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THE EFFECTS OF MINIMUM WAGES THROUGHOUT THE WAGE DISTRIBUTION

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The Effects of Minimum Wages Throughout the Wage Distribution
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ABSTRACT

This paper provides evidence on a wide set of margins along which labor markets can adjust in response to increases in the minimum wage, including wages, hours, employment, and ultimately labor income, representing the central margins of adjustment that impact the economic well-being of workers potentially affected by minimum wage increases. The evidence indicates that workers initially earning near the minimum wage are adversely affected by minimum wage increases, while, not surprisingly, higher-wage workers are little affected. Although wages of low-wage workers increase , their hours and employment decline, and the combined effect of these changes is a decline in earned income.

We also delve into the political economy of minimum wages, attempting to understand the vigorous support of labor unions for minimum wage increases. Using the same empirical framework, we find that relatively low-wage union members gain at the expense of the lowest-wage nonunion workers when minimum wages increase.

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I. Introduction

Labor markets can adjust along a variety of margins in response to increases in the minimum wage. For example, employers may alter the number of workers employed at an establishment, or they may adjust the average number of hours worked by each employee. In addition, firms may alter the mix of workers employed following an increase in the minimum wage, essentially attempting to realign the marginal product of their workers with the wages they are paid. Finally, the effects of minimum wages may extend beyond those workers whose wages are directly impacted by the higher floor. A result of these various margins of adjustment is that workers may be affected quite differently according to their skill level and position in the wage distribution, suggesting that the typical focus of past research on employment effects provides an inadequate characterization of the policy implications of raising the minimum wage.

The goal of this paper is to improve upon the existing body of research by providing a richer description of the effects of the minimum wage on labor markets. We attempt to achieve this goal in two ways. First, using an internally consistent framework, we explore evidence on a wide set of the margins along which labor market adjustments to minimum wages may occur, including changes in wage rates, hours, employment, and ultimately labor income; these represent the primary adjustments that impact the economic well-being of workers potentially affected by minimum wage increases. Second, we examine in a detailed manner the effects of minimum wages on wages, hours, employment, and incomes at different points of the wage distribution, with a particular, but not exclusive, focus on minimum wage effects at the lower end of the wage distribution. This information, which is largely missing from existing minimum wage research, is crucial to an evaluation of whether minimum wage increases help low-wage workers, and ultimately to a fuller understanding of how minimum wages influence labor market behavior.

We also delve into the political economy of minimum wages. It is well known that unions vigorously support minimum wage increases (e.g., Trumka, 1996).[1] One explanation of this support is that

[1]Bloch (1980, 1993) reports evidence that U.S. Senators' votes in favor of minimum wage increases (especially those of Republican senators) are positively influenced by the extent of unionization in their state, consistent with strong union support for higher minimum wages.

unions are generally in favor of public policies that increase earnings of low-wage workers and reduce earnings inequality, a goal that minimum wages are perceived to further. A second potential explanation, however, is that union members stand to gain from minimum wage increases because a higher wage floor shifts labor demand toward higher-paid and higher-skilled workers who are more likely to be union members. For example, Hamermesh and Rees (1993) suggest that "Union political activity often consists of efforts to push legislation restricting competition from low-wage, nonunion labor ..." (p. 393). As indirect evidence, they cite a study by Cox and Oaxaca (1982) indicating that states that are more heavily unionized are more likely to have a higher legislated state minimum wage. To shed some light on which explanation of union support for minimum wage increases better characterizes the data, we use our empirical framework to investigate the independent effects of minimum wage changes on wages, employment, hours, and incomes of union and nonunion workers at different points in the wage distribution.

II. Existing Research

Evidence from Studies of Employment Effects for Teenagers and Young Adults

Our efforts to distinguish minimum wage effects for low-wage workers differentiates our approach from much existing work on employment effects of minimum wages. Such research has typically studied teenagers as a group in order to focus on a set of relatively low-skilled workers, although there is no particular policy-related reason for doing so.[2] Indeed, one could argue that policy makers should be more concerned with adults working near the minimum wage. Whereas young workers are on the early part of their experience profile and hence are likely to "grow out" of minimum wage jobs, adults working at minimum wage jobs are more likely to be "permanent" low-wage workers.

Moreover, the emphasis on employment effects may provide a misleading picture with respect to

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[2]As pointed out in Neumark and Wascher (1995), an absence of net employment effects for teenagers may mask declining school enrollment stemming from minimum wage increases, so employment effects may not be the most important outcome to consider regarding minimum wage effects on teenagers.

the policy question of the effects of minimum wages on the economic well-being of low-wage workers. In particular, because many teenagers and young adults earn wages well above the minimum, estimates of disemployment effects for this group as a whole may mask larger disemployment effects for the lowest-wage workers, and thus implicitly overstate the resulting income gains experienced by low-wage workers.[3] Moreover, hours may respond differently to minimum wages than does employment, reflecting potential adjustments to average workweeks and the relative use of full-time and part-time workers. In the other direction, standard estimates of employment effects ignore the impact of minimum wages on the wage distribution, an omission that potentially ignores some of the "winners" from minimum wage increases. In the end, labor income provides perhaps the best summary statistic for measuring economic well-being at the level of the individual,[4] and, given the possibility of hours and wage effects, as well as the concentration of employment effects among certain groups of workers, an exclusive focus on employment is unlikely to be a sufficient measure of the costs and benefits of minimum wage policy.

Recognizing this shortcoming in the literature, some research has studied other margins of adjustments of low-wage labor markets to increases in the minimum wage, focusing either on effects on the wage distribution or on changes in full-time and part-time work. Below, we summarize this research and contrast it with our approach.

Effects on the Wage Distribution

There is a fairly extensive body of research exploring the effects of minimum wages on the wage distribution, with a particular emphasis on the extent to which minimum wage increases lead to positive "ripple" effects on the wages of workers previously earning wages above the new minimum. Such effects are of obvious importance in assessing the consequences of minimum wages for low-wage workers (and low-income families), both because the minimum wage in the United States is relatively low and because

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[3]See Neumark and Wascher (1997) for a full discussion of this point.

[4]A more overriding policy concern is the effects of minimum wages on family incomes; see Neumark, et al. (1998).

many U.S. workers earning above the minimum are in poor and near-poor families.

Gramlich (1976) originally broached this question, suggesting that standard substitution effects or union-related relative wage considerations might lead to increases in the wages of higher-skilled workers following an increase in the legislated minimum wage.[5] Gramlich presents some evidence, based on aggregate hourly wage equations, suggesting that minimum wage increases raise average wage rates by about twice what would be predicted from the direct impact of these increases on workers for whom minimum wages are binding (without accounting for possible employment effects). This evidence is consistent with some positive impact on other wages, although the reliance on aggregate data prevents an analysis of where in the wage distribution these spillovers occur.

Grossman (1983) introduced relative wage concerns into the analysis (in an efficiency-wage type model), in addition to the standard neoclassical effects. In particular, using samples for nine different occupations consisting of average wages in a set of cities represented in Area Wage Surveys, Grossman finds some evidence that minimum wages boost wages of higher-skill workers. She attempts to test for ripple effects based on relative wage concerns by asking whether there is a quick response of wages of higher-skilled workers to minimum wage increases, arguing that these pure relative wage effects should occur quickly, while wage effects stemming from substitution toward higher-skilled labor should occur more slowly, as quantity adjustments are likely to take some time. However, because theory does not make strong predictions regarding the timing, this evidence is not very conclusive, as Grossman readily admits (p. 376). Moreover, although relative wage concerns may provide another reason for "ripple" effects of minimum wages, they do not necessarily have different implications for the wage or income distribution than those of the neoclassical model. Relative demand shifts toward higher-skill workers unambiguously increase their earnings, but the introduction of relative wage concerns (in addition to substitution effects)

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[5]Another possibility not raised in the literature is that the labor supply of higher-skilled workers might increase as lower-skilled workers (in the same family) become disemployed or face lower hours as a result of minimum wage increases. This could lead to lower wages and higher hours for these higher-skilled workers.

does not necessarily overturn this prediction; relative wage concerns should raise wages but lower hours, with ambiguous implications for earnings, and substitution effects can still predominate even if relative wage effects lower incomes.

More recent analyses of the effects of minimum wages on the wage distribution have built on this previous research by using empirical methods that more directly reveal the impacts of minimum wages on the wage distribution, and by using nationally-representative micro-level samples. DiNardo, et al. (1996) present a semi-parametric analysis of how changes in national minimum wages have affected wage inequality, while Lee (1998) examines this question in more detail using state-level variation. The focus of these papers is more on how minimum wages "sweep up" workers in the bottom tail of the wage distribution, as opposed to an analysis of the effects on the part of the wage distribution above but near the new minimum. However, the estimates they present are suggestive of a positive spillover from minimum wages to this region of the distribution as well.[6]

Effects on Hours

There is relatively little evidence on the effects of minimum wages on hours worked, although some research has examined the effects of minimum wages on the probabilities of part-time and full-time employment, which is of course related. Gramlich (1976), for example, finds that for teenagers and adult males, minimum wages reduce full-time employment and increase part-time employment; although an overall disemployment effect is apparent for teenagers only, the switch from full-time to part-time is consistent with hours reductions for both groups. Hungerford (1996) reports that for workers with 12 or fewer years of education, minimum wages increase the proportion of involuntary part-time workers across a wide range of demographic groups, while the effects on the proportion working full-time are somewhat more ambiguous but generally negative. However, this research does not provide contrasts with evidence for higher-skill workers, which is needed to ask whether these effects impact low-skill workers particularly

[6]See also Spriggs (1992) and Card and Krueger (1995, Ch. 9) for more limited evidence consistent with minimum wages increasing wages of above-minimum wage workers, and Green and Paarsch (1998) for evidence on these spillovers in Canada.

strongly. More importantly, the models estimated do not include fixed state effects, making it difficult to sort out the causal effects of state and federal minimum wage increases from persistent state differences associated with minimum wages and employment status. In contrast to these results, studying an earlier period, Cunningham (1981) reports evidence suggesting that minimum wages discourage part-time employment and boost full-time employment, as do Katz and Krueger using data from fast-food restaurants in Texas.[7] Finally, Zavodny (1999) finds that teenagers who remain employed following a minimum wage increase tend to experience an increase in hours worked, which roughly offsets the overall negative employment effect for this age group.

More Comprehensive Approaches

Three papers that come closer to our more comprehensive approach are Linneman (1982), Currie and Fallick (1996), and Abowd, et al. (1999). The Abowd, et al. study is limited to employment, but improves on much of the existing research by asking how the effects of minimum wages differ depending on one's position in the wage distribution.[8] These authors examine individual-level panel data for France, where the real minimum wage rose throughout their sample period (1981-1989), and for the U.S., where it fell (1981-1987). They can then study minimum wage effects in two opposite but closely related ways. In particular, in France they condition on initial employment and ask whether those whose real wage in year t was between the real minimum in year t and year t+1 are less likely to be employed in year t+1 than those whose real wage in year t is marginally above the year t+1 real minimum wage. This can be interpreted as a test for disemployment effects among those who are "caught" by the minimum wage. In the U.S., where the real minimum wage fell, they instead look at those employed in year t+1 and ask whether workers

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[7]Neumark and Wascher (forthcoming) and Michl (1998) touch on the issue of effects of minimum wages on employment and hours in the context of the Card and Krueger (1994) New Jersey-Pennsylvania minimum wage study.

[8]Lang and Kahn (1995) take a different approach to this question by asking whether minimum wage effects differ for "permanent" low-wage workers than for "temporary" low-wage workers. Using data on the distribution of employment in food service occupations and eating and drinking establishments, they find that minimum wage increases shift employment opportunities away from low-wage adults (who are more likely to be permanent low-wage workers) toward teenagers.

whose year t+1 real wages are between the year t real minimum and the year t+1 real minimum (which is lower) are less likely to have been employed in year t. This can be interpreted as a test for disemployment effects using the positive employment response among those "released" by the reduction in the real minimum wage. For both France and the U.S., Abowd, et al. report considerably sharper disemployment effects of minimum wages for those constrained by the minimum than for those with marginally higher wages; in particular, "relative" employment elasticities range from -.4 to -1.6, with the larger (absolute) elasticities for women in each country.

Currie and Fallick (1996) carry out a similar analysis using NLSY data for the U.S. They identify workers who were "bound" by the 1980 and 1981 federal minimum wage increases, in the sense that their wage prior to the increase was between the old and the new minimum wage. As in the Abowd, et al. study, those workers earning near the minimum wage, but who are not bound by it, serve as the control group; in this study, though, the control group also includes those earning less than the old minimum. The results indicate that the employment of those initially bound by the gap fell significantly in relative terms in the year following the minimum wage increase, indicating disemployment effects of the minimum wage on those constrained by it; these disemployment effects are evident relative to both those above and those below the new minimum. The point estimates suggest that those bound by the minimum were about three percent less likely than the control group to be employed after the minimum wage increase, which given that the two minimum wage increases in this sample period were on the order of seven or eight percent, suggests relative employment elasticities for those bound by the minimum of about -.4.

Thus, these two papers indicate that disemployment effects of minimum wages are potentially more severe for those whose wages are most likely to be constrained by a minimum wage increase. In particular, they point to more adverse consequences for low-wage workers than are suggested by the estimated employment elasticities of -.1 to -.2 from the aggregate studies of teenagers and young adults. However, while these papers point to the importance of focusing on the affected group, they do not consider the possibility of secondary minimum wage effects for workers not directly affected by the minimum wage.

Moreover, because this research does not look at hours and income, it provides an incomplete picture of the effects of minimum wages on low-wage workers.

In contrast, Linneman's (1982) paper considers the effects of minimum wages on employment, hours, and income. Using PSID data from 1973, 1974, and 1975, he estimates the wage structure in 1973 and uses that wage structure to predict wages for each respondent in 1974 and 1975. These predicted wages, together with an adjustment for inflation, serve to identify workers who are constrained by the minimum wage in those years. Linneman's findings indicate hours (and to a lesser extent employment) reductions among constrained workers. However, he also estimates hours and employment effects for workers in various wage intervals above the minimum, finding that individuals just above the minimum (relative to those more than five dollars above the minimum) experience reduced employment prospects, but increased hours. Finally, Linneman also examines the impact of the minimum wage on income, finding a negative effect on the incomes of workers whose wages are constrained by the minimum wage and a positive effect on the incomes of unionized workers.

Although our approach is, in many ways, similar to that of Linneman in its focus and general methodology, we have a number of reservations regarding Linneman's implementation of this approach. First, Linneman uses an estimated wage structure derived from a regression of wages for those working in 1973 on various demographic and other control variables. As the coefficients from this regression are then used to predict wages for the non-employed, he includes in the wage equation the selection effect from a first-stage probit model on employment, but apparently identifies this selection effect solely from the functional form.[9] Second, he uses the predicted wage, based on the set of covariates, to predict wages of the non-employed, but uses actual wages plus the estimated difference in wages based on changes in these covariates, to predict wages of the employed. This procedure will tend to underpredict the wages of those who become employed (biasing the evidence against finding disemployment effects, as those falsely

[9]He notes that the wage equation includes the inverse Mills ratio, but mentions no variable that appears in the employment equation but not the wage equation.

predicted to be constrained by the minimum become employed), and to overpredict the wages of those who remain non-employed (also biasing the evidence against finding disemployment effects, as those falsely predicted to be unconstrained by the minimum remain non-employed). Moreover, when Linneman estimates the effects of the minimum wage on income for these two groups of workers, the estimates are not based on actual income in 1974 and 1975, but rather are imputed from the estimated hours and employment effects. Thus, these estimates take no account of the effects of the minimum wage on the wages of workers earnings more than the minimum, and hence likely understate income gains for these workers. In addition, this imputation method takes no account of the distribution of wage and hours effects across individuals.[10]

Below, we make a number of improvements to this method, provide a more complete characterization of minimum wage effects throughout the wage distribution, update and strengthen the empirical analysis by using much more data covering many more-and much more recent-minimum wage increases, and take advantage of the state-level variation in minimum wages that has been fruitfully exploited in the "new" minimum wage research.

III. The Empirical Approach

Basic Framework

Our basic approach is to estimate models for changes in wages, hours, employment, and income, using data on individuals in matched monthly CPS outgoing rotation group files over the period 1979-1997.[11,12] We illustrate our strategy by focusing on the estimation of the effects of minimum wages on the

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[10]A final problem is that Linneman does not compute standard errors for the income effects he estimates, so there is no way to determine which estimated effects are significant. Our approach yields these standard errors readily.

[11]While household identifiers are available for doing the matching, individual identifiers are not. In order to ensure that we match individuals correctly, we therefore filter the data through a procedure to arrive at successful matches. The basic technique is as follows. We specify a list of primary characteristics to serve as a basis for our match. These include the sex and age of the respondent. A match occurs when a household identifier-primary characteristics cell includes at least one pair of first-year and second-year records. For instance, a thirty-one year old female in the first year and a thirty-two year old female in the same household in the second year will be placed in the same cell. In the event of

wage distribution, although the discussion generalizes completely to the other dependent variables we consider. We first discuss the relatively simpler issue of estimating contemporaneous effects, to motivate the research design in a straightforward setting, and to illustrate our strategy of allowing the effects of minimum wages to differ across the wage distribution while controlling in a very flexible fashion for other sources of changes in wages throughout the wage distribution. This entails estimation of the following specification:

$$(1)\quad \frac{w_{i2}-w_{i1}}{w_{i1}} = \alpha + \sum_j \beta_j \frac{MW_2-MW_1}{MW_1}\cdot R(w_{i1},MW_1)_j + \sum_j \gamma_j R(w_{i1},MW_1)_j + \sum_j \phi_j R(w_{i1},MW_1)_j \cdot \frac{w_{i1}}{MW_1} + X_{i1}\delta + M_i\lambda + S_i\cdot Y_i\pi + \epsilon_i \quad .$$

In this specification, the i subscript denotes the individual, and 1 and 2 subscripts denote the year 1 or year 2 observation in the matched CPS data. We have omitted subscripts for state, year, and month. MW is the higher of the state or federal minimum wage, and w denotes the individual's wage. The vectors of variables X, S, Y, and M, are control variables defined as of year 1 for each individual. S denotes state dummy variables and Y year dummy variables; note that we include the full set of state-year interactions,

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multiple matches, we proceed to a set of tiebreakers. These include factors like educational attainment and major activity in the previous week. This tie-breaking phase checks for the correct matches in the cell at the most detailed partition of the specified variables first. If no match is found, then variables are systematically dropped to arrive at a match. Additional steps are conducted to match others that may have been missed in the first step. For example, since the CPS is not necessarily conducted on the same calendar day in subsequent years, a thirty-one year old female and a thirty-three year old female may be the same person, but they would have been excluded in our first step.

There are two sets of months that cannot be matched to observations 12 months ahead because of changes in the sample in response to decennial Censuses of Population: July 1984-September 1985 and June 1994-August 1995.

[12]We attempt to construct straight-time wages (excluding tips, commissions, and overtime) by using a reported hourly wage, as opposed to usual weekly earnings/usual weekly hours, whenever the former is reported. The weekly measure explicitly includes tips, commissions, and overtime, while the hourly wage measure is less likely to include these. Beginning with the redesigned CPS in 1994, the hourly wage measure was changed so as to explicitly exclude tips, commissions, and overtime. We assume that the year effects will pick up the influence of this change on average wage changes. For hours, we use usual weekly hours, which is coded as missing beginning in 1994 if the respondent indicates variable hours.

which subsumes standard state and year effects. These state-year effects capture non-independence between observations from the same state and year, such as that associated with the effects of omitted variables that vary at the state-year level.[13] Because the data set covers all months of the basic CPS, we also include calendar month dummy variables, denoted as M, to control for any form of seasonality–summer or holiday employment, for example–that might be spuriously correlated with minimum wage changes. The variables in X include sex, race, years of education, and a quartic in potential experience; their inclusion allows for different wage growth for workers distinguished by all of these characteristics.

R_j denotes a set of dummy variables for the position of the year 1 wage relative to the year 1 minimum wage. These are spelled out fully in Table 1, but as examples include a dummy variable for whether the wage is between 1.1 and 1.2 times the minimum, 1.5 and 2 times the minimum, etc. One category is omitted to avoid perfect multicollinearity. These dummy variables control for differences in wage changes at different points of the wage distribution for reasons unrelated to changes in minimum wages.[14] In addition, we include interactions of the R_j's with the ratio of the individual's wage to the minimum wage.[15] These terms allow wage growth to differ within the cells defined by the R_j's, which is particularly important for the rather broad cells defined by the R_j's higher up in the wage distribution.

The parameters of direct interest are the β_j, which capture the effects of a given percent change in the minimum wage at each point (or region) in the wage distribution defined by the R_j. The β_j's are still identified with the full set of state-year dummy interactions included, because the minimum wage change

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[13]This might include the nominal variation in general wage levels across states and within years that is typically captured in minimum wage-employment studies by including a state average wage in the denominator of a relative minimum wage variable, as well as state or year differences in inflation and most of the influence of the federal minimum wage. The alternative would be to use a random effects estimator that imposes the more restrictive assumption that state-year effects are uncorrelated with the included variables.

[14]Examples might include the effects of technology or trade on wage inequality. In addition, given some measurement error in wages, some of this may reflect regression to the mean.

[15]This amounts to a spline specification without restricting the lines to join at the knot points.

multiplying $R(\cdot,\cdot)$ may vary from month to month within the year. In principle, we could include month-state interactions, in which case we could only identify the effects of minimum wages at different points of the wage distribution relative to some omitted category, with the natural choice being the highest-wage workers. However, it seems inappropriate to assume a priori that higher-wage workers are not affected by minimum wage increases; supply shifts or relative demand shifts could affect these workers, even though their wages are not directly affected by minimum wage laws. Nonetheless, in most of the results we report below, the effects of minimum wages in the upper cell of the wage distribution we use (6-8 times the minimum) are relatively small, so the estimates for low-wage workers to a large extent mirror what we would obtain if outcomes were defined relative to this cell.[16]

Lagged Effects

Previous research has indicated that a significant portion of the total minimum wage effect on employment occurs with a lag of one year (Neumark and Wascher, 1992; Baker, et al., 1999). Although some have argued that high turnover for low-wage workers makes it likely that adjustments to minimum wages will occur quickly (e.g., Brown, et al., 1982), this ignores the possibility that changes in technology and management needed to produce with a workforce utilizing fewer low-skilled workers may take time.[17] Thus, the existence of lagged adjustment effects is, in our view, purely an empirical question. In addition, our earlier research on minimum wage effects on family incomes (Neumark and Wascher, 1997; Neumark, et al., 1998) indicated that minimum wage increases had beneficial effects on low-income families contemporaneously, but adverse effects after one year. This is consistent with upward wage adjustments occurring quickly, and quantity adjustments (employment and hours) occurring with a lag. As this paper also looks at incomes–although of workers rather than families–a parallel specification seems appropriate.

A complication arises, however, in estimating lagged effects with our data. The problem is that we

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[16]We verified this empirically; results are available upon request.

[17]As an example, consider the time involved in fast-food restaurants switching over to soda dispensing machines operated by customers.

cannot define a comparable set of R_j's in the year prior to year 1 (call it year 0); although we know the minimum wage for this period, we do not know the individual's wage because the matched CPS's provide only two years of data.[18] To get around this problem, we instead define the R_j's that we use to identify the lagged effects based on the year 1 wage (relative to the year 1 minimum), and estimate the equation

$$
\begin{aligned}
\frac{w_{i2}-w_{i1}}{w_{i1}} = \alpha &+ \sum_j \beta_j \frac{MW_2-MW_1}{MW_1}\cdot R(w_{i1},MW_1)_j + \sum_j (\gamma_j+\gamma^L{}_j)R(w_{i1},MW_1)_j \\
&+ \sum_j (\phi_j+\phi^L{}_j)R(w_{i1},MW_1)_j\cdot\frac{w_{i1}}{MW_1} + \sum_j \beta^L{}_j \frac{MW_1-MW_0}{MW_0}\cdot R(w_{i1},MW_1)_j \\
&+ X_{i1}\delta + M_i\lambda + S_i\cdot Y_i\pi + \epsilon_i \quad .
\end{aligned} \tag{2}
$$

This means that the lagged effects associated with a minimum wage increase from year 0 to year 1 are defined conditional on where a worker's year 1 wage was in the wage distribution relative to the minimum in year 1.

This specification of the lagged effect has the same interpretation as the usual lagged effect if "the individual's wage history does not matter." That is, it reflects the usual lagged effect if, conditional on w_1 relative to MW_1, the year 1 to year 2 effect of the minimum wage does not depend on the path of wage rates up to w_1–for example, whether an individual's wage was at w_1 all along or instead was swept up to w_1 by the initial minimum wage increase. To see this, consider the regression we would use instead of equation (2) if we actually had three years of data. This specification would be:

[18]In principle this problem could be avoided by using a data set covering 24 months or more, such as some of the SIPP or NLS panels. However, the rich characterization of minimum wage effects that we are attempting to provide in this paper requires very large samples, making the CPS the only feasible source of data.

$$
\begin{aligned}
\frac{w_{i2}-w_{i1}}{w_{i1}} &= \alpha + \sum_j \beta_j \frac{MW_2-MW_1}{MW_1}\cdot R(w_{i1},MW_1)_j + \sum_j \gamma_j R(w_{i1},MW_1)_j \\
&+ \sum_j \phi_j R(w_{i1},MW_1)_j \cdot \frac{w_{i1}}{MW_1} + \sum_j \beta^L{}_j \frac{MW_1-MW_0}{MW_0}\cdot R(w_{i0},MW_0)_j \\
&+ \sum_j \gamma^L{}_j R(w_{i0},MW_0)_j + \sum_j \phi^L{}_j R(w_{i0},MW_0)_j \cdot \frac{w_{i0}}{MW_0} \\
&+ X_{i1}\delta + M_i\lambda + S_i\cdot Y_i\pi + \epsilon_i \quad .
\end{aligned} \tag{3}
$$

The difference between equation (3) and equation (2) is that in that latter, in the R function in the lagged terms, w_{i0} replaces w_{i1}, and MW_0 replaces MW_1. These terms would provide conventional estimates of lagged effects, as we could classify a worker by his wage relative to the minimum in year 0, look at the minimum wage change from year 0 to year 1, and estimate the relationship between these and the wage change from year 1 to year 2. To see the sense in which our estimator still works if the wage "history" does not matter, consider the simplest case when the R function is simply the difference between the wage and the minimum wage, and in which we ignore the splines introduced by the term involving the ϕ_j's. Then the lagged terms in equation (3) would be

$$
\beta^L \frac{MW_1-MW_0}{MW_0}\cdot(w_{i0} - MW_0) + \gamma^L(w_{i0} - MW_0) \quad , \tag{4}
$$

while those in equation (2) would be

$$
\beta^L \frac{MW_1-MW_0}{MW_0}\cdot(w_{i1} - MW_1) + \gamma^L(w_{i1} - MW_1) \quad . \tag{5}
$$

Note that the expression in (4) can be rewritten as

$$
\begin{aligned}
&\beta^L \frac{MW_1-MW_0}{MW_0}\cdot[(w_{i1} - MW_1) + [(w_{i0} - MW_0) - (w_{i1} - MW_1)]] + \\
&\gamma^L\cdot[(w_{i1} - MW_1) + [(w_{i0} - MW_0) - (w_{i1} - MW_1)]] \quad .
\end{aligned} \tag{6}
$$

which we can further rewrite in a less restrictive fashion as

$$(7)\quad \beta^{L}\frac{MW_1-MW_0}{MW_0}\cdot(w_{i1} - MW_1) + \beta^{dL}\frac{MW_1-MW_0}{MW_0}\cdot[(w_{i0} - MW_0) - (w_{i1} - MW_1)] + \gamma^{L}(w_{i1} - MW_1) + \gamma^{dL}[(w_{i0} - MW_0) - (w_{i1} - MW_1)] \quad .$$

The assumption that the wage history does not matter implies that the coefficients β^{dL} and γ^{dL} are zero. In other words, once we know w_1 relative to MW_1, past history (in particular, the difference between the gap between an individual's wage and the minimum in year 0, and the wage and the minimum in year 1) has no predictive power for the wage change from year 1 to year 2. In this case the estimated lagged effects using the terms in (4) and (5) are equivalent, so we can estimate the lagged effects using the terms in (5).

Things are a bit more cumbersome when we reinsert the R function that is a set of dummy variables for the wage relative to the minimum and we re-introduce the splines. In this case equation (4) becomes

$$(8)\quad \sum_j \beta^{L}_j\frac{MW_1-MW_0}{MW_0}\cdot R(w_{i0},MW_0)_j + \sum_j \gamma^{L}_j R(w_{i0},MW_0)_j + \sum_j \phi^{L}_j R(w_{i0},MW_0)_j\cdot\frac{w_{i0}}{MW_0} \quad ,$$

while equation (5) becomes

$$(9)\quad \sum_j \beta^{L}_j\frac{MW_1-MW_0}{MW_0}\cdot R(w_{i1},MW_1)_j + \sum_j \gamma^{L}_j R(w_{i1},MW_1)_j + \sum_j \phi^{L}_j R(w_{i1},MW_1)_j\cdot\frac{w_{i1}}{MW_1} \quad .$$

Paralleling the expression in (6), (8) can be rewritten as

$$(10)\quad \sum_j \beta^{L}_j\frac{MW_1-MW_0}{MW_0}\cdot(R(w_{i1},MW_1)_j + [R(w_{i0},MW_0)_j - R(w_{i1},MW_1)_j]) + \sum_j \gamma^{L}_j(R(w_{i1},MW_1)_j + [R(w_{i0},MW_0)_j - R(w_{i1},MW_1)_j]) + \sum_j \phi^{L}_j(R(w_{i1},MW_1)_j\cdot\frac{w_{i1}}{MW_1} + [R(w_{i0},MW_0)_j\cdot\frac{w_{i0}}{MW_0} - R(w_{i1},MW_1)_j\cdot\frac{w_{i1}}{MW_1}]) \quad .$$

Paralleling equation (7), we can then rewrite (10) as

$$
\begin{aligned}
&\sum_j \beta^L{}_j \frac{MW_1 - MW_0}{MW_0} \cdot R(w_{i1}, MW_1)_j + \sum_j \gamma^L{}_j R(w_{i1}, MW_1)_j + \sum_j \phi^L{}_j R(w_{i1}, MW_1)_j \cdot \frac{w_{i1}}{MW_1} + \\
&\sum_j \beta^{dL}{}_j \frac{MW_1 - MW_0}{MW_0} \cdot [R(w_{i0}, MW_0)_j - R(w_{i1}, MW_1)_j] + \\
&\sum_j \gamma^{dL}{}_j [R(w_{i0}, MW_0)_j - R(w_{i1}, MW_1)_j] + \\
&\sum_j \phi^{dL}{}_j [R(w_{i0}, MW_0)_j \cdot \frac{w_{i0}}{MW_0} - R(w_{i1}, MW_1)_j \cdot \frac{w_{i1}}{MW_1}] \quad .
\end{aligned} \tag{11}
$$

As before, the assumption that the individual's wage history does not matter implies that in this less restrictive expression the coefficients β^{dL}, γ^{dL}, and ϕ^{dL} would be zero. In this case, we can again estimate the lagged effects from equation (2). This assumption is potentially problematic, as $\beta^{dL} \neq 0$ implies that our procedure may be missing a portion of the overall minimum wage effect. Nonetheless, we still think that our specification with contemporaneous and lagged effects provides the best available baseline estimate of minimum wage effects with these data, and is certainly preferable to a specification restricted to contemporaneous effects, as the latter assumes (by including only the current wage relative to the minimum) that the past history of wages and minimum wages is irrelevant.

Inferring Minimum Wage Effects for a Representative Worker

To this point, we have described how we estimate contemporaneous and lagged effects of minimum wages conditional on a worker's initial wage relative to the minimum wage. However, combining the estimated contemporaneous and lagged effects to obtain estimates of the longer-term or "total" effects of minimum wages on wages (or hours, employment, or income) is more complicated than in the usual case, because we have to apply the lagged effects to the appropriate cell of the wage distribution one year following a given minimum wage increase. In particular, workers experience wage growth whether or not minimum wages increase, and because many low-wage workers are on steep regions of experience or tenure profiles, a worker who is near the minimum wage in year 0 may be quite far above it in year 1. As a result, the typical minimum-wage worker may move several steps up through the wage

categories defined by our R_j variables, and thus inferences of the effects of minimum wages on low-wage workers need to be conditioned on expected changes in wages for other reasons. In addition, first-year minimum wage effects may move a worker to a different part of the wage distribution, in which case the estimated lagged effect needs to be applied to the region of the wage distribution in which the worker is likely to be found one year after the initial increase.[19]

To do this, we consider a set of hypothetical workers based on average characteristics and responses to minimum wage increases in each cell defined by the R_j's. The case we consider is a one-time c-percent increase in the minimum wage. We first use our estimates of equation (2) to predict the wage change for the representative worker in each cell defined by the R_j's, using

$$
\begin{aligned}
(12)\quad & E\left(\left[\frac{w_2-w_1}{w_1}\cdot\right]_j \;\middle|\; \frac{MW_2-MW_1}{MW_1} = c, \frac{MW_1-MW_0}{MW_0} = 0, \bar{X}_j, \overline{S\cdot Y}_j, \bar{M}_j\right) \\
& = \alpha' + \sum_{j'=1}^{J} \beta'_{j'}\cdot c\cdot R(w_1,MW_1)_{j'}\cdot\delta_{j'} + \sum_{j'=1}^{J} \phi'_{j'}\cdot R(w_1,MW_1)_{j'}\cdot\frac{w_1}{MW_1}_{j'}\cdot\delta_{j'} \\
& + \gamma' + \bar{X}_j\delta' + \bar{M}_j\lambda' + \overline{S\cdot Y}_j\pi' \quad j=1,\ldots,J \quad ,
\end{aligned}
$$

where $\delta_{j'}$ is the indicator function equal to one if j'=j, and 0 otherwise, the primes on the Greek letters indicate estimates, and the means of X, S, Y, and M are defined for individuals in cell j. Note also that the lagged terms from equation (2) drop out based on the assumption that this is a one-time increase in the minimum wage (and here we are looking at the contemporaneous effect). Based on these predictions, and the average value of w_1 in each cell,[20] we can obtain a predicted value of w_2 (denoted w_2^p) for the representative worker in each cell, which will have been affected both by the minimum wage increase, and

[19]Note that this problem is not related to our need to estimate lagged effects with only two years of data; the same issue would arise with three years of data. The problem arises because an individual's position in the wage distribution can change over time.

[20]We need these averages to assign a value to the ratios of wages to minimum wages that are interacted with the R_j's in equation (12).

the control variables (e.g., workers with a given level of experience will have a particular amount of predicted wage growth).

The next step is to predict the lagged effects that occur one year later. To do this, we shift the subscript on the predicted wage from w_2^p to w_1^p, use these predicted values to place workers in new "predicted" cells defined by the R_j's (based on MW_1 and w_1^p), and predict the lagged effect at the point where the contemporaneous increase is predicted to have moved the worker.[21] We do this using the equation

$$
\begin{aligned}
(13)\quad & E\left(\left[\frac{w_2 - w_1^p}{w_1^p}\right]_j \,\middle|\, \frac{MW_1 - MW_0}{MW_0} = c, \frac{MW_2 - MW_1}{MW_1} = 0, \bar{X}_j, \overline{S \cdot Y_j}, \bar{M}_j\right) \\
& = \alpha' + \sum_{j'=1}^{J} \beta_{j'}^{L'} \cdot c \cdot R(w_1^p, MW_1) \cdot \delta_{j'} + \sum_{j'=1}^{J} \phi_{j'}^{L'} \cdot R(w_1^p, MW_1)_{j'} \frac{w_1}{MW_{1_{j'}}} \cdot \delta_{j'} \\
& + \gamma^{L'} + \bar{X}_j \delta' + \bar{M}_j \lambda' + \overline{S \cdot Y_j} \pi' \quad j = 1, \ldots, J \quad .
\end{aligned}
$$

The sum of the expressions in (12) and (13) then yields the implied two-year effect of minimum wage increases on wages for workers in states with minimum wage increases. Note that the lagged effects are based on the average response within a wage category of a set of workers whose wages responded to a minimum wage increase one year prior. Similar expressions with c set to 0 provide estimates of the "counterfactual," i.e., changes in the wage distribution that would have occurred without minimum wage increases. Changes in the wage distribution for these workers are predicted based on the other control variables.[22]

Although the procedures described in this section have been described with the change in the wage as the dependent variable, they follow through precisely for hours, employment, and income. In these cases, we first estimate the contemporaneous effect using an equation corresponding to equation (12) for

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[21]We update potential experience by one year in doing this.

[22]We cannot simply subtract the terms involving these control variables off of equations (12) and (13) and report the estimated β's multiplied by the minimum wage increase, because these control variables influence w_1^p.

the relevant dependent variable. We then predict the year 1 wage as described above, and use an equation corresponding to equation (13), again for the relevant dependent variable, to estimate the correct lagged effect. Combining these predicted changes for wages, hours, employment, and income yields a detailed characterization of the effects of minimum wages at different points of the wage distribution.

One remaining issue is the appropriate way of performing hypothesis tests for our estimated "total" effects. The potential for cross-year and cross-equation correlations of errors, together with the rather complicated way we combine predictions from different equations, makes conventional standard errors difficult to calculate. We therefore instead use bootstrap-based standard errors. To support hypothesis tests for our estimation procedure, we estimate these standard errors based on 100 bootstrap repetitions. Hypothesis testing is done using the normal approximation so that only one value (the sampling variance) is estimated for each test. While not as flexible as direct tests based on the realized bootstrap sampling distribution, the quicker convergence of this approximation reduces the number of time-consuming iterations needed to a reasonable number. Efron and Tibishrani (1993) suggest a rule of thumb of at least 50 replications for this type of estimation.

IV. Results

Descriptive Statistics

Table 1 reports descriptive statistics for the full sample, and the subsamples defined by the R_j's that break up the distribution of initial wages into cells that–especially near the minimum–are quite disaggregated.[23] The figures in this table are largely as expected. With the exception of those initially paid below the minimum and those in the highest wage category, average hours worked per week increase monotonically with the initial wage, from the high 20's–suggestive of a fairly high proportion of part-time workers–to over 40. Combining this with wages, weekly labor income (defined in nominal terms) rises monotonically. Teenagers are heavily overrepresented in the lowest wage categories; although they make

[23]The notes to the table provide details on sample construction, exclusion restrictions, sample weights, etc.

up only six percent of the sample, they comprise 24 percent of below-minimum wage workers, 36 percent of minimum wage workers, and 29 percent of those earning above the minimum but below 1.1 times the minimum.[24] Similarly, women, blacks, and Hispanics are overrepresented among low-wage workers. Finally, union workers are underrepresented among wage categories up to approximately 1.5 times the minimum, with the converse holding (of necessity) for nonunion workers.

Wage Effects

We now discuss, in turn, minimum wage effects on wages, hours, employment, and labor income. Although the regression estimates do not provide a description of the total (contemporaneous and lagged) effects of minimum wages, we begin with these estimates before moving on to the more readily-interpretable graphs that report these total effects for representative workers at each point of the wage distribution.

Columns (1) and (1') of Table 2 report the estimates of β and β^L, respectively, in equation (2) using the change in wages as the dependent variable. The contemporaneous effects (the β's) are straightforward to interpret, as they measure the percentage change in the wage resulting from a one-percent increase in the minimum wage. The estimates reveal pronounced, statistically significant positive effects near the minimum. In particular, for workers at or just above the minimum wage, the elasticity of wages with respect to the minimum is about .8. This falls to about .25 to .4 for those between 1.1 and 1.5 times the minimum. For those below the minimum, the estimated elasticity actually exceeds one.[25] As we get higher into the initial wage distribution, the estimated elasticities become quite small, although some are

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[24]To account for rounding and slight reporting errors in wages, note that we define minimum wage workers as those with wages between ten cents less and ten cents more than the minimum (exclusive of the endpoints).

[25]We suspect that estimates for this part of the wage distribution are less reliable for a couple of reasons, including regression to the mean in wage data erroneously reported as below the minimum, and transitions between uncovered or tipped jobs and covered jobs. The latter scenario is likely to have a positive influence on the estimate of β for this cell, because the jump in the wage upon moving to a covered job will be higher the more the minimum has increased. Finally, we conjecture that minimum wage increases are followed by upward (perhaps temporary) ratcheting of minimum wage compliance, as employers and workers become better informed about prevailing minimum wages.

significant.

The estimates of the lagged effects (the β^L's) also reveal some interesting patterns. In particular, throughout the wage distribution, but especially near the minimum, the estimated coefficients are strongly negative. What this implies, and what shows up in the calculations for the representative worker in each cell of the wage distribution discussed below, is that part of the wage gains caused by minimum wage increases are "given back" in the following year. This point has not been noted in the previous literature on the effects of minimum wages on the wage distribution. However, it has an intuitive appeal, indicating that employers take advantage of inflation in subsequent years to partly undo the effects of legislated nominal wage increases.

Next, we report the estimated effects on the wage distribution one and two years out, based on the calculation described in the previous section. This information is more conveniently displayed graphically, and the wage effects are shown in the upper left-hand panel of Figure 1.[26] In this figure (and subsequent ones) we report the implied effect of a one-time ten-percent increase in the minimum wage. The figure displays the differential between the percentage change in the wage experienced by those in states with this minimum wage increase, and those in states without an increase. The gray bars simply replicate the estimated contemporaneous effects that were reported in column (1) of Table 2. Of more interest are the estimated total effects, the black bars, which incorporate lagged effects of minimum wages. As suggested by the negative estimates of the β^L's in column (1') of Table 1, the effects of minimum wages on the wage distribution are tempered considerably when lagged effects are incorporated. Near the minimum wage, the elasticity of the wage with respect to the minimum falls to about .4. The estimated elasticities then decline from about 1.1 to 1.5 times the minimum, and become negative, but small, above twice the minimum. The graph also displays information on the p-values associated with each estimated effect (for the null hypothesis of no effect, versus the two-sided alternative). Most of the effects greater than one percent or so

[26]Note that Table 2 reports conventional regression standard errors, while this figure and subsequent ones report bootstrapped standard errors. As might be expected, for the contemporaneous effects these standard errors are almost identical.

(in absolute value) are statistically significant at the five-percent level or better.

Taken as a whole, these results indicate that minimum wages increase wages of the lowest-wage workers. However, the evidence of wage declines for workers initially earning higher wages suggests either that outward labor supply shifts for this group outweigh increases in labor demand from substitution effects, or that the scale effects resulting from higher overall labor costs outweigh the substitution effects. In addition, the results in the figure indicate that wage losses at the upper end of the wage distribution are smaller in percentage terms than gains at the lower end, but larger in absolute terms. With more workers generally represented in the higher-wage cells (Table 1), this would suggest that minimum wages are a rather inefficient tax and transfer scheme; for example, abstracting from hours and employment effects, it would appear to cost more than $1 to raise earnings of low-wage workers by $1. Of course any such conclusions must be tempered by the possible demand and supply shifts that may accompany changes in minimum wages.

Hours

Having documented the effects of minimum wages on the wage distribution, we turn to effects on hours for workers at different points in the wage distribution. Here, we report results for hours conditional on remaining employed; below, we turn to results for employment. The regression estimates of β and β^L are reported in columns (2) and (2') of Table 2. The estimates reveal little evidence of contemporaneous hours reductions for workers at or slightly above the minimum, although there is a significant estimated decline for those initially earning below the minimum. For those earning between 1.2 and 1.5 times the minimum, there is evidence of moderate but statistically significant increases in hours. The lagged effects are more striking, with significant hours reductions for those at or above the minimum wage, up to about 1.5 times the minimum.

The display of the full set of contemporaneous and total effects are reported in the upper right-hand panel of Figure 1. For those below the minimum, the estimated total effect on hours in more negative than the contemporaneous effect alone. This occurs because the wage gains experienced by these workers (see

the upper left-hand panel of the figure) put them into higher cells in the wage distribution, where, as reported in Table 2, there are lagged hours reductions. More importantly, though, the figure reveals hours reductions for those who are initially at or just above the minimum wage, with elasticities of approximately -.2 to -.25; the estimates for those initially at the minimum are significant at the ten-percent level. On the other hand, hours are estimated to increase for higher-wage workers. Coupled with the reductions in their wages indicated in the upper left-hand panel, this evidence suggests that there are outward supply shifts of higher-wage workers–perhaps in response to reductions in hours for low-wage family members.

Employment

With respect to employment, the contemporaneous estimates in column (3) of Table 2 reveal disemployment effects for those at the minimum and those just above the minimum (up to 1.3 times the minimum); these estimates are statistically significant at the five- or ten-percent level. The estimated elasticities are in the -.12 to -.17 range (with the exception of the cell for those with wages 1.1 to 1.2 times the minimum), close to the "consensus" range of estimated disemployment effects for teenagers (Brown, et al., 1982; Fuchs, et al., 1998). Past research has focused on teenagers because they are viewed as low skill. Here, instead, we use low wages to identify low-skill workers, with similar results.

However, as suggested by the lagged estimates in column (3'), and as displayed in the lower left-hand panel of Figure 1, the disemployment effects are partially offset in the second year, becoming smaller and statistically insignificant, except for those with wages initially between 1.2 and 1.3 times the minimum. The pattern of stronger employment effects initially, but stronger hours effects later, is consistent with employers first laying off part-time workers, which reduces fixed costs of labor, and then later adjusting hours of the remaining low-wage workers.

Earned Income

Finally, we turn to earned income, combining the effects of minimum wages on wages, hours conditional on employment, and employment, in an unrestricted fashion. A priori, expectations are mixed based on the results reported above. Low-wage workers experience wage gains as a result of minimum

wage increases, but hours and employment declines (although evidence for the latter is weaker). Of course, we cannot simply use the elasticities for hours, employment, and wages to predict income effects, since we do not know the actual joint distributions of changes in these variables.

Columns (4) and (4') of Table 2 report the regression estimates. The contemporaneous effects are positive (and significant for most cells) for those initially earning up to twice the minimum wage. In contrast, the lagged effects are uniformly negative and quite strong, especially up to about twice the minimum.

The lower right-hand panel of Figure 1 reports the one-year and total effects. The contemporaneous effects, which replicate the regression coefficients, might be interpreted as suggesting that minimum wages increase the earnings of low-wage workers; the elasticities are in the .2 to .4 range for those initially earning up to twice the minimum and are statistically significant. However, adding in the lagged effects reverses this conclusion. As shown by the black bars, the total effects indicate that those below the minimum, at the minimum, and up to 1.1 times the minimum experience income declines. The estimated effect for minimum wage workers is on the order of a six percent decline, or a $-.6$ elasticity, and is statistically significant at the five-percent level. The source of the reversal is clear from the other panels of the figure. Although disemployment effects are tempered, hours reductions after one year are much sharper, and the wage gains considerably weaker.

Overall, this analysis indicates that the average low-wage worker is not helped, and is perhaps hurt, by a minimum wage increase. Although minimum wages bump up wages of these workers, hours reductions, in particular, interact with changes in wages in such a way that earned income declines.

Adults Only

One of the motivations we cited for looking at minimum wage effects conditional on workers' positions in the initial wage distribution is to see whether there is evidence of labor demand reductions for low-skilled workers generally. This contrasts with past work focusing on specific age groups (e.g., teens or young adults) in which there is likely to be a sizable group of low-skilled workers. To assess the extent to

which our results identify effects for low-wage adults, Figure 2 reports the same estimates as did Figure 1, but for the sample restricted to those aged 20 and over.[27] Most of the estimates reported in Figure 2 are quite similar. The positive wage effects for low-wage workers are pronounced in the year of the increase, but tempered the next year. The hours declines (conditional on employment) are a bit stronger for those initially earning the minimum wage or just above. However, the employment effects appear much weaker, with estimated total effects near zero for those initially at or just above the minimum.

The differences between the results for the entire sample and those for adults seem consistent with differences between teenagers and adults in the nature of the work relationship. In particular, minimum wage increases appear to result mainly in fewer job opportunities for teenagers, who tend to work part-time and have less of an attachment to the labor market. In contrast, the effect on low-wage adults, who probably have a strong attachment to the labor force, primarily occurs through a reduction in hours. Either way, however, the outcome of most interest–earned income–is similar, with negative effects of minimum wages evident for those initially at the minimum or earning just above the minimum.

Union vs. Nonunion Workers

Finally, we turn to the question of whether minimum wage effects differ substantively between union and nonunion workers. This is of interest in attempting to understand the strong support for minimum wages on the part of unions. As Table 1 showed, union workers are severely underrepresented in the lowest-wage jobs. But there are some union workers in these jobs, especially in jobs that are somewhat above the minimum but still relatively low wage (e.g., jobs paying 1.3 to 1.5 times the minimum). Moreover, it is possible that considerably higher-wage union workers benefit from minimum wage increases.

To answer this question, we estimated the models separately for union and nonunion workers. Because of the shortage of union workers in the lowest-wage jobs, it was necessary to combine cells,

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[27]We also attempted to estimate these models for teenagers only, but the estimates for hours and earned income were very imprecise. We suspect that this is because there is a high incidence of part-time/full-time transitions among teenagers that are unrelated to minimum wage changes.

grouping together those initially earning less than the minimum wage up to 1.5 times the minimum. The results for union workers are reported in Figure 3, while those for nonunion workers for the specification with the same aggregated low-wage categories are reported in Figure 4A. In contrast, Figure 4B reports results for nonunion workers using the full specification.

Comparing the figures, the results for union workers appear to be quite different from those for nonunion workers. First, while minimum wages increase wages for both union and nonunion workers in the lowest-wage category, the wage gains are more than twice as high for union workers. This may be because wages for some low-wage union workers are automatically adjusted with the minimum wage (perhaps contractually). Second, while hours of the lowest-wage nonunion workers are estimated to be unaffected (with a negative point estimate), hours of the lowest-wage union workers are estimated to increase.[28] Third, employment effects at the lower end of the wage distribution also go in opposite directions, increasing for union workers, and decreasing for nonunion workers. Note, also, that the estimates point to relative employment increases among higher-wage union members, suggesting that there is some substitution toward union workers in response to a minimum wage increase.

The net result of all these differences in minimum wage effects is that the earned income of the lowest-wage nonunion workers (and indeed all nonunion workers up to four times the minimum) is estimated to decline as a result of a minimum wage increase, while the earned income of low-wage union members is estimated to rise, with the estimated effects statistically significant. A comparison of Figure 3 with Figure 4B, which provides a more-detailed breakdown of effects for nonunion workers, makes it clear that it is the lowest-wage nonunion workers who bear the costs of minimum wage increases. Although we cannot estimate the more disaggregated effects for union workers, the distribution of these workers in the wage distribution (Table 1) suggests that it is union workers with higher wages (1.2 to 1.5 times the minimum wage) who are benefitting from minimum wage increases.

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[28]As can be seen in Figure 4B, the lowest-wage nonunion workers experience a large and statistically significant negative hours effect.

V, Conclusions

This paper presents evidence on wage, hours, employment, and labor income adjustments that occur in response to minimum wage increases. One of its main contributions is that these adjustments are estimated in a consistent framework that provides a relatively complete description of the effects of minimum wages throughout the wage distribution. We do this by characterizing in a very detailed manner the effects of minimum wages on wages, hours, employment, and incomes at different points of the wage distribution.

The evidence indicates that workers who initially earn near the minimum wage are most adversely affected by minimum wage increases; higher-wage workers, in contrast, are little affected. Although wages of low-wage workers increase, their hours and employment decline, and the combined effect of these changes is a decline in earned income. The inclusion of lagged minimum wage effects is a critical factor in arriving at this conclusion, as we find that contemporaneous effects overstate the wage gains and understate the hours and income declines experienced by low-wage workers when minimum wages rise.

Our finding that earned incomes of low-wage workers decline in response to minimum wage increases is consistent with other evidence we have presented indicating that minimum wages increase the proportion of families that are poor or near-poor (Neumark, et al., 1998; Neumark and Wascher, 1997). As motivation for that research, we suggested that an important component of the overall effect of minimum wages on the distribution of family incomes is the effect on earned incomes among low-wage workers. We further argued that the conclusion that minimum wages must help low-wage workers on net–because estimated employment elasticities from minimum wage studies typically are in the −.1 to −.2 range–is flawed, because the employment reductions are likely concentrated among the lowest-wage workers, implying that for such workers the income elasticity could plausibly be a much larger negative number. It appears, though, that the employment elasticities we obtain for minimum wage workers are in this range. On the other hand, the wage increases for low-wage workers that are induced by hikes in the minimum wage are considerably smaller than the minimum wage hikes themselves, and there are hours reductions

among employed workers that compound the negative impact of employment losses on earned income. In our previous research we only presented what amount to reduced-form effects of minimum wages on family incomes. The findings in this paper, which speak directly to the question of earned incomes of low-wage workers, show that the full range of labor market effects leads to a decline in the earnings of the lowest-wage workers as a consequence of minimum wage increases.

On a related issue that fits naturally into the same empirical framework, we document the differences in these effects between union and nonunion workers to attempt to understand the rationale for union support of minimum wages. Of course, we cannot rule out the possibility that unions favor minimum wages based on the goal of increasing incomes of the lowest-wage workers, union or not, in order to reduce earnings inequality. But, as noted above, the evidence suggests that minimum wages do not achieve this goal. Rather, our estimates are consistent with union support for minimum wages on the basis of the interests of union workers, as union members gain at the expense of low-wage, nonunion labor.

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Table 1: Means, Overall and by Position in the Wage Distribution

Year 1 variables:	Proportion	Hours, employed year 2	Weekly year 1 labor income	Age 16-19	Adults	Women	Men	Black	Hispanic	Non-black/ non-Hispanic	Union	Nonunion
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Full sample	1.00	38.8	377.3	.06	.94	.47	.53	.11	.06	.83	.18	.82
By year 1 wage:												
$w < MW - \$.10$	.026	32.0	86.4	.24	.76	.64	.36	.14	.07	.79	.03	.97
$MW - \$.10 \leq w \leq MW + \$.10$	.046	28.0	95.8	.36	.64	.62	.38	.17	.10	.74	.03	.97
$MW + \$.10 < w \leq 1.1 \cdot MW$	.031	30.9	114.3	.29	.71	.63	.37	.14	.09	.77	.04	.96
$1.1 < w/MW \leq 1.2$	.052	33.0	136.9	.19	.81	.61	.39	.15	.10	.76	.05	.95
$1.2 < w/MW \leq 1.3$	.032	35.8	159.7	.13	.87	.63	.37	.14	.09	.78	.06	.94
$1.3 < w/MW \leq 1.5$	.084	36.6	184.6	.09	.91	.59	.41	.14	.09	.78	.08	.92
$1.5 < w/MW \leq 2$	.168	38.9	249.4	.03	.97	.56	.44	.13	.08	.80	.11	.89
$2 < w/MW \leq 3$	.265	40.5	365.5	.01	.99	.45	.55	.10	.06	.84	.21	.79
$3 < w/MW \leq 4$	.148	41.4	531.6	.002	.998	.34	.66	.08	.05	.87	.31	.69
$4 < w/MW \leq 5$	.078	41.9	695.6	.001	.999	.28	.72	.07	.04	.89	.30	.70
$5 < w/MW \leq 6$	.043	42.1	862.8	.001	.999	.24	.76	.06	.03	.91	.22	.78
$6 < w/MW \leq 8$	.029	41.8	1082.6	.001	.999	.20	.80	.05	.03	.93	.16	.84

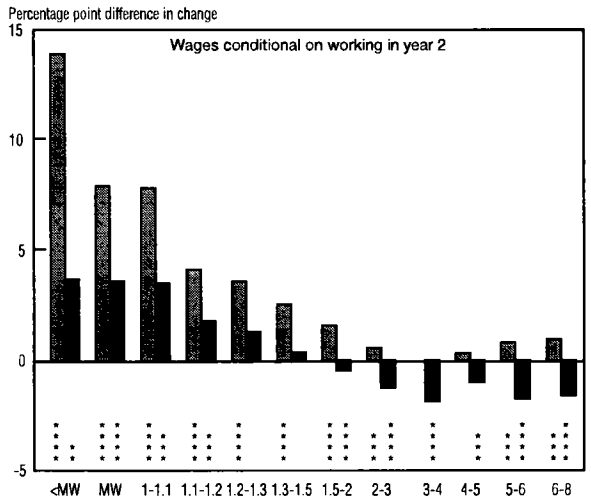
The sample is restricted to wage and salary workers working for a wage in year 1; this sample includes 847,175 observations. The sample conditioning on year 2 employment, in column (3), includes 749,510 observations. Observations with wages less than 50 percent of the minimum wage in year 1 are excluded, as are those with year 1 wages more than eight times the minimum (fewer than one percent of the observations), and observations with increases of 1000 percent or greater in wages or hours (fewer than one percent of the observations). All estimates are weighted to adjust for sampling weights and match probabilities (based on demographic characteristics). The samples with union information (available after 1982) are 615,597 without conditioning on year 2 employment, and 549,555 conditioning on year 2 employment. The union classification is based on union membership in year 1. Proportions black, Hispanic, and non-black/non-Hispanic do not always add to one, because of rounding.

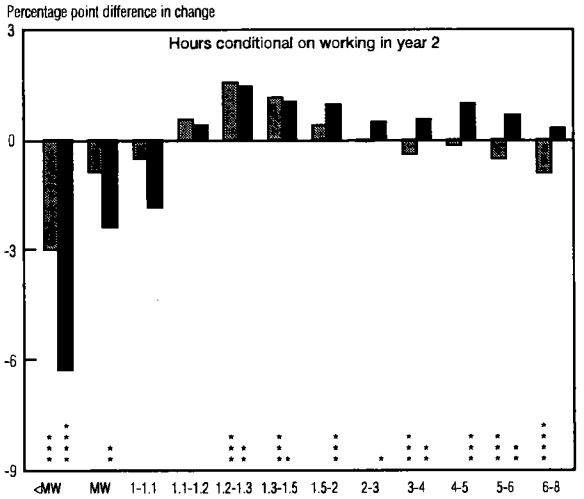
Table 2: Effects of Minimum Wages on Hours, Employment, and Income

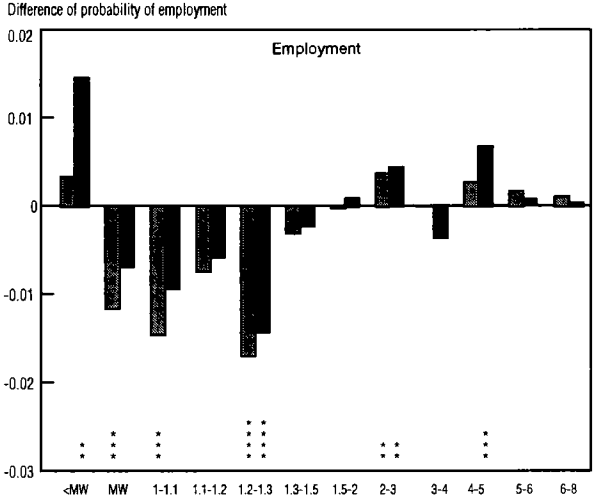
	Wages		Hours, conditional on year 2 employment		Employment		Weekly labor income	
	Current	Lagged	Current	Lagged	Current	Lagged	Current	Lagged
	(1)	(1')	(2)	(2')	(3)	(3')	(4)	(4')
Percent change in minimum wage × dummy variables for:								
$w < MW - \$.10$	1.39	-.76	-.30	.23	.034	-.014	1.00	-.75
	(.25)	(.23)	(.13)	(.13)	(.069)	(.066)	(.37)	(.33)
$MW - \$.10 \le w \le MW + \$.10$	.79	-.60	-.09	-.52	-.115	-.065	.19	-1.47
	(.10)	(.09)	(.11)	(.10)	(.062)	(.060)	(.20)	(.19)
$MW + \$.10 < w \le 1.1 \cdot MW$	.78	-.29	-.05	-.23	-.145	.100	.38	-.49
	(.12)	(.11)	(.10)	(.09)	(.069)	(.063)	(.21)	(.18)
$1.1 < w/MW \le 1.2$	.41	-.42	.06	-.20	-.074	-.003	.37	-.58
	(.08)	(.08)	(.07)	(.07)	(.048)	(.049)	(.16)	(.14)
$1.2 < w/MW \le 1.3$	.36	-.27	.16	-.11	-.169	.067	.26	-.29
	(.10)	(.10)	(.07)	(.07)	(.059)	(.052)	(.16)	(.16)
$1.3 < w/MW \le 1.5$	.26	-.27	.11	-.17	-.030	.014	.29	-.45
	(.06)	(.06)	(.05)	(.04)	(.036)	(.038)	(.10)	(.10)
$1.5 < w/MW \le 2$	.16	-.12	.04	-.01	-.002	-.004	.15	-.16
	(.04)	(.05)	(.03)	(.03)	(.025)	(.024)	(.06)	(.06)
$2 < w/MW \le 3$	.06	-.14	-.00	.05	.038	.012	.03	-.07
	(.03)	(.03)	(.02)	(.02)	(.020)	(.021)	(.05)	(.04)
$3 < w/MW \le 4$	.00	-.18	-.04	.09	.000	-.040	-.06	-.12
	(.03)	(.03)	(.02)	(.02)	(.023)	(.023)	(.05)	(.04)
$4 < w/MW \le 5$	.03	-.12	-.01	.11	.027	.047	.01	-.04
	(.04)	(.04)	(.02)	(.03)	(.025)	(.027)	(.05)	(.05)
$5 < w/MW \le 6$	.08	-.23	-.05	.11	.018	-.010	.10	-.14
	(.04)	(.04)	(.03)	(.03)	(.032)	(.036)	(.05)	(.06)
$6 < w/MW \le 8$	.09	-.21	-.09	.09	.011	.045	.02	-.13
	(.04)	(.05)	(.04)	(.04)	(.032)	(.037)	(.06)	(.06)
Adjusted R^2	.16		.04		.31		.07	
N	749,510		749,510		847,175		847,175	

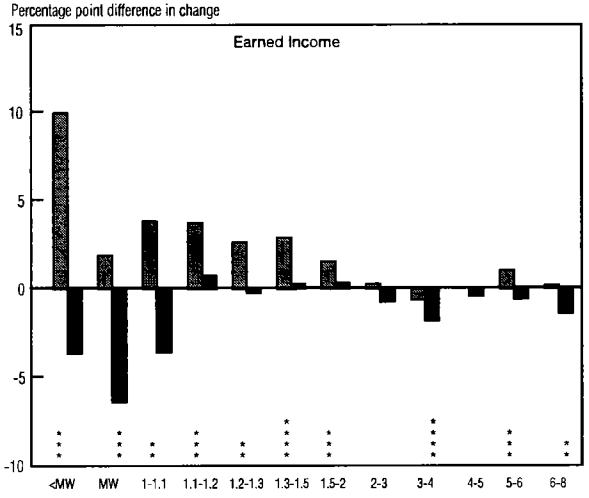
Dependent variable is the percent change from year 1 to year 2 in wages (columns (1)-(1')), hours conditional on employment (columns (2)-(2')), and labor income (columns (4)-(4')). Dependent variable is a dummy for employment in year 2, in columns (3)-(3'). In columns (3) and (3') coefficient estimates are multiplied by 100, so reported effects are for a 100 percent increase in the minimum wage; in the other columns the coefficient estimates are not multiplied, so reported effects are for a one percent increase in the minimum wage. In all columns the sample is restricted to individuals working for a wage in year 1; in columns (1)-(2') the sample is also restricted to individuals working for a wage in year 2. The percent change variables are defined from year 1 to year 2, and the dummy variables indicated in the left-hand column are based on the year 1 wage relative to the year 1 minimum. Each specification also includes the full set of dummy variables for the wage relative to the minimum wage that are used to define the interactions reported in the table, interactions of these with the wage relative to the minimum wage, as well as a quartic in potential experience, and dummy variables for female, black, Hispanic, high school dropout, some college, college graduate, and postgraduate education, and calendar month (to control for seasonal effects); all are defined as of year 1. In addition, the specifications include fixed effects for each state-year combination; all coefficients are identified because there are within-year minimum wage increases. All estimates are OLS with robust standard errors. As explained in the text, lagged effects are not equivalent to two-year effects; the latter are displayed in the figures.

FIGURE 1 Effects of 10% Minimum Wage Increase, Full Sample



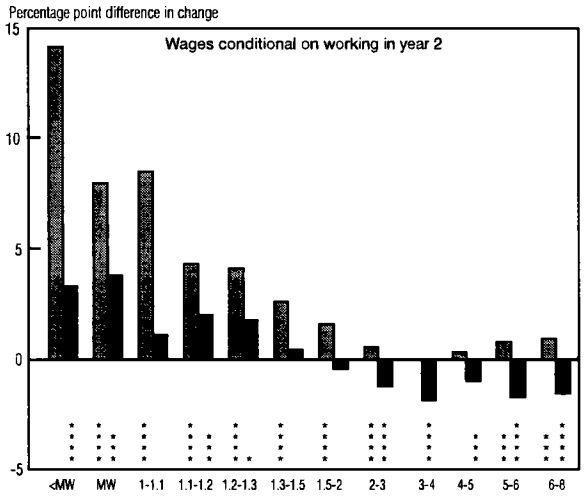


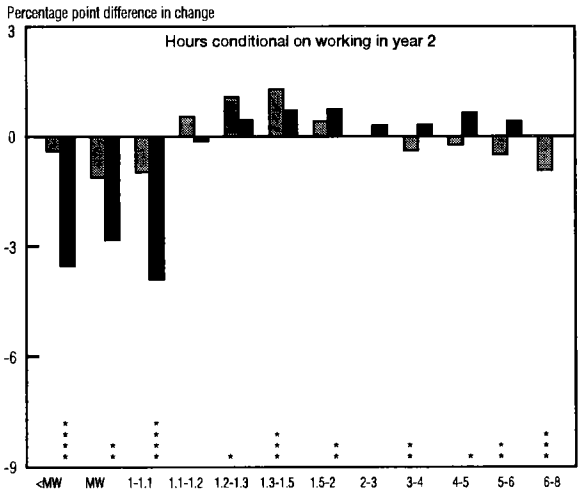


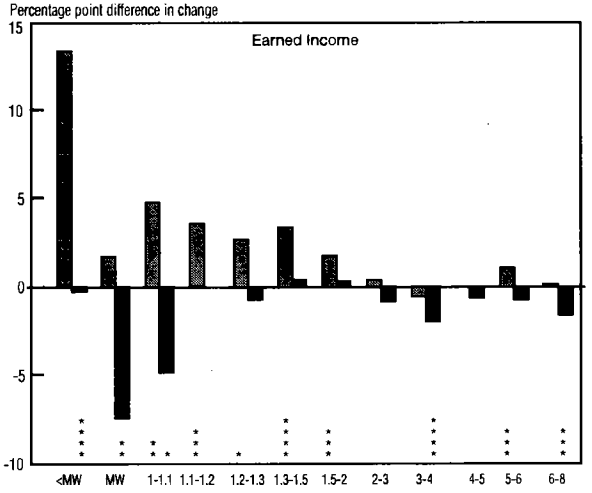


* Significant at the 1% level * Significant at the 5% level * Significant at the 10% level * Significant at the 15% level First year difference Second year difference

FIGURE 2 Effects of 10% Minimum Wage Increase, Adults

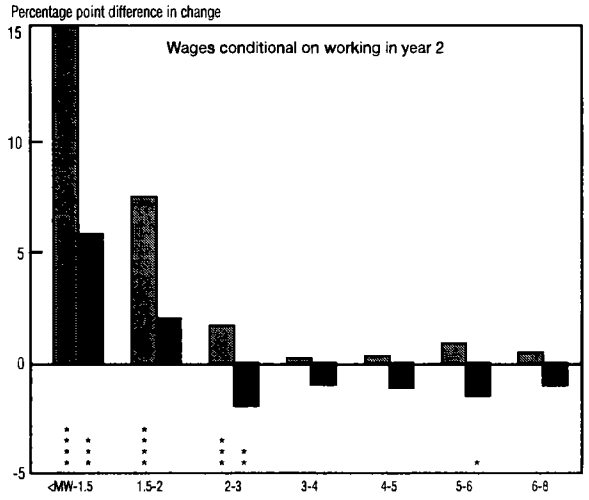


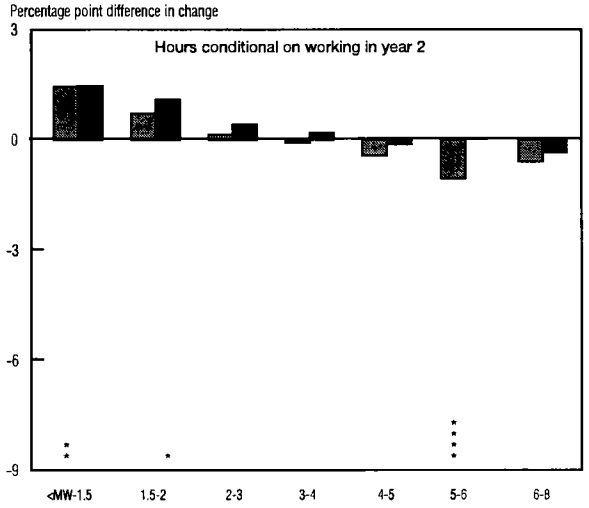


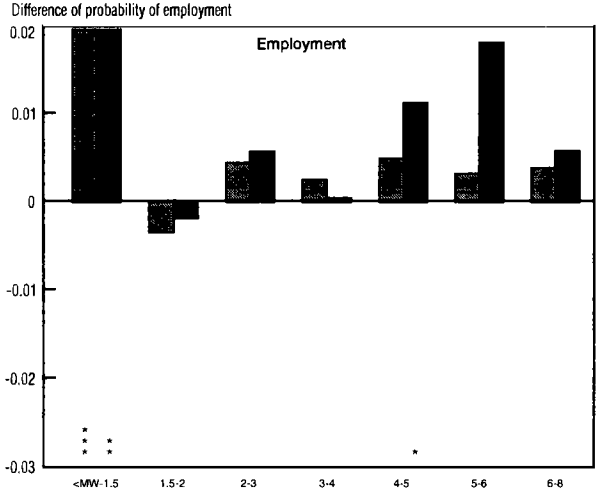


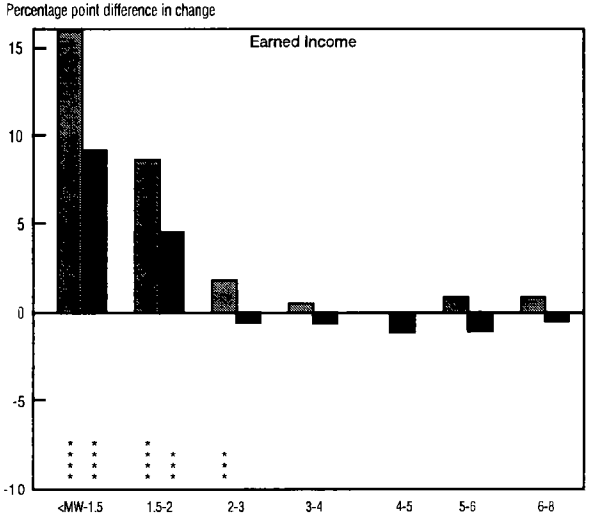
* Significant at the 1% level * Significant at the 5% level * Significant at the 10% level * Significant at the 15% level First year difference Second year difference

FIGURE 3 Effects of 10% Minimum Wage Increase, Union



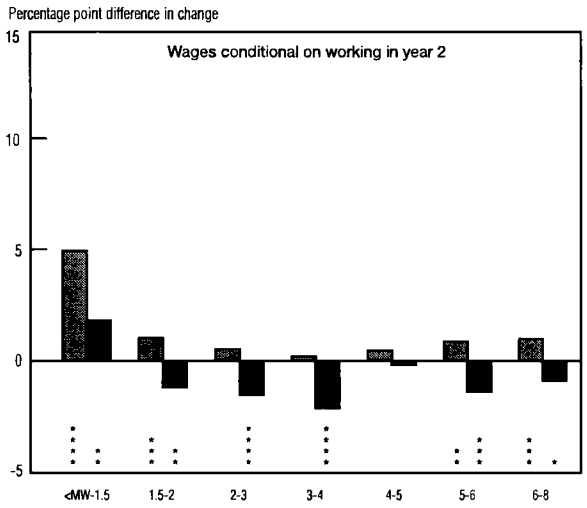


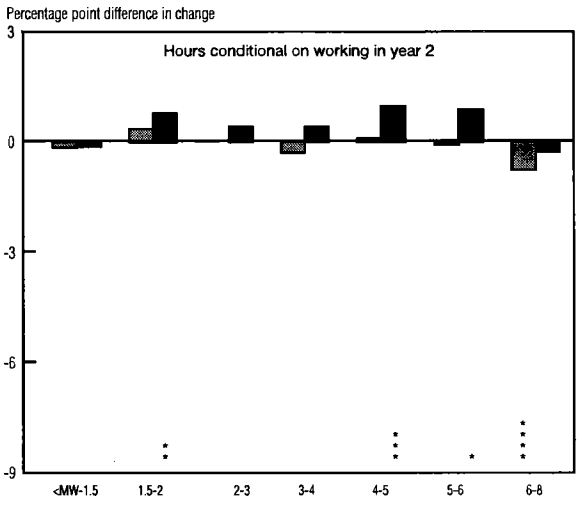


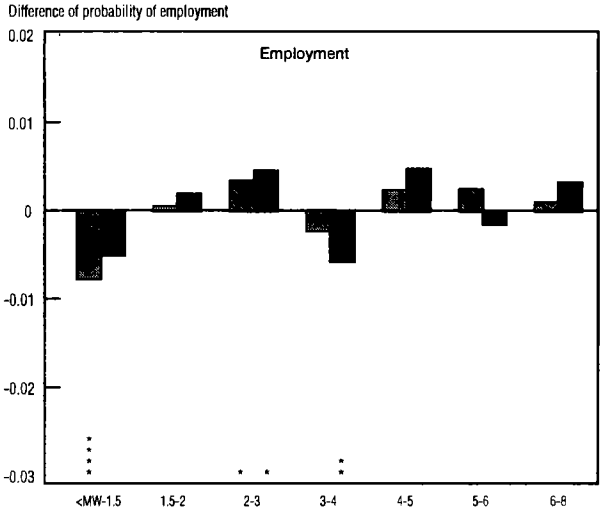


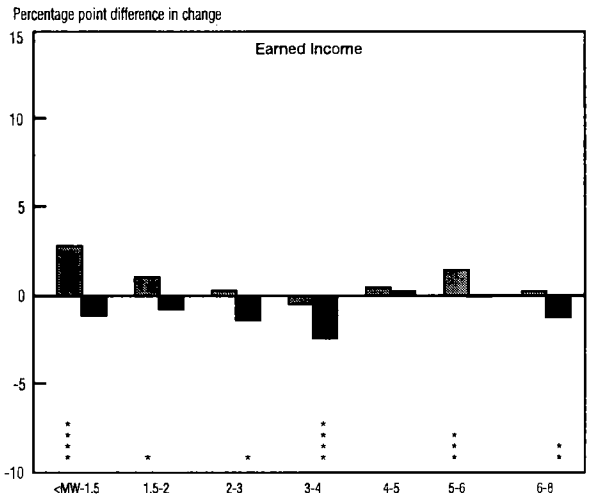
* Significant at the 1% level * Significant at the 5% level * Significant at the 10% level * Significant at the 15% level First year difference Second year difference

FIGURE 4A Effects of 10% Minimum Wage Increase, Nonunion



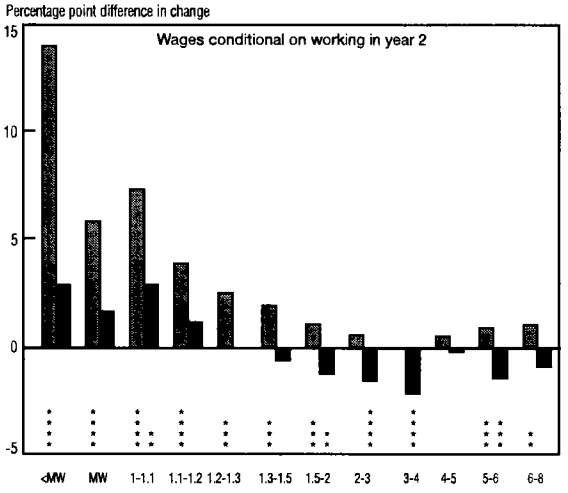


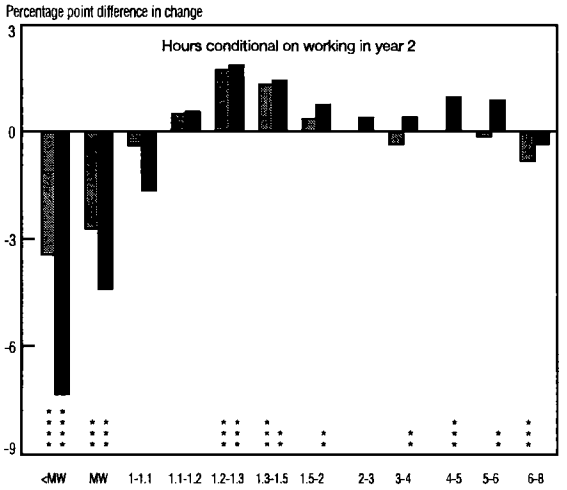


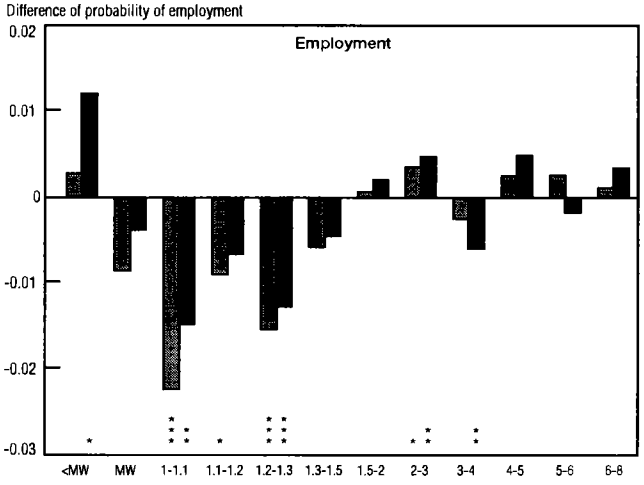


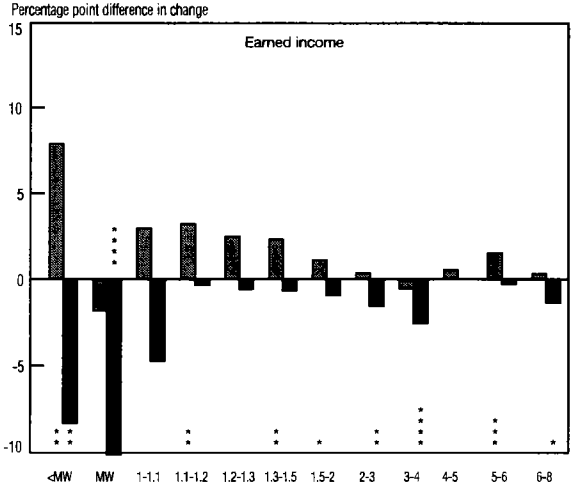
* Significant at the 1% level * Significant at the 5% level * Significant at the 10% level * Significant at the 15% level First year difference Second year difference

FIGURE 4B Effects of 10% Minimum Wage Increase, Nonunion









* Significant at the 1% level * Significant at the 5% level * Significant at the 10% level * Significant at the 15% level First year difference Second year difference