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The Taxable Payroll for Unemployment Insurance: An Empirical Analysis of South Carolina Manufacturing Firms

Carl P. Kaiser*

INTRODUCTION

The primary inflows into state unemployment insurance (UI) funds are generated by taxes levied upon employers. As defined in the laws of each state, the base for the UI tax—the employer's taxable payroll—is related to the employment pattern experienced by the employer over the calendar year. Brechling (1977a,b) has theoretically modeled the taxable payroll and its determinants. On the basis of some mathematical approximations and simplifying assumptions about the firm's employment pattern, he has derived a "general but approximate formula" for the taxable payroll for unemployment insurance. Using data categorized by 2-digit manufacturing industry, state, and year, Brechling (1980) has also generated empirical evidence that suggests that his general formula is valid. However, as Brechling (1980, p. 40) intimates, additional testing of the formula utilizing disaggregated data is required. This study documents such a test since the empirical evidence presented herein is based upon analysis of the taxable payrolls of 848 manufacturing firms.

As noted by Brechling (1980, p. 32), this strand of research is of practical importance. A finding that the general formula for the taxable payroll is empirically valid would verify the expected positive correlation between the firm's taxable payroll and its labor turnover rate, and consequently, indicate the presence of turnover costs that operate through the employer's taxable payroll. This implies that policymakers may be able to influence labor turnover rates by manipulating the parameters of the UI tax structure. Moreover, the existence of a reliable model of the inflows into state UI funds would be of great value in assuring the future solvency of state UI programs.

In the remaining sections of this paper, the legal definitions of the employer's taxable payroll are briefly discussed, Brechling's formula for the taxable payroll attributable to a given employment position is presented and then converted into a form appropriate to the data, and finally, the data and empirical results are discussed. These results confirm expectations that turnover costs are imposed upon employers as a consequence of the structure of the taxable payroll for unemployment insurance, but they do not suggest that the formula can be used with confidence to make accurate predictions of unemployment insurance tax inflows.

THE TAXABLE PAYROLL FOR AN EMPLOYMENT POSITION

The annual tax charge against each covered firm is the product of its tax rate and its taxable payroll. As dictated by the federal and state laws, an employer's taxable payroll is determined by summing the

*Department of Economics, Washington and Lee University, Lexington, VA 24450. The author is grateful to the South Carolina Employment Security Commission for providing the data necessary for this study, and to an anonymous referee for offering comments that significantly improved the paper.

earnings of all workers employed by the firm during the calendar year up to the limit of the taxable wage base on individual earnings.[1] According to these legal provisions, the taxable payroll attributable to a given employment position can be determined. To illustrate, first assume that only one worker fills position A during the entire calendar year. If the worker's annual earnings exceed the taxable wage base, then the taxable payroll attributable to this position is simply equal to the taxable wage base. Suppose, however, that position B is filled by two workers, each of whom is paid at an annual rate that exceeds the taxable wage base. If the first person earns at least as much as the taxable wage base before leaving the firm, then the firm's taxable payroll is simply increased by the amount of the taxable wage base. But the earnings of the next worker to fill position B in the same year, up to the taxable wage base, also contribute to the firm's taxable payroll. Hence, the total taxable payroll attributable to employment position B is greater than the taxable wage base. The taxable payroll for a given employment position therefore depends upon labor turnover, where it ranges from the taxable wage base (when there is no turnover) up to the annual earnings associated with the position (when there is turnover).[2]

Given the structure of the employer's taxable payroll as dictated by legal statutes, Brechling theoretically modeled the relationship between the taxable payroll and its determinants. Making the simplifying assumptions that annual earnings are paid and labor turnover takes place evenly throughout the calendar year, he derived the following general formula that approximates the taxable payroll attributable to a given employment position, m:

$$m = \tilde{w}[1 + q(1 - \tilde{w}/w)]. \tag{1}$$

In equation (1), $\tilde{w}$ is the taxable wage base, w is the annual rate of earnings payable to workers who fill the employment position, and q is the annual rate at which employees separate from and are (newly) hired into the position.[3]

The purpose of this paper is to provide empirical evidence that further bears upon the validity of Brechling's general formula. Since data for individual employment positions are not available but data at the firm level are, the empirical analysis is based upon firm averages. Therefore, on the assumption that the variances of both the annual wage and the labor turnover rate across employment positions are zero, the form of equation (1) appropriate to the empirical analysis becomes

$$\bar{m} = \alpha_1\tilde{w} + \alpha_2\tilde{w}\bar{q} - \alpha_3\tilde{w}^2\bar{q}/\bar{w} \tag{2}$$

where, $\bar{m}$ is the employer's average taxable payroll, $\bar{w}$ is the average annual wage paid by the firm, $\bar{q}$ is the firm's annual rate of labor turnover, and $\alpha_1 = \alpha_2 = \alpha_3 = 1$. Finally, rewriting the equation in the form of an estimating equation yields

$$\bar{m} = \beta_0 + \beta_1\bar{q} + \beta_2\bar{q}/\bar{w}. \tag{2'}$$

Since all firms represented in the sample upon which this paper is based reside in a state in which the taxable wage base was \$6,000 in the relevant time period, the theoretically predicted values of β_0 ($=\alpha_1\tilde{w}$), β_1 ($=\alpha_2\tilde{w}$), and β_2 ($=-\alpha_3\tilde{w}^2$) are 6000, 6000, and -36×10^6, respectively.

DATA AND RESULTS

Under the Continuous Wage and Benefit History (CWBH) program funded by the U.S. Department of Labor, a number of states maintain earnings and claims histories for a sample of workers covered by the unemployment insurance system. The results presented in this paper are based upon data collected by South Carolina for 1981. The earnings histories kept by employers and compiled by state employment security commissions under the CWBH program are rich in UI tax information pertaining to the employer. These data permitted the creation of variables that could be used to estimate equation (2′) over a sample of 848 manufacturing firms.

A direct measure of the firm's annual rate of labor turnover (for example, the average of total separation and accession rates) was not available. Therefore, the employer's annual lay-off rate, $\bar{q}'$, was used to proxy for $\bar{q}$ in equation (2′) on the assumption that annual layoff and labor turnover rates are positively correlated across a sample of firms.[4] $\bar{q}'$ was calculated by dividing the number of UI claimants who cited layoff as the reason for separation from a given employer by the average number of workers retained by that employer over the year. This figure was then adjusted by the UI claimant sampling rate used in South Carolina to arrive at an annual layoff rate for each employer. The figures necessary to calculate the employer's average taxable payroll ($\bar{m}$) and the average annual wage ($\bar{w}$) for each firm were directly available from the CWBH data.

Ordinary least squares was used to fit equation (2′) to the data. The regressions used to obtain the estimates in Table 1 correspond precisely to Brechling's formula for the taxable payroll as expressed in equation (2′). A separate regression was run for each SIC 2-digit manufacturing classification since each industry exhibits its own unique patterns of economic behavior. Of particular concern is that the relative importance of layoffs and other means of separation—primarily quits—varies across industries. Interindustry differences in quits would generate interindustry differences in the taxable payroll, and so are likely to generate biased results in a regression based on data pooled across industries. Moreover, the results of a Chow test—significant at the one percent level—indicated that it would be inappropriate to generate estimates on the basis of data pooled across industries. Therefore, the analysis was confined to the industry-specific regressions.

Empirical confirmation of Brechling's formula would be implied by a regression in which the estimated coefficients are not significantly different from their predicted values, *and* that exhibits explanatory power. Hence, for each industry, the regression should exhibit statistically insignificant estimates of β_0, β_1, and β_2, while generating a statistically significant F-statistic and a relatively high R^2. As Table 1 shows, in those industries for which all, or at least two, of the coefficients are not significantly different from their predicted values (SIC industries 27, 30, 32, 33, and 34), it is also clear that the regressions have little explanatory power as indicated by the regression F-statistics and the R^2s. Therefore, these regression results do not support Brechling's formula.

With regard to the industry regressions that explain a nontrivial portion of the variation of the dependent variable (SIC industries 20, 23, 24, 25, 28, 35, 36, 37, and 39), at least two, and usually three, of the estimated coefficients differ significantly from their predicted values. Hence the results for these regressions also lead to rejection of Brechling's formula, as written with the theoretically predicted coefficients.[5]

However, further interpretation of the coefficients generated by the regressions that exhibit explanatory power is called for. Use of a measure of the firm's layoff rate as a proxy for the firm's over-all labor turnover rate introduces measurement error into the data such that the estimates are biased upward in absolute value. The variation in $\bar{q}'$ must be less than the variation in the true labor turnover rate[6]; therefore, given the variation in the taxable payroll over a sample of firms, if Brechling's formula is correct then the absolute values of the estimated coefficients of both $\bar{q}'$ and $\bar{q}'/\bar{w}$ are expected to be greater than the absolute values predicted by the formula. The results (for all regressions) in the table are consistent with this interpretation. All the coefficients of $\bar{q}'$ are positive and (except for SIC industry 22) greater than the predicted value of 6000, and the absolute values of all of the estimated coefficients of $\bar{q}'/\bar{w}$, as expected, are greater than the predicted absolute value of 36×10^6.

Although these results do not support Brechling's formula, neither do they lead to the unambiguous conclusion that the formula is invalid. Moreover, these results provide a strong impetus for further empirical research that is based upon more accurate measures of labor turnover rates at the firm level. Before Brechling's formula can be rejected (or accepted) as a reliable tool for predicting UI tax inflows, it must be tested with direct measures of labor turnover (rather than the less-than-perfect measure of the layoff rate used as a proxy for turnover in this study). This would require a survey of a large number of firms to collect data that measure their total separation and accession rates, rehire rates,[7] new hire

TABLE I
Regression Estimates of Equation (2′)

SIC Industry	Constant [6000]♦	$\bar{q}'$ [6000]♦	$\bar{q}'/\bar{w}(x10^{-6})$ [−36]♦	degrees of freedom	R^2	F
20—Food & Kindred Products	6633*** (130)	57198*** (13290)	−598*** (129)	49	.316	11.3***
22—Textile Mill Products	6931*** (153)	1866*** (1269)	−36 (22.9)	132	.021	1.4
23—Apparel and Other Textile Products	6462*** (114)	9770 (3640)	−101** (33.3)	159	.060	4.8***
24—Lumber & Wood Products	6330** (127)	11790** (2564)	−99*** (19.8)	94	.213	12.7***
25—Furniture & Fixtures	6710 (861)	78175* (39211)	−644** (282)	19	.260	3.3*
27—Printing, Publishing, & Allied Products	6380 (237)	24398 (23373)	−265 (194)	15	.166	1.5
28—Chemicals & Allied Products	5990 (235)	56164*** (12385)	−429*** (128)	32	.399	10.6***
30—Rubber & Miscellaneous Plastics Products	6776*** (266)	12539 (8742)	−127 (74.6)	36	.077	1.5
32—Stone, Clay, & Glass Products	6498*** (171)	7113 (5182)	−73 (46.2)	32	.093	1.7
33—Primary Metals Industries	7294*** (356)	13400 (13113)	−174 (154)	12	.098	.7
34—Fabricated Metal Products	7031*** (309)	14934 (10667)	−134 (82.1)	55	.064	1.9
35—Machinery, except Electrical	7241*** (206)	12448 (4324)	−194** (65.2)	93	.087	4.4**
36—Electrical Machinery	7055*** (296)	26341 (13732)	−413** (153)	31	.318	7.2***
37—Transportation Equipment	7586*** (470)	27076** (8417)	−324** (104)	14	.433	5.3**
39—Miscellaneous Manufacturing Industries	7145*** (387)	37906*** (10772)	−383** (126)	18	.429	6.8***

Standard errors in parentheses.
♦Predicted value.
***Significantly different from predicted value at the one percent level.
**Significantly different from predicted value at the five percent level.
*Significantly different from predicted value at the ten percent level.

rates, and quit rates, as well as unemployment insurance tax payments data, and annual wage and employment data.

Also, as noted above, in deriving the formula, Brechling made some simplifying assumptions. In particular, he assumed that for a given employment position, annual earnings are paid and labor turnover takes place evenly during the calendar year. To the extent that these assumptions deviate from reality, it is possible that they might render the formula too imprecise to be of much use in generating accurate predictions of UI tax inflows. However, before the formula can be rejected on these grounds, it must be tested with direct measures of labor turnover.

Interpretation of the General Version of Brechling's Formula

Although the version of Brechling's formula analyzed in this paper—as in equation (2′)—involved specific predictions of the coefficients based upon the value of the taxable wage base in South Carolina for 1981, a more general version of the formula may be considered along with the weaker hypotheses that it implies. In particular, the functional equation for the taxable payroll per employment position can be expressed as

$$m = f(\bar{q}', \bar{q}'/\bar{w}) \quad (3)$$

(+, −)

where the signs above the independent variables indicate the theoretically expected direction in which a change in each variable will affect the taxable payroll per employment position.

As reflected in equation (3), Brechling's theory predicts that the firm's taxable payroll is positively affected by an increase in the labor turnover rate and negatively affected by a decrease in the labor turnover rate divided by the average annual wage. Although not explicitly flagged in Table 1, the estimates corresponding to the regressions that exhibit some degree of explanatory power (SIC industries 20, 23, 24, 25, 28, 35, 36, 37, and 39) tend to confirm these hypotheses[8]; as indicated by the standard errors, the estimates that are significantly greater than their predicted values are obviously significantly greater than zero as well.

Although these results are somewhat guaranteed by the structural characteristics of the unemployment insurance system, and despite Brechling's intent to specify the relationships between the taxable payroll and its determinants with greater precision, these results are worth noting simply because they are consistent with the policy prescriptions for minimizing unemployment that are implied by Brechling's formula. Returning to equations (1) and (2), it is obvious that the size of the coefficients in the model are primarily determined by the taxable wage base, which is specified by federal and state statutes. This, in turn, implies that for a given turnover rate, a change in the taxable wage base will change the taxable payroll per employment position and accordingly change the UI tax cost of labor turnover. Therefore, as Brechling (1977b, 492) argues, if the goal of economic policy is to minimize unemployment, then the optimal value for the taxable wage base is that which implies the highest marginal cost of labor turnover, and hence, provides the strongest incentive to minimize labor turnover. As shown by Kaiser (1980, 20–21) the optimal value occurs where the ratio of the taxable wage base to the average annual wage is some *a priori* unknown fraction greater than one-half.[9]

Existing evidence (Kaiser, 1987) suggests that the critical ratio of the taxable wage base to average annual earnings may be as high as seven tenths. For 2-digit manufacturing industry samples for which the ratio was as large as .722, a negative and significant relationship between the taxable wage base and layoff rates was observed. Since, in most states, this ratio is substantially less than seven tenths for most firms and industries, the simplest approach toward the goal of reducing turnover and unemployment would be for each state to increase the taxable wage base to a level that is greater than one-half the average state annual wage such that its precise (optimal) value would need to be determined experimentally.

SUMMARY AND CONCLUSIONS

In his work on the incentive effects of the U.S. unemployment insurance tax, Brechling (1977a,b) derived a "general but approximate formula" for the determination of the employer's taxable payroll for unemployment insurance. In a subsequent paper Brechling (1980) used aggregated data to demonstrate the validity of this formula. Yet Brechling, noting the limitations of using aggregated data,

called for further tests of his formula based on disaggregated data. Hence, the research reported in this paper can be viewed as an extension of this line of inquiry. Vis-a-vis Brechling's empirical work, the results obtained in this study, while benefiting from a rich source of unemployment insurance tax data at the firm level, suffer from unavailability of direct measures of overall labor turnover rates at the firm level.

The general formula implies that the taxable payroll is determined by the employer's annual labor turnover rate, the annual wage paid by the employer, and the taxable wage base—the legally specified limit on individual employee earnings that are taxable. On the assumption that the firm's layoff rate is a good proxy for its labor turnover rate, data for 848 South Carolina manufacturing firms were used to empirically analyze Brechling's formula.

As Brechling (1980, p. 32) argues, toward the goal of assuring the solvency of state unemployment insurance funds, a correct representation of the taxable payroll is highly desirable because it would facilitate the modeling of total unemployment insurance tax inflows. According to the regression results presented in this study, Brechling's formula does not appear to explain a large fraction of the total variation in the firm's taxable payroll. Therefore, until the formula receives stronger statistical confirmation on the basis of future empirical research that is based on true measures of turnover rates at the firm level, little confidence can be placed in Brechling's formula as a means of generating accurate predictions of the inflows into state unemployment insurance funds.

However, for nine of fifteen industries, the results of this study provide evidence that the taxable payroll for unemployment insurance is related to the firm's rate of labor turnover according to the functional form derived by Brechling. This result, coupled with previous empirical evidence (Kaiser, 1987), suggests a policy option that could be chosen to increase the unemployment insurance tax cost of labor turnover. In particular, for a given labor turnover rate, an increase in the taxable wage base for unemployment insurance to some *a priori* unknown level that exceeds one-half of average annual earnings would lead to a larger taxable payroll per employment position (i.e., a higher marginal cost of labor turnover) thereby increasing the employer's incentive to moderate labor turnover.

Finally, since labor turnover is typically controlled to a significant degree by the employer, the labor turnover cost actuated by the taxable payroll for unemployment insurance is, at least in part, determined by the employer. Therefore, inherent in the structure of the taxable payroll is a cost incentive for the firm to minimize its labor turnover rate. The firm may reduce turnover directly by reducing layoff rates, and indirectly, by restructuring the terms and conditions of employment so as to decrease quit rates. These results obviously suggest, as a topic for further research, the investigation of what appears to be a simultaneous relationship between the employer-determined elements of labor turnover and the employer's taxable payroll.

NOTES

1. According to federal law, the floor on the taxable wage base is currently $7,000 (raised from $6,000 as of January 1, 1983); however, if they so choose, individual states are free to legislate a taxable wage base that exceeds this amount.
2. This assumes that annual earnings equal or exceed the taxable wage base. If, however, the annual earnings for a position are *less* than the taxable wage base, then in the absence of turnover the position's contribution to the taxable payroll is simply equal to annual earnings.
3. This formula implicitly assumes that separations from the firm are permanent. When turnover through a position is the result of a temporary layoff, the taxable payroll for that position is determined as if a single worker filled the position without interruption throughout the calendar year. In other words, *ceteris paribus,* the taxable payroll attributable to an employment position is unaffected by temporary layoffs.
4. Data at the 2-digit industry level indicate that the layoff rate and the total separations rate (a measure of labor turnover) are positively but loosely correlated. For 2-digit manufacturing industry averages, the correlation coefficients between the lay-off rate and the total separations rate are .455 for durable goods industries and .433 for nondurable goods industries.
5. An alternative test of Brechling's formula confirms these conclusions. The theoretical requirement that $\alpha_1 = \alpha_2 = \alpha_3 = 1$ in equation (2) imposes a linear restriction on the empirical model that implies the specific predicted values for the estimated coefficients of equation (2′). Accordingly, a test for the validity of the linear restrictions imposed upon the model was also conducted. For each industry this required an F-test using the sums of the squared residuals from the restricted and unrestricted regressions. The results of these tests call for rejection—at the 99 percent level of confidence—of the null hypothesis that there are no significant differences between the restricted and unrestricted models for SIC industries 20, 22, 23, 24, 28, 35, and 36. Despite the fact that each of these industries is an element of the set of industries for which the regressions significantly explained a nontrivial fraction of the variation in the taxable payroll, the empirical evidence for these industries therefore fails to support Brechling's model because the linear restrictions are inappropriate.
6. Although other sources of measurement error are present, this is most likely to be the dominant source.
7. Recalling that the rate of temporary layoff is unrelated to the taxable payroll (see note 3), an effort to control for the rehire rate would be fruitful. The data available for this study did not permit determination of the firm's rehire rate, but since the data pertained to 1981, a recession year, it is not likely that there were a significant number of rehires. However, in general, the distinction between permanent and temporary separations becomes an important issue when estimating Brechling's formula.
8. In comparison to Brechling's empirical evidence exhibiting R^2s in excess of .95, we note that the largest R^2 in Table 1 is .429. These differences are not of great consequence; since the two empirical studies are not directly comparable, there is no reason to expect that they would generate very similar R^2s. The results presented here are based on industry-specific cross-section regressions where the unit of observation is the individual firm, and as is common knowledge, regressions of this type are typically not expected to generate very high R^2s. On the other hand Brechling's results were based upon annual observations of statewide industry averages spanning a period of eight years; he used data that were pooled across states and over time. Given the presence of both a time series element and a high level of aggregation in Brechling's data, the high R^2s he reported are not surprising.
9. Assuming that the firm's unemployment insurance tax rate (that is applied to the firm's taxable payroll to calculate in annual UI tax bill) is exogenously determined, Brechling concluded that optimal value of the taxable wage base is exactly equal to one-half of average annual earnings. However, when the assumption that the firm's UI tax rate is a function of its past experience with labor turnover is introduced into his model, the optimal value the alternative conclusion presented in the text is implied.

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