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QUIT BEHAVIOR IN U.S. MANUFACTURING INDUSTRIES

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I. INTRODUCTION

Models of job search have been increasingiy applied to explain labor market activities. A frequent criticism on the job search theory of employment and unemployment fluctuations concerns the assumption that workers choose to be unemployed while seeking jobs offering better wages rather than searching while remaining employed. In the interest of income security many workers would prefer to stay on the job while searching for a better wage. If the wage rate of an employed worker falls under an aspiration level, he will start searching for another job. A direct transfer from one job to another is effected if an employee is offered a better wage by another firm. Applying search theory to the analysis of quits is appropriate because the voluntary turnover is centered on individuals moving between jobs over relatively short periods with or without intervening periods of unemployment.[1] On the other hand, if people must quit low-paid work to search for high-paid work, it is also appropriate to turn to a job search model of unemployment to explain quits.

Analyzing quit behavior is important because the voluntary labor turnover is a key indicator for current labor market movements. Early and Armknecht (1973) argued that the manufacturing quit rate may be the best summary measure of manufacturing workers' attitudes about the labor market and these attitudes are in turn important contributors to aggregate demand and the course of the total economic activity. Geweke (1982) reported evidence that most nonseasonal variations in the quit rate among production workers in manufacturing is accounted for by workers who leave jobs after having found alternative employment and argued that the quit rate provides a proxy for excess demand in one important labor market. Medoff and Abraham (1982) argued that the manufacturing quit rate represents tightness in the labor market at least as well as either the official or the prime-age male unemployment rate.

There have been at least three different positions on the behavior of the quit rate. First, a number of studies have purported to have found a downward trend in the quit rate even after taking account of the cyclical nature of voluntary turnover.

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1) Mattila (1974) summarized the results of sixteen studies which estimated the proportion of quitters who line up a job in advance. This proportion ranged from 31 percent to 81 percent. The estimates differ in region, occupations, phase of business cycles, and the subset of quitters included in surveys. Weighing the quality of the various surveys, Mattila concluded that at least 50 to 60 percent of all quits move from job to job without ever experiencing unemployment. In Mellow's (1978) survey, 72 percent of quits were direct job changes and economic quits move directly to new jobs at substantially improved wages.

The secular decline in the quit rate has been attributed to "industrial feudalism", the hold which the non-transferable pension plans and other fringe benefits and seniority rights have on a worker.[2] A second position suggests that there exists a downward trend in the quit rate but that this largely was the result of factors such as the growth of unions, the aging of the manufacturing labor force, and the stability of employment in the manufacturing sector.[3] A third group holds that no significant downward trend in the quit rate is discernible and that most of its variations over time arise from cyclical factors.[4]

In this paper, job search theory is applied to examine the behavior of quitters and the implication is tested on data of U. S. manufacturing industries. The theory emphasizes the fact that differentials between workers' current wage rates and the average wages in markets and movements in the availability of job vacancies initiate workers to undertake search activities. The next section describes the basic framework of Parsons' (1973) model of quit behavior and outlines the model specification for empirical estimation. Section III presents an empirical analysis which describes data, estimation procedures and the results. Section IV summarizes the findings of this study.

II. A JOB SEARCH MODEL OF QUIT BEHAVIOR

An employed worker will quit the current job if he finds a wage offer which is greater than the sum of his current wage (W_0) and transfer costs (TC).[5] The probability that he will quit in a single search (s) is given by :

(1) $s = gP,$

where g is the probability of locating a wage offer, and P is the probability that the wage offer is greater than $W_0 + TC$. If the probability of finding a wage offer is an increasing function of vacancy rate (v), say $g(v)$, then (1) can be written as :

(2) $s = gP = g(v)P(a) = g(v)[1-F(a)],$

where a is the quitter's acceptance (or reservation) wage, i. e., $a = W_0 + TC$, and $F(a)$ is the cumulative distribution function of a. The probability of not quitting in a single trial is then $(1-s)$.

Suppose that the worker carries out sequential search. Assuming that s is constant, the probability of not quitting in N independent trials is $(1 - s)^N$. The probability of quitting in N searches, q, is then given by :

(3) $q = 1-(1-s)^N.$

By the binomial theorem :

2) Shister (1950) and Clague (1956).
3) Ross (1958).
4) Parker and Burton (1967) and Burton and Parker (1969).
5) An employed worker will also quit his current job when the wage paid falls below his reservation wage, i. e., when he becomes aware of better prospects elsewhere, or his benefit income rises.

(4) $q = 1-(1-s)^N = Ns - \frac{N(N-1)}{2}s^2 + \frac{N(N-1)(N-2)}{6}s^3 - \cdots$

Dropping the quadratic and higher order terms in s yields :

(5) $q \approx Ns.$

For simplicity assume that the total search cost function is given by $C = \frac{1}{2}cN^2$, so that $\partial C / \partial N = cN$, where c is the (constant) marginal search cost. The optimal number of searches N will be chosen such that the unsuccessful searcher's marginal returns from search equal marginal search cost :

(6) $R_i = cN,$

where R_i is the expected return to a unit of search. R_i will be the probability of finding a wage offer times the expected wage increase net of transfer costs :

(7) $R_i = g(v)\int_a^\infty (w-a)f(w)dw,$

where $f(w)$ is the normal density function of alternative wages. If wage offer w are normally distributed with mean $\bar{w}$ and variance σ^2_w, the expected net wage increase may be integrated as :

(8) $\int_a^\infty (w-a)f(w)dw = \sigma_w^2 f(a) - (a-\bar{w})[1-F(a)],$

where $F(a)$ is the cumulative normal distribution. From (6) and (8) :

(9) $N = \frac{g(v)}{c}\int_a^\infty (w-a)f(w)dw$

$= \frac{g(v)}{c}\{\sigma_w^2 f(a) - (a-\bar{w})[1-F(a)]\}$

From (2), (5), and (9) :

(10) $q = Ns = Ng(v)P(a)$

$= \frac{g(v)}{c}[\sigma_w^2 f(a) - (a-\bar{w})P(a)]\, g(v)P(a).$

Let $y(a) = \sigma_w^2 f(a)/P(a) - (a-\bar{w}).$ Then,

(11) $q = \frac{g(v)^2}{c}P^2(a)y(a)$

$= \frac{g(v)^2}{c}z(a),$

where $z(a) = P^2(a)y(a).$ Taking the logarithm of (11) yields :

(12) $\log q = -\log c + 2\log g(v) + \log z(a).$

In equation (12) a worker's quit propensity depends on search cost factors, job availability, and wage considerations.

For estimating purposes, the wage considerations $z(a)$ in equation (12) must be explicitly specified. However, the parameters of the alternative wage distribution are not known with certainty. Parsons (1973) argued that for the quit rate function, the difference of the worker's own wage (W_i) and his prediction of alternative wages (W^e) is the crucial variable to represent the wage considerations, $z(a)$.

$W_i - W^e$ is the deviation of the current local market wage from the expected average market wage. Workers do not have all the relevant information about movements of wages in other markets. Assuming a lag in the discernment of the average market wage, a surprise rise in the local market wage tends to influence workers to accept the employment currently being offered in the local market because their reservation wages are unaffected in the short run. The detection—lag hypothesis predicts that the estimated coefficient on $W_i - W^e$ in quit regression will have a negative sign.

The wage misperceptions term $W_i - W^e$ may be decomposed into two components :

(13) $W_i - W^e = (W_i - W) + (W - W^e).$

$W_i - W$ is the wage rate of the i-th market relative to the average market rate, and $W - W^e$ is the expectational error about the market average wage rate. The wage considerations in (12) will be represented by (13) in empirical analysis. Wage variables for quit rates do not include a term for intertemporal substitution effect. Since many workers quit the current job after successful completion of job search, no explicit line of causality is assumed running from intertemporal effect represented by real earning prospects to employment—acceptance decision and resulting effect on quit rates. [6]

Ⅲ. EMPIRICAL ANALYSIS

1. The Model

The basic regression equation to be estimated is of the from :

(14) $\log q_{it} = b_{0i} + b_{1i} \log v_t + b_{2i} \log (W_i / W)_t + b_{3i} \log (W/W^e)_t,$

where q_{it}, is the quit rate of the industry i, v is the industry—wide vacancy rate, W_i is the money wage rate in the industry i, W is the mean market wage rate, and W^e is expectations about W. The effects of each of the independent variables on the quit rate may be identified :

<u>The Job Availability Effect</u>

An increase in the industry—wide job availability suggests a higher job offer probability, which will tend to increase quit propensity ($b_{1i} > 0$).

6) Another problem of applying intertemporal substitution model to the analysis of quits is pointed out in Hall (1980, p. 9) : "a recurrent theme in the discussion of the (intertemporal substitution) model is the criticism that it makes employment fall by raising quits, when, in fact, quits are low during a downturn" (parenthesis added).

The Relative Price Effect

The effects of own wage rates, or relative to its mean, on quit rates may be linked in three different ways.

a) The Pure Price Effect

A rise in the relative price of a good increases the supply of the good. A rise in the relative wage of the i th industry will increase the employment supplied to the i-th industry and thus is expected to lower the quit rate ($b_{2i}<o$).

b) The Effect of Expected Search Outcome

Quits would vary directly (inversely) with own wage rates if the present value of the net revenue gained from job search, the expected present value of the return from job search minus the sum of direct search costs and foregone earnings, were a positive (negative) function of the wage rate and if workers were risk-neutral ($b_{2i} \gtrless o$).[7]

c) The Specific Training Hypothesis

Another major approach to the wage—quit relationship is the specific training hypothesis. Pencavel (1972) has argued that some employers increase their wage relative to the average wage in the market in order to discourage quits to the extent that the costs of higher remuneration are, at the margin, balanced by the harmful effects of the turnover on productivity typically associated with firm—specific training and human capital investment.[8]

The specific training hypothesis predicts that an industry's wage rate is inversely related to the perceived probability of quitting ($b_{2i}<o$). The specific training hypothesis has received considerable empirical supports.[9]

The net effect of changes in the relative wage on quits is an empirical matter.

The Wage Misperception Effect

Given a constant differential between a firm's wage rate and the mean of the wage distribution, an unexpected increase in the mean wage rate will aspire workers to search other firms for higher wages and therefore is expected to raise the quit probability of an individual worker ($b_{3i}>O$).

2. Empirical Results

Industry wage rates were represented by the average hourly earnings of production workers. The all—manufacturing average wage rate was used as a proxy for the mean of the alternative wage distribution. Expectations about the average market wage were generated using an autoregressive moving—average process. An ARMA (1, 1)

7) For an explanation, see Bloch (1979).

8) See also Parsons (1972).

9) Empirical investigations of the specific training hypothesis have shown overwhelmingly a negative correlation between quit rates and wage levels. Pencavel (1972) found a negative relationship between quit rate and the log of median annual wage and salary income from the data for U.S. manufacturing industries in 1959. Bloch (1979) presented a negative relationship between quit rate and average hourly earnings from the identical data with Pencavel (1972). Ragan and Smith (1982) reported a negative relationship between quit rate and the log of annual earnings using individual samples in manufacturing industries collected over the period 1959-1968. Utgoff (1983) found a negative correlation between quit rate and average hourly earnings form cross-industry and cross-state data.

model with a seasonal MA(1) term applied to the seasonal first differences of the wage variable was initially identified and estimated for the period January 1960—March 1969 using monthly data on average hourly earnings in manufacturing. This estimated model was used to generate the forecast of the wage for April 1969. The forecasts were updated at monthly intervals through December 1973. Industry quit rate is measured per employee.[10]
The industry quit rates, the manufacturing vacancy rate, and the industry and all—manufacturing wages are taken from *Employment and Earnings*.

Evidence mentioned in Mattila (1974) that more than half of all quitters move from job to job without experiencing unemployment suggests that many quitters conduct job search prior to quitting their current jobs. Therefore, the quit rate equations estimated contain a monthly lagged variables of each of the explanatory variables in equation (14). Regression results for twenty industries in manufacturing as well as durable goods, nondurable goods, and all manufacturing for the period April 1969-December 1973 using monthly data are presented in Table 1. All the regression equations are adjusted for the first-order autocorrelation of residuals using the Cochrane-Orcutt method. The correction factor $\hat{}$ is presented in the last row of Table 1.

The estimated coefficients on the contemporaneous vacancy rate have positive signs and are highly significant in 18 of the 20 subindustry equations. They are insignificant in equations for the tobacco manufactures and petroleum and coal products industries. The estimated coefficients on the lagged vacancy rate are insignificantly different from zero in all of the subindustry equations with the exception of the electric and electronic equipment industry where it is significant at the 10 per-cent level. Thus, the contemporaneous effect of changes in the industry—wide vacancy rate on quit rates appears quite pervasive across industries.

The effect of changes in the relative wage of the specific industry on the industry's quit rate does not reveal uniformity across industries. In 9 of the 20 industry equations, the coefficients on both the current and lagged relative wages are insignificantly different from zero. The estimated coefficient of relative wage is positive and significant in the lumber and wood products and fabricated metal products industries (the current variable) and the electric and electronic equipment and paper and allied products industries (the lagged variable). The relative wage coefficient is negative and significant in the transportation equipment and food and kindred products industries (the current variable) and the textile mill products and leather and leather products industries (the lagged variable). Both the current and lagged relative wage coefficients are significant, but they change in sign in three industries : primary metals, tobacco manufactures, and apparel and other textile industries. These mixed results on relative wage may reflect the theoretical prediction that the industry wage has a positive (negative) effect on the industry's quit rate if the expected net return

10) For the definition of the quit rate, see *Handbook of Cyclical Indicator* (U. S. Department of Commerce, 1977), p. 18.

from search were a positive (negative) function of the industry wage rate. However, this explanation cannot be confirmed without further information about expected post—quit wage rates. It is apparent that the obtained coefficient estimates on relative wage are not systematically related to industry wage rates. Another source of the more or less erratic behavior of the relative wage variable may lie in the measurement of the wage variable due to the limitations of the data.

As for unexpected wages, the coefficients for the contemporaneous variable are insignificantly different from zero in all of the 20 industry equations. The coefficients for the monthly lagged unexpected wage have positive signs and are significant in 9 of the 20 subindustry equations and in equations for all manufacturing and for nondurable goods manufacturing. The coefficients of the lagged unexpected wage have the t—statistics of 2.58—3.03 in five industries and in nondurable goods manufacturing, and the t—statistics of 1.81—2.06 in four industries and in all manufacturing. The coefficients of the lagged unexpected wage are "mildly significant" (t—statistics of 1.48—1.63) in three industries. In equations where unexpected wages have negative coefficients, none of them is statistically significant. This outcome indicates that in about half of the industries examined, wage misperception is of importance as a determinant of quits.

Parsons (1973) tested the detection—lag hypothesis and found little empirical support from the data for 27 manufacturing industries for the period 1959—1968. In Parsons' study the detection—lag effects are represented by the growth rates of industry own wages. The regression results presented here indicate that quit rates in manufacturing industries are strongly effected by the industry—wide job availability in the majority of cases and by the misperception about the mean of alternative wages in some (about half) industries in theoretically predicted directions. Effects of relative wages had no particular direction on quit rates. The coefficient estimates tend to conform this expectation.

These results are, of course, specific to the manufacturing industries for the time period considered. There are several theoretical and statistical assumptions made here which may bias estimation results. For example, a simultaneity problem arises if high quit rates may well lead to wage increases as firms try to hold their workers. The specific training hypothesis assumes an explicit line of causation running from quits to changes in wage (Pencavel (1972)). Another simultaneity problem aries if contemporaneous correlations exist between error terms of industry equations. These points suggest that estimation results may be further refined.

The primary goal of this empirical work has been to examine the relative importance of two alternative explanations—job availability constraints versus wage misperceptions—as determinants of quit rates. Therefore, the equations are not intended to provide the best possible explanation of actual quit behavior during the same period. The fit of these equations could undoubtedly be improved by including other explanatory variables, but this approach is not pursued here because of the focus on these two perspectives.

In many of theoretical as well as empirical studies of quit rates, the probability of quitting is affected by demographic and social characteristics of quitters besides labor market considerations. In Hall (1972), the probability that a worker quits a job is negatively related to his age and job tenure. In Burdett's (1978) model, the wage rate, the age of worker, and the worker's job tenure determine the probability of quitting. Demographic and socio—economic variables have been found to be significantly affecting quit propensity in many of past empirical studies. Barron and McCafferty (1977) estimated equations for the quit rate of those choosing unemployed job search. They included the index of help—wanted advertising, the average age of the labor force, and an August—September dummy variable in their quit rate regression. Using monthly data from February 1967 to August 1975, they found evidence that the average age of the labor force has a significant negative effect on the quit rate. Bloch (1979) included in quit rate regression variables representing labor market conditions as well as individual characteristics of employees. Using a 1960 sample of 49 manufacturing industries, he found that variables such as the proportion of employees under 30 years of age, the proportion of employees in large SMSAs, the years of education, and the ratio of female to male employees have significant positive effects on quit rates. Ragan (1981) also showed that the percentage of employees younger than age 25 has a significant positive effect on the quit rate in manufacturing based on the data for the period from 1950 : I to 1979 : IV. This evidence suggests that the additional consideration of demographic variables in quit rate regression may well improve the estimates of quit rates.

IV. SUMMARY AND CONCLUSION

Quits may result in either an unemployment or a job-to-job move. When unemployment is high, the quits for both reasons decline. When employment grows at a high rate, both quits rise because in a boom a worker can expect to find a better job more quickly than in a recession. Unemployment and quits move in the opposite direction, while employment growth and quits move in the same direction. In the job search unemployment literature a role of unemployment and vacancies stems from their effects on quits. Given a differential between a firm's wage and wages other firms are expected to pay, the direction of causality runs from changes in numbers of unemployment and vacancies to subsequent quit decision rather than from increases in quits to resulting increases in unemployment. For this reason, vacancy rate and wage differentials enter the quit rate equation.

The quit rate estimates indicate the compatibility of the search explanation of labor market behavior with the turnover experiences. Based on data from 20 manufacturing industries for the period 1969 : 4—1973 : 12, the empirical results suggested that changes in the vacancy rate significantly affected quit rates in the majority of cases while wage misperceptions significantly affected quit rates in about half of cases. This evidence disagrees with the findings reported by Parsons (1973) concerning the determinants of quit rates in 27 manufacturing industries for the period 1959—1968 in which the wage misperceptions effect received little empirical support. However, evidence in this paper suggests that omitting the wage misperceptions effect in the analysis of the voluntary turnover obscures an important determinant of the labor mobility.

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[Table 1] Regression Estimates of Quit Rates for Manufacturing Industries, Monthly Data 1969 : 4 - 1973 : 12

		Constant	$log\ v_t$	$log\ v_{t-1}$	$log\ (W_i/W)_t$	$log\ (W_i/W)_{t-1}$	$log\ (W/W^e)_t$	$log\ (W/W^e)_{t-1}$	R^2	$\hat{\rho}$
	Total Manufacturing	1.0558	.6618	.1497			-.4000	11.0063	.466	.590
		(15.15)	(3.43)	(.78)			(.07)	(2.06)		
DURABLE GOODS	Total	-.2073	.8012	.0750	4.1715	14.4273	-5.4022	5.6105	.534	.538
		(.22)	(3.98)	(.38)	(.41)	(1.39)	(.91)	(.95)		
	Lumber & wood	3.0205	.7937	-.0394	9.7095	.7395	7.7853	14.7747	.670	.322
		(11.14)	(4.07)	(.21)	(3.84)	(.30)	(1.28)	(2.82)		
	Furniture & fixtures	1.4850	.8218	-.1014	5.2240	-5.5724	1.4334	9.4538	.559	.525
		(1.96)	(4.13)	(.51)	(1.34)	(1.31)	(.23)	(1.81)		
	Stone, clay & glass	.9383	.7035	.1489	6.1022	3.1491	1.3141	10.7114	.597	.415
		(12.83)	(3.31)	(.72)	(1.52)	(.77)	(.19)	(1.90)		
	Primary metals	.8577	.6371	.3831	8.5170	-9.9716	-5.3051	12.0650	.586	.491
		(1.80)	(2.60)	(1.58)	(2.18)	(2.55)	(.80)	(1.86)		
	Fabricated metals	.1235	.8147	.1967	10.8407	8.0926	-2.3589	8.7671	.591	.535
		(.28)	(4.14)	(1.02)	(1.69)	(1.20)	(.42)	(1.63)		
	Nonelectric machinery	1.6342	.8064	.1070	-9.4394	.6439	-4.3018	6.7195	.652	.405
		(1.75)	(4.02)	(.54)	(1.52)	(.11)	(.70)	(1.12)		
	Electric equipment	1.1981	.6738	.3280	-3.6108	14.7373	-6.6248	10.0622	.614	.499
		(6.43)	(3.58)	(1.72)	(.72)	(2.86)	(1.13)	(1.93)		
	Transportation equipment	1.6773	.6430	.1290	-8.3730	2.9761	7.3452	9.2943	.498	.579
		(2.58)	(3.16)	(.63)	(2.70)	(.99)	(1.06)	(1.48)		
	Instruments	.6873	.6366	.1690	-2.0235	2.0658	-3.6258	18.4197	.519	.482
		(7.20)	(2.86)	(.78)	(.46)	(.47)	(.52)	(2.94)		
	Miscellaneous manufacturing	.7873	.5265	.1465	-2.4792	-.1905	-4.7139	4.5772	.409	.502
		(1.37)	(2.33)	(.66)	(.55)	(.04)	(.70)	(.74)		

		Constant	$log\ v_t$	$log\ v_{t-1}$	$log\ (W_i/W)_t$	$log\ (W_i/W)_{t-1}$	$log\ (W/W^e)_t$	$log\ (W/W^e)_{t-1}$	R^2	$\hat{\rho}$
	Total	2.7816	.6171	.2191	5.8281	10.8686	.7668	15.0385	.473	.616
N		(3.86)	(3.38)	(1.17)	(.94)	(1.70)	(.13)	(2.77)		
O	Food &	.1192	.3788	.0466	-16.6677	-2.6351	-2.9026	6.7118	.463	.596
N	kindred products	(.26)	(1.76)	(.20)	(2.97)	(.49)	(.45)	(1.12)		
D	Tobacco manufactures	.4417	.4167	.0793	-6.9005	4.3198	3.1844	-4.3348	.622	.177
U		(3.70)	(1.36)	(.26)	(6.17)	(3.73)	(.40)	(.55)		
R	Textile mill products	-1.5471	.5209	.0662	-1.2602	-8.4120	-.7472	3.6735	.524	.460
A		(1.67)	(2.88)	(.37)	(.39)	(2.49)	(.13)	(.74)		
B	Apparel &	-.1667	.5900	-.1624	9.3148	-13.4177	2.2182	5.2012	.589	.371
L	other textiles	(.36)	(3.39)	(.94)	(3.44)	(4.87)	(.43)	(1.07)		
E	Paper &	.4682	.7384	.2607	4.8704	12.8682	-1.9896	18.2421	.622	.489
	allied products	(3.71)	(3.42)	(1.21)	(.93)	(2.53)	(.30)	(3.03)		
	Printing & publishing	-.8092	.5349	.1870	7.8488	2.9519	1.7690	13.3363	.543	.367
		(1.36)	(2.87)	(1.04)	(1.54)	(.52)	(.29)	(2.58)		
G	Chemicals	-.7716	.8361	.1427	2.0168	9.8946	4.0944	21.2898	.477	.442
O		(1.40)	(3.11)	(.53)	(.29)	(1.40)	(.46)	(2.74)		
O	Petroleum &	.4396	.4770	.4502	-1.2291	.2012	7.2182	10.2368	.272	.554
D	coal products	(.31)	(1.28)	(1.20)	(.22)	(.04)	(.61)	(.96)		
S	Rubber & plastics	1.3488	1.4078	-.6937	5.9019	-3.5355	-11.2045	.6002	.370	.095
		(5.12)	(3.18)	(1.59)	(.77)	(.46)	(.85)	(.05)		
	Leather	.6015	.5423	.0733	3.2275	-6.0964	2.9918	7.1782	.521	.604
		(1.33)	(3.44)	(.48)	(.99)	(1.79)	(.59)	(1.62)		

Notes : Dependent variables are logs of industry quit rates. Numbers in parentheses are absolute values of t-statistics.