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The effect of the minimum wage on employment and hours

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Abstract

This study examines the effect of minimum wage increases on teen hours of work and employment using both state- and individual-level panel data in the US. The state-level results indicate that minimum wage increases may lower employment rates but do not adversely affect hours among either working teens or all teens. The individual-level results do not indicate that minimum wage increases have a significant negative effect on hours worked by low-wage teens who are likely to be affected by a minimum wage increase. The results suggest that low-wage teens are less likely to remain employed, relative to high-wage teens, when the minimum wage is raised. However, this adverse effect disappears when these low-wage teens are compared to other low-wage teens during periods when the minimum wage did not increase.

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1. Introduction

Recent research finding that increases in the minimum wage appear to not reduce employment has challenged the traditional model of the effects of the

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minimum wage. A growing set of papers find that increases in minimum wages do not significantly lower employment among teens or fast-food workers.[1] Earlier studies, in contrast, usually concluded that a 10% increase in the minimum wage reduced teen employment by 1% to 3% (Brown et al., 1982).[2] Reasons offered for the controversial recent findings include poor data, problematic methodologies and the possibility of monopsony power. This study investigates another possibility: employers may reduce hours instead of employment in response to minimum wage hikes.

There are several reasons why employers may adjust hours as well as employment when the minimum wage is raised. It may be easier for firms to change hours than employment, particularly in the short run. Firing workers may lower the morale of retained workers, so employers may reduce workers' hours in the short run and wait for natural attrition to reduce employment levels over time. In addition, workers earning a higher hourly wage because of a minimum wage hike may want to work fewer hours. Anecdotes from several low-wage employers indicate that they cut hours and increased workloads in response to minimum wage increases (Duff, 1996; Wysocki, 1997).

Although the minimum wage literature has focused on employment, a few studies have examined the relationship between the minimum wage and hours in the US. Gramlich (1976) finds that teens and adult males move from full-time to part-time employment when the minimum wages rises, and adult females appear to shift from part-time to full-time jobs. Katz and Krueger (1992) suggest that fast-food restaurants in Texas increased full-time employment and decreased part-time employment when the federal minimum wage rose in 1991. Cunningham (1981) reports similar results among teens. Neumark and Wascher (1996) simulate hours changes from the effects of the minimum wage on teens' employment and school enrollment and predict that average hours fall as the minimum wage rises.

This study examines the relationship between the minimum wage and teen employment and hours of work using both state- and individual-level data in the US. State annual averages are used to examine the effects of the minimum wage on aggregate teen employment and average usual weekly hours of work. Panel data on individuals are used to examine whether employed teens who initially earn near the minimum wage incur employment or hours losses relative to higher-wage teens when the minimum wage rises.

The results indicate that minimum wage increases may have small negative employment effects but do not appear to lower hours of work. In the state-level data, higher minimum wages do not result in lower average hours of work among

[1] See Wellington (1991), Card (1992a,b), Katz and Krueger (1992), Card and Krueger (1994) and Neumark and Wascher (1995). Machin and Manning (1994, 1997) reach similar conclusions for minimum wages in Europe.

[2] Currie and Fallick (1996), Kim and Taylor (1995) and Deere et al. (1995) find similar results in the US, and Abowd et al. (1997) and Bazen and Skourias (1997) find negative effects in France.

either employed teens or all teens but may lead to slightly lower employment rates. The individual-level results appear to show disemployment effects among teen workers likely to have been affected by a minimum wage increase. Those teens who remain employed and are likely to have been affected by a minimum wage hike appear to experience a relative increase in hours, and the estimated relative effect of the minimum wage on teen hours is non-negative even when teens who do not remain employed are included in the analysis. However, low-wage teens appear to experience similar relative changes in employment status and hours during periods when the nominal minimum wage is constant, suggesting that minimum wage increases do not affect employment and hours among initially employed teens.

The expected effect of minimum wage increases on teen employment and hours are discussed in the next section. The empirical methodology and data are discussed in Section 3. The effects of the minimum wage on employment and hours in state-level data are estimated in Section 4, and Section 5 contains the individual-level results. Section 6 concludes.

2. Theoretical effect of minimum wage increases

The traditional model of a competitive labor market gives clear predictions for the effect of a binding minimum wage increase on total employment and hours. The competitive model posits a downward-sloping labor demand curve and an upward-sloping labor supply curve. Firms demand less labor as the cost of labor increases, and additional workers enter the labor market as the wage offered increases. The imposition of a binding minimum wage therefore reduces the total quantity of labor demanded and increases the quantity of labor supplied. Total employment falls as the minimum wage rises because employers lay off workers whose marginal revenue product is less than the wage floor. If workers are paid their marginal revenue product, then workers who initially earn less than the new minimum wage should no longer be employed unless their marginal revenue product increases. Disemployment effects are therefore expected to be larger among workers initially earning close to the new minimum wage than among higher-paid workers.

Although the traditional model concerns employment, the decline in the quantity of labor demanded implies that total labor hours demanded also fall. However, the expected effect on hours per worker is ambiguous. Employers who must pay a higher wage will try to substitute higher-skilled workers for lower-skilled workers in order to keep the value of the marginal product of labor equal to the wage. Higher-skilled workers may work more hours than lower-skilled workers, perhaps because they are older and finished with school. Hours per worker may actually increase if employers retain and perhaps hire additional higher-skilled workers who work more hours while laying off lower-skilled individuals who work fewer hours.

The effect of a minimum wage increase on hours is likely to depend on an individual's position in the wage distribution. If initial wages reflect productivity, workers who initially earn less than the new minimum wage and remain employed are likely to experience a decline in hours relative to higher-paid workers who remain employed. The relative effect on hours is likely to be larger among all workers than among workers who remain employed because hours of work obviously go to zero for workers who are laid off, and disemployment effects are likely to be larger among lower-paid workers.

3. Methodology and data

The recent empirical literature on the effects of the US minimum wage relies on a difference-in-differences methodology. The effect of a minimum wage increase is estimated by comparing the change in employment among a group likely to be affected by the hike to the change among an unaffected group. Most recent studies use either state- or firm-level panel data to compare employment changes in areas experiencing a minimum wage increase to employment changes in other areas (e.g., Card and Krueger, 1994; Neumark and Wascher, 1992). These studies focus on groups likely to be affected by a minimum wage increase, such as teens, retail trade workers and fast-food restaurant workers. Abowd et al. (1997), Currie and Fallick (1996) and Neumark and Wascher (1996) use data on individuals to measure the effect of minimum wage increases on employment transitions.

This study utilizes both the state- and individual-level approaches and extends the analysis to hours. There are several advantages to using both state- and individual-level data. Using state averages allows for an examination of the aggregate effects of the minimum wage. Aggregate data capture the total effect of minimum wages on transitions from employment to nonemployment and on transitions from nonemployment to employment but do not allow researchers to distinguish between the two. Using individual-level data on workers who are initially employed allows for estimation of the effect of minimum wage increases on the probability of remaining employed.

This study uses data from the NBER extracts of the Current Population Survey (CPS) outgoing rotation groups for the years 1979–1993. Participants in the CPS are surveyed for 4 months, rotate out of the panel for 8 months, are surveyed again for 4 months and then exit the panel. In the last month of each rotation, participants are asked their employment status, usual weekly hours and earnings. New individuals are continually entering the CPS, and two observations on employment status, wages and hours are available for each individual who completes both rotations. This study uses CPS data on teens aged 16–19 because teens are the age group most likely to be affected by changes in minimum wages.

Both federal and state minimum wages experienced sizable change during the sample period. The nominal federal minimum wage rose from US$2.90 to US$3.10 in January 1980, to US$3.35 in January 1981, to US$3.80 in April 1990 and to US$4.25 in April 1991. The real value of the federal minimum wage declined by one-third between 1981 and 1990, and 16 states passed state minimum wages above the federal minimum wage during this period.[3] This gives variation in effective minimum wages (the higher of the state and federal minimum wages) not only over time but also across states. Workers covered by both federal and state minimum wage laws must be paid the higher of the two minimums.

The state-level regressions exploit this variation in effective minimum wages to test the predictions that employment rates and total hours among teens fall as the minimum wage increases. The average of usual weekly hours of work among all teens is used as a proxy for total hours; the variable is equivalent to calculating total hours among teens using the CPS population weights and normalizing by the state teen population. The effect of the minimum wage on average usual weekly hours of work among only teens who work is also estimated but is not necessarily expected to be negative.

In the individual-level regressions, I test the prediction of the traditional model that when a new wage floor is imposed, teens who initially earn less than the new minimum wage (“affected workers”) have a lower probability of remaining employed or experience a decline in hours relative to teens who initially earn more than the new minimum wage and relative to teens who do not experience minimum wage increases (“unaffected workers”). The sample is restricted to teens employed in a given year, and the regressions estimate the difference in the change in employment status and in the change in hours between affected and unaffected teens. To check that the regressions measure the effect of the minimum wage and do not simply reflect differences between high- and low-wage teens, workers who earn near the minimum wage during periods when the minimum wage was not increased are also classified as affected workers, and relative employment and hours changes among this group are compared to relative changes among affected workers during periods when the minimum wage did increase.

This paper differs from previous research in several ways. The empirical framework at the individual level is the same as Currie and Fallick (1996) but extends the analysis to hours. This study also includes data for years in which the nominal minimum wage was constant. Currie and Fallick (1996) use the National Longitudinal Survey of Youth (NLSY), which offers a longer panel than the CPS but is not ideal for examining the effects of the minimum wage during the late 1980s and early 1990s; the participants were no longer teenagers when most of the

[3] Neumark and Wascher (1992) provide a chronology of minimum wage changes through 1989. State minimum wages are also available in the annual summary of state labor law changes in the January issues of the Bureau of Labor Statistics publication *Monthly Labor Review*.

variation in state minimum wages occurred and when the federal minimum wage rose in 1990 and 1991. Abowd et al. (1997) employ a similar methodology using data from France and the US but only examine employment transitions during periods when the US federal minimum wage fell in real terms. Neumark and Wascher (1996) use a similar methodology but focus on the effect of the minimum wage on transitions between school and employment.

4. State-level estimates

State annual averages are used to estimate the effect of the minimum wage on the teen employment-to-population ratio and on the average of usual weekly hours of work of employed teens and of all teens. The averages are calculated from the individual responses of teens aged 16–19 in the CPS outgoing rotation groups, aggregated using the CPS population weights. Teens employed in agriculture, in unpaid jobs or self-employed were dropped from the sample.[4]

The estimation framework is a basic panel data model similar to the model employed by Neumark and Wascher (1992). The model estimated for all of the outcomes is:

$$\ln Y_{it} = \alpha + \beta \ln \mathrm{MW}_{it} + \gamma \mathrm{URATE}_{it} + \delta \mathrm{POP}_{it} + \sigma S_i + \theta T_t + \varepsilon_{it} \tag{1}$$

where Y_{it} is the employment-to-population ratio, average weekly hours of all teens, or average weekly hours of employed teens in state i in year t. One of two variables is used to measure the minimum wage, MW_{it}: the effective minimum wage deflated using the personal consumption expenditures (PCE) index or the relative minimum wage (the minimum wage divided by average adult hourly earnings). URATE_{it} is the unemployment rate of males aged 25–64, which is included to control for business-cycle effects. POP_{it} is the ratio of teens aged 16–19 to the total population aged 16–64 and is included to control for "baby boom" effects. S_i and T_t are state and year fixed effects included to control for time-invariant unobservable differences across states and business-cycle effects common to all states.

The state-level regressions are estimated using feasible generalized least squares to correct for AR(1) serial correlation. The serial correlation parameter is constrained to be the same for all states because the time-series dimension of the

[4] The results are similar if individuals employed in agriculture, in unpaid jobs or self-employed are kept in the sample. A teen is considered employed if the employment status recode is one (working last week).

panel is only 15 years. Durbin–Watson tests as modified by Bhargava et al. (1982) for panel data indicate that the error terms are serially correlated.[5] The data are annual averages for the 50 states for 1979–1993, giving a total of 750 observations.

The results are mixed. Table 1 reports that the real minimum wage is not significantly associated with the employment-to-population ratio, whereas a 10% increase in the relative minimum wage is associated with a 1.2% decline in the employment rate, although the effect is significant only at the 10% level. The real minimum wage is positively associated with both average hours worked by all teens and average hours among teen workers, while the relative minimum wage is not significantly associated with teen hours of work. Since neither of the minimum wage measures indicates that higher minimum wages are significantly associated with lower hours of work, the results suggest that total hours worked by all teens do not fall significantly even if the proportion of teens who are employed falls when the minimum wage increases.

The results are clearly sensitive to the choice of the minimum wage variable. The real minimum wage captures the effect of changes in the minimum wage on the cost of hiring teen workers. As column (7) of Table 1 indicates, the real minimum wage is strongly correlated with average hourly earnings among teen workers if Eq. (1) is estimated with average hourly earnings among teen workers as the dependent variable. However, the PCE deflator used to correct the minimum wage for inflation does not vary across states, so the real minimum wage may not reflect differential changes across states in the cost of hiring teen workers.[6]

The relative minimum wage is another way to measure the cost of hiring teen workers. The relative minimum wage is negatively associated with the average teen wage, as shown in column (8), suggesting that little weight should be given to results based on this measure of the minimum wage. However, Neumark and Wascher (1994) note that the relative minimum wage is positively associated with ratio of average teen wages to adult wages and therefore might be viewed as reflecting the cost of hiring teen workers relative to the cost of hiring adults.[7] Endogeneity is another potential difficulty with using the relative minimum wage; the average adult wage is likely to be correlated with business cycle conditions that also affect the teen employment rate and hours. If the relative minimum wage is endogenous, the estimated coefficients on the relative minimum wage variable would be negatively biased. Regardless of which variable is used, Table 1

[5] The estimated Durbin–Watson statistic for all regressions is about 1.5, well below the lower bound calculated by Bhargava et al. (1982).

[6] The state fixed effects control for time-invariant differences across states in the cost of hiring teen workers but do not capture differential changes across states. Because the regressions include year effects, the choice of a national deflator (i.e., PCE instead of CPI) does not affect the results.

[7] If Eq. (1) is estimated with the ratio of teen hourly earnings to adult hourly earnings as the dependent variable, the estimated coefficient on the relative minimum wage variable is 0.367 (0.035).

Table 1
State-level estimates of the effects of the minimum wage

Covariate	Employment		Hours, all teens		Hours, teen workers		Hourly wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log of real minimum wage	−0.021 (0.108)	–	0.241 (0.115)	–	0.136 (0.056)	–	0.685 (0.087)	–
Log of relative minimum wage	–	−0.116 (0.066)	–	−0.106 (0.077)	–	−0.035 (0.038)	–	−0.315 (0.051)
Adult male unemployment rate	−2.686 (0.206)	−2.727 (0.204)	−3.816 (0.253)	−3.887 (0.253)	−1.133 (0.131)	−1.135 (0.132)	−0.293 (0.171)	−0.591 (0.173)
Teen-to-total population ratio	0.115 (0.443)	0.270 (0.444)	0.358 (0.537)	0.348 (0.538)	0.179 (0.292)	0.102 (0.293)	−0.642 (0.364)	−0.767 (0.370)
χ^2 statistic	4134.08	4257.04	3035.13	3060.51	2293.05	2225.70	1186.48	1169.83

The regressions also contain a full set of state and year dummy variables. The data are annual averages for the 50 states over 1979–1993 for a total of 750 observations. Standard errors are shown in parentheses.

indicates that minimum wage increases do not appear to significantly lower teen hours of work.

A potential explanation for the failure to find a significant negative effect on total hours is that hours may fall among a group other than teens. Employers may substitute high-skill teens who enter the labor market when the minimum wage increases for low-skill adult and teen workers, resulting in no net change in teen hours and a fall in adult hours. Groups that may be substitutes for teens are young adults and adult women with relatively little education. Eq. (1) was estimated separately for young adults aged 20–24, adult women aged 25–64 with 12 or fewer years of education, and adult women aged 25–64 who did not complete high school to examine the effect of minimum wage increases on employment rates and the average of usual weekly hours worked among these groups. The results, which are not shown here, generally do not indicate that higher real or relative minimum wages adversely affect hours or employment among young adults or less-educated adult women.[8]

Although employers do not appear to substitute teens for adult workers when the minimum wage increases, they may substitute among teens of different skill levels. If firms replace lower-skilled teens with higher-skilled teens, total teen hours may be unaffected by the minimum wage. Cunningham (1981) and Neumark and Wascher (1995, 1996) suggest that minimum wage increases may cause higher-skilled teens to leave school in order to work. Lower-skilled teens who are initially employed should then experience employment and hours losses relative to higher-skilled teens who are initially employed as higher-skilled workers are substituted for lower-skilled workers. This possibility is examined below with panel data on individuals' employment status and hours.

5. Individual-level estimates

If workers are paid their marginal revenue product, imposition of a binding minimum wage will make it unprofitable for firms to continue to employ workers who initially earn less than the new minimum wage unless these workers raise their productivity. Individuals who initially earn less than the new minimum wage therefore should be less likely to remain employed or should experience a decrease

[8] The one exception is that the relative minimum wage is significantly negatively correlated with average hours among young adults who work; the real minimum wage is positively correlated with average hours among young adults who work, in contrast, but the estimated coefficient is not significant. Neither the relative nor the real minimum wage is significantly negatively correlated with average hours among all young adults. All results discussed in the text but not shown in tables are available on request.

in hours relative to higher-paid workers after a minimum wage hike. These effects should be larger the greater the difference between a worker's initial earnings and the new minimum wage, or the larger the "wage gap." These predictions are tested with panel data by comparing changes in employment status and hours between teens who are likely to have been affected by a minimum wage increase and teens who are not likely to have been affected.

The CPS sample is restricted to individuals who are employed, report wage data and are aged 16–19 in the first rotation. Teens who earned less than the effective minimum wage or who were salaried instead of paid hourly the first year in the sample are dropped from the sample because of the likelihood of measurement error in hourly wages for these observations.[9] Teens employed in the public sector, agriculture or domestic service or self-employed (sectors generally not covered by the minimum wage), whose records did not include an employment status recode in the second year, or who did not report positive hours or wages in the first year, were also dropped from the initial sample.[10] The final data set contains 36,643 matched records, with observations in each of the 50 states for the periods 1979–1980 through 1992–1993.[11]

Teens in the sample must also be matched across the two rotations, which are 12 months apart. The matching procedure may create sample selection bias if teens whose records match differ from all teens in unobservable ways that affect employment and hours. Individuals were matched using the household number, age, sex, race and ethnicity. About 60% of individuals were matched across the two surveys, with the match rate declining with age. The table in Appendix A displays sample averages for records that were matched and for records that were not matched; teens whose records could not be matched were older, more likely to have already graduated high school, and less likely to be enrolled in school. A lower proportion would be classified as affected workers if they were included in the sample, which is not surprising given the differences in observable characteristics.

Table 2 provides descriptive statistics for the final sample. More than 73% of teens employed the first year were employed 12 months later. The initial wages of about 5% of workers were less than a minimum wage imposed within the next 12 months. These teens are the most likely to have been directly affected by a minimum wage increase and are considered affected workers. To be classified as

[9] Many of the teens earning less than the minimum wage are likely to be tipped workers, who may have been affected differently than other workers by increases in state minimum wages.

[10] All of the results are robust to including salaried, public sector, agricultural, domestic and self-employed workers in the sample.

[11] Because the household numbers changed in 1985, matches for 1984–1985 could only be made for the months of January through June and matches for 1985–1986 could only be made through the months of October through December. An individual is defined as employed if the employment status recode is one.

Table 2
Descriptive statistics of individual sample

	Total sample (1)	Affected (2)	Unaffected (3)
Percent affected by increases in real minimum wage	4.63 (0.11)	–	–
Average real wage gap if affected	US$0.22 (0.003)	–	–
Percent employed in second year	73.56 (0.23)	70.22 (1.11)	73.72 (0.24)
Average real hourly wage in first year	US$5.68 (0.010)	4.08 (0.006)	5.76 (0.010)
Average change in real hourly wage among workers remaining employed	US$0.33 (0.01)	0.90 (0.06)	0.30 (0.02)
Average hours per week in first year	25.39 (0.06)	20.37 (0.23)	25.63 (0.06)
Average change in hours per week among workers remaining employed	3.17 (0.07)	4.56 (0.32)	3.11 (0.07)
Average age in first year	17.70	17.30	17.71
Percent female	46.99	53.36	46.68
Percent African-American	6.43	8.49	6.38
Percent Hispanic	5.16	5.19	5.16
Percent enrolled in first year	37.23	48.88	36.71
Percent completed 12th grade by first year	46.10	28.07	46.98
Sample size	36,643	1696	34,947

Data are based on matched individual records in CPS outgoing rotation groups for teens aged 16–19 for the years 1979–1993. See text for definition of affected workers. Standard errors are shown in parentheses.

affected, a worker had to earn at least the first-period minimum wage but less than the second-period minimum wage in the first period, or:

$$\mathrm{MW}_t \leq \mathrm{Wage}_t < \mathrm{MW}_{t+1}, \tag{2}$$

where all variables are in real terms. The average real wage gap, the difference between Wage_t and MW_{t+1} among affected workers, is 22 cents.

Those individuals who already earned more than the new minimum wage or who did not experience an increase in the real minimum wage during the year between interviews serve as the comparison group. As expected, these workers have higher initial hourly wages than affected workers. Table 2 reports that unaffected workers are also more likely, on average, to remain employed after a minimum wage increase. Affected workers who remain employed experience larger increases in hourly earnings and hours per week on average than do unaffected workers who remain employed. Unaffected workers are slightly older, less likely to initially be enrolled in school, and more likely to have completed high school than are affected workers.

Workers are classified as affected based on increases in the real minimum wage. Currie and Fallick (1996), in contrast, classify workers as affected based on increases in the nominal minimum wage and examine the effect of the 1980 and 1981 minimum wage hikes. However, the real minimum wage declined during these years because the minimum wage hikes were smaller than the increases in the consumer price index (CPI) or the PCE deflator. If workers are classified as affected based on nominal variables, 16% of teen workers in the sample would be considered affected, and the average nominal wage gap (the difference between the nominal minimum wage at time $t+1$ and nominal earnings at time t) is US$0.23. The sensitivity of the results to whether real or nominal variables are used to classify workers as affected is discussed below, but workers are classified as affected based on real terms in most of the analysis.

Affected workers who remain employed experience a larger increase in wages than unaffected workers who remain employed. To ensure that the wage gap variable captures a relative increase in the earnings of affected workers, the change in the real hourly wage among teens who remain employed is regressed on the wage gap and other characteristics, or:

$$\Delta \mathrm{Wage}_{it,t-1} = \alpha + \beta \, \mathrm{Wagegap}_{it} + \delta X_{it} + \eta_{it} \tag{3}$$

where $\Delta \mathrm{Wage}_{it,t-1}$ is the change in the real hourly wage for worker i, conditional on remaining employed. For affected workers, $\mathrm{Wagegap}_{it}$ is the difference between the real hourly wage at t and the real minimum wage at $t+1$ if Eq. (2) is satisfied. $\mathrm{Wagegap}_{it}$ equals zero for unaffected workers. The vector X_{it} contains demographic variables (age and dummy variables for high school graduate, enrolled in school, female, African-American and Hispanic).[12] The change in the adult male unemployment rate is also included in X_{it} to control for business cycle effects. State and year dummy variables are also included, and observations are weighted using the CPS population weights in the first year. Eq. (3) is estimated using ordinary least squares (OLS).

As column (1) of Table 3 indicates, the average real wage of affected workers who remain employed rises by US$2.31 relative to the change in wages among unaffected workers who remain employed. Evaluated at the average wage gap of

[12] Enrollment status is determined from the major activity last week.

Table 3
Individual estimates of the effects of the minimum wage

	Change in wage if still employed	Probability remain employed	Change in hours	
			Still employed	All teens
	(1)	(2)	(3)	(4)
Wage gap	2.305 (0.236)	−0.256 (0.149) {0.083}	4.115 (1.546)	1.704 (1.860)
Age	0.097 (0.028)	0.035 (0.010) {0.011}	0.567 (0.099)	0.173 (0.126)
Female	−0.169 (0.035)	−0.011 (0.016) {0.003}	0.060 (0.149)	0.534 (0.185)
African-American	−0.028 (0.081)	−0.459 (0.031) {0.164}	−0.724 (0.334)	−5.359 (0.410)
Hispanic	−0.031 (0.068)	−0.087 (0.037) {0.029}	−1.431 (0.343)	−2.626 (0.450)
Enrolled	−0.049 (0.038)	−0.140 (0.017) {0.046}	3.381 (0.171)	3.999 (0.197)
High school graduate	0.008 (0.054)	0.266 (0.023) {0.085}	−2.355 (0.215)	0.113 (0.282)
Change in adult male unemployment rate	0.047 (0.020)	−0.017 (0.008) {0.005}	−0.069 (0.077)	−0.237 (0.096)
χ^2 statistic	–	978.36	–	–
Adj. R^2	0.013	–	0.039	0.031
Sample size	26,954	36,643	26,932	36,578

Column 2 shows Probit results, and the marginal effects evaluated at the sample means are shown in brackets. The other columns show OLS results. All regressions include a full set of state and year fixed effects. Standard errors are shown in parentheses.

22 cents, the average wage of affected workers rises by 51 cents more than the average wage of unaffected workers. If workers are instead classified as affected based on increases in the nominal minimum wage, the average real wage of affected workers rises by 53 cents more than the average wage of unaffected workers.[13]

5.1. Employment effects

The traditional model predicts that the larger the wage gap, the lower the probability of remaining employed. Maximum likelihood Probit is used to estimate:

$$E_{it} = \alpha + \beta\,\mathrm{Wagegap}_{it} + \delta X_{it} + \eta_{it} \tag{4}$$

where E_{it} equals one if worker i remains employed 12 months after time t and zero otherwise. The other variables are the same as in the wage change regression above.

The second column of Table 3 suggests that the larger the wage gap, the lower the likelihood of remaining employed. The estimated marginal coefficient on the

[13] The estimated coefficient on the nominal wage gap variable is 2.302 (0.158) when workers are classified as affected based on increases in the nominal minimum wage.

wage gap variable, shown in brackets, indicates that a 10 cent increase in the wage gap results in a 0.8% decrease in the probability of remaining employed but is significant only at the 10% level. Multiplying the estimated marginal effect of the wage gap and the real average wage gap among affected teens, the average affected worker is 1.8% less likely than an unaffected worker to remain employed.[14] If workers are instead classified as affected based on increases in the nominal mininum wage, the average affected worker is 2.3% less likely to remain employed, and the estimate is significant at the 1% level.[15]

5.2. Hours effects

A similar model is used to test the prediction that affected workers should experience a decline in hours relative to unaffected workers. OLS is used to estimate:

$$\Delta \mathrm{Hours}_{it,t+1} = \alpha + \beta \mathrm{Wagegap}_{it} + \delta X_{it} + \eta_{it} \tag{5}$$

where $\Delta \mathrm{Hours}_{it,\ t+1}$ is the change in an individual's hours between the two interviews. The other variables are the same as above. The sample initially consists only of teens who remained employed, reducing the sample size to 26,932 matched records.[16]

When the sample is restricted to teens who remain employed, the coefficient on the wage gap variable is positive. The estimates in the third column of Table 3 imply that for every US$1 increase in the wage gap, an affected worker's hours increase by 4.1 hours relative to the change in unaffected workers' hours. Evaluated at the sample mean, the average affected worker's hours increase by 0.9 hours relative to the change in unaffected workers' hours. Because the average change in hours for both affected and unaffected workers who remain employed is positive, the average affected worker who remains employed experiences an increase in hours both in absolute terms and relative to unaffected workers who remain employed. The estimated effect on hours is also positive and significant if workers are classified as affected based on increases in the nominal minimum wage.[17]

[14] Including teens who did not earn at least the minimum wage in the first period and classifying them as affected workers lowers the magnitude of the estimated coefficient on the wage gap variable to −0.082 (0.021) {0.027}. The average wage gap is 66 cents when workers who earn less than the minimum wage are included, so the average affected worker is about 1.8% less likely to remain employed than an unaffected worker.

[15] The estimated coefficient on the wage gap variable is −0.311 (0.092) {0.100} if increases in the nominal minimum wage are used to classify workers as affected.

[16] Twenty-two individuals whose hours changed by more than 50 were dropped because of the likelihood that those observations had sizable measurement error. When teens who did not remain employed are included in the sample, an additional 43 teens were dropped from the sample because their hours changed by more than 50.

[17] If workers are classified as affected based on increases in the nominal minimum wage, the average affected workers' hours rise by 1.25 relative to unaffected workers.

The above estimates may not be surprising since they include only workers who remain employed. To estimate the total effect of minimum wage increases on hours, hours at $t+1$ were set equal to zero for individuals no longer employed and Eq. (5) was re-estimated. The coefficient on the wage gap variable should become smaller when teens who are no longer employed are included in the sample, and it is expected to be negative.

The results indicate that hours worked by affected teens do not fall relative to unaffected teens, even when accounting for hours losses among teens who do not remain employed. As shown in column (4) of Table 3, the coefficient on the wage gap variable is positive but not significant.[18] Both affected and unaffected workers experience a decline in hours when teens who do not remain employed are included in the hours sample, so affected workers' hours fall in absolute terms on average but do not fall more than the hours of unaffected workers. If workers are classified as affected based on increases in the nominal minimum wage, the estimated coefficient on the wage gap variable is positive and significant, implying that the hours of affected teen workers rise relative to unaffected teen workers even when accounting for employment losses.[19]

The results in Table 3 suggest that affected workers may be less likely to remain employed than unaffected workers, but affected workers who remain employed experience an increase in hours relative to unaffected workers. Even when including teens who are no longer employed and whose hours of work effectively go to zero, teens who are the most likely to be affected by minimum wage increases do not appear to experience a decline in hours relative to unaffected workers. The next section discusses whether minimum wage hikes underlie these results or whether low-wage teens experience such relative employment and hours transitions regardless of minimum wage changes.

5.3. Do minimum wage increases cause the observed changes?

Low-wage teens, who are likely to be affected by a minimum wage increase, may differ from high-wage teens in unobservable ways that are correlated with changes in employment or hours. In particular, low-wage workers may be more likely to leave employment or to experience an increase in hours regardless of changes in the minimum wage. If low-wage teens experience similar changes in employment status and hours relative to high-wage teens during periods when the

[18] The estimated effects are slightly smaller if teens who earn less than the minimum wage in the first period are kept in the sample.

[19] The estimated coefficient on the wage gap variable is 2.758 (1.113), implying that average hours of affected workers increase by 0.6 relative to unaffected workers.

real minimum wage increases and during periods when the real minimum wage falls, then it is unlikely that minimum wage hikes cause the employment and hours results reported in Table 3.

To examine whether differences between high- and low-wage teens drive the results, artificial wage gap variable is created for periods when the real effective minimum wage did not rise. Workers who earned at least the minimum wage but less than 25 cents above the minimum wage at time t during periods when the nominal minimum wage did not rise over the next 12 months are considered as workers who would have been likely to have been affected if the minimum wage had risen, or "artificially affected" workers. In other words, two conditions must be true for a worker to be considered artificially affected:

$$\mathrm{MW}_t \leq \mathrm{Wage}_t < \mathrm{MW}_t + 0.25$$

and:

$$\mathrm{MW}_t \geq \mathrm{MW}_{t+1}, \tag{6}$$

where all variables are in real terms. The artificial wage gap variable is defined as the difference between the real minimum wage at time t plus 25 cents and the real hourly wage at time t for these workers. The artificial wage gap variable is equal to zero for workers who earned at least 25 cents above the minimum wage at time t during periods when the real minimum wage rose and for workers who experienced a real minimum wage increase.

Sample means suggest that low-wage workers experience similar changes in employment and hours relative to higher-wage workers regardless of whether the real minimum wage rose. As Table 4 indicates, the fractions of low-wage teen workers who were employed a year later are similar during periods when the real minimum wage rose and during periods when the real minimum wage fell or was constant, and both fractions are lower than the fraction of high-wage teens who remained employed. The sample means also suggest that low-wage teens who remained employed experienced larger increases in hours than did high-wage teen workers regardless of whether the real minimum wage increased.

The wage change, employment and hours regressions are estimated with both the wage gap and the artificial wage gap variables. The comparison group consists of workers who initially earned at least 25 cents above the minimum wage during periods when the real minimum wage did not increase and workers who initially earned above the new minimum wage during periods when the real minimum wage rose. If differences between low-wage and high-wage workers — not real minimum wage increases — underlie differences in employment and hours transitions, the estimated coefficients on the wage gap and artificial wage gap variables should be the same.

Low-wage workers experience an increase in hourly wages relative to high-wage workers, conditional on remaining employed. Evaluating the results in the first

Table 4
Descriptive statistics of individual sample, by minimum wage regime

	Affected	Artificially affected	Unaffected	
	(1)	(2)	MW constant (3)	MW increased (4)
Average wage gap	US$0.22 (0.003)	0.19 (0.001)	–	–
Percent employed in second year	70.22 (1.11)	70.27 (0.39)	76.19 (0.32)	74.95 (0.71)
Average real hourly wage in first year	US$4.08 (0.006)	4.85 (0.004)	6.47 (0.017)	5.79 (0.034)
Average change in real hourly wage among workers remaining employed	US$0.90 (0.06)	0.53 (0.02)	0.14 (0.02)	0.23 (0.04)
Average hours per week in first year	20.37 (0.23)	21.87 (0.09)	28.43 (0.09)	26.54 (0.20)
Average change in hours per week among workers remaining employed	4.56 (0.32)	4.46 (0.12)	2.26 (0.09)	2.41 (0.20)
Average age in first year	17.30	17.39	17.95	17.85
Percent female	53.36	51.71	42.74	46.44
Percent African-American	8.49	7.45	5.37	6.69
Percent Hispanic	5.19	4.96	5.28	5.37
Percent enrolled in first year	48.88	45.67	29.98	34.91
Percent completed 12th grade by first year	28.07	33.77	56.39	52.03
Sample size	1696	13,823	17,403	3721

Data are based on matched individual records in CPS outgoing rotation groups for teens aged 16–19 for the years 1979–1993. See text for definition of affected and artificially affected workers. Standard errors are shown in parentheses.

column of Table 5 at the sample means, average wages for affected workers rose 57 cents more than the wages of unaffected workers, and average wages of artificially affected workers rose 36 cents more than the wages of unaffected workers. Low-wage workers who remain employed thus experience greater wage growth than high-wage workers. In addition, minimum wage increases do appear to boost the wages of low-wage workers; the estimated coefficients on the two wage gap variables are statistically different at the 1% level.

Table 5
Effects of the wage gap, by minimum wage regime

	Change in wage if still employed	Probability remain employed	Change in hours	
			Still employed	All teens
	(1)	(2)	(3)	(4)
Wage gap for affected workers	2.587 (0.245)	−0.316 (0.150) {0.102}	5.181 (1.547)	2.434 (1.866)
Artificial wage gap for artificially affected workers	1.889 (0.175)	−0.373 (0.081) {0.120}	7.157 (0.788)	4.622 (0.945)
Age	0.130 (0.029)	0.029 (0.011) {0.009}	0.692 (0.100)	0.248 (0.127)
Female	−0.203 (0.035)	−0.004 (0.016) {0.001}	−0.066 (0.149)	0.453 (0.185)
African-American	−0.067 (0.080)	−0.452 (0.031) {0.161}	−0.871 (0.332)	−5.451 (0.410)
Hispanic	−0.053 (0.067)	−0.082 (0.037) {0.027}	−1.515 (0.343)	−2.686 (0.450)
Enrolled	−0.075 (0.038)	−0.135 (0.017) {0.044}	3.283 (0.171)	3.934 (0.198)
High school graduate	0.032 (0.053)	0.260 (0.023) {0.083}	−2.263 (0.215)	0.179 (0.282)
Change in adult male unemployment rate	0.053 (0.020)	−0.018 (0.008) {0.006}	−0.047 (0.076)	−0.224 (0.096)
χ^2 statistic	–	1001.02	–	–
Adj. R^2	0.018	–	0.043	0.031
Sample size	26,954	36,643	26,932	36,578

Column 2 shows Probit results, and the marginal effects evaluated at the sample means are shown in brackets. The other columns show OLS results. All regressions are also a full set of state and year fixed effects. Standard errors are shown in parentheses.

Low-wage teen workers are less likely to remain employed than high-wage teens regardless of whether the minimum wage rises, and real minimum wage increases do not appear to have a disemployment effect among low-wage workers. The results in column (2) of Table 5 indicate that the average probability of remaining employed is 2.2% lower for low-wage teens who were affected by a real minimum wage increase than for high-wage teens, and 2.3% lower for low-wage teens when the minimum wage was constant than for high-wage teens.[20] The estimated coefficients are not statistically different, indicating that real minimum wage increases do not have a disemployment effect among low-wage

[20] If teens who did not earn at least the minimum wage in the first period are included in the sample, the average affected worker is not significantly less likely to remain employed than a high-wage worker, and the average artificially affected worker is about 1.6% less likely to remain employed than a high-wage worker.

teens. The disemployment result reported in Table 3 thus appears to be due to differences between low- and high-wage teens, not due to increases in the real minimum wage.

The results in the hours regressions similarly suggest that minimum wage increases do not affect the hours of low-wage teens relative to high-wage teens. Among workers who remain employed, the average affected workers' hours rose 1.1 hours relative to high-wage workers, and the average artificially affected workers' hours rose by 1.4 relative to high-wage workers. The estimated effects are not statistically different. When teens who do not remain employed are included in the sample, low-wage workers do not experience hours losses relative to high-wage workers. The estimated coefficients on the two wage gap variables are not statistically different from each other in the hours regressions, suggesting that minimum wage increases do not cause the observed changes in hours. Instead, low-wage workers who remain employed appear to experience an increase in hours relative to high-wage teens, and low-wage workers do not experience a relative decline in hours even when factoring in differences in the probability of remaining employed.

If nominal instead of real variables are used to determine whether a worker is affected by a minimum wage increase, the results generally are similar. Workers affected by a nominal minimum wage increase and artificially affected workers (workers who earn within 25 cents of the minimum wage during periods when the nominal minimum wage is constant) are both less likely to remain employed than high-wage workers; however, the coefficients on the two wage gap variables are not different from each other, indicating that increases in the nominal minimum wage do not have relative disemployment effects among low-wage workers. Low-wage workers who remain employed experience an increase in hours relative to high-wage workers regardless of whether the nominal minimum wage rose. When workers who do not remain employed are included, low-wage workers continue to experience a significant increase in hours relative to high-wage workers. The estimated coefficients on the two wage gap variables are not different from each other in the hours regressions, indicating that minimum wage hikes do not have a significant effect on the hours of low-wage workers.

6. Conclusion

There are several possible reasons why some recent studies have found that increases in the minimum wage do not lead to lower employment. The empirical methodologies used may fail to detect employment losses that really occurred, the data may contain flaws or the traditional model of competitive labor markets may not be true. Another possibility is that employers adjust hours rather than employment levels, particularly in the short run. This study therefore examines the effect of the minimum wage on both employment and hours using both state- and individual-level data.

The results indicate minimum wages do not significantly reduce teen hours but may have a small effect on employment. In the state-level results, the minimum wage is not significantly negatively associated with teen average hours of work, either among employed teens or all teens. Individual-level data show that teens who are likely to be affected by minimum wage increases do not experience a significant decline in hours relative to unaffected teens, even when teens who do not remain employed are included in the analysis. Some of the state-level results suggest that higher minimum wages may result in lower teen employment rates, but the estimates are sensitive to the choice of minimum wage variable. Individual-level employment regression results suggest that affected teens are about 2.2% less likely to remain employed a year later than unaffected teens; however, low-wage workers are equally less likely to remain employed than high-wage workers during periods when the minimum wage did not change. The effect of the minimum wage increases therefore may be smaller than other estimates, such as Currie and Fallick (1996), suggest.

The state- and individual-level data used in this study give a picture of the effect of minimum wages on aggregate outcomes and on employment and hours transitions among workers who are initially employed. Minimum wage increases may reduce the probability of becoming employed rather than the probability of remaining employed, potentially explaining the small adverse employment effects estimated in some of the state-level regressions but not in the individual-level regressions. The effect of minimum wage increases on transitions from nonemployment to employment is an area for future research.

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Appendix A. Descriptive statistics, by matching status

Data are based on individual records in CPS outgoing rotation groups for teens aged 16–19 for the years 1979–1992. See text for definition of affected workers. Standard errors are shown in parentheses.

	Matched (1)	Unmatched (2)
Percent affected by increases in real minimum wage	4.63 (0.11)	4.12 (0.12)
Average real wage gap if affected	US$0.22 (0.003)	0.24 (0.005)
Average real hourly wage in first year	US$5.68 (0.01)	6.08 (0.02)
Average hours per week in first year	25.39 (0.06)	29.07 (0.08)
Average age in first year	17.70 (0.006)	17.98 (0.006)
Percent female	46.99 (0.26)	48.30 (0.31)
Percent African-American	6.43 (0.13)	6.63 (0.15)
Percent Hispanic	5.16 (0.12)	7.38 (0.16)
Percent enrolled in first year	37.23 (0.25)	26.64 (0.28)
Percent completed 12th grade by first year	46.10 (0.26)	52.88 (0.31)

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