Short-Time Compensation as a Tool to Mitigate Job Loss? Evidence on the U.S. Experience during the Recent Recession*

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Abstract

During the recent recession only 17 states offered short-time compensation (STC)—pro-rated unemployment benefits for workers whose hours are reduced for economic reasons. New federal legislation will encourage the expansion of STC. Exploiting cross-state variation in STC, we present new evidence indicating that jobs saved during the recession as a consequence of STC could have been significant in manufacturing, but that the overall scale of the STC program was generally too small to have substantially mitigated aggregate job losses in the 17 states. Expansion of the program is necessary for STC to be an effective counter-cyclical tool in the future.

JEL codes: J65, J08, J20

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During the recent recession, the United States and other developed countries experienced economic dislocations on a scale not seen in decades. Between the peak of nonfarm payroll employment in January 2008 and the trough in February 2010, the United States lost more than 8.7 million jobs, a drop of 6.3 percent, and the U.S. unemployment rate jumped from a low of 4.4 percent in April 2007 to a high of 10.0 percent in October 2009, with particularly marked increases in the incidence of long-term unemployment. Even four years after the official end of the recession, neither employment nor unemployment had returned to pre-recession levels. The severity and persistence of the recent economic downturn has been unprecedented in the post-World-War-II period. Widespread joblessness and the well-documented negative effects it has had on American families and their communities have prompted interest in policies that would encourage work sharing in lieu of layoffs during future economic downturns.

During the recession, unemployment insurance (UI) rules in the majority of U.S. states discouraged the use of work sharing. In most states, workers were eligible for UI benefits only if they were laid off. A large body of research shows that the U.S. unemployment insurance system has the effect of subsidizing layoffs, causing employers to rely too much on layoffs and too little on work sharing to achieve hours reductions during recessions. At the start of the recent recession only 17 states offered short-time compensation (STC)—pro-rated unemployment benefits for workers whose hours are temporarily reduced for economic reasons—and, even during prior recessions, take-up of these benefits had always been extremely low.

The depth of the recent recession, however, sparked notably greater use of short-time compensation in states that already had STC programs as well as interest among additional states in implementing new STC programs. The Middle Class Tax Relief and Job Creation Act passed by the Congress in February 2012 included provisions designed to promote the use of work

sharing. Short-time compensation programs operating in other developed countries—where short-time compensation has long been available and used extensively—played a significant role in mitigating layoffs during the economic crisis by encouraging greater use of work sharing (OECD 2010a). An important empirical question is the extent to which an expansion of STC programs similarly could prevent employment losses during future recessions in the United States.

In this paper we review arguments concerning the desirability of expanding STC programs in the United States and present new evidence on the use of these programs during the recent recession. STC take-up rates in several U.S. states were comparable in recent years to take-up rates in Canada and the take-up rate in Rhode Island was considerably higher. STC use tends to be concentrated in manufacturing. Comparing the adjustment of manufacturing production employment and hours in STC and non-STC states during the recession, we find that manufacturers in STC states generally relied relatively more on hours reductions and relatively less on employment reductions to adjust total hours worked. If it can be assumed that the availability of STC benefits was responsible for the relatively greater reliance on hours adjustments in those states and that the reduction in total hours would have been the same in the absence of STC, this evidence implies that STC programs saved jobs in a number of states during the recession. Consistent with this finding, the states in which the number of full-time equivalent workers on STC was relatively large tended to be the states that relied more heavily on cutting average hours to reduce manufacturing labor input during the recession. Although available data do not permit us to test the employment effects of STC directly, the collection of indirect evidence presented in this paper suggests that there may have been significant effects in at least some states' manufacturing sectors.

SHOULD WORK SHARING BE ENCOURAGED?

There are both efficiency and equity arguments for STC programs that encourage the use of work sharing in lieu of layoffs during recessions. Unemployment insurance taxes levied on employers are experience-rated: Employers with more layoffs—and hence employers whose employees draw more from their state's unemployment insurance fund—pay higher UI taxes. This experience rating, however, is incomplete. Although employers are ultimately liable for reimbursing the state UI trust fund for the cost of benefits received by laid-off employees under the experience rating system operating in most states, employer repayment normally is spread out over a number of years and states do not charge interest on the balances employers owe, meaning that the system effectively subsidizes the cost of layoffs.[1] In addition, states set minimum and maximum UI tax rates, and for employers at these minimum or maximum rates, the cost of an additional layoff may be very low or zero. At the same time, workers are apt to oppose work sharing if they cannot access UI benefits to help compensate for their income loss, particularly when they have greater seniority and hence are less likely to be affected by layoffs. Imperfect experience rating in the UI system coupled with the absence of pro-rated UI benefits for work sharing has long been argued to skew the choice between hours and employment reductions during recessions, encouraging too much reliance on layoffs (see, for example, Anderson and Meyer 1993, 2000; Card and Levine 1994; Feldstein 1976; and Topel 1984).

Avoiding excessive layoffs during recessions has potential benefits for both employers and workers. For the employer, work sharing may be a means of retaining valued employees during a temporary downturn. Workers who are laid off may take jobs elsewhere, meaning that any investments the firm has made in these workers' job skills are lost. This may be an especially important consideration when workers are highly skilled and costly to replace when

demand rebounds. To the extent that workers care about the well-being of their colleagues or view an employer's efforts to avoid layoffs as a signal concerning their own job security, work sharing also may have a positive effect on employee morale and productivity.

In addition, work sharing is appealing on equity grounds. Work sharing spreads the burden of a recession across a larger number of workers rather than concentrating that burden on the minority of workers who lose their jobs. A substantial body of research has shown that job losers experience significant and persistent problems, including earnings losses, health problems and other adverse outcomes (see, for example, Davis and von Wachter 2011; Jacobson, LaLonde and Sullivan 1993; Stevens 1997; Sullivan and von Wachter 2009; von Wachter, Song and Manchester 2011). Keeping workers on the job with their current employers during a recession may be a way to avoid or lessen these adverse impacts. In addition, by mitigating layoffs, STC benefits may reduce adverse spillover effects on local communities that otherwise would be called upon to serve individuals who have lost incomes, health insurance, and pension benefits.

Even when STC is available, employers will not always find it in their interest to implement work sharing plans in lieu of layoffs during recessions. Because wages represent only a fraction of employees' total compensation, employers may save less money by reducing hours through work sharing than by achieving the same reduction in hours through layoffs. Many state STC programs had already stipulated that employers maintain health and other benefits for employees while they are on reduced hours, and the federal law passed in 2012 makes maintenance of full health and pension benefits a requirement for all state STC programs. Because those who are laid off tend to be less senior, however, the wage savings associated with hours reductions could be greater in the work sharing case (Abraham and Medoff 1984; Vroman and Brusentsev 2009). As noted, employers who keep workers on their payrolls during a

downturn can expect to save on hiring and training costs during the subsequent recovery. Thus, savings on wage and hiring costs may mitigate or exceed any increased costs associated with maintaining workers' benefits.

Another potential drawback of work sharing from the employer's perspective is that reducing the hours and compensation of workers across the board could induce the most productive workers to quit to pursue other opportunities; with layoffs, in contrast, the employer may be able to be more selective about who is let go. While differential attrition of more productive workers may be a significant concern during normal economic times, this seems less likely to be the case during recessionary periods when job opportunities are scarce and quit rates are low.

It also should be acknowledged that the use of work sharing is not always desirable from a societal perspective. Perhaps the most compelling argument against work sharing is that using short-time compensation to keep workers with their current employers may impede needed reallocations from declining to growing enterprises and sectors (OECD 2010a). Workers who are still employed at a declining enterprise, even on a reduced work schedule, may delay seeking alternative employment.[2] During recessionary periods, however, firms seeking to hire likely will have little difficulty attracting new recruits and any effect of STC on the pace of economic reallocation arguably has less force than other considerations. There is reason, however, to be more cautious about encouraging the use of work sharing during periods of stronger economic activity.

A final concern in the U.S. context is that drawing STC benefits may reduce the UI benefits available should the worker subsequently be laid off from the job. In other countries, drawing STC payments typically has no effect on workers' future eligibility for UI benefits. In

the United States, however, STC benefits count against workers' total benefit eligibility. Workers who draw STC benefits pro-rated at 50 percent of the full benefit level for 20 weeks, for example, would have 10 fewer weeks of benefit eligibility available if they are subsequently laid off.

OTHER COUNTRIES' EXPERIENCE WITH SHORT-TIME COMPENSATION PROGRAMS

In contrast to the United States, where there has been little use of formal STC programs, work sharing is an integral part of the unemployment insurance system in other developed countries. In Germany, STC was incorporated into the unemployment insurance system in the 1920s. Italy and Norway introduced formal STC programs in the 1950s; Austria, France, and Ireland in the 1960s; and Belgium, Canada, Denmark, Japan, and Luxembourg in the 1970s (Boeri and Bruecker 2011). In many of the countries with established STC programs, there are also employment protection laws that mandate significant advance notice before a worker can be laid off and substantial severance payments in the event a layoff occurs. By facilitating the adjustment of worker hours, STC programs serve as an important complement to legislation that constrains the adjustment of employment levels (Abraham and Houseman 1993, 1994; Boeri and Bruecker 2011).

Under the provisions of the laws that govern short-time compensation in other developed countries employers seeking STC benefits for their employees generally must file a plan that justifies their use of STC and explains how it will be used (Boeri and Bruecker 2011; Hijzen and Venn 2010). Some countries set a minimum on the share of the firm's workers who will receive benefits, and most specify a minimum reduction in worker hours. Such requirements are intended to limit the use of STC to firms that are experiencing significant economic difficulties.

In most countries, hours may be reduced by up to 100 percent, meaning that work sharing may take the form of temporary layoffs. Because STC generally is designed to help firms accommodate temporary rather than permanent reductions in demand, laws also typically specify a maximum duration for an STC plan. During the recent recession, many countries extended the permissible length of firms' STC plans. In Germany, for example, the maximum length for a work sharing plan was extended from 6 months to 24 months for applications submitted in the second half of 2009 and to 18 months for applications submitted in 2010 (Crimmann and Wiessner 2009; ILO 2010).

Countries also vary in the extent to which employers bear costs connected to their use of STC. Employers may be required, for example, to pay all or a portion of the social security contributions for hours not worked under an STC plan or to pay full wages for an initial period. In some countries, employers may be required to provide training to workers during the hours they are not working. In order to make the work sharing option more attractive to employers during the recession, many countries took steps to reduce the costs to employers of using STC. Germany, for example, temporarily excused employers from paying a portion of the social security contribution on hours not worked for which they otherwise would have been liable (ILO 2010).

Studies of cross-country differences in labor adjustment practices have documented the important role that STC can play in supporting work sharing arrangements during recessions, leading to greater reliance on hours adjustments rather than layoffs in countries where it is widely used (Abraham and Houseman 1993, 1994). A study completed by OECD researchers concludes that short-time work programs helped to preserve jobs during the recent recession. The impact of these programs was found to be particularly significant in Germany and Japan, where

they preserved an estimated 200,000 and 400,000 permanent jobs, respectively (OECD 2010a). Subsequent research has reached similar conclusions about the role of STC in preventing employment losses during the recession (Boeri and Bruecker 2011; Hijzen and Martin 2013).

EXPERIENCE WITH SHORT-TIME COMPENSATION IN THE UNITED STATES

In contrast to other countries where work sharing has evolved as an important alternative to layoffs, work sharing has not been common in the United States since it fell into disfavor during the 1930s. As used in the United States during the early years of the Great Depression, work sharing was imposed unilaterally by employers and often resulted in poverty-level take-home pay for affected workers. Labor historians link the decline in the use of work sharing during recessions—and companies' increased use of layoffs—to the growing strength of union-negotiated seniority systems, which meant that employers could not cut workers' hours without union approval, and to the introduction of the current system of unemployment insurance in the mid-1930s, which made layoffs a more palatable option (Nemirow 1984). During the deep recession of 1974-75, however, interest in work sharing as a policy option was revived and several states subsequently passed laws to permit workers on reduced work schedules to collect partial UI benefits.

Following passage of California's short-time compensation law in 1978, another 19 states implemented STC programs as part of their unemployment insurance systems, though three states later rescinded or abandoned these policies and no state added a permanent STC program between 1994 and 2009.[3] Balducchi and Wandner (2008) attribute this policy stalemate to the "administrative muddle" created by a lack of leadership in the federal government. In 1992, questions were raised about the federal law that enables states to adopt STC programs, creating

uncertainty about what states are and are not allowed to do. The onset of severe recession in 2008 sparked renewed interest in work sharing programs, however, and an additional nine states plus the District of Columbia passed STC laws by the middle of 2013. Moreover, Title II, Section D of the Middle Class Tax Relief and Job Creation Act of 2012 addresses the problems in the earlier federal law and actively promotes the adoption and use of STC programs in states.

The basic idea behind STC programs is that, rather than being eligible for UI benefits only when laid off, workers whose employers submit approved work sharing plans may collect UI benefits that are pro-rated according to the reduction in their hours. An employer who might otherwise have laid off 10 workers, for example, instead could submit a plan under which the same reduction in hours was achieved by having 50 workers reduce their hours by 20 percent (for example, for those on a five-day-a-week schedule, cutting back to four days a week). Employees working a reduced schedule then would be eligible to receive 20 percent of the UI benefit to which they would have been entitled if laid off entirely.

Under the new federal law, states must require employers who request STC for their employees to submit a written plan detailing how work sharing will be implemented and the estimated number of jobs that will be saved. Short-time compensation programs may be used for workers whose hours have been reduced by at least 10 percent up to a maximum determined by state law, though not to exceed 60 percent. In existing state STC programs, the maximum permissible period for an approved short-time plan in most states is either 6 months or 12 months. Benefits paid to workers on STC most often have the same effect on employers' UI tax rates as benefits paid to laid off workers, though a number of states impose surcharges on some or all STC employers or prohibit employers with negative balances in their UI accounts from implementing an STC plan. In many states, employers are required to maintain health benefits

for their workers under the same terms as would apply had their hours not been reduced, and under the new federal law, all conforming state programs must require full maintenance of health and pension benefits.[4]

Beyond some differences in the formal provisions of states' STC program, there have been important differences across states in the extent to which they have promoted the program to employers. At one end of the spectrum, the Rhode Island Department of Labor and Training has engaged in especially active outreach to increase awareness of its program. The Rhode Island department not only publicizes the STC option through its website and pamphlets targeting employers, but also issues periodic press releases highlighting companies that have successfully used STC to avoid layoffs, actively promotes STC to companies identified as good candidates for the program, and enlists the help of other parts of the state government and business organizations to spread the word about the program. At the other end of the spectrum, many states have done almost nothing to advertise their STC programs.[5]

In the past, usage of STC in the United States has been very low compared to that in other countries. The absence of strong employment protection laws in the United States, which makes layoffs a more accessible option for U.S. employers than for employers in many other countries, is likely to be a part of the explanation for low STC use in the United States. Even where state STC programs exist and employers might have been interested in them, however, many have been unaware of their existence. Further, the procedures that employers must follow to put workers on short-time benefits have tended to be more cumbersome than those for laying workers off, potentially discouraging use.

To address these issues, the new federal law provides federal guidance and assistance to the states in developing and implementing STC programs and federal grants to promote STC use

among employers and support enrollment efforts. Notably, under the new law, the federal government will fund 100 percent of STC benefit costs for up to three years for states with approved STC programs and 50 percent of benefits costs for up to two years for states without programs. States receiving this funding may continue to charge employers for benefits paid out under the STC program, or they may exempt employers from the usual charges associated with the payment of STC benefits.[6] Non-charging for STC benefits could make adoption of an STC plan considerably more attractive to a firm that experiences a temporary reduction in the demand for its products or services.

USE OF SHORT-TIME COMPENSATION IN THE UNITED STATES DURING THE RECENT RECESSION

While interest in short-time compensation programs always has been somewhat cyclical, the use of STC programs during the recent recession substantially exceeded that in prior recessions. Though still low by international standards, not only was the absolute level of use higher relative to that in past recessions, as would be expected given the severity of this recession, but the use of STC relative to regular unemployment insurance also was notably higher.

For the 17 states that have administered STC programs since the 1990s, Table 1 displays STC weeks claimed as a percent of regular unemployment insurance weeks claimed during each of the last three recessions. STC weeks claimed are adjusted to full-time equivalents (FTEs) to make them comparable to weeks claimed under the regular UI program. For instance, suppose that a company utilizes its state's STC program to reduce the hours of 100 employees from 40 to 32 hours per week, representing a 20 percent reduction in hours worked. These workers would represent 100 STC weeks of benefits per calendar week, but the FTE equivalent would be 20

weeks of benefit claims (100 employees × 0.2).[7] The annual FTE of STC weeks claimed did not reach 1 percent of regular UI weeks claimed in any state during the 1991-1992 recession and, in 2001-2001, exceeded 1 percent of regular UI weeks claimed in only two states, Rhode Island and Vermont. In 2009, however, the FTE weeks claimed for STC exceeded 1 percent of regular UI weeks claimed in 10 of the 17 states offering STC, and in Rhode Island they exceeded 4 percent of regular UI weeks claimed. STC weeks relative to regular UI weeks had fallen to much lower levels in all states by 2010.

Table 2 reports benefits paid under STC as a percent of regular UI benefits for the same years for the 17 STC states. Because work sharing plans are more likely to include more highly paid senior workers and because a significant share of regular UI benefit claims are rejected as ineligible, we might expect STC benefits as a share of regular UI benefits to be somewhat larger than STC full-time-equivalent weeks claimed as a share of regular UI weeks claimed, and this seems to be borne out in the data. Still, in past recessions, STC benefits rarely exceeded one percent of regular UI benefits. In 2009, however, STC benefits amounted to one percent or more of regular UI benefits for 12 of the 16 states for which data are available. Notably, in Rhode Island, STC benefits were close to 10 percent of regular UI benefits in 2009. Again, these ratios were generally much lower by 2010.[8]

While STC use in states with such programs reached record levels in 2009, data compiled by the OECD suggest that the levels of STC use in other countries was much higher. Table 3 shows "take-up" rates of short-time compensation programs in selected countries from 2007 to 2009. The take-up rate of 3.17 percent for German employees in 2009, for example, implies that on average 3.17 percent of all German workers were on state-sponsored work sharing plans

during that year. The rate of 0.22 percent for the U.S. STC states in 2009 is the lowest rate reported, although it is only slightly lower than the rate for Canada.[9]

The second panel in Table 3 shows the take-up rate of STC in the manufacturing sector. STC programs are used disproportionately by manufacturing employers in all of the countries for which data are reported. Most notable are Belgium, Germany, and Italy where, on average, 17 percent, 12 percent, and 10 percent of the countries' manufacturing workforces, respectively, were on STC programs in 2009.

Data on STC use by industry are not collected systematically in the United States, but available evidence suggests that manufacturers account for the majority of STC program use here as well. A study conducted in California following the recession of the early 2000s, for example, found that 62 percent of firms using the state's work sharing plans were in manufacturing, compared to just 11 percent of firms covered by the state's UI system (MaCurdy, Pearce and Kihlthau 2004). A special tabulation of Oregon's data shows that 55 percent and 43 percent of the STC plans operating in January 2009 and January 2010, respectively, were in manufacturing. Because manufacturing plants tend to be relatively large establishments, it is likely that even higher shares of STC participants were employed in that sector. STC administrators in Connecticut and Rhode Island also reported to us that manufacturers were the principal users of their programs, though specific figures were not provided.

Although overall use of short-time compensation is relatively low in the United States, there is considerable variation in take-up rates among the 17 states that had such programs in place during the recent recession. Table 4 displays the take-up rates among private sector employees for the years 2007 through 2010 by state. By 2009 the participation in work sharing programs in several states was comparable to the level found in Canada. And the take-up rate in

Rhode Island, while considerably below that found in the high-use work sharing countries such as Belgium, Germany, and Italy, was on a par with the take-up rates in European countries such as France and the Netherlands. Moreover, the take-up rates in manufacturing are quite likely to have been considerably higher. The second panel of Table 4 shows the average annual take-up rates for manufacturing production workers under the assumption that these workers account for all STC use in the state. These figures represent an upper bound estimate of the average percent of manufacturing production workers participating in STC programs in the indicated state and year. Even if manufacturing production workers accounted for just half of STC use each of these states, however, the manufacturing take-up rate would have been quite sizable in several states, most notably in Rhode Island.

POTENTIAL EFFECTS OF STC ON THE ADJUSTMENT OF PRODUCTION EMPLOYMENT IN MANUFACTURING

The descriptive evidence presented above indicates that STC use was moderately high during the recent recession in some states. Further, given the concentration of STC usage in the manufacturing sector, any impacts on employment adjustment would most likely have been manifested there. In this section, we look for evidence of such effects.

Some past research on how STC affects firms' adjustment behavior has used employer-level data. All else the same, one would expect STC usage to increase hours adjustment and reduce employment adjustment in response to a change in the demand for output at the firm. An obvious problem, however, is that the firms that use STC may differ in important ways from those that do not. The findings of Calavrezo, Duhautois and Walkoviak (2008, 2010) that French establishments using STC also lay off more workers and are more likely later to cease operations, for example, seem likely to be an artifact of unobserved differences between STC

users and non-users. Boeri and Bruecker (2011) develop an instrument for STC usage during 2009 based on past experience with STC, arguing that firms with such experience will be better informed about the STC option but no more likely to have experienced a current negative demand shock. To the extent, however, that such firms tend to face persistently more volatile demand or to have different management philosophies than firms with similar observable characteristics but no past STC usage, these estimates may be subject to bias.

An alternative approach to studying the effects of STC is to use aggregated data for jurisdictions that differ with respect to the availability of STC. In previous work, we compare the cyclical patterns of employment and hours adjustment in several countries with established STC programs to the U.S. pattern (Abraham and Houseman 1993, 1994). We find substantially greater adjustment of average per worker hours and correspondingly smaller adjustment of employment levels in Germany, France, and Belgium than in the United States. Building on work reported in OECD (2010a), Hijzen and Venn (2010) estimate models using country-by-time-period data that relate changes in aggregate labor input variables such as employment and hours to changes in aggregate output. In these models, the responsiveness of the labor input variables to output changes is allowed to vary with whether or not the observation is from the 2008-2009 crisis period, the average STC take-up rate in the country during the crisis, and an interaction between the crisis dummy and the average STC take-up rate. They find that countries with high STC take-up rates during the crisis experienced smaller declines in employment, particularly among permanent employees. Boeri and Bruecker (2011) carry out a similar country-level analysis and also conclude that STC take-up reduced the responsiveness of employment to output during the crisis. Hijzen and Martin (2013) find evidence suggesting that restrictions on the permissible range of working time reductions, more stringent STC eligibility

conditions, and requirements that employers share in the cost of STC reduce the responsiveness of STC take-up to changes in output and, thus, presumably how much an STC program mitigates the responsiveness of employment to changes in output.

As just described, aggregate analyses of the effects of STC programs typically allow the existence of an STC program or the take-up of STC benefits to affect the responsiveness of employment or hours to changes in output. In the United States, there is variation across states in the existence and nature of their STC programs. Limitations in the available data, however, require modifications to the standard estimation strategy. The Bureau of Labor Statistics (BLS) long has published monthly state-level employment estimates, but only recently began to publish state-level hours data for all employees. Official publication of the all-employee hours data did not begin until March 2010, and the new estimates cover only the period from January 2007 forward. Because it is important for our purposes to observe the behavior of employment and hours prior to as well as during the recent recession, these data cover too short a period to be usable. We were, however, able to obtain from the BLS state-level hours data for manufacturing production workers for a longer time period. These data can be analyzed in conjunction with production worker employment data.[10] To examine the responsiveness of labor inputs to changes in output, state-level information on manufacturing output at the same temporal frequency as the employment and hours data also would be needed. The Bureau of Economic Analysis (BEA) produces estimates of Gross Domestic Product by sector by state, but these estimates are only available annually.

Given the limitations of the available data, our empirical analysis examines the relative contributions of employment and average hours among manufacturing production workers to the total change in their hours. Consider the following identity:

$$L \equiv TH_t \equiv E_t \times AH_t$$

Labor input (L) is defined as total worker hours (TH) and equals the number of workers (E) multiplied by the average hours worked per worker (AH) in any time period t. Taking logarithms of each side of the equation, the change in labor input between period t and period $t-1$ may be decomposed into the change in employment levels and the change in average hours:

$$(1) \quad \ln TH_t - \ln TH_{t-1} \equiv (\ln E_t - \ln E_{t-1}) + (\ln AH_t - \ln AH_{t-1})$$

All else the same, we would expect that firms in states with STC would rely relatively more on average hours adjustment and relatively less on adjustment of employment levels during recessions—as companies put workers on STC—and during the early stages of recovery—as STC plans expire and employees resume working regular hours.

We test this prediction formally, using state-level data on manufacturing production worker employment and production worker average weekly hours over the period 2005 to 2009. The data we analyze are monthly, not-seasonally-adjusted numbers from the Current Employment Statistics (CES) program of the Bureau of Labor Statistics. The published data are incomplete for a number of states, but in most of these instances we were able to obtain unpublished monthly figures from BLS.[11] For several states the available data were incomplete or contained clear discontinuities in either the production worker employment or production worker average hours series, and so were dropped from our data set. Our analysis is based on data for 45 states, including all 17 states with STC plans operating during the recession, plus Puerto Rico.[12]

We use these data to estimate the following pair of equations:

(2) $$\Delta \ln AH_{it} = \alpha_1 + \alpha_2 \Delta \ln TH_{it} * D_{it}^{0607} + \alpha_3 \Delta \ln TH_{it} * D_{it}^{0809} + \beta_{1j} \Delta \ln TH_{it} * D_{it}^{0607} * STC_{jt} +$$

$$\beta_{2j} \Delta \ln TH_{it} * D_{it}^{0809} * STC_{jt} + \gamma_i S_i + \delta_t D_t + \varepsilon_{it}$$

(3) $$\Delta \ln E_{it} = \alpha_1^{'} + \alpha_2^{'} \Delta \ln TH_{it} * D_{it}^{0607} + \alpha_3^{'} \Delta \ln TH_{it} * D_{it}^{0809} + \beta_{1j}^{'} \Delta \ln TH_{it} * D_{it}^{0607} * STC_{jt} +$$

$$\beta_{2j}^{'} \Delta \ln TH_{it} * D_{it}^{0809} * STC_{jt} + \gamma_i^{'} S_i + \delta_t^{'} D_t + \varepsilon_{it}^{'}$$

In the model, the subscripts *i* and *t* index state and time, and *j* indexes the subset of 17 states with STC programs. Production worker total hours are computed as the product of production worker employment and average weekly hours. Employment and hours data are not seasonally adjusted, and changes in the log of production worker employment, average hours, and total hours are computed as year-on-year changes (e.g., the log of Rhode Island's production worker employment in January 2006 less the corresponding value for January 2005). Thus, with data beginning in 2005, we are able to compute the change in the employment and hours variables for the period 2006 forward. Because we expect that the formal characteristics of state STC programs as well as the degree to which those programs have been promoted to employers may have led to differential impacts of the STC program across states, we estimate separate effects on the composition of total hours adjustment for individual STC states. Each model also includes a full set of state, S_i, and time (year-month), D_t, dummy variables. State controls capture cross-state differences in employment trends that might be influenced by the industry composition of the state's manufacturing sector or other factors. Controls for time period will capture general trends in manufacturing employment, reflecting productivity growth, shifts in the locus of production, and other factors, as well as cyclical factors that may influence the share of employment in total hours adjustment.

The specifications we estimate allow for a different composition of total hours adjustment in the pre-recession period of 2006 and 2007 (as captured by the indicator variable, D^{0607}) than in the recession period of 2008 and 2009 (as captured by the indicator variable D^{0809}) for both STC and non-STC states. We expect that employers will rely more on average hours adjustment and correspondingly less on employment adjustment to reduce total hours worked in states with STC programs during the recession years and thus that the estimated β_{2j} coefficients will be positive while the $\beta_{2j}^{'}$ coefficients will be negative. Because average hours, employment, and total hours are related by the identity shown in equation (1), the following relationships between the estimated coefficients in equations (2) and (3) hold by construction: $\alpha_1 + \alpha_1^{'} = 1$, $\alpha_2 + \alpha_2^{'} = 1$, and for each STC state, j, $\beta_{1j} + \beta_{1j}^{'} = 0$ and $\beta_{2j} + \beta_{2j}^{'} = 0$.

Table 5 reports selected coefficients from our estimates of equation 3. Because the estimates of the β coefficients from equation 2 are of identical magnitude and opposite in sign to those from equation 3, we report just one set of results in the table. Robust standard errors, clustered on state, are in parentheses. The results are broadly consistent with our expectation that manufacturing establishments in STC states rely relatively more on average hours adjustment and relatively less on the adjustment of employment levels to achieve hours reductions as compared to manufacturers in non-STC states.[13] The coefficients on the STC state interactions with change in hours and recession period are negative and significant for eight out of the seventeen STC states, and in no cases are these coefficients significantly positive. It is notable that this pattern is not evident in the pre-recession period; instead, if anything, the coefficients on the STC state interactions for the earlier period are significantly positive, indicating that companies in these states relied more heavily on adjusting employment levels than on adjusting average hours to alter labor input in the years prior to the recession.

While the results in Table 5 are consistent with STC programs having a significant effect in some states on the choice between adjusting average worker hours versus employment levels to reduce labor, they are not definitive. To partially address the issue of causality, we consider whether the take-up of STC in these states was large enough to plausibly explain the observed differences in the composition of total hours adjustment during the recession.

We first estimate the full-time equivalent number of individuals on short-time in each participating state and month. To do so, we use data reported by states on weeks of benefits paid and adjust these numbers so that they reflect the average reduction in total hours during the month. For instance, if a state paid 430 weeks of STC benefits in a month to workers whose hours were reduced by 20 percent, the FTE weeks paid would be 86 (430×0.2).[14] To compute the average number of FTE persons on STC during the month, we divide this number by 4.3 (the average number of weeks in a month). In our numerical example, this would yield an estimate that 20 FTE persons on average were on short-time during the month.

Table 6 presents the average weekly FTE persons on STC in aggregate and by state for the years 2008 and 2009. Under the assumption that, in the absence of STC programs, employers would have laid off workers to achieve an equivalent reduction in total hours, these FTE figures represent potential jobs saved. In 2008 the weekly FTE persons on STC in the 17 states averaged about 4,500. In 2009, that figure increased five-fold with an FTE equivalent of about 22,000 workers on STC per week.

To place these figures in perspective with overall job losses, we also report them as a percent of the reduction of all private sector employment and as a percent of the reduction in manufacturing production employment from the previous year. Specifically, for each state we compute the average weekly FTE workers on STC in a month divided by the corresponding

year-over-year employment changes in the month. For the 17 states combined, the average FTE of persons on STC in 2009 represented less than one percent of average private sector employment declines from 2008 to 2009, but nearly five percent of the declines in manufacturing production jobs over that period. The absolute and relative size of STC programs was considerably higher in some states. If, as available evidence suggests, manufacturers accounted for a majority of the use of STC programs, then the effect on manufacturing production worker employment may have been sizable in some states. Rhode Island and Connecticut—where in 2009 the average FTE of persons on STC expressed as a percent of declines in manufacturing production worker employment amounted to 23 percent and 16 percent, respectively—particularly stand out.[15]

Had STC programs existed in all states and been used as intensively in all of them as in Rhode Island during the recent recession, back-of-the-envelope calculations suggest that the effect on U.S. employment could have been substantial. According to our estimates, the STC take-up rate in Rhode Island was about five times as large as the take-up rate in all STC states combined and, given that the 17 STC states account for about half of payroll employment nationwide, introducing STC programs in the remaining states could have doubled their effect. Had all states been like Rhode Island in their use of short-time compensation, the average number of full-time-equivalent workers on STC in 2009 would have been approximately ten times as large as the number actually observed—in the vicinity of 220,000 FTEs rather than 22,000 FTEs. And had the average take-up rate been similar to that in Germany or Italy in 2009 rather than in Rhode Island, which still was modest by international standards, the average number of full-time-equivalent workers on STC would have approached one million. In other words, with STC usage at European levels and assuming that STC expansions translate directly

into reductions in the number of layoffs, as many as one in eight of the roughly 8 million jobs lost during the recession could potentially have been saved.

CONCLUSION

Although the usage of short-time compensation programs by U.S. employers remains low by international standards, interest in these programs has grown: Among states with STC programs, weeks paid relative to regular UI benefit weeks paid was generally higher in the recent recession than in previous recessions; several states have enacted STC programs since the onset of the last recession; and new federal legislation seeks to facilitate the expansion of STC programs to other states and generally promote the use of work sharing as an alternative to layoff. With respect to the last, the notably high STC usage in Rhode Island, a state that has been unusually active in publicizing and promoting its STC program, suggests that increasing the visibility of the STC programs in other states could raise overall usage considerably.

While not constituting definite proof, the cross-state analysis we have carried out provides encouraging evidence that STC programs can alter the pattern of adjustment in the United States during economic downturns. During the recent economic crisis, manufacturing employers in STC states generally relied more on the adjustment of average hours and less on the adjustment of employment levels than did manufacturing employers in non-STC states. Further, the magnitude of the differences between STC and non-STC states is consistent with the actual levels of STC usage observed. Provided that STC did not affect the magnitude of overall adjustment during the downturn but only its composition, this suggests that the response of manufacturing employment to declining labor demand was smaller in STC than in non-STC states. On balance, our evidence indicates that jobs saved as a consequence of STC could have

been significant in sectors like manufacturing that made extensive use of the program. With the possible exception of Rhode Island, however, the overall scale of the STC program operating in the 17 states was too small to have substantially mitigated the aggregate job losses these states experienced in the recent severe recession.

Expansion of the program within STC states as well as to states without the program will be necessary for STC to be an effective counter-cyclical tool in the future. Given the U.S. institutional context, whether such expansions can be achieved remains an outstanding question. An important factor believed to have inhibited STC usage in the past has been the lack of employer awareness of the program. The Department of Labor currently is funding a randomized controlled trial to study the extent to which employer outreach to raise awareness can increase STC usage. In addition, variation across states in the treatment of employers who establish STC plans—in particular, whether or not those employers will be charged for the costs of STC benefits during the period when the federal government is reimbursing states for STC benefits paid—should provide valuable information about whether such subsidization of work sharing can significantly increase its use among employers. The experience of other countries suggests that STC programs can provide an important policy tool to combat unemployment during economic downturns. Ongoing research should help to determine whether significant increases in STC usage realistically can be achieved in the United States. Research also will be needed to understand the extent to which STC programs in the United States actually mitigate job losses and blunt the impact of recessions on businesses, workers, and communities.

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Table 1 Full-time Equivalent of STC Weeks Claimed as a Percent of Regular UI Weeks Claimed, Selected Years

Year	1991	1992	2001	2002	2008	2009	2010
Arizona	0.4	0.6	0.6	0.3	0.2	0.5	0.3
Arkansas	0.1	0.1	na	na	na	na	0.1
California	0.5	0.7	0.4	0.5	0.4	1.1	1.0
Connecticut	na	0.0	0.4	0.5	0.2	1.6	0.8
Florida	0.2	0.2	0.1	0.1	0.0	0.2	0.1
Iowa	0.1	0.0	0.0	0.2	na	1.1	0.5
Kansas	0.7	0.7	0.9	0.5	3.2	2.6	1.3
Maryland	0.2	0.1	na	na	0.0	0.2	0.2
Massachusetts	na	0.1	0.1	0.4	0.1	0.8	0.3
Minnesota	na	0.0	0.3	0.5	0.2	0.8	0.3
Missouri	0.3	0.3	0.8	0.5	0.8	1.6	0.9
New York	0.2	0.2	0.5	0.4	0.2	1.1	0.7
Oregon	0.1	0.1	0.2	0.2	0.2	1.0	0.7
Rhode Island	0.0	0.6	1.4	1.4	1.8	4.2	3.0
Texas	0.1	0.1	0.1	0.1	0.3	0.4	0.3
Vermont	na	0.1	1.0	1.3	0.7	1.5	0.7
Washington	0.1	0.1	0.3	0.3	0.5	1.3	1.6

NOTE: na = not available.

SOURCE: Authors' calculations based on data from the Employment and Training Administration, U.S. Department of Labor.

Table 2 STC Benefits Paid as a Percent of Regular UI Benefits Paid, Selected Years

Year	1991	1992	2001	2002	2008	2009	2010
Arizona	0.4	0.5	0.7	0.4	0.3	0.6	0.5
Arkansas	0.2	0.7	0.0	0.0	0.5	1.0	0.2
California	0.6	0.6	0.7	0.8	0.7	1.6	1.9
Connecticut	na	0.0	0.5	0.6	0.2	2.0	1.5
Florida	0.2	0.2	0.1	0.1	0.1	0.2	0.2
Iowa	0.2	0.2	0.0	0.2	0.0	1.4	0.7
Kansas	0.8	0.7	1.0	0.5	3.7	3.0	1.2
Maryland	na	na	na	na	na	na	0.1
Massachusetts	0.0	0.1	0.2	0.5	0.1	0.9	0.4
Minnesota	0.0	0.0	0.3	0.5	0.2	1.0	0.5
Missouri	0.4	0.4	0.8	0.6	0.9	1.9	1.1
New York	0.3	0.5	0.5	0.4	0.2	1.0	0.5
Oregon	0.1	0.2	0.3	0.3	0.4	1.5	1.2
Rhode Island	0.0	0.7	1.8	1.6	1.7	9.8	3.5
Texas	0.1	0.1	0.1	0.1	0.4	0.5	0.4
Vermont	0.0	0.1	1.3	1.7	0.9	2.1	0.8
Washington	0.1	0.2	0.4	0.3	0.6	1.6	1.9

NOTE: na = not available.

SOURCE: Authors' calculations based on data from the Employment and Training Administration, U.S. Department of Labor.

Table 3 Take-up Rates of Work sharing Programs, 2007–2009, Selected Countries*

	All Employees			Manufacturing		
	2007	2008	2009	2007	2008	2009
Austria	0.00	0.03	0.63	0.00	0.17	3.41
Belgium	3.22	3.53	5.60	6.44	7.36	16.99
Canada	0.02	0.03	0.34	na	na	na
Czech Republic	na	0.61	1.44	na	1.59	4.49
Finland	0.36	0.47	1.67	na	0.59	2.69
France	0.34	0.31	0.83	na	0.53	3.61
Germany	0.08	0.17	3.17	0.17	0.53	12.06
Ireland	na	0.17	1.03	na	0.48	1.34
Italy	0.64	0.78	3.29	1.75	2.29	9.95
Netherlands	na	0.20	0.75	na	1.39	5.01
United States*	0.04	0.07	0.22	na	na	na

NOTE: na = not available. *Take-up rate for the United States is computed for the subset of states with short-time compensation programs. These data were provided as a special tabulation in an EC-OECD questionnaire.

SOURCE: OECD 2010b, Table 1.A6.2, Table 1.A6.3

Table 4 Take-up Rates of Short-time Compensation Programs by State, 2007–2010

	All private sector employees				Upper bound estimates of take-up rates among manufacturing production workers			
	2007	2008	2009	2010	2007	2008	2009	2010
Arizona	0.01	0.02	0.11	0.06	0.24	0.41	2.01	
Arkansas	0.00	0.04	0.10	0.02	0.01	0.25	0.70	0.14
California	0.04	0.06	0.25	0.20	0.60	1.01	4.55	3.16
Connecticut	0.02	0.03	0.39	0.23	0.23	0.35	5.27	
Florida	0.00	0.01	0.03	0.02	0.04	0.12	0.91	
Iowa	0.00	0.00	0.18	0.07	0.00	0.00	1.54	
Kansas	0.02	0.17	0.39	0.14	0.15	1.44	3.69	
Maryland	na	0.02	0.03	0.02	na	0.38	0.75	0.38
Massachusetts	0.01	0.02	0.18	0.06	0.15	0.26	2.95	0.99
Minnesota	0.01	0.02	0.18	0.06	0.14	0.24	2.12	
Missouri	0.04	0.07	0.26	0.11	0.48	0.77	3.16	1.45
New York	0.01	0.01	0.14	0.06	0.19	0.28	2.99	
Oregon	0.01	0.03	0.31	0.17	0.13	0.29	3.44	1.98
Rhode Island	0.11	0.24	0.85	0.50	1.38	3.17	12.35	7.40
Texas	0.01	0.02	0.06	0.03	0.15	0.26	0.86	0.49
Vermont	0.11	0.09	0.37	0.11	1.01	0.88	4.01	1.17
Washington	0.01	0.04	0.29	0.27	0.15	0.61	4.27	4.14
US:	0.02	0.04	0.17	0.10	0.26	0.51	2.74	1.39

NOTE: na = not available. *Take-up rate of short-time compensation is the average percent of private-sector employees in the state participating in the state's STC program during the indicated year. The aggregate figures are computed as employment-weighted averages of the 17 states and differ slightly from the figures reported for the United States by OECD and reproduced in Table 3. (See ftn. 3 in text for further discussion.) The upper-bound estimate of take-up rates for manufacturing production workers assumes manufacturing production workers account for all STC use.

SOURCE: Authors' calculations based on STC program data supplied by the U.S. Department of Labor, Employment and Training Administration.

Table 5 Cross-state Differences in the Composition of Total Hours Adjustment among Manufacturing Production Workers

	Dependent variable: Δ ln production emp			
Δ ln total hours × pre-recession indicator	0.27**			
	(0.09)			
Δ ln total hours × recession indicator	0.47**			
	(0.10)			
Δ ln total hours × Pre-recession indicator × state		Δ ln total hours × Recession indicator × state		
Arizona	0.70**		Arizona	−0.09~
	(0.08)			(0.05)
Arkansas	−0.05		Arkansas	−0.20**
	(0.08)			(0.04)
California	0.51**		California	−0.01
	(0.10)			(0.05)
Connecticut	0.35~		Connecticut	−0.30**
	(0.18)			(0.04)
Florida	0.44**		Florida	0.06
	(0.07)			(0.05)
Iowa	−0.05		Iowa	−0.09~
	(0.11)			(0.05)
Kansas	−0.30**		Kansas	0.03
	(0.09)			(0.06)
Maryland	1.04**		Maryland	−0.14
	(0.20)			(0.09)
Massachusetts	0.05		Massachusetts	−0.15**
	(0.24)			(0.05)
Minnesota	-0.13~		Minnesota	0.06
	(0.08)			(0.05)
Missouri	0.04		Missouri	−0.04
	(0.11)			(0.04)
New York	−0.13~		New York	−0.20**
	(0.07)			(0.04)
Oregon	0.12~		Oregon	0.04
	(0.07)			(0.06)
Rhode Island	0.36**		Rhode Island	−0.09*
	(0.12)			(0.05)
Texas	0.33**		Texas	−0.15*
	(0.07)			(0.06)
Vermont	0.50**		Vermont	0.04
	(0.13)			(0.06)
Washington	0.45**		Washington	−0.04
	(0.05)			(0.08)
Constant	−0.00			
	(0.00)			
Observations	2,184			

NOTE: The table reports selected coefficients from equation (3) in the text. A full set of 46 state dummy variables and year-month time dummy variables also were included in the regression. Robust standard errors clustered on state are reported in parentheses. The symbol "~" indicates p<0.1, "*" indicates p<0.05, and "**" indicates p<0.01.

Table 6 Average Weekly FTE Persons on STC by State, 2008 and 2009

	2008	2009		
State	Number	Number	As % change in private sector employment	As % change in manuf production employment
All STC States	4,485	22,050	−0.73	−4.87
Arizona	107	476	−0.26	−4.00
Arkansas	76	188	−0.47	−1.11
California	1,578	6,578	−0.75	−6.78
Connecticut	78	1,420	−2.09	−16.34
Florida	71	368	−0.08	−0.92
Iowa	na	560	−1.17	−3.05
Kansas	604	1,063	−2.21	−6.36
Maryland	na	180	−0.21	−4.36
Massachusetts	114	1,123	−0.96	−6.03
Minnesota	105	795	−0.72	−2.25
Missouri	407	1,425	−1.32	−5.96
New York	318	3,044	−1.24	−7.51
Oregon	86	963	−0.89	−4.41
Rhode Island	257	887	−4.14	−22.88
Texas	345	1,022	−0.3	−1.47
Vermont	55	198	−1.85	−5.14
Washington	286	1,760	−1.29	−8.29

NOTE: na = not available.

SOURCE: Authors' calculations based on STC program data supplied by the U.S. Department of Labor, Employment and Training Administration.

Appendix Table Selected Characteristics of State Short-Time Compensation Laws, June 2013

State	Program Pre-dated 2007-2009 Recession?	Minimum Hrs. Redn	Maximum Hrs. Redn[a]	Maximum Plan Length (in weeks)	Maximum Weeks Payable (in weeks)	STC Employers May Incur Extra Charges?	Employers with Negative Balance or at Top UI Tax Rate Excluded?
Arizona	X	10%	40%	52	26[b]	X	
Arkansas	X	10%	40%	52	25		X
California	X	10%	n.a.	26	[c]		
Colorado		10%	40%	52	18		X
Connecticut	X	20%	40%	26	26		
District of Columbia		20%	40%	52	50[e]		
Florida	X	10%	40%	52	26	X	
Iowa	X	20%	50%	52	26		
Kansas	X	20%	40%	52	26		X
Maine		10%	50%	52	52		
Maryland	X	10%	50%	26	26		
Massachusetts	X	10%	60%	26	26	X	
Michigan		15%	45%	52	[f]		X
Minnesota	X	20%	40%	52	52		X
Missouri	X	20%	40%	52	52	X	
New Hampshire		10%	50%	26	26	X	
New Jersey		10%	n.a.	52	26		
New York	X	20%	60%	53	20		
Ohio		10%	50%	52	[c]		
Oklahoma		20%	40%	52	26		X
Oregon	X	20%	40%	52	52	X	
Pennsylvania		20%	40%	52	52		X
Rhode Island	X	10%	50%	52	52		
Texas	X	10%	40%	52	26		
Vermont	X	20%	50%	26	26		X
Washington	X	10%	50%	52	[g]		
Wisconsin		10%	50%	26	26		

NOTE:

[a] Under the Middle Class Tax Relief and Job Creation Act of 2012, programs must set a maximum hours reduction of no more than 60% and require employers to maintain full health and retirement benefits. Changes to state law must be made by August 22, 2014. During the period when the federal government is reimbursing states for STC benefits states may choose not to charge employers for benefits paid.

[b] Does not apply when IUR for preceding 12 weeks 4% or higher

[c] Total paid cannot exceed 26 times weekly benefit amount

[d] 26 week extension possible

[e] 2 week extension possible

[f] Total paid cannot exceed 20 times weekly benefit amount

[g] Benefits cannot exceed maximum entitlement

NOTES

1. Currently, 18 states use a so-called benefit-ratio formula for computing UI tax rates. Under this funding mechanism it is possible the state will never recover benefit charges from employers at the maximum UI tax rate, thus further subsidizing layoffs in these cases.

2. Partly addressing this concern, the new federal legislation governing STC programs stipulates that participating employees may enroll in training programs, including programs funded through the Workforce Investment Act, to improve their job skills. By enhancing their skills, such training could help prepare workers for alternative employment.

3. The three states that abandoned their STC programs are Illinois, Louisiana and North Dakota. Wandner (2008) reports that only one employer ever made use of the STC program in North Dakota.

4. The appendix to the paper summarizes selected provisions of state STC laws in effect as of June 2013. Some states will be required to make changes to their programs in order to be compliant with the new federal law.

5. The primary source of this information is a June 2013 telephone interview with Ray Filippone, former Assistant Director of Income Support, Rhode Island Department of Labor and Training.

6. The Middle Class Tax Relief and Job Creation Act permits states to amend their unemployment insurance laws to not charge employers for, or to not require the reimbursement of, STC benefits when the federal government is fully reimbursing states for the amount of STC benefits paid. At the time of this writing, several states had passed STC legislation with such non-charging provisions.

7. As part of the administrative reporting to the federal government during this period, states with STC programs were asked to compute full-time equivalents for both STC initial claims and STC weeks claimed. In a number of cases, however, these data items were missing. In cases where the FTE for weeks claimed was not reported, we multiplied STC weeks claimed by the average ratio of FTE weeks claimed to weeks claimed in the proximate months. In cases where FTE weeks claimed data were completely missing, we multiplied STC weeks claimed by the ratio of FTE initial weeks to initial claims. For Texas, no FTE information was available, and we assume a flat 20 percent reduction in hours.

8. In almost every state, both the ratio of STC claims to regular UI claims and the ratio of STC benefits paid to regular UI benefits paid remained at the 2010 level or fell further in 2011 and 2012.

9. The data for the United States were collected in a special questionnaire administered by the European Commission and OECD and reported in OECD 2010b. Using data supplied by the Employment and Training Administration, we report in Table 4 figures somewhat lower than those reported by OECD. Details of the methodology used by the OECD to calculate the U.S. take-up rates have not been published, but the aggregate rate appears to have been computed as a simple average of the component state take-up rates. This would overstate the importance of high-use but small states such as Rhode Island. The figures we report in Table 4 are weighted to account for differences in employment levels across STC states.

10. Production workers account for a little over 70 percent of manufacturing employment nationwide.

11. Unfortunately, we are unable to extend the analysis to include the early years of the recovery. The old computer system used by the BLS for this program had produced both published and unpublished estimates, but during 2010 and 2011 when the program was transitioning to a new computer system only published estimates were produced. This means that the unpublished estimates on which we relied for many states are unavailable for the period from January 2010 through February 2011.

12. Delaware, Oklahoma, Pennsylvania, Tennessee, and Wyoming were dropped from our data owing to missing or anomalous data. We also estimated models excluding Puerto Rico and obtained nearly identical results.

13. The year-to-year changes in total hours for 2007–2008 are generally negative; less than 20 percent of the state-month changes in production worker hours are positive. The changes in total hours in 2008–2009 are nearly all negative; only four state-month changes in this year are positive, three in Alaska and one in Washington state.

14. States report full-time equivalents for STC initial weeks claimed and for STC weeks claimed, but not for STC weeks paid. To adjust STC weeks paid, we multiply these figures by the ratio of FTE weeks claimed to weeks claimed in the month or, in instances where that data item is missing, by the ratio of FTE initial weeks claimed to initial weeks claimed. All FTE data were missing for Texas, and we assumed a ratio of 0.2 or 20 percent reduction in weekly hours.

15. As a further check on the plausibility of the hypothesis that STC significantly affected labor adjustment patterns of manufacturers in some states, we constructed a hypothetical production employment series for STC states and re-estimated equation (3) using the new series. Specifically, using monthly STC data reported by the states, we computed monthly FTE persons on STC for the years 2005 to 2009 and subtracted it from actual production worker employment. In using FTE persons on STC as a measure of potential jobs saved in manufacturing, we assume that manufacturers account for all STC use and that the presence or absence of an STC program does not affect the extent to which employers adjust total labor hours. As expected, the coefficients on the STC state interactions with total hours change and recession period generally became less negative, implying that in the absence of STC programs there could have been significantly greater reliance on employment reductions to reduce labor input. The change in the coefficient estimate was generally large and significant in states with the greatest utilization of STC programs, including Connecticut, Massachusetts, New York, and Rhode Island.