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Peter F. Orazem
Iowa State University, pfo@iastate.edu

Marvin L. Bouillon
Iowa State University

Benjamin M. Doran
Iowa State University

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Peter F. Orazem*
Marvin L. Bouillon**
Benjamin M. Doran**

*Department of Economics, and **Department of Accounting
 Iowa State University, Ames, IA 50011 USA

Corresponding author is Peter F. Orazem, Department of Economics, 267 Heady Hall, Iowa State
University, Ames, IA 50011-1070. Email: pfo@iastate.edu. Phone: (515) 294-8656.
Fax: (515) 294-0221.

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Abstract

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Long-term attachments between workers and firms are common. Numerous studies have examined worker returns to tenure, but little is known of firm returns to firm-worker matches. Yet, these attachments represent a human capital asset quasi-held by the firm which is not captured by traditional accounting measures of firm assets. Firms with large quasi-holdings of human capital will have higher measured return on assets, other things equal. Analysis of data on 250 large manufacturing firms supports the view that firms profit from long-term attachments with their workers. Consequently, unmeasured human capital assets contribute to the explanation of persistence in measured long-run excess profits across firms.

Long-Term Attachments and Long-Run Firm Rates of Return

One of the stylized facts of the U.S. labor market is that long-term attachments between firms and workers are common. Hall (1982) first noted the prevalence of long term attachments in the labor force. Despite reports in the popular press of declining firm and worker loyalty to one another, long-term attachments have remained common. Farber (1999) reported that in 1996, 35 percent of workers aged 35-64 had over 10 years of job tenure and 21 percent of those aged 45-64 had over 20 years of job tenure. Evidence presented by Diebold, Neumark and Polsky (1997), Neumark, Polsky and Hansen (1999) and Gottschalk and Moffitt (1999), suggest that job stability in the 1990s is similar to that in the 1970s and 1980s. Explanations for the prevalence of long-term attachments have concentrated on the role of firm-specific human capital (Becker 1964, Parsons 1972) and the quality of the match between the firm and the worker (Jovanovic 1979). In either case, the ongoing relationship between the firm and the worker generates increased productivity or lower production costs that would not persist if the worker were to switch to another firm. Because workers would be expected to receive some of the rents from the long-term attachment between firm and worker, the theories predict upward sloping wage profiles with job tenure.[1]

Tests of the theories have concentrated on estimating worker wage returns to tenure. Some studies (e.g. Abraham and Farber 1987; Altonji and Shakotko 1987) found negligible effects on wage growth while others (Antel 1985; McLaughlin 1991; Topel 1991; Parent 1999; and Abowd and Kang 2002) find more substantial returns. Studies that have attempted to measure firm-specific training directly (Brown 1989; Parent 1999) found significant positive wage responses. Another line of research examined the impact of permanent layoffs on subsequent wages. These studies (Hamermesh 1987; Addison and Portugal 1989; Topel 1981;

Jacobson, LaLonde and Sullivan 1993) have found substantial wage losses associated with exogenous disruptions of the firm-worker match, although some of the loss may be industry-specific and not firm-specific (Neal 1995).

Although the models explaining long-term attachments between the firm and the worker typically suggest that the firm and the worker share in the rents from the match, few studies have explored the link between long-term attachments and firm profitability. The most common approach has been to examine the link between firm provided training and measures of firm performance. Bartel's (2000) review reports that of the five cross-sectional studies that examined whether training can explain variation in measures of firm output, two found no effect and three found positive effects. A sixth study by Ichniowski, Shaw, and Prennushi (1997) found mixed effects of individual training measures on productivity. However, these studies do not directly address the issue of firm returns to long-term attachments. First, firm returns are typically measured in terms of output rather than profit. This makes it difficult to distinguish firm returns from worker returns because training would raise labor productivity even if workers were getting all the returns to training.[2] Second, training may not capture variation in long-term worker attachment to firms. Training is typically measured by expenditures over one year or less. Consequently, the stock of human capital is not measured, but rather the increment to the stock. In addition, labor turnover may be influenced by many factors other than measured training including benefits packages, compensating differentials and informal training. While training may be an indicator of long-term attachments, it is not necessarily the only indicator.

Previous studies have used the persistence of sub or supernormal firm profit over time as an indicator of firm monopoly power or union power to extract rents. However, atypical long-

term worker attachments can also help to explain the persistence of measured excess supernormal profit across firms. Traditional accounting measures of firm assets do not include firm holdings of human capital since the firm cannot force workers to stay with the firm. However, the fact that specific human capital investment or productive firm-worker matches lead to long-term voluntary attachments between the firm and the worker, even in the face of business cycle fluctuations, implies that firms may have a quasi-hold on the specific human capital embodied in its workers. For such firms, traditional accounting measures of profit rates such as firm revenue per unit of physical capital will overstate the firm's rate of return because the denominator will only include measures of physical capital and not human capital.

This study shows that variation in firm quasi-holdings of human capital does explain some of the variation in long-run measured firm profit rates. We exploit the theoretical link between firm's share of human capital investments and quit propensity to derive an observable estimate of a firm's quasi-holdings of specific human capital.[3] The model is tested using information on average profits for 250 manufacturing firms over the 1973-1983 period. The sample period was selected to coincide with a data series on industry turnover which was discontinued in 1981, and to utilize information from the 1982 Census of Manufacturers. Results support the view that firms get returns from long-term attachments to their workers.[4]

The paper first examines a simple model of firm turnover as it relates to firm returns to long-term attachments. Next, an empirical strategy for testing the theory is proposed. The results of the analysis are reported in the final section.

1. Theory

We need to establish an observable measure of firm quasi-holdings of specific human capital. To do this, we employ a model in the spirit of Becker (1964), Parsons (1972), Hashimoto (1981) and Antel (1985) which describes how workers and the firm share in the returns to the employment relationship. Let H be the expected value of production from a worker's general human capital and let h be the expected value of production from a worker's human capital specific to the firm.[5] The worker's opportunity wage (equal to the maximum of the value of the general training used in other firms or in nonmarket activities) is H, and the worker's gross value to this firm, V, is H + h.[6]

It is generally accepted that the worker and the firm will share in the investment in specific human capital. By so doing, each party suffers a loss if the employee separates from the firm, whether by quit or layoff. However, the optimum amount of specific training, h, is not sensitive to the firm or worker shares. Both the firm and the worker will have an incentive to invest in specific training until the marginal return on additional h is equal to the return on other physical or human capital investments. However, as shown below, the level of quits or layoffs will be sensitive to the share of costs and returns.

Let β be the firm's share of training costs and returns to specific training. The worker's share of costs and returns is $(1 - \beta)$. The worker's wage in the firm will be

$$W \ = \ H \ + \ (1 \ - \ \beta)h \tag{1}$$

The firm's net return on worker human capital will be the worker's gross value to the firm less the wage or

$$V - W = H + h - \big(H + (1 - \beta)h\big) = \beta h \tag{2}$$

Therefore, firms only make excess returns on the firm-specific human capital, h, and not H.

With no uncertainty about the value of the worker inside or outside the firm, the employment relation can go on indefinitely. The existence of separations that were not planned from the beginning implies that the *ex post* realized net value of the job to the worker or the firm must differ from the *ex ante* expected value. Quits occur when the worker's productivity outside the firm rises sufficiently so that wages elsewhere turn out to be higher than the wage in the firm. Layoffs occur when the worker's value in the firm falls to a level such that the worker's wage exceeds the worker's value.

To make these statements precise, define the value of the specific human capital as $(h + \phi)$ where ϕ has mean zero and density $f(\phi)$. Thus, h may be viewed as the expected value of specific human capital in the firm and $h + \phi$ is the *ex post* realized value. Productivity shocks can occur in other firms as well. Let the opportunity wage in other firms be $H + \theta$ where θ has a zero mean and density $g(\theta)$. As above, H may be viewed as the anticipated wage outside the firm and $H + \theta$ is the *ex post* realized opportunity wage.

Hashimoto (1982) argued that the wage may remain fixed as defined in (1), even when the shocks occur. Renegotiation may be very costly. In addition, asymmetries in information in which firms know ϕ and workers know θ may make it difficult for the two parties to change the wage conditional on θ and ϕ.

Quit Condition

Assuming wages remain fixed as in (1), a worker will quit the firm when the opportunity wage rises above the worker's contracted wage in the firm. This occurs when

$$H + \theta > W = H + (1 - \beta)h,$$
$$\text{or} \quad \theta > (1 - \beta)h$$

(3)

Quits occur when the unexpected wage increase in other firms is larger than the worker's expected return from specific training.

Layoff Condition

The firm will dismiss workers when the firm's net return on the specific training turns out to be negative. The firm's *ex post* value of production from the worker is $\hat{V} = H + (h + \phi)$. This will be less than the contracted wage when

$$\hat{V} - W = H + (h + \phi) - (H + (1 - \beta)h) < 0,$$
$$\text{or} \quad \phi < - \beta h$$

(4)

This condition implies that the firm will lay off the worker when there is a negative productivity shock in the firm that is larger in absolute value than the expected value of specific training to the firm.

Comparative Statics

It now remains for us to relate these conditions to observed quit rates and layoff rates in the firm. These can then in turn be related to the share of investment in specific training. The probability of a quit, q, is given by

$$Pr(q) \ = \ Q \ = \ \int_{(1-\beta)h}^{\infty} g(\theta)d\theta \tag{5}$$

and the probability of a layoff, ℓ, is given by

$$Pr(\ell) \ = \ L \ = \ \int_{-\infty}^{-\beta h} f(\phi)d\phi \tag{6}$$

These integrals in turn imply that

$$\frac{dQ}{d\beta} \ = \ hg([1-\beta]h) > 0 \tag{7a}$$

and

$$\frac{dL}{d\beta} \ = \ -hf(-\beta h) < 0 \tag{7b}$$

Therefore, given some fixed level of specific human capital, h, the quit rate is directly related and the layoff rate is inversely related to the firm's share of the investment in specific human capital. However, cross-sectional information on quit rates alone will not be enough to measure firm investments in specific human capital. In general, the level of h will differ across firms, as will firm's share of the investment in h. As h increases, both the layoff rate and the quit rate fall, other things equal. Taking the derivatives of (5) and (6) with respect to h,

$$\frac{dQ}{dh} \ = \ -(1-\beta)g([1-\beta]h) < 0 \tag{8a}$$

and

$$\frac{dL}{dh} \ = \ -\beta f(-\beta h) < 0 \tag{8b}$$

Ignoring turnover due to death, injury or retirement, the separation rate for the firm is S = 1 - [(1-L)(1-Q)]. The total investment in specific training by both the firm and the worker is inversely related to the firm's separation rate. Applying the signs from (8a) and (8b),

$\frac{\partial S}{\partial h} = (1-Q) \frac{\partial L}{\partial h} + (1-L) \frac{\partial Q}{\partial h} < 0.$ As h increases, both the firm and the worker will have a greater incentive to maintain the employment relationship. However, there is no unambiguous relationship between the separation rate and the firm's share of h because

$\frac{\partial S}{\partial \beta} = (1-Q) \frac{\partial L}{\partial \beta} + (1-L) \frac{\partial Q}{\partial \beta}$ which has an ambiguous sign. As a result, firms with low separation rates will not necessarily have higher quasi-holdings of firm-specific human capital. This may explain why studies have found inconsistent effects of firm turnover or training on measures of firm financial performance: low S signals high h, but not necessarily high β. The returns to h could be going to the workers in the form of higher wages rather than to the firm.

A Measure of Firm Quasi-holdings of Human Capital

The coefficient, β, is a direct measure of the firm's share of the match-specific human capital, h. It can be shown that β varies directly with the ratio of quits to separations, even if it has an ambiguous relationship with the overall separation rate. The conditional probability of observing a quit, given that a separation has occurred can be written (QS)/S, where the numerator is the joint probability of a quit and a separation, and the denominator is the probability of a separation, S. Because all quits are separations, (QS) is equal to the probability of a quit, Q. Thus, the probability of a quit, conditional on the existence of a separation is Q/S. The derivative of (Q/S) with respect to β is

$$\frac{d(Q/S)}{d\beta} = S^{-2} \left[S \frac{dQ}{d\beta} - Q \frac{dS}{d\beta} \right]$$

Substituting in S = 1 - [(1-L)(1-Q)] and using equations (7a) and (7b),

$$\frac{d(Q/S)}{d\beta} = S^{-2}\left[L\ \frac{dQ}{d\beta}\ -\ Q(1-Q)\ \frac{dL}{d\beta}\right] > 0$$

Thus, a cross-sectional regression of long-term firm profit rates on a measure of the long-term

separation rate, S, and the ratio of long-term quits to separations, Q/S, should reveal a positive

coefficient on Q/S. The sign on S cannot be predicted.

Efficient Separations

It is important to emphasize that the positive effect of Q/S on profits only occurs if there

are transactions costs that prevent the firm and the worker from renegotiating the wage in the

posttraining period. If the wage can be renegotiated, the firm and worker shares can be

recontracted so that only efficient separations will occur. That is, separations will happen when

the worker's gross value outside the firm, $H + \theta$, exceeds the worker's gross value inside the

firm, $H + h + \phi$. This separation condition reduces to the relative size of the expected joint

surplus shared by the firm and worker, h, compared to the shock to worker productivity outside

the firm net of the shock to worker productivity inside the firm:

$$h < \theta - \phi \tag{9}$$

This separation condition is no longer dependent upon β, so efficient separations are not

dependent on the firm's or worker's share of the surplus generated by the match. The

implication is that both the firm and the worker would be willing to initiate a separation when

condition (9) holds. The quit-layoff distinction disappears.[7]

2. Graphical Illustration

Figure 1 illustrates the role of fixed wages and firm-specific human capital in generating turnover. If there is a fixed sharing rule on returns to investment in firm specific human capital, then firm returns are given by βh and worker returns by $(1-\beta)h$. According to inequality (4), the firm lays off the worker when a negative productivity shock exceeds βh in absolute value. With fixed wages, layoffs occur to the left of the line defined by $\phi = -\beta h$. According to inequality (3), the worker quits when a positive shock to worker opportunity costs exceeds $(1-\beta)h$ in absolute value. With fixed wages, quits occur above the line defined by $\theta = (1-\beta)h$.

Not all of these separations are efficient. By condition (9), separations are efficient when $h < \theta - \phi$, which happens to the northwest of the line defined by $\theta - \phi = h$. Therefore, fixed wages result in regions of inefficient quits and inefficient layoffs. The relative size of these regions of inefficient quits and layoffs yield information on the firm's share of the match specific human capital, β.

Suppose that firm 1 and firm 2 have identical stocks of match-specific human capital: $h_1 = h_2 = h$. Suppose also that the firms have identical net revenues, $R_1 = R_2 = R$. Total assets, $\beta_i h + K_i$, are also equal between the two firms, but firm 2 invests more in human capital $\beta_2 > \beta_1$ and firm 1 invests more in physical capital ($K_1 > K_2$). True rates of return, $R_i/(\beta_i h + K_i)$, will be the same across the two firms, but firm 2 will have the higher observed ratio of net revenues to physical assets, R_i/K_i. However, as shown in Figure 2, the higher ratio of R_i/K_i in firm 2 can be explained by a higher ratio of quits to separations in firm 2. Because $\beta_2 > \beta_1$, firm 2 has a larger region of inefficient quits (region 1 and part of 5) and smaller region of inefficient layoffs (region 2 and part of 5). The ratio of quits to separations for firm 2 will be

larger than for firm 1, even though the overall separation rate is the same for the two firms. As a result, firm 2 will have a higher ratio of quits to separations and a higher ratio of net revenue per unit of physical capital.[8]

3. Empirical Formulation and Data

We wish to test the relationship between long-run firm return on assets and our measure of firm investments in human capital. For this purpose, we used a ten-year average of firm net return on assets. This period should be sufficiently long to prevent business cycles from clouding our measure of long-run returns.[9] It should also be long enough to prevent cyclical or transitory labor market shocks from influencing our measures of long-term quit or layoff rates.[10]

That a firm could have a ten-year average return significantly above the market norm has been commonly viewed as evidence of monopoly power by the firm. Conversely, union power has been used to explain why firms may have lower than average long-run returns. Our contention is that differences in firm investments in specific human capital might also explain these differences in long-term return on assets. The book value of firm assets only measures physical assets and not human capital assets that may be tied to the firm. Hence, firms with large quasi-holdings of human assets will have higher measured return on physical assets.

Our primary information on firm financial performance was derived from COMPUSTAT. We measure the firm's physical capital stock by the book value of its capital assets (BV). As noted above, this measure ignores firm's quasi-holdings of human capital, so there will be an upward bias in measures of firm rates of return on total assets.

We use two measures of firm profits. Net income (NI) is directly available from COMPUSTAT. Cash flow (CF) is measured as net income plus depreciation and amortization

expenses. Our measured profit rates are (NI/BV) and (CF/BV), expressed as percents. The two measures are highly correlated (.89) and yield similar results in the analysis to follow.

A second measure of the firm's assets is the market value of common stock (MV). In principle, MV need not be biased downward in the presence of high firm quasi-holdings of human capital. If the value of firm quasi-holdings of human capital are fully capitalized in the stock price, there should be no systematic relationship between long-term measures of returns relative to the market value of common stock ((NI/MV) or (CF/MV)) and firm quasi-holdings of human capital. On the other hand, if the firm's future returns to its quasi-holdings of human capital are not fully capitalized in the firm's stock price, then a positive relationship between firm quasi-holdings of human capital and net returns to market value may remain.[11]

Tobin's q, measured by (MV/BV), has been advanced as a superior estimate of firm rents attributable to market power or other firm-specific factors (Lindenberg and Ross 1981). The argument is that the stock price reflects the discounted stream of future profits per share, and so it better reflects long-term firm profits than do annual measures of CF or NI. It has been commonly used in studies of market concentration or union density on firm profits.[12] In our application, the denominator will not capture the firm's quasi-stock of human capital, while the numerator may, at least partially, capture the capitalized value of the flow of returns from that human capital. Therefore, we would expect Tobin's q to be biased upward in the presence of high quasi-stocks of human capital.

The precise definitions and sample statistics for the five measures of return on assets are reported at the top of Table 1, while the related information on the regressors are reported at the bottom of Table 1. The ten-year averages of these measures of return on assets were taken over

the period 1973 through 1983. The choice of time period for the study was dictated by the availability of data on turnover and industry health. There is no systematic collection of data on firm quits and layoffs. The closest equivalent was data on three-digit manufacturing industry quit rates and separation rates available from the Bureau of Labor Statistics' *Employment and Earnings*. The data were discontinued in March, 1981.[13] Our measure of Q/S is the ten-year average of the quit rate relative to the separation rate for all employees in the three-digit industry over the 1971-1981 period. The separation rate $S = \{1 - (1-Q)(1-L)\}$ where L is the layoff rate. This measure excludes separations for other reasons including death, permanent disability, retirement, military services, and terminations for cause. None of our results are sensitive to the use of this narrower measure of S versus the total separation rate.[14] Our implicit assumption is that large firms in the same 3-digit industry use similar production processes and labor contracts and have similar turnover rates.[15] This assumption is supported by evidence presented by Neal (1995) and Parent (2000) that much if not all of a worker's return to job tenure is due to industry-specific rather than firm-specific tenure.

COMPUSTAT reports firm Standard Industrial Classification (SIC) by product line as well as an SIC for the firm as a whole. Many firms have multiple product lines and multiple SICs, and the firm SIC may not reflect a majority of firm sales.[16] Therefore, we need to create a means of relating industry-level data to the firm. Let X_{jk} be the kth industry-level value for variable X_j. Let the ith firm's business share in industry k be ω_{ik}. Then the firm's prorated value of the variable would be

$$x_{ij} = \sum_{k=1}^{K} \omega_{ik} X_{jk}$$

where there are k possible industries. Business shares were alternatively measured by

$$\omega_{ik}^{a} = \frac{a_{ik}}{A_{i}}$$

$$\omega_{ik}^{Y} = \frac{y_{ik}}{Y_{i}}$$

(10)

where a_{ik} is assets in the kth line of business, y_{ik} is sales in the kth line of business, and A_{i} and Y_{i} are firm total assets and firm total sales respectively.

The sample size was dictated by the need to combine information from the COMPUSTAT lines of business data, which was initiated in 1973, with the turnover data from *Employment and Earnings*. Because turnover was only reported for manufacturing industries, we required information on publicly held firms whose lines of business were all in manufacturing, and for which ten years of information could be obtained from COMPUSTAT over the 1973-1983 period. Of the 800 largest publicly held firms as listed by *Forbes Magazine* in 1983, 250 had the necessary 10 years of COMPUSTAT data with all lines of business in manufacturing, and they make up the sample analyzed in this study. The other regressors are also based on share-weighted sums of industry data. We concentrated on measures of industry market structure or union density, the factors commonly presumed to explain variation in long-term profitability. Four measures were taken from the 1982 *Census of Manufacturers*. The number of firms in the four-digit industry, N, was used as a measure of industry concentration.[17] The expected sign is negative, since, industries with more firms will be subject to greater competitive pressure. Two measures of entry barriers to the industry were also used. LABINT is a measure of the labor intensity of production, taken as the ratio of total payroll to the value of shipments. The expected

sign is negative since entry should be easier in industries with a greater proportion of production expenses in variable inputs. SIZE is the average size of firm in the four-digit industry, taken to be the value of shipments per firm. This should be positively correlated with profits as entry should be more difficult in industries with larger scale of operations. We used the change in the industries' value of shipments from 1972 to 1982, GROWTH, to measure shifts in the demand for firm production. This also should be positively correlated with firm profit.

Many previous papers have shown that profit rates are lower in more heavily unionized firms.[18] We had access to two measures that could be integrated with the firms. use the three-digit industry-level unionization rates developed by Kokkelenberg and Sockell (1985) over the period 1973 through 1981. However the industry designations in the Kokkelenberg-Sockell data only imperfectly matches the SIC codes used in COMPUSTAT and their union density measures exclude professionals and managers from the base. To check for possible biases in using a noisy union density measure, we employed firm-level union estimates provided to us by Professor Barry Hirsch. The latter data avoid measurement error but were not available for 29 percent of the firms.

The last control is a measure of average education levels in the industry. The measure is included because education, training, and turnover have been shown to be correlated and we want to purge our estimated effect of Q/S on measured profit of possible missing variables bias. There are conflicting predictions regarding the impact of general skills on firm long-term profits.[19]

The estimated model is

$$R = \gamma_0 + \gamma_1 (1-S) + \alpha_1 Q/S + \alpha_2 H + \Sigma\delta_i M_i + e$$

where R is the measure of firm returns, the α's, γ's and δ's are parameters, the M_i are the five measures of market structure, and Q/S and H are the measures of firm investments in specific human capital and the level of general human capital. The firm's retention rate, 1-S, is included as a measure of the level of h, but is not itself a measure of firm investment since high values of 1-S can also be due to high worker investments in specific training. The theory suggests that $\alpha_1 > 0$ in the regressions using book value as the measure of firm assets. If stock prices will capitalize firm holdings of physical and human capital assets, then α_1 will be zero. If firm quasi-holdings of human capital are not fully capitalized, then α_1 will still be positive.

4. Long-run Profits in Low and High Q/S Industries

To illustrate how profits vary by our measure of worker attachments to firms, we aggregated our firm data into three "industries," low, medium and high Q/S. The low Q/S industry is made up of firms in the lowest quartile of the distribution of Q/S; medium Q/S by the middle two quartiles; and high Q/S by the highest quartile. We repeat the exercise using asset weights and sales weights to aggregate industry-level data by firm line of business. The results are reported in Table 2.

Firms in industries with the highest Q/S have average measured firm profits that exceed the bottom quartile firm average by one half using net income to book value, by one-third using cash flow to book value, and by 45 percent using Tobin's q.[20] The hypothesis that average long-term returns on book value of assets were equal across the top and bottom Q/S quartile firms was

easily rejected for these three measures. If market investors fully capitalize these quasi-holdings of specific human capital in valuing the firm's stock price, then the market value of common stock will incorporate both physical and human assets, and the upward bias in measured firm rates of return will disappear. Results in the last two columns of Table 2 are consistent with that conjecture. Although (NI/MV) and (CF/MV) are still higher in the highest versus the lowest Q/S industries, the null hypothesis of equal returns could not be rejected. Results were not sensitive to the method used to place firms into industries.[21] We conclude that quasi-holdings of human capital do bias upward measures of returns to capital assets, and that the stock market values these quasi-holdings at least in part. We test these preliminary conclusions more rigorously in the next section.

5. Regression Analysis

Table 3 reports the results from estimating equation (10) using the asset-weighted aggregations across firm lines of business. Sales-weighted aggregations yielded similar results. Several studies have shown that training is positively correlated with firm size, employee education levels and capital labor ratios and negatively related to union representation.[22] Similarly, turnover has been shown to be correlated with these variables. Consequently, controls for these measures are necessary to insure that the bivariate analysis of Table 2 is not capturing returns to measures correlated with long-term attachments or training. Columns labeled A use 3-digit industry level data to indicate union density, while those labeled B use firm-level data.

Moulton (1990) shows that when aggregate industry data are used as regressors in firm-level analysis, the estimated coefficients will be consistent but the estimated standard errors will be biased downward. The bias is greater, the larger the number of firms in each group facing the

same industry aggregates. In our data set, two-thirds of the firms have multiple lines of business that cross industry lines, and so they have unique industry aggregates as regressors. Of the remaining one-third of firms with a single line of business, half were the only firm in their industry. Consequently, only one-sixth of our sample involves multiple firms in the same industry.

To investigate the possible magnitude of the downward bias in the standard errors, we reestimated the model excluding all industries with multiple firms. Noting that the smaller sample size would also tend to raise the standard errors, none of the qualitative results changed. The standard errors on the coefficient on Q/S averaged 4 percent higher across the five regressions when the industries with multiple firms were dropped. Consequently, the bias from the use of industry data appears to be small in the present application.

We first discuss the columns labeled A which use the larger data set but with industry-level measures of union density. The first two measures of firm rates of return are ten-year averages of net revenue per dollar of book value of physical assets. The third is Tobin's q which also uses BV as the measure of the asset base. The last two use the value of common stock as the asset base.

Turning to the first two measures of returns to book value of assets, the model fits are comparable to other cross-sectional estimates explaining long-term return on assets.[23] Holding measures of market structure and union status constant, the coefficients on Q/S are consistently positive and precisely estimated. Elasticities evaluated at sample means varied from 0.3 to 0.5, suggesting that measured firm long-term profits are quite sensitive to cross-sectional variation in Q/S. The estimates imply that firms in industries at one standard deviation below mean Q/S have

estimated long-run returns that are about 1.8 percentage points below firms in industries at one standard deviation above mean Q/S, other things equal.

We can generate an upper-bound estimate of the extent to which ignoring quasi-holdings of human assets inflates observed firm returns. Suppose there are two firms whose true returns on assets are identical and equal to the sample mean. Firm 1 has no human capital quasi-holdings and firm 2 has values of Q/S equal to twice the standard deviation of Q/S. Estimates imply that the observed return on physical assets for firm 2 will be 1.8 percentage points above firm 1. In the scenario presented, the amount of quasi-holdings of firm-specific human capital in firm 2 necessary to equate true returns in the two firms would be 13 to 19 percent of total physical and human assets in firm 2.[24]

Results using Tobin's q yield similar conclusions regarding the role of Q/S in explaining cross-sectional variation in long-run returns. Firms one-standard deviation above mean Q/S have a Tobin's q measure that is 0.19 or 15 percent above that of otherwise identical firms that are one standard deviation below mean Q/S.

In columns headed by B, we repeat the exercise with firm-level measures of union density. If measurement error in union status is correlated with our turnover measure, Q/S, it is possible that our estimate of the impact of long-term attachments on firm profits will be biased. However, we lose 29 percent of the sample because of missing firm-level union data which may create its own bias. The estimated coefficient on Q/S remains positive but loses size and significance in the regressions explaining Tobin's q, but they increase in magnitude and significance in the other two specifications. Therefore, our results do not appear driven by our use of industry level measures of union density.

Theory does not generate a prediction on the sign of the retention rate, (1-S). The retention rate varies directly with firm-specific human capital, h, but the returns could go to the worker or the firm. The estimates on (1-S) are consistently negative in the specifications using BV as the firm's asset base, but the estimates are not precisely estimated.

Of the regressors that control for industry market structure, the most consistent results are for union density and labor intensity. Firms in industries with greater union density and with more labor intensive production processes had lower long-run returns to book value of assets. The other variables had inconsistent and/or imprecisely estimated effects.

When we use the market value of common stock as the measure of the firm's assets, the fit of the equation falls by half. This is expected, as the stock market price should capitalize the value of firm market power, union strength, and other factors that affect the firm's stream of future earnings. The magnitude of the coefficients in the last four columns are generally smaller in magnitude to their counterparts in the first four columns. Nevertheless, the coefficients on Q/S remain positive and have some power to explain variation in long-run returns to the market value of common stock. The coefficients increase in size and significance when the firm-level union density measure is used.

Because rational expectations theory suggests that there should be no variables that systematically explain long-run returns on the market value of common stock, regressions such as those in the last four columns must be interpreted with caution. By definition, the model is composed of numerous spurious regressors. Nevertheless, the results are consistent with the presumption that firm quasi-holdings of specific human capital are partially but not fully capitalized in MV. The estimated coefficients are one-quarter to one-half as large as when book

value is used as the asset measure. Firms with Q/S one standard deviation above the mean have long-term returns on market value that are about one percentage point higher than returns at firms one standard deviation below the mean. A plausible explanation is that firms with high asset shares in quasi-holdings of human capital have greater risk of asset loss than do firms with high asset shares in physical capital, and thereby require a risk premium over normal profit.

In the models of Acemoglu and Pischke (1998, 1999), it is possible that the firm can get a return on general training if labor is not perfectly mobile. In the earlier regressions, average years of education have a positive but small and imprecise effect on net income or cash flow, but had a large positive impact on the market value of common stock. In the regressions that use cash flow or net income in the numerator and market value of common stock as the measure of firm assets, the implied firm return on assets are lower in industries with high education levels. Numerous studies have pointed to the 1970s as a period of atypically low returns to education for workers (Gottschalk 1997). Our results suggest that the 1970s were also a period of atypically low returns to education for firms.

6. Conclusions

Numerous empirical studies have quantified individual rates of return to human capital investments and long-term attachments to a firm. Because these long-term attachments can generate a stream of earnings above what the firm could earn if it continually recontracted with new workers, the long-term attachment can be viewed as a human capital asset quasi-held by the firm. Firms with atypically large quasi-holdings of human assets will have inflated long-term rates of return on physical assets.

This study proposes an observable measure of firm quasi-holdings, the ratio of quits to separations conditional on the overall separation rate. Unfortunately, long-term measures of quits and separations are not available at the firm level, so we used three-digit industry turnover data matched with firm lines of business to approximate firm-level turnover measures. The use of industry-level measures is consistent with findings by other researchers that industry-specific tenure is more important in explaining wage growth for workers than is firm-specific tenure. The measure performs as predicted by the theory: firms in industries with high Q/S had systematically higher long-term return on physical assets. Those firms had smaller premia on long-term returns on market value of common stock, suggesting that the market partially values firm quasi-holdings of human capital.

This study does not pinpoint the source of firm quasi-holdings of human capital, but any strategy that retards worker mobility would raise incentives for the firm to invest in their workers and thus contribute to a higher value of Q/S. Likely factors include firm-specific training, pension or benefit policies, deferred payment mechanisms, and human resource practices that generate worker loyalty.[25]

Analysis of firm takeovers by Ravenscraft and Scherer (1987) found that takeover targets have disproportionately high return on assets before the takeover and disproprotionately low return on assets afterwards. Explanations have included the winner's curse, the cost of debt obligations incurred during the takeover, and even the speculation that empire building CEOs put ego over business in acquiring firms. The analysis herein suggests another possibility--layoffs that may accompany mergers and acquisitions may shed firm quasi-holdings of human capital that are not counted among the firm's assets but are nevertheless sources of a stream of potential

earnings.[26] Lichtenberg and Siegel (1992) found that mergers occurring after the period studied by Ravenscraft and Scherer were more successful, but those mergers also involved less shedding of labor (McGuckin and Nguyen 2001). Our analysis suggests that future research should explore the long-run cost to firms of shedding labor.

A definitive test of the linkage between firm turnover and long-term firm profitability would require firm-level data on turnover. If labor turnover can affect the market value of the firm, it would be reasonable to require such data on the firm's financial statements, similar to the treatment of changes in physical assets of the firm. Examples cited in Bassi et al. (2000) suggest that efforts to get firms to provide information on human capital investments on a voluntary basis have proven unsatisfactory. The recently initiated JOLTS survey by the U.S. Department of Labor may enable such analyses if firm-level data is made available to researchers.

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Endnotes

1. There are numerous other explanations for the apparent positive relationship between wages and tenure. Prominent examples include models of deferred compensation in which a rising wage profile increases work incentives for younger workers, tournament models in which executive prizes induce productive competition at lower levels, and sorting models where high productivity workers are hired by high wage, stable firms and low productivity workers get low wage, unstable jobs. Good surveys of these models include Hutchens (1989), Carmichael (1989), and Lazear (1995).

2. Several studies have compared the effects of training on wage growth and a supervisor's evaluation of worker productivity growth. Productivity rises much more rapidly than wages, suggesting that firms get most of the return from training. See Barron, Berger and Black (1997, Chapter 6) for a review of these studies. The lack of objective output measures makes it difficult to assess if the rapid productivity growth is real or perceived. Bartel (2000) reports on 16 firm studies of their own estimated returns to training. Reported rates of return varied from 100 percent to 5900 percent. It is not clear how generalizable these findings are as firms would not report failed training programs.

3. Antel (1985) previously exploited the theoretical distinction between quits and layoffs in his study of how tenure affects wage growth.

4. Recently, the U.S. Department of Labor has reintroduced turnover reports through their Job Openings and Labor Turnover Survey (JOLTS). These statistics have only been available for two years, so it will be several years before long-term turnover rates can be computed. In addition, statistics are reported only for very aggregated one-digit industry divisions, so they may not be suitable for firm-level hypothesis tests unless the firm-level data are made available. Another possibility suggested by a referee would be to use three digit industry-level estimates derived from the Panel Study of Income Dynamics, but resulting thin samples for some industries would necessitate concentrating only on firms in the largest industries.

5. While the theoretical and empirical discussion is couched in terms of specific human capital, the model can also be motivated in terms of firm-worker matches. Then, h is the expected value of the match between the firm and the worker, net of the worker's productivity elsewhere.

6. With frictions in the labor market that limit worker mobility, general human capital behaves much like the specific human capital in this model. Firms will have an incentive to invest in general training and turnover will be inversely correlated with general training (Acemoglu and Pischke 1998, 1999). In their framework, our h would include immobile general human capital as well, while H would be the opportunity wage net of mobility costs.

7. McLaughlin (1994) derives a model in which turnover is efficient but quits vary inversely with worker returns from the firm match. In that model, however, firm profits and worker wages

covary positively, so quits decrease with firm profitability. In this model, quits increase with firm profitability, holding the overall separation rates fixed.

A referee pointed out that if the firm faced separation costs due to mandatory severance or experience rated unemployment insurance, it would be possible for the firm to offer even more than $h + \phi$ to retain the worker so that the firm's share, $\beta < 0$. In that case, the quit rate would be inversely related to profitability, consistent with the McLaughlin model.

8. This distinction depends on the existence of costly renegotiation on β, given revealed information on θ and ϕ. If renegotiation is allowed, both firm 1 and firm 2 would only experience efficient separations to the northwest of the line, $\theta - \phi = h$.

Our model does not allow hold-up which could allow the worker to extract excess surplus from the firm. MacLeod and Malcomson (1993) suggested that restrictions on recontracting such as with long-term union contracts could result in more efficient contracts because they might eliminate the possibility of inefficient hold-up. It is commonly found that unions lower profitability, so it seems that they do not prevent workers from extracting firm surplus. In unreported estimates, we examined whether the apparent profitability of our Q/S term increased with union density and found no systematic evidence suggesting that pre-commitment to fixed contracts made firms more profitable.

9. Several studies have examined how quickly excess profits revert to the norm. Findings suggest that reversion to the norm occurs, but excess profits do indeed persist. The U.S. also appears to have greater persistence in long-run profit differentials across firms. Schohl's (1990) plotted path to long run profit levels appears to take between two to six years with more rapid convergence to the long run in Japan and Germany than in the U.S. Waring (1996) found that average persistence was 2-3 years in the U.S., with a few industries with very slow convergence. These findings suggest that our ten-year averages of profit should be reasonable estimates of long-run average profits.

10. Carrington's (1996) analysis of labor market responses to large positive or negative shocks associated with the Alaska pipeline construction suggested that the return to long-run paths occurs within two years.

11. One obvious reason why investors may not fully value firm quasi-holdings of human capital is that these human assets are more mobile. In the event of a hostile takeover, for example, the physical assets remain fixed but the human assets may leave. This explanation has been advanced for the rarity of hostile takeovers in the human capital intensive software and high technology industries (Mangalinden, Clark, and Sidel, 2003).

12. See for examples, Smirlock, Gilligan and Marshall 1984, Lustgarten and Thomadakis 1987, or Hirsch 1990, 1991.

13. Farber (1999, p. 2444-5) discusses these data.

14. The correlation between the narrower and broader measures the separation rate is 0.995.

15. The 1976 *BLS Handbook of Methods for Surveys and Studies* stated that the sampling for the turnover data was biased toward large establishments, so that establishments with over 250 employees were sampled with certainty. Consequently, industry averages would more closely reflect patterns in large firms.

16. In the sample, one firm had 10 lines of business. The firm SIC often represented less than one-third of firm sales.

17. This measure performed much better than more common measures (e.g. Herfindahl indices or four-firm concentration ratios) in explaining variation in long-term profit rates. Waring (1996) also found that number of firms explained profit persistence better than did other measures of concentration. Virtually identical cross sectional patterns in industry concentration measures were obtained when we averaged the 1972, 1977, and 1982 Census of Manufacturers data.

18. Addison and Hirsch (1989) present a review of numerous studies which find that unions lower profits and firm growth. Hirsch (1991) also finds sizable negative union impacts on profitability.

19. The literal interpretation of equation (2) is that firms should not generate excess returns to general human capital unless the firm can restrict worker mobility. However, recent papers by Acemoglu and Pischke (1998, 1999) present evidence that such frictions are sufficiently large to allow firms to invest in general training and Barron, Berger, and Black (1997) found that firms do indeed invest in general training. Acemoglu and Pischke's 1998 paper, which allows for endogenous quits, predicts that the high training equilibrium will have low quits, while the low training equilibrium would have high quits, the opposite of our model's prediction that high quits relative to separations will be positively correlated with the firm's share of the investment in human capital.

20. Bassi et al. (2000) report that in a sample of 67 firms, those with higher training expenditures in 1996 also had higher ratios (2.77 versus 2.42) of market to book value in 1996. This could be viewed as a short-run variant of our long-term tests in Table 2, although they do not report if the differences are significant.

21. Similar results were obtained when we placed firms into industries based on main line of business rather than weighted lines of business.

22. See Lynch and Black (1998) or Frazis, Gittleman, and Joyce (2000) for analyses of who gets training.

23. Although their measures of long-term profit differ from ours, similarly specified regressions in Mueller (1990) and Waring (1996) had similar R^2.

24. To derive the necessary level of h, fix the true rate of return in both firms at μ per dollar of total assets. We use estimates of observed average long-run returns in Table 1 as our measure of μ. The observed rate of return on physical assets in firm 2 is $\frac{\mu}{1-h}$ which is 1.8 higher than the return in firm 1. The value for h is derived by solving $\left(\mu = \frac{\mu}{1-h} - .018 \right)$ for h.

25. In response to a referee's suggestion, we used information on pensions provided by David MacPherson as an additional regressor to see if missing pension information was correlated with Q/S. None of our conclusions changed, although we did not get many matches. Dorsey, Cornwell, and MacPherson (1998) show that pensions are tied to higher firm productivity.

26. There is a limited literature on the impact of change of ownership on employment. Lichtenberg and Siegel (1992) found that layoffs are concentrated in the year of the takeover and prior years. McGuckin and Nguyen (2001) found no shedding of labor on average from mergers, but that mergers involving bigger plants did involve layoffs.

Table 1: Sample Statistics and Definitions of Variables[a]

Variable				
Endogenous				
NI/BV	Average Net Income to Book Value of Assets, 1973-83, in percent	7.54		
		(3.83)		
CF/BV	Average Cash Flow to Book Value of Assets, 1973-83, in percent	12.08		
		(4.07)		
NI/MV	Average Net Income to Market Value of Common Stock, 1973-83, in percent	5.79		
		(2.35)		
CF/MV	Average Cash Flow to Market Value of Common Stock, 1973-83, in percent	9.55		
		(2.98)		
q	Tobin's q, measured by MV/BV, 1973-83	1.29		
		(.49)		
Exogenous		Asset Weights[b]	Sales Weights[b]	
Q/S	Ratio of Quits to Separations, 1970-81	.609	.603	
		(.14)	(.14)	
1-S	One minus the separation rate, defined by {1- (1-L)(1-Q)}, 1970-81	.976	.976	
		(.01)	(.01)	
EDUC	Average Years of Education, 1973-83	12.69	12.68	
		(.22)	(.26)	
N	Number of Firms in the Industry (in ten thousands), 1982	.385	.331	
		(1.19)	(1.10)	
LABINT	Average Labor Intensity, 1982	.186	.186	
		(.10)	(.11)	
SIZE	Average Shipments Per Firm (in 100 million dollars), 1982	.642	.666	
		(1.60)	(1.61)	
UNION	Percent of Workers Belonging to Unions (Industry-level data), 1973-81	36.57	36.73	
		(15.6)	(15.0)	
UNION[c]	Percent of Workers Belonging to Unions in 1977 (Firm-level data)	34.0	34.0	
		(24.3)	(24.3)	
GROWTH	Ratio of Industry Shipments in 1982 Relative to 1972	3.36	3.32	
		(1.81)	(1.78)	

[a]Standard errors in parentheses.

[b]Firm i observation on the jth variable is approximated by $X_{ij} = \sum_{k=1}^{K} w_{ik} X_{jk}$, where there are K possible industries and w_{ik} is firm i's business

share in industry k. Business share in industry k is measured by share of firm assets or firm sales.

[c]Data provided by Barry Hirsch as used in Hirsch (1991).

Table 2: Firm Rate of Profit, by Low, Medium and High Q/S.

Q/S Level	$\dfrac{NI}{BV}$ [a]	$\dfrac{CF}{BV}$ [a]	q [a]	$\dfrac{NI}{MV}$ [a]	$\dfrac{CF}{MV}$ [a]
Asset Weights					
Lowest quartile	5.7	10.1	1.04	5.1	9.3
Middle two quartiles	8.0	12.4	1.31	6.1	9.8
Top quartile	8.4	13.4	1.48	5.8	9.4
Test of difference from lowest to highest[b]	3.65**	4.33**	5.16**	1.15	0.11
Sales Weights					
Lowest quartile	5.6	10.0	1.03	5.1	9.4
Middle two quartiles	8.0	12.4	1.32	6.1	9.7
Top quartile	8.6	13.5	1.49	5.9	9.5
Test of difference from lowest to highest[b]	4.30**	4.76**	5.90**	1.51	0.15

NI is net income; BV is book value of assets; q is Tobin's q; CF is cash flow and MV is market value of common stock.

[a]All measures are ten-year averages from 1973-1983.

[b]t-test of the null hypothesis of equality in mean returns between the lowest and highest quartile firms, allowing for unequal variances.

**indicates significance at the .05 level.

Table 3: Ordinary Least Squares Regressions of Ten-Year Return on Assets

	Dependent Variables									
	$\dfrac{NI}{BV}$		$\dfrac{CF}{BV}$		q		$\dfrac{NI}{MV}$		$\dfrac{CF}{MV}$	
Independent	A	B	A	B	A	B	A	B	A	B
CONSTANT	20.5	26.9	15.2	16.7	-3.21	-17.4	28.5	30.5	43.1	25.3
	(19.1)	(23.0)	(20.4)	(24.0)	(2.37)	(274.1)	(11.7)	(15.1)	(15.7)	(18.8)
Q/S	6.17	7.86	6.55	7.59	0.67	0.40	3.24	5.88	1.86	5.28
	(2.31)	(2.61)	(2.47)	(2.72)	(0.29)	(0.31)	(1.48)	(1.71)	(1.90)	(2.14)
1-S	-31.3	-51.9	-23.7	-37.1	-3.09	-5.81	-9.20	-15.8	10.7	15.6
	(19.6)	(21.6)	(21.0)	(22.6)	(2.44)	(2.58)	(12.6)	(14.2)	(16.2)	(17.7)
N	-0.43	-0.32	-0.36	-0.30	-0.04	-0.04	-0.20	-0.09	-0.09	-0.02
	(0.20)	(0.21)	(0.22)	(0.22)	(0.03)	(0.03)	(0.13)	(0.14)	(0.17)	(0.17)
LABINT	-3.95	-10.4	-1.67	-8.70	-0.21	-0.88	-1.54	-3.09	0.38	-1.10
	(2.61)	(3.77)	(2.79)	(3.94)	(0.32)	(0.45)	(1.68)	(2.47)	(2.15)	(3.09)
SIZE	-0.16	-0.122	-0.27	-0.25	-0.02	-0.02	-0.09	-0.06	-0.12	-0.12
	(0.16)	(0.18)	(0.17)	(0.18)	(0.02)	(0.02)	(0.10)	(0.11)	(0.13)	(0.14)
UNION	-0.047	-0.033	-0.033	-0.023	-0.005	-0.007	-0.017	-.002	-0.003	0.02
	(0.02)	(0.01)	(.021)	(.014)	(0.003)	(0.002)	(0.013)	(0.01)	(0.017)	(0.01)
GROWTH	-.270	-0.47	-0.15	-0.02	-0.01	-0.04	-0.10	-0.12	0.21	0.272
	(0.16)	(0.20)	(0.16)	(0.02)	(0.02)	(0.02)	(0.10)	(0.13)	(0.13)	(0.17)
EDUC	1.37	2.45	1.36	2.32	0.58	0.58	-1.73	-0.93	-3.61	-2.79
	(1.25)	(1.46)	(1.34)	(1.52)	(0.16)	(0.17)	(0.81)	(0.96)	(1.03)	(1.20)
N	250	177	250	177	250	177	250	177	250	177
R^2	.17	. 20	.15	.17	.21	.26	.08	.10	.07	.11
F(8,N-8)	5.97	5.41	5.43	4.30	7.92	7.35	2.73	2.38	2.18	2.59

Standard errors in parentheses.

NI is net income; BV is book value of assets; CF is cash flow, MV is market value of common stock, and q = MV/BV is a measure of Tobin's q.

Column A uses industry union density and column B uses firm union density figures provided by Hirsch (1991).

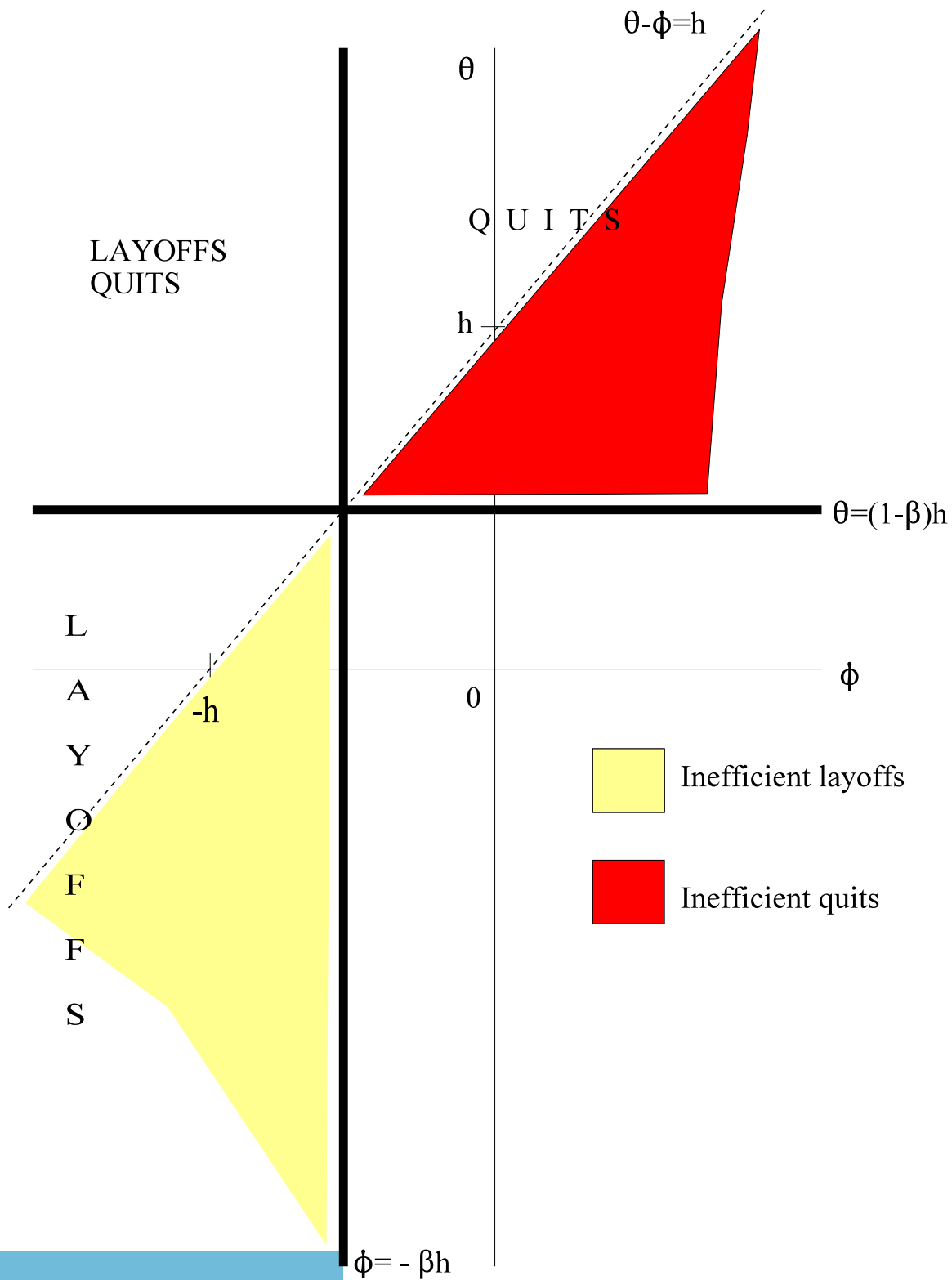Figure 1: Regions of Layoffs and Quits

Figure 2: Relationship of Quits to Firm Share of Return
to Firm-Specific Human Capital, β. Note: $\beta_2 > \beta_1$

$\theta-\phi=h$

θ

h

③

$\theta=(1-\beta_1)h$

④   ⑤   ①   ①

$\theta=(1-\beta_2)h$

②

ϕ

-h   0

① Quit in firm 2 without separation in firm 1

② Layoff in firm 1 without separation in firm 2

③ Quits or layoffs in firm 1 but only quits in firm 2

④ Quits or layoffs in firm 2 but only layoffs in firm 1

⑤ Layoff in firm 1 but quit in firm 2

②

$\phi=\beta_2h$ $\phi=\beta_1h$