



Pergamon

Economics of Education Review 22 (2003) 11–21

Economics of
Education Review

www.elsevier.com/locate/econedurev

Minimum wages and school enrollment of teenagers: a look at the 1990's

Duncan D. Chaplin^{a,*}, Mark D. Turner^b, Andreas D. Pape^c

^a *The Urban Institute, 2100 M St. NW, Washington, DC 20037-1207, USA*

^b *Johns Hopkins University, 3400 N. Charles St, 5th Floor, Baltimore, MD 21218, USA*

^c *The University of Michigan, 513 Oswego St, Ann Arbor, MI 48014, USA*

Received 1 May 1999; accepted 5 October 2001

Abstract

Interest in the effects of the minimum wage on teenagers' school enrollment has grown in recent years. This issue is of increasing importance given recent calls for increasing the minimum wage. Some authors argue that higher minimum wages will hurt teenagers by lowering their school enrollment. In this paper we estimate the effects of higher minimum wages on school enrollment using the Common Core of Data, collected by the US Department of Education. These data cover the entire population of public school students in the United States. Controlling for local labor market conditions and state and year fixed effects we find some evidence that higher minimum wages reduce teen school enrollment in states where students can drop out before the age of 18. This appears to be driven by the grade 9 to grade 10 transition. We find no effects for higher-grade levels or in states where students cannot drop out until they are 18. This suggests that minimum wages may have a substantial effect on teens' schooling effort in these early grades but also that these unintended effects can be offset by policies that encourage continued school enrollment.

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Keywords: I21; I28; J24; Educational economics; Human capital

1. Introduction

In 1996, President Clinton signed legislation raising the minimum wage from \$4.25 to \$5.15 an hour and in 2000 he proposed to increase it again to \$6.15 per hour. Increases in the minimum wage are designed to improve the employment outcomes of low-wage workers. Unfortunately, increasing the minimum wage may have unintended negative consequences for some teenagers. Foremost among these is that higher minimum wages may lower teen employment. This possibility is suggested both by economic theory and by some empirical evidence. An additional cause for concern, raised more

recently, is that increasing the minimum wage may reduce school enrollment. This could be especially true if the minimum wage increases teen labor force participation rates—either by increasing their search efforts or hours worked. For this reason, an increasing number of researchers and policy makers have become interested in finding out whether raising minimum wages induces some teenagers to drop out of school.

In this paper we use state-level data on the entire population of public high school students over almost an entire decade to analyze the possibility that higher minimum wages influence school enrollment rates. The minimum wage increased, in real terms, during the early 1990s while the high school continuation ratio¹ fell. On

* Corresponding author. Tel.: +1-202-261-5771; fax: +1-202-833-2477.

E-mail address: DChaplin@UI.Urban.Org (D.D. Chaplin).

¹ The continuation ratio is grade 10–12 enrollment in one year and the previous year's graduates summed and then divided by the previous year's grade 9–12 enrollment.

the other hand, the minimum wage fell during the late 1990s and the continuation ratio continued to decline. Thus, the time-series evidence alone suggests an ambiguous relationship between the Federal minimum wage and aggregated continuation ratios.

Several studies in this area find that higher minimum wages reduce school enrollment (Neumark & Wascher, 1995b, in press; Turner & Demiralp, 2001). For example, Turner and Demiralp find that higher minimum wages are correlated with a greater likelihood of leaving school for work. In addition, some teens—in particular ethnic minority and inner city teens—are more likely to become idle—neither working nor enrolled in school—following a minimum-wage increase and teens who are not enrolled in school are less likely to enroll in school following a minimum wage hike. On the other hand, other researchers (Card and Krueger, 1995) contend that increases in the minimum wage, such as those which have occurred in the recent past, are fairly small and would, therefore, have little if any effect on teen school enrollment decisions. They argue that the additional income derived from working, caused by these minimum-wage increases, seldom offsets the return to additional years of education. Therefore, few teens making rational decisions would be induced to drop out of high school to work additional hours. These same researchers also argue that school enrollment is a normal good. Therefore, to the degree that raising the minimum wage increases income, school enrollment will also increase.

This study contributes to the literature by using data covering all public school students in the United States. In comparison, most other studies on the minimum wage are based on samples of the population. In addition, we test to see if stricter dropout age laws reduce the impact of the minimum wage.

In Section 2 we discuss recent research examining the relationship between minimum wages and school enrollment. Section 3 outlines the theoretical reasons for how the minimum wage could affect school enrollment. Section 4 describes the data construction and key variables. Section 5 describes our model specification. Section 6 describes our findings while Section 7 explains them. In the conclusion we summarize our empirical results and discuss their policy implications.

2. Background

A number of researchers have estimated the impact of minimum wages on school enrollment (Ehrenberg & Marcus, 1982; Neumark & Wascher, 1992, 1994, 1995a,b, 2002; Evans & Turner, 1997; Turner and Demiralp, 2001). The studies thus far have one important shortcoming. None of the studies definitively identify why some teens decide to leave school while others

remain in school following minimum-wage increases. Research by Neumark and Wascher attributes different response elasticities to skill differences.² In their earlier work Neumark and Wascher also identify differential effects of the minimum wage on employment and school enrollment by age group and ethnic background. Turner and Demiralp identify different response elasticities by ethnic background and urban status, but note the strong possibility that employer discrimination, school quality, or spatial mismatch problems may explain these differences. None of these studies attempt to overtly explain why higher minimum wages have differential effects by ethnic background or urban status. In this paper we make use of the fact that compulsory schooling laws restricted young teens in some states from dropping out of school, while teens in other states were not constrained by compulsory school laws. Interacting these compulsory schooling laws with minimum wages provides insight into how higher minimum wages might affect teens' school enrollment decisions.

3. Theory

In order to affect school enrollment the minimum wage must affect labor market outcomes. This seems quite plausible since large fractions of teenage workers can be affected by minimum-wage increases. Turner and Demiralp (2001) estimate that over two thirds of employed teenagers were affected by the minimum-wage increases (state and federal) that occurred in 1992.³ However, it is generally agreed that the overall labor market effects of minimum wage changes are ambiguous. On the one hand, a higher minimum wage could increase the wages earned by at least some low-wage workers. On the other hand, being forced to pay a higher wage could cause some employers to offer fewer jobs. This, in turn, could lower employment for workers, especially for those who were earning less than the new minimum wage.

Presumably proponents of higher minimum wages believe that raising minimum wages makes employment more attractive for most low-skilled workers. If this is true, higher minimum wages are also likely to lower school enrollment for at least some teenagers, since most teens are considered low-skilled in the labor market, relative to older workers. This occurs in part because those students thinking primarily about the short run may leave school to take advantage of apparently improved labor market opportunities. In addition, those students thinking

² Neumark and Wascher use wages as proxies for skills.

³ More precisely, these teenagers had wages that were above the 1991 minimum effective in their state, but below the 1992 minimum.

primarily about the long run may leave school because improving outcomes for low-skilled workers reduce the expected long-run returns to education.

These arguments suggests that for a given individual, increasing the minimum wage can either raise employment and lower school enrollment or it can do the opposite—lower employment and increase school enrollment. Neumark and Wascher agree with this general point and suggest that the effects are uneven and not symmetric for high- and low-skilled teenagers. They argue that increasing the minimum wage causes relatively more-skilled teenagers to work more, because it forces employers to substitute more-skilled workers for less-skilled teenagers. Moreover, Turner and Demiralp (2001) find that some teens—black and Hispanic and teens in inner-cities—are more likely to become neither enrolled in school nor employed following a minimum-wage increase.

Another possible effect of a minimum-wage increase could be to increase the demand for full-time work relative to part-time work. Cunningham (1981) notes that part-time workers earn less than full-time workers and that students who work generally work part-time.⁴ Thus, a minimum wage increase is likely to displace more part-time than full-time jobs and thereby induce some youth in school and working part-time to leave school and work full-time.

The discussion above focuses on the “price” effects of the minimum wage (the price of leisure and the returns to education). The minimum wage might also have an “income” effect if it affects household income or the expected lifetime wage of a teenager. This will also be an ambiguous effect since it depends on how an increase in the minimum wage affects household income. If it raises household income, and education is a normal good, then we would expect a higher minimum wage to increase school enrollment. Conversely, increasing the minimum wage could lower household income by lowering the probability of employment. In this case it might lower teenage school enrollment (Basu, 2000). To summarize, it is not clear how increasing the minimum wage would affect school enrollment because both the price and income effects are ambiguous. Thus, additional empirical research is needed to determine whether schooling decisions may be affected by increases in the minimum wage.

⁴ This could happen if the fixed periodic costs of hiring and training a worker per hour worked are lower for full-time workers and/or if full-time workers are more productive than part-time workers. A full-time worker could be more productive than apparently identical part-time workers hired to do the same work because communication about shared tasks between part-time workers would be costly and relatively error-prone.

4. Data

Our data include information on the minimum wage, school enrollment, local labor market conditions, and rules regarding high school graduation and enrollment. All data are by state and year. To describe the tendency of students to move from one grade to the next we use continuation ratios (described below).

4.1. Minimum wage

Data on state and federal minimum wages are obtained from the Book of the States. Because both state and federal laws are in effect, the maximum of both wage levels is taken to be the operative minimum wage in each state by year. There are also special apprenticeship minimum wages but these are seldom used by employers so we exclude them from our analysis. To control for inflation we have adjusted the minimum wage variable using the CPI-U. In addition, we control for the average manufacturing wage in the state.

4.2. Continuation ratios

Our continuation ratios are based on high school enrollment data from the Common Core of Data (CCD) starting with the 1989–1990⁵ school year and going through to the 1996–1997 school year. These data include the total enrollment of public high school students by grade-level, state, and year. They are obtained from annual surveys of all public schools in the US which are processed by state education agencies and the US Department of Education. Internal data checks by the US Department of Education revealed that in the 1996–1997 school year almost 70% of the schools had data with no apparent errors and almost all of the remaining 30% had six or fewer errors per school (Hamann, 1999).⁶

We end up with about 400 observations by state and year. In comparison, Evans and Turner (1997) had 612 year/state combinations in their Current Population Survey (CPS) data going from 1978 to 1989. Similarly Neumark and Wascher (1995b) and Evans and Turner (1997) had about 700 year/state combinations using CPS data from 1977 to 1989 (October data) and 1974 to 1976 (May data) and Neumark and Washer (2003) had about 950 year/state combinations, using CPS data from 1980 to 1998. While the CPS data do allow for more state/year combinations, they provide much less precise outcome measures because they are based on only a small sample of individuals.

Using these CCD Data we create an overall high

⁵ This is the earliest year that the data are available.

⁶ These checks are only based on internal checks within the given year of data and across years.

school continuation ratio equal to last year's graduates and this year's grade 10–12 enrollment summed and divided by last year's grade 9–12 enrollment. We are also interested in continuation ratios by grade. To create a grade 9–10 continuation ratio we divide this year's grade 10 enrollment by last year's grade 9 enrollment. Similar measures are used to describe grade 10–11 and grade 11–12 continuation ratios. Finally, we divide the current year graduates by the current year 12th graders to calculate a grade 12-graduation ratio.

We use these continuation ratios as measures of school effort. Effort presumably affects performance and performance, in turn, affects the probabilities of being held back or dropping out of school. Thus, these continuation ratios capture the effects of school effort because they are affected by both the degree to which students are held back and by dropout rates.⁷

The grade-specific continuation ratios also have weaknesses that are likely to bias our estimated minimum-wage effects downwards. This is because students who are held back in one grade increase the continuation ratio for the earlier grade. For instance, while students who are held back in grade 10 lower the grade 10 to 11 continuation ratio, they increase the grade 9 to 10 continuation ratio. In addition, students who skip grades lower the continuation ratio. For these reasons we focus much of our discussion on the overall continuation ratio which does not have these problems because students can only be high school graduates once and cannot skip being a graduate without dropping out.

The overall continuation ratio has another strength. It is driven much more by dropout rates than the grade specific continuation ratios are. This is because students who are held back in grades 10–12 do not affect the overall continuation ratio unless they drop out of school.

In order to better understand the strengths and weaknesses of our continuation ratios we note that they can be broken down as follows.⁸ Let the grade-specific con-

tinuation ratio in year t for grade i (where $i=10, 11,$ or 12) be

$$CR_{it} = Y_{it}/Y_{i-1,t-1}$$

where: Y_{it} = total enrollment in grade i in year t , = $Y_{i-1,t-1} - R_{i-1,t-1} - DO_{i-1,t-1} + R_{i,t-1}$ R_{it} = Students retained DO_{it} = Students who drop out

The terms $-R_{i-1,t-1} - DO_{i-1,t-1}$ capture being retained or dropping out from grade $i-1$ in year $t-1$. We are looking for the relationship of the minimum wage with these terms. Unfortunately, enrollment in grade i in year t also includes the term $+R_{i,t-1}$. If retention rates are positively correlated across grades, then this term is likely to bias our estimates down.

The grade 12 to graduation continuation ratio will not be biased in this way because students cannot be graduates more than once. Similarly, our results based on the overall continuation ratio should not be biased in this way either. To see this note that the overall continuation ratio (CR_t) can be written in terms of the numbers we observe in the CCD as:

$$\begin{aligned} & [(Sum Y_{it} \text{ across grades 10 through 12}) \\ & + G_{t-1}] / (Sum Y_{i,t-1} \text{ Across grades 9 through 12}) \end{aligned}$$

where G_{t-1} refers to graduates in year $t-1 = Y_{12,t-1} - R_{12,t-1} - DO_{12,t-1}$.

We are interested in dropping out and being retained, however. To see how the continuation ratio relates to dropping out and being retained we rewrite the numerator of the continuation ratio as:

$$\begin{aligned} & Y_{9,t-1} - R_{9,t-1} - DO_{9,t-1} + R_{10,t-1} + \\ & Y_{10,t-1} - R_{10,t-1} - DO_{10,t-1} + R_{11,t-1} + \\ & Y_{11,t-1} - R_{11,t-1} - DO_{11,t-1} + R_{12,t-1} + \\ & Y_{12,t-1} - R_{9,t-1} - DO_{12,t-1} \end{aligned}$$

The $R_{i,t-1}$ terms for $i=10, 11,$ and 12 cancel out so we are left with:

$$\begin{aligned} & Y_{9,t-1} - R_{9,t-1} - DO_{9,t-1} + \\ & Y_{10,t-1} - DO_{10,t-1} + \\ & Y_{11,t-1} - DO_{11,t-1} + \\ & Y_{12,t-1} - DO_{12,t-1}. \end{aligned}$$

Thus, our overall continuation ratio captures being held back in 9th grade and dropping out any time between 9th and 12th grade.

To simplify our discussion we left out skipping grades. Skipping grades works in much the same way as being retained. It will bias our grade-specific continuation ratios, but it should not bias our overall continuation ratios since students remain enrolled regardless of what grade they skip into, unless they graduate from high

⁷ We were not able to find nationally-representative data on dropout and retention rates by grade. We have found evidence that the overall dropout rate during high school (grades 10–12, age 15–24) was around 4–6 % from 1972 to 1995 (Smith et al., 1997). In addition, evidence presented by Morris (1993) suggests that grade retention in 12 US states averaged 8% (unweighted by state) in both the 1979–1980 and 1985–1986 school years. This suggests that grade retention is substantially more common than dropping out. However, grade retention probably matters less than dropping out for our overall continuation ratio for reasons described below.

⁸ In the following discussion we ignore migration and changing to private schools for the reasons given above. These factors can be thought of as additional error terms that affect our continuation ratios but that are assumed to be uncorrelated with our variables of interest (the minimum wage) after controlling for the other variables in our model.

school.⁹ In addition, students who skip from a lower grade (before 9th grade) into grade 10 or above increase our continuation ratio. Thus, the overall continuation ratio includes the positive effect of 8th graders who are able to skip to grades 10 or above just as it correctly reflects the negative effect of 9th graders who are held back.

We also omitted dropping in—re-enrollment by students who had previously dropped out for at least 1 year. This will also be captured correctly by both our overall and grade-specific continuation ratios as dropping in represents an increase in school effort and also increases the continuation ratios.

While the overall continuation ratios do capture dropping in, skipping grades, and being retained, they do have two potential weaknesses. In particular, students who switch to non-public schools or migrate out of a state lower these continuation ratios. It is not clear why moving to non-public schools would be correlated with changes in the minimum wage so we believe this is unlikely to bias our estimates. Higher minimum wages could, however, affect migration of families and, therefore, bias our results.¹⁰ We discuss this possibility in Section 6.¹¹

4.3. High school rules, including dropout age

States have set different ages at which dropping out is legal. These data are represented by three variables in our regressions; whether the state allows students younger than 17 years old to drop out¹², whether one cannot drop out until one is 17, and whether one cannot drop out until one is 18.

We interact the dropout dummy variables with the minimum wage variables. In order to be able to interpret the coefficient estimates on the dropout variables we first subtract \$4.00 (the approximate mean) from the minimum wage. Therefore the dropout age variable coef-

ficients can be interpreted as the estimated effect of the dropout age for individuals in states with a \$4.00 minimum wage.

Many states have, over time, begun requiring that high school students pass an exit exam to graduate from high school. A dummy variable was created to represent whether such an exam is required. A variable representing the minimum number of Carnegie credits required at the state level for graduation has also been created. Descriptive statistics for all these variables are given in Table 1.

5. Method

The minimum wage and continuation ratios could be correlated for a large number of reasons. For example, legislators might increase the minimum wage in response to a high demand for labor. This high demand for labor might also have the effect of lowering high school continuation ratios. To help control for such factors we include both state and year fixed effects in our regressions. These should control for any systematic differences across states or over time. Controlling for these fixed effects means that our estimates of the effect of the minimum wage on continuation ratios are driven by the across-state difference in changes over time.

One concern about this method is that controlling for both state and year dummy variables (59 dummies) might leave us with little variation to identify the effect of the minimum wage on continuation ratios. However, we note that the number of states with minimum wages above the federal minimum varied from five to 17 during this period and was ten or higher in five of the 8 years from 1989 to 1996.¹³

Remaining differences in minimum wages and continuation ratios might also be related to changes in related factors within states, such as concern about youth delinquency. For this reason we also include a number of controls in our models for factors that might be associated with changes in the minimum wage and other policies at the state level. These include the rules governing high school completion (if an exit exam is required, number of credits needed, and the dropout age). In results discussed, but not presented, we also test the robustness of our models in a number of ways.

6. Results

Estimated effects of the minimum wage on the overall continuation ratio are presented in Table 2. The mini-

⁹ About 2.7 percent of the sample (unweighted) of students in the National Educational Longitudinal Survey of 1988 skipped a grade and finished high school sometime between when they were in 8th grade (in 1988) and four years later (1992), when most of their class was still enrolled in 12th grade. Based on this, a rough estimate would be that about 0.7% of students skip a grade each year during high school.

¹⁰ We are aware of no literature that estimates the effect of the minimum wage on interstate migration. A related literature, on the effects of welfare benefits on migration, suggests ambiguous effects (Brueckner, 1998).

¹¹ The results could also be biased by selection caused by dropping out in previous grades. This would also be true if we had individual-level data on dropout decisions.

¹² Only one state had a dropout age below sixteen during these years. Mississippi set its dropout age at fourteen until 1992.

¹³ State minimum wages were higher than the federal minimum wage and had changed in the previous year 28 times between 1990 and 1996.

Table 1
Descriptive statistics^{ab}

	<i>N</i>	Mean	SD	Minimum	Maximum	Year
<i>High school continuation ratios</i>						
10th Graders/9th Graders _{t-1}	402	0.929	0.057	0.787	1.100	89–96
11th Graders/10th Graders _{t-1}	402	0.917	0.046	0.726	1.073	89–96
12th Graders/11th Graders _{t-1}	402	0.929	0.045	0.758	1.077	89–96
Graduates _{t-1} /12th Graders _{t-1}	401	0.921	0.067	0.677	1.130	89–96
Overall HS continuation ^c	401	0.924	0.034	0.841	1.041	89–96
Overall HS continuation last year	352	0.927	0.033	0.841	1.041	90–96
<i>Minimum wage (Real)</i>						
Minimum Wage (-\$4) ^d	408	-0.607	0.229	-0.968	0.299	89–96
<i>Legal minimum dropout age</i>						
Age one can legally drop out	406	16.510	0.816	14	18	89–96
Can drop out at 16 or less	408	0.650				89–96
Cannot drop out before 17 years old	408	0.174				89–96
Cannot drop out before 18 years old	408	0.176				89–96
<i>Interactions</i>						
Min. Wage/16 year Old dropout age interaction	408	-0.398	0.343	-0.968	0.135	89–96
Min. Wage/17 year Old dropout age interaction	408	-0.114	0.261	-0.968	0.075	89–96
Min. Wage/18 year Old dropout age interaction	408	-0.096	0.236	-0.968	0.299	89–96
<i>High school rules</i>						
Exit exam required for graduation	406	0.362				89–96
Total HS credits required (state level)	408	17.962	6.240	0	24	89–96

^a Sources: Continuation Ratios from Common Core of Data. High School rules data from Digest of Education Statistics '88–'97. Minimum wage from the Book of the States by the Council of State Governments, 1990–91, 1996–97, 1998–99.

^b Standard deviation (SD), Minimum, and Maximum have been excluded for dummy variables.

^c $(\text{Graduates}_{t-1} + 12_t + 11_t + 10_t) / (12_{t-1} + 11_{t-1} + 10_{t-1} + 9_{t-1})$.

^d The minimum wage is the maximum of the federal and state minimum wages and is in \$ 1988, using the CPI for all Urban consumers.

imum wage is interacted with the dropout age in the state ($\leq 16, 17, \text{ or } 18$). As Table 2 shows we find statistically insignificant effects for individuals in states where the dropout age is over 16.¹⁴ However, for states with dropout ages equal to or less than 16 the effect is -0.011 and is significant at the 5% level. This estimate is moderately large in comparison to the overall continuation ratio of over 90% (see Table 1). The estimate implies that increasing the minimum wage by \$1 would decrease the continuation ratio by about 1 percentage point. In comparison, allowing 16 year olds to drop out when the minimum wage is around \$4 (in 1988 \$) lowers continuation ratios by about 3 percentage points. One can also think about how the minimum wage affects the non-continuation ratio ($1 - \text{the continuation ratio}$), which averages around 10 percentage points. Raising the minimum wage by one dollar is estimated to increase non-continuation by about 10%.

6.1. Robustness

The results in Table 2 are based on models with both state and year fixed effects as well as controls for rules governing high school enrollment and graduation and for labor market demand. We conducted a number of additional tests for our results. First, we controlled for the lagged value of the overall continuation ratio.¹⁵ Second, we added an additional interaction for state/year observations where the dropout age was only 14. Third, we dropped our controls for labor demand. These changes made almost no difference to the results presented in Table 2. Finally we calculated grade-specific continuation ratios. These regressions suggest that the negative effect of the minimum wage found in Table 2 is driven by primarily the grade 9 to grade 10 tran-

¹⁴ The minimum-wage effect estimated without interactions is -0.004 and is not statistically significant.

¹⁵ That is we controlled for the value of the overall continuation ratio in the previous year. This meant dropping the 1989 observations.

Table 2
Regression results: effects on overall continuation ratio^{ab}

	Overall continuation ratio		
	Slope estimate	Standard error	P-value ^c
<i>Minimum wage (real)</i>			
Min. wage*16 year old dropout age	-0.011	0.005	0.036**
Min. wage*17 year old dropout age	0.006	0.009	0.503
Min. wage*18 year old dropout age	0.006	0.007	0.416
<i>Labor demand</i>			
Unemployment rate	-0.178	0.086	0.039**
Manufacturing wage	0.006	0.002	0.008***
<i>Legal minimum dropout age (vs. 18)</i>			
Can drop out at 16 or less	-0.029	0.006	0.000***
Can not drop out before 17 years old	-0.010	0.009	0.259
<i>High school rules:</i>			
Exit exam required for graduation	-0.003	0.004	0.554
Total HS credits required (state level)	-0.002	0.002	0.491
R-square		0.9056	
Number of observations		399	

^a Sources: Continuation Ratios from Common Core of Data; High School rules data from Digest of Education Statistics '88-'97; minimum wage from the Book of the States, 1990–91, 1996–97, 1998–99.

^b Regression controls for state and year dummies.

^c *10%, **5%, ***1% significance level.

sition.¹⁶ These robustness test results are described in more detail below.

6.1.1. Controlling for lagged continuation ratio

Controlling for the overall lagged continuation ratio had almost no effect on our estimates. In particular the estimated effect of the minimum wage in states where the dropout age is 16 increases to 0.013 and remains statistically significant at the 5% level.¹⁷

¹⁶ We attempted to do one additional robustness test—adding in rules covering the GED exam which have been shown to affect continuation ratios (Chaplin, 1999). The result of this test was inconclusive because of a lack of data. More precisely, the data on many GED rules are not available for all year-state observations used in this analysis. When we restrict our analysis to the observations for which all the GED rules are available the estimated effects of the minimum-wage variables become statistically insignificant. When we use only the GED rules available in all years and control for these rules the minimum-wage effects remain but these GED rules have no effect on the continuation ratios. To summarize, we cannot determine whether controlling for the GED rules that were shown to affect continuation ratios in Chaplin (1999) would change our results.

¹⁷ Curiously, the estimated effect of the lagged continuation ratio was negative and significant. We suspect there are two reasons for this negative coefficient estimate on the lagged continuation ratio. First, students who are held back in one year may be less likely to be held back in the next year. Second, students who drop out in one year are no longer in school the next year and can, therefore, no longer affect the continuation

6.1.2. Adding dropout age=14 interacton

In four state/year observations the dropout age was 14. Adding in this interaction had almost no effect on the other coefficient estimates or their significance levels and the interaction itself was not statistically significant. We exclude it from Table 2 because of the small sample of such observations and because individuals under the age of 16 are not allowed to work during school hours (National Research Council (1998)).

6.1.3. Dropping controls for labor demand

Many other studies on the minimum wage include controls for labor demand. However, since the minimum wage affects low-wage workers it may also affect most measures of labor demand, such as the unemployment rate or any average wage measure (Gramlich, 1976; Grossman, 1983; Meyer and Wise, 1983). Therefore, we also estimated models that do not control for labor demand. When we drop our controls for the unemploy-

ratios. For both of these reasons there may be a somewhat negative correlation between continuation ratios over time. One might expect to see a positive relationship between current and lagged continuation ratios. Indeed, when we run these models without the state dummy variables the coefficient estimates on the lagged continuation ratios are very positive (close to 1) and statistically significant (t-stats from 10 to 20). Thus, continuation ratios are highly correlated with each other within states and over time.

ment rate and average manufacturing wage¹⁸, the results remain almost unchanged. The estimated effect of the minimum wage in states where 16 year olds can drop out remains negative (-0.011) and significant at the 5% level.

6.1.4. Grade-specific continuation ratios

In Table 3 we present results estimating the effects of the minimum age on grade-specific continuation ratios (from grades 9–10, 10–11, 11–12, and 12 to graduation). In these regressions the estimates are again not significant for most groups. However for the grade 9–10 continuation ratio we find negative and significant estimates in states with dropout ages of 16 and 17.¹⁹ The estimated effects are -0.02 and -0.05 suggesting large increases in non-continuation associated with a \$1 increase in the minimum wage.²⁰ The estimated effects for the higher-grade levels are generally not statistically significant but the standard errors are moderately large meaning that negative effects are possible for these grade levels as well.²¹ However the effects are probably smaller based on the point estimates which are all either positive or else small and negative (<0.01 in magnitude).

These results suggest that the effects of the minimum wage occur primarily for the grade 9 to 10 transition. As discussed earlier, there are two problems with the grade-specific continuation ratios. First, students who are held back in grade 10 will make the grade 9–10 continuation ratio increase. Second, students who skip from grade 9 to 11 will make the continuation ratio decrease. In both cases decreased schooling effort (which could result from a minimum-wage increase) increases the continuation ratio instead of decreasing it. For both of these reasons the estimated minimum-wage effects by grade-level may be biased downwards in magnitude. There is

no reason to expect the sign to change. Therefore, these are unlikely explanations for our finding of negative (versus positive) effects of the minimum-wage variables on the grade 9 to 10 continuation ratios.

Another problem with the results by grade-level is that the estimated effect of the minimum wage is larger in states where students cannot drop out until age 17 than it is in states where they can drop out at 16. Similarly the estimated effect of the dropout age being 16 (at a minimum wage of \$4.00 per hour) is smaller than for the dropout age being at 17 (relative to 18). The reverse might be expected since 16 and 17 year-old youths are allowed to drop out when the dropout age is 16 but only 17 year-olds can drop out when it is 17. It is possible that in the states where the dropout age is 16, youth who were held back in school drop out before 9th grade and are therefore not included in our analysis. However, as can be seen in Table 2, when we use the overall continuation ratio as our outcome, the effect of the minimum wage is larger when the dropout age is 16 than when it is 17 or 18. To summarize, while the grade-specific continuation ratios are suspect, they do suggest that the effects of the minimum wage are concentrated on the grade 9–10 transition.

6.2. Controls

The control variables in our regressions appear to generally behave as expected. In particular, stricter dropout age laws appear to increase continuation ratios. For instance, as shown in Table 2, being in a state where students can drop out at age 16 is associated with lower overall continuation ratios than being in a state where you must be 18 to drop out (assuming a minimum wage of \$4.00 per hour). The estimate is also negative, though not statistically significant for the age 17 (compared to 18) drop out age. In Table 3 we can see that the estimates for the age 16 dropout age are negative and significant for all transitions except from grade 12 to graduation. The estimates for the age 17 dropout age are also negative and significant on the grade 9–10 continuation ratio and not statistically significant for the higher continuation ratios. Having to complete more credits or take an exam to finish high school are either negatively and significantly related to the continuation ratio or insignificantly related.

Interestingly the unemployment rate has a negative and statistically significant coefficient estimate and the manufacturing wage has a positive and statistically significant coefficient estimate in Table 2, suggesting that, as the demand for labor rises, so does school enrollment. We interpret this as possible evidence of an income effect—as earnings of parents rise, the parents are better able to keep their youth in school.

¹⁸ Both of these variables were obtained from the Bureau of Labor Statistics for all years and states in our data set. These results, and all others referred to but not presented, are available upon request from the authors.

¹⁹ The effect of the minimum wage is statistically significant for the grade 9–10 transition when we do not interact the minimum wage with the dropout age, but not for the higher grade levels.

²⁰ These results are also robust to the changes discussed above (adding the lagged value of the continuation ratios, adding the additional interaction for dropout age=14, and dropping the controls for labor demand). For instance, the estimated effects of the minimum wage variables that are statistically significant in Table 3 remain so and are similar in magnitude across models. In addition, the estimated minimum-wage effects on grade 11–12 and grade 12-graduation continuation ratios remain statistically insignificant.

²¹ The one exception is that the estimated effect of the minimum wage on the grade 10–11 continuation ratio in states with a dropout age of 18 is positive and statistically significant. It remains so across models.

Table 3
Regression results: effects on grade-specific continuation ratios^{ab}

	Model 1 9th to 10th grade		Model 2 10th to 11th grade		Model 3 11th to 12th grade		Model 4 12th grade to graduation	
	Slope estimate	Standard error	Slope estimate	Standard error	Slope estimate	Standard error	Slope estimate	Standard error
		<i>P</i> -value ^c		<i>P</i> -value ^c		<i>P</i> -value ^c		<i>P</i> -value ^c
<i>Minimum wage (real)</i>								
Min. wage*16 year old dropout age	-0.021	0.008	0.011**	0.007	-0.007	0.007	0.009	0.013
Min. wage*17 year old dropout age	-0.050	0.013	0.000***	0.011	0.000	0.011	0.012	0.022
Min. wage*18 year old dropout age	0.007	0.011	0.522	0.009	0.015**	0.009	-0.019	0.018
<i>Labor demand</i>								
Unemployment rate	-0.463	0.129	0.000***	0.104	0.019**	0.110	-0.182	0.216
Manufacturing wage	0.012	0.003	0.001***	0.003	0.001***	0.003	-0.003	0.006
<i>Legal minimum dropout age (vs. 18)</i>								
Can drop out at 16 or less	-0.032	0.009	0.000***	0.007	0.000***	0.007	-0.004	0.014
Can not drop out before 17 years old	-0.060	0.013	0.000***	0.010	0.141	0.011	0.017	0.021
<i>High school rules:</i>								
Exit exam required for graduation	-0.004	0.006	0.576	0.005	0.009***	0.001	-0.014	0.011
Total HS credits required (state level)	-0.008	0.003	0.026**	0.003	0.594	0.003	-0.015	0.006
<i>R</i> -square		0.9253		0.9249		0.9142		0.8504
Number of observations		400		400		400		399

^a Sources: Continuation Ratios from Common Core of Data; High School rules data from Digest of Education Statistics '88–97; Minimum wage from the Book of the States, the Council of State Governments, 1990–91, 1996–97, 1998–99.

^b All regressions contain state and year dummies.

^c *10%, **5%, ***1% significance level.

7. Discussion

Our results suggest that there is a negative effect of higher minimum wages on the continuation ratio for grade 9–10 in states with dropout ages under 18. The results are much less clear when the dropout age is higher. Similar differences in the effects of the minimum wage on school enrollment by state dropout age were found by Neumark and Washer (2003) using CPS data. These results are plausible for a number of reasons. First, younger teenagers are more likely to be considering minimum wage jobs than older teenagers because younger teenagers have not had time to develop the human capital needed to earn higher wages. In addition, these younger teenagers may have thought little about the trade-off between finishing high school and employment. For them a \$1 increase in the minimum wage could seem like an enormous incentive to leave high school. Finally, these younger teenagers may be particularly naive about their chances of getting a job. Thus, an increase in the minimum wage may encourage some of these teenagers to look for employment even if it is unlikely they will find it. To summarize, an increase in the minimum wage may encourage some of these younger teenagers to reduce their schooling effort either to work or to look for work. This in turn may cause them to be held back in high school or to drop out. In either case we would expect to see a negative effect on continuation ratios.

It should also be noted that youth under the age of 16 are not allowed to work during school hours. Therefore, our results are probably driven to a large degree by teenagers age 16 and 17 who are still in grade 9. It is likely that such students have been held back and are therefore at a greater risk of dropping out of high school than other students (Gleason and Dynarski, 1998). Therefore it is not surprising that the effects are largest for this group.

As discussed earlier, we are concerned about the possibility that our results could be biased by the effect of minimum wages on family migration between states. It seems unlikely, however, that such family migration would be related to the dropout age in the state. In addition, we believe that the minimum wage is far more likely to affect employment opportunities of teenagers than to affect cross-state migration decisions of their parents. First, parents tend to have higher wages than teenagers and would, therefore, be less likely to be affected by changes in the minimum wage. Second, even if a parent's employment status changes, out-of-state migration is costly. For these reasons we believe that migration effects are an unlikely explanation for our results.

8. Conclusion

In this paper we estimate the associations between minimum wages and high school continuation ratios over

time and across states. We use data covering all public school students in the US. This provides us with much more precise estimates than could be obtained using data on samples of students. We find evidence that increasing the minimum wage lowers continuation ratios for grades 9–10 in states with drop out ages under 18. This suggests that these policies may have the unintended negative consequence of diverting some young people from continuing with their education.

The costs and benefits of changing the minimum wage through its effect on school enrollment depend in part on the benefits of working during high school. Chaplin and Hannaway (1999) show that high school employment may be beneficial in the long run, even if it increases the risk of dropping out, especially for at-risk youth. On the other hand, most students are probably much better off staying in high school even if they are working. For these reasons we believe that our results suggest that employment policies be adjusted to better ensure that teenagers remain in high school. Increasing the drop out age would be one means of accomplishing this goal.²² Indeed, this result is also supported by the work of Neumark and Washer (2003). Alternatively requiring parental and/or school permission for employment (as is often done for sports participation or for obtaining a GED) would be another way to ensure that teenagers are not taking too much time away from their education in order to work.²³ Finally one could further restrict the hours that teenagers are allowed to work when school is in session.²⁴ In any case, our results suggest that the trade-offs between employment and school enrollment for teenagers should be kept in mind when increases to the minimum wage are being considered.

Acknowledgements

Based on paper presented at the 1999 annual meetings of the Eastern Economics Association, Boston, MA. Thanks to Pam Loprest, Stephanie Schmidt, and Wayne Vroman for helpful comments. This work was supported

²² The mean dropout age (by state) was around 16.5 in 1989 and had risen only slightly, to 16.7, by 1997. A reviewer pointed out that increasing the dropout age might also help target the minimum wage towards poor families with workers, if non-poor teenagers were disproportionately removed from the labor market by the dropout age increase.

²³ Chaplin (1999) shows that requiring parent permission to obtain a GED appears to increase continuation ratios relative to not allowing youth to obtain a GED at all.

²⁴ All youth under 16 are prohibited from working during school hours. Many states also restrict the employment of 16 and 17 year olds during this time. The National Research Council (1998) recommends additional restrictions on the employment of teenagers.

by a Field Initiated Studies Grant from the office of Education Research and Improvement, Department of Education. The views expressed in this paper are those of the authors and should not be attributed to any of the institutions for which they work or to the institutions which funded the research.

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