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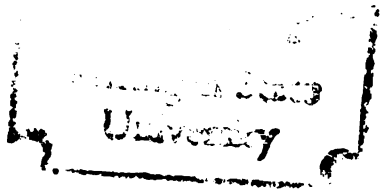

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UNION EFFECTS ON QUIT RATES AND TRAINING

By

Charles Livingston Shearer

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ABSTRACT

UNION EFFECTS ON QUIT RATES AND TRAINING

By

Charles Livingston Shearer

Prior studies have emphasized the way in which unions affect quit rates, but little research has been done on the effects of changes in the quit rate on training.

This study is an attempt to fill that void by providing a measure for training that does not depend on proxy variables, and by examining the factors that determine the amount of training received. Union voice affects the quit rate as do increases in wages. The objective is to determine to what extent unionization, and wage increases lower quits and in turn raise investments in firm-specific training.

Using a neoclassical model of the profit maximizing firm, the factors affecting the demand for labor and training are determined. From prior studies, we know that wage increases lower the quit rate. In addition, union voice plus wage increases combine to lower voluntary separations by employees.

In order to test the reaction by the firm on the amounts of training provided in response to a decrease in quits induced by union voice and wages, three regression equations are used. The functional form of the equations are:

$$Q = f(F, Acc, W, U, T, W \cdot U, T \cdot U)$$

$$T = f(W, L, Acc, N, U, Q, W \cdot U)$$

$$W = f(W, N, T, U \cdot T)$$

Where Q = the quit rate in industry i

F = the percentage of workers in industry i who are female

Acc = the number of additions to the work force per one hundred employees

W = the median wage and salary income

U = the proportion of employees covered by collective bargaining

T = the amount of training received by the employee

W·U = the interaction of wages and unionism

U·T = the interaction of unionism and training

N = the percentage of employees who are white

L = the layoff rate per 100 employees

Two sets of data are tested using two stage least squares techniques and a third set using ordinary least squares. The first two sets of data come from selected three-digit manufacturing industries for 1958 and from forty-two selected large SMSA's. The results

from the SIC data indicate that training does vary inversely with the quit rate. The SMSA results were less supportive because of the use of education as the measure of training.

A third set of data from the National Longitudinal Survey -- Mature Men -- was used to test a similar set of regression equations. Using ordinary least square techniques, the evidence suggests that lower quits stimulate less training. The kind of training offered by the firm is more oriented toward bringing the new worker up to par than to firm-specific training of currently employed workers.

Once the impact of the union through voice and wage benefits lowers the quit rate, the firm will experience lower employment costs. The firm then faces the decision of whether to provide more specific training of employees to achieve efficiency gains. These gains can then pay a return to the firm which helps to fund the costs of the training as well as to defray the costs of collective bargaining.

To my wife and family.

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INTRODUCTION

Traditional studies of quit-rate behavior in manufacturing industries have been based on relationships surrounding wages, unionization, and specific training in terms of their effects on the quit rate. Prior studies have emphasized one factor or another in relation to the quit rate, but none have presented a unified theoretical approach. While there has been some success in the past regarding research along these lines, there have been some shortcomings as well.

In this study we construct a model that includes a neoclassical approach to decision-making regarding the amount of training provided by the individual firm. The interaction of wages, quits, and training will be examined and tested to determine the validity of the functional relationships proposed. Those who have studied this area before have been clearly limited by the lack of an adequate measuring device to represent specific training. An alternative will be offered here and compared to one of the common proxy measures often used to measure specific training.

CHAPTER ONE

BEHAVIORIAL ASPECTS OF UNIONS, QUITS, AND WAGES

A. Exit-Voice

The exit-voice literature helped to explain the political role of the union within the structure of business enterprises. According to Albert O. Hirschman, the union negotiation is the main voice mechanism as well as a deciding factor in determining certain atmospheric aspects of work conditions.[1] Hirschman's approach stresses the power of collective voice and ensuing satisfaction. The union provides the vehicle for this action, yet the decision to quit (exit) remains an individual one.

The idea that the employer talks with employee representatives to understand their problems is voice at work. This alternative, it has been pointed out, is superior to experiencing high turnover rates as a means of finally recognizing that a problem exists. The work of Slichter, Healy, and Livernash supports this concept.[2] While few workers participate directly in determining their working conditions, their union participation gives them a feeling of belonging.[3]

Freeman summarized the union's role in this area by pointing out that "the reduction in quits will reduce labor turnover and training costs, and increase firm specific investments in human capital and possibly have efficiency gains."[4] Freeman has also attributed increased job tenure partly to the combined influence of voice and of industrial jurisprudence.[5] Although these conclusions are reasonable, the causal link between union and wages must be re-emphasized. Without the economic gains of collective bargaining, the exercise of voice alone will wear thin quickly.

When job vacancies occur due to quits, it is expected that the replacement will need some training. On the other hand, lower quits also mean more firm investments can be made in human capital and specific training. The union-voice argument enters the picture by lowering quits through the benefits derived and by making more firm specific investment desirable. The union-voice argument is sound only as long as identifiable benefits are derived. These benefits affect the quit rate, which then results in more training. The influence of wages and unionization on the quit rate have been examined separately in the past, but little effort has been directed to the flow of their interaction and to their effects on training.

B. The Union Influence

The study of the effect of unions on wages has a long history. Such research began with the well known work of H. Gregg Lewis. Since Lewis, several others have examined various aspects of union versus non-union wage differentials. Depending upon the nature of their study, some researchers have found large differentials. For some selected occupations, for instance, Frank Stafford reported union non-union differentials of 24 and 26 percent for craftsmen and operatives respectively.[6] In contrast, Daniel Hamermesh in 1971 observed that "The wage effect of unions of clerical workers in manufacturing is roughly five percent."[7] More recently, C. J. Parsley surveyed this issue and pointed out that the test of a union's strength on wages must be tempered with concern for employment trends, for the degree of concentration, and for the quality of labor.[8]

Throughout the literature, the evidence has pointed to a clear, although not always large, impact of unionization on wages. In more recent years, attention has been given to unionization as one of the determinants of the quit rate. While the exit-voice literature supports the role of the union in lowering the quit rate, the union also has a wage impact that affects the voluntary turnover rate.

The objective of our next section is to provide

support for the derivation of the quits function. The latter function will be used within the neoclassical model that follows later. Our goal is to test the proposition that the union affects the quit rate and that the quit rate in turn determines the amount and kind of training provided by the firm.

When the employer and the employee share the costs of training, both will suffer an investment return loss if separation occurs. A worker who shares the training costs will experience a loss if he voluntarily quits the job. From the employer's perspective, the lower quit rate indicates the desirability of investing in more firm specific training. Although the employee makes the decision to quit, the employer can only control this decision by making the opportunity costs of a voluntary separation as high as possible. The labor union and its inherent bargaining advantages represent one influence that can make the quit a less desirable alternative. The employer, given a choice, would prefer to have a non-union shop. Given the existence of a union, however, the voluntary quit rate is reduced because the union offers employees the opportunity to use the voice mechanism of the organization and the traditional wages and fringe benefits associated with the union. A reduction in the voluntary quit rate results in a higher return to training and in an employer who responds by providing more firm specific

training.

For the firm in a competitive market, the lower quit rate will result in an adjustment at the point where the returns from training equal the costs of training. Since the quit rate is a part of the training function, its reduction will mean a reduction in the costs of training. This reduction makes the expansion of firm specific training a desirable and profitable decision.

C. The Quits Function

Other researchers have focused attention on the impact of unionization on voluntary job separations. Pencavel's 1970 work on quit rates in manufacturing gave empirical credence to the role of the union in affecting the quit rate.[9] In Pencavel's quit rate regression, the union variable was significant. Using an activitism variable, Pencavel concluded decisively that the presence and militancy of unions affect the quit rate.[10]

Burton and Parker's study of determinants of 1960 interindustry variations in the quit rate revealed that the unionization variable was significant in their regression.[11] Going one step further, Burton and Parker noted that the inclusion of incentive variables in the second phase of their analysis destroyed the statistical significance of the regression coefficient

for unionization.[12] As they pointed out, the correlation between unionization and wages was not surprising.[13]

The prior empirical work on the relationship between unionization and quits justifies the inclusion of a unionism variable in the quits function. The correlation between unionization and quits described by Burton and Parker leads us down the path to the selection of wages as the second element making up the quits function.

In a 1972 study, Pencavel included wages in his quit-rate regression and found that his estimates supported the causation line from wage income to quits.[14] His 1970 study similarly established the effect on the level of wages on quits.[15] Parsons found the wage variable to be significant in a 1972 study that included quit rate regressions.[16] Burton and Parker included wages in their "incentive" category, and the results again proved significant. The decision to voluntarily leave one job in search of another is clearly affected by the wage rate. This finding allows us to identify the quits function at this point as dependent on unionization and wages, $q = q\ (U, P_L)$.

Little previous consideration has been given to the interaction of wages and unionization. It is known from earlier studies that there is a correlation between the two, but there has been no interaction term in a quits regression recognizing this relationship. In

short, there will be further discussion of this as movement is made toward the estimating equation for the quit rate regression.

D. Quits and Specific Training

In this discussion of specific training, I will begin by providing an overview of the background literature on this topic. Particular attention will be given to the relationship of quits to training, as well as to the relevant investment aspects of the employee and employer. Prior research has been limited by the inability to find an adequate measure of training. This gap has left researchers with a choice of proxy measures, and the alternative presented here does not fully solve the problem of measuring specific training. The shortcoming of inadequate training measures have been discussed by Hamermesh who has pointed out that "only through an accounting study can we discover how much general and specific training is being produced and what the distribution is across occupations and industries."[17]

The distinction between general and specific training was clarified by the work of Gary Becker.[18] Becker argues that "Employees with specific training have less incentive to quit ... than employees with no training or general training, which implies that quit rates are inversely related to the amount of specific

training."[19] It was this work that provided the foundation for the various studies of quits using age, length of service, wage and other independent variables in the regression equations.

Parsons used a series of variables to represent specific human capital.[20] In his conclusion, Parsons implies that quit rates will be lower in industries in which worker-financed specific investments are heavy.[21] One of the most common threads of measurement for specific training has been the wage rate. The inverse relationship between turnover rates and wages has been previously described by Oi (1962) and Pencavel (1970).

The assumption that the wage rate belongs as a proxy, or in a set of proxies for training, does limit the extent to which the correlation between wages and quits can be attributed to differences in training as well as other factors. The union has an impact on wages and quits that is equally important and that affects the training picture to some degree. These factors are part of the optimal union-wage-training-quit strategy utilized by a firm.

Determining the extent to which quits are affected by training depends upon the means by which training costs are financed. When the training is worker-financed, a loss of investment follows voluntary separation. When the employer finances the training, the voluntary quit represents a loss that is expensive to the firm.

The inclusion of training into the quits function assumes that both employer and employee share in the costs of training. It is also assumed that there is some specificity in the training. Jovanovic and Mincer stressed that, "as long as specificity exists, both workers and employers share in the costs and returns from these skills."[22]

The preceding arguments allow for the specification of the following quit rate function:

$$(1) \quad q = q\,(U, P_L, T)$$

CHAPTER TWO

DERIVATION OF THE COMPLETE MODEL

The following section is a neoclassical approach to the profit maximizing firm that must make certain decisions regarding the amount of labor to be hired and the quantity of training to be provided within a union framework. The objective of this approach is to determine what factors enter into the optimal decisions regarding levels of training and employment.

A. The Neoclassical Model -- The Demand Functions

It is relatively unique to use a neoclassical model that includes the quits function described above to arrive at a firm's optimal training decisions. Others have looked at the quits function within an optimal wage strategy, but no one has included the training costs within the framework that is to be presented. Specific concern will be directed to the factors determining the demand for labor and the demand for training.

Consider the model for the firm in which the firm produces output for a competitive product market. Assume that the firm has a concave production function with two

inputs, labor and training:

(2) $Q = f(L, T)$

where L = the number of workers used in production

T = the hours spent in training per worker

An examination of costs requires an accounting for the number of employees used in production. Those employees who were paid for include both those used in production and those who quit:

(3) $L + qL = L(1 + q)$

Recalling that:

$q = (U, P_L, T)$,

by substitution into (3), we have:

(4) $L = L + q(U, P_L, T)$

Since workers who quit must be replaced by new employees who must be trained, the number of workers who are trained is determined by the prevailing quit rate:

(5) $L\,[q(U, P_L, T)]$

The total cost of production can be shown as follows:

(6) $C = P_L L + P_L L q(U, P_L, T) + (t, T)\, L\,[q(U, P_L, T)]$

where t = the cost of training per hour

The first term is the price of labor times the number of workers used in production. The second term $P_L Lq(U, P_L, T)$ represents the wage costs of those used in production who quit. The final term, which is the cost of training per hour times the number of workers trained, represents the total training costs.

Assuming the existence of a profit-maximizing firm operating in competitive output and input markets, we show the following expression:

$$(7)\quad \pi = P_Q Q - \left[P_L L + P_L Lq(U,P_L,T) + (t,T)\, L\,[q(U,P_L,T)]\right]$$

Taking the production function from (2) and substituting into (7):

$$(8)\quad \pi = P_Q f(L,T) - \left[P_L L + P_L Lq(U,P_L,T) + LTtq\ (U,P_L T)\right]$$

In the process of maximizing profit, the firm will choose the levels of labor and training that are optimal.

The equilibrium, or first-order conditions for a constrained maximum, are that all first partial derivatives are zero. Taking the partial derivatives, one obtains:

$$(9)\quad \frac{\partial \pi}{\partial L} = P_Q f_L - P_L - P_L\, q(U,P_L,T) - tTq\ (T,U,P_L) = 0$$

$$(10)\quad P_Q f_L = P_L + P_L q\ (U,P_L,T) + tTq\ (T,U,P_L)$$

The rule of choosing labor is that the extra benefits from employing more labor should be equal to the wage

costs of hiring another worker plus the training costs of hiring another worker given the quit rate and the training level per worker. The terms $P_L + P_L q(T,U,P_L)$ represent the wage costs of hiring another worker given the quit rate and the training level per worker.

Performing the same differentiation technique with respect to training, one obtains:

$$(11)\quad \frac{\partial \pi}{\partial T} = P_Q f_T - P_L L q_T - \frac{\partial}{\partial T}\ [tTLq(U,P_L,T]$$

$$(12)\quad \frac{\partial \pi}{\partial T} = P_Q f_T - P_L L q_T - Lt\ \frac{\partial}{\partial T}\ [Tq(U,P_L,T)]$$

$$(13)\quad \frac{\partial \pi}{\partial T} = P_Q f_T - P_L L q_T - Lt\ \{T\frac{\partial q(U,P_L T)}{\partial T} + q(U,P_L,T)\}$$

$$(14)\quad \frac{\partial \pi}{\partial T} = P_Q f_T - P_L L q_T - Lt\ \{Tq_T + q\ (U,P_L,T)\}$$

$$(15)\quad \frac{\partial \pi}{\partial T} = P_Q f_T - P_L L q_T - LtTq_T - Ltq(U,P_L,T)$$

setting $\frac{\partial \pi}{\partial T} = 0$, then

$$(16)\quad P_Q f_T = P_L L q_T + LtTq_T + Ltq\ (U,P_L,T)$$

Expression (16) gives the rule for the optimal usage of the input training. The input training is used up to the point where the extra returns from training equal the cost of training. The cost of training includes the indirect costs ($P_L L q_T$) which reflects the wage costs due to the rate of change of quits with respect to training.

The second part of the expression represents the change in the direct costs of training where there is a

change in training. In the event that increases in training do reduce the quit rate, q_T will be negative.

In the instance where the quit rate faced by the firm increases, the firm will have a lower incentive to invest in more specific training. The quit by a trained employee imposes a particular cost on the firm. Where the quit-rate trend is upward, the employer will realize losses from further training. This is because the higher probability for voluntary separation reduces the time horizon available to recover human capital investments in training.

The equations (10), (16), shown above are the jointly derived input demand functions in their implicit form. It is assumed that the second order, or stability conditions, are met. The generalized isoquant is concave from above in all directions.

In the usual setting for a two-factor model of a profit-maximizing firm, the quantity of an input demanded is a function of the two input prices and of the commodity price.[1] The model presented here introduces the quit rate and unionism as additional variables affecting the demand functions.

Taking the first-order equations (10), (16), we can demonstrate the factors the firm can choose in a reduced form. The demand for labor can be written:

$$(17)\quad L = L\,[P_Q, P_L,\ t,\ U, q(T,U,P_L)]$$

The demand for training can be written:

$$(18)\quad T = T\,(P_Q, P_L, t, U, q)$$

In the latter equation (18), training is a function of prices plus unionism and the quit rate. Holding prices constant, the stronger the union is as a vehicle for the expression of voice by the employees, the lower the quit rate. The lower the quit rate, the greater the incentive for the firm to invest in training, especially firm specific.

The demand for labor (17) is determined by the price of the output, the price of labor (wage rate), the cost of training, unionism, and the quit rate.

Output price is assumed to be constant. We also assume that the price of labor is equal to the wage rate. The purpose of these assumptions is not to deny that changes in market conditions affect the decisions to be made by the profit-maximizing firm, but to allow us to isolate the variables instrumental to our hypothesis. As we move toward the estimation equations (17) and (18), we will add some of the non-price variables that have been determined to be useful in measuring quit rate-related trends.

B. The Wage Function

Our equations have been derived by finding the profit-maximizing conditions for the individual firm,

assuming constant output prices. Earlier we pointed out that the labor union provides a vehicle that allows the expression of voice within a work environment. Expression of voice through the union vehicle in turn results in a reduced labor turnover rate only as long as there is an obvious return to the employee. The employer's reaction must go beyond offering merely a listening ear. It is proposed that the employee-union group's payoff is in the wage and fringe benefits derived, as well as in other advantages stemming the influence of the union into the work setting. Unless there is some evidence of return from the employer to the employees, the union voice wears thin and ceases to be effective.

Regarding the impact of the union on the work setting, Richard Freeman concluded that workers are more attached to the firm in the union work setting because of the existence of voice and of the industrial jurisprudence mode of operation.[2] His conclusion is consistent with the findings of Sargent and Clawson, who observed lower separation rates in hospitals with grievance systems than in those without such systems.[3]

The influence of increased wages and benefits on quit rates has been examined before. More recently, Freeman found that the effect of wages on the probability of separation was less significant. It has long been assumed that the wage rate is part of the causal relationship between unionism, quits, and training. Because of

its importance, the wage rate thus deserves significant consideration. Quits are affected by the impact of the union through increased wages. A decrease in quits resulting from such union and wage activity will stimulate an increase in training activity.

The optimal wage-quit strategy described by Pencavel takes into account the effect of union activity on the wage rates.[4] He used wages and education as proxies for specific training, but there was no separate estimation of training as a dependent variable. In Pencavel's other work on this subject, he again used wages as a dependent variable that included a significant union coefficient.[5] He concluded by pointing out that "there does appear to be limited evidence supporting the thesis that growing wage supplements have contributed to the decline in the quit rate..."[6] The link of wage rates to quits requires further testing. To determine the extent to which wages are affected by union activity, wages too must be examined as an independent variable within the system. Based on this, we are able to show wages as a function of unionization.

$$(19)\quad W = W(U)$$

Clearly, wages are determined by factors other than just unionization. While union bargaining strength is important, other influences affecting wages include skill or quality of labor, geographical differences, industry

concentration, and unemployment rates. Geographical differences, industry concentration, and unemployment will not be examined here in terms of effects on wages.

Skill or quality differences will be studied through the amount of training received by the worker. The more training a worker has received, the more efficient that worker is on the job. Workers who have received more training are often rewarded in terms of higher wages. Thus, the amount of training received is also viewed as a determinant of the wage rate.

Becker observed that one way to reduce the likelihood of a quit by a trained employee was to offer higher wages than could be received elsewhere.[7] The higher wage is the employee's reward or incentive, as well as a deterrent to quitting. For this reason, we show training as a variable in the wage equation.

Training, in our three equation system, is an endogenous variable determined by the system. However, in examining the factors affecting the wage rate, training must also appear as a variable that affects wage determination.

The inclusion of training into the wage equation introduces the circular flow aspect of training. The reduction in quits in the system stimulates more training. The amount of training determined then results in higher wages, which also reduce quits. Our purpose here is not to describe such a process lagged over time, but to create

an awareness of its existence, keeping in mind that the union-voice-wage-causation process still remains as the initial impetus.

The union influence on the wage rate does have an effect on the conditions surrounding the maximization rules for choosing levels of labor and training. Returning to equation (10), the wage rate affects the cost of hiring one more worker as well as the training costs of hiring another worker. If the presence of a union raises the overall wage rate, it becomes more costly to hire at each employment level.

From the employer's viewpoint, the higher wage rate induced by union pressure means higher costs affecting the optimal level of input usage. Given the existence of the union and its monopoly on labor supply, the employer does not have the choice of doing better in an outside market.

The impact of higher wages on the employee is to reduce the attraction of an outside opportunity. When the employee receives a higher wage due to the union presence, the extent to which the employee can benefit from another position is comparatively reduced. The relative wage advantage of the present position makes the decision to quit less desirable. The lower quit rate tends to offset the increase in costs of employment resulting from the higher wage. The return on the higher wage is the lower quit rate, which has the effect

of lowering the costs of employment and training. Thus, the higher wage costs are counterbalanced by the lower employment and training costs. The extent to which this latter effects occurs is dependent on the elasticity of the quit rate in regard to changes in the wage level.

The existence of the wage equation allows for the examination of the link from unionism to wages to quits in a three equation wystem. A wage equation is not unique to a study of quit rates. It is necessary, however, if we are to determine the impact of unionism in relation to its interaction with training.

CHAPTER THREE

ESTIMATION EQUATION FOR THE MODEL

A. The Quit Equation

We have assumed that output prices are constant in order to eliminate their effects in equations (17), (18), and (19). Unfortunately, the data on prices do not exist at the three-digit industry level where we are going to be testing the model.

The most convenient starting point for testing the model is a brief reference to the previously discussed variables that enter into the quits equation. Based on equation (17), the demand for labor is dependent upon unionism, quits, and the prices of output, labor, and training. We have already eliminated output price but will include the wage rate as the price of labor. The price of training represents a cost to the firm that is real but that is not reported or quantified for a study of this type.

In our arguments leading up to equation (1), we justified the inclusion of U, P_L and T into the quits function. Looking at the reduced form demand for labor equation (17), we are able to test the factors we expect

will affect the quit rate. In addition to these variables, our model will be revised slightly by the addition of two variables that have been used earlier by writers who examined the quits function.

Pencavel used a variable represenging the ratio of female to male employment.[1] In our theoretical section, we proposed that the amount of training offered by the firm is dependent upon the quit rate. The empirical results of Pencavel suggest that the higher the proportion of female employees, the higher will be the quit rate.[2] Assuming the latter is true, it follows that as an industry's employment mix is made up of a higher female ratio, there will be more quits and a lower tendency to invest in training by the firms. Thus, the demand for labor will be dependent on a higher quit rate due to the higher proportion of females.

While the union provides a voice for the employee as well as a wage bargaining unit, there are certain non-pecuniary benefits that employees obtain with length of service. Length of service is typically rewarded with seniority and other desirable benefits that would be forfeited if voluntary separation occurs. Freeman suggested years of tenure with an employer as a potential proxy for "specific training."[3] The longer the tenure, the more training the employees have received. Although we have a measure for training, the accessions will be included to verify this observation. Accessions represent

the number of additions to the work force. Lower accessions imply that employees have longer tenure of service. Longer service means lower quit rates.

To test the hypothesis that increased wages have a greater effect on the quit rate in firms in which unionism is high, we add the interaction term W.U. The role of a strong union in providing a vehicle for the expression of voice leads us to expect that the quit rate will be lower at firms in which wages are higher and union strength greater.

Prior studies have omitted any examination of the interaction of wages and unionism against the quit rate. Similarly, they have also not included an interaction term to determine whether the quit rate effect of training is independent of unionism. This omission is undoubtedly the result of the use of several proxy variables to represent training. Such a representation makes interaction more difficult.

When the employer and employee share training costs, both parties have a stake in seeing returns on their investment. The employee who in some manner shares in training costs will have less inclination to quit. If the same employee also belongs to a union, the opportunity to have a "voice" will further deter the worker from voluntarily separating from the job. The interaction of training and unionism is expected to result in an indirect relationship when it is part of a quit rate regression.

The preceding permits the specification of the following equation:

$$(20)\quad Q = B + B_1F + B_2Acc + B_3W + B_4U + B_5T + B_6W \cdot U + B_7T \cdot U$$

Q = the quit rate in industry i

F = the percentage of workers in industry i who are female

Acc = the number of additions to the work force per one hundred employees

W = the median wage and salary income

U = the proportion of employees covered by collective bargaining agreements

T = the amount of specific vocational preparation received

W•U = the interaction of wages and unionism

U•T = the interaction of unionism and specific vocational preparation

B. The Training Equation

In this model, the input of training is used up to the point where the extra returns from training equal the cost of training. The amount of training paid for by the firm is included as a cost of production. The firm's optimal decision-making process includes both the direct costs (wages) and indirect costs (training).

The reduced form equation (18) for training included the wage rate, unionism, and the quit rate. We have included accessions in the quit rate equation and will add them here as well. Fewer accessions imply that there is

less need for training. Older, more tenured employees have completed training and require less additional training. Newer employees, on the other hand, require more training to make them more productive to the firm.

An additional measure of employment activity is the number of workers who are laid off. The decision to lay off the trained employee represents a loss of return on investment. Higher layoffs imply that there is less training required. Layoffs reflect market and employment conditions.

Burton and Parker found an inverse relationship between the number of workers who are white and quits. The quit rate declined as the percentage of white employees increased.[4] Consequently, the implication for training is that the firm would be less inclined to train non-white employees since their quit rates are higher. From a policy point of view, this finding suggests that non-whites are a less desirable training investment. A variable that represents the proportion of employees who are white will be included to test this phenomenon.

As noted earlier, quit rates are reduced by unionization. In addition, unions can be expected to increase the total amount of wages and benefits received by the employees. Assuming the training is desirable, unionization will increase job satisfaction and wages. The interaction of wages and unionization as a determinant in the training equation has not been examined in the

past. The interaction term W·U is included to test the hypothesis that unions have a different effect on the training of high-wage employees than they do on low-wage employees.

In the second estimating equation, training is presented as the dependent variable.

$$(21)\quad T = \alpha_0 + \alpha_1 W + \alpha_2 L + \alpha_3\ Acc + \alpha_4 N + \alpha_5 U + \alpha_6 Q + \alpha_7 W \cdot U$$

L = the industry layoff rate per 100 employees

N = the percentage of employees who are white

C. The Wage Equation

The traditional wage equation includes a variable for unionization. The linkage route between unionization and quits is through the channel of wages and specific training. Unionization raises wages and reduces quits. Since lower quits stimulate more training, the interaction of unionization and training is expected to increase wages. The way to test this observation is to include an interaction term of unionization and training (U·T) in the wage equation.

Since unionization provides voice opportunities to the employees in training, it is expected that the wages of unionized employees will be higher than those of non-union employees who are trained.

Prior studies have used education or some combination of proxies to represent training. We will

use specific vocational preparation as a measure of training. Specific Vocational Preparation comes from the 1950 survey listed in Estimates of Worker Trait Requirements for 4000 Jobs.

The final variable in the wage equation is the percentage of employees who are white (N). If race discrimination exists, there will be a higher wage trend when there are more white workers.

The third assumption is:

$$(22)\quad W = z + z_1 U + z_2 N + z_3 T + z_4 U \cdot T$$

CHAPTER FOUR

ESTIMATION AND RESULTS FOR THE MODEL USING TWO DATA SOURCES

A. Data Sources for Estimation

The three equation systems will be estimated using data from forty selected three digit manufacturing industries for 1958. Information on wages, quit rates, percentage female, layoffs and accessions was gathered from the publication, "Employment and Earnings." In order to find the percentage of white by three digit industry code, we had to use 1966 data from the "Equal Opportunity Report." Unionism data came from the "Handbook on Labor Statistics." The measure of training is specific vocational preparation Estimates of Worker Trait Requirements for 4000 Jobs and was first estimated on an industry by industry basis by R. S. Eckaus (1964).

B. Estimation Methods and Results

The model is estimated by two-stage least squares with only the second stage showing in the results. The results appear in Table 1 on page 33 . The dependent

variables are listed across the top of the page with the results of the second stage listed vertically below. In the parenthesis, t values are listed, and a t value of one or greater is understood to be significant.

Based on established criteria of a t value of one or greater, accessions is the only variable that passes the test with a t value of 4.222. Longer term employees receive certain non-pecuniary benefits, that make it more costly to quit. The significance of this beta coefficient reinforces the important role of longevity and of its benefits in the decision to stay with a particular job. Unions are effective in improving a job's non-pecuniary benefits as well as its pecuniary, rewards and seniority rights.

Earlier we discussed Freeman's suggestion that years of tenure could be used as a proxy for specific training. The accessions variable is as close as we come in this equation to such an estimation. Three other estimated coefficients came close to meeting the significance test with t values of .94 or higher. The highest of these was the training variable, which had a negative coefficient and a t value of -.9974. This result is not discouraging because it does support the proposition that workers with high levels of training are less inclined to quit. The sign of the coefficient, although not significant, is consistent

with Becker's proposition that employees with specific training have less incentive to quit.[1] Since SVP has not been used previously as a measure in a quits equation, it is significant that our results are as expected.

The use of proxy variables of one form or another has consistently introduced some doubt as to the reliability and interpretation of such results. Clearly, the SVP measure still leaves room for improvement that would provide a totally accurate accounting across occupations and industries. Our initial quits function was dependent upon the number of workers used in production and on the hours spent in training. Our results, while not significant on the basis of standard criteria, do not discourage us from asserting the necessity of including training in the quit-rate function. The negative sign for the estimated coefficient for SVP supports our contention that q_T in the training equation (16) is negative.

The two interaction terms also border on significance at the 1.00 level. Wages and unionism came in at a surprising negative beta coefficient. This finding is contrary to our expectations and is inconsistent with our theoretical model. The interaction of the SVP and unionism variables, however, did show a positive estimated coefficient.

In the training equation, the estimated coefficient for accessions was significant and positive as we expected. Newer employees require more training and the positive

coefficient for accessions verifies that need. Increased layoffs mean more training based on the results shown here. The variable that has the greatest meaning is the estimated coefficient for quits, which -- as expected -- was negative. The higher the quit rate, the lower the training.

In our theoretical section, we proposed that the decision to offer more training is a function of prices, unionization, and quits. The lower the quit rate, the greater the incentive to invest in training. Prior studies had shown training as a variable in a quits equation in proxy form and had failed to set up a non-proxy measure as a dependent variable. In this instance, we have supplied a variable measuring training and have shown that quits affect training in an inverse relationship. The negative coefficient for the quits variable and its significance is supportive of training as a function of quits as predicted from our theoretical model. The model proposed that the firm employs the input training up to the point where the return from training equals the cost of training (equation 16). In that expression, the quit rate was part of the cost of training. The loss of the trained employee results in a cost to the firm. When quit rates go up, we predicted that the amount of training provided by the firm would go down. The higher probability of separation makes the investment in training less desirable. Our significant negative estimated coefficient

TABLE 1

Two-Stage Least Squares Coefficients and t Statistics From SIC Data

Variables	Q (t value)	SVP (t value)	W (t value)
F	.4382 (.8529)		
Acc	.1187 (4.2220)	.5416 (1.0083)	
W	.01335 (.4114)	-.0952 (-.8031)	
U	.0059 (.4408)	.0376 (.4462)	1.344 (2.8189)
(W•U)	-.0003 (-.9417)	-.0002 (-.2626)	
(U•SVP)	.0204 (.9470)		-.7959 (-1.5942)
L		.0305 (1.0946)	
N		-.0234 (-.3211)	.1498 (.2967)
Q		-6.2388 (-1.1688)	
SVP	-1.6925 (-.9974)		72.4734 (1.8210)
C	1.2234 (.9694)	14.4265 (.9926)	-36.6589 (-.7965)

of quits in the SVP regression supports our prediction that the firm's desire to train is dependent in part on an inverse relationship with the prevailing quit rate.

The estimated coefficients for wages, unionism, and for the interaction of wages and unionism were not significant. Freeman found that unionism raises tenure and reduces separations.[2] Our expectations were that the union environment would provide a stable work environment, thus encouraging more investment in training. Unionism would then have a significant direct effect on increasing training. The insignificant coefficient for unionism did not support our theory that training is in part determined by the impact of union strength.

Union influence also manifests itself in the form of higher wages. Since employees with additional training also typically receive higher wages, we expected wages and training to have a positive or direct relationship. Finding that the estimated coefficient for wages was negative was contrary to our expectations. The t value for the wages coefficient was insignificant, suggesting that wages and unionism also failed to be significant.

The wage equation reported significant results for unionism, the interaction term, and the training variable. As expected, the higher the percentage of work force covered under collective bargaining, the higher the wage rate. This finding is consistent with our theoretical expectations and is not unlike earlier results of others

who have examined the same relationship.

The interaction of training (SVP) and unionism was significant although the sign was contrary to our expectations. This result indicates that union strength in combination with training tends to cause lower wages rather than the higher wages we had anticipated.

The training variable, when considered alone in the equation, did show a positive sign. The estimated coefficient was also significant. Increased training results in higher wages, and this finding is consistent with our prior expectations.

While interaction terms provide information concerning the combined effect of two variables on the dependent variable, another approach is needed to determine how one variable affects the relationship between a second independent variable and the dependent variable. For example, one could inquire about the effect of different levels of unionization in the relationship of training (specific vocational preparation) to quits. Taking the first equation (20) as an example, partial derivatives can be used to arrive at a basis for such an approach.

Recalling that equation (20) is as follows:

$$Q = B + B_1F + B_2Acc + B_3W + B_4U + B_5T + B_6W \cdot U + B_7T \cdot U$$

$$(23)\ \frac{\partial Q}{\partial T} = B_5 + B_7U$$

Expression 23 shows the partial derivative with the change in quits as a result of a change in training. In order to evaluate the impact of unionization at different levels, we can now substitute into the equation a high, low, or mean value for unionization. To determine whether the effect is significant from zero at a high, low, or mean value, a standard deviation term is needed to divide into the right side of expression 23. Taking the square root of the variance and dividing into the partial effect shown in expression 23, we are able to arrive at a t value.

Table 2 on page 37 shows the values for the numerator and t statistic for each of the partial derivatives listed at their respective minimum, mean, and maximum values. This approach has not been used in any of the prior studies of quit rate activity or in any of the studies pertaining to the measurement of training.

The measure unionism is used to determine to what extent union activity (voice) affects quit rates, training, and wages. The data in Table 2 shows that the union's strength or weakness has little effect on the impact of training on quits. By varying the levels of training, it is clear that union activity does not have a significant impact on the quit rate at average and high levels of training. With a positive sign, however, the relationship is contrary to what was expected. This result is not encouraging, as it suggests a higher quit rate at higher levels of training where the union affects the quit rate.

TABLE 2

T VALUES AND PARTIAL DERIVATIVES
FROM THE SIC REGRESSIONS

		Min.	Mean	Max.
$\frac{\partial Q}{\partial T}$ at U levels	Partial Effect	2.4149	3.0225	3.5183
	t statistic	.9057	.3193	.5554
	U value	30.1	65.2	89.5
$\frac{\partial Q}{\partial U}$ at T levels	Partial Effect	.0134	.0265	.04977
	t statistic	.9306	1.0950	1.0612
	T values	.37	1.01	2.15
$\frac{\partial T}{\partial U}$ at W levels	Partial Effect	.0270	.0210	.0065
	t statistic	.7526	.0848	.1337
	W levels	52.88	83.16	122.71
$\frac{\partial T}{\partial W}$ at U levels	Partial Effect	-.101	-.1082	-.2742
	t statistic	-.9439	-.8153	-.9461
	U levels	30.1	65.21	89.5
$\frac{\partial W}{\partial T}$ at U levels	Partial Effect	48.5168	20.57	1.24
	t statistic	1.9445	2.427	.17
	U level	30.1	65.21	89.5
$\frac{\partial W}{\partial U}$ at T levels	Partial Effect	1.0496	.5401	-.3671
	t statistic	3.4987	4.6281	-.31
	T level	.37	1.06	2.15

None of the partial derivatives in the training equation proved to be significant. In the wage equation, at low and average levels of union strength, training had a significant impact on increasing wages. This finding implies that in firms with strong unions, training has a diminishing effect on wages. A strong union presence changes the work environment, wage structure, and fringe benefits to such an extent that wages no longer respond to changes or increases in training levels. Once average skill levels are achieved, the wage rewards of training cease to exist for workers in strong union environments.

At low and average levels of training activity, the union does have a significant impact on increasing wages. Higher levels of training result in there being no significant response of wages to changes in union strength. In a union setting, training has some effect on the union's impact on wages. Unions tend to equalize wages somewhat once a certain skill level is reached. Beyond the average level of training, changes in wages resulting from changes in union strength are not significant. Once high levels of training are attained, wages change only in response to other factors unrelated to the union.

These results are not surprising and do verify the linkage of both training and unionization to the wage rate. Levels of union voice interact with training to

raise wages up to a limit. Once that limit or level of unionization is reached, training's effectiveness on raising wages ceases to exist. Similarly, the union impact on wages also becomes insignificant at high levels of training. This suggests that an excess of either training or union voice activity precludes the significant impact of the other. At high levels of measurement, they become mutually exclusive in terms of pressure on wages. Going back to the original individual beta coefficients, they were positive and significant. At low and average levels, training and union strength reinforce each other when examined through the interaction process. From a policy viewpoint, highly trained people will not find the union raising their wages in response to above-average training, and employees in a strong union environment will not seek more than average training as a means to raise their wages.

From an original theoretical perspective, these latter results are supportive. The most disappointing results from the SIC data exist in the quit rate equation. The accessions variable consumes the only precise significance that exists. If wages had shown a negative significant relationship in determining quits, the accomplishments of the union and training variables in the wage equation would have been further supported, thus verifying the theoretical linkage we have proposed.

The training equation provided strong support for the role of quits in determining the amount of training to be offered. The ability to show training as a dependent variable is an advance.

In comparison to the prior work of Pencavel, there is some inconsistency. The quits equation was most satisfactory in showing the wage impact for Pencavel. Our results were not supportive on the estimated coefficient for wages. Accessions were consistent with Pencavel's results.

The Pencavel wage equations reported the same signs for comparable coefficients that we did. The other major difference was our inclusion of the training equation, thereby establishing a different equation system. This equation system precludes any further comparison. In addition, our use of interaction terms and their interpretation constitute an extension beyond Pencavel's work. A comparative summary of our results and those of Pencavel are shown in Table 3 on page 41.

C. A Similar Test Using SMSA Data

Additional testing using SMSA data is necessary to examine further the extent to which training is affected by quit rates and by the related interactions through union voice and wages.

Using 1970 data from forty-two large SMSA's, the two-stage multiple regression was run again, utilizing

TABLE 3

COMPARISON OF SIGNS --
OUR RESULTS AND PENCAVEL'S

Quit Rate Regression	Pencavel	Our SIC Results
Wages	-	+
Accessions	+	+
Unionism	-	+
Female	+	+
Wage Rate Regression		
Unionism	+	+

NOTE: Our quit rate and wage rate regressions included a training variable not used by Pencavel. Pencavel also did not include a training regression. Coefficient signs shown above only pertain to the usage of established variable measures.

the same equation with two exceptions. Data sources included the "Census of Population," "Employment and Earnings," and the "Area Wage Survey Bulletin" from the U.S. Department of Labor. Since data are not available on special vocational preparation by SMSA, a substitute for the training variable was used. Education is used as a substitute proxy measure of training.

The link between training and education is not new. In a U.S. Department of Labor study cited by Jacob Mincer, a high positive correlation was found between schooling and on-the-job training.[3] Parsons used a total human capital function that includes formal education as one of the determining variables.[4] Specifically, the variable education used here represents the median grade level achieved by persons aged 14 or older.

Education has been used before in quit rate regression analysis. Pencavel used it and observed a positive relationship between formal school education and quits, and between formal education and wages. Since formal education is a far different measure than we used in testing SIC data, the results are expected to be different. Pencavel observed that for a given wage, the higher the formal schooling, the lower the worker's investment in skills specific to his current employment.[5]

It is important to note another word of caution

pertaining to education as a measure. Haworth and Rasmussen observed that while median years of education are often used to measure differences in human capital, they are in effect a poor measure of human capital whenever they fail to evaluate quality differences.[6] Citing the Coleman Report, Haworth and Rasmussen pointed out that the quality of the input education varies particularly by race.[7]

The other variance from the SIC study is the race variable. For the SMSA data, the race variable represents the percentage of non-whites rather than the percentage of whites as presented in the SIC data earlier.

On the basis of the results shown in Table 4 on page 44, the regression's second stage indicates that there are several differences from the results of the SIC data. The estimated coefficient for accessions was significant, and wages were as we expected. The unionism coefficient had the correct sign but was not significant.

The education equation displayed results far different from what we observed earlier using the SVP training measure. New entrants into the labor force reflect lower educational attainment based on the sign and significance of the accessions coefficient. Higher wages reflect more education as does the presence of a stronger union representation. The interaction of wages and unionism proved significant in showing an indirect

TABLE 4

Two-Stage Least Squares Coefficients and t Statistics From SMSA Data

Variables	Q (t value)	Ed (t value)	W (t value)
F	-.1332 (-.2262)		
Acc	.690180 (7.5007)	-3.7809 (-1.4699)	
W	-.0153 (-1.14008)	.115923 (1.3567)	
U	-28.3311 (-.7450)	22.6060 (1.3181)	-2473.39 (-1.6368)
Q_1(W•U)	.01524 (.8181)	-.1340 (-1.2078)	
Q_2(U•Ed)	2.1673 (.6405)		213.247 (1.6672)
L		-.2203 (-.7113)	
N		-.4855 (-.1994)	-21.9218 (-.5398)
Q		5.7450 (1.5886)	
Ed	-1.5525 (-.5757)		-160.655 (-1.5632)
C	21.0624 (.6925)	-7.8717 (-.6017)	2003.53 (1.6515)

effect on education.

Although the costs of training can be shared by both employer and employee, such an investment would be discouraged by the likelihood of a quit or layoff. In contrast, education -- particularly through the public school level -- has no direct cost to the employer or student. Strictly speaking, of course, public education is not free since it is financed by taxes. However, its cost is not as direct as that of an in-house, industrial training program.

The results of the quit rate within the education regression point to this vast difference. The higher the quit rate, the greater the education. This finding confirms the Pencavel argument that years of formal schooling and the quit rate should be positively associated. It also testifies to differences in what is actually measured in education as compared to vocational training.

The wage regression reported significant results, but they were most unexpected. The estimated union coefficient is significant and totally the opposite of what we have predicted from our theory. The interaction of unionism and education did prove significant with a positive influence on the wage rate. This result is consistent with our theory.

Increased education means lower wages according to the results of the estimated education coefficient

in the wage equation. Specific training in our SIC study showed a positive impact upon wages. The result here is inconsistent with our view of the importance of training. Since education represents our proxy for training, this result implies that higher training results in lower wages and is the exact opposite of our expectations.

One possible explanation for this result is that younger workers tend to be better educated than more senior, older workers. Since wage rates are based on seniority among other factors, it is not surprising that younger, better-educated workers receive lower wages than their more senior counterparts. The average level of educational attainment for younger employees tend to be higher than that achieved by older workers. As workers entering the work force today are in general better educated than those who started to work thirty years ago.

The negative sign for the race variable is consistent with our expectations in that the higher the non-white percentage, the lower the education attainment. The estimated beta coefficients for race were not significant in any of the results.

Using the same approach that we did earlier, partial derivatives were used to further examine the causal relationships. From Table 5 on page 47, the first significant results are the effects of unionization

TABLE 5

T VALUES AND PARTIAL DERIVATIVES
FROM SMSA DATA

	Min.	Mean	Max.
$\frac{\partial Q}{\partial E}$ at U levels--Partial Effect	-1.1841	.0296	.5064
t statistic	-.8128	.1152	.9054
U value	.17	.73	.95
$\frac{\partial Q}{\partial U}$ at Ed levels--Partial Effect	-5.7912	-2.5402	-1.2398
t statistic	-1.79	-.3261	-.2695
Ed value	10.4	11.9	12.5
$\frac{\partial Ed}{\partial U}$ at W levels--Partial Effect	8.9056	3.8972	-1.1917
t statistics	1.4567	1.3872	-.3278
W levels	101.56	138.72	176.41
$\frac{\partial Ed}{\partial W}$ at U levels--Partial Effect	.0930	.0174	-.0123
t statistic	1.3859	.9157	-.41
U levels	.17	.73	.95
$\frac{\partial W}{\partial Ed}$ at U levels--Partial Effect	-124.40	-4.985	+41.9296
t statistic	-.3461	-.00413	.027631
U levels	.17	.73	.95
$\frac{\partial W}{\partial U}$ at Ed levels--Partial Effect	-255.62	64.25	192.20
t statistic	-.1092	.0286	.0833
Ed levels	10.4	11.9	12.5

in the reduction of the quit rate is significant at the lowest education level. This finding leads to the conclusion that higher education (training) levels do not make the union impact on the quit rate any greater.

Unionization does increase the educational level at minimum and average wage levels. At high wage levels, the signs reverse and unionization and education show an inverse relationship. Viewing education as a proxy for training, this result means that unions support more training at low and average wage levels, but not at high wage levels. This fact suggests the conclusion that educational attainment and training are not high priorities for the union when wages are high. From a practical standpoint, once the goal of high wages is achieved, there is little incentive to seek further education or training. In fact, the causal relationship is reversed since the higher the unionization, the lower the level of education or training attainment.

The only other significant t statistic was for the effect of wages on education at low levels of unionization. Wages do influence educational achievement in the same direction at low levels of unionization. As people earn more money, we tend to find an increase in their level of formal education. Again, at high levels of unionization the signs reverse, and there is an inverse relationship between wages and

education.

In summary, the effect of unionization on the quit rate at low levels of education is reassuring. The interrelationship between education and wages, whatever the causal effect, is quite different and of no significance when there is a high level of union activity.

In Table 6, we show a comparison of Pencavel's results and of our SMSA results. There is a difference in perspective in this comparison since Pencavel's study was by SIC category rather than by SMSA. The signs for the estimated beta coefficients for education and female differ in the quit rate regression. The signs for unionism and education in the wage rate regression are also the opposite of each other. The major differences are in data sources used.

D. A Summary of Findings -- SIC and SMSA

Our original objective was to test the impact of unionism (voice), which in turn lowered the quit rate and stimulated an increase in training. The first leg of this causation line is the effect of unionism on the quit rate. Our two tests showed contrasting results. The partial derivatives also failed to support this causation. Prior studies have clearly shown that unionization and quits have an inverse relationship.

The presence of interaction terms in addition to

TABLE 6

COMPARISON OF SIGNS --
OUR SMSA RESULTS AND PENCAVEL'S

Quit Rate Regression	Pencavel	Our SMSA Results
Wages	-	-
Accessions	+	+
Unionism	-	-
Education	+	-
Female	+	-
Wage Rate Regression		
Unionism	+	-
Education	+	-

the presence of a training variable opens the question of whether multicollinearity exists. Sufficient multicollinearity can lead to a decrease in significance and to signs for estimated coefficients that are the reverse of the true signs. Interaction terms in this system of regression equations have not been used before and raise the potential for collinearity among the variables.

The second step in the causation line is the effect of the quit rate on training. The SIC results verified our proposed impact of the quit rate on training in a significant way. In Table 7, the comparison of results shows an opposite effect on the SMSA education regression. This effect is accounted for by the difference in the formal education measure. The significance of the SIC results does reinforce our theory regarding the effect of the quit rate on the demand for training. The higher the quit rate, the lower the amount of training.

Returning to our model, a decrease in the quit rate means a lower cost for training. With this lower cost, the firm can be expected to more to an equilibrium position in which it can offer more specific training.

Earlier it was proppsed that wages play an important role in this process. Greater union voice and additional training will both lead to higher wages.

TABLE 7

COMPARISONS OF SIGNS AND SIGNIFICANCE
OF SIC AND SMSA RESULTS

	SIC	SMSA
Quit Regression		
F	+	-
Acc	+*	+*
W	+	-*
U	+	-
W·U	-	+
U·SVP	+	+
SVP	-	-
Training Regression		
Acc	+*	-*
W	-	+*
U	+	+*
W·U	-	-
L	+*	-*
N	-	-
Q	-*	+*
Wage Regression		
U	+*	-*
U·SVP	-*	+*
N	+	-*
SVP (Ed)	+*	-*

* Significant

Both of these propositions were supported in the SIC wage equation and in the partial derivative results. Totally contrasting results were found in the SMSA wage equations as observed in our comparison in Table 7. Prior studies have verified the effect of the union on the wage rate. While the SMSA wage regression is a disappointment, the SIC results support prior studies, and the training measure SVP appeared as we proposed.

This section cannot be complete without a final word about the accessions and layoff variables. These variables were significant in every appearance. In particular, the accessions coefficients were of the same sign and were significant in the quit rate regressions. Higher accessions mean more new workers, and our results show that such employees contribute to higher quit rate.

When there is an increased number of new entrants to the work force, the new employees' early days or months of work represent the time period during which the probability of quitting is the highest. Since these new additions to the work force tend to be younger in age than the work force overall, their voluntary mobility also tends to be higher. As Hamermesh pointed out, "New hires and quits move together very closely over the cycle."[8] Consequently, when accessions increase, quits also tend to increase.

Recalling Freeman's suggestion that one potential

proxy for "specific training" is years of tenure with an employer, the results of our quit rate regressions suggest that more new workers will result in less tenure and training, and in a higher quit rate.[9]

In the SIC training regression, the positive estimated coefficient for accessions is a reflection of the need to train entrants into the work force. The opposite relationship existed inthe SMSA training regression. This result implies that newer additions to the work force tend to have less formal education. The difference between SVP and education as measures of firm specific training account for the differences in the relationship to the accessions variable.

Layoffs appeared only in the training regressions and were the opposite in sign. The SIC estimated layoff coefficient is inconsistent with our expectations. The observation that higher layoffs mean more training is surprising. When employers lay off employees, there is little emphasis on training unless it is cross training on more than one jobs of the remaining employees.

Overall, the consistencies found with our SIC results were more encouraging, both when compared to our theory and to the applicable results of prior studies. The use of the training measure SVP as a dependent variable and the inverse dependency on quits represent a step forward. Prior studies have not

used the model or regression system presented here. The introduction of interaction terms has set the stage for the existence of multicollinearity within the regressions.

CHAPTER FIVE

EMPIRICAL TEST USING LONGITUDINAL SURVEY

In this chapter we investigate data provided by the National Longitudinal Survey. In contrast to our first two sets of macrodata, this survey is composed of micro-data. The survey included a series of interviews of a sample of individuals over a ten-year period beginning in 1966. The four groups covered in the U.S. population are: men 45 to 59 years of age, women 30 to 44 years of age, and young men and women 14 to 24 years of age as of 1966.

The data collected during this survey includes information about a variety of social, psychological, and economic characteristics. The breakdown into the four groups distinguished by age and sex allows for the survey of one group at a time. In this study, we have selected the group of men aged 45 to 59.

A. Characteristics of Men 45 to 59

There are several logical reasons for choosing this group for examination and further testing of the theoretical model. From an age perspective, younger workers are typically characterized by being less stable.

They are more unsure of career objectives and paths. Such turnover has a tendency to be unresponsive to the holding power of union benefits, seniority, and training programs. Regardless of sex, the high incidence of voluntary mobility among younger workers often occurs for a far broader variety of reasons than those we have examined earlier.

In contrast, the older, more experienced employee has had the time to accumulate the seniority and benefits associated with union membership. This longer exposure leads to an understanding of the role of the union voice in the determination of wages and related benefits. It also includes time to invest in the job, and time for the firm to invest in the employee. While older workers are likely to have less formal education, the job-related possibilities for training are greater. From the firm's perspective, workers who may be too close to retirement are not good candidates for training because the remaining time to recapture returns is too short. On the other hand, older workers have had greater opportunities to experience more gains from the training process.

This observation does not mean that men in this age group do not quit their jobs. What it does mean is that those who do quit are relinquishing some benefits. The price or cost of quitting includes the various wages and benefits that have been earned over time. An examination of the rationale for a quit is more meaningful when a cost is involved. For the older worker, the time frame

left to recoup these benefits is obviously much narrower than for the younger employee. Because of age, the older person also has a lower probability for re-employment.

Arvil Adams found that there is not a consistently positive effect on earnings and employment for middle-aged workers who participate in formal occupational training during the middle-age years.[1] The benefits of such training vary according to prior training experience, institutional source of training, and race. While there is a variance in training benefits during these years, middle-aged workers are more likely to have participated in training programs and to have reaped the benefits of union seniority programs.

In his 1969 study, Sherwin Rosen found that unions seem to benefit older and less educated workers to a greater extent than they benefit younger and more educated workers.[2] The seniority systems that protect and reward experience clearly provide a shield of protection from the performance challenge of other workers on the job.

Earlier we proposed that the quit rate is a function of training, unionization, and wages. Looking at the group of men in the age group of 45 to 59, no other single group will have had the opportunity to have experienced training, understood the effects of the union influence, and realized an improvement in wages.

From the employee's perspective, the loss of the older, more productive, and experienced employee is the

most damaging loss. This recognition, along with acknowledgment of the union's monopoly over the labor supply, effects a mutual employer-union interest in rewarding employees who have achieved seniority.

Having outlined the reasons for selecting this group for study, our attention now focuses on the equations used to test the effects onthe dependent variables of quits, training, and wages. Initially, variances with our earlier equations will be explained. Following explanatory material, we will present the results of the regressions on the empirical data.

In general, the basic equations to be estimated are similar to those used earlier. Due to the nature of data, however, there are some differences that should be explained. One of the questions asked required information about the sponsor of the longest occupational training program taken since the last interview. Using dummy zero one variables, this variable was set up in the quits equation to distinguish between company-sponsored training programs as opposed to all others. The purpose of this test was to examine whether there was a particular effect on the quit rate when the company rather than the individual, had sponsored the training program.

In our tests using the SIC and SMSA data, we had information regarding the number of accessions representing additions to the work force. This measure is not available in the longitudinal survey, but an alternative is

proposed. We are including the unemployment rate as a labor market indicator in the quit-rate equation. People tend to quit their jobs when an alternative means of employment is available. When the unemployment rate is high, there are fewer options since the competition for positions is greater.

Another variation in our regression is the use of the natural logarithm of wages. The quit-rate equation appears as follows:

$$(24)\quad Q = a_0 + a_1 \ln W + a_2 U + a_3 T + a_4 \ln W \cdot U + a_5 U \cdot T + a_6 S + a_7 E$$

Where: S is the sponsor of the training program
E is the unemployment rate

Because we are using microdata, we will be using ordinary least square techniques in our regressions.

With two exceptions, the training equation is the same as used in prior empirical tests. Again, the natural logarithm of wages will be used, and there is no layoff variable. Thus, the training equation is:

$$(25)\quad T = b_0 + b_1 \ln W + b_2 U + b_3 \ln W \cdot U + b_4 Q$$

The training variable is this survey is the number of weeks of occupational training received during 1967-1969.

B. Wage Equation

In our theoretical model and in our earlier empirical work, we pointed out that wages are affected by the collective bargaining of unions, by training, and by the incidence and magnitude of discrimination. We also assumed that there are variations in productivity, product demand, and related factors affecting wages that are held constant. In our SMSA study, we used education as a measure and substitute for training. This approach, of course, is a simplified look at the total picture of wage determination.

There are many factors that enter into the picture of wage determination. Some we have studied, some are assumed constant, and some cannot be measured. We examined race as a factor but such other factors as location and region of the country can also be included. Our study has not included regional variables, but their impact is often significant.

There are other factors that are impossible to measure. There is the impact of the individual productivity of a worker. Some workers have more innate ability than others to do a job. There is also the fact that a person may accept a lower wage in a more attractive job than in a less attractive position.[3]

The basic hourly wage equation is a regression of the natural logarithm of hourly earnings in a set of

variables similar to those used inour two earlier tests. In this instance, a dummy variable is used for union membership. It was coded 1 for a union membership and 0 for a non-member.

The general form of the equation is as follows:

$$(26)\ \ln W = Z_0 + Z_1 U + Z_2 T + Z_3 U \cdot T + Z_4 N$$

Using a regression in which the logarithm of the wage rate is the dependent variable, the above equation allows us to estimate the relative wage impact of unionism.[4]

In the longitudinal survey, our unionism variable is set up by the question that asks whether wages on the current or last job are set by collective bargaining. Of the 3,336 who responded, 1325 answered yes and 2,011 no. The wage rate came from questions that asked the hourly rate of pay on current or last job for 1969.

C. Empirical Results

The survey of the men in the age group of 45 to 59 provides quit rate information for 1969 only. An alternative measure for 1971 was used, but the frequency was so low that all of the results were insignificant. The year 1969 is the only year in which the question is asked appropriately: Did respondent leave current job during 1969?

To understand the extent of the survey, Table 8

TABLE 8

VALID CASES--LONGITUDINAL SURVEY
MEN AGES 45-59

Variable	Means	Valid Cases	Standard Deviation
Q	.12	3632	.325
W	3.54	3169	.185
U	.39	3336	.489
T	1.05	4335	5.198
S	.30	434	.460
N	.70	5020	.458
E	3.90	4381	17.461
W·U	2.34	3162	2.888
U·T	.39	3298	3.381

indicates the number of people responding to each individual question. Although there were over 5,000 respondents at the beginning of the survey, attrition and non-response to questions lower the maximum expected return to below 5,000 responses.

Table 9 gives the results of the least squares estimation of the three equations. The estimated beta coefficients are shown along with the respective t statistics for each one.

The correlation coefficient of the relationship between the unionism variable and the interaction variable of unionism and wages is .99784. By the normal standards of measurement, this correlation between two independent variables represents multicollinearity. This correlation presents a problem in interpreting the meaning of the signs and the significance of the estimated beta coefficients. In order to understand the effects of these two variables in our longitudinal survey regressions, it is important to recall that a value for a correlation coefficient of 1 represents linear dependence. The value of .99 is extremely close and suggests that caution is needed in interpreting the relationship to the dependent variable.[5]

A possibility for future study would be the exclusion of one of the variables from the regression equation. Such an exclusion where a linear functional relationship exists would not decrease the explanation of

TABLE 9

Regressions, National Longitudinal Survey,
Men, 1969 (t values in parenthesis)

Variables	Q	T	ln W
ln W	-.035517 (-1.0202)	-1.8943 (-1.1118)	
E	.0003326 (.300125)		
U·T	.0025787 (1.05518)		.00592858 (1.370668)
S	-.002016 (-.0575765)		
T	.00071753 (.480566)		-.003494 (-1.350272)
U	.517352 (.908240)	-38.37580 (-1.37064)	-.133852 (-1.64360)
W·U	-.0933254 (-.9898367)	6.697532 (1.447351)	
Q		4.0801343 (1.4288125)	
N			.203409 (2.691088)
Constant	.2817944 (1.2956217)	22.127558 (2.11464)	5.97208 (76.29210)

the dependent variable.[6] The result is that the remaining variable captures most of the effect of the omitted variable.

A similar problem of correlation exists between our unionism variable and our interaction term of unionism and training. The correlation coefficient here is .59, which is sufficient to warrant caution. Fortunately, we do have some prior knowledge about how some of these variables are expected to behave. The interaction term wages-unionism and training-unionism are also correlated at .59.

Examining the quit rate equation, we see that the effect of wages is negative as predicted. The results are significant and reinforce the fact that higher wages mean a lower inclination to quit. This result supports our theory and is consistent with our theoretical expectations.

The only other estimated beta coefficient in the quits equation to reach a t value of 1 or greater is the interaction term of unionism and training. We would expect this estimated coefficient to have a negative sign. The implication is that union members who have received training are more likely to quit their jobs than those who do not have the training. Our theory said that union membership plus training would mean a lower inclination to quit.

Based on our prior studies, the union impact would be sufficient to lower the quit rate. Pencavel's studies, disclosed an inverse relationship between unionism and the quit rate. Where the training is more general than specific, it is highly marketable to another job position. This would mean a higher employability elsewhere and a higher quit probability.

The estimated coefficient for the unemployment rate was not significant. This result is in contrast to our earlier findings in which accessions were significant as a labor market indicator. The estimated coefficients for the sponsor of the training program and the training also were not at all significant. The unionism coefficient had a positive sign and fell just short of significance. The interaction term of wages and unionism had the expected negative sign and was a small fraction short of being a t = .99. This latter result supports our earlier expectations that employees who earn high wages and who belong to a union are less likely to quit than if they were not members of a collective bargaining unit. The opportunity to use their union voice and the wage rate represent two deterrents to quitting.

In this particular age group, employees are likely to have a number of years of seniority as well as an at least average, if not higher, hourly wage. Older workers are not only more senior in their union membership, but by virtue of their seniority, often they are more

influential in union affairs. This opportunity for voice may be felt more by the older workers than by the younger ones who are relatively new in the organization. The opportunity for expression of voice, along with a higher wage rate, keep the older employee on the job.

Summarizing our quits regression, we found support for the wage effect and an unexpected sign for the training influence. The coefficient for sponsor of the training program was not significant, the negative sign for the wage-union interaction supports the role of the union in combination with a higher wage. This finding stresses the importance of the wage rate as a means of communicating the success of the union voice in the collective bargaining process. For the firm seeking to maximize profits, the costs of voluntary turnover can be reduced through higher wages.

In our quits regression, the estimated coefficient for training and the estimated coefficient for the interaction of training and unionism were not what we had anticipated. The latter result was significant and suggests that increases in the training of union employees result in increased quits. In this instance, voice activities associated with union strength coupled with further training, increase the costs of labor turnover for the firm.

Our significant estimated coefficient for wages in the quit rate equation suggests that workers will stay on the job longer when wages are going up. This conclusion

is in contrast to the findings of Richard Freeman. He observed that greater job tenure is not primarily the result of monopoly wage gains due to union influence.[7]

In this 1980 article, Freeman used the data from the National Longitudinal Survey to analyze the factors affecting the worker's attachment to the firm.[8]

Variables in the Freeman quit rate regression included tenure, age, race, sex and education.[9] Besides some differences in methods of measurement, Freeman studied the period 1969-1971 in contrast to our examination of 1969 only. He did not include or attempt to measure training and also omitted the usage of interaction terms. Whether Freeman used the mean of separation as a dependent variable or quits, his unionism coefficient was negative, and his wage coefficient positive. Both of these results are the opposite of our findings.

His success with the unionism coefficient led him to conclude that it is the work setting effects of unionism that raise tenure or decrease quits.[10] Since his wage coefficients were positive and union coefficients negative, he concluded that while there are monopoly wage increases resulting from union influence, the presence of union voice and industrial jurisprudence have some effect on reducing the costs of turnover and on raising productivity.[11]

Freeman's use of tenure and other variables, along with our utilization of interaction terms plus training,

are in part responsible for the different signs in front of the estimated coefficients for unionism and earnings. By not including an interaction term for wages and unionism, Freeman was unable to capture and examine the union-wage impact on separation and quits. Our results suggest a much stronger role for wages and an expected influence of wages and unionism in reducing quits and in consequently lowering the cost of labor turnover.

Overall, while Freeman de-emphasized the union's role in influencing the wage rate and quits, his observations regarding voice and industrial jurisprudence support our theory of the union as a variable in the basic quits function.

D. Empirical Results from the Training Regression

All of the estimated beta coefficients of the training regression met the $t \geq 1$ criteria for significance. The estimated coefficient for the natural logarithm of wages was significant with a negative sign. In contrast to the education variable used in the SMSA data, occupational training must be paid for by either the individual or the firm (employer). When it is paid for by the firm, it is a production cost as shown earlier in expression (16). Wages are a cost of training, and when wages go up, the firm's demand for training goes down. Since wages are a cost factor in determining the optimal usage of the input training, the inverse relationship shown in Table 9 is

expected. We found a different result in the SMSA study because of the manner in which formal education is funded. The results of the wage coefficient in the SIC training regression were not significant, but the sign was consistent with our findings in the longitudinal survey regression.

The negative estimated beta coefficient for unionism in the training regression indicates that more union strength means less training. This is contrary to our expectations that unionization as part of our quit rate function would, through the quit rate, help increase the firm's investment return. With the lower quits, we expected that the firm would choose to invest in more training since the time horizon for a return is higher.

Duncan and Stafford believed that blue collar union members received less on-the-job training. They also felt that once a wage rate was adjusted to allow for on-the-job training, the relative wage advantage of union membership was reduced.[12] Moreover, Duncan and Stafford's claim that the organization of work can be a substitute for specific and individual akills also provides an explanation for our negative beta coefficient.[13]

The interaction of wages and unionism supports our theory that employees who are union members and who bargain collectively for higher wages tend to stimulate more training by the firm. Clearly, this coefficient signals that training is increased due to union-wage pressure,

whereas the union variable alone indicates the opposite. This finding is consistent with that we have found in other regressions where unionism and the interaction term of union-wages appeared together. The combination of wages and unionism will thus encourage more training by the firm.

Earlier we referred to Becker's statement that quit rates were inversely related to the amount of specific training.[14] We also pointed outthat lower quits will reduce labor turnover and training costs. In equation (16), we showed that training is used up to the point at which the extra returns from training equal the costs of training. While the number of workers trained is determined by the prevailing quit rate, the quit rate we have proposed is also affected by the amount of firm specific training.

The results of the estimated coefficient for quits in the training equation suggest that the higher the quit rate, the more training provided by the firm. This statement is supportive of equation (16) wherein we show that the quit rate determines the amount of training. We had expected lower quits to stimulate further investment in training, not less. What proportion of the occupational training is general and what is specific is not clear.

In our measure of training used in our first empirical test (SVP), we found an inverse relationship. In our second test (Ed), we found a direct relationship but attributed it to the difference in the education

measure. Now, in our test of microdata of men in the age group 45 to 59, we find a direct relationship between quits and training.

The question that arises is what is the difference between the test on the first set of data and the last. Our 45 to 59 age group includes a higher proportion of veteran employees than our test of industry-wide employees presented earlier. John Pencavel pointed out that a firm's wage-quit strategy depends upon the extent to which the firm's work force embodies specific training, for it is the loss of these employees that imposes particular costs on the employer.[15] It is impossible to know what amounts of specific as opposed to general training have been received by the workers in this older age group. One would assume that by seniority alone, older workers have received more specific training than a group of younger workers. The other question that arises is at what point these workers received the training. The question in the survey only polls the amount of training received during the two years prior to 1969 when the question was asked.

The results from the first study of industry data support the proposition that lower quits will stimulate more specific training, and that quit rates are inversely related to the amount of specific training. The results from the longitudinal data support the opposite conclusions.

From the firm's perspective, the increase in quits will mean that more funds will have to be spent on training to bring the replacement employee up to an acceptable productivity level. When a worker in the 45 to 59 age group quits, he must be replaced by an employee who will be as productive within the shortest time. The training required will be dependent upon the qualifications and experience of the new replacement. In general, there is the expectation there would be some mixture of both general and firm specific training.

In summary, the wage coefficient reminds us that wages are a cost of employment. As these costs go up, there is a squeeze on the funds available for other expenditures, such as training. For the firm facing this situation, a decision must be made regarding the substitution of trained versus untrained labor. The cost of paying trained workers must be counterbalanced against the costs of untrained labor. The untrained labor may be less expensive in terms of wages paid, but any minimal training required must be considered in addition to wages and worker productivity.

When a firm must decide between expending funds for more highly trained workers as opposed to paying for untrained employees, it is expected that the amounts available for training and wages would have an inverse relationship with each other. In firms where unionization is also a reflection of additional costs, it is not

surprising that there would be an inverse relationship between wages and training.

When both wages and unionism are combined, however, we realize our expectations that the firm has an incentive to increase training. The firm would increase firm specific training with the expectation that efficiency and productivity gains would help offset higher employment costs. The wage-union impact points to the stability of the worker with these characteristics as an investment candidate for more firm specific training.

The net effect of the union-wage impact is to bring about more training as the firm reacts to recoup the higher wage costs incurred. Indirectly, the union-wage pressure effects more training, but the training is instigated by the firm voluntarily rather than as a response to union pressure.

Our disappointment is in the direct relationship between quits and training. We were not able to prove that the firm will offer specific training due to the lower quit rate. When we used the measure Specific Vocational Preparation in the industry study, we were able to prove this hypothesis. This discrepancy in results suggests that the difference lies in the measurements used. Specific Vocational Preparation appears to be a better measure of specific training than the longitudinal occupational training measure. The latter measure is the reaction to fill a job vacancy and would appear to include more general

than specific training. The inability to segregate the kinds of training through an accurate accounting presents a problem when making an analysis of this type.

We have verified the dependency of training on the quit rate. The results of this regression support our earlier propositions that (1) wages are part of the training function; (2) unionization and wages in interaction will increase training; (3) union voice is only effective in increasing training when combined with wages; (4) quits are a significant factor in the determination of the total training costs; and (5) wages are part of the costs of training.

E. The Wage Regression

Our expectations here are the same as in the past. We looked for a positive sign in front of the beta coefficients for unionism, the interaction terms of unionism and training, and race. In this instance, the race variable was coded 1 when white and 0 when other. The difference in this regression as compared to our earlier ones is that we used the logarithm of wages and the dependent variable.

The interaction of unionism and wages came in as expected. Union membership plus training result in higher wages. As before, the training and unionism variables came in with negative estimated coefficients. Their interaction, however, had a positive estimated

coefficient. The inverse relationship between training and wages suggests that they both represent a cost that involves a choice. When the cost of training goes up, the funding trade-off occurs by spending less on wages. For the employee in the 45 to 59 age bracket, this is particularly true since the firm has little time to pay the higher wage that would be justified by long-term productivity.

The percentage differential for workers who are union members with some training is 6.2%. In other words, the employee who is a union member and who has received occupational training will make a 6.2 percent more than the average wage. The employee who has received training, as opposed to the one who has not, will make 3.7 percent less than the average wage.

A major surprise is the negative estimated beta coefficient for the unionism variable. This result gives us a percentage differential between union and non-union earnings of 12.5 percent. The net effect of the union impact alone is to lower wages. When combined with the training variable, the union influence raises wages. Employees who are union members and who have received training earn higher wages thanemployees without these characteristics. From a policy perspective, the firm rewords further training of union members with higher wages, but does not reward mere union membership or training. For the employee, there is a wage incentive to

become a union member and to receive as much training as possible.

Researchers George E. Johnson and Kenwood C. Youmans found that unions increase the wage rates of their members by as much as 34.2 percent over their non-union counterparts.[16] In our own industry study, we found that unions raised wages. Similarly, Nguyen Thank Quan's dissertation on union effects on earnings used the same longitudinal survey and determined a union/non-union differential of 17.3 percent in 1969.[17]

The reasons for this variance in results are apparent. Quan's study included more explanatory variables, and his R^2 values reflect this difference. His R^2 value reached .49, whereas ours failed to go above.04. Clearly, Quan's study was more complete in his listing of variables that determine the wage rate.

The omission of other variables can cause bias such as the effect of an included variable capturing the effects of an omitted variable.[18] There are also problems due to Quan's omission of information pertaining to region, industries, occupations, and the multicollinearity among some of our independent variables.

The estimated coefficient for the race variable did come in as we expected, and it supported our belief that white workers receive a higher wage than black workers. Their differential inwages of 22.6 percent is consistent with other evidence on this subject.

In summary, the major disappointment in the wage equation was the negative union coefficient. The interaction of union voice and training resulted in the direct relationship we expected. Increases in training caused lower wages, a finding that refers back to the trade-off in funding of employment costs. For the firm, an increase in union bargaining strength plus occupational training will raise the wage rate. The significance levels reaffirm our original wage function, which included unionism and training as determining factors. The interaction term supports the wage function as we expected, and the individual terms provide confirmation in the opposite direction of causation.

F. A Further Look at the Longitudinal Survey

The effect of the interaction terms can be best evaluated by taking partial derivatives of each regression as we did in our two earlier samples. In this sample, we will look at the various values somewhat differently than we did before. The usage of a logarithmic wage function poses some differences as we work through the process.

In Table 10, we show the change in quits as a result of a change in training at various levels of unionism. At all levels of unionism, ranging from 25 percent to 100 percent, training increases the quit rate. The fact that training increases quits implies that the training being given is more general than specific. Specific training

TABLE 10

$\frac{\partial Q}{\partial T}$ at U

Unionism	Partial Effect	t Value
.25	.001362	1.8283
.397 (mean)	.0017412	1.3463
.50	.0020068	1.2692
.75	.0026515	1.1206
1.00	.0032962	1.04244

does not provide skills that are easily transferable to other firms or employers. General training does provide such an advantage and tends to make the employee more mobile.

In our SIC survey, we found a similar positive relationship with quits, but the results of the partial derivatives were not significant. The SMSA data revealed a negative relationship, but it fell short of significance. When a higher proportion of the training is general rather than specific, a positive effect on increasing the quit rate can be expected. When the reverse is true, we would expect an inverse relationship. The consistent effect of training on quits at all levels of unionism points out that the union voice has no impact on the causation of training to quits. Thus, a trained worker's decision about a voluntary quit is not influenced by whether or not he belongs to theunion. The union does not have a job-holding effect on the employee in this particular circumstance.

In Table 11, we look at the impact of unionism on the quit rate at various levels of training. The average number of weeks of occupational training received is low at a value of 1.2. Thus, 3,913 of the 4,335 respondents, or 90.7 percent, did not take part in any training during the previous two years. This is indicative of the age level of the workers being examined. In order to see the effects of more training, we have set the training value equal to 10, 25 and 52 weeks.

TABLE 11

$\frac{\partial Q}{\partial U}$ at T

Training	Partial Effect	t Value
1.2	.5203471	.9134741
10.0	.5431397	.952042
25.0	.5818202	1.0117
52	.6514451	1.0987756

At 10 weeks or less of training, the effect of unionizationon quits is positive and not significant. At 25 and 52 weeks of training, the unionism variable increases quits at a significant level. The additional weeks of occupational training make the union employee more likely to quit. Again, this finding suggests that the training being measured is more general than specific. The problem is, however, that unionism usually reduces quits. In our similar observation on SIC data, we observed the same process. At higher training levels, the positive causation from unionism to quits became significant. This fact would lead us to believe that workers become highly mobile after receiving large amounts of training. It also means that the training is transferable to another position, or that it is more general than firm-specific.

In looking at the effect of unionism on training at a particular wage rate, we have to convert our wage values to their respective logarithms. In Table 12, we assume wage values from $3.00 per hour up to $10.00 per hour to evaluate the effects of unionism on training in a wide range of wages. At both lower and higher wages, an increase in union bargaining strength tends to the lower amount of training.

Earlier we proposed that union voice would reduce quits and would thus make training a more desirable investment for the firm. In the effects shown in Table 12, we are looking directly at the influence of unionism on

TABLE 12

$\frac{\partial T}{\partial U}$ at Wage Rate

Wage	Partial Effect	t Statistic
3	-31.10179	-2.19
5	-27.322536	-5.10288
7	-25.068996	-5.264122
10	-22.680154	-1.2329049

training. The union represents job security, and for the older worker, it means tenure and recognition of time spent on the job. As the union voice grows stronger, there is less need for training, particularly among older workers who are less likely to need it. Moreover, the firm has less incentive to invest in additional training of older workers.

This conclusion is also supportive of the Duncan and Stafford hypothesis that the organization of work can, in part, be a substitute for specific individual skills.[19] Duncan and Stafford also felt that union presence was a response by workers to the character of certain work conditions in certain jobs or occupations.[20] Following this line of thinking, an inverse relationship between unionism and training would be expected.

Table 12 illustrates the effects of a change in wages on training at various levels of unionization. Since we are dealing with the natural logarithm of wages, we made assumptions about wages in order to reflect accurately the impact of a change in wages on the training level.

In Table 13, we show the impact of wages on training at a specified wage level and at a specified level of unionization. In order to convert the natural log of wages to wages, the following is necessary in order to arrive at the partial effect:

TABLE 13

$\frac{\partial T}{\partial W}$ at a Specified W and U

Wage Rate	Unionism	Partial Effect $1/W(b_1+b_3U)$	t Statistic
3	.25	-.0733296	-.004457
7	.25	-.0314269	-.0191027
3	.397 (mean)	.2548494	.063729
7	.397 (mean)	.109271	.0273194
3	.75	1.959033	.33352801
7	.75	1.0429257	.31973

$$(32)\quad \frac{\partial T}{\partial W} = b_1\left(\frac{\frac{\partial W}{\partial W}}{W}\right) + b_3\,\frac{U}{W}$$

$$(33)\quad \frac{\partial T}{\partial W} = \frac{1}{W}\left(b_1 + b_3 U\right)$$

Since our partial effect is $1/W\ (b_1 + b_3U)$, we specify two selected wage rates from which a change in the wage rate will bring about a change in training. Concurrently, we also specify three levels of union strength at each of the two wage levels.

At any level of union strength and wages, a change in wages has no significant effect on training. Higher wages thus do not encourage more or less training, and the presence of a strong or weak union does not alter this insignificant relationship.

In Table 14, we explore the effects of training on wages are various levels of unionism. In this case, we want to see what effect a change in training has on changing wages. To accomplish this, we must change the partial effect to wages from the log of wages.

$$(34)\ \text{Since}\quad \frac{\partial \ln W}{\partial T} = \frac{\frac{\partial W}{\partial T}}{W}$$

$$(35)\ \text{then}\quad \frac{\frac{\partial W}{\partial T}}{W} = Z_2 + Z_3U$$

$$(36)\quad \frac{\partial W}{\partial T} = W\,[Z_2 + Z_3U]$$

We show the effects of a change in training at a specified wage rate of \$3.00 and at three levels of union strength. We used only one wage rate since higher levels

TABLE 14

$\frac{\partial W}{\partial T}$ at a \$3.00 Wage and Specified Levels of Unionism

Wage Rate	Unionism	Partial Effect $[W(Z_2+Z_3U)]$	t Statistic
3	.25	-.006036	-2.42443
3	.397 (mean)	-.00324	-1.49980
3	.75	.002865	1.114703

of wages made no difference in the results.

Increases in training result in lower wages when union strength (voice) is average or relatively low, but such increases raise wages when the union has a stronger influence. Table 14 shows that at the mean value of union bargaining strength and at the level of .25, there is an inverse relationship between training and wages. When 75 percent of the employees are covered by collective bargaining, an increase in training results in higher wages.

A strong union voice -- as measured by the percentage of workers covered by collective bargaining contracts -- is sufficient to bargain for higher wages for those who have received more training. This fact suggests that union voice supports the higher wages that result from more training, and it is consistent with the view that unions support higher wages generally.

From a theoretical perspective, union's support of higher wages is consistent with our expectation that unionization and training both interact to raise wages. In particular, it reemphasizes the ability of the union voice to play a role in bargaining for and achieving higher wages as a return to the employee for more training. In the age group we are examining, it is particularly true that the older workers view the union influence as a means of security.

The union voice comes into full being in the protection of the older worker. Its protection and

bargaining strength results in wage increases for the older worker who has received some training. In this instance, the union causes the return to training for workers who have little incentive at this age to invest in themselves along with an employer who also sees little benefit to further investments into the aging worker.

Our final look in this section is at the effects of changes inthe levels of collective bargaining strength on wages at different levels of occupational training. In Table 15, we show this effect using three different levels of wages and two different levels of occupational training. Since we are looking at an original regression with the natural log of wages as a dependent variable, we must reduce the equation to wages by the same method used earlier. Thus, the right-hand side of the partial derivative must be multiplied by an assumed wage rate.

(37) Since $\frac{\partial \ln W}{\partial U} = \frac{\frac{\partial W}{\partial U}}{W}$

(38) then $\frac{\frac{\partial W}{\partial U}}{W} = Z_1 + Z_3 T$

(39) $\frac{\partial W}{\partial U} = W [Z_1 + Z_3 T]$

Table 15 reflects the effect of a change in unionism on wages at three wage rates and at two specified levels of training.

At higher levels of training and at high levels of wages, increases in the union bargaining strength cause

TABLE 15

$\frac{\partial W}{\partial U}$ at Specified Levels of Wages and Training

Wage Rate	Training	Partial Effect $W(Z_1 + Z_3T)$	t Statistics
3	1.2 (mean)	-.3802134	-4.865423
7	1.2	-.88716	-11.35265
9	1.2	-1.14063	-14.596178
3	25	.04397	.37598
7	25	.10052	.87132
9	25	.12924	1.12794

increases in the wage rate. At low levels of training, regardless of the wage rate level, any increase in union voice will lower the wage rate. In Table 15, we observe an inverse relationship between unionism and wages at various wage levels, assuming 1.2 weeks of occupational training.

An analysis of Table 15 suffers from the shortcoming of the negative coefficient for unionism. We know that this result is inconsistent with all prior studies showing that wages and union strength move in the same direction. The only significant point is the effect of the increases in training and wage rates which reverse the signs from negative to positive.

Overall, the results of the data from the regression run on the longitudinal survey helped support our prior expectations. In terms of significance alone, the results of the beta coefficients were superior to those of the other two samples.

Whenever the interaction term of wages and unionism appeared in the regressions, the signs were as we had anticipated. These results are consistent with our contention that the union voice in concert with wage gains are by far the most influenctial factors affecting quit rates and training.

Although the independent variable quits in the training regression showed a direct effect, it was attributable to the kind of training being measured and to the

inability to distinguish firm specific from general training in the measurement process.

Stronger union voice has the effect of reducing the amount of training. This result from the longitudinal survey is not surprising considering the age group of the men being studied. Older workers are more interested in the security payoff of the union than in additional training. The time frame left of recapture any benefits from more training is too short, and the benefits from union membership are far more rewarding for the worker in this age group.

We also observed that when wages go up, training goes down. This is consistent with our model showing both training and wages as part of the total employment costs facing the firm.

In the wage equation, the interaction of training and unionism supported the view that these two factors together raise wages. Workers with training will receive higher wages when they are also members of a collective bargaining unit. We also reaffirmed in this microdata study that whites receive higher wages than non-whites.

We have mentioned that the wage equation was not as successful as that of another recent study using the same data. Our purpose here was to observe the results of the regressions used from the beginning of the study. Our results rest with the three regressions that have been utilized to test the theoretical propositions found in the

first chapter. The three regressions used here are unique in having never been used before in the structure we presented on any of the data tested.

CHAPTER SIX

CONCLUSION

Concluding with our study of the longitudinal survey sample, we have examined three sets of data to verify our theoretical expectations regarding the effect of union voice in relation to quits, training, and wages. Using our neoclassical model, we were able to establish what factors enter into the firm's decision in employing optimal amounts of labor and training. Using multiple regression analysis, we tested to determine these factors and the direction in which they affect quit rate levels, training, and wages.

Taking the regressions in order of their appearance, we found mixed results pertaining to the significance of the variables affecting the quit rate. Our longitudinal and SMSA studies consistently verified that increases in wages will lower the quit rate. The SIC results found the contrary result. We established that wages in interaction with union bargaining influence do lower the quit rate, but the results were not significant. Accessions, representing additions to the work force, also affect the quit rate.

From a policy perspective, the firm can be assured

that increases in wages will lower the quit rate. In addition, union representation and its inherent union-wage advantages will tend to effect a lower quit rate than that of firms without union representation.

Perhaps the most significant contributions of this study stem from its examination of training as a dependent variable along with the independent variables in the training regression. The use of three different measures representing training point out the problems of utilizing any measury, proxy or otherwise, to denote the amount of training offered by the individual and/or received by the employee. The results of the SMSA study, which used formal education, offered the greatest contrast and were not surprising.

A related problem is the kind of training being measured. It is impossible to distinguish what portion of any hour or week of occupational training is general as compared to how much is firm-specific or job-specific. The difficulty of assessing general versus specific training is pointed out by the difference in results obtained when comparing SIC and longitudinal survey data pertaining to training and quit relationships.

Another concern centers on who sponsors the training. While our model indicated some sharing of the costs, the regression results are not consistent on this issue. If it is the individual who funds most of the cost, the reaction to the possibility of a quit is far different

regardless of whether the training is general or firm-specific. On the other hand, if the firm is the sponsor, then the type of training determines whether the employee views himself as more mobile for employment at another firm.

Our model assumed that there is some specificity in the training offered. Our results from the industry study lead us to believe that this training (SVP) is specific or that the costs of the training are at least partly paid for by the employee. Our longitudinal results show just the opposite. The latter suggest that the training is more general than specific, and that it is paid for by the firm. The term specific vocational preparation (SVP) in the industry study is perhaps more specific to a trade than to a firm. If it is specific to a trade, the costs are more likely to be paid for by the employee.

The longitudinal survey results reveal that quits in general trigger more training in order to make the replacement as productive as possible and as soon as possible. While this result seems to contradict our argument that lower quits means more training, it points out that training for newer employees is more prevalent than training that is firm-specific for more senior or current employees. The lesson is that the amount of training offered by the firm is more oriented toward bringing the new worker up to par than to offering firm-specific training for currently employed workers. As a

result, higher quits will stimulate more training and higher employment costs for the profit-maximizing firm. In particular, in the case of the longitudinal study the loss of a veteran employee is far greater in terms of the training necessary to bring a new worker up to a comparable level of productivity.

This result also implies that the training given is proportionately more general than firm-specific. Since the kind of training being offered by the firm is more oriented toward the new worker, it is expected to be more general than specific. Employees who do receive more specific training are likely to be the more stable veteran employees who have a lower quit rate.

Our examination of the interaction terms in the wage equation and in the training regression reaffirm the key role of the wage rate in the linkage process.

Because unions are effective in voice expression and in wage bargaining, the worker who is a union member and who has received training is more likely to earn higher wages than a non-union worker in similar circumstances. In addition, an employee who is a union member and who has received training is more likely to earn a higher wage than a union member who has not had training. Both union pressure and training can raise wages. This assumes that there is a reward for having received more training.

From the firm or employer's perspective, the employee may or may not receive a substantial wage return

due to more training. If a strong union has bargained for a substantial union wage advantage, the firm may not have the monetary flexibility from a cost perspective nor the incentive to reward further training. Since there is already a wage differential and a lower quit rate, the firm is not motivated to raise wages further to guarantee a return on investment.

The question arises as to why the firm would make further training investments. The answer is that doing so is desirable because the firm wishes to operate more efficiently as a result of offering more training, thereby recouping the additional training costs and some of the higher wages and benefits resulting from collective bargaining. Since the union has already bargained for higher wages and has also provided an atmosphere of voice through industrial jurisprudence, the firm does not need to reward training with higher wages to prevent voluntary turnover. The fact that there is already less voluntary turnover due to union presence provides the incentive and environment for the firm to make human capital investments that have a higher probability of positive net returns.

Our disappointment is in the inability to prove that the firm makes the training investment decision resulting from the union-inspired lower quit rate. The inability to distinguish between replacement training versus advanced or further training results in the contrasting results shown in our SIC data as compared to

our NLS study.

Our results do reaffirm that a wage-quit strategy can be utilized to lower the firm's costs of training. This strategy will enable the firm to experience lower employment costs. The firm obviously has an interest in lowering employment and training costs, and one way to do so is through a lower voluntary turnover rate. This finding suggests that the non-union firm can also implement a wage-quit strategy designed to lower employment costs associated with the training needed for replacement employees. In the unionized firm, the wage-quit strategy is part of the results derived from the union grievance and bargaining procedures. While the union maximizes the return to employees through higher wages and other benefits, then factors also have the effect of lowering the quit rate. While higher wages are costly for the firm, these costs may be at least partially offset by a lower quit rate.

Although we were not able to prove it consistently with empirical data, the lower quit rate will mean less general training for new replacements and more firm-specific training. The direct relationship with replacement training is verified, but we could not determine the stimulation of more firm-specific training.

The results of our empirical studies supported the equations illustrated earlier pertaining to the rules for choosing the optimal amounts of training and labor. The

shortcoming was in distinguishing between the two kinds of training since these cannot be accounted for by any currently known means of measurement.

A firm in the process of profit maximization faces choices when it is confronted with the additional costs of union presence. While the union offers indirect advantages that will lower the quit rate, it inevitably also requires up front increases in wages and fringe benefits. Through additional training, the firm can seek to gain efficiencies in production to offset the rising costs of the union's presence. The decision to invest in further training and the associated marginal costs must be weighed against the marginal returns. The firm has also made similar gains historically through automation, which has had a dual impact on efficiency and on labor requirements.

The gains of a wage-quit strategy that lowers employment costs accrue to the firm. First, there are the gains that result from lower employment costs due to less turnover. Secondly, gains result when the firm chooses to invest in further specific training to obtain efficiencies in production as a result of the lower quit rate. These efficiencies are advantages gained by the firm. Whether the second decision is made is dependent upon the returns as measured within the constraints of the structured union-work environment.

In the exit-voice model reviewed by R.B. Freeman,

reference was made to possible efficiency gains resulting from the firm's reduction in quits and training costs and from its increase in specific investments in human capital.[1] The first part of the Freeman claim can be supported by the results shown here. In addition to affirming the voice mechanism supported so strongly by Freeman, we have also provided further credence to the role of union-inspired wage gains as a part of the lower voluntary labor turnover experienced by unionized firms. Quits and replacement training costs will be lowered, but the problem lies in determining the further firm-specific training investments. The difficulty in measuring or observing this latter phenomenon stems from the problems of segregating general training from firm-specific training, and from separating routine replacement training from advanced training. The latter is defined as further training, subsidized wholly or in part by the firm, whose objective is to improve productivity sufficiently to lower or offset unit labor costs imposed on the firm by collective bargaining. The present study has confirmed that lower quits lower the amoung of replacement training and in doing so results in lower employment costs. The determination of the amount of advanced training induced by the lower quit rate must be deferred until distinct measurements in the types of training can be made.

FOOTNOTES

Chapter One

[1]R. B. Freeman, "Some Uses of the Exit-Voice Approach -- Discussion," American Economic Review, American Economics Association, (May, 1976) p. 390.

[2]Summer H. Slichter, James J. Healy, E. Robert Livernash, Impact of Collective Bargaining on Management, The Brookings Institute, Washington, D.C., 1960, p. 79.

[3]Ibid, p. 960.

[4]R. B. Freeman, "Individual Mobility and Union Voice in the Labor Market," American Economic Review, American Economic Association, Nashville, Tennessee (May 1976) p. 365.

[5]R. B. Freeman, "The Effect of Unionism on Worker Attachment to Firms," The Journal of Labor Research, Department of Economics, George Mason University, Fairfax, Virginia, (Spring, 1980) p. 57.

[6]C. J. Parsley, "Labor Union Effects on Wage Gains: A Survey of Recent Literature," The Journal of Economic Literature, 18 (March 1980), p. 9.

[7]Daniel S. Hamermesh, "White Collar Unions, Blue-Collar Unions, and Wages in Manufacturing," Industrial and Labor Relations Review, 71 (January, 1971) p. 170.

[8]C. J. Parsley, Op. Cit., p. 9.

[9]John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, Industrial Relations Section, Princeton University, Princeton, New Jersey, 1970, p. 24.

[10]Ibid., p. 5.

[11]John F. Burton, Jr., and John E. Parker, "Inter-industry Variations in Voluntary Labor Mobility," Industrial and Labor Relations Review, 22 (June, 1969) p. 213.

[12]Ibid., p. 213.

[13]Ibid., p. 213.

[14]John H. Pencavel, "Wages, Specific Training, and Labor Turnover in U.S. Manufacturing Industries," International Economic Review, 13 (February, 1972) p. 61.

[15]John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, p. 22.

[16]Donald O. Parsons, "Specific Human Capital: An Application to Quit Rates and Layoff Rates," Journal of Political Economy, University of Chicago Press, 70 (December 1972), p. 1137.

[17]Daniel S. Hamermesh, "Potential Problems in Human Capital Theory," Proceedings of the 26th Annual Meeting of the Industrial Relations Research Association, p. 229.

[18]Gary Becker, Human Capital, Princeton, New Jersey, Princeton University Press, (1964), p. 18.

[19]Ibid., p. 24.

[20]Parsons, Op. Cit., p. 1134.

[21]Parsons, Op. Cit., p. 1140.

[22]Boyan Jovanovic, Jacob Mincer, "Labor Mobility and Wages: On the Job and Over the Life-Cycle," Conference on Low Income Labor Markets, National Bureau of Economic Research, New York, New York, (June, 1978) p. 19.

Chapter Two

[1]C. E. Ferguson, The Neoclassical Theory of Production and Distribution, The University Press, Cambridge (1971) p. 146.

[2]R. B. Freeman, "The Effect of Unionism on Worker Attachment to Firms," p. 57.

[3]Ibid., p. 61.

[4]John H. Pencavel, "Wages, Specific Training, and Labor Turnover in U.S. Manufacturing Industries," International Economic Review, 13 (February, 1972) p. 62.

[5]John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, p. 38.

Chapter Two (cont'd.)

[6]Ibid., p. 50.

[7]Becker, Op. Cit., p. 22.

Chapter Three

[1]John H. Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, p. 39.

[2]Ibid., p. 23.

[3]R. B. Freeman, "Individual Mobility and Union Voice in the Labor Market, The American Economic Review, (May 1976) p. 367.

[4]Burton and Parker, Op. Cit., p. 214.

Chapter Four

[1]Gary Becker, Op. Cit., p. 18.

[2]R. B. Freeman, "The Effect of Unionism on Worker Attachment to Firms," p. 50.

[3]Jacob Mincer, "On-The-Job Training: Costs, Returns, and Some Implications," Journal of Political Economy, 70 (April 1962), p. 60.

[4]Parsons, Op. Cit., p. 1132.

[5]John H. Pencavel, "Wages, Specific Training, and Labor Turnover in U.S. Manufacturing Industries," International Economic Review, 13 (February 1972) p. 59.

[6]C. T. Haworth and D. W. Rasmussen, Human Capital and Interindustry Wages in Manufacturing," The Review of Economics and Statistics, Cambridge, Massachusetts, Harvard University Press, 53 (November, 1971) p. 377.

[7]Ibid., p. 377.

[8]Daniel S. Hamermesh, "A Disaggregated Analysis of Gross Changes in Employment," Yale Economic Essays 9 (1969) p. 132.

[9]R. B. Freeman, "Individual Mobility and Union Voice in the Labor Market," p. 367.

Chapter Five

[1]Arvil V. Adams, "Earnings and Employment of Middle Aged Men: A Special Study of Their Investment in Human Capital," in The Pre-Retirement Years, Vol. 4, Ed: Parnes et. al., Manpower Research Monograph, No. 15.

[2]Sherwin Rosen, "Trade Union, Power, Threat Effects and the Extent of Organization," Review of Economic Studies 36 (April, 1969) pp. 185-196.

[3]George E. Johnson and Kenwood C. Youmans, "Union Relative Wage Effects by Age and Education," Industrial and Labor Relations Review, 25 (January, 1971) p. 172.

[4]In particular, the estimate of u is seen to be $e^{B^*}-1$, where B* is the estimated coefficient on unionism. This is obtained by taking the anti log of b minus 1, where b is the estimated coefficient on unionism.

[5]Ronald J. Wonnacott and Thomas H. Wonnacott, Econometrics, John Wiley and Sons, Inc., (1970) p. 61.

[6]Potluri Rao and Roger LeRoy Miller, Applied Econometrics, Wadsworth Publishing Company, Inc., Belmont California (1971) p. 51.

[7]R. B. Freeman, "The Effect of Unionism on Worker Attachment to Firms," p. 57.

[8]Ibid., p. 30.

[9]Ibid., p. 51.

[10]Ibid., p. 50.

[11]Ibid., p. 51.

[12]Greg Duncan and Frank Stafford, "Pace of Work, Unions and Earnings in Blue Collar Jobs," Institute for Social Research and Department of Economics, The University of Michigan, Ann Arbor, Michigan (March, 1977) p. 25.

[13]Ibid, p. 25.

[14]Becker, Op. Cit., p. 24.

[15]John H. Pencavel, "Wages, Specific Training, and Labor Turnover in U.S. Manufacturing Industries," International Economic Review, 13 (February, 1972), p. 61.

[16]Johnson and Youmans, Op. Cit., p. 174.

[17]Nguyen Thanh Quan, Union Effects on the Size Distribution of Earnings, Dissertation, Michigan State University, 1978, p. 70.

[18]Rao and Miller, Op. Cit., p. 21.

[19]Duncan and Stafford, Op. Cit., p. 25.

[20]Ibid., p. 7.

Chapter Six

[1]Freeman, Op. Cit., p. 365.

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