Layoffs and Experience Rating of the Unemployment Insurance Payroll Tax: An Analysis of Firms in Three States

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Layoffs and Experience Rating of the Unemployment Insurance Payroll Tax: An Analysis of Firms in Three States (Abstract)

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In the United States, Unemployment Insurance (UI) is financed through a payroll tax that is collected from employers. The payroll tax is "experience rated," meaning that, in principle, the tax rate paid by firms that have laid off more workers in the past is higher than the rate paid by firms that have laid off relatively few workers. Experience rating is intended both to ensure that employers who lay off workers make tax contributions commensurate with the UI benefits received by their former workers and to give employers an incentive to adopt an organization of production that avoids temporary layoffs (both seasonal and cyclical).

This research uses longitudinal data on firms in Missouri, Washington, and Pennsylvania to examine the extent to which experience rating of the UI payroll tax affects the propensity of firms to lay off workers. We estimate models in which various measures of a firm's layoffs are regressed on measures of the extent to which the firm will be burdened by additional costs if it lays off an additional worker. The approach has three main features. First, the unit of observation is the firm rather than the worker or some industry subaggregate. Second, the UI administrative data used allow direct observation of the tax rates and layoff incentives facing each firm. Third, the panel data allow us to distinguish between firm fixed effects (that is, heterogeneity) and experience rating of the UI payroll tax as determinants of layoffs.

The results suggest that experience rating does significantly reduce layoffs, although the estimated impacts are more modest than those found in the majority of past research.

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1. Introduction

In the United States, Unemployment Insurance (UI) is financed through a payroll tax that (in all but a few states) is collected entirely from employers. The payroll tax is "experience rated," meaning that in principle the tax rate paid by firms that have laid off more workers in the past is higher than the rate paid by firms that have laid off relatively few workers. The idea behind experience rating is to attain an efficient allocation of unemployment risk, which arguably implies placing the burden of financing UI benefits on employers (who are assumed to be risk-neutral) rather than on workers (who are assumed to be risk-averse) and implies ensuring that employers who are responsible for more benefits being paid to unemployed workers ultimately make larger tax contributions. By imposing costs on employers who lay off workers, experience rating internalizes the social costs of unemployment and gives employers an incentive to adopt an organization of production that avoids temporary layoffs — in particular, temporary layoffs that are associated with seasonal and cyclical fluctuations (see, among others, Becker 1972; Mortensen 1983; Deere 1991).

Institutionally, complete experience rating of the UI payroll tax would mean that every dollar of UI benefit that is paid to a job loser would be traced to the employer who is in some sense responsible for the benefit payment, charged to that employer, and collected.[1] However, experience rating of the UI payroll tax is incomplete for two main reasons. First, some benefits that are paid are "noncharged," or not charged to

[1] This line of argument has been pursued by Brechling and Laurence (1995) in the context of permanent layoffs. Some of the insurance arguments for UI are reviewed in Davidson and Woodbury (1997) and Karni (1999).

any firm. For example, benefits are sometimes paid to workers who have quit voluntarily or been discharged for cause, but these are not charged to a firm on the grounds that the unemployment was not "caused" by the separating employer. In addition, many states provide an allowance for dependents that also is not charged to any employer. Finally, the states' share of benefits paid under the standby Extended Benefits program is not charged to any employer in many states, and benefits paid under federal emergency extended benefit programs have never been charged to employers.

The second reason for incomplete experience rating is that some benefits that are charged to a firm cannot be recovered through future taxes. There are two main reasons for this. First, in all states, there is a maximum UI payroll tax rate. As a result, once a firm reaches the maximum tax rate, further layoffs may be charged to the firm, but they cannot result in higher tax rates or larger payments into the UI trust fund because the firm is already at the maximum tax rate. These benefits are "ineffectively charged." Second, if an employer goes out of business, it will be impossible to collect UI payroll taxes to cover the benefits that are charged to the firm. Benefits charged to employers that have gone out of business are "inactive charges."[2]

Incomplete experience rating of the UI payroll tax has two measurable implications that have been examined in past research. First, it has been shown to result in transfers and subsidies among firms and across industries. In companion piece, we have reviewed earlier work on this first issue and added evidence based on firm-level data. Second, compared with complete experience rating (which would

[2] The extent to which each of the above factors leads to incomplete experience rating has been made much clearer in recent years with the development and publication by the U.S. Department of Labor of its Experience Rating Index (ERI). The ERI shows the percentage of all benefits paid in a given year that are effectively charged (that is, both charged to an employer and collected from an employer). Useful discussions of the Experience Rating Index include Advisory Council on Unemployment (1995, chapter 6) and Vroman (1996).

presumably create an incentive for employers to avoid laying off workers), incomplete experience rating may create an incentive to lay off workers. That is, incomplete experience rating of UI benefits creates a situation where some employers may be able to lay off workers without incurring any additional payroll tax. Even in cases where payroll taxes rise as a result of some additional layoffs, the increase may be less than enough to cover the cost of the benefits paid to the laid off workers. As a result, the UI benefits paid to firm A's workers will be subsidized by other firms, and there will be an incentive for firm A to lay off more workers than it would if it had to pay the full cost of the benefits. These behavioral effects of incomplete experience rating on firms' behavior were first spelled out in detail by Feldstein (1976), Baily (1977), and Brechling (1977a,b).

This paper uses data on firms observed in three states over a full business cycle to examine the layoff incentives created by incomplete experience rating of the UI payroll tax. Section 2 describes the structure of the UI payroll tax, with particular attention to the three states whose data are used in the empirical analysis — Missouri, Washington, and Pennsylvania. Section 3 briefly reviews the theory of firms' layoff behavior in the presence of the UI payroll tax. As discussed in the review of empirical literature (section 4), a large body of empirical work on the layoff incentives created by incomplete experience rating already exists. However, we are aware of only one study that has used firm-level data, which many have argued is the appropriate type of data to use in examining this issue. In section 5, we describe the design of the empirical work, with special attention to construction of the dependent variables and key independent variables. Section 6 describes the empirical findings, which suggest impacts of experience rating on firms' layoff behavior that are statistically significant but smaller than most existing empirical studies. The implications of the empirical results are elaborated in section 7 by using those results to simulate three different

increases in the degree of experience rating of the UI payroll tax. Section 8 summarizes the findings and adds some concluding remarks.

2. The UI Payroll Tax

We begin with a brief description of the UI payroll tax systems in the three states that have provided data for this study: Missouri, Washington, and Pennsylvania.[3] Like any tax, the UI payroll tax comprises a tax base and a tax rate. The tax base (or "taxable wage base") is the first B dollars paid to a worker in a given year. In 1995, the taxable wage base varied from a minimum of $7,000 in eleven states to a high of $25,500 in Alaska. In the median state, Indiana, the taxable wage base was $9,000 (Advisory Council on Unemployment Compensation 1996; U.S. Department of Labor). The tax is collected from employers, and virtually all workers are covered, so the relatively low taxable wage base in most states implies that, for most employers, the UI payroll tax can be regarded as a fixed (per worker) nonwage labor cost.

Covered workers' taxable wages are taxed at a rate determined by one of five methods. Each method calculates some measure of a firm's layoff experience and then maps this measure of layoff experience into a tax rate that the firm is charged. Each method attempts to assign higher tax rates to firms whose employees have drawn more UI benefits in the past. Hence, subject to minimum and maximum tax rates, firms with a high propensity to lay off workers are assigned a higher tax rate than firms with a low propensity for layoffs.

The three states we are examining use the most common methods of experience rating the UI payroll tax. Missouri uses the reserve ratio method, which is used by 32 states, Washington uses the benefit ratio method, which is used by 16 states, and Pennsylvania uses a hybrid method that combines the reserve ratio and benefit ratio methods (a similar hybrid method is used by one other state, Michigan).

[3] For more complete treatments of UI financing, see Mackin (1978), Vroman (1990), and Levine (1997).

We discuss each of these below. Two states, Delaware and Oklahoma, use a method of experience rating known as the benefit-wage ratio method, and Alaska uses the payroll decline method.[4] Because data from these states are at present unavailable, we do not describe these methods here (but see Spencer, Anderson, and Woodbury 1998).

Regardless of the method of experience rating, most states determine the UI payroll tax rate by applying the measure of layoff experience directly to a tax table. A few states (including Washington) use an alternative known as "array allocation." Under array allocation, all employers in the state are rank-ordered by their degree of layoff experience. Employers are then assigned to tax rate classes by their order in the ranking (Vroman 1999).

Many states add fixed percentage charges to the rate paid by all employers for a variety of purposes: "fund building" (that is, maintenance or restoration of a state's UI trust fund to solvency), workforce training, or financing benefits that cannot be charged to a specific employer.

In each state, the UI payroll taxes paid by firms go into a trust fund from which UI benefits are paid. The health of each state's trust fund depends on the past health of the state's economy and labor market, given the generosity of benefits paid to workers and the size of the UI payroll tax. Regardless of the method used to map a firm's layoff experience into a UI payroll tax rate, all states change their tax rates according to some measure of the size of the UI trust fund. Most do this by specifying several tax schedules in their UI law, and then shift from one schedule to another depending usually on the solvency of the trust fund. During good economic times, a schedule with low tax rates is used. When the trust fund shrinks in a recession, a schedule with

[4] The wage-benefit ratio method measures an employer's layoff experience as the ratio of base-period wages paid to UI beneficiaries laid off by the employer during the last 3 years to the employer's average payroll over the last 3 years. The payroll decline method measures an employer's layoff experience by the change in payroll from quarter to quarter.

relatively high tax rates is used.

2.1. The Reserve Ratio Method (Missouri)

The reserve ratio method measures a firm's layoff experience by first creating a "reserve account" for each firm. UI payroll taxes paid by the firm are credited to the firm's reserve account, and chargeable benefits paid to the firm's laid off employees are debited. The balance in each firm's account, the "reserve balance," is the difference between the total tax contributions paid into the account by the employer (during the firm's existence) and the total UI benefits charged to the employer's account (again during the firm's entire existence):

(2.1) Reserve Balance = Total Taxes Paid – Total Benefits Charged

The reserve balance is then divided by a measure of the employer's payroll, usually the average of the past three years taxable payroll, to obtain the reserve ratio:

(2.2) Reserve Ratio = Reserve Balance / Average Taxable Payroll

In general, the reserve ratio reflects the history of tax contributions and benefit charges for the entire life of the firm — or, for a firm that existed when the UI system began, since the beginning of the UI system. In other words, it has an infinite memory of past benefit charges and contributions. (Some states, however, forgive negative balances below a floor and ignore positive balances above a ceiling, so for some firms, the entire history of taxes and charges is not reflected in the reserve ratio.)

In Missouri, which is a typical reserve ratio state, the reserve ratio for a given firm in year t is the ratio of (a) the reserve balance as of July 1 in year t-1 to (b) the 3-

year average annual payroll (as of July 1 in year t-1). This ratio is applied to the reserve ratio tax table to obtain the basic tax rate, which is in percentage terms.

To obtain the total tax rate actually faced by a firm, two additions are made to the basic tax rate: (a) a surcharge, calculated by multiplying the basic tax rate by a surcharge percentage, which varies annually and ranges from -7 percent to 40 percent annually during the years we observe; and (b) an additional surtax (or fund builder), which is a percentage that is added to the base tax rate. The total tax rate is the sum of the basic tax rate and the two additional tax rates.

Figure 1 shows the Missouri UI payroll tax schedules for 1985 through 1994, the years used in the empirical work below. The gray line (second from the top) shows the schedule for 1985 and 1986. The schedule then shifted down and became flatter as the Missouri UI trust fund grew during the expansion of the late 1980s, until in 1989 and 1990 it had fallen to the dark dashed line (the lowest line shown). After 1990, Missouri's trust fund dwindled, and the tax schedule was raised. By 1993 it was back to the 1985/1986 schedule, and in 1994 it moved up to the highest line shown. It is important to see that as the Missouri tax schedule shifts down, it also flattens, and that as it shifts up, it also becomes steeper.

2.2. The Benefit Ratio Method (Washington State)

Another method used to quantify a firm's layoff experience is to calculate a "benefit ratio," which equals the UI benefits charged to the firm during the last 3 to 5 years divided by the firm's average taxable payroll over the same period of time:

(2.3) Benefit Ratio = Benefits Charged / Average Taxable Payroll

The benefit ratio has a shorter "memory" than does the reserve ratio because it takes

account only of the benefits charged to an employer's account over the last 3 to 5 years.

In Washington, the benefit ratio for a given firm in year t is the ratio of (a) the sum of all UI benefit charges over the 4-year period ending June 30 of year t-1 to (b) the sum of annual taxable payroll during the last 4 years ending June 30 of year t-1. Washington State uses array allocation to convert the benefit ratio into a tax rate. That is, it rank-orders all employers by their benefit ratio, then divides employers into 20 rate classes, with each rate class representing 5 percent of taxable wages. All employers in a given rate class are assigned the same tax rate (Vroman 1999).

Figure 2 shows the Washington UI payroll tax schedules in 1989 (the dashed line), 1992 (the gray line), and 1995 (the dark line). The figure shows that between 1989 and 1992, both the level and slope of the tax schedule increased; that is, a given benefit ratio translated into a higher UI payroll tax rate (usually) in 1992 than in 1989. This increase was a response to the recession of the early 1990s and the subsequent drain on the UI trust fund. After 1992, the labor market recovered, and in response, the UI payroll tax schedule both fell and flattened somewhat; the dark line in Figure 4 representing 1995 generally lies below and is flatter than the lines representing 1989 and 1992.

2.3. The Hybrid Reserve Ratio / Benefit Ratio Method (Pennsylvania)

In Pennsylvania, the total UI payroll tax rate for each firm is based on both a reserve ratio and a benefit ratio. A firm's reserve ratio in year t is the ratio of (a) the reserve account balance as of June 30 in year t-1 to (b) the 3-year average annual payroll as of June 30 in year t-1. This ratio is applied to a reserve ratio tax table to obtain the reserve ratio factor rate, which is in percentage terms. Figure 3 depicts the reserve ratio components of Pennsylvania's tax schedule for 1986 through 1994. (The

schedules are drawn based on the assumption that a firm's benefit ratio is 0. If the firm's benefit ratio were greater than zero, the reserve ratio schedule for each year would shift up by some amount that would depend on the year.) Figure 3 shows the now-familiar pattern in which the tax schedule falls and becomes slightly flatter during an expansion, and rises and becomes slightly steeper in a recession. (The next-to-lowest line in Figure 3 represents the reserve ratio schedule for 1986 through 1989. The schedule fell to the lowest line in 1990 and 1991, then rose to the highest lines in 1992 through 1994.)

A Pennsylvania firm's benefit ratio in year t is the ratio of (a) the average benefit charges over the 3-year period ending June 30 of year t-1 to (b) the average annual taxable payroll over the 3-year period ending June 30 of year t-1. Figure 4 depicts the benefit ratio components of Pennsylvania's tax schedule for 1986 through 1994. [These schedules are drawn for a firm with a reserve ratio of 0. If the firm's reserve ratio were greater than (or less than) zero, the benefit ratio schedule for each year would shift down (or up) by some amount that would depend on the year.] Figure 4 again shows the pattern in which the tax schedule falls and becomes flatter in good times, and rises and becomes steeper in a recession.

The basic tax rate facing a Pennsylvania firm is the sum of the reserve ratio factor rate, the benefit ratio factor rate, and a .015 (1.5 percent) state adjustment factor rate, which is constant over the years for which data are available.

The total tax rate for a firm is obtained by adding the following three factors to the basic tax rate: (a) a surcharge adjustment, calculated by multiplying the basic tax rate by a surcharge rate, which varies annually; (b) an additional contributions rate (a fund builder); and (c) an interest factor rate (to repay interest on federal loans). Figure 5 depicts the total tax rate schedule for Pennsylvania in 1994. Because the total tax rate in Pennsylvania depends on both a benefit ratio and a reserve ratio, Figure 5 is

three-dimensional, with the benefit ratio on the x-axis, the reserve ratio on the y-axis, and the tax rate for each reserve ratio/benefit ratio combination on the z-axis.

3. The UI Payroll Tax and Firms' Layoff Behavior: Theory

Feldstein (1976) and Baily (1977) first elaborated an equilibrium theory of firm behavior in the presence of UI benefits financed through a payroll tax that is only partially experience rated. That theory has been extended to incorporate dynamic considerations in several subsequent studies, for example, Brechling (1977a,b) and Wolcowitz (1984).

In the equilibrium models of Feldstein (1976) and Baily (1977), workers are offered an employment package that includes wages, hours, and a probability of layoff (including a layoff duration). Labor markets are assumed to be competitive, so the utility derived from the employment package is a constraint to the firm; however, the firm can trade off one component of compensation for another as long as total utility is unchanged. Different workers and firms negotiate different combinations of wages, hours, and layoff probabilities, so that, in the absence of a UI system, workers in jobs with a higher layoff probability receive a compensating differential in the form of a higher wage.

In the Feldstein-Baily set up, a UI system that is not experience rated results in a windfall to high-layoff employers and their workers. That is, UI benefits are provided to workers during their layoff, eliminating at least party the need to provide a compensating differential for the relatively high probability of layoff. The existence of UI also creates an incentive for employers to lay workers off: Because at least part of the compensating differential for layoff is paid by the UI system, the marginal tax cost of laying off a worker is less than it would be if the firm had to bear the full cost of the compensating differential. The UI system, in effect, subsidizes firms that lay off more

workers.

Experience rating can curtail the layoff subsidy that the UI system offers. If employers whose workers receive UI benefits are charged for those benefits, then the marginal tax cost (MTC) of layoff is raised. If the system of experience rating were complete — if employers were charged immediately for the UI benefits received by their laid-off workers — then the MTC would return to the competitive level and the layoff subsidy would be eliminated.

The Feldstein-Baily model just sketched has two main predictions that are germane to empirical work and policy. First, increases in the degree of experience rating (that is, a reduction in the subsidy to layoffs or an increase in the MTC) will reduce temporary layoffs during periods of economic slack. Periods of economic slack may be either seasonal or cyclical. What matters is that periods of slack be regular enough and predictable enough to be factored into workers' and firms' behavior. Second, increases in UI benefits in a system that is less than completely experience rated will increase layoffs during periods of economic slack. This follows because an increase in UI benefits implies additional compensation to workers during a layoff, which in turn implies an increase in the subsidy to layoffs (or a decrease in the MTC).[5]

In sum, the Feldstein-Baily model is an equilibrium model of firms' turnover decisions (that is, firms' equilibrium decisions about temporary layoff and rehire), so that all unemployment is the result of temporary cyclical and seasonal demand fluctuations. The model does not consider disequilibrium behavior, adjustment processes, or decisions about the level of employment (and, by implication, permanent layoffs).

Disequilibrium and adjustment are likely to be important empirically, and it

[5] In a different model, Frank Brechling (1977a,b) assumes that the total compensation package is independent of UI benefits. This alternative assumption yields the implication that an increase in UI benefits reduces equilibrium layoffs, rather than increasing them as in the Feldstein-Baily model. The relationship between the level of UI benefits and layoffs, then, is ambiguous in theory.

striking that little attention has been paid to them in the context of the UI payroll tax — indeed, little theoretical work has been done on experience rating and unemployment since the mid-1980s. A notable exception is work by Alvi (1998), which examines the effects of experience rating in the context of modern theories of involuntary unemployment — in particular, the efficiency wage and insider-outsider models. Alvi's conclusions are remarkable because they suggest that the implications of the Feldstein-Baily equilibrium model do not carry over to models in which unemployment is involuntary. Specifically, Alvi shows that increased experience rating increases involuntary unemployment in both the efficiency wage and insider-outsider models.

The intuition behind Alvi's conclusions can be stated briefly. In the standard efficiency wage model, information about effort expended by workers on the job is difficult to observe (that is, monitoring costs exist), and firms induce workers to work hard by paying wages above the market-clearing level.[6] But wages above the market-clearing level imply involuntary unemployment. Hence, in the efficiency-wage model, high wages and the "threat" of unemployment induce workers to expend the appropriate level of effort. When an experience-rated UI payroll tax is introduced in such a model, the efficiency wage rises because laying off a worker is now more costly — UI benefit costs are charged back to the firm and collected by means of a higher payroll tax rate. As a result, firms must rely more on paying high wages to induce effort and less on the threat of permanent layoff because the later is now more costly. Alvi refers to this as an "effort-information" effect of experience rating on unemployment. It suggests that greater experience rating results in higher efficiency wages, which implies in turn a higher level of unemployment.

A parallel argument suggests that increased experience rating increases unemployment in an insider-outsider model as well. In the standard insider-outsider

[6] For reviews of both the efficiency wage and insider-outsider models, see Davidson (1990).

model, transaction costs such as hiring, training, and layoff costs give currently employed workers (or "insiders") an advantage over prospective workers (or "outsiders"). This advantage manifests itself in insiders' ability to bargain a higher wage than they would receive if there were no transaction costs. Alvi argues that, when an experience-rated UI payroll tax is introduced in this model, the bargaining advantage of the insiders increases because (again) layoff costs increase. As a result, insiders are able to extract greater rents in the form of higher wages, and involuntary unemployment increases in turn. Alvi refers to this as the "bargaining effect" of increased experience rating.

Alvi offers some simulations suggesting that, together, the effort-information effect and the bargaining effect of full experience rating could increase the unemployment rate in the United States by over 50 percent (for example, from 4.0 to 6.1 percent). The effort-information effect is about two-thirds of this increase, and the bargaining effect is about one-third. These large effects are based on complete experience rating and do not suggest that the existing system of financing UI increases the unemployment rate by 50 percent. Nevertheless, Alvi's model and results clearly imply that increases in the degree of experience rating of the UI payroll tax could substantially increase permanent unemployment.

4. Previous Empirical Research

Empirical work on the impact of experience rating on layoff behavior has generally proceeded by regressing some measure of the layoff rate (or layoff probability) on several parameters of the UI payroll tax system or a single summary measure of experience rating. Let L_i denote the probability of layoff or the layoff rate for observation i, let $T_{1i}, T_{2i}, \ldots, T_{Ji}$ denote J parameters of the UI payroll tax that face observation i, let $X_{1i}, X_{2i}, \ldots, X_{Ki}$ denote K additional characteristics of observation i

that influence layoffs, and let e_i denote a random error term. A linear model of layoffs can then be written as follows:

$$(4.1) \quad L_i = \beta_0 + \beta_1 T_{1i} + \beta_2 T_{2i} + \ldots + \beta_J T_{Ji} + \gamma_1 X_{1i} + \gamma_2 X_{2i} + \ldots + \gamma_K X_{Ki} + e_i$$

where the coefficients $\beta_1, \beta_2, \ldots, \beta_J$ give the impact of variation in the parameters of the UI payroll tax on layoffs, controlling for other factors that influence layoffs. This is the basic model that has been used to estimate the impact of experience rating on layoffs.

Studies that have estimated the model represented by equation (4.1) have varied in three ways. First, they have varied in their choice of a unit of observation. Most have used data in which the unit of observation is either the individual worker or the industry (typically within a state, observed over a period or months or years). Second, they have used different dependent variables to capture layoff activity (L_i). Studies that use individual worker data generally use a dummy dependent variable equal to 1 if a worker in observed on layoff, 0 otherwise. Studies that use an industry subaggregate as the unit of observation typically use the layoff rate in the industry as the dependent variable. Third, they have used different variables to model the UI payroll tax and the degree of experience rating — the key independent variables (T_{1i}, $T_{2i}, \ldots, T_{Ji}$). Early work used particular features of the UI payroll tax facing the worker's industry (in studies of the layoff probability of individual workers) or the average firm in an industry (in studies of the industry layoff rate) to capture the UI payroll tax and the degree of experience rating. Starting with Topel (1983), most studies have used a measure of the Marginal Cost of Layoff (MCL), mentioned above and discussed further in section 4.2, to capture the degree of experience rating and the incentive for a firm to

lay off workers.

Table 1 summarizes the main features and findings of the studies that have appeared to date on experience rating and unemployment. These studies can be summed up in three broad statements. First, the studies that use a variety of specific parameters of the UI system to capture experience rating consistently find that changes in the system that imply greater experience rating do reduce turnover and temporary layoffs. However, due to the diversity of parameters used to estimate the impact of experience rating, these studies make it difficult to say whether the impact of experience rating is "large" or "small."

Second, studies that impute a Marginal Cost of Layoff (MCL) to each observation in order to estimate the impact of experience rating are consistent in finding an impact of experience rating on layoffs that is both statistically significant and quite large. For example, Topel's estimates suggest that full experience rating would reduce temporary layoff unemployment by between 20 and 30 percent (Topel 1983, 1984a, 1985). Similarly, Card and Levine (1994) estimate that complete experience rating would reduce the temporary layoff rate by 50 percent in the trough of a recession.

Third, the two studies that observe directly the MCL associated with each observation — either the firm (Anderson 1993) or the individual worker (Anderson and Meyer 1994) — find a significant impact of experience rating on seasonal employment variability (Anderson 1993) or temporary layoffs of individual workers (Anderson and Meyer 1994). However, these latter studies find impacts that could be characterized as relatively small. Anderson (1993) finds that the elasticity of seasonal employment variability with respect to the MCL is about -0.1. Anderson and Meyer (1994) obtain a range of estimates; however, their differenced estimates (obtained by OLS) reported in their Table 5 suggest that under 10 percent of temporary layoffs can be accounted for

by incomplete experience rating.

We conclude that the existing literature is consistent in finding a significant impact of experience rating on temporary layoff activity. However, the literature is less than unanimous in offering an estimate of the size of that impact. Notably, the studies that impute the MCL associated with an observation obtain quite large estimates of the impact of experience rating, whereas the two studies that observe directly the MCL associated with a unit of observation obtain smaller estimates.

5. Research Design and Data

The models of Feldstein, Brechling, Baily, and others take the firm as the decision-making entity, making the firm the natural unit of observation to use in estimating the effect of experience rating on layoffs. However, as noted in the previous section, lack of firm-level data has forced research on experience rating to use data on industry subaggregates or individual workers. The present study estimates models of firm layoff behavior in which the unit of observation is the firm observed over a period of years.

5.1. Panel Data Models of Firm Layoff Behavior

The available data allow observation of each firm in each of several years. Let L_{it} denote the measure of layoffs by firm i in year t, let MTC_{it} denote the marginal tax cost of layoffs facing firm i in year t, let $X_{1it}, X_{2it}, \ldots, X_{Kit}$ denote K control variables (observed for each firm i in each year t) that influence layoffs, let a_i denote unobserved characteristics of firm i that affect layoffs, and let e_{it} denote a random error term. The layoff model estimated can then be written:

$$(5.1)\quad L_{it} = \alpha + \beta MTC_{it} + \gamma_1 X_{1it} + \gamma_2 X_{2it} + \ldots + \gamma_K X_{Kit} + a_i + e_{it}$$

In this model, β is the impact of a change in the MTC on layoffs, controlling for other factors that influence layoffs.

The above model in principle allows one to examine the influence of changes in the MTC both across firms at a point in time and within firms over time. A straightforward way to estimate equation (5.1) would be to pool the observations of each firm over the T years in which each is observed and apply ordinary least squares (OLS). Although straightforward, this approach would necessarily leave out the unobserved firm characteristics (the a_i) and would yield inconsistent estimates of β unless each firm's MTC were uncorrelated its unobserved characteristics. Another way of saying this is that estimating equation (5.1) by OLS does not take advantage of the panel nature of the data. Accordingly, in the remainder of this section, we outline three alternative well-known estimators of β and discuss the appropriateness of each. Section 6 below reports estimates of equation (5.1) that are based on OLS and the three alternative estimators. (Useful summaries with further references include Baltagi 1995, Jakubson 1991, Greene 1997, Johnston and DiNardo 1997, StataCorp 1999, and Wooldridge 2000.)

5.1.1. Between estimator. Observations on the same firm are likely to be similar over time. In the context of layoffs and UI, once a firm chooses an organization of production, it is likely that the firm will exhibit similar layoff behavior year after year. A manufacturing firm that is set up for an annual changeover will lay off its production workers for a period of time each year. Construction and retailing firms that experience seasonal ups and downs (winter slack in construction, holiday season peaks in retailing) will similarly be observed laying off workers at predictable times each year.

One way of capturing the notion that different observations of the same firm will be similar is to collapse the data on each firm into a single observation. This is done by taking the average of each variable for each firm in the data set. Let $L_{i\bullet}$ denote the average layoff rate in firm i over the T years observed, $MTC_{i\bullet}$ denote the average marginal tax cost of layoff in firm i over the T years observed, $X_{1i\bullet}$, $X_{2i\bullet}$, ... $X_{Ki\bullet}$ denote the average of each control variable over the T years observed, and $e_{i\bullet}$ denote the average error term over the T years observed. Then we can write:

$$(5.2) \quad L_{i\bullet} = \alpha + \beta MTC_{i\bullet} + \gamma_1 X_{1i\bullet} + \gamma_2 X_{2i\bullet} + \ldots + \gamma_K X_{Ki\bullet} + a_i + e_{i\bullet}$$

Equation (5.2) is similar to a cross-sectional model, except that it is based on data averaged over a period of years. It is referred to as the "between" estimator because all of the variation on which the estimate of β is based comes from variation across (or "between") firms. Like OLS estimation of equation (5.1), OLS estimation of equation (5.2) will yield inconsistent estimates of β unless $MTC_{i\bullet}$ is uncorrelated with the unobserved firm characteristics (a_i, which are necessarily omitted because they are unobserved). For example, firms that have laid off many workers will be at the maximum payroll tax rate and face a zero MTC. Firms with fewer layoffs will be on the experience-rated portion of the payroll tax schedule and will face a positive MTC. Equation (5.2) will estimate a response to experience rating (β) based on these inter-firm differences, but in fact, those differences in MTC are endogenous and depend on the firms' underlying organizations of production. (That is, the high-layoff firm chooses an organization of production that gives rise simultaneously to a zero MTC and a high lay off rate.)

5.1.2. Within estimator (fixed effects). If panel data are available, it is possible to take account of the unobserved individual characteristics (a_i) by making a fixed effects transformation, which amounts to subtracting equation (5.2) from equation (5.1) to obtain:

$$(5.3)\quad L_{it} - L_{i\bullet} = \alpha + \beta(MTC_{it} - MTC_{i\bullet}) + \gamma_1(X_{1it} - X_{1i\bullet}) + \gamma_2(X_{2it} - X_{2i\bullet}) + \ldots$$
$$+ \gamma_K(X_{Kit} - X_{Ki\bullet}) + (e_{it} - e_{i\bullet})$$

Note that $L_{it} - L_{i\bullet}$ is the difference between firm i's layoffs in year t and its average level of layoffs over the T years observed; $MTC_{it} - MTC_{i\bullet}$ is the difference between firm i's MTC in year t and its average MTC over the T years observed, and so on. Also, because a_i appears in both equations (5.1) and (5.2), it drops out of equation (5.3); unobserved firm characteristics are now accounted for, and OLS estimation will yield an unbiased and consistent estimate of β [assuming that $(MTC_{it} - MTC_{i\bullet})$ and $(e_{it} - e_{i\bullet})$ are uncorrelated].

Equation (5.3) can be thought of as a model that includes a dummy variable for each firm in the sample. The coefficients of the dummy variables (in effect, the a_i) are the fixed firm effects, and the estimated β is based strictly on variation that occurs within a firm over the years observed. Accordingly, equation (5.3) is called the "within" or "fixed effects" estimator.

The fixed effects estimator is attractive in the present context because unobserved firm characteristics are likely to be correlated with the MTC faced by a firm (as mentioned above), and the within estimator controls for those unobservables. Nevertheless, the fixed effects estimator remains vulnerable to two problems in this

context. These are discussed in the "remarks" subsection below.

5.1.3. Random effects. A final way of estimating equation (5.1) is to assume (again) that different observations of the same firm are similar, but instead of assuming that the firm-specific effect is fixed (as in the fixed effects model) to assume that the firm-specific effect is a random disturbance. The result is a so-called random effects estimator that can be written as follows:

$$(5.4)\quad L_{it} - \psi L_{i\bullet} = \alpha(1-\psi) + \beta(MTC_{it} - \psi MTC_{i\bullet}) + \gamma_1(X_{1it} - \psi X_{1i\bullet}) + \gamma_2(X_{2it} - \psi X_{2i\bullet}) + \ldots$$
$$\gamma_K(X_{Kit} - \psi X_{Ki\bullet}) + (\varepsilon_{it} - \psi \varepsilon_{i\bullet})$$

where ε_{it} is a composite error term equal to the sum of a_i and e_{it}, and ψ is a weight. The random effects estimator is a weighted average of the between estimator (5.2) and the within estimator (5.3), with the weight (ψ) a function of the variances of the firm-specific residual and the random residual.

5.1.4. Remarks. The econometric problem posed by estimating the relationship between experience rating and firm layoff behavior can be stated simply and visualized by referring to the UI payroll tax schedules shown in Figures 1 through 5. In choosing an organization of production, the firm decides on a layoff rate, which implies a point on the UI payroll tax schedule, which implies in turn a degree of experience rating (and MTC). In other words, the firm chooses its layoff behavior and its degree of experience rating simultaneously.

This endogeneity of the degree of experience rating makes the between estimator described above highly unattractive. Consider, for example, a construction firm that lays off much of its workforce during the winter months. That firm will have both a high layoff rate and a high tax rate — the maximum tax rate, quite possibly. The

reason is that (depending on the state) the firm will have either a high benefit ratio or a low reserve ratio, either or which in implies the maximum tax rate. Firms at the maximum tax rate, however, are not experience rated — because they have reached the maximum tax rate, additional layoffs cannot trigger further increases in the tax rate, and the MTC facing the firm will be zero. In contrast, firms on the sloped (or experience rated) portion of the tax schedule have lower layoff rates and face a positive MTC. The between estimator, which depends on variation across firms to estimate the relationship between experience rating and layoffs, will estimate a negative relationship between the MTC and layoffs because high layoff firms face a zero MTC, whereas low layoff firms face a positive MTC. But that estimated relationship is spurious.

Like other users of panel data, we presume that the fixed effects estimator has the potential to eliminate this problem. The fixed effects estimator depends on variation in the degree of experience rating that a given firm faces over time. To the extent that variation in the degree of experience rating facing a given firm over time is the result of strictly exogenous year-to-year shifts in the UI payroll tax schedule (as opposed to the firm's layoff activities or shifts in the tax schedule that are systematic), the fixed effects estimator will give a clean estimate of the effect of experience rating on layoff behavior.

However, in order for the fixed effects estimator to yield convincing estimates of the impact of experience rating, the MTC facing firms must be strictly exogenous. For two reasons, strict exogeneity may not hold in this context. The first reason goes back to the way the UI payroll tax schedule in each state changes over the business cycle. Recall that, during an expansion, UI payroll tax schedules both shift up and become steeper; that is, the level of the payroll tax and the degree of experience rating both increase. During a recession, UI payroll tax schedules both shift down and become flatter; that is, the level of the payroll tax and the degree of experience rating both fall.

As a result, just as firms are increasing their layoffs, experience rating rises, and vice versa. Changes in the degree of experience rating are not strictly exogenous, as required by the fixed effects estimator in equation (5.3). Estimates of β obtained by fixed effects are likely to be upward-biased (that is, if the true effect is negative, the estimated effect will be closer to zero or even positive) because increased layoff rates will be observed concurrent with increases in the MTC of layoffs.

The second reason that the fixed effects estimator may be flawed in this context may be equally important. As already discussed, firms choose their location on the payroll tax schedule by means of their layoff behavior. This implies that changes in a firm's MTC may depend on its behavior rather than on an exogenous change in the tax schedule. For example, in a reserve ratio state, a firm that has a high reserve ratio may face a zero MTC. If the economy goes into recession, and the firm lays off workers, the firm's reserve ratio will fall, and its MTC should rise. This potential endogeneity of changes in the MTC poses a problem for the fixed effects estimator no less than the endogeneity of MTC poses a problem for pooled OLS of the between estimator. In section 7, we explore some possible solutions to these violations of strict exogeneity.

The various estimators just described would give similar estimates of the impacts of experience rating (β) if the model were properly specified; that is, if layoffs and experience rating were not chosen simultaneously by the firm. That the different estimators produce dramatically different results suggests endogeneity of the MTC facing firms (that is, simultaneity between layoffs and experience rating). The question is whether there is enough within-firm variation in the MTC facing a firm over time, and whether this variation is sufficiently independent of the firm's activities and systematic changes that are related to economy-wide economic behavior, to obtain convincing estimates of the the impact of experience rating on layoff behavior.

In the remainder of this section, we describe the longitudinal firm data and the

construction of variables that are used to estimate equations (5.1) through (5.4). Section 6 then examines the extent of within and between variation in the data and describes the results of estimation.

5.2. Samples Used in Estimation

The data we examine come from the administrative records of Missouri, Washington State, and Pennsylvania. Specifically, we have complete UI payroll tax records with annual data on the payroll (both total and taxable), employment, UI benefit charges, and UI payroll taxes paid by the population of employers covered by the UI program in Missouri, Washington, and Pennsylvania. The data either include or allow one to derive all relevant aspects of the UI payroll tax for each firm, including the benefit ratio and/or the reserve ratio (as appropriate) and the UI payroll tax rate. The data also identify the primary industry of each firm and the number of years the firm has been in existence.

The Missouri data cover 1985 through 1994, the Washington data cover 1989 through 1995, and the Pennsylvania data cover 1986 through 1994. Because the populations are so large, we have drawn stratified random samples of firms that were active (or reported positive wages) in all years for which data are available.[7] The stratification is based on the average number of workers employed by the firm in years the firm's account was active (or reported positive wages). For firms with an average of 50 or more workers, we have drawn a 100 percent sample; for firms with fewer than 50 workers, we have drawn a simple 20 percent random sample.

From these stratified random samples, we drop any firm that either acquired another firm (or part of another firm) or spun off part of itself during the years we observe. This is done to eliminate problems of measuring layoffs in firms that had

[7] The Missouri data include a field indicating whether an employer's account was active during each year. The Washington and Pennsylvania data do not include such a field, so we use positive employment as an indicator of whether an employer was active in a given year.

acquisitions and spinoffs. We also drop firms that were ever not eligible for an experience rated UI payroll tax rate during the years observed. This includes firms that were either new or delinquent in paying UI payroll taxes during the years observed. We also drop firms that directly reimbursed the state UI agency for charged UI benefits. Most of these firms are nonprofit organizations, and those that are not may differ in other unobserved ways from other firms. Finally, we drop firms whose average annual employment was less than 5, firms whose average annual wages per worker exceeded $500,000, Missouri firms that ever participated in the short-time compensation program, and firms with missing data.[8]

The above selection criteria yield a sample of 6,812 Missouri employers (from the population of 44,575 Missouri employers), a sample of 6,609 Washington employers (from the population of 39,726 Washington employers), and a sample of 12,792 Pennsylvania employers (from the population of 83,304 Pennsylvania employers).

5.3. Construction of Dependent Variables

Equation (5.1) shows that estimating the impact of UI experience rating on employers' layoff behavior using firm-level data entails regressing some measure of layoffs (the dependent variable) on (a) some measure of the cost to the employer of laying off workers and (b) additional control variables. We choose six layoff measures to represent the outcomes that experience rating may affect. Experience rating is intended primarily to reduce seasonal and cyclical fluctuations in employers' use of labor. Accordingly, we focus on reasonable measures of each firm's seasonal and cyclical layoff activity. However, one of the measures of cyclical layoffs generates a

[8] Results obtained using samples that include firms that were new, were ever delinquent, were ever reimbursable, had average employment less than than 5, had average annual wages per worker over $500,000, or ever participated in short-time compensation were essentially similar to those reported below. (Appropriate controls for each of these characteristics were included in the specifications.)

measure of permanent layoffs as a byproduct, and we use this as well. (See Table 2 for a brief description of each of the dependent variables.)

5.3.1. Index of seasonal variation in a firm's employment. Measuring the effect of experience rating on seasonal unemployment entails isolating the seasonal component of each firm's employment time series. There are various ways of doing this, but we follow the method used by Anderson (1993). Using quarterly employment data for each firm, a log-linear employment trend is estimated, then the range of quarterly residuals within a year is taken as an estimate of seasonal employment variability within that year.[9]

5.3.2. Negative deviations from trend employment. A first measure of the extent of a firm's cyclical layoff behavior is the deviation of actual employment from an estimated trend (in proportional terms). We use two such measures. For the first, we use annual employment data to fit a linear employment trend for each firm. (The idea is to eliminate cyclical and irregular components from the employment time series.) We take the (absolute value of the) negative deviation of actual employment from the fitted trend as an estimate of cyclical layoffs. This deviation, as a percentage of the trend level of employment, is one dependent variable used to measure cyclical layoffs. (A midpoints formula is used to keep changes in the employment of small firms from distorting the measure.) The second measure is analogous, but uses deviations from a fitted quadratic employment trend. These measures are potentially useful because we have data covering roughly a full business cycle for each firm in each of the three samples. However, these are unlikely to be pure measures of temporary layoffs because it is unclear whether, for each firm, a full cycle is observed. For many firms, permanent layoffs may be mixed in with the temporary layoffs that we intend to capture with these measures.

[9] We also implemented an alternative that is based on the well-known ratio to moving average procedure. However, this approach has the disadvantage that it drops at least one year of data. Using this alternative produced results that are comparable to those reported below using Andersons's method.

5.3.3. A direct measure of temporary layoffs. Brechling and Laurence (1995, chapter 3) suggest an alternative measure of temporary layoffs. This measure evaluates whether a decline in employment between years t-1 and t is temporary or permanent by examining employment in the subsequent year or years (t+1 or t+2). For example, if employment in year t+2 is lower than in year t, then the decline between t-1 and t is considered permanent. If, on the other hand, employment in year t+2 is higher than in year t, then part or all of the decline between t-1 and t (depending on the extent of recovery) is considered temporary. This measure of temporary layoffs may be useful even without observing a full business cycle, although it may also be sensitive to the time one waits before deciding whether an employment decline is temporary or permanent. We have used employment in both years t+1 and t+2 to gauge whether the drop between years t-1 and t is permanent, and find that the results are not very sensitive to this choice. In the results reported below, the dependent variable used is temporary layoffs between years t-1 and t as a proportion of employment in year t, with a lapse of two years (that is, employment in year t+2) used to decide whether an employment drop is temporary or permanent.

5.3.4. A direct measure of permanent layoffs. The Brechling-Laurence approach used to capture temporary layoffs also yields a measure of permanent layoffs. Specifically, any portion of an employment decline between years t-1 and t that is not found to be temporary is considered permanent. Again, the dependent variable used is in proportional terms.

5.4. Experience Rating and the Marginal Tax Cost of Layoff (MTC)

The key independent variable in equation (5.1) is the marginal tax cost of a layoff (MTC), which provides a concise measure of the degree to which the firm is subject to experience rating. The MTC measures used are based on the slope of the

UI payroll tax schedule facing each firm in each year. For a reserve ratio system, the MTC depends on the slope of the UI payroll tax schedule (λ) and the interest rate (i) (Topel 1983; Card and Levine 1994):

$$(5.5) \quad MTC = \lambda / (\lambda + i)$$

For a benefit ratio system, the MTC depends on the slope of the UI payroll tax schedule (λ), the interest rate (i), and the number of years over which each employer's payroll is averaged in computing the benefit ratio:

$$(5.6) \quad MTC = (\lambda / iT) [1 - 1/(1 + i)^T]$$

Because the MTC depends on the slope of the payroll tax schedule and because it can be manipulated directly through state tax policy, we also use the slope of the payroll tax schedule as a separately independent variable. As can be seen in Figures 1 through 4, three of the four UI payroll tax schedules in the states examined are step functions (the benefit ratio schedule for Pennsylvania is the exception), so it is necessary to piecewise-linearize the tax schedule by connecting the midpoints of adjacent steps of each tax schedule. The slopes of these piecewise segments represent the MTC facing a firm.

5.5. Additional Control Variables

The longitudinal firm files allow one to construct and control for the following additional variables in the estimated models. (See Table 2 for brief descriptions.)

5.5.1. Age of firm. Younger firms tend to be less stable than older firms, and

may be more prone to layoffs. Accordingly, we include a set of dummy variables capturing the number of years the firm has been covered by the UI system. The variable equals the last year in which the firm's account was observed active (1994 in Missouri and Pennsylvania, 1995 in Washington) minus the year in which the firm's UI account began. In general, this equals the number of years the firm has existed. Note that age of firm takes a single time-invariant value for each firm in the sample.

5.5.2. Size of firm. Firms of different size are structured differently and are likely to exhibit different layoff behavior. We control for firm size by including a set of dummy variables for the average number of workers employed by the firm (per month) over all years the firm is observed. Other possible measures of firm size can be imagined (sales or capitalization, for example), but are not available in the data we are using. Note that, like age of firm, size of firm takes a single time-invariant value for each firm in the sample.

5.5.3. Industry. Firms in different industries are also structured differently and, in addition, face different seasonal demand patterns. Accordingly, firms in different industries are likely to exhibit different layoff behavior. We control for each firm's industry by including a set of dummy variables indicating the one-digit SIC of the firm, based on the firm's classification in the first year of the data. Firm industry is again time-invariant.

5.5.4. Reserve ratio or benefit ratio. Some of the specifications below control directly for the firm's reserve or benefit ratio. These are discussed in section 2.

5.5.5. Average weekly benefit amount (WBA). Some of the specifications below also include an approximation of the weekly UI benefit amount for which the average worker in each firm would be eligible if laid off. This is calculated by applying the average quarterly earnings of workers in the firm (for a given year) to the applicable UI benefit schedule (for that year) and converting to 1994 dollars. Clearly,

this WBA measure offers only a rough estimate of the WBA for which workers in a given firm would be eligible if laid off. It uses the average quarterly earnings of a firm's workers workers to approximate the high-quarter earnings that are used to calculate the WBA. Also, it ignores variation in the earnings of a firm's workers and turnover of the firm's workforce, both of which could affect the proportion of firm's workers who would be eligible for UI if laid off. However, given the available data, this is arguable the best WBA estimate that can be constructed.

5.5.6. Average annual wages. Some of the specifications below also control for the annual average wage (in natural log form) ion of the weekly UI benefit amount for which the average worker in each firm would be eligible if laid off.

5.5.7. Taxable wage base. Finally, some of the specifications below control for the taxable wage base in the state during the current year (converted to 1994 dollars). During the years examined, there were changes in the nominal taxable wage base in both Missouri and Washington (which indexes its wage base).

6. Empirical Findings

This section begins with a brief presentation of descriptive statistics for the three samples examined, including a discussion of the relative importance of variability between and within firms in the samples. Section 6.2 then presents the main findings on employers' responses to changes in the degree of experience rating. Section 6.3 describes the result of several alternative specifications of the model, including instrumental variables estimates.

6.1. Descriptive Statistics and Variability

Table 2 displays descriptive statistics of the variables used to estimate equation (5.1) and its variants for Missouri, Washington, and Pennsylvania. The Missouri data

are made up of a panel of 6,812 firms observed in each of 10 years (1985 through 1994). The Washington data are made up of a panel of 6,609 firms observed in each of 7 years (1989 through 1995). The Pennsylvania data are made up of a panel of 12,792 firms observed in each of 9 years (1986 through 1994). Note that each of the three panels is balanced; that is, each includes the same firms observed in each of T years (where T equals 10 for Missouri, 7 for Washington, and 9 for Pennsylvania).

Most variables displayed in Table 2 are common across the three states.[10] The "slope" and MTC variables are the key independent variables. In Missouri, the slope of the payroll tax schedule is based on the firm's reserve ratio, has a mean of 0.23 and ranges from 0 to 0.72. The MTC in Missouri has a mean of 0.61 and ranges from 0 to 0.88. In Washington, the slope of the tax schedule is based on the firm's benefit ratio, has a mean of 1.37 and ranges from 0 to nearly 4. The MTC in Washington has a mean of 1.09 and ranges from 0 to 3.2. In Pennsylvania, each firm in effect faces two payroll tax schedules — one for the reserve ratio and the other for the benefit ratio. In Pennsylvania, the slope of the reserve ratio tax schedule has a mean of 0.03 and ranges from 0 to 0.11, whereas the slope of the benefit ratio tax schedule has a mean of 0.90 and ranges from 0 to 1.1. Table 2 shows the MTC in Pennsylvania divided into its reserve ratio and benefit ratio components (these are summed to obtain the effective MTC for a firm). The former has a mean of 0.21 and ranges from 0 to 0.51; the later has a mean of 0.75 and ranges from 0 to .91. Hence, in Pennsylvania, the benefit ratio component of the UI payroll tax exhibits a greater degree of experience rating than does the reserve ratio component. Comparison of the MTC figures in the three states suggests that Washington has the greatest degree of experience rating, followed by Pennsylvania and Missouri.

Table 2 also reports descriptive statistics on the payroll tax rates and reserve ratio and/or benefit ratio (as appropriate) for each of the three samples. The average

[10] Because the Missouri panel is 10 years long, no Missouri firm has age less than 10 years.

UI payroll tax rate is highest in Pennsylvania (3.6 percent), followed by Washington (2.5 percent) and Missouri (1.7 percent). Given that Washington had a 1994 taxable wage base of $19,000, Missouri a wage base of $8,500, and Pennsylvania a wage base of $8,000, UI payroll taxes per worker are largest for the average Washington employer ($467), followed by Pennsylvania ($291) and Missouri ($145).

In section 5.1, we raised the question whether there is adequate within-firm variation over time to make the within estimator viable. Table 3 displays overall standard deviations of the key independent variables (MTC and slope of the payroll tax schedule) as well as of the dependent variables, and decomposes those overall standard deviations into between-firm and within-firm components. (The between- and within-firm components are normalized to make them comparable.) The figures in Table 3 make it clear that the year-to-year shifts of the UI payroll tax schedules shown in Figures 1 through 4, along with firm's behavior, generate substantial within-firm variation over time. In all three states, within-firm variability of both MTC and the slope of the payroll tax schedule is close to (or exceeds) between-firm variability. Similarly, for all the dependent variables except seasonal variation in layoffs, variability within firm exceeds variability across firms.

6.2. Basic Results of Estimation

Tables 4, 5, and 6 display the main parameter estimates from the models described in section 5.1. Table 4 gives estimates for Missouri, Table 5 for Washington, and Table 6 for Pennsylvania. The top panels of Tables 4, 5, and 6 display estimated coefficients on the slope of the UI payroll tax schedule in equations in which one of the five dependent variables shown is regressed on the slope of the tax schedule and in addition the following independent variables: age of the firm (5 categorical variables), number of employees in the firm (6 categorical variables), and one-digit industry (ten

categorical variables). Note that each coefficient displayed in the tables comes from a separately estimated equation.

The bottom panels of Tables 4, 5, and 6 display estimated coefficients on MTC in equations where one of the five dependent variables shown is regressed on the MTC and the same independent variables as in the payroll tax slope equations.

In each panel, four estimates are displayed for each of the dependent variables, corresponding to the four estimators described in section 5.1: OLS, the between estimator, the "within" (or fixed effects) estimator, and random effects estimator. In the case of the within estimates, the additional independent variables are in effect differenced out and do not appear in the estimated equation.

As discussed above, the OLS, between, and random effects estimators use variation across firms in experience rating to estimate a spurious "effect" of experience rating on layoff behavior. The within estimator is the most likely to avoid this error because it is based on variation in the slope of the tax schedule (or MTC) facing a firm over time. It follows that the within estimator minimizes the extent to which differences between firms in the organization of production are used to estimate the β parameter. Because inter-firm differences in the organization of production imply both layoff behavior and a location on the payroll tax schedule, minimizing their influence on the estimates is clearly desirable. In accord with this reasoning, the between estimator tends to yield the largest estimates of the relationship between experience rating and layoff activity, followed by the OLS and random effects estimators. The fixed effects estimator generally yields the smallest estimates of the impact of experience rating on layoff behavior.

The fixed effects estimates of the impact of changes in MTC on layoff behavior suggest that increased experience rating leads to statistically significant reductions in seasonal variations in employment (in all three states) and deviation-from-linear-trend

cyclical layoffs (again in all three states). Increased experience rating reduces deviation-from-quadratic-trend cyclical layoffs only in Missouri, according to the fixed effects estimates. These results are broadly consistent with existing research on the impacts of experience rating on seasonal and cyclical layoffs.

In contrast, fixed effects estimates of the impact of experience rating on the Brechling-Laurence "direct" measures of temporary and permanent layoffs conflict with most existing empirical findings. These estimates suggest that increased experience rating increases temporary layoffs (in Washington and Pennsylvania) and permanent layoffs (in all three states). These results could be interpreted in light of section 3's discussion of how of experience rating may increase involuntary unemployment — Alvi's results based on the efficiency wage and insider-outsider models. Alternatively, it might be argued that the fixed effects estimator generates a spurious positive relationship between experience rating and permanent layoffs because the slopes of UI payroll tax schedules (and hence the degree of experience rating) increase when the economy goes into recession; that is, MTC and permanent layoffs are positively correlated in a mechanical way that shows up in the fixed effects estimates. (Note that the OLS, between, and random effects estimators suggest that increased experience rating reduces permanent layoffs.)

Further discussion of the estimates in Tables 4, 5, and 6 is simplified by examining elasticities of the layoff measures with respect to the slope of the tax schedule or the MTC. These elasticities, computed at the sample mean, are displayed in Table 7.

The estimated elasticities suggest that the impact of experience rating on reducing layoff activity is rather modest. Relying on the fixed effects estimates, it can be seen that the elasticity of seasonal variation in employment with respect to the MTC is less than -0.05 in all three states. The estimated elasticities of deviation-from-linear-

trend cyclical layoffs with respect to the MTC are -0.27 in Missouri, -0.08 in Washington, and -0.51 in Pennsylvania. The estimated elasticities of deviation-from-quadratic-trend cyclical layoffs with respect to the MTC are very close to -0.04 in all three states.

As discussed above, the fixed effects estimates in Tables 4, 5,and 6 suggest that increased experience rating may increase permanent layoffs. Accordingly, the elasticities of permanent layoffs with respect to MTC are positive — 0.83 in Missouri, 0.09 in Washington, and 0.78 in Pennsylvania. Although still less than 1, the estimates for Missouri and Pennsylvania are the largest of the fixed effects elasticities displayed in Table 7.

In sum, the estimates in Tables 4, 5, and 6, and the implied elasticities in Table 7, suggest that seasonal and cyclical layoffs are significantly but modestly reduced by experience rating. The estimates also suggest that increased experience rating may increase permanent layoffs by firms, although this finding could be interpreted as spurious, as discussed above.

6.3. Alternative Specifications and Instrumental Variables Estimates

Section 5.1 raised various econometric issues in estimating the impact of experience rating on the layoff behavior of firms. The main concern in using pooled OLS and the between estimator is that unobserved firm characteristics are likely to be correlated with the MTC of layoffs facing a firm. Omitting these unobservables from the specification is likely to result in estimates of the impact of experience rating on layoffs that are biased upward. Adding more and better controls for firm characteristics should reduce this upward bias and move the OLS and between estimates toward the fixed effects and random effects estimates, which arguably control for the unobservables that are omitted from the OLS and between specifications. Section 6.3.1 pursues this

line of reasoning.

Section 5.1 also raised the possibility that the MTC is not strictly exogenous in the fixed effects model. The argument is twofold. First, when the economy goes into recession (and firms lay off workers), state UI payroll tax schedules tend to become steeper. Second, changes in firm's layoff activity will move the firm along the UI payroll tax schedule and possibly change the MTC that the firm faces. For both reasons, an alternative to the straightforward fixed effects estimator needs to be used. Section 6.3.2 examines possible modifications to the fixed effects estimator.

6.3.1. Alternative Specifications. Tables 8 and 9 show the results of estimating models that include additional controls for characteristics of the firm. Following the line of argument above, our expectation is that additional controls should mitigate the omitted variables problem that faces the OLS and between estimators, and drive these estimates closer to the fixed effects and random effects estimates.

Table 8 shows the results of estimating models that are identical to those underlying Tables 4, 5, and 6, except that the firm's reserve ratio (in Missouri) or benefit ratio (in Washington), or both (in Pennsylvania) have been added to the specification. Comparison of the fixed effects estimates in Table 8 with the corresponding fixed effects estimates in Tables 4, 5, and 6 shows that they are essentially similar. However, comparison of the OLS, between, and random effects estimates in Table 8 with the corresponding estimates in Tables 4, 5, and 6 shows that Table 8's estimates tend to be smaller, which is in accord with expectation. That is, the evidence in Table 8 is consistent with the reasoning that the OLS and between estimators suffer from an omitted variables problem.

Table 9 shows the results of estimating models that are identical to those underlying Table 8, except that three more variables have been added to the

specification: the imputed weekly UI benefit amount (WBA) for which the average worker in a firm would be eligible if laid off, the log of average earnings of workers in the firm, and the taxable wage base. The estimates in Table 9 are essentially similar to those in Table 8, with one exception: the OLS and between estimates of the impact of experience rating on seasonal employment variation in Table 9 are smaller than those in Table 8 and are still closer to the fixed effects estimates. Otherwise, however, there is little evidence that the added control variables improve the estimates.

Table 10 gives further details of the fixed effects estimates (only) underlying Table 9. Specifically, Table 10 reports the coefficients on the MTC, the reserve and/or benefit ratio, the average WBA, the log of average wages, and the taxable wage base from those estimates. The WBA and average wages are of interest mainly because the Feldstein-Baily model implies that increases in UI benefits (relative to earnings) will increase layoff activity, whereas Brechling's model implies the opposite. The results for Missouri and Pennsylvania in Table 10 tend to favor Brechling's model, whereas the Washington results are mixed. On balance, the results suggest that Brechling's model, in which UI benefits and the compensation package are independent, is better supported in these data. Table 10's results on the taxable wage base suggest that increases in the wage base tend to reduce most types of layoff activity. This is consistent with the view that increases in the wage base raise the overall importance of the UI payroll tax for employers and make employers more responsive to the incentives that are created by the payroll tax.

Table 11 reports the results of an additional specification check. It is possible that the response to experience rating varies by industry in ways that are important from the standpoint of policy. Table 11 displays estimated elasticities of layoffs with respect to the MTC for each of 20 firm-size/1-digit industry categories. All the elasticities are derived from fixed effects models similar to the model underlying

Tables 9 and 10; that is, each model regresses the dependent variable on the MTC, the reserve and/or benefit ratio, average WBA, log of average wages, and the taxable wage base from those estimates.

In some cases, the subsamples underlying the estimates in Table 11 are too small to yield reliable estimates (see, for example, the subsample sizes for agriculture, mining, and the public sector). However, even for industries in which the samples are "large enough" by conventional standards, the estimates are wide-ranging and often statistically insignificant. On an industry-by-industry basis, there is little consistent evidence that experience rating has a significant impact on the layoff behavior of firms. Whether a different or more careful specification would reveal industry-level impacts of experience rating is an open question.

In a reserve ratio system of financing UI benefits, firms at the maximum or minimum UI payroll tax face a zero MTC of layoffs, and hence face no incentive to economize on layoffs. Similarly, under a benefit ratio system, firms at the maximum payroll tax rate face a zero MTC and no incentive to reduce layoffs. That is, firms on the "experience-rated" portion of the tax schedule are most likely to respond to the system's incentives. Tables 12 displays the percentages of firms that are on each portion of the reserve ratio tax schedule (in Missouri and Pennsylvania) and the benefit ratio tax schedule (in Washington and Pennsylvania),along with descriptive statistics of the firms in each of these categories. Table 13 displays results that attempt to test whether firms on the experience-rated portion of the tax schedule are indeed more responsive to the layoff incentives that are built into the system.

The estimates in Tables 13 are fixed effects estimates in which the MTC is interacted with an indicator of whether the firm is (a) at the maximum reserve ratio (in Missouri and Pennsylvania) or benefit ratio (in Washington), (b) the minimum reserve ratio (in Missouri and Pennsylvania) or benefit ratio (in Washington), or (c) on the

experience-rated portion of the reserve ratio tax schedule (in Missouri and Pennsylvania) or the sloped portion of the benefit ratio schedule (in Washington). Apart from these interaction terms, the specification underlying the estimates in Table 13 is the same as that underlying Tables 9 and 10; that is, each dependent variable is regressed on the reserve ratio and/or the benefit ratio, MTC, average WBA, log of average earnings, the taxable wage base, and year dummies, in addition to the interaction terms displayed.

The estimates in Table 13 suggest that, in all three states, firms on the experience-rated portion of the UI payroll tax schedule tend to be more responsive to the layoff incentives of experience rating than firms at the maximum and minimum tax rates. However, the results are not especially strong, and inconsistencies do arise. For example, high benefit ratio firms in Washington appear to be more likely than other Washington firms to reduce seasonal layoffs in response to experience rating. Nevertheless, the results are generally consistent with expectations.

6.3.2. Instrumental variables. Because the slopes of UI payroll tax schedules increase in recessions and because firms' behavior results in movement along the tax schedule, the MTC is not strictly exogenous in the fixed effects model. As a result, the fixed effects estimates presented are likely upward-biased (that is, a truly negative effect would be estimated as zero or positive). Relatively little attention has been paid to failure of the strict exogeneity assumption in panel data models, but most discussions in the literature have relied on instrumental variables or two-stage least squares (Keane and Runkle 1992; Arellano and Bond 1991). Accordingly, this section presents results of several instrumental variables (IV) versions of the fixed effects model.

Table 14 displays estimates from several fixed effects models in which the MTC variable has been replaced by one or another instrument (the standard fixed effects

estimates are also displayed for comparison). The model underlying Table 9 is the basis for the IV models estimated, and the first row under each state (FE) repeats the fixed effects estimates from Table 9. In the second row [FE IV (1-year difference of MTC)], MTC has been replaced by an instrument for MTC that is derived from regressing current MTC on the difference between current MTC and MTC 1 year ago. In the third row [FE IV (1-year lag of first difference of MTC)], MTC is replaced by an instrument for MTC that is derived from regressing current MTC on the difference between MTC 1 year ago and MTC 2 years ago. Both of these IV approaches are attempts to purge MTC of its correlation with the error term in the fixed effects model.

It is useful to compare the fixed effects IV estimates in Table 14 with the standard fixed effects estimates. Regarding seasonal variation, the IV estimates suggest a smaller response to experience rating than the standard fixed effects estimator in Missouri; a larger response in Washington, and essentially no response in Pennsylvania. Regarding deviations from linear-trend employment, the IV estimates suggest a larger response to experience rating than the standard fixed effects estimator in all three states. Regarding deviations from quadratic-trend employment, the IV estimates show no clear pattern compared with the standard fixed effects estimator. Regarding the direct estimate of temporary layoffs, the IV estimates suggest essentially no response to experience rating in any of the states, which is consistent with the fixed effects estimates. Finally, regarding the direct estimate of permanent layoffs, the IV estimates are similar (and still positive) to the standard fixed effects estimates in Missouri; mixed in relation to the standard fixed effects estimates in Washington, and smaller than the standard fixed effects estimates in Pennsylvania. To summarize, only the IV estimates for the deviation from linear-trend employment accord with the prior expectation that the standard fixed effects estimates are upward-biased.

Table 14 also displays estimates of "first difference" (FD) models of experience rating; that is, models in which differences between adjacent observations are taken, then used in a regression. The FD model is analogous to the fixed effects model, but differs from it when the number of time periods observed exceeds two (as is the case here). Wooldridge (2000, pp. 447-448) suggests that estimating both fixed effects and FD models may be useful as a specification check. If the two differ, then there is evidence of specification error.

In Table 14, the fixed effects and FD estimates differ substantially in several cases, suggesting that the concerns about specification error and the failure of strict exogeneity in this case are valid. Table 14 also displays the results of applying IV to the FD estimator. A comparison of these estimates with their standard FD counterparts yields mixed results, as is the case in comparing the fixed effects IV estimates with their standard fixed effects counterparts. In some cases, there is support for the expectation that the FD estimator is upward-biased, but this support is sporadic.

Two conclusions can be drawn from the results in Table 14. First, comparison of the standard fixed effects estimates with the standard FD estimates lends credence to the idea that there is specification error in standard fixed effects models of experience rating. The specific concern is endogeneity of the MTC, which we have argued should result in upward-biased estimates of the impact of experience rating on firms' layoff behavior. Second, our efforts to improve estimates of firms' responses to experience rating by using IV versions of the fixed effects and FD estimators are not very successful. Specifically, IV estimates of both the fixed effects and the FD models generate results that are quite fragile — only sporadically do the IV estimates differ from their standard fixed effects or FD counterparts in ways that accord with prior expectation.

7. Policy Simulations Based on the Estimates

Microsimulation is helpful in interpreting the results and appraising the impact of changes in the level of experience rating on employment variability and layoffs. Accordingly, this section uses the estimates described in the preceding section to simulate the impact of changes in UI payroll tax policy on firms' layoff behavior.

We use the underlying distribution of firms in the samples to appraise the impact of three different increases in experience rating of the UI payroll tax. The simulations take the fixed effects models displayed in Table 13 as a reference, and substitute into the estimated models the MTC that would apply if experience rating were strengthened. Three changes in tax policy are of interest:

- First, subject employers who are currently below the average MTC facing all firms in the state to that (unconditional) average MTC. Employers currently at or above the average MTC remain at their current level of experience rating.
- Second, subject employers who are currently below the average MTC facing experience-rated firms in the state (that is, firms with an MTC > 0) to the (conditional) average MTC. Employers currently at or above the conditional average MTC remain at their current level of experience rating.
- Third, subject all employers who currently face MTC < 1 to MTC = 1. Employers with MTC ≥ 1 remain at their current MTC.

We refer to the first two changes as increased experience rating, and to the third as full experience rating. More formally, from equation (5.3), write the estimated fixed effects model as:

(6.1) $L_{it}' = a + b(MTC_{it})$,

where a and b are estimated coefficients, MTC_{it} is the actual MTC facing firm i in year t, and L_{it}' is the predicted layoff outcome (index of seasonality, deviation of linear employment from trend, etc.) for firm i in year t. To simulate the impact of a change in experience rating on the outcomes, substitute a new vector of MTCs into the estimated equation:

(6.2) $L_{it}^* = a + b(MTC_{it}^*)$,

where MTC_{it}^* is the MTC that would face firm i in year t under the simulated policy and L_{it}^* is the resulting simulated outcome. To summarize the outcome of the simulated policy change, we sum the predicted values for a given dependent variable (weighted by the sample proportion of each observation) and compare this with the weighted sum of the simulated values for that dependent variable.

The top panel of Table 15 displays results of the microsimulation of the first type of "increased experience rating" described above. In these simulations, the experience rating of firms that face an MTC below the unconditional sample average is raised to the average of all firms in the state; that is, for firms at or above the unconditional average, MTC_{it}^* equals its actual value, but for firms whose actual MTC is less than the unconditional average, MTC_{it}^* is set to that unconditional average. The upper panel suggests that, for Missouri, increased experience rating would reduce seasonal variability by 0.39 percent, reduce negative deviations of employment from linear trend by 4.7 percent, reduce negative deviations of employment from quadratic trend by 1.4 percent, reduce temporary layoffs by 1 percent, and increase permanent layoffs by 12.1 percent. The impacts for Pennsylvania are broadly similar. For Washington, the impact on seasonal variation is somewhat larger, the impacts on deviations from trend

employment are somewhat smaller, and the impacts on temporary layoffs are estimated to be positive.

The middle panel of Table 15 displays results of the microsimulation of the second type of "increased experience rating" described above. In these simulations, the experience rating of firms that face an MTC below the conditional sample average of firms in the state (that is, the average of firms with MTC > 0) is raised to the conditional average. The impacts shown in the middle panel tend to be somewhat large than those in the top panel. However, the impacts are uniformly in the same direction as those in the top panel and are generally of similar (and sometimes the same) magnitude.

The bottom panel of Table 15 displays the results of simulating full experience rating. In these last simulations, the experience rating of firms that face an MTC less than 1 is raised to 1; that is, MTC_{it}^* equals its actual value for firms whose MTC exceeds 1, but for firms whose actual MTC is less than 1, MTC_{it}^* is set to 1. The bottom panel suggests that, in Missouri, full experience rating would have impacts on seasonal employment variations, deviations from trend employment, and permanent layoffs that are 3 to 7 times the impacts of the increased experience rating simulated in the top panel of Table 15 (although the differences between the two policy changes are not simply proportional).[11] In Washington, full experience rating has a smaller impact on the various measures of layoff activity that either type of "increased experience rating" shown in the upper two panels. This results from compositional effects.[12] In Pennsylvania, the impacts of full experience rating are very similar to the impacts of increased experience rating shown in the top two panels.

[11] The impact of full experience rating on temporary layoffs in Missouri, which is positive, appears anomalous in comparison with the upper two panels. This is due to a compositional effect. Note that, in Table 13, the point estimates on the impact of experience rating on temporary layoffs are positive for firms with high and mid-range reserve ratios. Because over 5 percent of all firms are in this range, the simulation shows an increase in temporary layoffs in response to full experience rating.

[12] See the preceding footnote.

The simulations accord with the general impression left by the fixed effects elasticities displayed in Table 7 — that increased experience rating would have a significant but modest impact on firms' layoff behavior. In particular, the simulations suggest that increased experience rating would reduce seasonal variations in unemployment by up to 1 percent, and would reduce deviations from trend employment by up to 6 percent. The simulations also suggest that increased experience rating would increase permanent layoffs by 4 to 6 percent in Washington and Pennsylvania, and by over 10 percent in Missouri. Although there are some theoretical arguments suggesting that this latter result makes sense (see section 3), there are empirical reasons suggesting that the positive relation between experience rating and permanent layoffs my be spurious.

8. Summary and Conclusions

This research uses longitudinal data on firms in Missouri, Washington, and Pennsylvania to examine the extent to which experience rating of the UI payroll tax affects the propensity of firms to lay off workers. The approach has three main features. First, the unit of observation is the firm rather than the worker or some industry subaggregate. Second, the UI administrative data used allow direct observation of the tax rates and layoff incentives facing each firm. Third, the panel data allow us to distinguish between firm fixed effects (that is, heterogeneity) and experience rating of the UI payroll tax as determinants of layoffs.

We estimate models in which various measures of a firm's layoffs are regressed on measures of the extent to which the firm will be burdened by additional tax costs if it lays off an additional worker (see section 5 for a full description). The five dependent variables used are: an index of seasonal variation in a firm's employment, negative deviations from linear and quadratic employment trends, a direct measure of

temporary layoffs, and a direct measure of permanent layoffs. The key independent variables are the slope of the UI payroll tax schedule and the marginal tax cost of layoff (MTC) facing a firm in a given year.

The preferred estimates are obtained by a fixed effects estimator that relies on variation over time in the degree of experience rating facing a given firm (section 6.2). The results suggest that experience rating does significantly reduce seasonal and temporary layoffs, although the estimated impacts are more modest than those found in the majority of past research. In particular, simulations based on the estimates (section 7) suggest that increased experience rating would reduce seasonal employment variability by up to 1 percent, would reduce negative deviations from trend employment by up to 6 percent, and would would increase permanent layoffs substantially (by 4 to 6 percent in Washington and Pennsylvania, and by over 10 percent in Missouri).

There are reasons to believe that the estimated fixed effects models do not satisfy the assumption of strict exogeneity and that they may yield upward-biased estimates. This could explain why the fixed effects estimates suggest smaller employer responses to increased experience rating of the UI payroll tax than most previous research. Accordingly, we estimate several alternative models in an attempt to pin down the extent to which the fixed effects models are indeed upward-biased (see section 6.3). These efforts offer only sporadic support for the hypothesis that the estimated fixed effects models yield upward-biased estimates of the impact of experience rating on firms' layoff behavior.

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Table 1
Summary of Selected Studies of Unemployment Resulting from Incomplete Experience Rating of the UI Payroll Tax

Study	Data	Dependent Variable(s)	Main Independent Variable(s)	Main Findings
Feldstein (1978)	24,545 individuals from March 1971 CPS	0-1 dummy variable = 1 if worker is on temporary layoff	Imputed UI replacement rate	10% increase in UI replacement rate leads to about a 5% increase in temporary layoff unemployment
Halpin (1979)	Monthly data (by state) for three seasonal 3-digit SIC industries, 1960-1974	Spectral measure of seasonal variation in unemployment	Ratio of taxable to total wages, minimum and maximum tax rates, % of taxable wages at state's maximum tax rate	Seasonal variation in unemployment falls with higher ratio of taxable to total wages, rises with higher minimum tax rate
Halpin (1980)	40,868 individuals in 30 states from 1977 Survey of Income and Education	0-1 dummy variable = 1 if worker is on temporary layoff	Ratio of taxable to total wages, MAXGAP (gap between maximum tax rate and rate needed to fund benefits of negative balance firms), minimum and maximum tax rates, % of benefits noncharged	10 %age point increase in ratio of taxable to total wages lowers incidence of layoffs by 5 %age points; 1 %age point reduction in MAXGAP lowers incidence of layoffs by 15 %age points
Brechling (1981)	170 state-year observations on manufacturing (reserve-ratio states only), 1962-1969	Annual layoff rate, annual rehire rate, average weekly hours, average unemployment duration	Negative balance, minimum, and maximum tax rates; slope of tax schedule; reserve ratio where maximum tax rate is reached	Increases in minimum tax, maximum tax, and slope of schedule increase turnover, hours, duration; increase in negative balance tax reduces turnover, hours, duration
Saffer (1982)	14,899 individuals from March 1975 CPS, linked to 2-digit SIC industry data from ES202	0-1 dummy variables = 1 if worker is on temporary layoff or if worker is on permanent	Proportional deviation of industry average UI tax rate from schedule midpoint, imputed UI replacement rate, state taxable wage base	Increases in estimated degree of experience rating increase probability of temporary layoff
Saffer (1983)	468 state-year observations on industries (all states), 1967-1975	Annual layoff rate (linear or logarithmic)	Difference between minimum and maximum payroll tax rates, average weekly benefit and wage, taxable wage base	Increases in difference between minimum and maximum payroll tax rates lower layoffs (elasticity = -.63)

Table 1 (continued)

Study	Data	Dependent Variable(s)	Main Independent Variable(s)	Main Findings
Topel (1983)	8,280 individuals from March 1975 CPS, linked to 2-digit SIC industry data	Probability of temporary layoff	UI subsidy as % of weekly earnings (imputed for 551 state/2-digit SIC cells), benefit replacement rate (imputed)	Increases in subsidy reduce probability of temporary layoff; full experience rating would reduce temporary layoffs by 31%
Topel (1984a)	33,653 individuals from March CPS, 1973-1976, linked to 2-digit SIC industry data	0-1 dummy variables = 1 if worker on temporary layoff (or permanently laid off)	UI subsidy as % of weekly earnings (imputed for each state/2-digit SIC cell), benefit replacement rate (imputed)	Increases in subsidy reduce probability of temporary layoff; smaller effect of subsidy on permanent layoff
Topel (1985)	76,106 men from March CPS, 1977-1981, linked to 2-digit SIC industry data	0-1 dummy variables = 1 if worker on temporary layoff (or permanently laid off, or quit)	UI subsidy as % of weekly earnings (imputed for each state/2-digit SIC cell), benefit replacement rate (imputed)	Increases in subsidy reduce probability of temporary layoff; full experience rating would reduce unemployment rate from 5.1% to 3.7%
Kaiser (1987)	Annual data (for reserve-ratio states) for 15 2-digit SIC industries, 1964-1969	Log annual layoff rate, log average annual hours per worker	Maximum and minimum tax rates, ratio of maximum to negative balance tax rates (RATIO), slope of tax schedule, WBA, taxable wage base	Layoff rates fall with increases in maximum tax rate, RATIO, and taxable wage base; average hours rise with increases in GAP and maximum tax rate
Deere (1991)	State-year observations on 7 one-digit industries in 31 reserve ratio states, 1962-1967	Industry's share of state employment	Minimum and maximum UI payroll tax per worker in state, MTC in state	10% decrease in MTC lowers construction employment by 1.7%, service employment by 1%; layoff unemployment up by 5% due to employment shifts
Anderson (1993)	Quarterly observations of 8,278 retail firms in six states, 1978-1984	Seasonal employment variability	Marginal tax cost of layoff (MTC), year, and firm fixed effects	Elasticity of seasonal variability w.r.t. MTC is -0.1; full experience rating would reduce seasonal variability by 14%

Table 1 (continued)

Study	Data	Dependent Variable(s)	Main Independent Variable(s)	Main Findings
Card and Levine (1994)	187,598 individuals from CPS outgoing rotation group, 1979-1987, linked to 2-digit SIC industry data	0-1 dummy variables = 1 if worker on temporary layoff (or permanently laid off, or other unemployment)	Marginal tax cost of layoff (MTC) imputed for each state/2-digit SIC cell)	Complete experience rating would reduce temporary layoff rate by 50% (1 %age point) in trough of a recession
Anderson and Meyer (1994)	Over 300,000 quarterly wage records from GA, ID, LA, MO, NM, and SC, matched to UI claims records	0-1 dummy variable = 1 if worker laid off during the quarter	Marginal tax cost of layoff (MTC) measured at the firm level; amount and potential duration of benefits for which worker eligible, other controls	Estimates vary; between 13% and 23% of temporary layoffs (8% of all layoffs) accounted for by incomplete experience rating
Betcherman and Leckie (1995)	Mail survey of 331 establishments in Ontario, Minnesota, Pennsylvania, and Wisconsin	Firm-specific layoff rate in 1993	Marginal tax cost of layoff (MTC) measured at the level of the province/state and industry	No evidence of an impact of experience rating on the layoff rate
Anderson and Meyer (1998)	State-year observations on 51 states, 1972-1997	Monthly claim rate (UI claims/ employment) and range of claim rate	Change to experience rating in WA in 1985; impact obtained by difference-in-differences estimator	Point estimates suggest move to full experience rating lowers claim rate 10 to 18 percent (p-values > 10%)

Table 2
Brief descriptions and summary statistics of key variables

		MO	PA	WA
Variable	Brief Description	Mean (Std. dev.) [Min./Max.]	Mean (Std. dev.) [Min./Max.]	Mean (Std. dev.) [Min./Max.]
Seasonal variation	The within-year range of residuals from a regression of log employment on a time trend (Anderson 1993).	.396 (.412) [0/10.69]	.252 (.392) [0/7.21]	.359 (.478) [0/6.54]
Deviation from linear trend	Absolute value of negative deviation of actual employment from an estimated linear trend (in proportional terms).	.071 (.155) [0/1.99]	.063 (.133) [0/1.98]	.063 (.134) [0/1.91]
Deviation from quadratic trend	Absolute value of negative deviation of actual employment from an estimated quadratic trend (in proportional terms).	.059 (.131) [0/1.99]	.050 (.111) [0/1.97]	.056 (.119) [0/1.93]
Temporary layoffs	Temporary drop in employment between year t-1 and year t, in proportional terms (Brechling and Laurence 1993).	.022 (.069) [0/2.00]	.019 (.064) [0/1.92]	.026 (.080) [0/1.86]
Permanent layoffs	Permanent drop in employment between year t-1 and year t, in proportional terms (Brechling and Laurence 1993).	.035 (.107) [0/2.00]	.033 (.098) [0/1.97]	.035 (.105) [0/1.96]
Slope (Reserve Ratio)	Local linearization of the slope of the tax schedule at the firm=s position on the tax schedule in year t, based on the firm=s reserve ratio. (See text for details.)	.226 (.132) [0/.72]	.033 (.028) [0/.106]	na
Slope (Benefit Ratio)	Local linearization of the slope of the tax schedule at the firm=s position on the tax schedule in year t, based on the firm=s benefit ratio. (See text for details.)	na	.900 (.331) [0/1.09]	1.370 (0.968) [0/3.99]
Marginal tax cost of layoff (Reserve Ratio)	Proportion of each dollar of UI benefits charged to a firm that the firm can expect to pay through increased future payroll taxes.	.611 (.245) [0/.878]	.214 (.157) [0/.513]	na
Marginal tax cost of layoff (Benefit Ratio)	Proportion of each dollar of UI benefits charged to a firm that the firm can expect to pay through increased future payroll taxes.	na	.746 (.275) [0/.906]	1.09 (0.77) [0/3.16]
Tax rate	Firm=s UI payroll tax rate in year t.	1.71 (1.65) [0.00/8.70]	3.64 (2.18) [1.00/9.90]	2.46 (1.46) [0.36/5.42]
Reserve ratio	Firm=s reserve ratio in year t.	8.21 (14.06) [-99.9/99.9]	13.99 (70.26) [-16,753/2,722]	na
Benefit Ratio	Firm=s benefit ratio in year t.	na	2.32 (5.88) [0.0/814.4]	1.71 (7.70) [0.0/1,590.3]
Average WBA	Average weekly UI benefit amount payable to a firm=s workers, based on average quarterly earnings per worker (in 1994 dollars).	158.67 (38.13) [19.28/191.23]	214.21 (89.95) [35.0/329.0]	185.59 (83.75) [68.0/342.0]

Average annual wages	Natural log of average annual wage of a firm=s employees (in 1994 dollars).	9.90 (0.67) [5.69/13.10]	9.93 (0.68) [4.97/13.06]	9.71 (0.72) [5.70/12.52]
Taxable wage base	Annual wages per worker subject to the unemployment insurance tax (in 1994 dollars).	8,789.59 (1,248.52) [7,394/11,018]	9,252.98 (954.18) [8,000/10,818]	18,872.80 (538.52) [18,280/19,900]
Size of firm 5 - 9	=1 if firm=s average monthly employment over all years observed equals 5 - 9, else 0.	.276 (.447) [0/1]	.269 (.443) [0/1]	.245 (.430) [0/1]
10 - 19	=1 if firm=s average monthly employment over all years observed equals 10 - 19, else 0.	.197 (.398) [0/1]	.184 (.388) [0/1]	.190 (.392) [0/1]
20 - 49	=1 if firm=s average monthly employment over all years observed equals 20 - 49, else 0.	.147 (.354) [0/1]	.134 (.341) [0/1]	.153 (.360) [0/1]
50 - 99	=1 if firm=s average monthly employment over all years observed equals 50 - 99, else 0.	.218 (.413) [0/1]	.233 (.423) [0/1]	.196 (.397) [0/1]
100 - 499	=1 if firm=s average monthly employment over all years observed equals 100 - 499, else 0.	.139 (.346) [0/1]	.159 (.366) [0/1]	.192 (.394) [0/1]
>= 500	=1 if firm=s average monthly employment over all years observed is greater than or equal to 500, else 0.	.023 (.149) [0/1]	.021 (.143) [0/1]	.024 (.153) [0/1]
Industry Agriculture	=1 if firm=s 1-digit SIC industry is agriculture, else 0. Industry is determined by the firm=s 1-digit SIC in the first year of data.	.016 (.124) [0/1]	.015 (.121) [0/1]	.049 (.216) [0/1]
Mining	=1 if firm=s 1-digit SIC industry is mining, else 0.	.003 (.055) [0/1]	.007 (.082) [0/1]	.002 (.046) [0/1]
Construction	=1 if firm=s 1-digit SIC industry is construction, else 0.	.085 (.280) [0/1]	.074 (.261) [0/1]	.097 (.295) [0/1]
Manufacturing	=1 if firm=s 1-digit SIC industry is manufacturing, else 0.	.162 (.368) [0/1]	.188 (.391) [0/1]	.128 (.334) [0/1]
Transportation	=1 if firm=s 1-digit SIC industry is transportation, communications, and utilities, else 0.	.044 (.206) [0/1]	.042 (.201) [0/1]	.050 (.217) [0/1]
Wholesale Trade	=1 if firm=s 1-digit SIC industry is wholesale trade, else 0.	.120 (.325) [0/1]	.104 (.305) [0/1]	.110 (.313) [0/1]
Retail Trade	=1 if firm=s 1-digit SIC industry is retail trade, else 0.	.220 (.415) [0/1]	.209 (.406) [0/1]	.197 (.397) [0/1]
Finance,	=1 if firm=s 1-digit SIC industry is finance, insurance, and real estate, else 0.	.070 (.255) [0/1]	.064 (.244) [0/1]	.067 (.251) [0/1]

Services	=1 if firm=s 1-digit SIC industry is services, else 0.	.264 (.441) [0/1]	.295 (.456) [0/1]	.297 (.457) [0/1]
Public Administration	=1 if firm=s 1-digit SIC industry is public administration, else 0.	.015 (.120) [0/1]	.003 (.055) [0/1]	.003 (.059) [0/1]
Age of firm 6 - 9	=1 if firm=s age equals 6 to 9, else 0. Age of firm is the difference between the last year of data in which the firm=s account is active and the year in which the firm=s UI account began.	na	.011 (.106) [0/1]	.117 (.321) [0/1]
10 - 14	=1 if firm=s age equals 10 to 14, else 0.	.109 (.312) [0/1]	.258 (.438) [0/1]	.277 (.448) [0/1]
15 - 19	=1 if firm=s age equals 15 to 19, else 0.	.177 (.382) [0/1]	.225 (.417) [0/1]	.210 (.408) [0/1]
20 - 29	=1 if firm=s age equals 20 to 29, else 0.	.303 (.460) [0/1]	.266 (.442) [0/1]	.210 (.407) [0/1]
30 - 39	=1 if firm=s age equals 30 to 39, else 0.	.175 (.380) [0/1]	.113 (.316) [0/1]	.091 (.287) [0/1]
>= 40	=1 if firm=s age is greater than or equal to 40, else 0.	.235 (.424) [0/1]	.127 (.333) [0/1]	.098 (.293) [0/1]

Notes: Authors' tabulations of stratified random samples of 68,120 employer/year observations in Missouri, 115,128 employer/year observations in Pennsylvania, and 46,263 employer/year observations in Washington. Samples include 6,812 Missouri firms that were active during all ten years from 1985-1994, 12,792 Pennsylvania firms that were active during all nine years from 1986-1994, and 6,609 Washington State firms that were active during all seven years from 1989-1995.

Table 3
Variation between and within firms for selected variables, Missouri, Washington, and Pennsylvania firm panels

Variable	Missouri	Washington	Pennsylvania
Marginal Tax Cost			
overall variation	0.245	0.767	0.321
between variation	0.163	0.552	0.251
within variation	0.183	0.532	0.200
Slope (reserve ratio)			
overall variation	0.132	na	0.028
between variation	0.069	na	0.017
within variation	0.112	na	0.022
Slope (benefit ratio)			
overall variation	na	0.968	0.331
between variation	na	0.697	0.259
within variation	na	0.672	0.206
Seasonal variation			
overall variation	0.412	0.478	0.392
between variation	0.320	0.410	0.235
within variation	0.260	0.246	0.314
Deviation from linear trend			
overall variation	0.155	0.134	0.133
between variation	0.078	0.069	0.062
within variation	0.133	0.115	0.117
Deviation from quadratic trend			
overall variation	0.131	0.119	0.111
between variation	0.059	0.055	0.048
within variation	0.117	0.105	0.101
Temporary layoffs			
overall variation	0.069	0.080	0.064
between variation	0.025	0.033	0.025
within variation	0.064	0.073	0.059
Permanent layoffs			
overall variation	0.107	0.105	0.098
between variation	0.046	0.051	0.046
within variation	0.097	0.092	0.086

Source: Author's tabulations of panels of firms in Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994). For Missouri, the overall and within standard deviations are calculated over 68,120 firm-years of data, and the between standard deviation is calculated over 6,812 firms. For Washington, the overall and within standard deviations are calculated over 46,263 firm-years of data, and the between standard deviation is calculated over 6,609 firms. For Pennsylvania, the overall and within standard deviations are calculated over 115,128 firm-years of data, and the between standard deviation is calculated over 12,792 firms.

Table 4
Estimates of the responsiveness of employer layoffs to experience rating of the UI payroll tax, Missouri, 1985-1994

Independent variable and estimator	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Slope of tax schedule:					
OLS	-.2550*	-.0880*	-.0480*	-.0110*	-.0175*
	(.0121)	(.0046)	(.0039)	(.0023)	(.0036)
Between	-.8821*	-.2842*	-.1886*	-.0407*	-.1774*
	(.0551)	(.0137)	(.0103)	(.0044)	(.0083)
Within (fixed effects)	-.0202*	-.0145*	.0047	.0007	.0456*
	(.0097)	(.0050)	(.0044)	(.0027)	(.0040)
Random effects	-.0460*	-.0460*	-.0246*	-.0106*	.0032
	(.0095)	(.0047)	(.0040)	(.0023)	(.0037)
Marginal tax cost:					
OLS	-.1795*	-.0676*	-.0313*	-.0054*	.0110*
	(.0065)	(.0025)	(.0021)	(.0012)	(.0019)
Between	-.3819*	-.1158*	-.0682*	-.0155*	-.0859*
	(.0236)	(.0059)	(.0045)	(.0019)	(.0035)
Within (fixed effects)	-.0300*	-.0319*	-.0040	.0025	.0469*
	(.0058)	(.0030)	(.0026)	(.0016)	(.0024)
Random effects	-.0502*	-.0491*	-.0205*	-.0052*	.0046*
	(.0057)	(.0027)	(.0023)	(.0012)	(.0020)
Mean of dependent variable (standard deviation)	.3964 (.4125)	.0709 (.1545)	.0587 (.1314)	.0215 (.0690)	.0346 (.1072)

Notes: Each estimate shown is the coefficient on either (a) the slope of the UI payroll tax schedule facing the firm in a given year or (b) the marginal tax cost of a layoff (MTC) in an equation in which one of the five dependent variables shown is regressed on the slope or MTC and (in addition) the following variables: age of firm (five categorical variables), number of employees in the firm (six categorical variables), and one-digit industry (ten categorical variables). For the "within" estimates, these additional independent variables are in effect differenced out and do not appear in the estimated equation. All estimates are based on a sample of 6,812 firms observed over a ten-year period (for a total of 68,120 firm-year observations.) The mean slope facing firms is 0.226 (with a standard deviation of 0.132). The mean MTC facing firms is 0.611 (with a standard deviation of 0.245). See the text for further discussion. Coefficient standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 5
Estimates of the responsiveness of employer layoffs to experience rating of the UI payroll tax, Washington, 1989-1995

Independent variable and estimator	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Slope of tax schedule:					
OLS	-.0593*	-.0098*	-.0061*	-.0036*	-.0057*
	(.0022)	(.0007)	(.0006)	(.0004)	(.0006)
Between	-.1134*	-.0162*	-.0106*	-.0079*	-.0123*
	(.0069)	(.0013)	(.0010)	(.0005)	(.0009)
Within (fixed effects)	-.0069*	-.0036*	-.0018*	.0017*	.0023*
	(.0019)	(.0009)	(.0008)	(.0006)	(.0008)
Random effects	-.0147*	-.0078*	-.0053*	-.0036*	-.0043*
	(.0019)	(.0007)	(.0006)	(.0004)	(.0006)
Marginal tax cost:					
OLS	-.0748*	-.0124*	-.0077*	-.0045*	-.0072*
	(.0028)	(.0009)	(.0008)	(.0005)	(.0007)
Between	-.1431*	-.0204*	-.0134*	-.0099*	-.0156*
	(.0087)	(.0016)	(.0013)	(.0007)	(.0011)
Within (fixed effects)	-.0087*	-.0046*	-.0023*	.0022*	.0030*
	(.0024)	(.0011)	(.0011)	(.0008)	(.0010)
Random effects	-.0186*	-.0099*	-.0067*	-.0045*	-.0055*
	(.0024)	(.0009)	(.0008)	(.0005)	(.0008)
Mean of dependent variable (standard deviation)	.3595 (.4779)	.0626 (.1341)	.0557 (.1191)	.0263 (.0801)	.0355 (.1053)

Notes: Each estimate shown is the coefficient on either (a) the slope of the UI payroll tax schedule facing the firm in a given year or (b) the marginal tax cost of a layoff (MTC) in an equation in which one of the five dependent variables shown is regressed on the slope or MTC and (in addition) the following variables: age of firm (five categorical variables), number of employees in the firm (six categorical variables), and one-digit industry (ten categorical variables). For the "within" estimates, these additional independent variables are in effect differenced out and do not appear in the estimated equation. All estimates are based on a sample of 6,609 firms observed over a six-year period (for a total of 46,263 firm-year observations.) The mean slope facing firms is 1.370 (with a standard deviation of 0.968). The mean MTC facing firms is 1.086 (with a standard deviation of 0.767). See the text for further discussion. Coefficient standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 6
Estimates of the responsiveness of employer layoffs to experience rating of the UI payroll tax, Pennsylvania, 1986-1994

Independent variable and estimator	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Slope of tax schedule: (reserve ratio)					
OLS	-.0822*	.0006	.0260*	.0055	.0047
	(.0416)	(.0143)	(.0119)	(.0083)	(.0126)
Between	.1090	-.0105	.0267	-.0074	-.1296*
	(.1162)	(.0321)	(.0245)	(.0128)	(.0238)
Within (fixed effects)	-.0365	.0134	.0459*	.0255*	.1268*
	(.0455)	(.0170)	(.0145)	(.0109)	(.0157)
Random effects	-.0768	.0048	.0293*	.0055	.0338*
	(.0425)	(.0150)	(.0125)	(.0083)	(.0131)
Slope of tax schedule: (benefit ratio)					
OLS	-.1697*	-.0453*	-.0267*	-.0125*	-.0133*
	(.0037)	(.0013)	(.0011)	(.0008)	(.0011)
Between	-.3077*	-.0509*	-.0446*	-.0198*	-.0308*
	(.0085)	(.0024)	(.0018)	(.0010)	(.0018)
Within (fixed effects)	-.0075	-.0387*	-.0054*	.0005*	.0189*
	(.0048)	(.0018)	(.0015)	(.0013)	(.0018)
Random effects	-.0791*	-.0432*	-.0218*	-.0125*	-.0074*
	(.0042)	(.0014)	(.0012)	(.0008)	(.0013)
Marginal tax cost: (reserve ratio)					
OLS	-.0114*	.0011	.0068*	.0014	.0031
	(.0075)	(.0026)	(.0021)	(.0015)	(.0023)
Between	.0436*	.0049	.0105*	-.0013	-.0222*
	(.0193)	(.0053)	(.0041)	(.0021)	(.0040)
Within (fixed effects)	-.0143	-.0002	.0091*	.0065*	.0325*
	(.0086)	(.0032)	(.0027)	(.0021)	(.0030)
Random effects	-.0187*	.0004	.0069*	.0014	.0095*
	(.0079)	(.0027)	(.0023	(.0015)	(.0024)
Marginal tax cost: (benefit ratio)					
OLS	-.2044*	-.0547*	-.0323*	-.0151*	-.0162*
	(.0045)	(.0015)	(.0013)	(.0009)	(.0014)
Between	-.3727*	-.0616*	-.0542*	-.0238*	-.0364*
	(.0103)	(.0028)	(.0022)	(.0012)	(.0022)
Within (fixed effects)	-.0093	-.0469*	-.0065*	.0006	.0227*
	(.0057	(.0021)	(.0018)	(.0015)	(.0022)
Random effects	-.0953*	-.0521	-.0264*	-.0151*	-.0092*
	(.0050)	(.0017)	(.0014)	(.0009)	(.0016)
Marginal tax cost:					
OLS	-.1534*	-.0399*	-.0219*	-.0103*	-.0106*
	(.0038)	(.0013)	(.0011)	(.0008)	(.0012)
Between	-.2732*	-.0457*	-.0387*	-.0181*	-.0328*
	(.0089)	(.0024)	(.0019)	(.0010)	(.0018)
Within (fixed effects)	-.0107*	-.0331*	-.0019	.0027*	.0261*
	(.0049)	(.0018)	(.0016)	(.0013)	(.0018)
Random effects	-.0725*	-.0377*	-.0172*	-.0103*	-.0035*
	(.0043)	(.0015)	(.0012)	(.0008)	(.0013)

Mean of dependent variable (standard deviation)	.2516 (.3920)	.0629 (.1329)	.0504 (.1114)	.0195 (.0644)	.0325 (.0977)

Notes: Each estimate shown is the coefficient on either (a) the slope of the UI payroll tax schedule facing the firm in a given year or (b) the marginal tax cost of a layoff (MTC) in an equation in which one of the five dependent variables shown is regressed on the slope or MTC and (in addition) the following variables: age of firm (five categorical variables), number of employees in the firm (six categorical variables), and one-digit industry (ten categorical variables). For the "within" estimates, these additional independent variables are in effect differenced out and do not appear in the estimated equation. All estimates are based on a sample of 12,792 firms observed over a nine-year period (for a total of 115,128 firm-year observations.) The mean RR slope facing firms is 0.033 (with a standard deviation of 0.028). The mean BR slope facing firms is 0.900 (with a standard deviation of 0.331). The mean RR MTC facing firms is 0.214 (with a standard deviation of 0.157). The mean BR MTC facing firms is 0.746 (with a standard deviation of 0.275). The mean combined MTC (RR + BR) is 0.960 (with a standard deviation of 0.321). See the text for further discussion. Coefficient standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 7
Estimated elasticities of employer layoffs (various measures) with respect to the slope of the UI payroll tax schedule and the marginal tax cost of layoff, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

With respect to: (estimator)	Elasticity of: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
SLOPE OF TAX SCHEDULE:					
Missouri					
OLS	-.1452*	-.2800*	-.1845*	-.1134*	-.1125*
Between	-.5023*	-.9043*	-.7251*	-.4184*	-1.1375*
Fixed effects	-.0115*	-.0462*	+.0179	+.0071	+.2924*
Random effects	-.0262*	-.1462*	-.0945*	-.1095*	+.0207*
Washington					
OLS	-.2259*	-.2144*	-.1509*	-.1942*	-.2319*
Between	-.4321*	-.3537*	-.2613*	-.4295*	-.4988*
Fixed effects	-.0264*	-.0796*	-.0441*	+.0939*	+.0948*
Random effects	-.0562*	-.1711*	-.1309*	-.1942*	-.1757*
Pennsylvania (reserve ratio)					
OLS	-.0107*	+.0003	+.0168*	+.0095	+.0049
Between	+.0142*	-.0054	+.0173	-.0128	-.1340*
Fixed effects	-.0047	+.0069	+.0298*	+.0440*	+.1310*
Random effects	-.0100	+.0025	+.0190*	+.0095	+.0349*
Pennsylvania (benefit ratio)					
OLS	-.6066*	-.6489*	-.4760*	-.5768*	-.3695*
Between	-1.0999*	-.7278*	-.7964*	-.9158*	-.8543*
Fixed effects	-.0267	-.5542*	-.0962*	+.0232	+.5246*
Random effects	-.2826*	-.6179*	-.3893*	-.5768*	-.2059*
MARGINAL TAX COST:					
Missouri					
OLS	-.2766*	-.5816*	-.3256*	-.1534*	-.1956*
Between	-.5885*	-.9969*	-.7098*	-.4420*	-1.5233*
Fixed effects	-.0463*	-.2748*	-.0418*	+.0697	+.8310*
Random effects	-.0774*	-.4230*	-.2138*	-.1474*	+.0822*
Washington					
OLS	-.2259*	-.2144*	-.1509*	-.1942*	-.2319*
Between	-.4321*	-.3537*	-.2613*	-.4295*	-.4988*
Fixed effects	-.0264*	-.0796*	-.0441*	+.0939	+.0948*
Random effects	-.0562*	-.1711*	-.1309*	-.1942*	-.1757*
Pennsylvania					
OLS	-.5850*	-.6099*	-.4179*	-.5122*	-.3155*
Between	-1.0421*	-.6976*	-.7379*	-.9031*	-.9786*
Fixed effects	-.0409*	-.5055*	-.0369	+.1333*	+.7794*
Random effects	-.2766*	-.5753*	-.3285*	-.5122*	-.1050*
Pennsylvania (reserve ratio)					
OLS	-.0097	+.0039	+.0290*	+.0164	+.0213
Between	+.0371*	+.0168	+.0444*	-.0151	-.1522*
Fixed effects	-.0121	-.0005	+.0388*	+.0749*	+.2229*
Random effects	-.0160*	+.0015	+.0292*	+.0164	+.0655*
Pennsylvania (benefit ratio)					
OLS	-.6057*	-.6490*	-.4776*	-.5785*	-.3717*
Between	-1.1046*	-.7306*	-.8020*	-.9139*	-.8361*
Fixed effects	-.0274	-.5559*	-.0971*	+.0218*	+.5204*
Random effects	-.2824*	-.6182*	-.3907*	-.5785*	-.2113*

Notes: Elasticities based on estimates displayed in tables 4, 5, and 6, computed at sample means. Starred estimates have a p-value of .05 or less.

Table 8
Estimates of the responsiveness of employer layoffs to MTC of layoff, reserve/benefit ratio included as an explanatory variable, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

State and estimator	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Missouri					
OLS	-.1064*	-.0616*	-.0253*	-.0026*	-.0086*
	(.0065)	(.0025)	(.0022)	(.0012)	(.0019)
Between	-.1902*	-.1173*	-.0647*	-.0101*	-.0959*
	(.0251)	(.0064)	(.0049)	(.0021)	(.0039)
Within (fixed effects)	-.0300*	-.0317*	-.0038	.0024	.0469*
	(.0058)	(.0030)	(.0026)	(.0016)	(.0024)
Random effects	-.0467*	-.0446*	-.0158*	-.0025*	.0069*
	(.0057)	(.0027)	(.0023)	(.0013)	(.0020)
Washington					
OLS	-.0694*	-.0107*	-.0064*	-.0044*	-.0072*
	(.0029)	(.0009)	(.0008)	(.0005)	(.0007)
Between	-.1203*	-.0157*	-.0098*	-.0093*	-.0147*
	(.0093)	(.0017)	(.0014)	(.0007)	(.0012)
Within (fixed effects)	-.0074*	-.0039*	-.0017	.0021*	.0028*
	(.0024)	(.0011)	(.0011)	(.0008)	(.0010)
Random effects	-.0169*	-.0086*	-.0055*	-.0044*	-.0055*
	(.0024)	(.0009)	(.0008)	(.0005)	(.0008)
Pennsylvania					
OLS	-.0936*	-.0255*	-.0141*	-.0027*	-.0011
	(.0044)	(.0015)	(.0013)	(.0010)	(.0015)
Between	-.0718*	.0200*	.0239*	.0001	-.0093*
	(.0130)	(.0035)	(.0027)	(.0016)	(.0029)
Within (fixed effects)	-.0084	-.0318*	-.0074*	.0009	.0198*
	(.0052)	(.0019)	(.0016)	(.0014)	(.0020)
Random effects	-.0534*	-.0297*	-.0148*	-.0027*	.0023
	(.0046)	(.0016)	(.0013)	(.0010)	(.0016)
Pennsylvania (RR)					
OLS	.0045	.0042	.0085*	.0030*	.0046*
	(.0075)	(.0026)	(.0022)	(.0015)	(.0023)
Between	.0976*	.0251*	.0300*	.0032	-.0172*
	(.0194)	(.0053)	(.0040)	(.0022)	(.0040)
Within (fixed effects)	-.0145	.00002	.0085*	.0065*	.0322*
	(.0086)	(.0032)	(.0027)	(.0021)	(.0030)
Random effects	-.0145	.0019	.0073*	.0030*	.0101*
	(.0079)	(.0027)	(.0023)	(.0015)	(.0024)
Pennsylvania (BR)					
OLS	-.1413*	-.0400*	-.0251*	-.0071*	-.0054*
	(.0053)	(.0018)	(.0015)	(.0013)	(.0020)
Between	-.1855*	.0166*	.0198*	-.0028	-.0020
	(.0162)	(.0044)	(.0033)	(.0021)	(.0039)
Within (fixed effects)	-.0055	-.0468*	-.0149*	-.0030	.0111*
	(.0061)	(.0023)	(.0019)	(.0017)	(.0025)
Random effects	-.0721*	-.0446*	-.0253*	-.0071*	-.0035
	(.0055)	(.0019)	(.0016)	(.0015)	(.0021)

Notes: See Tables 4, 5, and 6. Each estimate is the coefficient on the marginal tax cost of a layoff (MTC) in an expanded version of the models underlying Tables 4, 5, and 6. Coefficient standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 9
Estimates of the responsiveness of employer layoffs to MTC of layoff, reserve/benefit ratio, average earnings, WBA, and taxable wage base included as explanatory variables, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

State and estimator	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Missouri					
OLS	-.0928*	-.0612*	-.0249*	-.0022	-.0075*
	(.0064)	(.0025)	(.0022)	(.0013)	(.0020)
Between	-.1550*	-.1132*	-.0607*	-.0078*	-.0937*
	(.0247)	(.0065)	(.0049)	(.0021)	(.0039)
Within (fixed effects)	-.0321*	-.0357*	-.0075*	.0011	.0462*
	(.0057)	(.0029)	(.0026)	(.0016)	(.0024)
Random effects	-.0463*	-.0452*	-.0163*	-.0021	.0076*
	(.0056)	(.0027)	(.0023)	(.0013)	(.0020)
Washington					
OLS	-.0556*	-.0109*	-.0094*	-.0042*	-.0071*
	(.0027)	(.0009)	(.0008)	(.0005)	(.0007)
Between	-.0953*	-.0151*	-.0089*	-.0085*	-.0145*
	(.0084)	(.0017)	(.0014)	(.0007)	(.0012)
Within (fixed effects)	-.0059*	-.0047*	-.0024*	.0017*	.0027*
	(.0024)	(.0011)	(.0010)	(.0008)	(.0010)
Random effects	-.0147*	-.0090*	-.0057*	-.0042*	-.0055*
	(.0023)	(.0009)	(.0008)	(.0005)	(.0008)
Pennsylvania					
OLS	-.0879*	-.0260*	-.0144*	-.0027*	-.0009
	(.0044)	(.0015)	(.0013)	(.0010)	(.0015)
Between	-.0572*	.0210*	.0248*	.0007	-.0087*
	(.0127)	(.0035)	(.0027)	(.0016)	(.0029)
Within (fixed effects)	-.0081	-.0333*	-.0086*	.0004	.0195*
	(.0051)	(.0019)	(.0016)	(.0013)	(.0020)
Random effects	-.0524*	-.0308*	-.0154*	-.0027*	.0023
	(.0046)	(.0016)	(.0013)	(.0010)	(.0016)
Pennsylvania (RR)					
OLS	.0069*	.0037*	.0081*	.0030*	.0046*
	(.0074)	(.0026)	(.0021)	(.0015)	(.0023)
Between	.1022*	.0254*	.0304*	.0035	-.0170*
	(.0189)	(.0053)	(.0040)	(.0022)	(.0040)
Within (fixed effects)	-.0140	-.0020	.0068*	.0053*	.0314*
	(.0086)	(.0031)	(.0027)	(.0020)	(.0030)
Random effects	-.0126	.0010	.0067*	.0030*	.0101*
	(.0079)	(.0027)	(.0023)	(.0015)	(.0024)
Pennsylvania (BR)					
OLS	-.1342*	-.0405*	-.0254*	-.0071*	-.0051*
	(.0074)	(.0026)	(.0015)	(.0013)	(.0020)
Between	-.1644*	.0180*	.0210*	-.0019	-.0010
	(.0158)	(.0044)	(.0033)	(.0021)	(.0039)
Within (fixed effects)	-.0053	-.0480*	-.0158*	-.0030	.0111*
	(.0061)	(.0022)	(.0019)	(.0017)	(.0025)
Random effects	-.0715*	-.0458*	-.0258*	-.0071*	-.0034
	(.0055)	(.0019)	(.0016)	(.0013)	(.0021)

Notes: See Tables 4, 5, and 6. Each estimate is the coefficient on the marginal tax cost of a layoff (MTC) in an expanded version of the models underlying Tables 4, 5, and 6. Coefficient standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 10
Fixed effects estimates of the responsiveness of employer layoffs, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

State and independent variable	Dependent Variables: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Missouri					
MTC	-.0321*	-.0357*	-.0075*	.0011	.0462*
	(.0057)	(.0029)	(.0026)	(.0016)	(.0024)
Reserve ratio	-.0004*	-.0014*	-.0011*	-.0001*	-.0002*
	(.0002)	(.0001)	(.0001)	(.00005)	(.0001)
Average WBA ($100's)	-.3608*	-.0240*	-.0080	.0053	-.0026
	(.0117)	(.0060)	(.0052)	(.0032)	(.0048)
Log of average annual wages	.3480*	.1546*	.1292*	.0476*	.0270*
	(.0076)	(.0039)	(.0034)	(.0021)	(.0031)
Taxable wage base ($1,000's)	-.0022	.0002	-.0077*	-.0004	-.0053*
	(.0013)	(.0006)	(.0006)	(.0003)	(.0005)
Washington					
MTC	-.0059*	-.0047*	-.0024*	.0017*	.0027*
	(.0024)	(.0011)	(.0010)	(.0008)	(.0010)
Benefit ratio	.0015*	.0008*	.0007*	-.00002	-.0002*
	(.0002)	(.0001)	(.0001)	(.00005)	(.00007)
Average WBA ($100's)	-.0445*	.0285*	.0278*	.0152*	.0124*
	(.0081)	(.0038)	(.0034)	(.0028)	(.0036)
Log of average annual wages	-.2148*	.1191*	.1077*	.0557*	.0071
	(.0108)	(.0050)	(.0046)	(.0037)	(.0047)
Taxable wage base ($1,000's)	.0044	-.0103*	-.0033*	-.0053*	-.0004
	(.0029)	(.0014)	(.0013)	(.0009)	(.0011)
Pennsylvania					
MTC	-.0081	-.0333*	-.0086*	.0004	.0195*
	(.0051)	(.0019)	(.0016)	(.0013)	(.0020)
Reserve ratio	-.0001*	.00003*	.0001*	.00003*	.00006*
	(.00002)	(.000007)	(.000006)	(.00001)	(.00002)
Benefit ratio	.0003	.0003*	-.0009*	-.0003*	-.0013*
	(.0003)	(.0001)	(.00008)	(.0001)	(.0002)
Average WBA ($100's)	-.0206*	-.0169*	-.0124*	.0032	-.0099*
	(.0074)	(.0027)	(.0023)	(.0018)	(.0026)
Log of average annual wages	-.0109	.1831*	.1468*	.0620*	.0548*
	(.0097)	(.0035)	(.0030)	(.0023)	(.0034)
Taxable wage base ($1,000's)	.00007	-.0055*	.0037*	-.0004	-.0069*
	(.0015)	(.0005)	(.0005)	(.0003)	(.0005)

Notes: Estimates from fixed effects models in which one of the five dependent variables is regressed on MTC, the control variables shown, and year dummies. Additional controls, including the multiple-plant dummy variable and dummy variables for the age of the firm, size of the firm, and industry are in effect differenced out and not included. Estimates are based on a sample of 68,120 firm-years of data for Missouri, 46,263 firm-years of data for Washington, and 115,128 firm-years of data for Pennsylvania. Standard deviations in parentheses. Starred estimates have a p-value of .05 or less.

Table 11
Fixed-effects elasticities of employer layoffs with respect to MTC by industry/size category, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

Industry/size category state	Sample size	Elasticity of Seasonal variation	Deviation from trend linear	 quadratic	Temporary layoffs	Permanent layoffs
Agriculture/small						
Missouri	860	-0.021	-0.373	-0.193	-0.744*	+0.351
		(0.053)	(0.206)	(0.205)	(0.376)	(0.373)
Pennsylvania	1,179	-0.090	-0.559*	+0.148	+0.038	+0.627
		(0.098)	(0.256)	(0.257)	(0.512)	(0.598)
Washington	1,232	-0.033	-0.061	-0.016	+0.197	-0.008
		(0.022)	(0.078)	(0.076)	(0.124)	(0.135)
Agriculture/large						
Missouri	200	-0.210	-0.363	-1.638	-3.944*	-4.595*
		(0.493)	(1.325)	(1.383)	(1.466)	(1.550)
Pennsylvania	531	+0.582*	-0.829	-1.275*	-0.933	-1.007
		(0.228)	(0.557)	(0.579)	(1.030)	(1.151)
Washington	1,036	-0.019	-0.114	-0.133	-0.125	+0.133
		(0.013)	(0.071)	(0.073)	(0.106)	(0.146)
Mining/small						
Missouri	90	+0.231*	+0.712	+0.233	-0.083	-0.344
		(0.101)	(0.440)	(0.463)	(0.709)	(0.765)
Pennsylvania	369	-0.172	-0.907*	-0.773*	+0.115	-0.371
		(0.110)	(0.207)	(0.222)	(0.475)	(0.310)
Washington	42	-0.030	+2.979*	+2.893*	+2.171	-0.721
		(0.297)	(0.928)	(0.812)	(1.225)	(3.395)
Mining/large						
Missouri	120	+0.018	+0.019	-0.204	-0.090	-0.009
		(0.078)	(0.351)	(0.382)	(0.621)	(0.566)
Pennsylvania	405	+0.027	+0.124	+0.007	+0.474	+0.525*
		(0.147)	(0.177)	(0.205)	(0.383)	(0.227)
Washington	56	-0.892*	-1.490*	-1.001*	-0.694	2.013*
		(0.391)	(0.663)	(0.490)	(1.187)	(0.878)
Construction/small						
Missouri	4,340	+0.004	-0.102	-0.045	+0.102	+0.189
		(0.028)	(0.073)	(0.076)	(0.127)	(0.121)
Pennsylvania	5,832	-0.028	-0.271*	-0.165*	-0.321*	+0.050
		(0.027)	(0.064)	(0.066)	(0.141)	(0.118)
Washington	2,968	-0.031	-0.027	-0.060	+0.047	-0.087
		(0.016)	(0.048)	(0.049)	(0.083)	(0.076)
Construction/large						
Missouri	1,480	-0.080*	-0.234*	-0.176	-0.023	+0.382*
		(0.034)	(0.110)	(0.117)	(0.163)	(0.186)
Pennsylvania	2,655	+0.085*	-0.033	+0.021	+0.089	+0.563*
		(0.042)	(0.076)	(0.075)	(0.152)	(0.161)
Washington	1,498	-0.004	-0.027	-0.009	-0.051	+0.059
		(0.018)	(0.055)	(0.057)	(0.085)	(0.107)
Manufacturing/small						
Missouri	4,250	+0.000	-0.122	+0.152	+0.236	+0.850*
		(0.028)	(0.084)	(0.090)	(0.144)	(0.139)
Pennsylvania	7,344	-0.112*	-0.434*	-0.097	+0.147	+0.547*
		(0.051)	(0.094)	(0.095)	(0.190)	(0.152)
Washington	2,170	-0.046	-0.122	-0.042	-0.025	+0.251*
		(0.030)	(0.068)	(0.073)	(0.124)	(0.115)

Manufacturing/large						
Missouri	6,770	+0.073	-0.055	+0.180	+0.025	+0.898*
		(0.039)	(0.117)	(0.130)	(0.186)	(0.189)
Pennsylvania	14,283	-0.079	-0.692*	-0.356*	+0.278	+0.203
		(0.073)	(0.066)	(0.073)	(0.144)	(0.131)
Washington	3,738	-0.035	-0.273*	-0.159	+0.041	-0.163
		(0.033)	(0.078)	(0.086)	(0.126)	(0.122)
Transportation/small						
Missouri	1,720	+0.028	-0.452*	-0.197	-0.063	+1.076*
		(0.039)	(0.130)	(0.142)	(0.245)	(0.254)
Pennsylvania	2,628	+0.068	+0.069	+0.027	-0.433	+0.681*
		(0.097)	(0.200)	(0.208)	(0.416)	(0.345)
Washington	1,176	+0.010	+0.022	+0.099	0.062	+0.239
		(0.042)	(0.103)	(0.102)	(0.185)	(0.181)
Transportation/large						
Missouri	1,310	-0.053	+0.207	0.423	+0.569	+0.936*
		(0.071)	(0.226)	(0.240)	(0.389)	(0.368)
Pennsylvania	2,205	+0.056	-0.508*	-0.565*	-0.417	-0.181
		(0.228)	(0.202)	(0.230)	(0.534)	(0.548)
Washington	1,120	-0.043	-0.264	-0.229	-0.321	-0.176
		(0.081)	(0.207)	(0.213)	(0.407)	(0.291)
Wholesale/small						
Missouri	5,660	-0.055*	-0.236*	-0.050	+0.148	+0.595*
		(0.026)	(0.081)	(0.085)	(0.152)	(0.142)
Pennsylvania	7,830	-0.029	-0.058	+0.113	+0.225	+0.584*
		(0.063)	(0.133)	(0.140)	(0.280)	(0.236)
Washington	2,898	-0.047	+0.085	+0.039	-0.233	+0.118
		(0.041)	(0.094)	(0.099)	(0.173)	(0.165)
Wholesale/large						
Missouri	2,450	-0.241*	-0.533*	-0.323	-0.401	+0.798*
		(0.065)	(0.219)	(0.246)	(0.331)	(0.349)
Pennsylvania	4,169	+0.440*	-0.322*	-0.491*	-0.463	+1.027*
		(0.213)	(0.206)	(0.233)	(0.558)	(0.488)
Washington	2,212	+0.058	-0.119	-0.086	-0.142	-0.210
		(0.044)	(0.114)	(0.117)	(0.219)	(0.178)
Retail/small						
Missouri	10,100	-0.100*	-0.335*	-0.131*	-0.071	+0.628*
		(0.021)	(0.051)	(0.053)	(0.090)	(0.087)
Pennsylvania	15,453	-0.073	-0.341*	-0.146	+0.039	+0.281
		(0.044)	(0.098)	(0.101)	(0.204)	(0.171)
Washington	5,614	-0.043	+0.025	-0.004	+0.108	-0.051
		(0.025)	(0.064)	(0.064)	(0.109)	(0.103)
Retail/large						
Missouri	4,920	+0.004	-0.262*	+0.012	-0.031	+0.676*
		(0.039)	(0.127)	(0.130)	(0.221)	(0.181)
Pennsylvania	8,577	+0.112	-0.169*	+0.087	-0.283	+0.517
		(0.148)	(0.143)	(0.154)	(0.361)	(0.313)
Washington	3,479	+0.054	+0.198	+0.091	+0.058	-0.115
		(0.053)	(0.112)	(0.117)	(0.186)	(0.186)
Finance/small						
Missouri	2,610	-0.010	-0.196	+0.044	-0.420	+1.276*
		(0.044)	(0.125)	(0.130)	(0.294)	(0.224)
Pennsylvania	4,257	+0.031	-0.110	+0.107	-0.095	+0.443
		(0.104)	(0.204)	(0.213)	(0.509)	(0.392)
Washington	1,596	+0.084	-0.116	-0.092	-0.361	-0.427*
		(0.059)	(0.117)	(0.125)	(0.232)	(0.211)

Finance/large						
Missouri	2,170	-0.096	-0.581*	-0.278	-0.016	+0.397
		(0.065)	(0.192)	(0.217)	(0.366)	(0.278)
Pennsylvania	3,060	-0.884*	-0.787*	-0.636*	+0.001	+0.944
		(0.392)	(0.220)	(0.252)	(0.631)	(0.595)
Washington	1,526	+0.098	+0.111	+0.022	+0.247	-0.104
		(0.110)	(0.181)	(0.209)	(0.361)	(0.347)
Service/small						
Missouri	11,980	-0.079*	-0.417*	-0.215*	+0.089	+0.531*
		(0.019)	(0.052)	(0.054)	(0.100)	(0.091)
Pennsylvania	22,455	-0.012	-0.199*	-0.056	+0.062	+0.649*
		(0.037)	(0.078)	(0.083)	(0.173)	(0.163)
Washington	9,380	-0.050*	+0.028	-0.001	+0.013	-0.169
		(0.019)	(0.051)	(0.051)	(0.089)	(0.087)
Service/large						
Missouri	6,010	-0.024	-0.738*	-0.377*	-0.393	+0.542*
		(0.052)	(0.138)	(0.147)	(0.257)	(0.271)
Pennsylvania	11,565	+0.013	+0.138	+0.107	+0.294	+0.943*
		(0.111)	(0.116)	(0.130)	(0.309)	(0.282)
Washington	4,361	+0.019	-0.158	-0.048	+0.237	+0.163
		(0.036)	(0.084)	(0.085)	(0.157)	(0.140)
Public/small						
Missouri	590	-0.009	-0.665*	-0.599	-0.656	+1.206
		(0.124)	(0.325)	(0.394)	(0.599)	(0.807)
Pennsylvania	279	+0.188	+1.025	+0.340	-0.907	-0.377
		(0.280)	(0.609)	(0.596)	(1.369)	(1.681)
Washington	119	-0.086	+0.148	-0.028	+1.636	+0.066
		(0.232)	(0.719)	(0.734)	(1.151)	(1.939)
Public/large						
Missouri	400	+0.393*	-0.298	+0.225	-0.187	+1.010
		(0.190)	(0.543)	(0.657)	(1.036)	(1.378)
Pennsylvania	72	-2.790	+0.490	-0.588	-3.489	-5.710
		(2.243)	(1.265)	(2.108)	(3.948)	(4.576)
Washington	42	+0.540	-0.433	-0.451	+6.991*	-2.952
		(0.653)	(0.761)	(0.728)	(2.231)	(2.138)

Notes: Estimated elasticities are obtained from fixed effects models in which each dependent variable is regressed on MTC, reserve ratio (Missouri and Pennsylvania), benefit ratio (Washington and Pennsylvania), average weekly UI benefit amount, log of average annual wages, the state's taxable wage base, and year dummies. Elasticities are computed at sample means for each industry/firm size category. The sample size for each industry/firm size category reflects ten observations per firm for Missouri, 9 observations per firm for Pennsylvania, and 7 observations per firm for Washington. Temporary layoff and permanent layoff estimates are based on one less observation per firm for Missouri and Washington and two less observations per firm for Pennsylvania. Standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 12
Means of key variables by reserve or benefit ratio category for Missouri (1985–1994), Washington (1989 –1995), and Pennsylvania (1986–1994)

State reserve/benefit ratio category	% of firms in category	Variables					
			Seasonal	Deviation from trend		Temp.	Perm.
		MTC	variation	linear	quadratic	layoffs	layoffs
Missouri (RR)							
High	6.84	0.286	.388	.109	.075	.021	.079
		(.361)	(.423)	(.231)	(.182)	(.068)	(.173)
Mid-range	89.11	0.657	.377	.065	.055	.021	.029
		(.184)	(.380)	(.138)	(.120)	(.066)	(.092)
Low	4.05	0.151	.832	.136	.104	.040	.077
		(.284)	(.725)	(.276)	(.226)	(.111)	(.200)
Washington (BR)							
High	4.36	0.123	.852	.111	.096	.059	.066
		(.341)	(.749)	(.212)	(.187)	(.143)	(.168)
Mid-range	93.13	1.112	.338	.060	.054	.025	.034
		(.743)	(.450)	(.128)	(.114)	(.076)	(.102)
Low	2.51	1.786	.315	.064	.060	.025	.026
		(.804)	(.431)	(.150)	(.136)	(.077)	(.080)
Pennsylvania (RR)							
High	30.31	0.943	.190	.052	.041	.016	.037
		(.214)	(.333)	(.117)	(.098)	(.054)	(.100)
Mid-range	64.31	1.035	.258	.065	.052	.019	.028
		(.263)	(.392)	(.132)	(.109)	(.064)	(.089)
Low	5.38	0.155	.523	.099	.084	.039	.060
		(.339)	(.547)	(.204)	(.180)	(.108)	(.160)
Pennsylvania (BR)							
High	10.79	0.386	.453	.098	.083	.034	.066
		(.445)	(.521)	(.203)	(.179)	(.099)	(.167)
Mid-range	81.39	1.027	.229	.059	.047	.018	.029
		(.222)	(.374)	(.121)	(.099)	(.058)	(.085)
Low	7.82	1.051	.206	.056	.046	.018	.023
		(.154)	(.262)	(.119)	(.100)	(.063)	(.077)

Notes: For Missouri, firms with a mean reserve ratio greater than or equal to 15.0 are in the high category, firms with a mean reserve ratio between –12.0 and 15.0 are in the mid-range category, and firms with a mean reserve ratio less than or equal to –12.0 are in the low category. For Washington, firms with a mean benefit ratio greater than or equal to 6.0 are in the high category, firms with a mean benefit ratio between 0 and 6.0 are in the mid-range category, and firms with a mean benefit ratio equal to zero are in the low category. For Pennsylvania (RR), firms with a mean reserve ratio greater than or equal to 25.0 are in the high category, firms with a mean reserve ratio between –20 and 25 are in the mid-range category, and firms with a mean reserve ratio less than or equal to –20 are in the low category. For Pennsylvania (BR), firms with a mean benefit ratio greater than or equal to 5.0 are in the high category, firms with a mean benefit ratio between 0 and 5.0 are in the mid-range category, and firms with a mean benefit ratio equal to zero are in the low category. Standard deviations in parentheses.

Table 13
Estimates of the responsiveness of employer layoffs to MTC of layoffs and estimated elasticities with respect to MTC of layoffs, by reserve ratio/benefit ratio category, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)

	Panel (a)				
	Dependent Variables				
State and RR/BR category	Seasonal variation	Deviation from trend linear	Deviation from trend quadratic	Temporary layoffs	Permanent layoffs
Missouri					
High	-.0217	-.0438*	.0051	.0002	.0894*
	(.0121)	(.0062)	(.0054)	(.0032)	(.0049)
Mid-range	-.0393*	-.0278*	-.0094*	.0031	.0266*
	(.0068)	(.0035)	(.0030)	(.0019)	(.0029)
Low	.0094	-.0913*	-.0309*	-.0158*	.0890*
	(.0239)	(.0122)	(.0107)	(.0064)	(.0097)
Washington					
High	-.0512*	-.0126	.0046	.0087	.0371*
	(.0194)	(.0091)	(.0083)	(.0066)	(.0083)
Mid-range	-.0047	-.0047*	-.0027*	.0017*	.0022*
	(.0025)	(.0012)	(.0011)	(.0008)	(.0010)
Low	-.0141	-.0026	-.0005	.0005	.0018
	(.0096)	(.0045)	(.0041)	(.0036)	(.0045)
Pennsylvania					
High	-.0125	-.0091*	.0076*	.0039	.0468*
	(.0100)	(.0036)	(.0031)	(.0024)	(.0034)
Mid-range	-.0049	-.0381*	-.0106*	-.0007	.0061*
	(.0062)	(.0022)	(.0019)	(.0017)	(.0025)
Low	-.0218	-.0728*	-.0469*	-.0057	.0093
	(.0176)	(.0064)	(.0054)	(.0041)	(.0060)

	Panel (b)				
	Elasticity of				
	Seasonal variation	Deviation from trend linear	Deviation from trend quadratic	Temporary layoffs	Permanent layoffs
Missouri					
High	-.0160	-.1285*	.0193	.0022	.3455*
Mid-range	-.0685*	-.1762*	-.1110*	.0979	.5969*
Low	.0017	-.0791*	-.0450*	-.0621*	.1787*
Washington					
High	-.0074*	-.0140	.0059	.0172	.0662*
Mid-range	-.0154	-.0869*	-.0551*	.0793*	.0754*
Low	-.0798	-.0738	-.0161	.0023	.0080
Pennsylvania					
High	-.0620	-.1637*	.1748*	.2334	1.2127*
Mid-range	-.0198	-.6093*	-.2098*	-.0371	.2280*
Low	-.0065	-.1139*	-.0862*	-.0237	.0243

Notes: Estimates from fixed effects models that include the MTC interacted with reserve ratio category dummies for Missouri and Pennsylvania and MTC interacted with benefit ratio category dummies for Washington. Elasticities in Panel B are elasticities of each dependent variable with respect to MTC. Standard errors in parentheses. Starred estimates have a p-value of .05 or less.

Table 14
Instrumental variables estimates of the responsiveness of employer layoffs to MTC

State and Estimator	Dependent Variables: Seasonal variation	Deviation from linear trend	Deviation from quadratic trend	Temporary layoffs	Permanent layoffs
Missouri					
FE	-.0321*	-.0357*	-.0075*	.0011	.0462*
	(.0057)	(.0029)	(.0026)	(.0016)	(.0024)
FE IV (2SLS)	-.0167*	-.0742*	-.0432*	-.0024	.0334*
(1-year difference of MTC)	(.0107)	(.0055)	(.0049)	(.0029)	(.0045)
(1-year lag of first difference of MTC)	-.0028	-.0760*	-.0098	-.0012	.0369*
	(.0259)	(.0132)	(.0119)	(.0076)	(.0119)
FD	.0085	.0163*	.0297*	.0089*	.0329*
	(.0071)	(.0029)	(.0028)	(.0022)	(.0029)
FD IV (2SLS)	-.0008	-.0603*	-.0785*	-.0005	.0433
(1-year lag of first difference of MTC)	(.0300)	(.0123)	(.0120)	(.0093)	(.0129)
(2-year lag of first difference of MTC)	.0964	-.2071*	-.1825*	.0155	.0111
	(.1113)	(.0469)	(.0459)	(.0336)	(.0473)
Washington					
FE	-.0059*	-.0047*	-.0024*	.0017*	.0027*
	(.0024)	(.0011)	(.0010)	(.0008)	(.0010)
FE IV (2SLS)	-.0121*	-.0144*	-.0123*	-.0024	-.0013
(1-year difference of MTC)	(.0053)	(.0025)	(.0024)	(.0017)	(.0022)
(1-year lag of first difference of MTC)	-.0358*	-.0298*	-.0129*	.0132	.0300*
	(.0136)	(.0065)	(.0060)	(.0093)	(.0125)
FD	-.0052	.0016	.0024*	.0034*	.0097*
	(.0029)	(.0012)	(.0011)	(.0010)	(.0012)
FD IV (2SLS)	.0068	-.0023	-.0115	-.0120	-.0041
(1-year lag of first difference of MTC)	(.0149)	(.0060)	(.0059)	(.0073)	(.0087)
(2-year lag of first difference of MTC)	-.0875*	-.0149	.0016	.0262	.0344*
	(.0352)	(.0143)	(.0140)	(.0129)	(.0158)
Pennsylvania					
FE	-.0081	-.0333*	-.0086*	.0004	.0195*
	(.0051)	(.0019)	(.0016)	(.0013)	(.0020)
FE IV (2SLS)	.0039	-.0672*	-.0345*	-.0024	.0115*
(1-year difference of MTC)	(.0096)	(.0035)	(.0030)	(.0026)	(.0038)
(1-year lag of first difference of MTC)	.0190	-.0551*	.0092	-.0113	.0031
	(.0220)	(.0079)	(.0067)	(.0084)	(.0128)
FD	.0227*	.0063*	.0202*	.0064*	.0233*
	(.0067)	(.0019)	(.0018)	(.0017)	(.0022)

FD IV (2SLS) (1-year lag of first difference of MTC)	.0054 (.0362)	-.0594* (.0103)	-.0980* (.0100)	.0105 (.0082)	.0281* (.0112)
(2-year lag of first difference of MTC)	.0513 (.0816)	-.0916* (.0241)	-.0998* (.0234)	-.0508* (.0242)	.0039 (.0339)
Pennsylvania (RR)					
FE	-.0126 (.0079)	-.0020 (.0031)	.0068* (.0027)	.0053* (.0020)	.0314* (.0030)
FE IV (2SLS) (1-year difference of MTC)	-.0023 (.0157)	-.0317* (.0056)	-.0012 (.0048)	.0014 (.0036)	.0147* (.0054)
(1-year lag of first difference of MTC)	.0139 (.0430)	-.0109 (.0154)	.0412* (.0130)	.0082 (.0110)	.0328* (.0167)
FD	-.0034 (.0108)	.0127* (.0031)	.0185* (.0030)	.0031 (.0026)	.0084* (.0034)
FD IV (2SLS) (1-year lag of first difference of MTC)	-.0237 (.0466)	-.0405* (.0132)	-.0285* (.0130)	-.0050 (.0117)	-.0142 (.0159)
(2-year lag of first difference of MTC)	-.0302 (.1092)	-.0770* (.0323)	-.0268 (.0315)	-.0373 (.0274)	.0120 (.0384)
Pennsylvania (BR)					
FE	-.0053 (.0061)	-.0480* (.0022)	-.0158* (.0019)	-.0030 (.0017)	.0111* (.0025)
FE IV (2SLS) (1-year difference of MTC)	.0070 (.0115)	-.0848* (.0041)	-.0510* (.0035)	-.0052 (.0034)	.0093* (.0050)
(1-year lag of first difference of MTC)	.0208 (.0231)	-.0710* (.0082)	-.0023 (.0070)	-.0279* (.0113)	-.0221 (.0172)
FD	.0372* (.0082)	.0028 (.0024)	.0211* (.0022)	.0087* (.0022)	.0336* (.0029)
FD IV (2SLS) (1-year lag of first difference of MTC)	.0289 (.0567)	-.0747* (.0161)	-.1543* (.0158)	.0221 (.0116)	.0599* (.0159)
(2-year lag of first difference of MTC)	.1013 (.1099)	-.1005* (.0325)	-.1446* (.0317)	-.0620 (.0333)	-.0028 (.0467)

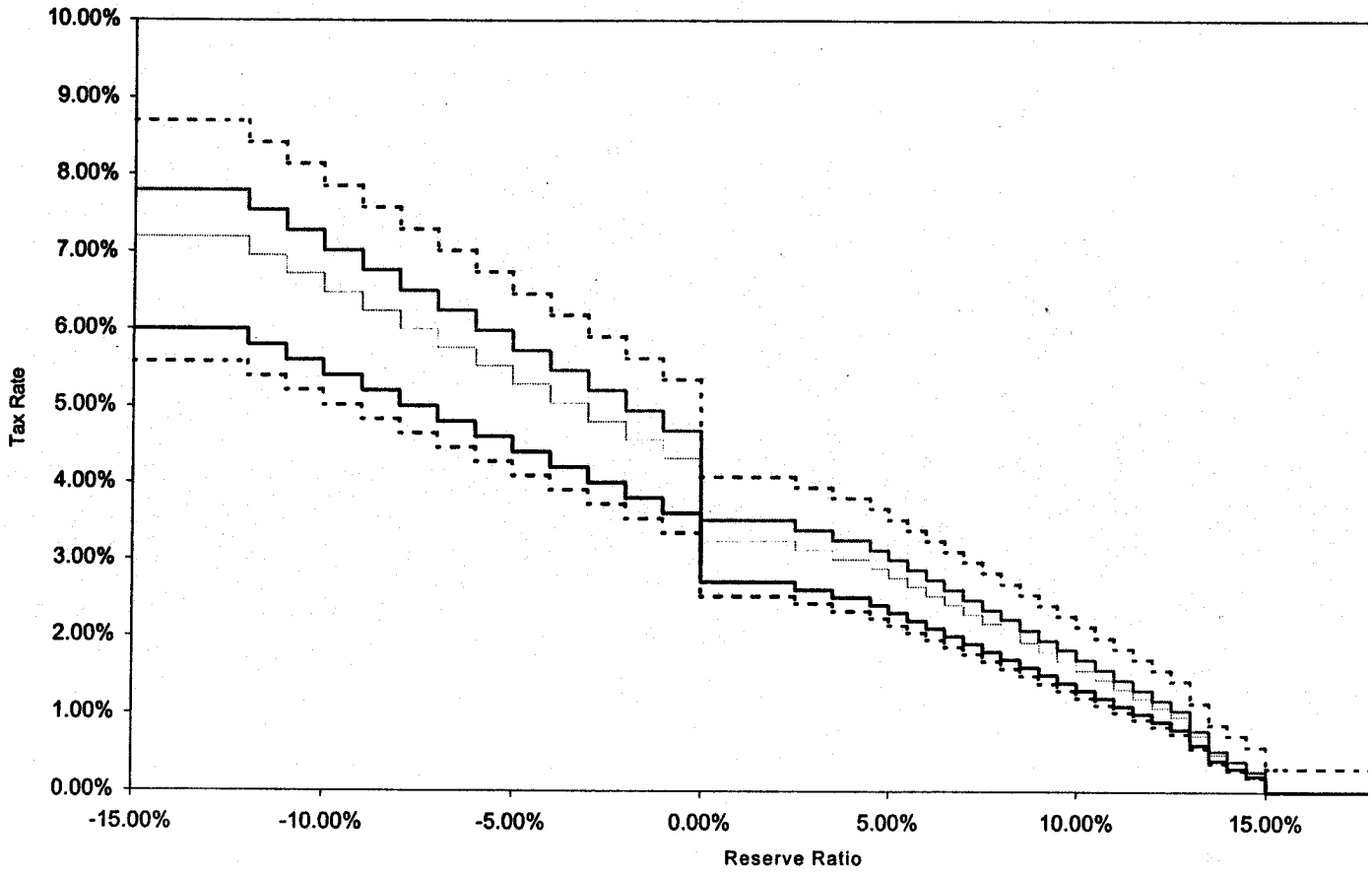
Notes: Estimated coefficients on MTC in models in which each dependent variable is regressed on MTC, reserve ratio (Missouri and Pennsylvania), benefit ratio (Pennsylvania and Washington), average weekly UI benefit amount, log of average annual wages, and the state's taxable wage base. Standard errors in parentheses. Starred estimates have a p-value of .05 or less. Fixed effects estimates are based on 68,120 firm-years of data for Missouri, 46,263 firm-years of data for Washington, and 115,128 firm-years of data for Pennsylvania. Estimates of the first-difference models and fixed effects models with the one-year difference of MTC as an instrument are based on 61,308 firm-years of data for Missouri, 39,654 firm-years of data for Washington, and 102,336 firm-years of data for Pennsylvania. Estimates of the fixed effects models with the one-year lag of the first difference of MTC as the instrument and estimates of the first-difference models that use the one year lag of the first difference of MTC as an instrument are based on 54,496 firm-years of data for Missouri, 33,405 firm-years of data for Washington, and 89,544 firm-years of data for Pennsylvania. First-difference estimates that use the two-year lag of the first-difference of MTC as an instrument are based on 47,684 firm-years of data in Missouri, 26,436 firm-years of data for Washington, and 76,752 firm-years of data for Pennsylvania.

Table 15
Microsimulations of changes in UI payroll tax policy, Missouri (1985-1994), Washington (1989-1995), and Pennsylvania (1986-1994)
(percentage change in outcome variable resulting from specified policy change)

Policy change and state	Outcome Variable: Seasonal variation	Deviation from trend: linear	Deviation from trend: quadratic	Temporary layoffs	Permanent layoffs
Increased experience rating: MTC of all firms below the average MTC of all firms in the state raised to the average of all firms in state					
Missouri	-0.39	-4.68	-1.36	-0.96	+12.10
Washington	-0.98	-1.77	-0.69	+1.83	+4.66
Pennsylvania	-0.56	-5.55	-2.78	-0.23	+6.59
Increased experience rating: MTC of all firms below the average MTC of experience rated firms in the state raised to the average of experience rated firms in state					
Missouri	-0.53	-5.57	-1.66	-0.96	+14.24
Washington	-1.11	-2.06	-0.82	+2.09	+5.22
Pennsylvania	-0.63	-6.00	-2.85	-0.23	+6.59
Full experience rating: MTC of firms with MTC < 1 raised to MTC = 1					
Missouri	-3.00	-16.30	-5.57	+1.32	+39.89
Washington	-0.74	-1.26	-0.44	+1.23	+3.37
Pennsylvania	-0.61	-5.86	-2.83	-0.25	+6.31

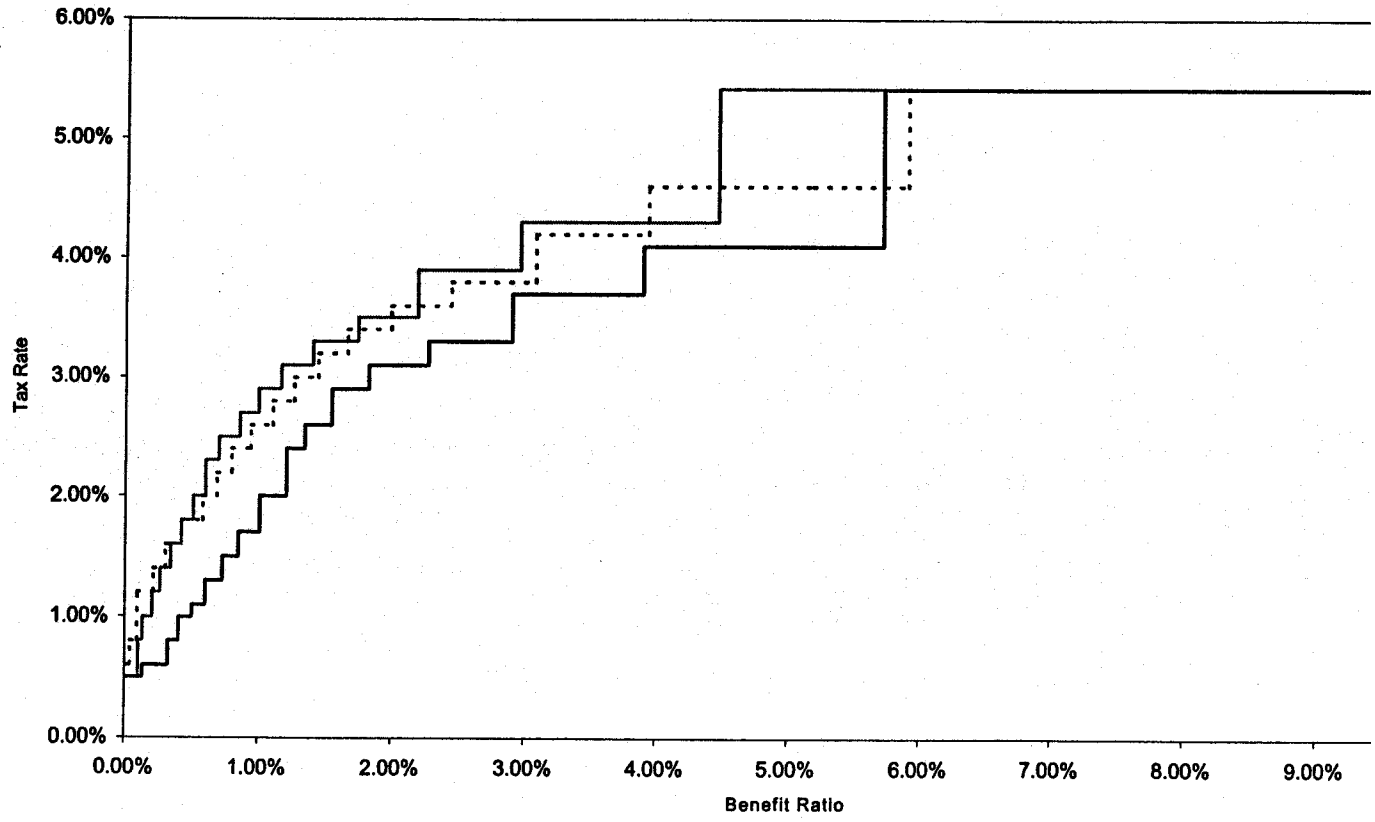
Notes: Micro-simulations based on fixed effects models in which MTC is fully interacted with reserve ratio (Missouri and Pennsylvania) or benefit ratio (Washington) category dummy variables.

Figure 1: Unemployment Insurance Payroll Tax Schedules for Missouri, 1985–1994



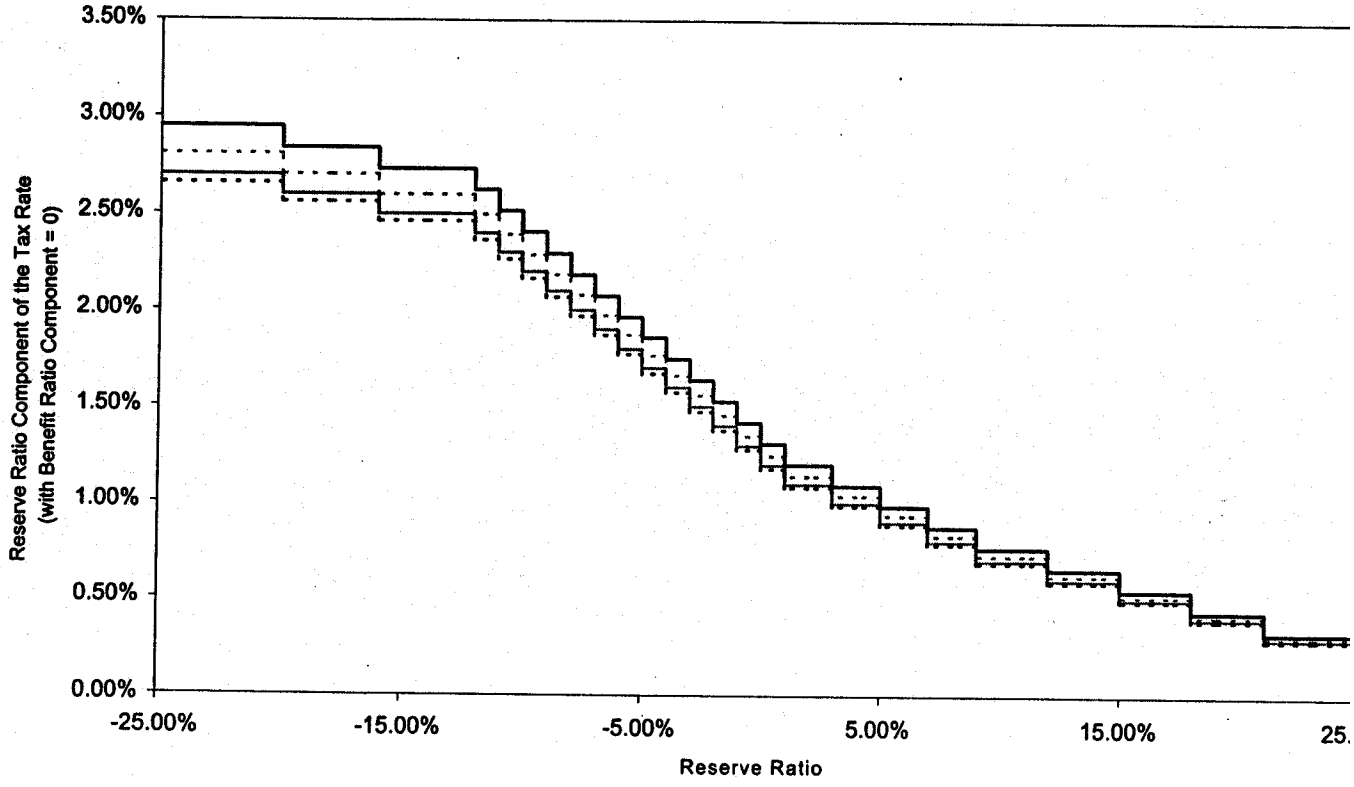
Source: Missouri Department of Labor and Industrial Relations, Division of Employment Security.

Figure 2: Unemployment Insurance Payroll Tax Schedules for Washington, 1989, 1992, 1995



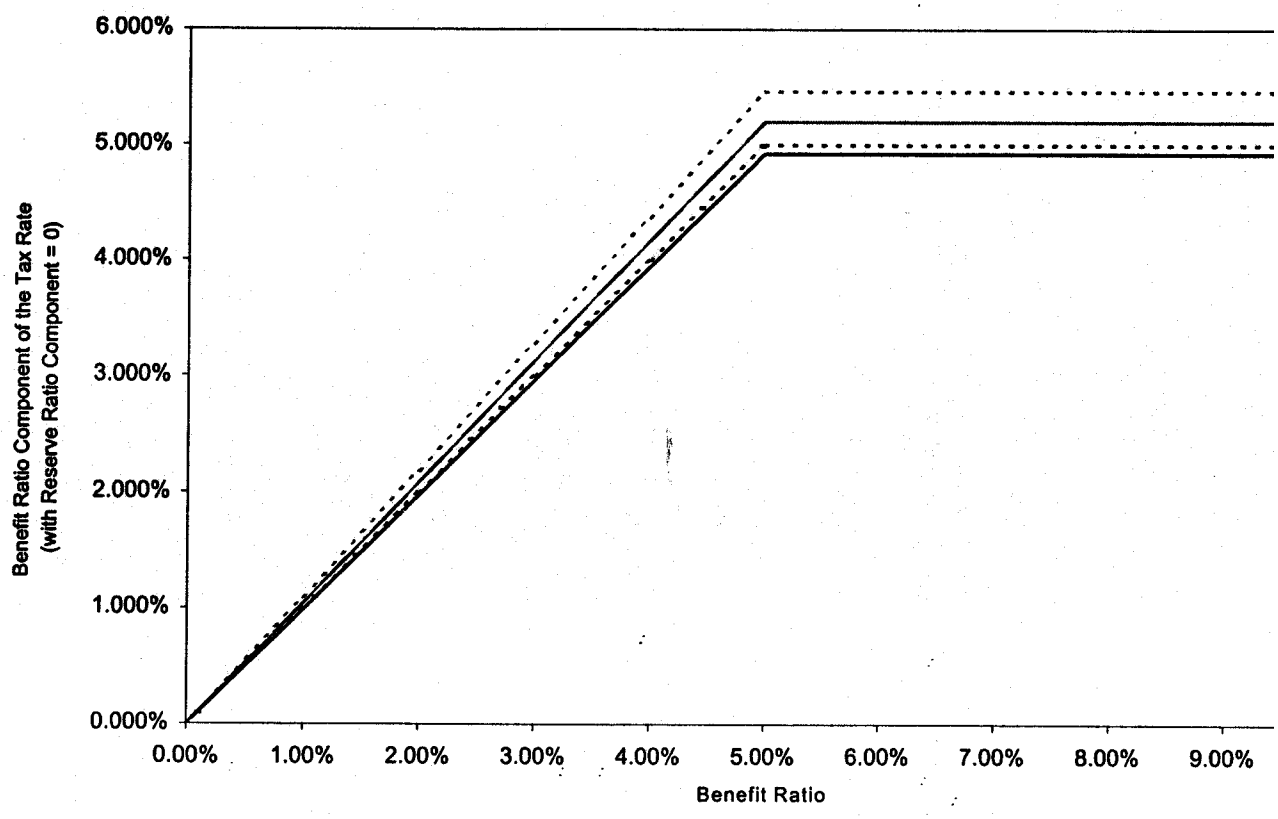
Source: Washington State Unemployment Security Department, Experience Rating System Annual Tax Rate Distributic

Figure 3: Reserve Ratio Component of the Unemployment Insurance Payroll Tax Schedules for Pennsyl



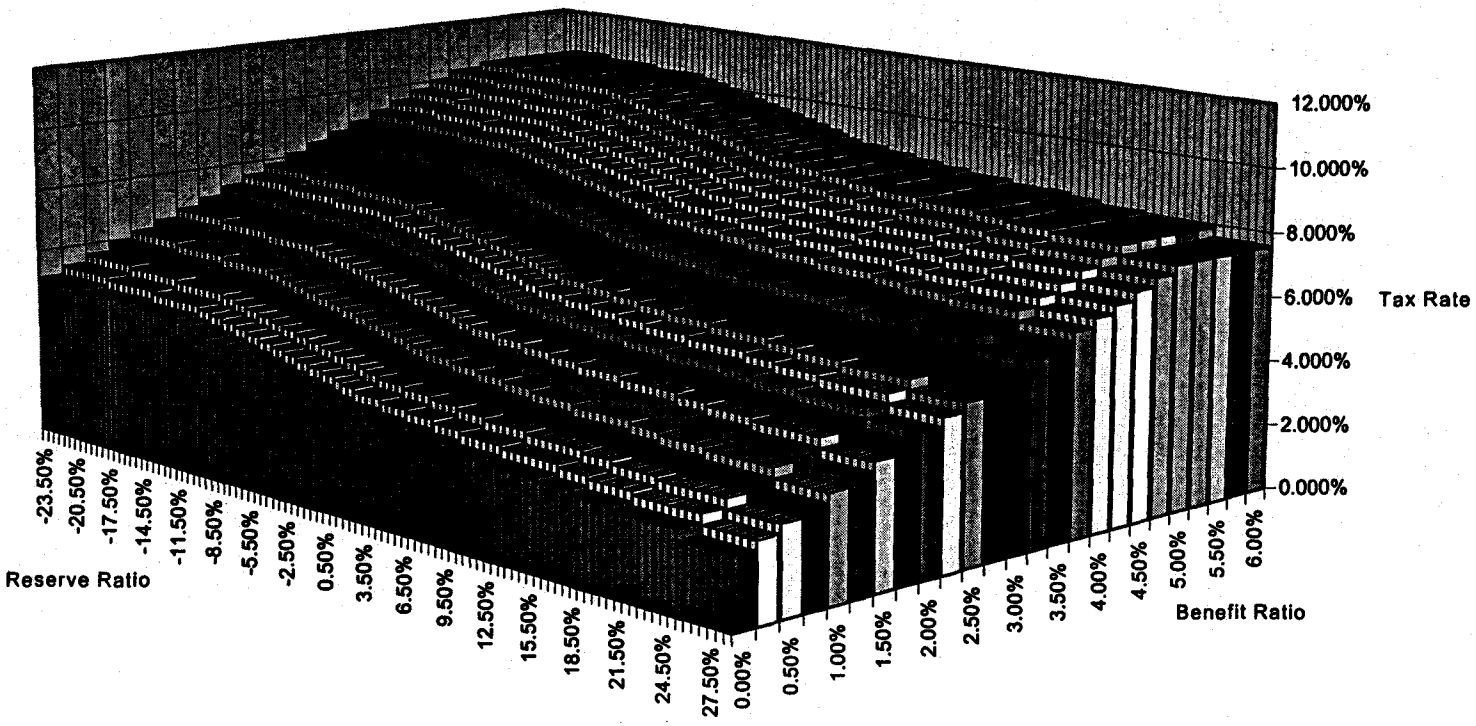
Source: Pennsylvania Department of Labor and Industry, Employment Security, 1992.

Figure 4: Benefit Ratio Component of the Unemployment Insurance Payroll Tax Schedules for Per



Source: Pennsylvania Department of Labor and Industry, Employment Security, 1992.

Figure 5: Unemployment Insurance Tax Schedule for Pennsylvania, 1994



Source: Pennsylvania Department of Labor and Industry, Employment Security, 1992.