Unemployment Insurance and the Diminished Importance of Temporary Layoffs Over the Business Cycle

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Abstract

Recessions in the U.S. have historically featured surges in temporary layoffs as a share of overall unemployment, but this phenomenon was almost entirely absent from the downturns of the early 1990s and 2001. We consider two explanations for the reduced cyclicality of temporary layoffs—lower tax incentives toward their use and lower production volatility in the manufacturing sector. Past studies using data from the 1970s and 1980s have identified imperfect experience rating in state unemployment insurance programs as being responsible for a third to a half of all temporary layoffs. While we document an increase in the average experience rating beginning in the mid-1980s, we find that this explains only a small portion of the decline in the use of temporary layoffs. In contrast, our analysis suggests the pronounced drop in the volatility of manufacturing production in the mid-1980s, particularly in the durables sector, offers a more promising explanation for the observed change in layoff behavior over the recent two business cycles.

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Temporary layoffs have historically been an important mechanism for firms to adjust their labor input over the business cycle.[1] The Bureau of Labor Statistics (BLS) provides tabulations of temporary layoffs as a share of total unemployment starting in 1967, and Figure 1 plots this share through 2003. Prior to the mid-1980s, the share of total unemployment due to temporary layoffs rose significantly during recessions. From the mid-1980s onwards, however, these cyclical surges in temporary layoffs are not a pronounced feature of the data.

To further illustrate this point, Table 1 provides tabulations that compare the average temporary layoff share in expansions and contractions for both the pre- and post-1985 period. We use the NBER dates for each business cycle, but extend recessions by an additional six months to allow for the fact that the share of temporary layoffs tends to stay high for a period of time following the business cycle trough. During expansions temporary layoffs average around 13 percent of total unemployment. This feature of temporary layoffs has not changed over time. During contractions in the pre-1985 period, temporary layoffs averaged 17.6 percent of total unemployment, an increase of 35.4 percent relative to expansions. In contrast, during contractions in the post-1985 period, temporary layoffs averaged 15.1 percent of total unemployment, an increase of only 12.7 percent relative to post-1985 expansions. Over the past two decades, the degree to which firms rely on temporary layoffs during downturns has diminished.

What might account for the smaller role played by temporary layoffs during the last two downturns? Our answer to that question is obtained by wedding two previously distinct lines of inquiry—the older literature on the incentives to use temporary layoffs created by imperfect experience rating in state unemployment insurance (UI) systems, and a considerably newer literature on the increase in the stability of U.S. economic activity starting in the mid-1980s. The literature on the potential subsidy created by UI systems, pioneered by Topel (1983) and Card & Levin (1994), uses data largely from the pre-1985 period to quantify the effects of imperfect experience rating in state UI systems and concludes that this can account for roughly 30 - 50 percent of all temporary layoffs.[2]

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[1] A temporary layoff is an unemployment spell where at the outset there is an expectation that at some point in the future the worker will be recalled by his/her current employer.

[2] By experience rating we mean the extent to which firms are charged for the present value of the UI benefits received by a worker placed on layoff by the firm.

If states have significantly improved their experience rating in the late-1980s and 1990s, then this could potentially explain the pattern of data in Figure 1.

To focus only on the tax incentive for using temporary layoffs, however, would leave one very large stone unturned. The standard deviation of manufacturing industrial production over the period since the mid-1980s is less than half of the standard deviation for the three decades prior to that—for durable manufacturing the standard deviation in the recent period is only a third of what it had been in early years.[3] If the heavy reliance on temporary layoffs was primarily a by-product of large swings in production, then the reduced use of temporary layoffs may be a straightforward consequence of the reduced variability of production, and would not necessarily hinge on (but might be influenced by) a change in the subsidy toward the use of temporary layoffs.

Our findings indicate that very little of the decline in the use of temporary layoffs can be attributed to improvements in experience rating in the state UI programs. While the overall responsiveness of temporary layoffs to the incentives implied by imperfect experience rating has remained unchanged, there have been significant changes within durable manufacturing. Within this sector we find that production workers used to face both a higher incidence of a temporary layoff and a higher sensitivity to the UI incentive than non-production workers. Since 1989, however, both the overall incidence and the sensitivity to the UI incentive have converged toward the levels for non-production workers. This pattern, which is not found in any other industry sector, is consistent with the view that reduced output volatility in durable manufacturing has reduced the need for firms in this sector to use temporary layoffs to manage their labor requirements.

In the next section we review the mechanics of the financing of state UI systems and describe the implicit subsidy to the use of temporary layoffs created when there is imperfect "experience rating" within these systems. In Section 3 we document the changes in manufacturing production volatility, particularly durable manufacturing, and explore the relationship between production and layoffs historically. In Section 4 we use CPS data to test the relative importance of the two hypotheses. Section 5 concludes.

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[3] The decline in manufacturing industrial production volatility is only a part of a more widespread decline in the overall volatility of U.S. economic activity that is the subject of a recent literature. See Kim and Nelson (1999), McConnell and Perez Quiros (2000), Stock and Watson (2002),

2. Experience rating in state UI programs

Unemployment insurance is largely funded at the state level through specific taxes paid by employers in each state.[4] An important feature of these state UI systems is the degree of "experience rating" in the system. The degree of experience rating is typically measured by the marginal tax cost (MTC) to the firm from an additional dollar in UI benefits paid to one of its workers. The MTC is the present value of the additional tax payments by the firm to the state UI system that are triggered by the payout from the state of an additional dollar of UI benefits to a worker from that firm. If the MTC is less than one, then a firm does not bear the full cost of the UI benefits paid to the workers it places on layoff. The subsidy implied by a MTC that is below one creates an incentive for the firm to favor using temporary layoffs over other methods to reduce its labor input during a cyclical downturn.[5]

Calculating the marginal tax cost to a layoff

The two most popular type of UI tax systems are the "benefit-ratio" system, currently used by 11 states, and the "reserve-ratio" system currently used by 27 states. These two systems permit a straightforward calculation of the MTC associated with a layoff.

Consider first the benefit-ratio system.[6] A firm's UI tax rate under a benefit ratio system is a function of the firm's current "benefit ratio." Most states define a firm's benefit ratio as the sum of the UI benefits charged back to the firm over the past 3 years divided by the size of the firm's taxable wage base over those same 3 years.[7] Using the notation from Card and Levine (1994), let μ_t be the firm's insured unemployment rate in

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Ramey and Vine (2002), Kahn McConnell and Perez Quiros (2002), Ahmed, Levin and Wilson (2004), Kim, Nelson and Pigor (2004) and Kahn and McConnell (2005) among others.

[4] There is a Federal UI program that extends the duration of unemployment benefit payments by an additional 12 weeks in states suffering from high unemployment rates. This program is funded by a separate Federal tax.

[5] For example, workers on reduced hours do not qualify to UI benefits.

[6] Details of the MTC calculations can be found in Topel (1983, 1984, 1985, 1990) and Card and Levine (1992, 1994).

[7] Indiana and Michigan calculate a firm's benefit ratio using up to 5 years of data, while Utah and Virginia use of to 4 years of data.

year t, N_t the firm's employment level, B_t the average UI benefit, α the fraction of UI benefits paid to a firm's workers that are charged back to the firm, and W_t the taxable wage base for that state and year.[8] Using this notation, the UI benefits charged back to a firm in a given year are $\alpha B_t \mu_t N_t$. The firm's benefit ratio (BR_t) is given by

$$BR_t = \frac{\sum_{i=1}^{3} \alpha B_{t-i} \mu_{t-i} N_{t-i}}{\sum_{j=1}^{3} W_{t-j} N_{t-j}} \tag{1}$$

Let the state's UI tax schedule be given by $\tau_t = \psi_t + \lambda_t BR_t$, with a minimum and maximum tax rate of $\tau_{\min}$ and $\tau_{\max}$. Firms with very low and very high benefit ratios are charged the minimum and maximum tax rates respectively, while firms with intermediate benefit ratios are assigned a tax rate that varies with their benefit ratio to a degree that depends on the slope of the state's tax schedule, λ_t.

If the firm's employment level and all of the parameters of the state's UI tax system remain constant through time, then we can define the firm's steady-state UI tax rate, τ^s, in terms of its steady-state insured unemployment rate, μ^s.

$$\tau^s = \psi + \lambda \left(\frac{\alpha B}{W} \right) \mu^s \quad , \tag{2}$$

for steady-state unemployment rates where $\tau_{\min} < \tau^s < \tau_{\max}$. The firm's steady-state UI tax rate depends not only on the parameters of the state tax schedule, but also on the ratio of the charged benefits to the taxable wage base in the state.

We can now calculate the implied MTC for a benefit ratio UI system. Consider first the simple case where there is no time variation in any of the parameters of the firm's benefit ratio or in the states tax schedule. In this case, an additional UI benefit

[8] In 2002, approximately 93 percent of paid benefits are charged back to firms. States assess UI taxes to a firm on workers wages only up to the taxable wage base. The UI tax rate is zero for wages that exceed the taxable wage base.

dollar paid this year (and charged back to the firm) will increase the firm's benefit ratio by $1/3WN$ in each of the next three years, resulting in an increase in the tax rate assessed to the firm of $\lambda/3WN$ over this 3 year window.[9] This higher tax rate increases the firm's annual UI taxes by $\lambda/3$ in each year. Ignoring discounting for the moment, the firm's overall UI taxes will increase by λ as a result of the extra UI benefit dollar paid to one of its workers. In this simple example, if λ equals one, then the firm pays back over time the full value of the UI benefits paid to its workers on layoff. To summarize, the MTC depends on the firm's steady-state unemployment rate, the state's tax schedule, and the ratio of charged benefits to the taxable wage base. This case is illustrated in Figure 2.

The more general expression for a firm's MTC allows for trends in the state's taxable wage base and the firm's employment level, as well as takes into account discounting given that benefits are paid in the current year while the UI taxes are collected over the following three years.[10]

(3) $$MTC = \frac{\alpha\lambda(1+\pi)^2(1+g)^2}{3}\left[\frac{1-(1+i)^{-3}}{i}\right],$$

where π is the growth rate in the state's taxable wage base, g is the growth rate in the firm's employment level, and i is the real discount rate.

In a state using the reserve ratio system, each firm has a UI account established with the state. This account tracks the firms "reserves" (RES_t) which are defined as the difference between UI taxes paid into the account less UI benefits paid out of the account. The firm's reserve ratio (r_t) is the ratio of the firm's reserves to a 3 year average of its taxable wage base.

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

[9] This expression assumes that the firm's current benefit ratio does not place it at either the minimum or maximum tax rate. For firms with benefit ratios that put them at the minimum or maximum tax rates, the MTC is zero.

The UI tax assigned to a firm is a declining function of the firm's reserve ratio in that year. Most reserve ratio tax schedules consist of step functions mapping intervals of reserve ratios into specific tax rates.

Again, consider the MTC in a simple steady state where the firm's employment as well as all of the parameters of the UI system remain constant through time. If at this steady state the firm's reserves are either increasing or decreasing, then the firm's reserve ratio will drive its MTC to zero by moving its UI tax rate to either the state maximum or minimum. A positive MTC can only occur in this simple steady state if the firm's reserves are constant. This implies that each additional dollar of UI benefit that is paid out must trigger an additional dollar of undiscounted tax payments to be paid over the ensuing three years. The implication, then, is that the MTC (which takes discounting into consideration) must be less than one. That is, in this simple steady state calculation reserve ratio tax systems must involve a degree of imperfect experience rating.

The general MTC expression for a reserve ratio tax system can be approximated as follows.

$$MTC = \frac{\alpha(1+\pi)^2(1+g)^2\xi}{i+(1+\pi)^2(1+g)^2\xi} \quad , \tag{5}$$

where ξ is the slope of a local linear spline approximation to the states tax schedule.

Estimating UI marginal tax costs over time

As discussed in the introduction, one possible explanation for the decline in the use of temporary layoffs during the last two recessions is that states may have made efforts to improve the experience rating in their UI tax systems. Assessing this explanation requires that we calculate the time path of the MTC for states using the benefit ratio and the reserve ratio systems. Details of the data construction are presented in the data appendix.

[10] See Card and Levine (1992) for details of the derivation of equation (3) and (5).

Before turning to a description of the MTC estimates, it is useful to get a feel for the values of the underlying MTC parameters. In 2002, we have 11 benefit ratio states in our sample and 27 reserve ratio states. Using 2002 data, the average charge rate for UI benefits (α) is 90% unweighted and 92% when weighted by total benefits paid. The taxable wage base (W) in 2002 ranges from a low of $7,000 in eleven states to a high of $29,300 in Hawaii. The unweighted average taxable wage base is $11,068 while the benefit weighted average is $10,445.

Card and Levine calculate the MTC for a state/industry using sample averages (across all years of their sample) of the parameter values. They also average the tax rate schedules for each state over their full sample period. We follow a slightly different approach. We take nine year centered averages of all of the parameters of the MTC. Given these parameter values, we evaluate the MTC for each industry/state using the current state UI tax schedule and the tax schedules for the next two years. We then take a simple average of these three MTC estimates. This approach assumes that firms take account of trends in the MTC parameters and that firms anticipate changes to the state UI tax rates over the business cycle.

We show the overall average MTC from 1979 to 2002 in Figure 3. The overall average is a weighted average of the state/industry-specific MTC estimates where the weights reflect the relative employment in that state/industry group.[11] At the end of the 1970s, the average MTC was quite low with the overall average just under 0.65. This implies that in 1979 firms on average faced a 35 percent state subsidy on every dollar of UI benefits paid out to their workers on layoff. Following the sharp employment recession of the early 1980s, the average MTC rose sharply as states attempted to restore funding to their UI programs.[12] The average MTC increased throughout the 1980s peaking at just under 0.76 in 1988. As a result of this refunding effort, at the outset of the recession of the early 1990s firms faced less of an incentive to using temporary layoffs. The average MTC remained relatively constant throughout the long expansion of the 1990s and into the most current recession. We will evaluate later in the paper the degree

[11] The employment weights are based on the outgoing rotation group from the Current Population Survey.
[12] See Vroman (2005) for details.

to which this can account for the reduced reliance on temporary layoffs during the recent two recessions.

Movements in the overall average MTC reflect both changes in the fraction of state/industry groups that face a zero MTC, and changes in the average MTC among state/industry groups that face a positive MTC. Figure 3 disaggregates the overall average MTC into these two components. There was a sharp decline in the 1980s in the fraction of workers assigned to state/industry groups that faced a zero MTC. There was also a modest rise in the conditional MTC. However, the decline in the prevalence of zero MTC accounts for roughly 72 percent of the rise in the average MTC from 1980 to 1988.[13]

The average MTC can also change over time as the composition of employment shifts in the labor market. For example, the construction industry has the lowest average MTC of the five broad industry groups in the data. If the fraction of workers in the labor market that are employed in construction is falling over time, this will shift up the average MTC. To evaluate this possibility, we include in Figure 3 a "fixed weight average" MTC that holds the industry composition constant at the 1979 values. Comparing the overall average to the fixed weight average illustrates that most of the variation across time in the overall average MTC has not being driven by changes in the composition of employment in the labor force.

The sharp decline in the fraction of state/industry groups facing a zero MTC reflects decisions by states to raise their maximum and/or lower their minimum UI tax rates during this period. The distribution of these maximum and minimum UI tax rates are shown in Figure 4. Note that each state/industry maximum/minimum tax rate in a year is weighted by the number of workers in that state/industry cell in that year. The entire distribution of maximum tax rates shifted upward in the first half of the 1980s. For example, the median maximum tax rate went from slightly over 4 percent in 1979 to around 5.5 percent by 1985. From the mid-1980s onward, the distribution of maximum tax rates remained relatively stable. The most pronounced declines in minimum tax rates took place at the upper end of the distribution. Minimum taxes at the 90th percentile fell

[13] Let S_{t1} (S_{t0}) denote the fraction of zero MTC in time period t_1 (t_0) and MTC^c_{t1} (MTC^c_{t1}) denote the average MTC in time period t_1 (t_0) conditional on the MTC being positive. Then one decomposition of the change in the MTC is given by: $MTC_{t1} - MTC_{t0} = MTC^c_{t0}*(S_{t0} - S_{t1}) + (1 - S_{t1})*(MTC^c_{t1} - MTC^c_{t0})$.

from over 2.5 in 1982 to around 1.25 in 1986. In contrast to the distribution of maximum tax rates, there is evidence of upward shifts in the distribution of minimum tax rates in the early 1990s.

The data do indicate, then, that one likely factor contributing to a diminished use of temporary layoffs over the last two recessions was that firms on average faced a higher MTC for placing a worker on a temporary layoff. Later in the paper, we will investigate the magnitude of the decline in the use of temporary layoffs implied by this rise in the average MTC. In addition, we will explore the extent to which firms may also have changed how they responded to any given subsidy in the UI system. In the next section, we provide background on why firms may have changed how they respond to the UI subsidy. We detail in this section the decline in production volatility in manufacturing and its link to the use of temporary layoffs.

3. Temporary Layoffs and Production Volatility in Manufacturing

The absence of pronounced surges in temporary layoffs in the last two decades can be better understood by decomposing the data by sector, as plotted in Figure 5. The share of manufacturing layoffs has diminished markedly, most notably during recessions. While this fact can explain the lack of aggregate surges, it doesn't explain why there are fewer manufacturing layoffs. Do firms in that sector now use different methods to adjust their labor input in response to production conditions, for example permanent layoffs or temporary help workers? Or instead, do firms now simply make fewer large employment adjustments because production conditions are more stable?

In this section, we argue that much of the diminished use of temporary layoffs may be a consequence of a significantly reduced need to make layoffs, and this is in turn a consequence of significantly more stable production. We argue that this phenomenon is most pronounced in the durable manufacturing sector, a finding that is consistent with one of the main explanations from the literature on the aggregate volatility decline—namely that changes in production technology and inventory management in the durables sector have contributed importantly to the overall reduction in output volatility.[14]

[14] Kahn and McConnell (2005), Kahn, McConnell and Perez Quiros (2002) and McConnell and Perez Quiros (2000) argue that changes in production and inventory behavior in the durable

As a simple illustration of the potential importance of the drop in production volatility, we modify Figure 1 by adding monthly observations on durable industrial production (IP) growth for months in which this growth was *below* −10%. We plot this in Figure 6. Two observations are immediately apparent. First, large (defined here as below −10.0%) drops in industrial production in the narrow sector of durable manufacturing look to be a fairly reliable predictor of large spikes in the temporary layoff share. Second, there are simply far fewer "big" drops in durable IP over the last twenty years, and those that do occur are on average about half the size of the drops we witnessed in the period from 1967 to 1983.[15] These two observations prompt us to look more closely at the behavior of production in this sector as a potential explanation for the changed behavior of layoffs.

The Decline in Production Volatility

While there is much debate over the sources and breadth of the decline in the volatility of aggregate U.S. real activity, there is little disagreement that the most pronounced drop in volatility occurred in the goods sector, a component of which is the manufacturing sector. Within the goods sector, the durable goods sector has experienced the largest drop in volatility. To explore the link between production per se and the use of layoffs, we will use manufacturing IP data as produced by the Federal Reserve Board.

The easiest way to see the drop in production volatility is to compare histograms of IP growth over the post-war period, splitting the sample after the end of early 1980s recession. Figure 7 shows nonparametric estimates of the distributions for monthly manufacturing IP.[16] The top panel shows the period from 1954 to 1983 and the bottom

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goods sector contribute importantly to the aggregate decline, though there are a number of views on this issue that do not emphasize this mechanism. For a discussion of the sources of the aggregate decline, see also Ahmed, Levin and Wilson (2004), Kim, Nelson and Pigor (2004), Irvine and Schuh (2005), Stock and Watson (2002).

[15] We show data beginning in 1967 only because we are limited by the availability of data on temporary layoffs. If we were to extend the durables industrial production series back to 1947 we would see that these large spikes were at least as typical in those years as they were from 1967 to 1983.

[16] The distributions shown here are calculated directly off the monthly growth rate of industrial production, rather than off the residuals from a correctly specified model of the mean growth rate. Hence these plots cannot be interpreted as showing the distribution of shocks to industrial production. We use a kernel estimator to compute the distribution graphs. Details of the

panel the period from 1984 to 2004. We break the sample in 1984 following the literature on the decline in aggregate activity, though the results would be largely unchanged if we used a break later in the 1980s. The lighter shading in each panel indicates values on the horizontal axis of less than –10% (the threshold used in the construction of Figure 6 above), and the darker shaded region marks values of –20% or lower. In the early sample, nearly 13% of monthly manufacturing growth rates were below –10%, and just over 5% were less than – 20%. In the later sample, in contrast, just under 3% of monthly growth rates were less than 10%, and none were below –20%! The virtual disappearance of extreme contractions in IP may simply necessitate fewer layoffs, temporary or otherwise.

Does the drop in the variance of IP growth only reflect more mild recessions, or has there also been a drop in the magnitude of short-run adjustments to production (those that are uncorrelated with the overall state of the business cycle)? Decomposing IP growth into business cycle frequency (18 to 96 months) fluctuations and high frequency (2-18 months) fluctuations gives us some insight into this. Figure 8 plots these distributions. While 10.1% of business cycle fluctuations were below –10% in the early sample, none were that severe in the later sample. A substantial contraction in high frequency fluctuations is evident as well. Thus it appears that reduced variance is a feature of production at both the high and business cycle frequencies.

To show how production volatility has changed across manufacturing industries, the top panel of Table 2 reports the standard deviation of IP for quarterly growth rates and both the high and business cycle frequencies for aggregate as well as durable and nondurable manufacturing. The reduction in volatility is apparent in both sub-sectors and at all frequencies. However, there are a few details worth pointing out. First, the drop in volatility is larger for durables than for nondurables—in fact, the standard deviation of durables IP growth in the early sample is nearly three times as large as in the later period, while the drop in the standard deviation of nondurables IP is less than half. The standard deviations by frequency provide insight into the source of the differences between the two sectors. In particular, while the drop in the business cycle frequency is comparable across sectors (though larger for durables), the drop at the high frequency end is

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estimation method are available in an appendix, and the results are robust to a variety of estimation methods.

substantially greater for durables—the standard deviation in the first period is 2.8 times larger than in the later period for durables, and only 1.6 times larger for nondurables.[17]

The Relationship between Production Volatility and Temporary Layoffs

If greater production stability in manufacturing is the reason for the diminished use of temporary layoffs, then we should find that the relationship between manufacturing production and the temporary layoff share has weakened, as other sectors now contribute proportionately more to the overall layoff rate. We might also suspect, however, that there should be some relationship between production and layoffs *within* an industry even in the last two decades for the reason that while substantial drops in production are much less likely to occur, they still might trigger layoffs when they do occur.

Table 3 reports the correlations of the temporary layoff share (as used in Figures 1 and 6) with IP by sector, and the correlation of industry layoff rates (computed as new flows into temporary layoff as a share of total employment in that sector) with sector IP.[18] In all cases the estimated correlations are of the expected sign (a drop in IP leads to an increase in the temporary layoff share) or are zero. We see that there has indeed been some decline in the relationship between the temporary layoff share and IP, most notably for durables IP. Turning now to the relationships *within* an industry, the correlation between durables IP and durables layoffs does not drop off as markedly in the second sub-sample, suggesting that some relationship still exists. There does not seem to be a close relationship between IP and layoffs in the non-durable sector.

[17] We also computed the sub-sample standard deviations for 2-digit durable manufacturing industries and found that each of these experience a drop in volatility as well.
[18] Because our industry layoff data begins in 1979, the early sample correlations for the within industry correlations is 12 years shorter than the sample used to compute correlations with the aggregate layoff rate and thus the early sample correlations are not directly comparable.

Digression: BLS Data on Employment By Type of Worker

In our estimation in the next section, we use information on whether an individual in the CPS sample is a production worker as a means of identifying the effects of production volatility on the incidence of layoffs and the sensitivity to changes in the marginal tax cost of a layoff. Before turning to the estimation, we briefly motivate this empirical strategy by showing that the behavior of "production" employment is very closely related to IP, and that the variance of production employment contracted in the early 1980s, at the same time that IP stabilized.[19]

The drop in the relative variance of production to non-production employment can be seen by comparing the business cycle component of each employment measure for the durables sector, as shown in Figure 9. From the early 1980s forward, the two series simply do not diverge as extremely as in the earlier sample, and this convergence is brought about by a notable contraction in the variation of production employment. A plot of the high frequency component would tell the same story.

To quantify the differing sensitivities of the two types of employment to IP, Table 4 reports their correlations with IP. Growth in production employment is generally quite highly correlated with IP, and this correlation is strongest for the durable goods sector in the early period. The correlation between IP growth and non-production employment is considerably lower than for production employment, though it actually rises slightly in the later period. At the business cycle frequency both types of durables employment are highly correlated with IP. At higher frequencies, however there is virtually no correlation between non-production employment and durables IP, while the correlation between IP and production employment remains high.

These results are intuitively appealing. If short-run production adjustments (as captured by the high frequency component) take the form of reducing a shift or eliminating a line rather than closing an entire plant or operation, we might expect very little effect on non-production employment and a very large effect on production employment, and this is in fact what our correlations suggest. On the other hand, business cycle adjustments might entail the closure of a plant and hence might encompass broader

[19] The Bureau of Labor Statistics includes in its monthly employment report a count of "production" workers by sector. To compute non-production workers we subtract this count from the aggregate.

measures of activity such as support and management, thus strengthening the relationship of production with non-production employment at this frequency. The results for the non-durables sector are qualitatively unchanged, but the relationship between production workers and IP even at the high frequencies is weaker than it is for durables.

If production employment is most closely related to IP, then declines in the ratio of production to non-production workers should be related to surges in temporary layoffs in the same way that declines in IP are. To check this, we compute ratio of production employment (P) to non-production employment (N), fit a trend and take deviations of the actual from the trend, and call this (P/N).[20] We report the correlations between (P/N) and aggregate and industry layoff rates in Table 3. The results indicate that (P/N) for both sectors was highly related to the temporary layoff share (an implication of which is that production workers were disproportionately put on temporary layoff) in the early period, but that this relationship weakened substantially in the later period. Finally, there is some evidence that P/N and layoffs within durables are still correlated in the second sub-sample.

4. Estimating the Firm's Layoff Decision

In this section we turn to the micro data to investigate the extent to which the diminished cyclicality of temporary layoffs is due to improved experienced rating in state UI systems, or an overall reduced need to make layoffs based on lower production volatility. We begin by estimating the impact that imperfect experience rating has on the firm's decision to put a worker on temporary layoff. To do this we use data on workers drawn from the Current Population Survey (CPS) outgoing rotation group (ORG) files from 1979 to 2002.[21] Following Card and Levine (1994) we select individuals in the labor force age 16 and older who report as their current or previous industry either construction, durable manufacturing, nondurable manufacturing, trade or services. We use the individual's broad industry and state of residence to merge in the appropriate MTC.

[20] We estimate the trend using a Hodrick Prescott Filter.

[21] In the CPS a household is interviewed for four months, exits the survey for eight months, and then is reinterviewed for four months. The outgoing rotation groups in any month consist of those

Descriptive statistics on this sample is provided in Table 5. The overall sample is large with over 2.3 million observations. The average potential work experience in the sample is 18 years. Nearly 22 percent of the sample consists of young workers between 16-24 years old. The average education is 12.7 years of schooling. Females represent around 47 percent of the sample and nonwhites 14 percent of the sample.

The distribution of the sample across the five broad industry groups is given in the top row of Table 5. Trade and services account for the employment of 65 percent of the individuals. Manufacturing jobs make up for 27 percent of the total with the durable goods industries comprising 57 percent of overall manufacturing employment. The construction industry which faces the lowest average MTC makes up nearly 8 percent of the sample.

The bottom of Table 5 displays three different unemployment rates for the overall sample and disaggregated by broad industry. We focus on temporary layoffs, permanent layoffs and a third category consisting of quits and new entrants. Theory suggests that MTC considerations should have the strongest effect on a firm's decision to place a worker on temporary layoff. At the other end of the spectrum, the MTC should not significantly affect the decision by a worker to quit a job or to reenter the labor market.[22] While the overall incidence of temporary unemployment is 1.1 percent, it varies from a high of 3.8 percent in construction to a low of 0.5 percent in trade and services.

There are a variety of forms of measurement error that will tend to attenuate the estimated effects of our MTC variable on unemployment rates. As discussed earlier, ideally we would like to calculate the MTC using the insured unemployment rate for the worker's firm. However, the identity of the firm is not provided in the CPS data and so we have to use an estimate of the average insured unemployment rate in that state for the firm's industry. As we discussed earlier, state-specific insured unemployment rates are only available for broad industry groups. Similarly, we have to assume that each worker placed on temporary or permanent layoff is eligible to receive UI benefits. The CPS ORG

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households on their fourth and eight interviews. The advantage of the ORG data is that it provides a large sample of workers with interviews evenly distributed over the calendar months.

[22] Workers who quit their job or who reenter the labor force and are unemployed while they search for a job are not eligible to receive UI benefits in most states.

files do not contain enough information on the worker's earnings history to verify this eligibility.

The impact of the MTC measure on the incidence of each type of unemployment is given in Table 6. Specifications (1), (3) and (5) report linear probability estimates where we constrain the unemployment response to the MTC to be constant across industries and time. Each specification focuses on a different type of unemployment. Specifications (2), (4) and (6) allow the MTC response to vary between the pre- and post-1989 period.[23] All of the specifications control for a worker's potential work experience, and indicators for whether the worker is young, female or non-white. In addition, we control for state, industry, occupation and year effects.

The MTC has a significant effect on temporary and permanent layoffs and no effect on quits and reentrants. The estimates indicate that increasing the MTC from 0.71 (the sample average) to 1 would reduce the temporary layoff rate by 0.39 percentage points, a 35 percent reduction. This is nearly identical to the estimate produced by Card & Levine (1994).[24] Similarly, moving all state UI tax systems to complete experience rating is estimated to reduce the permanent layoff rate by 0.20 percentage points, a 7 percent reduction. The data indicate no impact of the MTC on the incidence of "other" unemployment. This lines up with the prediction from the literature that imperfect experience rating should have the strongest effect on temporary layoffs, followed by permanent layoffs, and no effect on other types of unemployment. Finally, during the post-1989 period there is no evidence of an overall diminished response by firms to the MTC incentive to use temporary layoffs. The data does indicate that the impact of the MTC on the firm's decision to put a worker on permanent layoff diminished by around a third.

We can use these estimates to assess the role that improved experience rating played in the diminished use of temporary layoffs during the recession of the early 1990s

[23] We use 1989 rather than 1985 to split the micro sample since the CPS ORG data only begins in 1979.

[24] Card and Levine's (1994) estimated impact for the MTC on temporary layoffs of –1.59 (Table 2 column 4) implies that the UI subsidy accounts for 36% of temporary layoffs. Our MTC estimate for temporary layoffs for the 1979-1987 period is slightly lower, –1.35. When we substitute Card and Levine's methodology for calculating the MTC measure for our own, we get an estimate of –1.57. Our sample size for 1979-1987 is 868,512 as compared to their half sample of 187,598.

as compared to the recession of the early 1980s. The temporary layoff rate in 1982 was 2.2 percent and in 1991 was only 1.3 percent. The average MTC was nearly 4 percentage points higher in 1991 as compared to 1982. Using the overall estimate of the response of temporary layoffs to the MTC from specification (1) of Table 6, this increase in the average MTC would explain only about 6 percent of the nearly 1 percentage point decline in the temporary layoff rate.[25] So, the improvement in experience rating from the 1980s to the 1990s can help explain only a small portion of the change in the overall use of temporary layoffs.

We explore these incentive effects in more detail in Table 7 where we disaggregate the temporary layoff results in Table 6 by each of the five major industry groups. The first line in Table 4 indicates that only construction and manufacturing (durable and nondurable) show a significant response of temporary layoffs to imperfect experience rating. Trade and services both have insignificant coefficients associated with the MTC variable. Looking at the pre- and post-1989 results indicates that in the later half of our sample the coefficient on MTC in durable manufacturing declined in absolute value by 1.5, a 55 percent reduction from its pre-1989 value. In contrast, the MTC coefficient in construction increased slightly over the two time periods.

Card and Levine (1994) present a model that generates the prediction that the response by firms to the MTC should be stronger during contractions. To explore this prediction as well as any changes in the cyclical sensitivity of temporary layoffs over time, we reestimated the empirical specifications shown in specification (1) of Table 6 allowing the coefficient on the MTC for each industry to vary by year. Rather than present these results in a table, we present them visually in Figure 10.

The results indicate that both construction and durable manufacturing displayed a very cyclical pattern in their response to the MTC during the early 1980s contraction. This same cyclical pattern is repeated in the construction industry during the early 1990s contraction. In sharp contrast, durable manufacturing displays no cyclical sensitivity to the MTC during the early 1990s. Looking at the most recent contraction, both

[25] Repeating the calculations for permanent layoffs, we find that the increase in the average MTC would explain less than 3 percent of the 1 percentage point drop in the permanent layoff rate.

construction and durable manufacturing show a slight cyclical response, but one that is significantly diminished from the early 1980s.

Does the reduced cyclical response to the MTC for durable manufacturing in the early 1990s reflect a change in behavioral response by firms, or a change in the cyclical behavior of durable manufacturing output during this cycle? The analysis in Section 3 highlighted the link between industrial production growth and employment of production workers, particularly in the durable manufacturing sector. This link provides us with a method by which we can more explicitly control for the effects of reduced production volatility in our assessment of the impact of changes in the marginal tax cost. In particular, if the underlying behavior of production has changed over the period in which we are interested, we can isolate the effects of the production change by comparing the relative responses to the MTC for production and non-production workers. We explore this possibility in Table 8 where we drop the major occupation controls from our baseline empirical specification and include an indicator for production workers.[26] While our focus is on durable manufacturing, the table displays results for each of the five major industry groups for comparison.

The first two rows of the table indicate the differences in average temporary layoff rates for production workers as compared to non-production workers. Production workers in durable manufacturing faced a 2.7 percentage point higher temporary layoff rate (as compared to non-production workers) in the pre-1989 period. This differential incidence of temporary layoffs declines significantly in the post-1989 period to 0.4 percentage points. Lines 3 and 4 indicate the responsiveness of temporary layoffs to the UI incentive as given by the MTC. In the pre-1989 period, the response by firms in durable manufacturing to the MTC was twice as high for production workers as compared to non-production workers. However, in the post-1989 period this differential responsiveness to the UI incentive disappears. The bottom two rows of the table display the difference in the MTC responses for each period. This differential is large and statistically significant in the earlier period, and is small and not statistically different from zero in the later period.

The evidence in Table 8 indicates that durable manufacturing firms in the pre-1989 period, despite facing the same UI incentives for both types of workers, were more likely to place production workers on temporary layoff than they were non-production workers, and would respond to changes in the MTC more aggressively for production workers than for non-production workers.

However, in post-1989 durable manufacturing firms show a much less pronounced propensity to layoff production workers over non-production workers, and also display no differential responsiveness in the layoff rates across worker type to a given change in the MTC. This pattern of convergence in the behavior of production and non-production workers in durable manufacturing is consistent with the drop in production volatility in this sector, and it is not observed in any of the other four major industry groups.

To check for the possibility that durable manufacturing firms during the past two contractions were substituting permanent layoffs for temporary layoffs, we repeated the estimation in Table 8 using permanent layoffs as the dependent variable. The substitution hypothesis would predict that the differential in permanent layoff rates for production and non-production workers should have widened and that the permanent layoff response for production workers to the UI incentive should have strengthened over time. In results not reported, the data indicate the opposite. The differential permanent layoff rate between production and non-production workers declines significantly between the two time periods. The response by firms to the MTC on permanent layoffs of production workers does not change over time.

Conclusion

Temporary layoffs used to be an important form of labor adjustment during recessions. Prior to the mid-1980s, the temporary layoff share of overall unemployment would typically rise by over 4.5 percentage points during a recession. Since the mid-1980s, the temporary layoff share has risen by less than 2 percentage points during a recession. We have examined the role of the unemployment insurance system in helping

[26] We code an individual as a production worker if his occupation classification is in the *Precision Production, Craft and Repair Occupations or Operators, Fabricators and Laborers* (1983 – 2002); and *Craft and Kindred Workers or Operatives, except Transport* (1979 – 1982).

to explain the reduced cyclical sensitivity of temporary layoffs. While states did improve the experience rating of their UI programs following the recession of the early 1980s, this can explain only a small amount of the decline in the use of temporary layoffs.

Coincident with the decline in the temporary layoff share during recessions was a reduction in the volatility of production in the manufacturing sector. This reduced volatility is evident at both the business cycle frequency and at higher frequencies. The periodic large cuts in durable IP growth that generally coincided with surges in the temporary layoff share in the pre-1989 period have simply not been a feature of the economic landscape over the past two decades.

Using micro data from the CPS ORG we show that there has been a significant decline in the response by firms in durable manufacturing to the UI MTC associated with a temporary layoff. This decline is concentrated among production workers in durable manufacturing, and is not evident for non-production workers. Our findings are consistent with the hypothesis that production in durable manufacturing is less volatile in the recent period and consequently firms have less need to use temporary layoffs to manage their labor input requirements. We find no evidence of a similar decline in the construction industry.

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Table 1. Relative Importance of Temporary Layoffs over the Business Cycle

	Pre-1984	Post-1984	Difference
Recession	17.6	15.1	2.4
Expansion	13.0	13.4	–0.5
Difference	4.6	1.7	2.9
	(35.4)	(12.7)	

Notes: NBER business cycle dates are used. Recession period includes an additional six months following the business cycle trough. Table reports the average share of temporary layoffs in total unemployment over the indicated period. Numbers in parentheses are the differences between recessions and expansions expressed as a percent of the average for expansions.

Table 2. Standard Deviation of Manufacturing Industrial Production

Frequency	**Growth**		**Business Cycle**		**High**	
Sample	**1954-1983**	**1984-2004**	**1954-1983**	**1984-2004**	**1954-1983**	**1984-2004**
Industrial Production						
Manufacturing	17.2	7.1	8.8	3.1	14.6	6.1
Durable	29.9	10.8	13.2	4.3	26.7	9.7
Nondurable	11.3	6.6	5.3	2.2	9.7	6.1

Notes: Industrial production data is from the Federal Reserve Board. Growth indicates monthly growth at an annual rate. The business cycle and high frequency components are obtained by applying a fixed-length symmetric Baxter-King filter with 36 lags to the monthly growth rates, with BC defined as cycles between 18 and 96 months and High as cycles between 2 and 18 months.

Table 3. The Correlation between *Layoffs and Production*

Sample	**1967 - 1989**	**1990 - 2004**
Aggregate Temporary Layoffs / Total Unemployment:		
Durables IP Growth	–0.4	–0.1
Durables IP Growth < 0	–0.5	–0.2
Nondurables IP Growth	–0.1	–0.1
Nondurables IP Growth < 0	–0.4	–0.1
Durables P/N Employment	–0.8	0
NonDurables P/N Employment	–0.7	–0.3
New Flows into Temp Layoff / All Workers by Industry:	**1979 - 1989**	**1990 - 2004**
Durables		
Industrial Production		
Growth	–0.4	–0.3
Growth < 0	–0.5	–0.3
P/N Employment	–0.5	–0.4
Nondurable Manufacturing		
Industrial Production		
Growth	0	–0.1
Growth < 0	–0.1	–0.1
P/N Employment	–0.3	–0.3

Notes: (Aggregate Temporary Layoff / Total Unemployment) is the stock of workers on temporary layoff over the total number of 16+ unemployed. The data on aggregate layoffs extends back to 1967. (New Flows into Temporary Layoff / Employment) is the ratio of temp layoffs (< 4 months) to (employed + temp layoffs(<4 months)+quits(<4 months)+perm layoffs(<4 months) within an industry. The data on industry layoffs used here corresponds to the data used in the estimation in Section 4 and hence it begins in 1979. P/N is computed as deviations of the ratio of production (P) to non-production (N) workers from a trend estimated using a Hodrick Prescott Filter. Growth < 5% indicates the correlation was computed using all months in which the growth of industrial production was < 5%. Data sources and Growth, BC and High are as defined in Table 1.

Table 4. Correlation of Industrial Production with Employment by Type of Worker

Frequency	**Growth**		**Business Cycle**		**High**	
Sample	**1954 - 1983**	**1984 - 2004**	**1954 - 1983**	**1984 - 2004**	**1954 - 1983**	**1984 - 2004**
Worker Type:						
Manufacturing						
Production	0.80	0.58	0.94	0.78	0.75	0.49
Non-production	0.11	0.19	0.41	0.26	–0.03	0.01
Durable Manufacturing						
Production	0.83	0.63	0.94	0.81	0.80	0.58
Non-production	0.14	0.18	0.41	0.31	0.08	–0.02
Nondurable Manufacturing						
Production	0.53	0.30	0.90	0.65	0.44	0.11
Non-production	0.02	0.09	0.18	0.20	–0.04	0.03

Notes: See notes to Table 1. Reported numbers are simple correlations of industrial production (monthly growth or frequency filtered) with employment (monthly growth or frequency filtered).

Table 5. Descriptive statistics

	All	Construction	Durable Mfg	Non-durable mfg	Trade	Services
Percent of sample		7.9	15.4	11.5	30.2	35.1
Demographic characteristics						
Average MTC	0.71	0.40	0.69	0.66	0.75	0.77
Average experience	17.9	17.9	20.4	20.5	15.3	18.2
Percent age 16-24	21.7	20.3	12.6	14.2	33.5	18.3
Average education	12.7	11.8	12.5	12.1	12.3	13.4
Percent female	47.1	9.2	29.2	42.9	48.9	63.4
Percent non-white	14.3	10.3	12.5	16.1	12.8	16.7
Unemployment rates						
Temporary layoffs	1.1	3.8	1.7	1.5	0.5	0.5
Permanent layoffs	2.8	5.7	2.9	2.9	2.5	2.1
Quits, new entrants	2.7	2.6	1.5	2.2	3.7	2.6
Sample size	2,308,506	181,570	354,805	263,916	697,840	810,375

Notes: Current Population Survey, outgoing rotation group data, 1979 - 2002. Sample is restricted to individuals in the labor force who are age 16 and older who report as their current or previous industry either as construction, durable manufacturing, nondurable manufacturing, trade or services.

Table 6. Probability of unemployment, by type

	Temporary Layoff		Permanent Layoff		Other	
	(1)	(2)	(3)	(4)	(5)	(6)
MTC (x100)	–1.36**		–0.70**		–0.09	
	(0.04)		(0.06)		(0.06)	
Pre-1989 MTC		–1.35**		–0.77**		–0.03
(x100)		(0.04)		(0.06)		(0.06)
Post-1989 MTC		–1.38**		–0.53**		–0.20**
(x100)		(0.05)		(0.07)		(0.07)
Experience	0.01	0.01	0.82**	0.82**	–0.90**	–0.90**
(x1,000)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
Experience squared	–0.00	–0.00	–0.19**	–0.19**	0.80**	0.80**
(x10,000)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Youth (x100)	–0.08**	–0.08**	0.54**	0.54**	1.52**	1.52**
	(0.03)	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
Years of Education	–0.08**	–0.08**	–0.22**	–0.22**	–0.20**	–0.20**
(x100)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female (x100)	0.17**	0.17**	–0.72**	–0.72**	1.36**	1.36**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Non-white (x100)	0.20**	0.20**	2.16**	2.16**	2.01**	2.01**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
(Post-1989 MTC –		–0.02		0.25**		–0.16**
Pre-1989 MTC)x100		(0.04)		(0.07)		(0.07)
R-square	0.015	0.015	0.014	0.014	0.017	0.017

Notes: Linear probability estimates with standard errors given in parentheses. Specifications contain state, industry, and year effects, as well as 12 occupation indicators. The "other" unemployment category consists of quits and re-entrants to the labor force. Number of observations is 2,308,506.

Table 7. Probability of temporary layoff - by industry

	Construction		Durable Mfg		Non-durable Mfg		Trade		Services	
MTC (x100)	–1.40**		–2.33**		–0.29		0.06		–0.15	
	(0.32)		(0.17)		(0.20)		(0.07)		(0.07)	
Pre-1989 MTC		–1.30**		–2.71**		–0.30		0.06		–0.05
(x100)		(0.33)		(0.17)		(0.20)		(0.07)		(0.07)
Post-1989 MTC		–1.59**		–1.22**		–0.28		0.20**		–0.06
(x100)		(0.35)		(0.22)		(0.25)		(0.10)		(0.08)
(Post-1989 MTC –		–0.29		1.49**		0.01		0.13**		–0.01
Pre-1989 MTC)		(0.21)		(0.19)		(0.17)		(0.06)		(0.06)
R-square	0.020	0.020	0.019	0.019	0.012	0.012	0.003	0.003	0.002	0.002
Observations	181,570		354,805		263,916		697,840		810,375	

Notes: Linear probability estimates with standard errors given in parentheses. Specifications contain the same control variables displayed in Table 6 in addition to state, industry, and year effects, as well as 12 occupation indicators.

** denotes significance at the 5 percent level

* denotes significance at the 10 percent level

Table 8 Probability of temporary layoff - by industry, production worker status

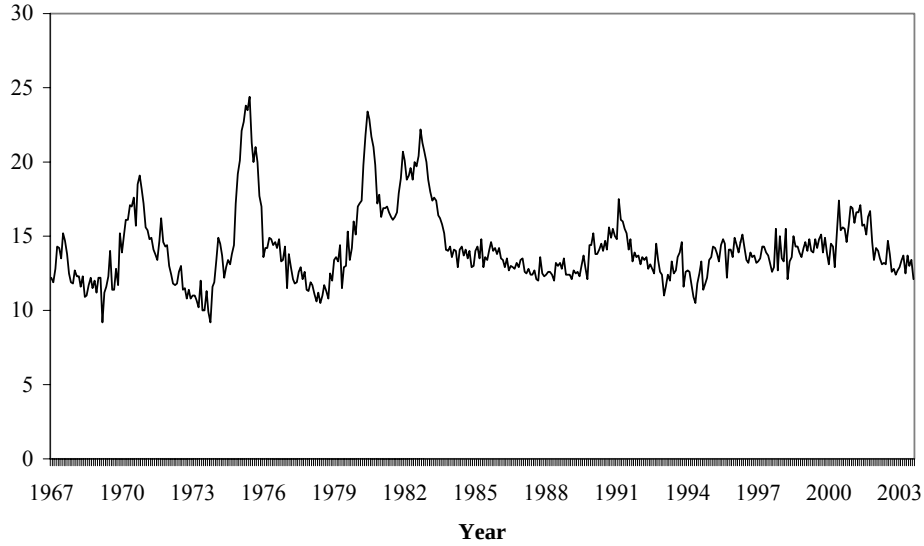
	Construction	Durable Mfg	Non-durable Mfg	Trade	Services
Production	1.89**	2.70**	1.87**	0.68**	0.88**
Pre-1989 (x100)	(0.19)	(0.15)	(0.14)	(0.08)	(0.10)
Production	4.34**	0.43*	1.36**	0.05	0.61**
Post-1989 (x100)	(0.25)	(0.22)	(0.19)	(0.10)	(0.11)
MTC Production	–1.42**	–3.21**	–0.50**	–0.09	–0.45**
Pre-1989 (x100)	(0.34)	(0.19)	(0.22)	(0.11)	(0.13)
MTC Non-prod	–0.77*	–1.67**	–0.01	0.10	–0.01
Pre-1989 (x100)	(0.40)	(0.22)	(0.23)	(0.07)	(0.07)
MTC Production	–2.14**	–1.09**	–0.60**	0.41**	–0.18
Post-1989 (x100)	(0.36)	(0.25)	(0.28)	(0.14)	(0.14)
MTC Non-prod	1.01**	–1.43**	0.05	0.15	–0.04
Post-1989 (x100)	(0.47)	(0.28)	(0.30)	(0.10)	(0.08)
Pre-1989:					
MTC Prod –	–0.65**	–1.54**	–0.49**	–0.19**	–0.44**
MTC Non-prod	(0.31)	(0.21)	(0.19)	(0.09)	(0.12)
Post-1989:					
MTC Prod –	–3.15**	0.33	–0.64**	0.26**	–0.14
MTC Non-prod	(0.38)	(0.28)	(0.26)	(0.12)	(0.13)
R-square	0.018	0.018	0.011	0.002	0.002
Observations	181,570	354,805	263,916	697,840	810,375

Notes: Linear probability estimates with standard errors given in parentheses. Specifications contain the same control variables displayed in Table 6 in addition to state, industry, and year effects.

** denotes significance at the 5 percent level

* denotes significance at the 10 percent level

Figure 1. Temporary Layoffs as a Percent of Total Unemployment



Source: U.S. Bureau of Labor Statistics

Figure 2. Simplified steady-state MTC for benefit ratio tax system

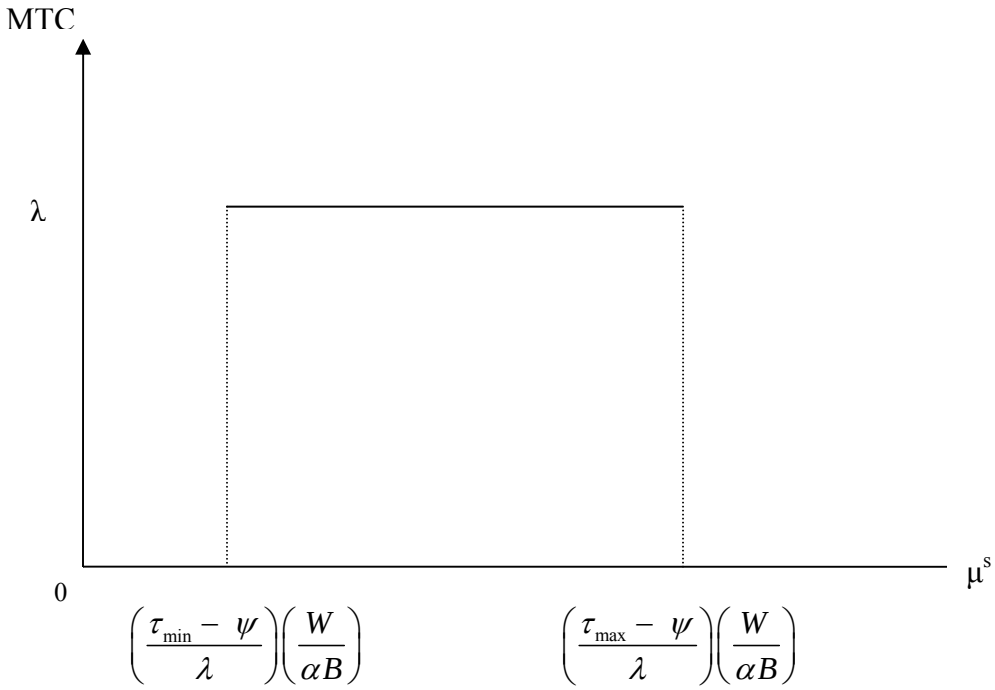


Figure 3. Average Marginal Tax Cost to a layoff

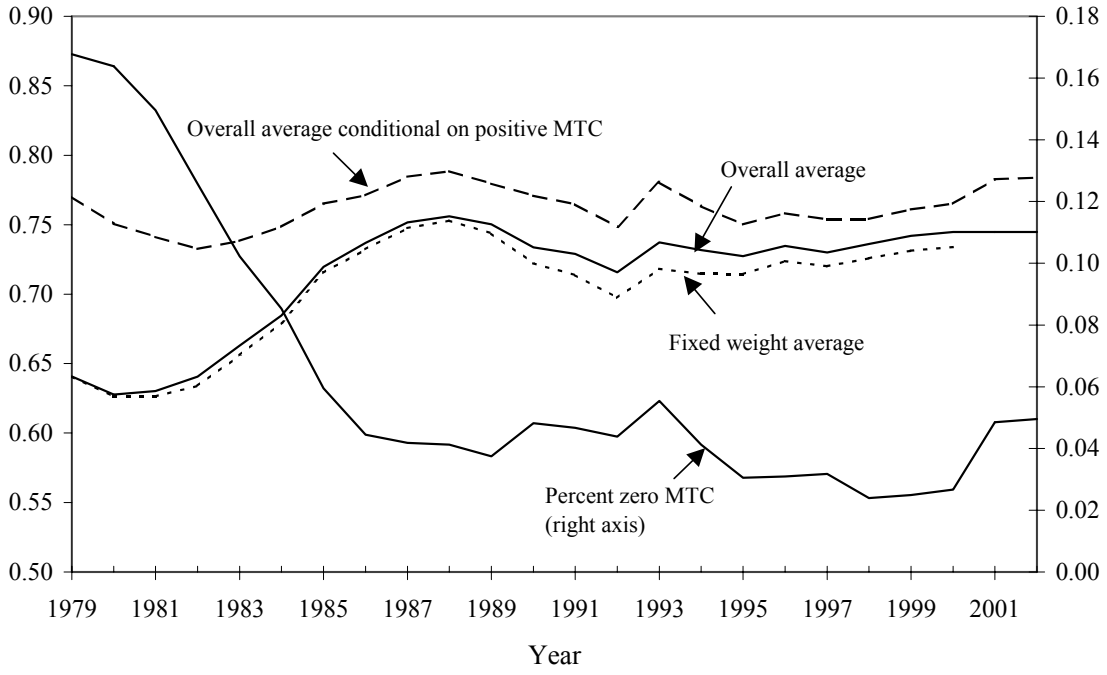
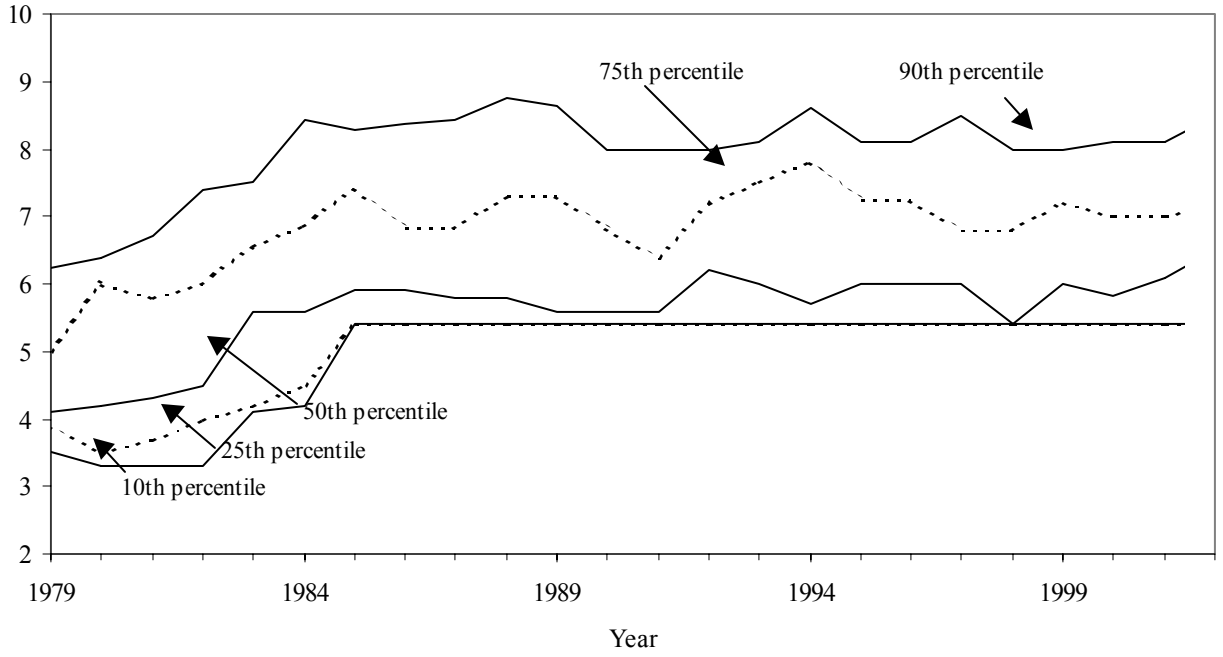


Figure 4. Distribution of UI Maximum and Minimum Tax Rates – weighted by workers

a) Maximum UI Tax Rates



b) Minimum UI Tax Rates

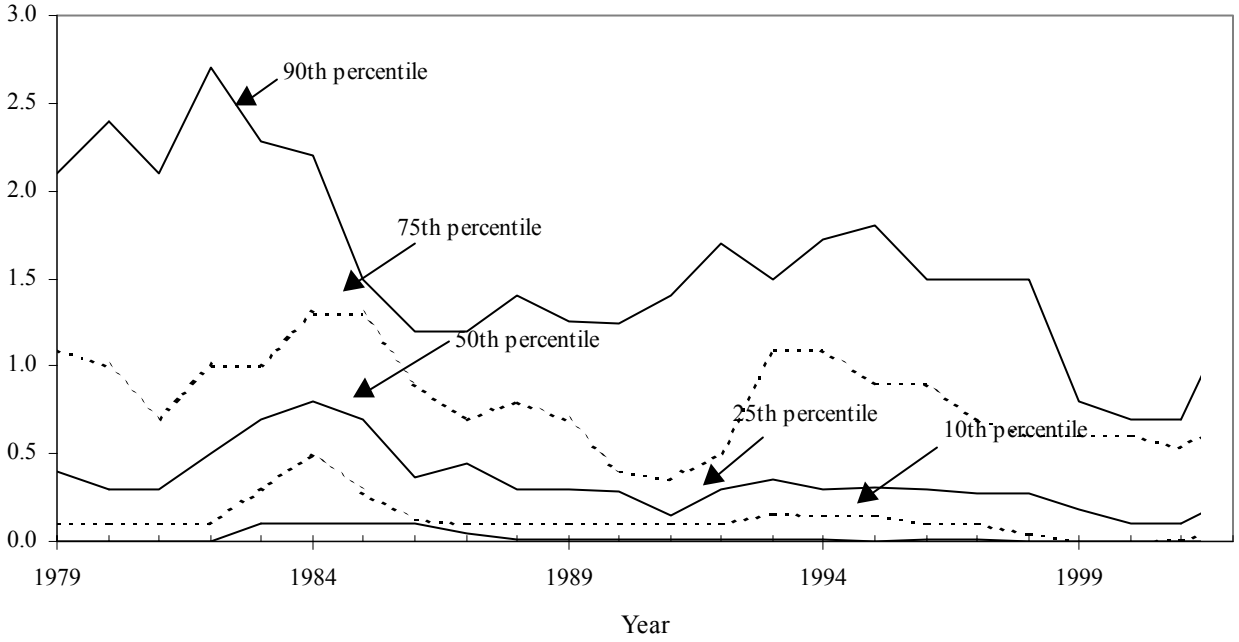
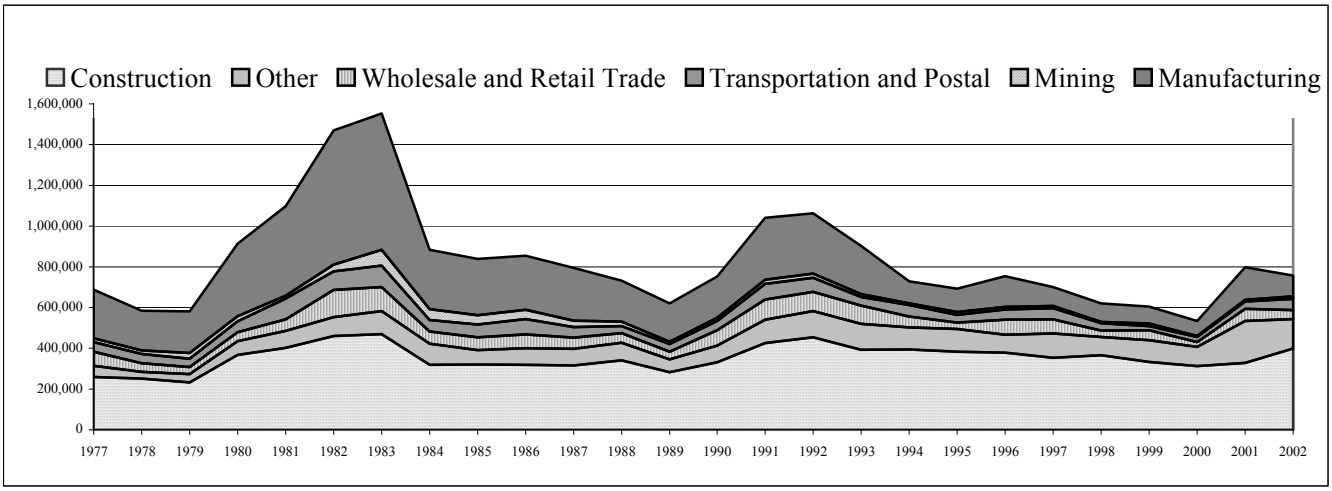


Figure 5: Workers on Temporary Layoff - by Industry



Source: CPS data, males only.

Figure 6: Surges in Layoffs and Large Drops (< -10%) in Durables Industrial Production

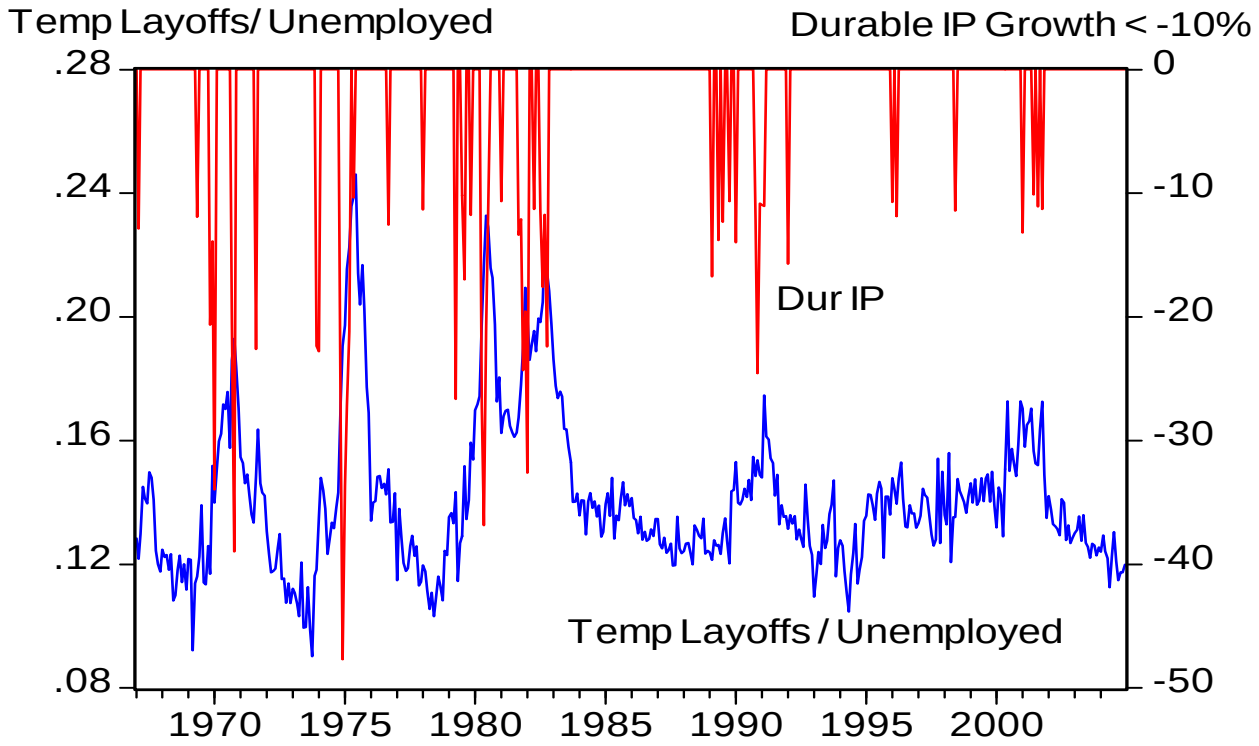
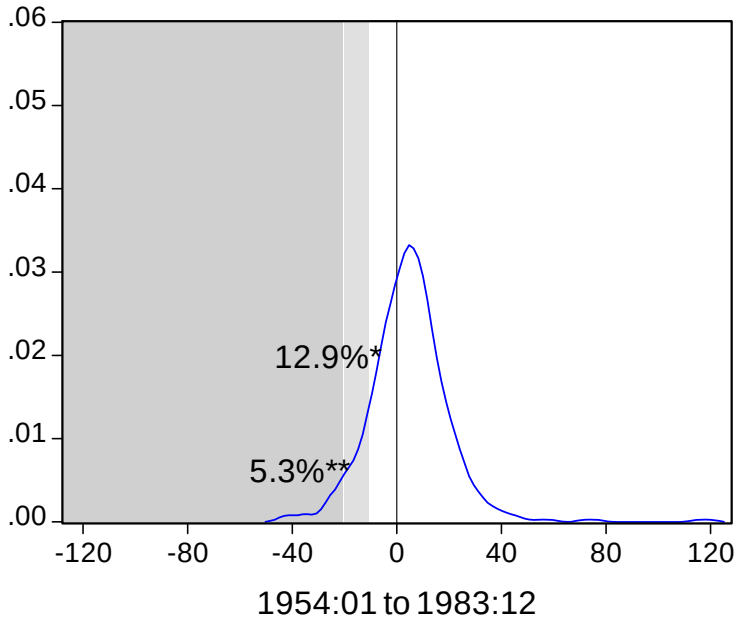
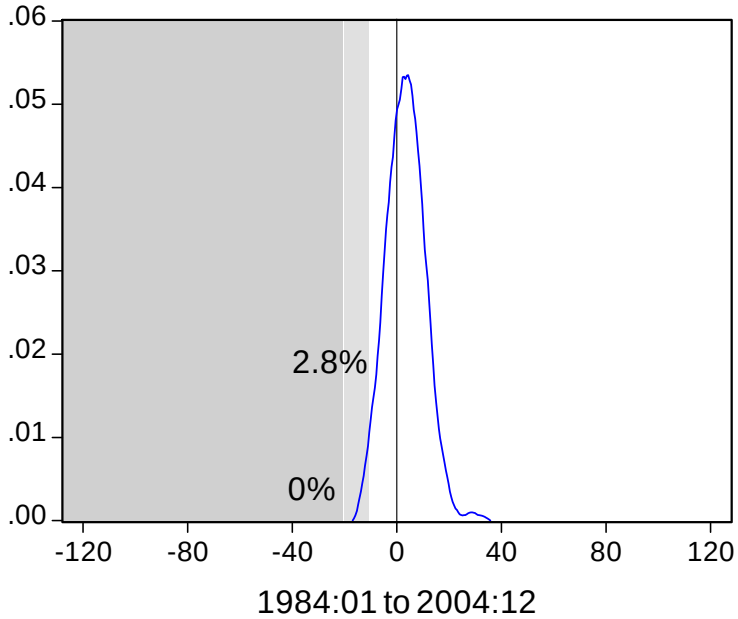


Figure 7: Distributions for Manufacturing Industrial Production by Sample





* % of observations < -10%

** % of observations < -20%

Figure 8: Distributions for Manufacturing Industrial Production by Frequency and Sample

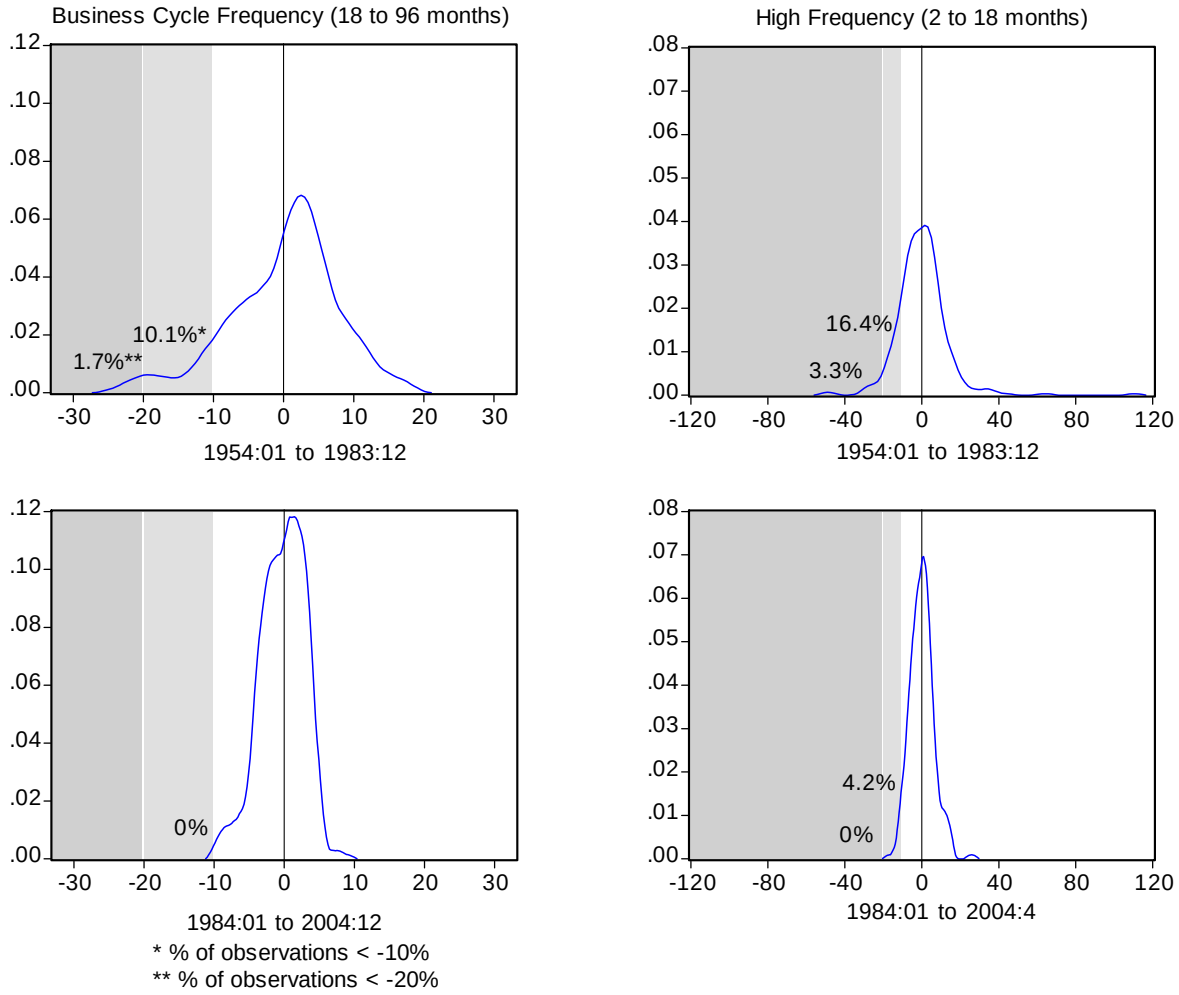


Figure 9. Durable Manufacturing Employment: Business Cycle Components by Type of Worker

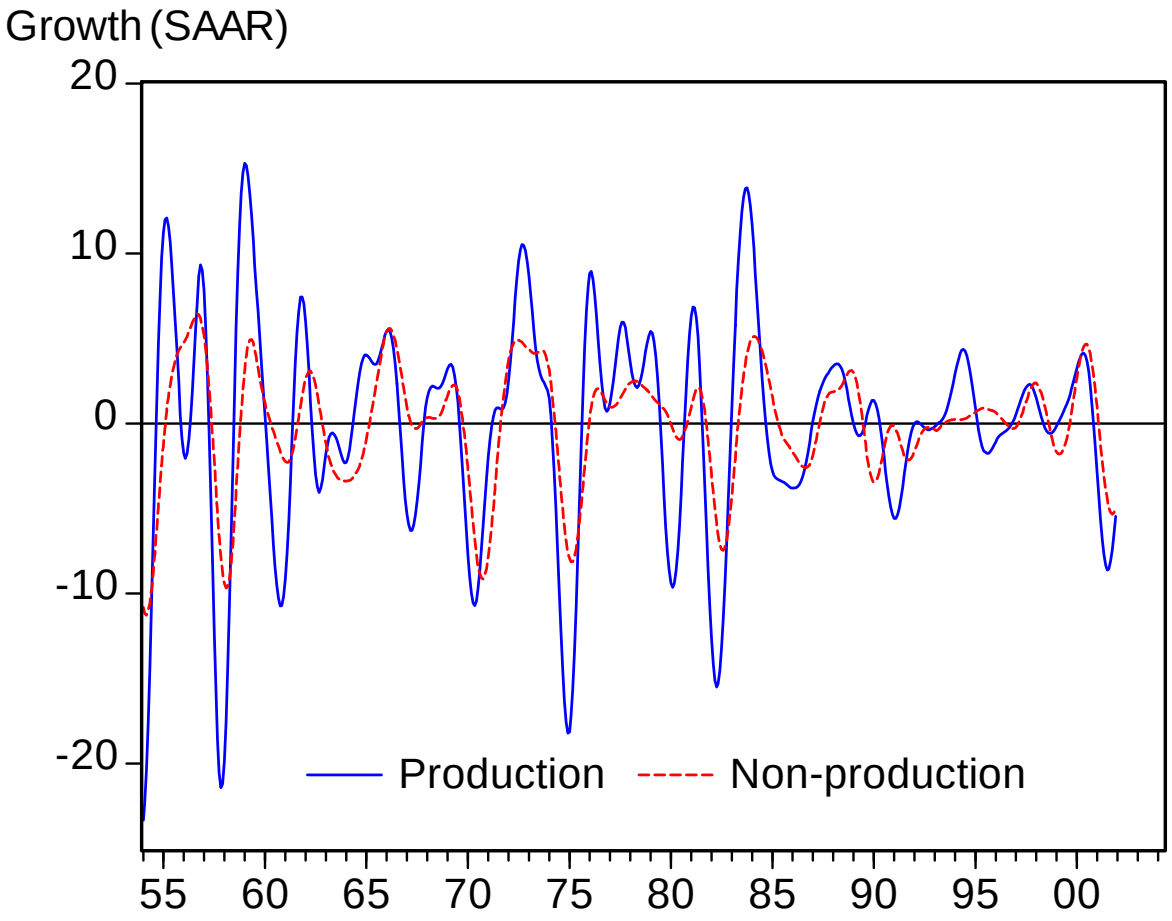
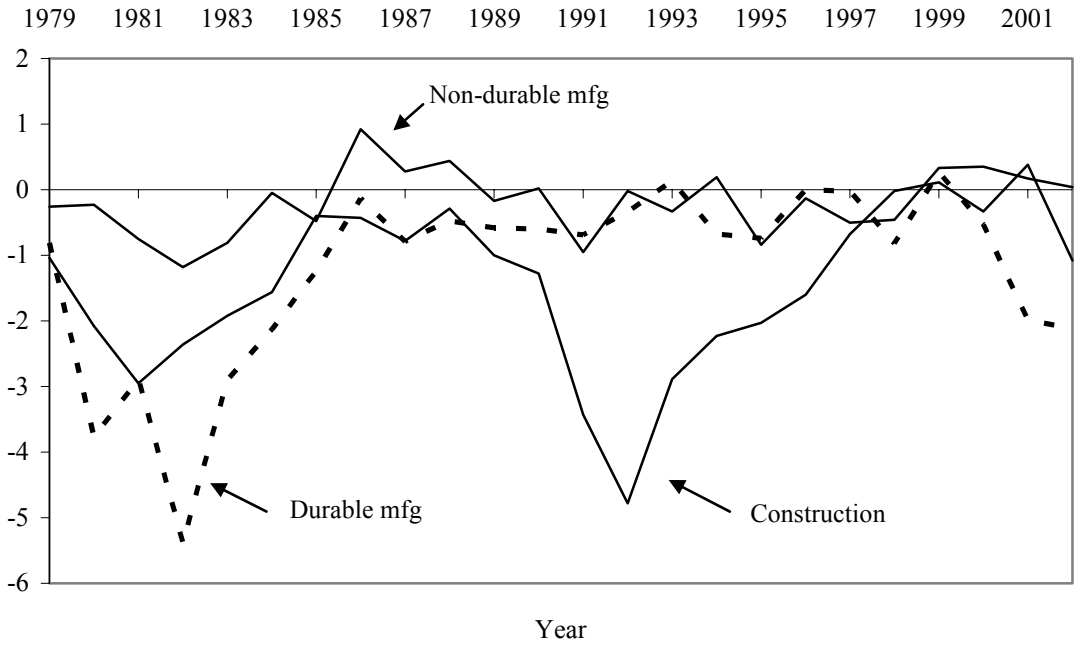



Figure 10. Temporary Layoff Responses to Marginal Tax Cost, by industry