other stories that generate positive tenure coefficients that have nothing to do with firm-specific human capital. Upward-sloping tenure-earnings profiles can provide incentives as in Lazear (1979, 1981). They may also reflect pure rent seeking activity if more senior workers are better at extracting rents than their junior counterparts.

$$(1) \qquad y_i = \lambda_i A + (1-\lambda_i) B$$

with $0 \leq \lambda_i \leq 1$. The λ_i reflects the fact that each firm i may weight the two skills differently from another firm j.

The worker must decide on his human capital investment strategy. Define the initial firm, denoted firm 1, as the firm at which the worker is employed during the first period. The worker receives one job offer before starting the initial job, so λ is not a choice variable from the worker's point of view (relaxed later). Initially, consider the case where the initial λ_1 is sufficiently high that A>B so workers favor high λ firms.

Before the second period begins, the worker obtains an offer from another firm, denoted j, which depends on the skills that he takes into that period. If output is given by (1), then output at firm j is given by

$$y_j = \lambda_j A + (1-\lambda_j) B .$$

The random variable λ has density $f(\lambda)$.

Because the situation is one of ex post bilateral monopoly, the second period wage is determined by the equilibrium to some bargaining game. None of the results are specific to the game selected so long as there is some rent splitting that occurs during the second period. To make things concrete, it is assumed that the wage during period two is determined according to a Nash bargaining framework. Since the worker is worth $\lambda_j A + (1-\lambda_j) B$ at the alternative firm, the alternative firm would be willing to pay up to $\lambda_j A + (1-\lambda_j) B$ for the worker's services. The initial firm receives output of $\lambda_1 A + (1-\lambda_1) B$ so the Nash bargain implies that the wage in period 2 is

(1) $W_2 = ½ \{ [\lambda_1 A + (1-\lambda_1) B] + [\lambda_j A + (1-\lambda_j) B]$

or

$W_2 = B + ½ (\lambda_1+\lambda_j)(A- B)$

This formula holds whether the worker stays or quits to accept the outside offer. In the former case, the threat is the offer by the new firm. In the latter case, where the outside firm can pay more, the threat value is the level of output at the initial firm.

The period 2 wage is stochastic because it depends on the realization of the period 2 outside value. High outside values result in high period 2 wages, even for workers who choose to stay, because their alternatives are better, which raises the threat value. Given the ex ante expectation of the period 2 wage, the firm must offer a wage during period 1 (the investment phase) that attracts workers. The period 1 wage is deterministic because it depends only on the expected wage for period 2 and is derived in a later section.

Nash bargaining implies that the wage paid exceeds the maximum that the losing firm could pay, which guarantees that labor moves voluntarily to its highest value. Separation is efficient, despite the existence of specific human capital, because the structure allows for bargaining after both inside and outside offers are observed.[3] The worker stays with his initial firm during the second

[3]Inefficiencies would result were workers and firms to pre-commit to a second period wage based on ex ante rather than ex post information.

period whenever the inside value exceeds the outside output value. This happens whenever

$$\lambda_1 A + (1-\lambda_1) B > \lambda_j A + (1-\lambda_j) B$$

or whenever

$$(\lambda_1 - \lambda_j) (A - B) > 0 .$$

The condition for retention becomes

$$\lambda_1 > \lambda_j$$

which happens with probability $F(\lambda_1)$ where F() is the c.d.f. of λ .

Turnover that occurs when $\lambda_j > \lambda_1$ is often, if not always, associated with a quit because firm j can outbid firm 1 for the worker's services. This turnover is called "voluntary." Were all turnover voluntary, a separation would never be associated with wage loss. Wage loss at separation can only occur if workers leave firms involuntarily. It is important to distinguish the two kinds of turnover -- voluntary and involuntary. Empirically, quits are generally associated with wage gains whereas layoffs are more likely to involve a wage loss. To capture this, let there be some exogenous probability of a layoff, say, from a plant shut-down, given by q. Much, if not most, of this turnover shows up as layoffs. When a worker is laid off, he does not have the initial job as an alternative to discipline the wage paid by the new firm. Instead, his fall back position is to accept leisure, which is normalized to have value zero. The Nash bargaining wage for those laid off exogenously and who have no alternative job is then

$$W_{layoff} = (\lambda_j A + (1-\lambda_j) B) /2 .$$

The probability of remaining with firm i during the second period is given by

$F(\lambda_1)$ [1 - q]

which depends on λ_1. This is the probability that a worker is not laid off exogenously, 1-q, times the probability that the worker's outside offer λ_j is inferior to the one at the current firm, $F(\lambda_1)$. A firm that has very high levels of λ retains its workers more often because it is less likely that outside firms will value the dominant skill more.

The worker's investment problem is to choose A and B, knowing that he may remain at the initial firm, but that there is some chance that he will move to another firm, either because he gets a better outside offer, or because his firm shuts down. Then a worker at firm 1 chooses A and B so as to maximize expected net earnings, y,

$$\begin{aligned} \mathrm{y}(\lambda_1) = F(\lambda_1)(1-q)E(W_{stay}) &+ [1\text{-}F(\lambda_1)](1-q)E(W_{quit}) \\ &+ qE(W_{layoff}) - C\big(A(\lambda_1), B(\lambda_1)\big) \end{aligned}$$

or

$$\begin{aligned} \mathrm{y}(\lambda_1) = F(\lambda_1)(1-q)&\left\{ B(\lambda_1) + \frac{\big(\lambda_1 + E(\lambda_j | \lambda_j < \lambda_1)\big)\big(A(\lambda_1) - B(\lambda_1)\big)}{2} \right\} \\ &+ \big(1 - F(\lambda_1)\big)(1-q)\left\{ B(\lambda_1) + \frac{\big(\lambda_1 + E(\lambda_j | \lambda_j > \lambda_1)\big)\big(A(\lambda_1) - B(\lambda_1)\big)}{2} \right\} \\ &+ \frac{q}{2}\big(\bar{\lambda}A(\lambda_1) + (1-\bar{\lambda})B(\lambda_1)\big) - C\big(A(\lambda_1), B(\lambda_1)\big) \end{aligned} \tag{2}$$

where $\bar{\lambda}$ / $E(\lambda)$.

Eq. (2) has three terms. The first reflects earnings if the worker remains with his current firm, which happens $F(\lambda_1)$ (1-q) of the time. The second term reflects earnings when he receives a better outside offer than at the current firm and his current firm does not shut down. This occurs whenever $\lambda_j > \lambda_1$, and when no layoff occurs.[4] Finally, the firm may shut down, in which case he must take the alternative job with earnings shown in the third term. This occurs q of the time.

The first-order conditions are

(2) $$\frac{\partial}{\partial A} = (1-q)F(\lambda_1)(\frac{\lambda_1 + E(\lambda_j|\lambda_j < \lambda_1)}{2}) + (1-q)\big((1-F(\lambda_1)\big)(\frac{\lambda_1 + E(\lambda_j|\lambda_j > \lambda_1)}{2}) + \frac{q}{2}\bar{\lambda} - C_A = 0$$

and

(3) $$\frac{\partial}{\partial B} = (1-q)F(\lambda_1)(1 - \frac{\lambda_1 + E(\lambda_j|\lambda_j < \lambda_1)}{2}) + (1-q)\big((1-F(\lambda_1)\big)(1 - \frac{\lambda_1 + E(\lambda_j|\lambda_j > \lambda_1)}{2})$$
$$+\frac{q}{2}(1-\bar{\lambda}) - C_B = 0$$

[4] Actually, even when a layoff occurs, sometimes the worker would have left anyway, i.e., when $\lambda_j > \lambda_1$. This is included in the third term because $\bar{\lambda}$ integrates over these high λ events.

where $\bar{\lambda}$ is the (unconditional) expectation of lambda.

Eq. (3) and (4) hold for workers who find themselves in firms with $\lambda_1 > \lambda^*$ where λ^* is the minimum value of λ such that A>B in (3) and (4). There is another set of initial firms, specifically those with low values of λ, for which workers choose to favor B relative to A. The first order conditions are identical for those firms, except that the interpretation of each term is different. In firms for which $\lambda_1 \geq \lambda^*$, the first term is that relates to stayers and the second to voluntary quitters. In firms for which $\lambda_1 < \lambda^*$, the second term relates to stayers and the first relates to voluntary quitters. In all that follows, the benchmark is firms for which $\lambda_1 \geq \lambda^*$ so that A>B. But all results shown for firms and their workers favoring A also hold for firms favoring B except when noted.[5]

Investment is a weighted average of the relevant skill-weights inside the firm and outside, where the weights depend on the probability of separation. Separation takes two forms, voluntary and involuntary and the investment strategy reflect this. Specifically, the first term describes optimal investment if the worker stays. The second term describes optimal investments in the event that the worker has an outside value higher than the inside one. The third term describes optimal investment given that exogenous separation occurs, in which case the unconditional expected value of λ is relevant.[6] Exogenous separation is made up of turnover that is truly involuntary, where wages

[5]Most results do not make use of specific properties of the density function, f(), nor of the cost function except that C_A, C_B, C_{AA}, and $C_{BB} > 0$, which hold irrespective of details about A and B. Below, it is shown that there is at most one switch point so if $A(\lambda^*)>B(\lambda^*)$, then $A(\lambda^*+x)>B(\lambda^*+x)$ œ x>0.

[6] Investment has two effects. It raises the wage directly by making the worker more productive at the chosen firm and it raises it indirectly by making him increasing productivity elsewhere, which is reflected in the bargaining outcome.

fall with the departure, and separation that would have occurred voluntarily anyway because

$$\lambda_2 A + (1-\lambda_2) B > \lambda_1 A + (1-\lambda_1) B$$

Extreme cases make the intuition clear. First, suppose that q=0 and that $\lambda_1 = \lambda_{max}$, the maximum value of λ ($\lambda_{max} \leq 1$), so that $F(\lambda_1) = 1$. Then there is certainty of continued employment with the initial firm and (3) and (4) become

$$\frac{\lambda_1 + \bar{\lambda}}{2} - C_A = 0$$

and

$$(1 - \frac{\lambda_1 + \bar{\lambda}}{2}) - C_B = 0 \quad .$$

Only the wage at the initial firm is relevant and that wage depends on λ_1 and the average outside λ because the full distribution of λ lies below λ_1.

Next, suppose that q=1 so that the plant closes down and separation is a certainty. Under these circumstances, (3) and (4) are

$$\frac{\bar{\lambda}}{2} - C_A = 0$$

and

$$\frac{(1-\bar{\lambda})}{2} - C_B = 0$$

and the current firm is irrelevant. Of course, the worker does not know where he will end up so he invests based on the unconditional expectation of λ. The coefficient is divided by 2 because the rent is split according to the Nash bargain.

Period 1 Wage

When the worker joins the firm, he has a choice. He can accept the job that he is offered or choose not to work. The worker does know that once he joins the firm, it will be optimal to invest idiosyncratically, which will affect his wage in the next period. The period one wage must be set so as to make the worker indifferent between working and not working.[7] Given that the utility from leisure is assumed to be U_0 which has been normalized at 0 per period, the equilibrium condition for setting wages in period one is

$$W_1(\lambda_1) + E(W_2|\lambda_1) - C\big(A(\lambda_1), B(\lambda_1)\big) = 0$$

[7] Rents are assumed to go to the firm because the firm's technology is a specialized factor that is not available to other firms. Alternatives are considered in "Extensions." The assignment of rents to one side or the other is irrelevant except as it affects the level of the period 1 wage.

or

$$W_1(\lambda_1) + y(\lambda_1) = 0$$

The wage that the firm offers in period 1 depends on its value of λ_1. Very high λ_1 firms (as is shown below) are more favorable because they result in higher expected earnings. The worker takes into account the expected wage in period 2, knowing that a quit, layoff or optimal retention is possible and that he will be in a bargaining situation when period 2 comes around. The period 1 wage is then set so as to attract the worker to the job for every job.

Wage Differences: Stayers and Leavers

One motivation given for the new view of firm-specific human capital provided in this analysis is that workers lose sometimes significant earnings when they suffer an involuntary separation. Wage loss associated with involuntary separation is reflected in the tenure coefficient that is sometimes estimated in standard wage regressions. The model presented above also has implications for wage differences between stayers and leavers and it is instructive to examine the implications of this model for empirical earnings functions.

The typical OLS method of identifying tenure coefficients in earnings regressions is to compare those who leave the firm with those who stay at the firm. The difference between the earnings growth associated with a given amount of experience for those who stay and those who go loads on the tenure coefficient.[8] The amount of wage growth that the leavers get loads on the

[8] Typically, the regression is
$\ln(\text{wage}) = b_0 + b_1(\text{experience}) + b_2(\text{tenure})$.

experience coefficient.[9]

Since period 1 wages are the same for both leavers and stayers, all that is relevant is the difference between period 2 wages. For stayers, wages are set as the outcome to the period 2 bargain taking into account the alternative wage offer. Using (1), the expected wage among stayers at a firm with weight λ_1 is

(5) $$W_{stay} = B(\lambda_1) + ½ [\lambda_1+E(\lambda_j * \lambda_j<\lambda_1)][A(\lambda_1)- B(\lambda_1)] \quad \text{if } \lambda_1 \$ \lambda^*$$

and

$$= B(\lambda_1) + ½ [\lambda_1+E(\lambda_j * \lambda_j>\lambda_1)][A(\lambda_1)- B(\lambda_1)] \quad \text{if } \lambda_1<\lambda^*$$

where λ_j is the weight at the firm from which the worker receives an offer in the period 2. Recall that λ^* is defined as that value of λ such that A=B from the first-order conditions. The expected wage among quitters is

(6) $$W_{quit} = B(\lambda_1) + ½ [\lambda_1+E(\lambda_j * \lambda_j>\lambda_1)][A(\lambda_1)- B(\lambda_1)] \quad \text{if } \lambda_1 \$ \lambda^*$$

and

$$B(\lambda_1) + ½ [\lambda_1+E(\lambda_j * \lambda_j<\lambda_1)][A(\lambda_1)- B(\lambda_1)] \quad \text{if } \lambda_1<\lambda^* \quad .$$

Finally, there are those who are laid off whose wages are

(7) $$W_{layoff} = ½ ((\bar{\lambda}\, A(\lambda_1) + (1- \bar{\lambda})B(\lambda_1)) \quad .$$

Those who stay 1 period have

$$\ln (wage) = b_0 + b_1 + b_2 .$$

Those who leave and take a new job have

$$\ln (wage) = b_0 + b_1 .$$

The difference between the wages of stayers and leavers is therefore b_2, the tenure coefficient.

[9] Topel (1991) uses a somewhat different method, bounding the tenure coefficient by using within-firm and between-firm experience effects.

A worker who quits a firm that has initial weight λ_1 enjoys a wage gain. The expected value of that gain is derived by subtracting (5) from (6)

$$\text{(8)}\qquad \text{Wage change} = ½\,[E(\lambda_j{*}\lambda_j{>}\lambda_1) - E(\lambda_j{*}\lambda_j{<}\lambda_1)][A(\lambda_1) - B(\lambda_1)] \qquad \text{if } \lambda_1 \geq \lambda^*$$

$$= ½\,[E(\lambda_j{*}\lambda_j{>}\lambda_1) - E(\lambda_j{*}\lambda_j{<}\lambda_1)][B(\lambda_1) - A(\lambda_1)] \qquad \text{if } \lambda_1 < \lambda^* \;.$$

The expression in (8) is positive.

Similarly, the expected wage change among involuntary leavers is

$$\text{(9)}\qquad W_{layoff} - W_{stay} = \frac{-B(\lambda_1)}{2} + ½\,[\bar{\lambda} - \lambda_1 - E(\lambda_j{*}\lambda_j{<}\lambda_1)][A(\lambda_1) - B(\lambda_1)] \quad \text{if } \lambda_1 \ \$\ \lambda^*$$

and

$$= \frac{-B(\lambda_1)}{2} + ½\,[\bar{\lambda} - \lambda_1 - E(\lambda_j{*}\lambda_j{>}\lambda_1)][A(\lambda_1) - B(\lambda_1)] \quad \text{if } \lambda_1 < \lambda^* \;.$$

A sufficient, although not necessary, condition for (9) to be negative is $\lambda^* = \bar{\lambda}$.

Wage Loss and Turnover

Is there always a loss associated with moving from the first firm to another? The empirical answer is no. Many job changes, especially voluntary ones, result in wage gain.

The traditional view of specific human capital, taken literally, does not permit wage increases with job change because human capital is either completely general or completely firm-specific. The specific capital has no value elsewhere. This is too literal an interpretation of the standard model, but the skill weights formulation allows for both wage loss and wage gain with job change and is exact in predicting the prevalence of each.

If all turnover were voluntary, then at any firm with a given λ, the quitters would be those who were lucky in finding an outside offer from a better λ firm. The wage among stayers at that firm would be lower than the wage of quitters, which could result in a negative tenure effect.[10]

Were all turnover involuntary, the wage change on turnover would be negative.[11] For all turnover to be involuntary in that no one would have quit from an A-favoring firm, $\lambda_1 = \lambda_{max}$ (or $\lambda_1 = \lambda_{min}$ ($\lambda_{min} \geq 0$) in B-favoring firms). Then $E(\lambda_j \mid \lambda_j < \lambda_1) = \bar{\lambda}$ and $F(\lambda_1) = 1$. Expected wage loss on leaving such a firm would be

$$\frac{B(\lambda_{max})}{2} + \frac{\lambda_{max} + \bar{\lambda}}{2}((A(\lambda_{max}) - B(\lambda_{max})) - \frac{\bar{\lambda}}{2}A(\lambda_{max}) - \frac{(1-\bar{\lambda})}{2}B(\lambda_{max})$$

or

$$\frac{B(\lambda_{max})}{2} + \frac{\lambda_{max}}{2}(A(\lambda_{max}) - B(\lambda_{max}))$$

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[10] This is not necessarily true for the average because departures are disproportionally from "bad" firms, i.e., those with λ_1 close to λ^*. Stayers are disproportionally located in extreme λ, high-wage firms, which could result in a positive tenure effect in OLS regressions, even among voluntary movers.

[11] It is possible that the turnover effect could be negative even for voluntary moves if workers who are not doing well at their current firm move to a firm that offers a lower current wage, but steeper transition.

which is necessarily positive.[12] If all turnover is involuntary in the sense that workers would not choose to move, then stayers do better than leavers.

Positive tenure coefficients in basic OLS regressions may well reflect significant involuntary turnover, at least among some groups of individuals.

Idiosyncratic firms and unbalanced investment

The pattern of investment is more unbalanced for workers whose initial job is at a firm with relatively idiosyncratic weights. Idiosyncratic weights induce workers to invest idiosyncratically.

Formally, an idiosyncratic firm is one defined as having λ that is far away from the mean. For A-favoring firms with $\lambda_1 > \lambda^*$, more idiosyncratic firms are those with higher values of $\lambda_1 - \lambda^*$. Since λ^* is given, this amounts to having high values of λ_1. It is now shown that A-B increases in λ for $\lambda>\lambda^*$.

First note from (3) and (4) that $C_A + C_B = 1$. It is also clear from the first order conditions that both A and B depend on λ_1. Convexity of the cost function implies that C_A and C_B are both increasing so the condition on the sum means that if B increases with λ_1, A must decrease with λ_1. To see that A increases and B decreases in λ_1, assume the opposite.

Consider some value of x>0. Eq. (2') above is net income and is the worker's maximand. After some manipulation it can be written explicitly as

$$(2') \qquad Y(A,B,\lambda_1) = \frac{1}{2}(1-q)[\lambda_1 A + (1-\lambda_1)B] + \frac{1}{2}[\bar{\lambda}A + (1-\bar{\lambda})B] - C(A,B)$$

[12] This is true because A>B by definition in A-favoring firms.

Define A and B as optimal for λ_1 and A* and B* as optimal for $\lambda_1 + x$. Using (2'), the difference $Y(A,B,\lambda_1+x) - Y(A,B,\lambda_1) = ½ (1-q)(A-B)$ and

$Y(A^*,B^*,\lambda_1+x) - Y(A^*,B^*,\lambda_1) = ½ (1-q)(A^* - B^*)$. By assumption, $A^*-B^* < A - B$, which implies that

$$Y(A,B,\lambda_1+x) - Y(A,B,\lambda_1) > Y(A^*,B^*,\lambda_1+x) - Y(A^*,B^*,\lambda_1)$$

or that

$$Y(A,B,\lambda_1+x) + Y(A^*,B^*,\lambda_1) > Y(A^*,B^*,\lambda_1+x) + Y(A,B,\lambda_1)$$

Optimality implies that

$$Y(A^*, B^* , \lambda_1+x) > Y(A, B , \lambda_1+x)$$

so

$$Y(A,B,\lambda_1+x) + Y(A^*,B^*,\lambda_1) > Y(A,B,\lambda_1+x) + Y(A,B,\lambda_1)$$

which means

$$Y(A^*,B^*,\lambda_1) > Y(A,B,\lambda_1)$$

contradicting the definitions of A*, B* , A and B. Therefore, A-B cannot decrease when λ rises. Since one must rise and one must fall, it must be A that rises and B that falls so the difference between A and B increases as λ_1 rises.

This also implies that $A>B$ œ $\lambda>\lambda^*$ because once $A>B$, the proof above implies that A must increase and B must decrease in λ. Obviously, the proof could have been reversed to show that for $\lambda_1<\lambda^*$, decreases in λ_1 favor B over A.

The implication is that firms that have more idiosyncratic technology also induce more idiosyncratic investment by their workers. The unbalanced investment that workers make at unusual technology firms affect the rest of their careers by altering the wages at the current firm, their alternatives and therefore their decisions to stay or quit.

Implications of the Model

The traditional view of firm-specific capital is merely a special case of this approach. Let each firm j have a factor a_j with an identical positive weight associated with it. Let all firms k...j have weight zero on that factor. Suppose also that there is another factor, b, to which all firms attach positive (and the same) weight. Then, the traditional view of general and firm-specific human capital is captured by this specification where b is general and each a_j is firm-specific capital. Because the traditional view is a special case, all of the implications of the traditional view must also be implications of the skill-weights approach. In what follows, additional implications are drawn out.

Market Thickness

One implication of the skill-weights view of human capital that is less obvious under the traditional view is that wage loss associated with job turnover is greater in very thin markets than in very thick markets. As is made clear in this section, the definition of firm-specific human capital is endogenous. As markets become very thick, investments that would otherwise be viewed as firm-specific become more general. Also, as markets become thick, the individual undertakes investment strategies that are closer to the strategy that would prevail in the absence of any involuntary mobility.

An increase in market thickness is modeled here as allowing more offers. The model above assumes that before the work period begins, the worker gets a new draw of λ. A thicker market is represented as one where the worker gets multiple independent draws of λ before the work period and can select the job that best suits his prior investment strategy. There are two key results in this section. First, as the market gets extremely thick, investment becomes idiosyncratic, i.e., A-B increases to its limiting value. Second, and despite this, as the market thickens, the wage loss associated with separation declines. Workers lose less when they change jobs in thick market than when they change jobs in thin ones.

Define z / z (n) as the expectation of the maximum value of λ given n draws, so z is the expectation of the highest order statistic. Further, define s / s(n) as the expectation of the second highest order statistic given n draws. The probability that the current weight λ_1 exceeds all n draws is $F(\lambda_1)^n$ so expected earnings in (2) is now given by

$$
\begin{aligned}
y(\lambda_1) = F(\lambda_1)^n (1-q)E(W_{\text{stay}}) &+ [1-F(\lambda_1)^n](1-q)E(W_{\text{quit}}) \\
&+ qE(W_{\text{layoff}}) - C\big(A(\lambda_1), B(\lambda_1)\big)
\end{aligned} \tag{2''}
$$

The worker stays when then $\lambda_1 > z(n)$ so the threat for stayers is their best alternative, which is z(n). Among leavers, z(n) exceeds λ_1. It is possible that λ_1 is the next highest value of λ obtained, but more often, the second order statistic will be the threat level among leavers. Still, it is $\max[s(n), \lambda_1]$ that is the relevant alternative for voluntary leavers. Finally, those who are laid off have their wage bargain set by the highest and second highest order statistics, so z(n) and s(n) are relevant.

As is intuitively obvious, expected income, eq. (2"), increases in thickness of the market. The more offers the better. Formally, note that for a given A, B, an increase in n raises the expected wage of both stayers and quitters. Second, differentiate (2") with respect to n to obtain

$$My/Mn \quad = \quad F(\lambda_1)^n \ln[F(\lambda_1)] \, (1\text{-}q) \, [E(W_{stay}) - E(W_{quit})]$$

which is positive because $\ln[F(\lambda_1)]$ and $[E(W_{stay}) - E(W_{quit})]$ are both negative. Finally, allowing A and B to vary optimally can only increase y. Therefore, expected net income increases in market thickness.

The most significant implication is that wage loss reflected in the tenure coefficient declines as market thickness increases.

In the thinnest possible market, there are no alternative offers and no voluntary departures. The worker's fall back position is simply the value of leisure, normalized to 0. Then, the tenure effect reflects and the average wage among those who are not laid off minus the wage (here zero) of those laid off or

$$Wage\ Loss\big|_{n=0} = E\left\{\frac{\lambda_1}{2}A(\lambda_1) + \frac{1-\lambda_1}{2}B(\lambda_1)\right\} > 0$$

because the bargaining wage splits the difference between output and zero.

At the other extreme, as n 6 4 , the worker is certain to get an outside value of λ that not only dominates the current one, but also is the upper support of the distribution. So $z(n)=\lambda_{max}$. The same logic implies that $s(n) = \lambda_{max}$. Every worker, whether a quit or layoff, leaves the initial firm for another firm that has the best possible value of λ. The only workers who stay with the firm are those who have drawn maximum (or minimum) values of λ in their initial firm. Thus, wages of stayers and leavers are given by

$(\lambda_{max})\, A(\lambda_{max}) - [1 - \lambda_{max}]\, B(\lambda_{max})$.

Because the worker knows that he will be able to obtain $\lambda=\lambda_{max}$, he invests completely idiosyncratically, focusing on A to the detriment of B (or vice versa). Despite idiosyncratic investment, the wage loss for movers is necessarily zero because wages are the same for both stayers and leavers, voluntary or involuntary. There is no wage loss on changing firms.

In very thin markets, the wage loss associated with an involuntary move is positive, whereas loss in very thick markets is zero. When thickness of the market increases, investment in human capital, although unbalanced, is not firm-specific. Each skill taken by itself can always find a use in another firm, and as market thickness increases, the chances of finding a firm that uses skills in a less unfavorable combination also increases. It is in this sense that the definition of specific capital is endogenous. Wage loss reflecting the inferior skill weights that the worker expects to encounter in thin markets is smaller in thick markets, where better skill weights can be found.

The number of offers that a worker receives depends not only on the number of vacancies, but also on the number of other workers searching for a job. The analysis in this section has implications for business cycle downturns, when there are many searchers and few vacancies. During downturns, the wage loss associated with an involuntary termination should be greater than during booms because the ability to find a firm with favorable weights is reduced during downturns.

More to the point, Jacobson, LaLonde and Sullivan (1993) find that wage loss associated with mass layoffs is greater than wage loss associated with other displacement. When there are mass layoffs, many workers with the same (or similar) prior investment patters are looking for jobs in other firms with like skill weights. The number of offers, n, per worker is lower, markets are thinner for those who are subject to mass layoffs, and the probability of finding a firm with favorable skill weights is reduced. As such, individual displacement should, on average, be associated with less wage loss than mass layoff, which is consistent with their findings.

Under the traditional notion of specific human capital, the thickness implication is less obvious, if present at all. When specific human capital takes the form of learning who does what in a firm, it is unclear why having more firms in a market would make such knowledge more general.

Skill-Weights and Matching

The skill-weights interpretation is also consistent with the matching view of the labor market.[13] Think of a worker as being endowed with some vector of skills, (A_0,B_0) . Output is

[13] Jovanovic (1979a, b).

$$\text{Output} = \lambda_1 A_0 + (1-\lambda_1)\, B_0 ,$$

and the derivative with respect to λ_1 is

$$\frac{\partial \text{Output}}{\partial \lambda_1} = A_0 - B_0$$

which carries the sign of $A_0 - B_0$. Matching consists of finding a firm with the highest λ_1 if $A_0 - B_0 > 0$ and finding a firm with the lowest λ_1 if $A_0 - B_0 < 0$.[14]

The notion behind matching is that an individual has a set of skills that fit better in some firms than others. Unlike traditional specific human capital, there is no presumption in matching that the worker learns the specific skills that make him a good match with a firm. Instead, in the matching story, the worker has an endowed set of skills and those skills are better suited to some firms than to others. A reasonable interpretation of matching is that the value placed on skills that the individual possesses differs across firms. Thus, the skill-weights interpretation is not only consistent with matching, but seems a natural view of it.

A variant of the matching story has workers endowed with different cost functions rather than different levels of A and B. Some workers are relatively good at acquiring A, whereas others are relatively good at acquiring B. Under this interpretation, matching consists of finding a firm that

[14] Heckman and Sedlacek (1985) and Heckman and Scheinkman (1987) consider a linear multifactor model that has some similarities to the one in this paper. Heckman and Sedlacek estimate an extended Roy model, where workers have different characteristics and sort to various sectors. They refer to "sector specific capital." Their emphasis is on sorting and estimating prices across the sectors. Sorting in their model relates closely to that considered in Willis and Rosen (1979). Heckman and Scheinkman also use a model with linear technology and different skills. Their focus is on describing conditions under which characteristics are uniformly priced across sectors and testing the validity of uniform pricing.

favors the skill that the worker is better at acquiring.

Matching implies that turnover declines with tenure, a result that is implied by the skill-weights approach as well.[15] Suppose that some workers are endowed with more A than B, and some with more B than A (or equivalently, with cost functions that favor one or the other factor). If workers are limited in their choice of initial firm, then workers who favor B move to firms with lower λ and those who favor A move to firms with higher λ. As a result, more sorting occurs earlier in the career and turnover declines with tenure, even within a given firm. The formal analysis follows.

Consider a firm j with λ_j that exceeds the median level of λ. Then $F(\lambda_j) > ½$. Let α of the population have $A_0>B_0$ and $1-\alpha$ have $B_0>A_0$. Workers receive one offer per period, so those who are just entering the labor force take whichever job they are offered. (In fact, any search technology that allows for some who have $B_0>A_0$ to end up at firms with λ greater than the median value will suffice, but this structure is the easiest.)[16] Then the proportion of new employees at every firm are initially α and $(1-\alpha)$, respectively.

There are three types of turnover in the initial period. First, there is exogenous turnover,

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[15]See the firm-based studies such as Lazear (1992), or the newer studies that make use of country-wide data at the firm level, e.g., see a number of different country studies contained in Lazear and Shaw (2004).

[16]If workers obtained a signal on λ, say, $\hat{\lambda} = \lambda + \nu$, where ν is a noise term, then the proportion of A's at a given firm would depend on the firm's λ. High λ firms would get mostly A types and low λ firms would get mostly B types, with firms with λ close to the mean (or median) getting a mixture. As search technology improves, the proportion of A types at the firms with high λ values increases, but unless search is perfect, it will always be true that there are some B-types at the high λ firms. This is all that is necessary for the derivation in the text to hold.

which occurs with probability q. Of those who do not leave involuntarily, those who have $A_0>B_0$, leave if they encounter a $\lambda>\lambda_j$. This occurs with probability $1-F(\lambda_j)$. Those who have $B_0>A_0$ leave if they encounter $\lambda<\lambda_j$, which occurs with probability $F(\lambda_j)$. Thus, the turnover rate from firm j of those who are in their first period of work with the firm is

$$\gamma_0 = \alpha(q+(1-F(\lambda_j))(1-q)) + (1-\alpha)(q+F(\lambda_j)(1-q))$$

As a result of selective turnover, the proportion of worker types with one period of tenure is no longer α and $1-\alpha$. Instead, the proportion with $A_0>B_0$ is now

$$p \equiv \frac{\alpha F(\lambda_j)}{\alpha F(\lambda_j) + (1-\alpha)(1-F(\lambda_j))}$$

because of the original α A-types, $\alpha F(\lambda_j)(1-q)$ remain at the end of a period and of the B-types, $(1-\alpha)(1-F(\lambda_j))(1-q)$ remain at the end of a period. Obviously, the proportion after one period with $B_0>A_0$ is $1-p$. Thus, turnover during period 1 is then

$$\gamma_1 = p\,[\,q + (1-F(\lambda_j))\,(1-q)\,] + (1-p)[q+F(\lambda_j)(1-q)]$$

It is now shown that $\gamma_0 > \gamma_1$.

Because λ_j is above the median,

$$1-F(\lambda_j) < F(\lambda_j)\ .$$

Also, note that $p=\alpha$ when $F= ½$ and $p>\alpha$ when $F>½$. Since $p>\alpha$,

$$(\alpha-p)(1-F(\lambda_j)) > (\alpha-p)F(\lambda_j)$$

and

$$(\alpha-p)(1-F(\lambda_j))(1-q) > (1-p-(1-\alpha))\,F(\lambda_j)\,(1-q)$$

which implies

(11) $\alpha(1\text{-}F(\lambda_j))(1\text{-}q) + (1\text{-}\alpha)F(\lambda_j)(1\text{-}q) > p(1\text{-}F(\lambda_j))(1\text{-}q) + (1\text{-}p)(F(\lambda_j)(1\text{-}q)$

and that

$$\alpha(q+(1\text{-}F(\lambda_j))(1\text{-}q)) + (1\text{-}\alpha)(q+F(\lambda_j)(1\text{-}q)) > p(q+(1\text{-}F(\lambda_j))(1\text{-}q)) + (1\text{-}p)(q+F(\lambda_j)(1\text{-}q))$$

or that

$$\gamma_0 > \gamma_1 \quad .$$

An analogous proof shows that $\gamma_0 > \gamma_1$ at firms that have λ less than the median value. These firms favor B-types and turnover declines with tenure as the A-types, who are more likely to quit, leave the firm.

Quits, Layoffs, and Tenure

There is an additional and related implication. Turnover can either be voluntary (quits) or involuntary (layoffs). The analysis of the last section implies that the ratio of quits to layoffs declines with tenure. Turnover early in a worker's career is disproportionately voluntary and late in the career, disproportionately involuntary.

The voluntary turnover rate in period zero is

$$V_0 = \alpha\,(1\text{-}F)(1\text{-}q) + (1\text{-}\alpha)F(1\text{-}q)$$

and in period 1 is

$$V_1 = p\,(1\text{-}F)(1\text{-}q) + (1\text{-}p)F(1\text{-}q)$$

The ratio of voluntary turnover to total turnover is

$V_t / (V_t + q)$

with M/MV > 0. To show that the ratio of voluntary turnover declines with tenure, it is sufficient to show that $V_1 < V_{0,}$ which is exactly (11) above.

The intuition is that workers sort themselves out early in their careers, choosing the firms that have skill-weights that are best suited to their skills. Over time, there is less of this sorting to be done and so voluntary turnover becomes less frequent. As a result, a disproportionate amount of involuntary turnover occurs for older workers.

There is a long history of evidence that supports this point. Turnover among young workers is most likely to be a quit and results, on average, in wage increases. Turnover among older workers is most likely to be a layoff and results, on average, in wage decreases. This was first shown by Bartel and Borjas (1981).

Firms and Jobs

Do skill weights relate to firms, industries or jobs? The answer is probably all three. Were skill weights measurable, a regression to explain them would likely reveal the importance of firm, industry and occupation effects.

Consider again the motivating example of the Silicon Valley start-up. The CEO in this firm must know java, tax and economics. But a software engineer can get by knowing mostly java and some tax, with very little economics. Even the software engineer knows more about tax than the typical software engineer, but his skills are more specialized in java programming than those of the CEO.

Thus, one can think of the λ_i as being not only firm specific, but job and perhaps industry specific. For modeling purposes, virtually nothing is changed by expanding the view to include jobs. But at the empirical level, the distinction matters. It suggest, for example, that there may be firm effects that are important in explaining wage loss associated with involuntary turnover, but it also suggests that occupation might matter as well.

Once we begin to think of λ as being tied to jobs, the approach of Gibbons and Waldman (2004) becomes relevant. They model "task specific" human capital and argue that different jobs in the firm use different amounts of it. Promotions are performed in a way to minimize underutilization of task specific skills. This is not unlike selecting a new job in round two that has weights that favor the skills already acquired during period one.

Who Pays for General Training?

One of the "puzzles" in the literature has been that some forms of training seem general, yet firms sometimes bear the cost of acquiring them.[17] Under the skill-weights view, it is natural that the firm would pay for at least some of the human capital that appears to be general. Take the example given earlier where a firm requires tax, economics and java programming. Because a worker who leaves the firm will almost certainly fail to find another firm that needs the skills in the same proportions, and because this imposes a wage cost on mobile workers, the worker is unwilling to bear the full cost of training. The firm finances some learning about taxes, economics, and java,

[17]This issue has attracted a good bit of attention in the literature, especially recently. Best known among recent contributions are Acemoglu and Pischke (1998) and Booth and Zoega (1999). Cappelli (2002) argues that this helps attract better workers to the firm.

even though each of these skills, taken separately, is completely general. Furthermore, the amount that a firm finances, through higher period one wages, depends on thickness of the market. When markets are very thin, workers are unwilling to bear as large a fraction of the cost because they expect to lose more on involuntary separation. This is reflected in higher W_1 that corresponds to lower $E(W_2|\lambda_1)$ associated with thinner markets.

An Extension: Endogenous Technology Choice

Even when workers receive only one offer in period 1, there are advantages to being a firm that has extreme values of λ. First, workers are more likely to stay in those firms because workers are less likely to find a firm that dominates. Second, the rent associated with production in high λ firms is higher. The proof follows.

Recall that expected net income is given by

$$(2')\ y(\lambda_1) = \frac{(1-q)}{2}\left[\lambda_1 A(\lambda_1) + (1-\lambda_1)B(\lambda_1)\right] + \frac{1}{2}\left[\bar{\lambda} A(\lambda_1) + (1-\bar{\lambda})B(\lambda_1)\right] - C\left(A(\lambda_1), B(\lambda_1)\right)$$

Consider a firm with $\lambda_1 > \lambda^*$. Now fix A and B. Increasing λ_1 increases y because A>B. Allowing A and B to vary with λ_1 can only further increase y because the optimum values of A and B can produce no lower y than that obtained where A and B are fixed at previous values. Thus, y increases in λ_1 for $\lambda_1 > \lambda^*$. An identical proof shows that y gets larger as λ_1 decreases for $\lambda_1 < \lambda^*$.

The Nash (or virtually any) bargaining game played in period 2 implies that there is some rent splitting algorithm. As such, the firm would like to maximize the total rent and would therefore like to choose extreme values of λ. But if all firms did this, then either all firms would have identical technologies or the market would have to adjust to ensure that equilibrium was restored. The second is more likely because some technologies are better suited to a particular product than are others. In the motivating example, although a particular combination of tax, economics and java programming are well suited to the production of a particular form of software, the same combination of skills is less likely to be of value in producing garden tools.

The product market restores equilibrium by adjusting product prices. If labor market considerations induce firms to prefer to specialize in very high (or very low) λ technologies, the supply of the products made with those technologies is large and that of products made with more balanced technologies is small. As such, the price of goods made with balanced technology must rise enough to induce firms to be indifferent between choosing those technologies and choosing the extreme λ ones.

Wage Profiles and Idiosyncratic Technologies

An alternative view and one that is perhaps more realistic is that firms differ in their ability to produce with varying technologies. Some of this reflects luck and skill of the entrepreneur and as such, shows up in the rents available in the firm. If there were a perfectly elastic supply of labor at the base level of utility, then workers would prefer to work in firms that had more extreme technologies. As shown in the last section, those firms produce greater levels of y, and in the rent-splitting bargaining environment, higher expected wages to workers.

To clear the market, workers in idiosyncratic firms take lower wages in the initial period, knowing that their post-investment wages will be higher. From above, the period 1 wage is determined by

$$W_1(\lambda_1) + E(W_2|\lambda_1) - C\big(A(\lambda_1), B(\lambda_1)\big) = 0$$

More idiosyncratic technologies imply higher values of $E(W_2 \mid \lambda_1)$, which given optimal choices of A and B, are not fully absorbed in increased costs. As a result, W_1 decreases.

The empirical implication is that the experience-earnings profile is steeper in firms with more idiosyncratic technologies. Workers in such firms take lower initial wages for the opportunity to extract higher rents in period 2, which show up as higher ex post wages and lower turnover rates.

Other Views of Wage Loss

Firm-specific human capital is not the only reason why wages might fall with involuntary turnover. Lazear (1979) provides an incentive motivation for upward sloping age earnings profiles where workers wages exceed output later in life. Additionally, asymmetric information in labor markets can offer an alternative view.

For example, in Waldman (1990), when insiders have more information about workers than outsiders, up-or-out contracts may be used to reduce the ability of outsiders to use the actions of insiders to gauge worker productivity. Chang and Wang (1996) focus on under-investment in human capital that might occur as a result of asymmetric information. Acemoglu and Pischke (1998) provide an explanation for why firms might pay for general training. Lazear (1986) describes the bidding and turnover process when workers have a component of productivity that is general across firms and a component that is specific to each firm and where information about the two components is imperfect and asymmetric. The common thread of these papers is that all involve asymmetric information, where insiders and outsiders do not have the same amount of information about worker productivity. As a result, firms must guess the amount of human capital that the worker possesses, which can result in expected wage loss associated with turnover.

Asymmetric information has a different implication than the skill-weights view that relates to market thickness. In the skill-weights view, thick markets result in higher alternative wages and higher wages within the firm. Asymmetric information does not yield this implication. If outsiders have less information than insiders, it does not matter how many outsiders there are relative to insiders because having more outsiders does not produce more information that is held only inside, at least as the models are specified.

Empirically Testable Implications

The goal of theory is to provide implications that can be tested and verified or refuted. There are a number of implications of the skill-weights approach that go beyond those of the traditional view of firm-specific human capital and some that can distinguish between the two.

1. Market Thickness: The implications regarding market thickness distinguish between the two theories. In the skill-weights approach, wage loss from involuntary turnover should be smaller in very thick markets than in very thin markets. No such implication comes from the traditional view. A market is thick when the worker receives many offers for a given amount of search effort.

Empirical proxies of search costs and offer frequencies might include regional population densities and industry and occupation concentration ratios.

2. Idiosyncratic Firms: The more idiosyncratic is a firm's skill-weights, the less balanced is investment and the larger is the income of stayers. To offset the higher wages period two wages, initial wages must be low resulting in steeper tenure profiles firms with more idiosyncratic technologies. Since more extreme values of λ_1 also mean lower turnover rates, steeper (internal) wage profiles go hand-in-hand with low voluntary separations. The traditional view also produces this implication, but for different reasons.

3. Payment for General Training: As already mentioned, firms pay for what would otherwise appear to be general training because leaving a firm involuntarily implies wage loss when inferior skill weights are encountered on the replacement job. The payment takes the form of a higher period one wage that increases with thinness of the market.

4. Industries and Occupations: A very detailed definition of industry and occupation might be thought to hold constant the skill-weights. That is, one way to define an industry or occupation is such that all individuals in the industry or occupation have identical skill weights. If so, then holding industry and occupation constant in the wage regression should reduce the magnitude of the tenure effect. There is some evidence of this in Shaw (1984), table 4. Wage regressions that include occupational experience have somewhat lower tenure coefficients than those without. More important, the occupational effect itself is about four times as large as the pure tenure effect. To the extent that occupation is a proxy for skill-weights -- and it surely cannot reflect firm-specific capital in the traditional sense -- then the fact that occupational experience is so important suggests that the

skill-weights view has merit.[18]

5. Quits and positive wage growth at job change are disproportionately more likely for young workers than for old ones. As workers acquire tenure in a firm, involuntary turnover accounts for a disproportionate share of job change. There exists long-standing empirical evidence of this pattern, but this is also consistent with the traditional view of specific human capital.

6. In firms that have low probabilities of exogenous layoff (low q), workers base more of their investment decision on the firm-specific skill weights. As a result, period 2 wages are higher and wage loss on involuntary layoff is greater in firms that are ex ante unlikely to lay off their workers.

Conclusion

Workers who experience involuntary job changes often have significantly lower wages on their subsequent jobs. One frequent interpretation is that the loss reflects firm-specific human capital. The wage reduction that many suffer seems too large to be consistent with the traditional views of specific human capital.

An alternative approach that is based on general human capital with firm-idiosyncratic weights provides all the implications of the traditional story, but has the virtue that it is more realistic. Furthermore, the skill-weights approach provides a number of additional implications,

[18]See also Neal (1995) and Parent (2000), who find that industry effects reduce or even eliminate the firm tenure effects. Neal also holds constant broadly defined occupations (e.g., manager, professional, technician, sales, and other similar titles.

some of which have already been shown to be consistent with the data.

Like the traditional view, the skill-weights approach implies that workers who experience an exogenous change in job lose some earnings associated with their previous tenure. The amount of the loss associated with involuntary turnover tends to be greatest when exogenous separation probabilities are low, inducing a worker to invest idiosyncratically based on the weights at the initial firm. Further, the more idiosyncratic is the initial firm's technology, the more unbalanced is the investment.

There are a number of additional implications that come from the skill-weights view. First, wage loss from involuntary turnover varies with the thickness of the market. In markets where job offers are rare, the wage loss is larger than in those where offers are very common.

The firm may bear some or even most of the cost of skills that look general. In the skill-weights version, no skills need be truly "firm-specific" in the sense of there being no other firm at which they have value. On the contrary, the skills appear to be general because in isolation, they are used at a number of firms in the market. But the weights differ by firm. If the skills are acquired in relatively idiosyncratic patterns, e.g., learning medicine and law in the same firm, experience earnings profiles are steep and expected wage loss is great when the worker is involuntarily separated.

Matching stories are a natural application of the skill-weights view. If workers possess some combination of general skills before arriving at a firm, a firm that weights most heavily those skills that the worker possesses in abundance is a good match for the worker. This results in a higher ratio of quits to layoffs among young workers than old, and smaller wage loss or even wage gain for separated younger workers.

Finally, the wage loss should be reduced when industry and occupation effects are taken into account. There is ample evidence, found in a variety of data sets, that supports this implication.

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