NBER WORKING PAPER SERIES

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Working Paper No. 4960

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1994

We would like to thank Bo Honoré, Carolyn Moehling, Jonathan Thomas and seminar participants at Columbia, Maryland, MIT, the NBER Summer Institute, Northwestern, and Yale for their comments, and Sherryl Bailey and John Steinman for helping us obtain the data. Anderson would like to thank the Rockefeller Fund for Research in Economics at Dartmouth College for its support. Meyer would like to thank the Sloan Foundation and the NSF for its support through grants SES-8821721, SES-9024548 and SBR-9310280. This paper is part of NBER's research programs in Labor Studies and Public Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

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ABSTRACT

We examine the effects of unemployment insurance (UI) experience rating on layoffs using high quality firm and individual data. Our preferred estimates imply that incomplete experience rating is responsible for over twenty percent of temporary layoffs. The results are more mixed regarding the predictions of the alternative models of UI as a firm adjustment cost or a component of the worker compensation package. While the evidence favors the adjustment cost model, some of the predictions of each of these models are rejected by at least one of our specifications. Using our new data, we also confirm the correlation between experience rating proxies and layoffs found in past studies. However, the differences between these proxies and state average firm tax costs and the anomalous instrumental variables estimates that we find suggest that it may be inappropriate to causally interpret this correlation.

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Unemployment insurance in the U.S. is financed by a payroll tax which, due to the efforts in the 1920's and 1930's of a group of Wisconsin labor economists,[1] is experience rated. Under experience rating, a firm's current tax rate depends on the amount of unemployment benefits received in the past by its workers. However, state experience rating systems are incomplete so that almost all firms pay only a part of the costs of increases in unemployment benefits received by their employees. This reduction in the cost of layoffs makes firms more likely to lay off their workers in times of low product demand, an argument which has been formalized by Baily (1977), Brechling (1977a,b), and Feldstein (1976).

Empirical work testing these theoretical arguments has led several authors to attribute a large fraction of unemployment to this layoff subsidy. For example, Topel (1983) estimates that incomplete experience rating may account for as much as 30 percent of all temporary layoff spells, while Card and Levine (1994) estimate that incomplete experience rating accounts for 50 percent of temporary layoff unemployment during cyclical downturns. Like nearly all previous work on experience rating,[2] however, these estimates rely on aggregate proxies for firm level incentives since they lack information on firm level tax rates. We are able to improve upon this research by

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[1]See Becker (1972) for an account of the activities of John Commons and his students.

[2]Exceptions are Anderson (1993) and Section 4 of Meyer (1989).

examining the effects of unemployment insurance taxes and benefits on layoffs using previously unavailable firm and individual data.

There are several reasons why the analysis of firm and individual level data may be preferred.[3] First, we obtain a much more accurate measure of firm incentives. While previous work has imputed firm tax rates using state and industry, we have shown that tax rates and tax incentives vary greatly within these state/industry cells (Anderson and Meyer (1992, 1993a)). We further report here that nonlinearities in these tax schedules lead to systematic biases in these imputations. Using our administrative data we are also able to exclude the substantial fraction of firms that are standard rated, and thus do not face the usual incentives. These firms are too new to be experience rated. In addition, there are a number of individual level variables available in our data that interact with UI taxes to determine layoff incentives. In particular, we have accurate information on the eligibility, level and duration of UI benefits, as well as an income measure which we use to impute individual income tax rates.

Perhaps most importantly, though, work on experience rating must credibly handle the endogeneity of tax incentives. These incentives are endogenous because they depend on both past firm layoffs and state tax schedules, where these tax schedules are likely in

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[3]Earlier authors have stressed the value of firm level data. For example, Brechling (1977, p. 197) indicates that "Since the models [of employment decisions] describe the behavior of individual firms, the data on layoffs, rehires, hours, and layoff duration should ideally also refer to individual firms. Unfortunately, however, no such micro data are readily available." Feldstein (1978, p. 844) indicates that "It would be particularly valuable to extend the current data to include information on the experience rated tax of each individual's employer."

part determined by the size and layoff tendencies of industries within a state.[4] We begin by reproducing past methods with our high quality administrative data. We then try several new approaches including methods which control for past firm layoffs and methods which rely on changes in state tax schedules. We also take advantage of the fact that past layoffs enter the current tax incentives of a firm with a substantial lag.

The paper proceeds by first providing a theoretical model of the effects of incomplete experience rating and its interaction with other characteristics of state UI systems. Section 2 outlines the mechanics of experience rating, while Section 3 describes the unique mix of firm and individual data that we use in the paper. Section 4 describes how we measure firm level incentives, and Section 5 discusses our empirical approaches and the results we obtain. Section 6 concludes.

1. Theoretical Framework

The effects of unemployment insurance, and in particular, experience rating, on firm layoffs have generally been analyzed using two main approaches. One approach treats UI as an adjustment cost, while the other treats UI as part of a compensation package. We begin with the adjustment cost approach, and then expand the model to allow for wage flexibility, which is the key element of the compensation package approach. By combining these two approaches we make comparisons of their predictions clear.

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[4]See Adams (1986) for a paper which models the determinants of UI tax systems.

The adjustment cost approach begins with the observation that if a firm is responsible for paying any of the costs of the UI benefits generated by a layoff, a firing cost is introduced into the firm's decision problem. To see this, consider the general discrete nonstochastic labor demand model with firing cost β per layoff (and hiring cost α). The firm's profit maximization problem can then be stated as

$$\max \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t [R_t(N_t) - wN_t - \alpha A_t - \beta F_t]$$

$$\text{s.t. } N_t = (1-\delta)N_{t-1} + A_t - F_t,\ A_t \geq 0,\ F_t \geq 0,$$

where A_t and F_t are the number of workers hired and laid off respectively in period t, and δ is the quit rate (implying a discount rate $k = (1-\delta)/(1+r)$, where r is the interest rate). w is the exogenous wage rate (the exogeneity assumption is dropped later) and $R_t(N_t)$ is the revenue function at time t with employment N_t. The key first order condition for this problem is then

$$(1.1)\quad R_N(\,)_t = w + \lambda_t - k\lambda_{t+1}$$

where R_N is marginal revenue, $R_N > 0$ but is assumed to be decreasing in N, and λ_t is the Lagrange multiplier on the constraint for N_t.

Since a simple deterministic model in which product demand fluctuates between two states is sufficient to capture the major aspects of the theory, consider the simple case where t alternates between the two states H and L. In this case, assuming an interior solution, $\lambda_t = \alpha$ when the firm is hiring in the high demand state (H) and $\lambda_t = -\beta$

when the firm is laying off in the low demand state (L). The first order conditions in the two states are

(1.2) $R_N(\,)_L = w - \beta - k\alpha$ and

(1.3) $R_N(\,)_H = w + \alpha + k\beta$.

Thus, adjustment costs drive a wedge between the marginal product of labor and the wage. Increases in α or β will decrease employment in the high demand state, but will increase employment in the low demand state. This result follows from the assumption that R_N declines with N. Since layoffs are the difference between employment in the high and low demand states, higher adjustment costs will decrease layoffs.[5]

Experience rating enters the firm decision problem because one component of the firing cost β is the expected increase in future UI taxes due to experience rating. Therefore, β can be expressed as eb+c, where e is the fraction of a dollar in benefits that the firm expects to pay back in higher future taxes (thus e=0 represents the case of no experience rating, and e=1 represents the case of perfect experience rating), b is the dollar value of benefits received by workers, and c is other firing costs. Note that b is the product of the benefit amount and the average duration of UI receipt. It is clear from this relationship that since increased experience rating increases β, there is a negative relationship between e and the probability of a layoff. Within this framework, we can

[5]There may also be an effect on the average employment level if the change in N_H and N_L differ in magnitude. See Anderson (1993) for empirical work on this topic, and Bertola (1990), Hopenhayn and Rogerson (1993) and Millard and Mortensen (1994) for theoretical discussions of adjustment costs and average employment.

similarly predict that both the weekly benefit amount and the potential number of weeks of benefits will be negatively related to the layoff probability.[6]

Taking the wage to be exogenous, however, ignores likely adjustments in the wage to reflect changes in other parts of the compensation package. Besides adding to adjustment costs, increases in unemployment benefits paid to workers may allow the firm to decrease wages as unemployment becomes less burdensome to the worker. A simple way to add this feature to the model is to assume that firms must provide a contract which supplies a level of utility equal to that at alternative employment. To add this complication without making the model intractable we assume that k=1.[7] The utility constraint facing the firm can then be written as

$$U_0 = u\{w(1-\tau_y)(\frac{N_H+N_L}{2N_H}) + b(1-\tau_b)(\frac{N_H-N_L}{2N_H})\} + v(1)(\frac{N_H+N_L}{2N_H}) + v(0)(\frac{N_H-N_L}{2N_H}) \quad ,$$

where U_0 is the utility of alternative employment. Utility is taken to be separable in income and leisure, with u(y) the utility of income y, v(1) the value of leisure when working, v(0) the value of leisure when unemployed, and τ_y and τ_b the tax rates on

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[6]Note that while the potential duration of benefits is not the same as the actual duration, the two are very likely to be positively related.

[7]If we allow discounting it complicates introducing the utility constraint since the present value of a given wage and benefit combination would depend on whether the current state was H or L.

income and benefits, respectively. The key first order conditions for this revised problem in the two states are

$$(1.4)\quad R_N(\,)_L = w + (N_H+N_L)\frac{\partial w}{\partial N_L} - \beta - \alpha \quad \text{and}$$

$$(1.5)\quad R_H(\,)_H = w + (N_H+N_L)\frac{\partial w}{\partial N_H} + \alpha + \beta .$$

In order to see the implications of this extension, first totally differentiate the utility constraint to obtain

$$\frac{\partial w}{\partial N_L} = -\frac{1}{N_H+N_L}\left[w - \frac{b(1-\tau_b)}{(1-\tau_y)} - \frac{v(0)-v(1)}{u'(y)(1-\tau_y)}\right] \quad \text{and}$$

$$\frac{\partial w}{\partial N_H} = \frac{N_L}{N_H(N_H+N_L)}\left[w - \frac{b(1-\tau_b)}{(1-\tau_y)} - \frac{v(0)-v(1)}{u'(y)(1-\tau_y)}\right].$$

Substituting these expressions in (1.4) and (1.5) and using β=eb+c yields

$$(1.6)\quad R_N(\,)_L = w - \left[w - \frac{b(1-\tau_b)}{(1-\tau_y)} - \frac{v(0)-v(1)}{u'(y)(1-\tau_y)}\right] - eb - c - \alpha \quad \text{and}$$

$$= b\left[\frac{(1-\tau_b)}{(1-\tau_y)} - e\right] + \frac{v(0)-v(1)}{u'(y)(1-\tau_y)} - c - \alpha$$

$$(1.7)\quad R_H(\,)_H = w + \frac{N_L}{N_H}\left[w - \frac{b(1-\tau_b)}{(1-\tau_y)} - \frac{v(0)-v(1)}{u'(y)(1-\tau_y)} \right] + eb + c + \alpha .^{8}$$

While these expressions are more complex than the simple case where w is exogenous, it remains true that the degree of experience rating is negatively related to the probability of a layoff. On the other hand, the effect of benefits is the reverse of that in the pure adjustment cost model in most situations. Here, the generosity of benefits is likely to be positively related to the probability of a layoff. This result occurs because $\tau_b \leq \tau_y$ and e is generally appreciably less than one.[9] In certain circumstances the reverse could hold, i.e. if e=1 and $\tau_b = \tau_y$ then higher benefits decrease layoffs. Increases in (1-τ_b) and decreases in (1-τ_y) also lead to increases in layoffs in the model.

The two models just presented make alternative assumptions about wage determination. The models' predictions agree for the effects of experience rating, but differ for the effects of benefits and taxes. However, it is likely that a more reasonable model would lie between the polar cases of fixed wages and perfect adjustment. It is likely that wages are not exogenous, but do not fully adjust for changes in unemployment

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[8]Equation (1.6) is the same as equation (3.7) in Feldstein (1976), except we have added terms which allow hiring and non-UI firing costs. Since Feldstein takes employment in the good state to be fixed, he does not have an analog to (1.7).

[9]Note that e is necessarily less than one in reserve ratio experience rating states as discussed below.

risk since compensating differentials are often found to be incomplete.[10] In such a situation, we might expect that increases in benefits would reduce layoffs while the effects of taxation would be softened. However, at very low levels of experience rating (e close to 0) we would expect more generous benefits to increase layoffs, while the reverse would be true at high levels of experience rating (e close to 1).

While the above discussion does not distinguish between permanent and temporary layoffs, past theoretical and empirical work has emphasized the effects of UI on temporary layoffs. In fact, some of the models begin with the assumption of a permanently attached labor force so that all separations are temporary. While the above theory would seem to apply equally to all layoffs, it is likely that for temporary layoffs the UI component of layoff costs is more important, while permanent layoffs would involve hiring and training costs that far exceed the UI component. Thus, the empirical work below will emphasize temporary layoffs.[11]

2. The Mechanics of Experience Rating

This section describes state experience rated payroll tax systems, with particular emphasis on the most prevalent system which we analyze below. State experience rating

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[10]See Brown (1980) or Smith (1979) for a general discussion of compensating differentials and Abowd and Ashenfelter (1981), Bronars (1983), and Topel (1984) for papers on unemployment risk.

[11]Note that since our definition of temporary and permanent are ex post (i.e. determined by actual recall) there will be some permanent layoffs which originally were thought to be temporary.

systems take many forms, but the most common is reserve ratio (30 states and D.C.).[12] In reserve ratio systems, a firm's tax rate is a decreasing function of the difference between taxes paid and benefits accrued divided by average covered payroll. Taxes paid and benefits accrued are typically summed over all past years and are not discounted, while average payroll is typically the average over the last three years. Formally, the reserve ratio for a firm in year t is given by

$$RR_t = \frac{\sum_{j\geq 1} \text{taxes paid}_{t-j} - \sum_{j\geq 1} \text{UI benefits charged}_{t-j}}{\frac{1}{3}\sum_{j=1}^{3} \text{taxable payroll}_{t-j}}.$$

The taxes paid in a given year are the product of a firm tax rate and the wages paid to each employee in a calendar year up to the taxable wage base. Benefits charged in a given year depend on the benefit schedule for a state which relates the level and potential duration of benefits to employees' past wages. Benefits charged to a firm also depend on wages paid, the number of layoffs and the number of resulting weeks of unemployment. Taxable payroll is wage payments in a calendar year to each employee up to the taxable wage base.

Firm tax rates rise in steps as the reserve ratio decreases. However, the tax rates do not rise sufficiently when benefit payments rise to cause firms to pay the full UI costs

[12]See National Foundation for Unemployment Compensation & Workers' Compensation (1994). Michigan and Pennsylvania are counted as benefit ratio states even though they have hybrids of reserve ratio and benefit ratio systems.

of laying off a worker. Firms between the minimum and maximum rate eventually repay the nominal cost of additional benefits received. But since interest is not credited on taxes paid or charged on benefits received, such firms pay a fraction of the costs of additional UI payments. In addition, there are large ranges at the top and bottom of the tax schedules, over which a firm's layoff history has no effect on its tax payments. These factors lead experience rating to be incomplete and subsidize layoffs.

3. The Data

The data we use come from two types of administrative records from the UI systems of six states which participated in the Continuous Wage and Benefit History (CWBH) project.[13] The first type are quarterly wage records for a sample (typically 10 to 20 percent) of all of the state's covered workers. Since coverage of workers is nearly universal except for the self-employed, we have close to a random sample of employees in our states. In addition to the wages received by the employee, the record contains a firm identifier, and several firm characteristics, including the UI tax rate, the industry, the average monthly employment over the quarter, the total quarterly wage bill, and the taxable wage bill. While the number of quarters of data available differs by state, the average is about 20 quarters between 1978 and 1984. Since there are over 22 million quarterly wage records available, we have drawn a sample of 100,000 to 200,000 records

[13]The states are Georgia, Idaho, Louisiana, Missouri, New Mexico and South Carolina. Two other states are available, but do not have experience rating systems with incentives that are easily characterized.

from each state. The second type of data are UI claims records, containing observations for each week of UI receipt for any worker filing for UI. We have summarized the weekly data into quarterly records, and then matched them by quarter of UI claim to the wage sample.

In order to identify job separations, the quarterly wage records are sorted by employer and employee to form job-match histories. A permanent separation is defined if a job match last appears in a quarter other than the last quarter of data collection. If there is a gap in the quarterly job-match history, the quarter before the gap defines a temporary separation. This method will, however, miss any temporary layoffs which do not encompass an entire calendar quarter. If such a layoff results in a UI claim, though, we will identify it from the matched UI claims records.

One strength of our data is that the detailed wage history allows us to accurately calculate the potential dollar amount and duration of weekly benefits, regardless of whether UI is actually received. Based on the state laws, we calculate for each observation the potential UI benefits were the worker to separate in a given quarter. In the work that follows, quarters in which the individual would not qualify for UI benefits are dropped. For our six states, the weekly benefit amount (WBA) and potential duration (PD) of benefits are simply a function of base period earnings (BPE) and high quarter wage (HQW).[14] BPE are just total earnings over the first four of the last five

[14]the functions vary across states and include state-specific minima and maxima. A typical formula is WBA=1/26*HQW and PD=(BPE/HQW)*8/3.

quarters, while HQW are total earnings in the quarter with the highest earnings.[15] The appropriate state and federal schedules are used to calculate marginal tax rates for each individual. We use BPE to proxy for total income, and then calculate adjusted gross income by treating everyone as a single filer taking the standard deduction. For those workers with income below the threshold for benefit taxation, the federal part of τ_b is zero.[16] In addition, the worker's share of the social security tax is calculated and added to the state and federal income tax rates to obtain a value for τ_y.

A final strength of the data set is the availability of the exact UI tax rate. As described in detail in Section 4, along with the state tax schedule, knowledge of this rate allows us to precisely characterize the experience rating incentives facing the firm. We also construct alternative measures of experience rating based on aggregate industry-level information, which will allow us to make direct comparisons with past methods. The final data set is made up of quarterly job match observations, with dummy variables indicating if a permanent and/or temporary separation occurred. Additionally, we retain information on base period and high quarter earnings, potential weekly benefits and duration, the marginal tax rates on income and benefits, the degree of experience rating, and background variables such as industry and firm size.

Despite all the strengths of the data outlined above, there remains a

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[15]Note that the necessity of calculating base period earnings implies that we cannot use observations prior to 1979.

[16]For 1979-1982 this level was $20,000, while for 1983-86 it was $12,000.

potential weakness. The theoretical framework implies an effect of the UI system on firm-initiated separations, but the data do not actually allow us to distinguish firm-initiated layoffs from worker-initiated quits. However, as long as the key variables of interest, those that measure experience rating, benefits and taxes, are not highly correlated with quits, we would not expect appreciable biases in our estimates. Since we might expect quits to vary with the business cycle, we include calendar quarter dummies in the estimates below. More importantly, we place much of the focus of our empirical work on temporary separations that are unlikely to be quits. In addition, we examine temporary separations resulting in UI receipt, since quitters are generally ineligible for UI benefits.

4. Measuring Experience Rating at the Firm Level

Locally linearized versions of the tax schedules which relate the tax rate to the reserve ratio for our six states in 1981 are reported in Figure 1. These tax schedules vary widely in their slopes over several reserve ratio ranges and in the locations of their minimum and maximum rates. There is also substantial variation across states and time in benefit amounts, taxable wage bases, and tax rates. Table 1 reports some summary statistics for our six states in 1980 and 1983. Note that four of these states changed their tax schedules at least once between 1980 and 1983. Other UI parameters, such as the potential duration of benefits, also vary across states and years but are not as easily summarized.

To summarize the incentives faced by a firm, we use the marginal tax cost of an additional layoff, where the marginal tax cost is defined as the fraction of a dollar in UI benefits paid to a former employee that the firm will pay in future taxes. Since additional layoffs reduce a firm's reserve ratio, layoffs by a firm not at the minimum or maximum tax rate will result in an upward movement along the tax schedule, and thus in an increase in future UI tax payments. The steeper the slope of the schedule, the greater will be the increase in the firm's future payments. Building on the work of Brechling (1977a,b), Topel (1983) derives a method of estimating how much of a marginal dollar paid in benefits this period a firm expects to pay back in future taxes. He defines the change in present value of taxes the firm expects to pay per dollar of benefits received by former employees as

$$(4.1) \quad e = \frac{\eta_1}{\eta_1 + i},$$

where η_1 is the slope of the tax schedule and i is the nominal interest rate. As shown in greater detail in the Appendix, this formula can be adjusted to allow for growth in employment and taxable wages giving us

$$(4.2) \quad e = \frac{(\theta\gamma)^2\eta_1}{(\theta\gamma)^2\eta_1 + i},$$

where θ and γ are one plus the growth rate in employment and taxable wages respectively. Note that high growth rates in employment and/or taxable wages raise this cost.

Since the CWBH data include the UI tax rate that a firm pays, we can determine the incentives provided by experience rating at the firm level. Given the firm's tax rate, we determine the firm's location on the state's tax schedule.[17] We then treat the schedule as being locally linear and take the slope to be how the firm's tax rate would change in response to a small one-time increase in unemployment by its former employees. All of our approaches (and those of others) approximate in this way the general stochastic dynamic programming problem that the firm faces. A permanent change in layoffs might have a different cost if a firm permanently moves to a different part of the tax schedule. We also assume that the firm takes the current tax schedule to be the one that it will face in the future.[18]

Table 2 provides summary statistics on the distribution of marginal tax costs in our six states in 1981 using (4.2) and setting i to be 10 percent.[19] The distribution of tax

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[17]The determination of states' tax schedules was done mostly by contacting the individual states. Some information was obtained from the Department of Labor's Comparison of State Unemployment Insurance Laws and Commerce Clearing House's Unemployment Insurance Reports. Reimbursable employers, and employers that are charged the standard rate are excluded from the sample. Tax incentives cannot be determined for standard rated firms, since future changes in rates depend on the firms' age and reserve ratio which are unavailable.

[18]We could alternatively look at the firm decision as a nonlinear budget set problem. Such an approach would have firms maximize over the points on the tax schedule. There are several reasons to prefer our approach. First, a firm's decisions today do not affect its current tax rate, but rather affect its tax rate in the future. Most of the points on the tax schedule could only be reached after many years. We take the simpler approach that gives an approximate present value to the cost of marginal changes from the current situation. Second, we will need to control for past firm decisions in some way as is discussed below.

[19]We take θ to be 1, and calculate the average γ for each state over the period 1978 to 1984.

costs is given for the entire state as well as several industries. The industries reported are the two 1-digit industries with the greatest receipt of UI, and five of the largest 2-digit industries. The table reports the percentage of total employment at firms with the minimum or maximum tax rate and the percentage of employment with different tax cost values. Only those firms between the minimum and the maximum tax rate have positive tax costs and thus can expect to pay part of the costs of additional layoffs through higher taxes in the future.

There are several things that are striking about the numbers reported in Table 2. First, the vast majority of employees are at firms that pay part of the costs of additional layoffs. In most states at least 80 percent of employment is at firms which are between the minimum and maximum rate. The most notable exception is South Carolina where 40 percent of employees are at firms with the minimum tax rate. Second, because the minimum is applicable to a substantial fraction of employment in most states, there is no clear linear or even monotonic relationship between past layoffs and tax costs. Third, even though the vast majority of firms pay some of the costs of additional layoffs, most pay considerably less than the full cost. This is particularly true in Idaho and South Carolina. We should note that the reported tax costs would be even lower if we used a nominal discount rate higher than the 10 percent we currently use in the calculations. The discount rate plays a crucial role in the tax cost calculations, because on the sloped portion of the tax schedule firms pay back the cost of UI payments in nominal terms. As firms pay back the costs over a long time period (how long a period essentially depends on the slope of the schedule), the discount rate has a large influence on the level of the

tax cost. With a higher nominal discount rate, all positive tax cost firms would have lower tax costs.

We also construct two alternative measures of the tax cost that are similar to those used in past empirical studies, such as those of Topel (1983 1984a, 1986) and Card and Levine (1994). These studies approximate the tax cost for a firm using the tax cost implied by the average benefit and average insured unemployment rate (IUR) for its industry. More precisely, we determine a tax rate that, if applied to all firms in an industry, would balance taxes collected and benefits received. Thus, given an industry's insured unemployment rate, average weekly benefits received (B) and the state's taxable wage base (W), we have $\tau = IUR*(B*52)/W$. This tax rate is then located on the tax schedule and the slope at that point determines the tax cost. Our first alternative uses the IUR for the 29 national industry groupings used by Topel (1983).[20] Our second alternative uses the IUR for 5 major industry groups by state, as in Card and Levine (1994). In both cases, we use the IUR for a period prior to our data, taking the average of the annual IUR's for 1973 through 1978. We then define the ratio of benefits to wages for our time period, taking the average of B and W for 1979 through 1984. Table 3 compares the means for the three tax cost measures, both overall and within each state for the major industry groups.

Looking at Table 3, we see that overall the measures are fairly close, with the actual mean cost being slightly below the two proxy measures. However, it is the

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[20]The 29 industry groups are 2 digit SIC groups for manufacturing, and major industry group in all other cases.

variation across industries and states that identifies the regression coefficient on the tax cost, and it is there that we find substantial differences between the actual mean cost and the proxy measures. For several of the industry groups the proxy measures result in a zero (or close to zero) cost being assigned, while the actual average is rarely below 0.4. This result is not surprising given the nonlinearity (and nonmonotonicity) of the tax cost as a function of the layoff rate. Furthermore, even in those industries with a high average layoff rate, the majority of employment is at firms with a positive tax cost. These two facts lead the proxies to differ dramatically from the industry average firm tax costs. In the empirical work below we will use each of the three tax cost measures in models typical of those estimated in past work, allowing us to evaluate the effect of using such proxies. An additional advantage of using the actual firm tax rate is that we are able to exclude standard rated firms, which are too new to be experience rated.

While the following results are based on six states, the implications of the results are more general. Reserve ratio experience rating is by far the most common system and aggregate measures of experience rating reported in previous work show our states to be broadly representative of the entire U.S.[21] Thus, the lessons from this paper are likely to be widely applicable.

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[21]See Topel (1990) p. 120, where aggregate experience rating measures for all six states are reported for the 1977-81 period, and Card and Levine (1992) where industry by state measures are reported for the 1978-87 period for five of our states.

5. Empirical Strategy and Results

We rely on two main empirical strategies to estimate the effects of experience rating on layoffs. The first approach, in using proxies for tax costs at the state and industry level, applies past methods to our firm and individual data. Thus, as in Topel (1983, 1984a, 1986) and Card and Levine (1994) we take differences in tax schedules across states to be exogenous, or at least take differences in how different industries within a state are treated to be exogenous.

The second approach takes changes in tax schedules and movements of a firm along a tax schedule to be exogenous. As mentioned earlier, state tax schedules change because of legislative action or, more commonly, automatic adjustments due to changes in the state UI trust fund balance. These automatic adjustments occur as statewide benefit and tax payments change and are part of most states' laws. The movements of a firm along a given schedule can be due to state changes in benefit levels, the duration of benefits, or the taxable wage base. Table 1 documented some of these changes for our states. Firm movements along a given schedule can also be due to changes in firm layoffs or employment. We rely, though, on the fact that past layoffs by a firm take awhile to affect tax incentives because of the lag structure in experience rating. We then examine if layoffs change when tax incentives later change. We also directly look at the effects of changes in tax schedules and the consequent changes in firm incentives.

In all of our estimates we use a large sample of quarterly records of employment to estimate a linear probability model for the event that a worker is laid off in a quarter.

We restrict our sample to those workers with sufficient previous earnings to be eligible for UI. We also use a linear probability model rather than a logit or probit model because of our very large sample size, our large number of explanatory variables, and our use of instrumental variables for some estimates. Logit and linear probability models give very similar average derivatives in subsamples and simpler models using our data. Standard errors which correct for heteroskedasticity in the linear probability model are also very similar to the uncorrected ones.[22] In the estimation we include our UI tax cost measures, the weekly UI benefit, the potential duration of benefits, the tax rate on income and the tax rate on UI benefits.

While we focus on the UI variables, in all of the estimates we control for several other characteristics. First, we control for a very general function of previous earnings to insure that our weekly benefit and potential UI duration variables are not simply capturing differences in past earnings. Recall that the level and potential duration of benefits within a state at a point in time are simple functions of base period earnings and the high quarter wage. For our general function we use a bilinear spline in the log of HQW, and the log of the ratio of BPE to HQW. We use the median values of these

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[22]We estimate logit and linear probability models using the specification of column (6) of Table 4, but with only 20% of the sample, only 29 industry controls and no state and calendar quarter interactions. In the two models the same variables are significant, and the average derivatives from the logit model are very close to those from the linear probability model. For example, the coefficient on the tax cost is -0.035 in the linear model, and the corresponding average derivative from the logit is -0.032. We also use the 20% sample to calculate heteroskedasticity consistent standard errors which tend to differ from the uncorrected ones only in the 4th digit. For example, the corrected standard error for the coefficient on the tax cost is 0.0037, while the uncorrected value is 0.0034. Thus, one should keep in mind that while the reported standard errors probably understate the true values, this understatement is likely to be fairly small.

variables as knot points to define our spline. The result is a set of 8 variables which form a flexible and continuous function of two variables which controls for past earnings. Firm level variables include indicators for 2-digit SIC industry and for 5 firm size classes--under 20 employees, 20 to 99, 100 to 499, 500 to 1999 and over 2000 employees. Finally, we also include state and calendar quarter effects, along with their interaction.

PREVIOUS METHODS APPLIED TO FIRM DATA

We begin by applying the methods of previous studies to our combination of accurate firm and individual administrative data. The top panel of Table 4 presents estimates for both total separations and temporary separations, using three tax cost measures. Columns (1) and (4) report estimates using tax cost proxies based on the national industry IUR (the approach of Topel), columns (2) and (5) report estimates using tax cost proxies using the state industry IUR (the approach of Card and Levine), while columns (3) and (6) report estimates using firm based tax costs for comparison. All of the coefficients imply substantial effects of experience rating on layoffs, especially temporary layoffs, given their lower frequency. However, the estimates based on the national IUR are much smaller than those found in past studies. The state IUR and firm based tax costs are fairly similar to past estimates and are highly significant. The standard errors are likely to be somewhat understated as we ignore error correlations

across workers within a firm and over time within a given job-match.[23] For temporary layoffs the implied elasticities are -0.05, -0.29, and -0.25 for the national IUR, state IUR and firm based tax costs, respectively. These coefficients tend to confirm the correlations found by past studies which use Current Population Survey (CPS) data on in-progress layoffs, though our national IUR estimates are considerably smaller.

There are some possible biases in estimates using proxies for firm costs, however. Earlier we indicated that these proxies are not a good measure of average tax costs within our states and industries. A more difficult issue to assess, though, is the potential endogeneity of these differences across states. If a state favors certain industries because they have frequent UI compensated layoffs, cross-state differences are unlikely to be a valid source of variation. There is some suggestion in past work on the political economy of state UI legislation that this issue is a problem (Adams (1986)). Another potential problem with the Card and Levine approach is that they assume that functions of the state/industry unemployment rate would be uncorrelated with the layoff rate in the

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[23]Since our data contain multiple observations per firm, standard errors calculated under the assumption of independence will be incorrect. If we were to use only one observation per firm-quarter, we would lose only 40 percent of the observations. In the unlikely case that separations at a firm are perfectly correlated, so that a firm always lays off all or none of its workers, it is easy to calculate that our reported standard errors would understate the truth by about 30 percent. However, since firms rarely lay off all of their workers, the assumption of perfect correlation is extreme. A more reasonable guess is a 10 to 20 percent understatement. A more difficult problem to assess is the correlation across time in multiple observations for the same job-match. Since on average there are just over 5 observations per job-match this also leads to an understatement of the standard errors. While separations are concentrated in certain individuals, the concentration is not extreme (see Anderson and Meyer (1994b)) and would likely be less pronounced for those with sufficient previous earnings to qualify for UI.

absence of experience rating. They generate their tax cost measure by inserting the state/industry insured unemployment rate in the state tax schedule and do not control separately for the insured unemployment rate.[24]

There are also possible biases in estimates using firm level tax costs, in that layoff incentives may reflect permanent firm differences in factors such as technology or seasonality. To see this result, let the probability that individual i is laid off by firm j in period t be

(5.1) $P(\lambda_{ijt}=1) = \beta T_{jt} + z_{ijt}'\gamma + \alpha_{ij}$, or

(5.2) $\lambda_{ijt} = \beta T_{jt} + z_{ijt}'\gamma + \alpha_{ij} + \epsilon_{ijt}$,

where $\lambda_{ijt}=1$ if the individual is laid off and 0 otherwise, T_{jt} is the tax cost of laying off an additional worker, and z_{ijt} is other explanatory variables. α_{ij} is a fixed component of the error term that captures permanent individual characteristics and permanent firm characteristics that affect the layoff probability, such as the firm's technology or its degree of demand seasonality. ϵ_{ijt} is taken to be a shock to labor demand plus other factors.

Unfortunately, T_{jt}, the tax cost, is correlated with α_{ij} since

(5.3) $T_{jt} = f_t(\lambda_{jt-k},\lambda_{jt-k-1},...)$,

where λ_{jt} is the layoff rate at the firm level, and $f_t()$ is a function which varies by state and over time. In addition, fixed effects estimation applied to (5.2) would be inconsistent

[24]Topel controls for his national source of variation in unemployment rates using industry dummies. Card and Levine's equations would not be identified if they controlled for state/industry interactions.

since lagged values of ϵ_{ijt} enter T_{jt}.[25] We take two approaches to dealing with the probable correlation between T_{jt} and α_{ij}. First, we attempt to control directly for past layoffs. Alternatively, we eliminate α_{ij} by differencing the data.

CONTROLS FOR THE RESERVE RATIO

To control for past firm layoff rates, we include as a regressor the reserve ratio for the firm. The reserve ratio is the overall summary of past firm decisions that determines the tax cost for a firm. Thus, it will be true that $E[T_{jt} | \alpha_{ij}, RR_{jt}] = E[T_{jt} | RR_{jt}]$. If we include RR_{jt} on the right hand side of the equation, we should eliminate most of the correlation between T_{jt} and α_{ij} that biases estimates of β and γ. Our estimates now measure the effects of changes over time in tax incentives as captured by the firm rates and proxies. Since the reserve ratio is affected by many parameters of a state's UI system, we include a separate reserve ratio variable for each state and quarter. Specifically, we interact separate dummy variables for each quarter for each state with an estimate of the reserve ratio, based on the midpoint of the tax bracket applicable to the firm.[26] Since we cannot define this measure for firms at the minimum and maximum tax rate, such firms are excluded. A weakness of this approach is that we are implicitly

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[25]To see this result note that in deviations from means the explanatory variable is correlated with the error term, i.e. T_{jt}-$T_{j.}$ is correlated with ϵ_{ijt}-$\epsilon_{ij.}$.

[26]If we only interact the reserve ratio with state the results are very similar.

assuming that the relationship between α_{ij} and RR_{jt} is linear, though we allow its slope to vary by state and quarter.

Moving to the bottom panel of Table 4, we see that when controls for the reserve ratio are added the main change in the temporary layoff estimates is a smaller effect of the firm tax cost and a larger effect of the national IUR based cost. The drop for the firm cost is not surprising since the correlation between T_{jt} and α_{ij} is likely to be negative. For temporary layoffs, the estimated elasticities are now -0.15, -0.25 and -0.23 for the national, state and firm-based costs. Interestingly, though, there is very little change in the estimates of the overall probability of a separation.[27] At the overall means, the firm level tax cost estimates imply that 8 percent of all separations and 13 percent of temporary ones are due to incomplete experience rating.[28]

In general, then, Table 4 does support the prediction of the theoretical models that increased experience rating decreases layoffs. The results on benefits and duration, however, are more mixed. While the weekly benefit amount always enters significantly positively, the potential duration is either negative or insignificantly positive. A reasonable summary of the combined effect of the benefit level and duration is the

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[27]Recall, however, that these are different samples, since the bottom panel excludes firms at the minimum and maximum tax rates. Using the sample which excludes firms at the minimum and maximum, but not including the reserve ratio controls results in somewhat different estimates, especially using the firm tax cost. For permanent separations, the estimated coefficients are -0.004, -0.035 and -0.104 for the national, state and firm costs, while for temporary layoffs, the estimated coefficients are -0.009, -0.022 and -0.058 for the national, state and firm costs.

[28]These numbers are calculated by multiplying the tax cost coefficient by (1-.584), where .584 is the average tax cost from the top panel of Table 4, and dividing by the dependent variable mean from the top panel of Table 4.

logarithm of total potential benefits, Ln(WBA*PD) = Ln(WBA) + Ln(PD), so that the overall effect is the sum of the coefficients on level and duration, which is always positive. This result agrees with the findings of Feldstein (1978) who found a positive association between benefit levels and temporary layoff unemployment in a CPS cross-section. The taxation variables are not significant in the preferred specifications of the bottom panel, although the tax on benefits is significantly positive in the top panel.

As a check on our estimates, we also examine only those temporary separations which result in UI receipt to exclude quits (which are generally not UI compensable). However, because benefit takeup by eligible workers is far less than 100 percent,[29] unlikely to perfectly predicted by a firm, and may depend on UI parameters, we generally prefer our other separation measures. Using only those temporary separations which result in UI receipt does give results which are fairly similar to those using all temporary separations, particularly for the firm cost or state IUR based cost. For example, the specification in the top panel of Table 4 yields coefficient estimates and standard errors for the national, state and firm based costs of -0.011 (.002), -0.026 (0.002) and -0.022 (0.001), respectively. Similarly, the specification in the bottom panel yields coefficient estimates and standard errors of -0.021 (0.002), -0.024 (0.003) and -0.020 (0.003) for the national, state and firm based costs.

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[29]See Blank and Card (1991), Anderson and Meyer (1994a), and McCall (1994), for example.

DIFFERENCING THE DATA TO ELIMINATE FIRM AND INDIVIDUAL EFFECTS

While the above approach may satisfactorily control for past layoffs, there may be individual (as opposed to firm) components of α_{ij} for which we should control, making such an approach inadequate. However, a number of techniques can be used which difference out α_{ij} and rely on changes in tax schedules and firm moves along tax schedules to provide variation in tax costs. Given the relationships in equations (5.2) and (5.3), we can use to our advantage the fact that past layoffs by a firm only affect its tax cost with a lag. In particular, all states we examine base this year's tax rate on the reserve ratio last year as of June 30 or July 1. In this situation, if we difference (5.2) by subtracting 4th quarter year y-1 from 4th quarter year y or subtracting 3rd quarter year y-1 from 3rd quarter year y, we will eliminate α_{ij} from the equation. In addition, since neither λ_{jt-4} or λ_{jt} enter T_{jt} or T_{jt-1} we obtain consistent estimates. However, this linear probability model will not be consistent if ϵ_{ijt} is serially correlated. Note that if the ϵ_{ijt} are serially correlated and the correlation declines with time, we should expect β to be biased towards zero.[30] We can also obtain consistent estimates of β and γ in (5.2) if the ϵ_{ijt} are correlated one year apart ($E[\epsilon_{ijt}\epsilon_{ijt-4}]\neq 0$) by using instrumental variables. We

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[30] To see this result, write the differenced linear probability model as

(5.4) $\lambda_{ijt} - \lambda_{ijt-4} = \beta(T_{jt} - T_{jt-4}) + (z_{ijt} - z_{ijt-4})'\gamma + \epsilon_{ijt} - \epsilon_{ijt-4}$. If higher layoffs lead to lower tax costs and the correlation in the ϵ_{ijt} declines over time, then the differenced tax cost will have a positive correlation with the differenced error. This result occurs because ϵ_{ijt-k}, $k \geq 5$ enters T_{ijt} negatively, while ϵ_{ijt-m}, $m \geq 9$ enters T_{ijt-4} negatively, and ϵ_{ijt-k} is closer in time to the error term.

report estimates where we instrument the change in tax cost in (5.4) with last period's tax cost level, i.e. we instrument T_{jt}-T_{jt-4} with T_{jt-4}.

Table 5 presents these estimates where we difference observations one year apart from the same job-match.[31] Here we focus only on temporary layoffs, since a permanent layoff in the first year would not be possible for a given job-match. In the first column, which uses ordinary least squares (OLS), we find an estimated coefficient on the tax cost which is significantly negative but smaller than the estimate in the bottom panel of the previous table. The estimated impacts of the other UI variables, however, are very different from those in Table 4. Here the coefficients on benefits and potential duration are both significantly negative, as is that for the benefit taxation variable. By contrast, the coefficient on the income taxation variable is significantly positive. These last two results are the opposite of what the flexible wage model predicts.

Columns (2) and (3) of Table 5 present the results from instrumenting the tax cost. In the first case, we simply use the lagged tax cost as the instrument. In the second case, we instrument using the part of the change in the tax cost due to shifts in tax schedules, rather than due to any firm behavior. Specifically, we calculate the tax cost given last year's reserve ratio and this year's tax schedule, and use the difference between

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[31]As before, the reported standard errors are likely to be slightly understated. The understatement due to multiple observations from a firm will be small as in the levels specifications. The understatement due to multiple observations from a job-match is likely to be off much less importance in the first difference specifications. Here we drop first and second quarter observations and only rely on changes over time within a given job-match. We also calculate heteroskedasticity corrected standard errors for the specification of column (1), and obtain a corrected standard error for the coefficient on the tax cost variable of 0.0047, versus the uncorrected value of 0.0044.

this measure and last year's actual tax cost as an instrument. The results of the two specifications are similar. The only differences between the coefficients in these specifications and the OLS differenced estimates are increases in the absolute value of the tax cost coefficient. These large increases suggest that there is serial correlation in the error terms of (5.2). These coefficient estimates further imply large elasticities of the temporary layoff probability with respect to the tax cost of -0.33 and -0.30 for columns (2) and (3) respectively. The corresponding fractions of temporary layoff unemployment that can be attributed to incomplete experience rating are 23 and 21 percent.[32]

We also estimated the specification of column (1) using the conditional logit model of Chamberlain (1980) which eliminates the fixed effect α_{ij} from the equation and has a more attractive functional form. Not surprisingly, the signs of the significant coefficients are the same, again implying that there is a negative effect of the tax cost, WBA, PD and benefit tax measures.

INSTRUMENTAL VARIABLES ESTIMATES WITH THE TAX COST PROXIES

The mean tax costs by industry for our states reported in Table 3 indicate that the tax cost proxies used in past work and Table 4 differ systematically from mean firm level tax costs. Since the schedules which relate reserve ratios to tax costs are nonmonotonic, it is not surprising that the tax cost for an "average firm" will not equal the average of the

[32]Again, these numbers are calculated by multiplying the derivative by (1-.584) and dividing by .064 from the top panel of Table 4.

firm level tax costs. In this situation past proxy variable approaches would be expected to yield biased and inconsistent estimates of the effects of experience rating. However, as long as the proxies are exogenous, instrumental variables estimation using the proxies as instruments for firm level tax costs would be consistent even if the proxies poorly approximate true tax costs. The danger in using this cross-state variation is that the differences in schedules may reflect political factors. For example, political pressure groups may convince state legislatures to have a low maximum rate if there are a few high layoff industries in the state. With the state IUR based proxies there is also the danger that functions of state/industry unemployment are not exogenous in layoff equations. Thus, our instrumental variables estimates also implicitly provide a test of the exogeneity of the proxies used in past work.

Table 6 reports estimates from several specifications where we instrument firm or state level tax costs with state or national proxies. Again, we report separate estimates for permanent and temporary separations.

The results are not supportive of these proxies being valid instruments, in that the results are inconsistent with theory and earlier estimates. The estimated effect of experience rating has the wrong sign in columns (1) and (4) and in the other columns the estimates have the expected sign but are implausibly large. For example, column (6) implies that all of temporary layoffs are due to incomplete experience rating, while column (5) indicates that incomplete experience rating is responsible for 500 percent of temporary layoffs.

An examination of the first stage of the above two-stage least squares estimates makes the results more understandable. When the national IUR based proxy is used as the instrument it typically has a coefficient of -0.031, while the state IUR based proxy typically has a coefficient of 0.035. In both cases these coefficients are estimated fairly precisely with t-statistics close to 10. It is clear that after we control for state and industry, the correlation between the tax cost proxies and the mean state/industry firm costs is low and not always of the right sign. The proxies also have a greater variance than the true mean tax costs.

A difference between the state and national IUR based cost measures that we construct, and those used by Card and Levine (1994) is the treatment of shifts in the tax schedule. Card and Levine average the schedules over their time period and treat that as a steady state schedule. In order to gauge the effect of our use of each yearly schedule, we compared our results to those using the actual cost measures used by Card and Levine.[33] Using these measures directly in the regression, as in the top panel of Table 4 reveals some differences. Looking at temporary layoffs, for example, the state IUR based measure is smaller than our estimate, at -0.014, while a positive effect of 0.021 is estimated for the national IUR based measure. Using these measures as instruments gives results which, while not as extreme as those in Table 6, are similarly inconsistent with the tax cost proxies being exogenous. Again taking temporary layoffs as an example, the estimated coefficients and standard errors when using the Card and

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[33]We would like to thank Phil Levine for providing us with the national cost measures. The state measures used are those reported in the appendix of Card and Levine (1992).

Levine state and national measures as instruments are -0.159 (0.042) and 0.103 (0.050), respectively. Finally, instrumenting Card and Levine's state measure with their national measure gives us -0.088 (0.013).

FELDSTEIN SUBSIDY ESTIMATES

Since the models which focus on firms' use of UI as a part of the compensation package are often formulated in terms of the UI subsidy of Feldstein (1976), we also estimated specifications using this subsidy variable, rather than the separate tax cost, benefit and income tax variables. This subsidy measure, in the analogue of the Table 4 specifications, implies that eliminating the UI subsidy would have an effect on temporary layoffs similar to that of eliminating incomplete experience rating. In the analogue of the Table 5 specifications, however, the negative effect of higher benefits on layoffs leads the subsidy measure to have the opposite sign, implying that eliminating the subsidy would increase layoffs. This result does indicate, however, that our negative benefit coefficients in Table 5, which contradict the compensation package model, were not merely due to our choice of functional form.

6. Conclusions

We have examined the effects of experience rating on layoffs using high quality firm and individual data. While we have found a range of estimates using a number of alternative methodologies, our preferred estimates imply that incomplete experience rating is responsible for over twenty percent of temporary layoffs. These differenced estimates remove permanent individual and firm characteristics and either allow some serial correlation in layoffs or only rely on changes in tax schedules.

We find mixed results when comparing models where UI is a firm adjustment cost to models where UI is a component of the worker compensation package. In the differenced estimates, the predictions of the adjustment cost model for the effects of experience rating and the level and duration of benefits are supported, while only the experience rating prediction of the alternative model is supported. In particular, our estimates for the effects of benefits and taxes are the opposite of those predicted by the compensation package model. In the less preferred estimates where we control for past use of UI, we find that higher benefits increase layoffs, thus contradicting the adjustment cost model, while all other UI variables besides experience rating are insignificant.

Using our new data, we also confirm the correlation between experience rating proxies and layoffs found in past studies. However, the differences between these proxies and state average firm tax costs, along with our anomalous instrumental variables estimates suggest that it may be inappropriate to causally interpret these correlations.

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Figure 1

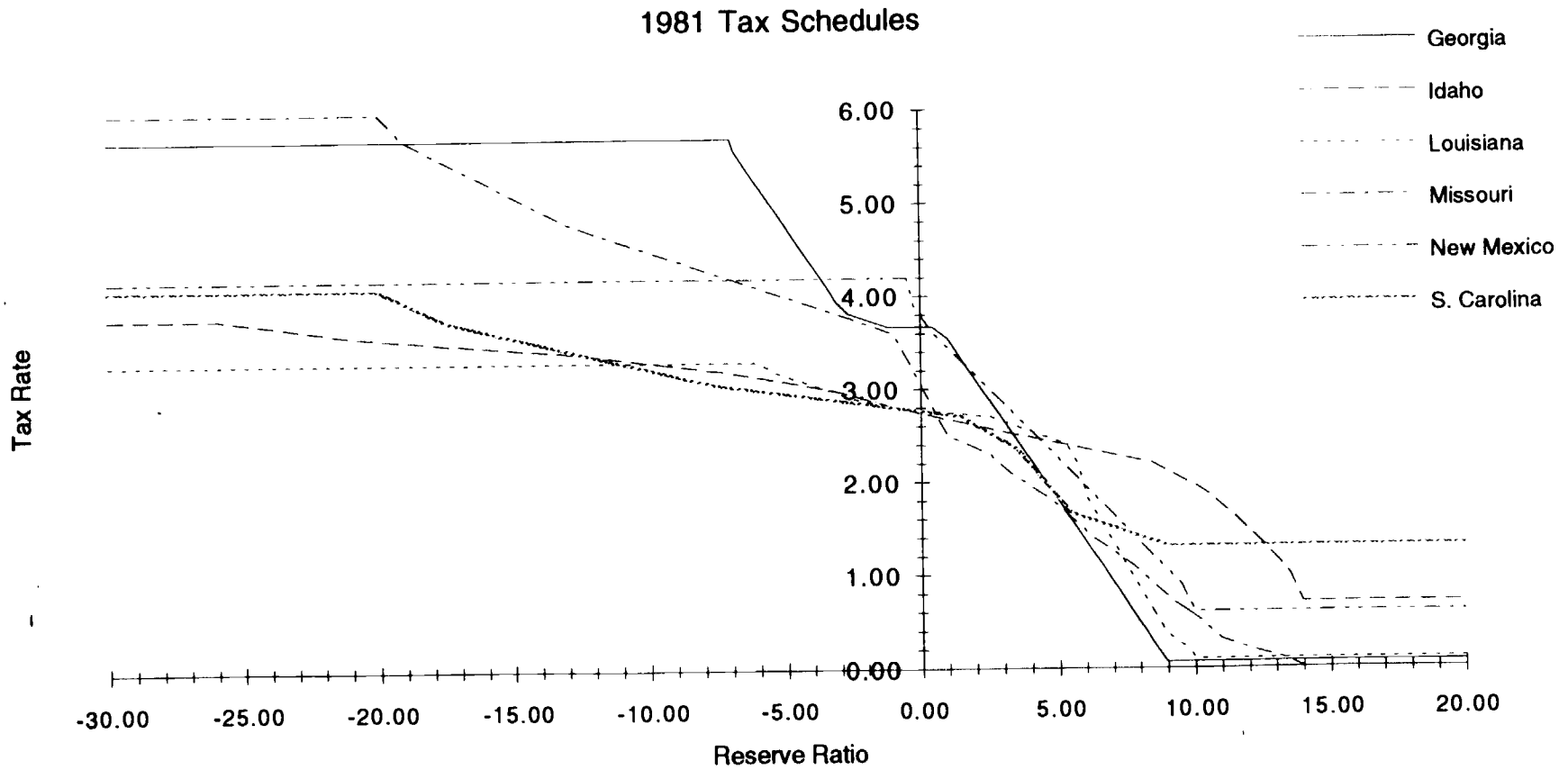
1981 Tax Schedules
Georgia
Idaho
Louisiana
Missouri
New Mexico
S. Carolina
Tax Rate
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-30.00
-25.00
-20.00
-15.00
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
Reserve Ratio

Table 1

Key Unemployment Insurance Program Parameters
on July 1, 1980 and July 1, 1983

	Georgia	Idaho	Louisiana	Missouri	New Mexico	South Carolina
Taxable Wage Base ($)						
1980	6,000	10,800	6,000	6,000	7,200	6,000
1983	7,000	14,400	7,000	7,000	9,300	7,000
Maximum Weekly Benefit ($)						
1980	90	132	149	105	106	114
1983	125	159	205	105	142	118
Minimum Tax Rate (%)						
1980	.07	.90	.13	.00	.60	1.30
1983	.06	1.70	.37	.80	.60	1.30
Maximum Tax Rate (%)						
1980	5.71	4.00	3.33	6.00	4.20	4.10
1983	5.38	5.60	5.50	4.40	4.20	4.10

Table 2

1981 Tax Cost Distributions by State and Selected Industry
(Percent of Employment)

	State Total	Con-struction	SIC 17	Manu-facturing	SIC 24	SIC 37	SIC 58	SIC 73
Georgia								
0 (Min Rate)	2.0	2.8	3.1	0.4	3.8	0.0	2.1	0.4
0.21 - 0.30	2.2	6.9	7.8	3.6	4.8	2.9	0.2	0.0
0.71 - 0.80	1.0	1.3	1.6	0.6	1.0	0.0	0.6	0.7
0.81 - 0.90	93.3	81.2	79.2	92.2	88.6	67.7	96.9	98.9
0 (Max Rate)	1.5	7.9	8.3	2.5	1.9	29.4	0.2	0.0
N	5941	394	192	1821	103	68	514	276
Idaho								
0 (Min Rate)	12.0	2.0	3.6	3.4	0.4	0.0	24.7	5.5
0.11 - 0.20	1.7	11.4	5.9	2.4	5.2	0.0	0.8	0.0
0.21 - 0.30	1.5	3.0	4.7	2.0	2.0	12.5	5.2	0.0
0.31 - 0.40	20.2	26.7	30.2	26.9	34.4	56.3	19.0	9.5
0.41 - 0.50	1.2	4.1	2.4	1.6	4.4	0.0	0.8	0.4
0.51 - 0.60	15.6	32.2	26.0	23.6	11.7	25.0	10.1	8.4
0.61 - 0.70	11.4	6.9	10.7	17.6	29.8	6.3	10.1	8.4
0.71 - 0.80	35.0	6.9	11.2	19.9	3.7	0.0	28.8	67.5
0 (Max Rate)	1.4	6.9	5.3	2.6	8.5	0.0	0.5	0.4
N	6525	509	169	1521	460	16	385	274
Louisiana								
0 (Min Rate)	1.9	1.5	1.8	0.6	0.8	0.0	3.6	1.8
0.21 - 0.30	15.1	25.8	28.3	16.9	32.0	12.1	9.2	17.4
0.31 - 0.40	1.7	2.5	5.1	4.0	4.1	0.4	0.3	1.4
0.51 - 0.60	2.6	10.4	5.5	3.6	13.9	2.3	2.5	0.9
0.61 - 0.70	1.7	0.8	1.2	0.5	2.5	0.0	2.5	1.7
0.81 - 0.90	52.7	11.2	17.9	56.7	18.7	67.9	55.3	49.5
0.91 - 1.00	5.4	3.0	4.3	6.2	2.5	3.0	6.2	5.7
0 (Max Rate)	19.0	44.9	35.9	11.6	15.6	14.3	20.6	21.7
N	11252	1359	491	1910	122	265	730	651
Missouri								
0 (Min Rate)	11.1	0.6	0.5	5.9	0.0	3.5	2.8	1.0
0.41 - 0.50	0.9	0.3	0.0	0.2	0.0	0.0	3.0	1.2
0.51 - 0.60	4.4	14.5	9.8	4.4	2.6	14.9	4.6	1.6
0.61 - 0.70	54.7	41.6	49.0	51.8	63.2	14.4	16.9	19.0
0.71 - 0.80	25.7	24.4	22.2	33.4	15.8	58.5	24.9	24.7
0 (Max Rate)	3.2	18.6	18.6	4.4	18.4	8.7	26.4	24.9
N	5996	344	194	1518	38	229	301	309
New Mexico								
0 (Min Rate)	10.9	3.3	5.3	3.3	0.0	2.6	12.1	7.9
0.71 - 0.80	85.5	78.1	83.6	94.0	89.6	92.1	87.0	91.3
0.81 - 0.90	0.4	1.1	0.0	0.1	0.0	0.0	0.0	0.0
0 (Max Rate)	3.2	17.6	11.0	2.6	10.5	5.3	1.0	0.8
N	10345	1293	489	1048	67	76	1112	519
S. Carolina								
0 (Min Rate)	40.2	19.7	19.7	41.4	58.6	31.0	20.4	21.5
0.21 - 0.30	26.0	45.9	43.6	23.2	18.0	59.5	32.7	43.7
0.41 - 0.50	2.7	14.5	12.7	1.2	2.3	0.0	4.2	1.9
0.71 - 0.80	30.1	18.0	23.2	33.0	20.3	9.5	40.0	32.9
0 (Max Rate)	1.0	1.9	0.9	1.2	0.8	0.0	2.7	0.0
N	8895	823	427	3656	128	42	480	325

Note: SIC 17 = Special Trade Contractors, SIC 24 = Lumber & Wood Products, SIC 37 = Transportation Equipment, SIC 58 = Eating & Drinking Places, SIC 73 = Business Services

Table 3

Mean of Marginal Tax Cost
by Industry

State	Major Industry Group	Cost based on actual firm tax rate	Cost based on State- Industry IUR	Cost based on National Industry IUR
Overall		0.584	0.649	0.609
Georgia	Mining	0.822	--	0.822
Georgia	Construction	0.687	0.505	0.000
Georgia	NonDurable Manufacturing	0.773	0.822	0.662
Georgia	Durable Manufacturing	0.757	0.822	0.679
Georgia	Utilities	0.797	--	0.822
Georgia	Trade	0.778	0.822	0.822
Georgia	FIRE	0.779	--	0.822
Georgia	Services	0.769	0.822	0.822
Georgia	Public Sector	0.817	--	0.822
Georgia	Other	0.760	--	0.000
Idaho	Mining	0.452	--	0.733
Idaho	Construction	0.403	0.000	0.109
Idaho	NonDurable Manufacturing	0.522	0.494	0.471
Idaho	Durable Manufacturing	0.535	0.590	0.699
Idaho	Utilities	0.643	--	0.780
Idaho	Trade	0.520	0.777	0.780
Idaho	FIRE	0.662	--	0.335
Idaho	Services	0.577	0.780	0.777
Idaho	Public Sector	0.341	--	0.000
Idaho	Other	0.368	--	0.000
Louisiana	Mining	0.663	--	0.431
Louisiana	Construction	0.228	0.000	0.000
Louisiana	NonDurable Manufacturing	0.619	0.454	0.385
Louisiana	Durable Manufacturing	0.602	0.410	0.315
Louisiana	Utilities	0.646	--	0.574
Louisiana	Trade	0.671	0.910	0.593
Louisiana	FIRE	0.716	--	0.907
Louisiana	Services	0.578	0.669	0.710
Louisiana	Public Sector	0.196	--	0.875
Louisiana	Other	0.291	--	0.000

(Continued)

Table 3
(continued)
Mean of Marginal Tax Cost
by Industry

State	Major Industry Group	Cost based on actual firm tax rate	Cost based on State- Industry IUR	Cost based on National Industry IUR
Missouri	Mining	0.515	--	0.678
Missouri	Construction	0.469	0.000	0.000
Missouri	NonDurable Manufacturing	0.581	0.437	0.465
Missouri	Durable Manufacturing	0.591	0.427	0.528
Missouri	Utilities	0.516	--	0.678
Missouri	Trade	0.597	0.678	0.678
Missouri	FIRE	0.571	--	0.698
Missouri	Services	0.589	0.678	0.678
Missouri	Public Sector	0.663	--	0.742
Missouri	Other	0.591	--	0.000
New Mexico	Mining	0.688	--	0.778
New Mexico	Construction	0.600	0.000	0.000
New Mexico	NonDurable Manufacturing	0.729	0.788	0.669
New Mexico	Durable Manufacturing	0.728	0.875	0.725
New Mexico	Utilities	0.671	--	0.778
New Mexico	Trade	0.653	0.778	0.778
New Mexico	FIRE	0.713	--	0.778
New Mexico	Services	0.660	0.778	0.778
New Mexico	Public Sector	0.702	--	0.778
New Mexico	Other	0.651	--	0.000
South Carolina	Mining	0.167	--	0.240
South Carolina	Construction	0.275	0.000	0.000
South Carolina	NonDurable Manufacturing	0.284	0.424	0.174
South Carolina	Durable Manufacturing	0.347	0.424	0.487
South Carolina	Utilities	0.142	--	0.787
South Carolina	Trade	0.218	0.787	0.787
South Carolina	FIRE	0.223	--	0.000
South Carolina	Services	0.291	0.787	0.787
South Carolina	Public Sector	0.521	--	0.000
South Carolina	Other	0.355	--	0.000

Note: State-level insured unemployment rates are only available for construction, nondurable manufacturing, durable manufacturing, trade and services.

Table 4

Linear Probability Models of the
Effect of Unemployment Insurance on Separations

	Overall Separation Probability			Temporary Separation Probability		
	Cost based on National Industry IUR	Cost based on State-Industry IUR	Cost based on actual firm tax rate	Cost based on National Industry IUR	Cost based on State-Industry IUR	Cost based on actual firm tax rate
	(1)	(2)	(3)	(4)	(5)	(6)
Marginal Tax Cost	-0.008	-0.033	-0.034	-0.005	-0.028	-0.027
	(0.004)	(0.005)	(0.002)	(0.002)	(0.003)	(0.002)
Ln(Weekly Benefit)	0.050	0.059	0.060	0.021	0.028	0.025
	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)
Ln(Potential Duration)	-0.015	-0.013	-0.009	-0.013	-0.006	-0.014
	(0.006)	(0.006)	(0.006)	(0.003)	(0.004)	(0.004)
Ln(1- tax rate on benefits)	0.010	0.013	0.013	0.008	0.013	0.010
	(0.005)	(0.006)	(0.006)	(0.003)	(0.004)	(0.004)
Ln(1- tax rate on income)	-0.006	0.003	0.007	-0.012	-0.004	-0.004
	(0.014)	(0.017)	(0.016)	(0.009)	(0.010)	(0.010)
R^2	0.071	0.068	0.069	0.038	0.041	0.042
N	437598	343293	347175	437598	343293	347175
Dependent Mean	0.190	0.200	0.203	0.059	0.063	0.064
Tax Cost Mean	0.613	0.649	0.584	0.613	0.649	0.584
Including Controls for Reserve Ratio						
Marginal Tax Cost	-0.008	-0.035	-0.039	-0.015	-0.025	-0.020
	(0.005)	(0.006)	(0.007)	(0.003)	(0.004)	(0.004)
Ln(Weekly Benefit)	0.062	0.069	0.061	0.032	0.040	0.032
	(0.005)	(0.006)	(0.005)	(0.003)	(0.004)	(0.003)
Ln(Potential Duration)	-0.011	-0.008	-0.011	-0.005	0.002	-0.005
	(0.007)	(0.008)	(0.007)	(0.004)	(0.005)	(0.004)
Ln(1- tax rate on benefits)	0.001	0.007	0.002	-0.002	0.004	-0.001
	(0.007)	(0.008)	(0.007)	(0.004)	(0.005)	(0.004)
Ln(1- tax rate on income)	-0.002	0.010	-0.003	-0.007	0.008	-0.007
	(0.018)	(0.020)	(0.018)	(0.011)	(0.012)	(0.011)
R^2	0.072	0.068	0.072	0.049	0.052	0.048
N	287574	229206	287312	287574	229206	287312
Dependent Mean	0.202	0.213	0.202	0.062	0.066	0.062
Tax Cost Mean	0.613	0.652	0.705	0.613	0.652	0.705

Notes: Standard errors in parentheses. All models also include dummy variables for 2 digit SIC, firm size class, state, calendar quarter and state by calendar quarter, as well as an 8 variable spline in past earnings. The marginal tax cost is the fraction of a dollar in UI benefits received today that can be expected to be repaid through higher future taxes. See text for a complete description of the variables.

Table 5

Differenced Models of the
Effect of Unemployment Insurance on Temporary Separations

	OLS	2SLS	2SLS
	(1)	(2)	(3)
Marginal Tax Cost	-0.012	-0.036	-0.033
	(0.004)	(0.009)	(0.009)
Ln(Weekly Benefit)	-0.048	-0.048	-0.048
	(0.011)	(0.011)	(0.011)
Ln(Potential Duration)	-0.076	-0.076	-0.076
	(0.012)	(0.012)	(0.012)
Ln(1- tax rate on benefits)	-0.054	-0.054	-0.054
	(0.009)	(0.009)	(0.009)
Ln(1- tax rate on income)	0.068	0.068	0.068
	(0.022)	(0.022)	(0.022)
R^2 (-2 ln likelihood for logit)	0.027	0.028	0.028
N	78420	78420	78420
Dependent Mean	-0.015	-0.015	-0.015

Notes: Standard errors in parentheses. All above variables are in differences. All models also include a differenced 8 variable spline in earnings, as well as dummy variables for state by calendar quarter. The marginal tax cost is the fraction of a dollar in UI benefits received today that can be expected to be repaid through higher future taxes. Differences are annual differences for the 3rd and 4th quarters (ie. 1981:3 - 1980:3). For model (2), the lagged cost is used as instrument, while for model (3), the difference in cost due to schedule shifts only is used as instrument. See text for a complete description of the variables.

Table 6

Two Stage Least Squares Estimates of the
Effect of Unemployment Insurance on Separations

	Overall Separation Probability			Temporary Separation Probability		
	Firm-based cost instrumented with National-based cost	Firm-based cost instrumented with State-based cost	State-based cost instrumented with National-based cost	Firm-based cost instrumented with National-based cost	Firm-based cost instrumented with State-based cost	State-based cost instrumented with National-based cost
	(1)	(2)	(3)	(4)	(5)	(6)
Marginal Tax Cost	0.245	-1.066	-0.110	0.339	-0.722	-0.135
	(0.143)	(0.156)	(0.022)	(0.088)	(0.097)	(0.014)
Ln(Weekly Benefit)	0.043	0.101	0.059	0.006	0.055	0.027
	(0.009)	(0.008)	(0.005)	(0.005)	(0.004)	(0.003)
Ln(Potential Duration)	-0.015	-0.002	-0.013	-0.020	-0.005	-0.005
	(0.007)	(0.007)	(0.006)	(0.004)	(0.004)	(0.004)
Ln(1- tax rate on benefits)	0.012	0.048	0.014	0.008	0.037	0.013
	(0.006)	(0.008)	(0.006)	(0.004)	(0.005)	(0.004)
Ln(1- tax rate on income)	0.017	-0.022	0.005	0.007	-0.019	-0.002
	(0.017)	(0.020)	(0.017)	(0.010)	(0.012)	(0.010)
R^2	0.068	0.063	0.068	0.041	0.043	0.040
N	347175	277884	343294	347175	277884	343294
First stage coefficient on tax cost variable	-0.031	0.035	0.245	-0.031	0.035	0.245
	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)

Notes: Standard errors in parentheses. All models also include dummy variables for 2 digit SIC, firm size class, state, calendar quarter and state by calendar quarter, as well as an 8 variable spline in past earnings. The marginal tax cost is the fraction of a dollar in UI benefits received today that can be expected to be repaid through higher future taxes. See text for a complete description of the variables.

Appendix
Reserve Ratio Experience Rating and Marginal Tax Costs

This appendix derives a formula for the amount paid by a firm in future benefits if one dollar is paid to the firm's recent former employees by the UI system. The formula applies to reserve ratio experience rating systems which are is use in most states. The derivation below extends the work of Brechling (1977a, 1977b) and Topel (1983). The notation follows that of Topel.

Some useful definitions are:

μ_t = fraction of employees receiving UI on average during year t,

B_t = UI benefits on an annual basis in year t, i.e. B_t is the average weekly benefit amount times 52,

R_t = reserves credited to employer's account in year t,

W_t = taxable wage base per employee in year t,

N_t = number of employees in year t,

τ_t = UI tax rate in year t,

θ = geometric growth rate of firm's employment, i.e., $N_{t+1}=\theta N_t$,

γ = geometric growth rate of the nominal taxable wage base, i.e.,$W_{t+1}=\tau W_t$

i = nominal interest rate, and

r_t = reserve ratio in year t.

The reserve ratio is the ratio of reserves to taxable payroll averaged over the last three years,

$$(1) \qquad r_t = \frac{R_t}{\frac{1}{3}\sum_{i=0}^{2} W_{t-i}N_{t-i}} \approx \frac{R_t}{W_{t-1}N_{t-1}}$$

for θ and τ close to 1. The change in reserves is the difference between taxes paid and benefits paid to former employees

$$(2) \qquad R_t = R_{t-1} + \tau_t W_t N_t - \mu_t B_t N_t \quad .$$

In terms of the reserve ratio,

$$r_t \approx \frac{r_{t-1}}{\theta\gamma} + \theta\gamma\tau_t - \frac{\theta\gamma\mu_t B_t}{W_t} \quad . \tag{3}$$

Let the tax schedule be approximated by the linear relationship

$$\tau_{t+1} = \eta_0 - \eta_1 r_t \quad , \text{ or} \tag{4}$$

$$r_t = \frac{\eta_0 - \tau_{t+1}}{\eta_1} \quad . \tag{5}$$

Substituting (5) in (3) yields

$$\frac{\eta_0 - \tau_{t+1}}{\eta_1} \approx \frac{\eta_0 - \tau_t}{\theta\gamma\eta_1} + \theta\gamma\tau_t - \frac{\theta\gamma\mu_t B_t}{W_t} \quad , \text{ or} \tag{6}$$

$$\tau_{t+1} \approx \left(\mu_0 - \frac{\mu_0}{\theta\gamma}\right) + \left(\frac{1}{\theta\gamma} - \theta\gamma\eta_1\right)\tau_t + \frac{\theta\gamma\eta_1\mu_t B_t}{W_t} \quad . \tag{7}$$

If one multiplies (7) by the wage base and employment one obtains the total tax bill for year t+1

$$N_{t+1}W_{t+1}\tau_{t+1} \approx (\eta_0\theta\gamma - \eta_0)N_tW_t + (1 - \theta^2\gamma^2\eta_1)N_tW_t\tau_t + \theta^2\gamma^2\eta_1 N_t\mu_t B_t \quad . \tag{8}$$

Now, if $N_tB_t\mu_t$ increases by 1 dollar, the present value of the implied increase in future taxes is

$$e \approx \frac{\theta^2\gamma^2\eta_1}{(1+i)} + \frac{\theta^2\gamma^2\eta_1(1-\theta^2\gamma^2\eta_1)}{(1+i)^2} + \frac{\theta^2\gamma^2\eta_1(1-\theta^2\gamma^2\eta_1)^2}{(1+i)^3} + \ldots$$

(9)

$$= \frac{\theta^2\gamma^2\eta_1}{i + \theta^2\gamma^2\eta_1} \quad .$$

The degree to which e, the marginal tax cost, is less than one is a measure of the subsidy to layoffs or prolonged unemployment spells.