# The Minimum Wage and Teen Educational Attainment

*By* Alexander A. Smith*

*Teen employment effects are central to the minimum wage debate, but important indirect effects on education receive relatively little attention. I investigate the effect of changes in the minimum wage on high school dropout decisions. Consistently across two sources of variation and three individual-level datasets, I find that increases in the minimum wage substantially reduce the dropout likelihood of low-socioeconomic status (SES) teens, but have no effect on other teens. I find additional evidence consistent with this effect arising from a reduction in labor demand for low-SES teens that causes them to shift their time from work to education-related activities.*

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The economic literature on the consequences of the minimum wage is both vast and contentious. Researchers concentrate mainly on the possible disemployment effects of the minimum wage, frequently focusing on teens, the age group most subject to the minimum wage.[1] Comparatively few studies have investigated the effect of the minimum wage on teen educational outcomes. This lack of attention is surprising given the primary importance generally accorded to teen educational attainment by policymakers and researchers, who typically view education

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[1] One quarter of 16-19 year old wage earners earn the minimum wage (and many more are just above it), while only a tenth of 20-24 year old and a twentieth of 25-34 year old wage earners earn the minimum wage (calculations from March CPS).

as more closely linked to the later-life wellbeing of teens than teen employment.[2] I make two primary contributions to this literature. First, I use multiple data sources and sources of variation in concert to establish the causal effect of minimum wage changes on the educational choices of high-risk teens. Second, I provide evidence that the mechanism of this effect is a re-allocation of time from work to school, resulting from a reduction in the demand for teen labor.

While the effect of the minimum wage on educational outcomes is indirect, it is an intuitive byproduct of human capital theory. Teens face a tradeoff between investing in human capital (i.e. time and effort spent on school-related activites) and immediate consumption from time spent in the labor market.[3] To the extent that changes in the minimum wage alter the labor market opportunities faced by teens, these changes will also alter their investment-consumption tradeoff and therefore their educational outcomes. I investigate the impact of changes in the minimum wage on high school dropout decisions using two distinct sources of variation and three individual-level datasets. I use two decades of the Current Population Survey (CPS), one decade of the American Community Survey (ACS), and the 1996, 2001, 2004, and 2008 4-year panels of the Survey of Income and Program Participation (SIPP). To identify the effect of a minimum wage change, I leverage both variation in minimum wage rates within states over time and variation in minimum wage rates between neighboring localities on either side of a state border at a given point in time. Each of these sources of data and variation have their own advantages and disadvantages in measuring the educational effect of minimum wage changes. I use them in concert to address a variety of internal validity threats that would not be possible to address with only one source of data and variation.

[2] When controlling for demographics and cognitive ability, dropping out of high school is associated with decreases in later-life outcomes (i.e. employment, income, family income, and arrest record at age 26) that are more than twice the magnitude of the positive associations with employment at age 18 (author's naïve cohort fixed effects regressions using data from the National Longitudinal Survey of Youth 1997).

[3] Teens can also consume using transfers from their family. These transfers could be affected by changes in household income caused by minimum wage changes.

Consistently across data sources, sources of variation, and empirical specifications, I find that an increase in the minimum wage lowers the likelihood that low socio-economic status (SES) teens will drop out of high school but has no effect on the likelihood of drop out for other teens. The effect on low-SES teens, who have a higher *ex ante* dropout rate, is substantial. I find that a ten percent increase in the minimum wage, equivalent to an increase of 73 cents per hour at the current federal minimum, lowers the likelihood of dropping out by 0.5 to 1.0 percentage points, or between four and ten percent of the average dropout rate for the low-SES group.

I investigate how an increase in the minimum wage reduces the dropout rate for low-SES teens in two ways. First, I find evidence from the American Time-Use Survey (ATUS) that low-SES teens respond to an increase in the minimum wage by reallocating their time from work to education-related activities. Second, I find evidence from CPS cross-sectional data and SIPP individual-panel data that an increase in the minimum wage reduces the likelihood that teens work long hours, which past studies have linked to increased risk of dropout (Ruhm, 1997 and Turner, 1994). Similar to recent work by Jardim et al. (2017), I do not observe that an increase in the minimum wage raises low-SES teen earnings. This suggests that the reduction in hours worked by low-SES teens likely arises from a drop in labor demand rather than from an income effect on labor supply.

Taken together, my results suggest that the near-exclusive focus of prior research on the teen employment effects of the minimum wage may have missed part of the larger picture of this policy's impact on teens. While increasing the minimum wage may reduce hours worked by teens, this shift results in a reallocation of time from work to education-related activities. Such a shift, while perhaps costly to teens in the short-run, will benefit those teens (and society more broadly) in the long run if teenage educational outcomes are more important than teenage employment outcomes in determining later-life well-being.

## I. The Minimum Wage, Teen Work Hours, and Teen Educational Outcomes

The effect of the minimum wage on educational outcomes is indirect, but straightforward. Unlike most of the adult labor force, teens allocate their time between work, leisure, and school-related activities (e.g. classes, homework, after-school clubs, sports teams). A minimum wage change that impacts the teen labor market and thereby the time that teens spend working, will necessarily be accompanied by a change in the time allocated to leisure and school-related activities, so long as these activities are continuous normal goods.[4] The effect of the minimum wage on teen educational outcomes will therefore depend on three factors, each of which is likely to be influenced by socio-economic status: (1) The impact of the minimum wage on the work hours of teens, (2) the magnitude of teen school-related time responses to a given change in work hours, and (3) the sensitivity of high school drop out to school-related time inputs.

The impact of the minimum wage on educational outcomes will depend on the effect of the minimum wage on the teen labor market. Neoclassical economic theory generates a relatively simple prediction for the effect of the minimum wage on the work hours of teens: Firms will respond to an increase in the minimum wage by shifting their inputs away from these workers and toward other (substitutable) production inputs, such as higher-skilled workers or capital. This yields an unambiguous prediction that demand for low-skilled labor will decrease. If firms view high-SES teens as more skilled than low-SES teens, then the reduction in work hours would be larger for low-SES teens than high-SES teens.[5] However, incorporating the labor market participation decision into a model of job search, as in

[4] If leisure and/or school time are not continuous in practice, then a reduction in work time could be associated with only an increase in leisure or only an increase in school-related activites.

[5] The predictions of the simple neoclassical model do not necessarily hold for models incorporating search. For example, Lang and Kahn (1998) find an increase in employment from a minimum wage in a bilateral search model with heterogeneous workers, while Finn (2006) finds that employment may increase or decrease in a search-match model with endogenous contract rates. As in the simple neoclassical model, Lang and Kahn (1998) find the minimum wage results in worse outcomes for less productive workers relative to more productive ones.

the model of Pissarides (1978), could yield the opposite conclusion under certain conditions. If high-SES teens have shorter work horizons in the low wage labor market than low-SES teens (e.g. they are more likely to leave their job and go to college), then an increase in the minimum wage that reduces the probability of a job offer, but increases the wage conditional on an offer, could differentially reduce high-SES relative to low-SES teen labor force participation (since high-SES teens would have a shorter time period to benefit from a successful search).

The empirical literature examining the effects of the minimum wage on the teen labor market is vast and contentious, but most studies find at least small disemployment effects. The recent literature can be divided broadly into two camps with differing methodologies. The first, led by Neumark and Wascher in several works (Neumark, 1992, 2006; Neumark and Wascher, 1995, 2007; Neumark, Salas, and Wascher, 2013a), use the traditional two-way (state and year) fixed effect approach and find substantial disemployment effects (elasticities between $-0.1$ and $-0.3$).[6] The second, pioneered by Card and Krueger (1992) and exemplified by Allegretto et al. (2013), criticize the traditional approach for failing to account for spatial heterogeneity in labor market shocks and advocate the use of local area controls. Primarily, they use cross border designs which compare neighboring localities that cross a state border. These studies tend to find small or null disemployment effects.[7]

The magnitude of the impact of the minimum wage on educational outcomes will depend, in part, on whether teens respond to a reduction in work hours primarily by spending more time on school-related activities or leisure activities. In equilibrium teens will set their marginal utilities of each activity to be equal, so their response to an exogenous reduction in work time will depend on how the marginal utilities of school and leisure change in response to a change in school,

[6] Meer and West (2015) argue that minimum wage changes have dynamic rather than discrete impacts on employment and therefore these fixed effects specifications, particularly those using state-specific time trends, will underestimate the true magnitude of disemployment effects.

[7] Jardim, et al. (2017) use detailed administrative data to show that defining the labor market by wage-level rather than by demographics (i.e. teens) or industry (i.e. restaurants) yields larger elasticity estimates (in the context of Seattle's recent minimum wage increase).

leisure, and work time. Assuming that there are no school-leisure time or school-work time complementarities, then a teen who experiences a reduction in work time will shift more of that newfound time towards school-related activities (and less toward leisure) if they have a greater complementarity between leisure and work time or if their marginal utility from school time diminishes less quickly, all else equal. If low-SES and high-SES teens are similar except that earnings affect leisure enjoyment more for low-SES teens, then low-SES teens would increase their school time by more than high-SES teens in response to the same reduction in work time. This differential response from low and high-SES teens could also arise from differences in tastes for or future returns from school-related activities that affect the second derivative of utility with respect to school-related time.

If educational outcomes are sufficiently sensitive to time inputs, then an effect on time allocated to school-related activities will translate into an effect on educational outcomes. The well-documented negative relationship between high intensity work and academic achievement in high school suggests that these outcomes are, in fact, sensitive to time inputs. For example, Ruhm(1997) finds that high school seniors working 20 (40) hours per week complete 0.21 (0.68) years less schooling than non-workers, while Turner (1994) finds that working 30 or more hours per week significantly reduces standardized test scores, grade point averages, and the chances of completing high school. Though these studies do not specifically address differential drop out by SES, drop out is likely more sensitive to time inputs by low-SES teens since they are more likely to be on the margin of dropping out.[8]

Recent studies in the U.S. and other developed countries have come to conflicting conclusions regarding the effects of the minimum wage on teen educational outcomes. A number of studies have found negative enrollment effects (Neumark and Wascher, 1995, 1995b, 2003; Turner and Demiralp, 2001; Chaplin et al. 2003)

[8]The baseline dropout rate of teens who have at least one parent without a high school diploma is between two and four times higher than the rate for other teens, depending on the data source and year.

while others have found mixed or null enrollment effects (Warren and Hamrock 2010; Campioleti et al, 2005; Pacheco and Cruickshank, 2007) or positive enrollment effects (Matilla, 1978, 1982). I make a number of specific contributions to the existing literature in the U.S.. First, I look at the effect of the minimum wage on high school dropout behavior separately by SES. This is a critical distinction as my analysis concentrates on the teens who are at the highest risk of dropping out. Second, I use multiple individual-level data sources in concert, which improve on prior data used in U.S. studies. I have direct measures of drop out and enrollment rather than estimates of aggregate state by year continuation and graduation rates, as in Chaplin et al. (2003) and Warren and Hamrock (2010). I have data spanning up to 20 years of minimum wage changes (compared to two years in Turner and Demiralp, 2001) and including more recent changes than elsewhere in the literature. In my analysis using the SIPP, I observe nearly all teens and can therefore rule out that my results are driven by sample selection, a concern for Neumark and Wascher (1995b, 2003) which use a 65% matched sample of teens observed in consecutive years of the May CPS.[9] Third, I am the first to use local cross-border variation in minimum wage in a given year in the investigation of educational effects of the minimum wage. Fourth, to my knowledge, I am the first to provide evidence that connects changes in minimum wage to improvements in low-SES teen educational outcomes through a change in teen time allocation.

## II. Data

I match data on state-level minimum wage rates and local labor market characteristics to three individual-level datasets with information on teens' labor market, educational outcomes, and parental education: the Current Population Survey

[9]I focus narrowly on high school dropout and enrollment outcomes (age 16-18), unlike Neumark and Wascher (1995b, 2003) and Turner and Demiralp (2001), which look at joint enrollment-employment outcomes (age 16-19). Limiting my sample to 16-18 year olds narrows my focus to decisions regarding completing high school, whereas including 19 year olds, as in Neumark and Wascher(1995b, 2003), would mean also capturing decisions of whether to go to college.

Out-going Rotation Group (CPS), the 2000 Census and American Community Survey (ACS), and the Survey of Income and Program Participation (SIPP). Each of these datasets has advantages and disadvantages in measuring the impact of minimum wage changes on teen educational outcomes. Taken as a group, these datasets allow me to avoid the major drawbacks of the data used in prior research (e.g. imprecise measures and potentially substantial endogenous sample selection), while also allowing me to differentiate effects on high and low-SES teens.

I use the CPS to construct a nationally-representative monthly cross-section of 16-18 year olds for 1992-2012 (CPS).[10] Each month's sample is relatively small and only contains coarse geographic information (i.e. state of residence) for all individuals.[11] The 2000 Census and 2005-2011 ACS provide a larger sample (1-in-20 and 1-in-100, respectively) and residence information at the Public-Use Microdata Area (PUMA) level for all individuals, while the 2001-2004 ACS provides a sample of less than 1-in-230 and only state of residence information.[12] I use the 2000 Census and ACS datasets to construct four distinct samples with increasing geographic specificity: (1) An annual cross-section for 2000-2011 that identifies residence at the state-level (ACS), (2) An annual cross-section for 2005-2011 that identifies residence at the PUMA-level (ACS-P), (3) An annual cross-section for 2005-2011 that identifies residence at the county-level for residents of large counties (ACS-C), (4) An annual cross-section for 2005-2011 with a probabilistic match between the Public Use Microdata Areas (PUMAs) in the ACS-P sample and their corresponding commuting zones (ACS-CZ).[13]

Observing a teen's parents/guardians is a requirement for determining her socio-

[10]Prior to 1992, the IPUMS-CPS does not differentiate between having attended 12 years of school and obtaining a high school diploma or equivalent.

[11]The IPUMS-CPS contains county of residence and metropolitan area of residence for some individuals in large counties or metropolitan areas, but the sample size is not large enough for meaningful analysis at this geographic level.

[12]PUMA codes are only comparable across the 2000 Census and 2005-2011 ACS. PUMA boundaries were were changed in 2012.

[13]I obtain the geographic crosswalk file matching PUMAs to 1990 Commuting Zones from Autor and Dorn (2013).

economic status. In the CPS and ACS, parents/guardians will only be observed if they reside in the same household as the teen. While this is true for more than 86% of 16-18 year olds in the CPS and ACS samples, there is a possibility that this selectively observed sample could bias estimates of the minimum wage's impact on drop out. Unlike these cross-sectional datasets, the SIPP reliably tracks the same individuals for 3-4 years (regardless of changes in residence), and therefore observes parental/guardian education for more than 98% of 16-18 year olds.[14] I combine the 1996, 2001, 2004, and 2008 panels of the SIPP to construct an individual-level panel where educational outcomes are observed three times per year and labor market outcomes are observed monthly.

In my primary analysis, I define a teen's socio-economic status using the educational attainment of her parents. Specifically, I define a teen as "high SES" if all of her observed parents (or guardians) have graduated from high school. I define a teen as "low SES" if any of her observed parents (or guardians) has not graduated from high school. In all data samples, roughly 80% of 16-18 year olds whose observed SES are classified as high SES (see Table 2).[15] In all samples, I create a simple dropout indicator as follows: teen $i$ has dropped out if she is not currently enrolled in school and she has not obtained a high school diploma (or greater level of education). [16,17] This is a stock variable indicating those who are currently dropouts (regardless of how recently they dropped out), rather than a flow variable, which would indicate those who had newly transitioned from enrolled to dropout. Table 2 shows the average dropout rates by SES (9-12% for

[14] In Table 6, results are also shown for a subsample of the SIPP including only 16-18 year olds who appear in the first wave of a given panel. Parent/guardian education is observed for more than 99% of this subsample.

[15] I provide robustness checks with alternative definitions of high SES teens as those whose parents attended "some college" or whose household income (excluding their own income) is above the $p^{th}$ percentile of the yearly distribution, for $p \in 20, 30, 40, 50$. My primary formulation has two advantages over these potential alternatives. First, family income is relatively volatile from year-to-year and may be affected by the minimum wage. Second, using parental high school education to define low SES effectively identifies teens who are at highest risk of dropping out.

[16] For comparability between datasets and over time within datasets, I count GED recipients as equivalent to HS diploma holders in the primary analysis. I also include students enrolled part-time as currently enrolled in my primary analysis.

[17] For the SIPP, I only count a teen as a drop out if she satisfies this definition for two waves in a row.

low-SES and 3-4% for high-SES) for select data samples under these definitions. Figure 1 shows the modest downward trends in these dropout rates over time, particularly among low-SES teens.[18]

I obtain state-by-month information on state minimum wage rates for 1992-2012 from the Tax Policy Center at the Urban Institute and Brookings Institution and merge it with the individual-level informations on teens in each data sample.[19,20] Figures 3 and 4 show the substantial variation over the last two decades in effective state minimum wages, constructed as the maximum of federal and state minimum wage laws. Figure 3 depicts the variation in the minimum wages over time. The federal minimum is depicted as the black line, while states with minimums above the federal minimum are in gray (the size of the bubble denotes the number of states in a given $0.25 bin). Figure 4 maps the difference between state and federal minimum wages geographically and over time, in percentage terms.

## III. Empirical Strategy

I utilize two different sources of variation to identify the effect of minimum wage increases on teen educational outcomes. First, I use a traditional two-way (state and year) fixed effects framework which leverages the variation within-states, over-time in the minimum wage. Second, I use a cross-border design which leverages variation in the minimum wage at a given point in time between nearby PUMAs in the same commuting zone on either side of a state border.

[18] It is possible that some portion of this trend is driven by increased GED recipients, but my main data sources do not treat GED recipients separately from high school graduates for sufficient time periods to analyze. Therefore, to ensure that this or some other aspect of my dependent variable construction is not driving my results, I repeat all analyses using a simple enrollment indicator as the dependent variable. Additionally, results using only the October CPS, which enables GEDs to be counted as dropouts, do not differ substantively from the main CPS results.

[19] This data is compiled by the Tax Policy Center from January issues of the Bureau of Labor Statistics' Monthly Labor Review, the 1968-1999 Book of the States published by the Council of State Governments (for 1990-1999), and U.S. Department of Labor data (for 2000-2012).

[20] I also obtain yearly state and county unemployment rates from the Bureau of Labor Statistics' Local Area Unemployment Statistics.

### *A. Traditional Two-way Fixed Effects*

I begin by adopting an approach that has been used frequently in the minimum wage literature to investigate employment effects and applying it to all three datasets (CPS, ACS, and SIPP). This approach includes state fixed effects to remove time-invariant differences between states that may be related to both differences in teen outcomes and minimum wage levels, such as the industrial structure of the state economy, the generosity of social welfare programs, and the quality of the state educational system. In my preferred specifications, state-specific polynomial time trends are included to account for these differences evolving smoothly overtime. Year fixed effects are included to remove differences between years, common to all states, that may be related to both outcomes and minimum wage levels, such as shocks to the national economy and the political climate at the federal level. The effect of the minimum wage is identified by variation over time in a state's effective minimum wage (the maximum of the state and federal minimum wages). I diverge from the traditional analysis by including an interaction between the minimum wage term and an individual's socio-economic status, allowing me to examine the differential effects of minimum wage by family background. The basic specification is as follows:

$$y_{isgt} = \beta_0 + \beta_1 ln(mw_{st}) + \beta_2 HSES_{isgt} + \beta_3 ln(mw_{st}) \times HSES_{isgt} + \gamma X_{isgt} + \nu_t + \theta_g + \sigma_s(t) + \epsilon_{isgt}, \tag{1}$$

where $y_{isgt}$ is the outcome of interest. For the main results, the outcome of interest is an indicator for whether individual $i$ in state $s$ and geography $g$ at time $t$ is identified as a high school dropout.[21] $ln(mw_{st})$ is the log of the minimum wage in state $s$ at time $t$. $HSES_{isgt}$ is an indicator equal to one if individual $i$ is high SES, that is, if all of his observed parents/guardians have at least a high school

[21] Depending on the sample, geography $g$ may be measured at the state-, county-, or PUMA-level. $t$ is measured in years for ACS samples, in months for the CPS sample, and in trimesters for the SIPP primary sample.

diploma. $X_{isgt}$ are demographic characteristics of individual $i$ (i.e. indicators for age, sex, race, and whether she is above the state's compulsory schooling age) and characteristics of the labor market in state s at time t (i.e. state unemployment rate). $\nu_t$ and $\theta_g$ are year and geography fixed effects.[22] $\sigma_s(t)$ , included in some specifications, is a state-specific polynomial time trend to account for differential trends across states. The primary coefficients of interest are $\beta_1$, which captures the impact of changes in the minimum wage on the likelihood that low-SES teens will drop out of high school, and $\beta_1 + \beta_3$, which captures the same effect for high-SES teens. I estimate this equation using OLS with standard errors clustered at the $g$-level.

Estimates using the finer geographic granularity for $g$ available in the ACS-P (PUMA-level) and ACS-C (county-level) samples leverage the same within-state minimum wage variation over time for identification, but remove time-invariant differences at the PUMA or county-level, rather than the state-level. While unobserved (time-invariant) spatial heterogeneity at this more local level is unlikely to create endogeneity problems since minimum wage policy during this period is generally determined at the state-level, removing it should improve estimates by reducing noise from persistent differences across localities in industrial structure and school quality. Estimates using the SIPP sample provide a check of whether the results using the CPS and ACS samples are driven by sample selection (since SES is observed for more than 98% of the SIPP sample).

### *B. Internal Validity of Traditional Two-way Fixed Effects*

Estimates of Equation 1 may simply be capturing elements of states' labor or educational environments that pre-date minimum wage changes and are not accounted for by state-specific polynomial time trends. Endogenous policy change would be one example of this possibility, where state politicians adjust the min-

[22]Since the SIPP sample is an aggregation of four panels, I include panel-by-state fixed effects rather than only state fixed effects. This accounts for any systematic differences between panels for a given state, such as the samples selected.

imum wage in response to changes in the state that are correlated with state dropout rates. I address this concern by testing whether minimum wage changes "affect" outcomes prior to their implementations. Specifically, I use the ACS to estimate an equation similar to Equation 1, but with 3 year lags and leads of changes in the log minimum wage. Using log minimum wage *changes* rather than log minimum wage is necessitated by the high correlation from year-to-year in log minimum wage, muddying attempts to separately identify effects from different years. The specification is as follows:

$$y_{ist} = \beta_0 + \sum_{\tau \in [-3,3]} \alpha_\tau \Delta ln(mw_{s,t-\tau}) + \delta_\tau \Delta ln(mw_{s,t-\tau} \times HSES_{ist}) + \eta HSES_{ist} + \gamma X_{ist} + \nu_t + \theta_s + \sigma_s(t) + \epsilon_{ist}, \tag{2}$$

where $\Delta ln(mw_{s,t-\tau})$ is the year-to-year change in the log minimum wage $\tau$ years prior to year t ($\tau < 0$ refers to changes after year t). If my effect estimates from Equation 1 are capturing pre-existing conditions rather than effects of minimum wage changes, then estimates of $\alpha_\tau$ or $\alpha_\tau + \delta_\tau$ (or both) would be significant for $\tau < 0$.

Estimates of the differential effect of the minimum wage on high vs. low-SES teens ($\beta_3$ in 1) may be driven by differential trends in the dropout rate of high and low-SES teens that are not accounted for by the common state-specific trends (and common year and state fixed effects) included in Equation 1. To address this concern, I leverage the large sample size in the ACS to estimate Equation 1 separately for high and low-SES teen subsamples.

There may be time-varying heterogeneity in local labor markets that bias the effect estimates from the two-way fixed effects approach. For example, Allegretto et al. (2013) show that states experiencing greater increases in minimum wages differ systematically from other states in terms of the severity of economic downturns, the reduction of routine task intensive jobs, and the growth in upper-half wage inequality. To the extent that these types of differential trends across states are

not sufficiently smooth to be captured by state-specific polynomial time trends, they will bias the estimates of Equation 1. The alternative approach discussed in the following subsection is designed to account for this concern.

### *C. Cross-Border Design*

I address the possibility of endogeneity due to time-varying heterogeneity in local labor markets by employing an approach used by Allegretto et al (2013) to look at the employment effects of the minimum wage. This framework leverages variation in minimum wage within a commuting zone, that spans a state border, in a given year.[23] I apply this approach to the ACS-CZ sample, which has a sample size large enough to allow for analysis at geographic levels finer than state of residence. The ACS-CZ sample includes all teens in the ACS.

The specification is largely the same as Equation 1 except that it includes commuting zone ($z$) by year fixed effects, $\rho_{zt}$, and geography (PUMA) fixed effects, $\theta_g$.

$$y_{iszgt} = \beta_0 + \beta_1 ln(mw_{st}) + \beta_2 HSES_{iszgt} + \beta_3 ln(mw_{st}) \times HSES_{iszgt} + \gamma X_{iszgt} + \rho_{zt} + \theta_g + \epsilon_{isgt}. \tag{3}$$

This approach accounts for time-varying local labor market heterogeneity as well as time-invariant differences between PUMAs. The cost of this improved internal validity is a reduction in external validity. The estimates are identified by comparing teens in the same commuting zone on either side of a state border, where the difference in minimum wages on either side of the border changes during 2005-2011. If teens in these border-spanning commuting zones are more or less responsive to minimum wage changes than typical American teens, the estimates of $\beta_1$ and $\beta_3$ will not represent the average effect nationwide of a minimum wage increase. Figure 2 shows the commuting zones that have minimum wage variation

[23] I obtain commuting zones from Autor and Dorn (2013).

within commuting zone-years during the period 2005-2011.[24]

## IV. High School Dropout Results

Estimates of the effect of minimum wage changes on high school dropout from my preferred specifications for each sample and empirical strategy are presented in Table 3.[25] The table shows OLS estimates for $\beta_1$ (effect of minimum wage change on low-SES teens) and $\beta_3$ (differential effect of minimum wage change on high-SES teens compared to low-SES teens) in Equation 1, which leverages within state variation, and Equation 3, which leverages within commuting zone by year variation. Consistently across samples and empirical approaches, I find that raising the minimum wage significantly reduces the likelihood of dropping out among low-SES teens ($\beta_1$), but has a much smaller or null impact on the likelihood of dropping out among high-SES teens ($\beta_1 + \beta_3$). A 10% increase in the minimum wage produces a 0.5-1.0 percentage point decrease in the dropout likelihood of low-SES teens (approximately 4-10% of this group's dropout rate) and a near zero impact on high-SES teens.

The consistency of the results in Table 3 across data samples and empirical approaches help to alleviate two major internal validity concerns. First, the SIPP coefficient estimates are similar to the CPS and ACS estimates (though smaller in magnitude than the ACS estimates), suggesting that any bias in the ACS and CPS due to the selection of a sample with observed parental education (parental education is observed for nearly all teens in the SIPP) is not driving the results. Second, the similarity of the cross-border estimates (column 6) and two-way fixed effects estimates (columns 1-5) suggest that time-varying spatial heterogeneity is

[24] Figure A1 gives an example of the identifying variation in one such commuting zone, Jacksonville, FL, which includes 7 counties: 5 in Florida and 2 in Georgia. For half of the years from 2005-2011, residents on the Florida side of the border faced a higher minimum wage than residents on the Georgia side.

[25] For the CPS sample I select a cubic trend (following Neumark et al., 2013) and for the samples with shorter timeframes (i.e. SIPP, ACS, ACS-P, and ACS-C) I select a linear trend. While the SIPP sample timeframe is four-fifths of CPS, the selected SIPP specification also includes state by panel fixed effects, leaving much less variation remaining to accommodate a higher polynomial state-specific time trend.

not driving the latter estimates. [26]

Table 4 shows the results for the same specifications as Table 3, but varies the definitions of high SES. Column 2 defines a teen as high SES if all of her observed parents have gone to college, coded as "some college" in the various datasets. Columns 3-6 define high SES by whether household income (excluding the teen) is above various percentile thresholds of the household income distribution for teens in that year. The results are consistent with the estimates in Table 3, but predictably, as the defined threshold between high and low SES moves up the socioeconomic distribution (i.e. from high school diploma to some college or from 20th to 50th income percentile), the magnitudes of the estimates for low-SES teens decrease. This is consistent with a concentration of the dropout effects among the lowest-SES teens.[27]

Additional tables provide robustness checks for the preferred specifications shown in Table 3 using the same definition of high/low SES, but showing different specifications and/or time periods.[28] Table 5 show OLS estimates of Equation 1 using the CPS sample and an alternative March CPS sample with various state-specific trends.[29] Table 6 shows the OLS estimates of equation 1 using the SIPP sample and a "first wave only" sample with various state-specific time trends and state or state by panel fixed effects. The high school dropout results (Table 6) are consistent across specifications with the exception of the state fixed effect and state-specific quadratic time trend specification (Column 6 and 12),

[26] The robustness across empirical approaches in the educational effects of the minimum wage, but not the employment effects (as seen in the contentious literature), suggests that state minimum wage policy decisions may be endogenous with respect to employment outcomes but not with respect to educational outcomes. This could occur if state minimum wage policy changes are made in response to the overall unemployment rate.

[27] Table A2 replicates Table 4 using an enrollment indicator as the dependent variable. The results are largely similar though less precise in some cases.

[28] Tables A3, A6, and A5 repeat these robustness checks using an enrollment indicator for the dependent variable.

[29] Table A4 shows the same dropout results as Table 5 (and enrollment results as Table A3) for a time period that excludes the Great Recession (1992-2007). The enrollment results are consistent with Table A3, though less precise. The dropout results are imprecise but consistent with Table 5 for the March sample but the magnitudes of the coefficient estimates drop substantially for the main CPS sample (Out-going Rotation Group).

which provides an insignificant estimate of $\beta_1$.[30] Table 7 show OLS estimates of Equation 1 using the ACS, ACS-P, ACS-C, and ACS-CZ samples for various state-specific time trends. The results are significant and similar in magnitude across all specifications. [31]

Table A7 shows separate OLS estimates for Equation 1 on high and low SES subsamples of the ACS, ACS-P, and ACS-CZ samples. State and year fixed effects with the ACS sample (Column 1) yields a significant (at the 10 percent level) 0.3 percentage point decrease in dropout likelihood for low-SES teens (and no significant change for high-SES teens) from a 10% increase in the minimum wage. PUMA and year fixed effects with the ACS-P sample (Column 2) yields a similar low-SES point estimate, but significant only at the 12 percent level, while PUMA and CZ by year fixed effects with the ACS-CZ sample yields a larger but less precise low-SES estimate. These estimates are in line with those in Table 3, but the ACS and ACS-P low-SES estimates are smaller in magnitude than corresponding estimate in Table 3 (the magnitude of the ACS-CZ low-SES estimate is nearly identical to estimate in Table 3). This suggests two possibilities. First, the relatively small size of the low-SES sample may result in a larger role for measurement error in dampening the effect estimate in the ACS and ACS-P samples. Second, the existence of differential trends by SES may mean that using common trends and fixed effects moderately exaggerates the true magnitude of the effect on low-SES teens.

Finally, Figure 5 depicts OLS estimates of the falsification test defined in Equation 2 using the ACS sample. It shows the estimated effect of a 10% minimum wage increase in year t on the dropout likelihood of low-SES and high-SES teens in year $t + \tau$ for $\tau \in [-3, 3]$.[32] The figure shows significant negative effects of minimum wage changes on low-SES teens in year $t$ through $t+2$, but not in years

[30]Enrollment estimates of $\beta_1$ in Table A5 are similar in magnitude to the dropout estimates in Table 6 but are not significantly different from zero in most specifications ($\beta_3$ estimates remain significant).

[31]Table 7 shows simlar results to Table 7 using an enrollment indicator for the dependent variable.

[32]High and low-SES effect estimates are $0.1\alpha_\tau$ and $0.1(\alpha_\tau+\delta_\tau)$, respectively. This assumes a minimum wage change in year $t$ given by $\delta ln(mw_{s,t}) = 0.1$, which implies a 10.5% minimum wage change.

prior to the change ($\tau < 0$). There are no significant effects on high-SES teens. These results provide evidence that the negative dropout effects for low-SES teens in Table 3 are not driven by pre-existing trends in states where the minimum wage increased.

## V. Mechanism: Teen Labor Market and Time Allocation

As discussed in Section I, a possible pathway for a minimum wage increase to reduce high school dropout among low-SES teens is through a shift in the time allocation of these teens from work to education-related activities. I test directly for such a shift using the American Time Use Survey (ATUS), which categorizes time spent on various activities for a subsample of the CPS. Table 8 shows Equation 1 estimates for the 16-18 year olds in the ATUS (2007-2012), where the dependent variables are defined as minutes during a 24-hour period spent on various categories of activities.[33] Column 1 and 4 show estimates for the effect of an increase in the minimum wage on time spent on work-related activities, Column 2 and 5 show estimates for leisure-related activities, Column 3 and 6 show estimates for education-related activities.[34] For those enrolled in high school, the education-related time-use categories are measured in minutes per day *outside of the school day.* Therefore any effects on time-use during the school day (e.g. changes in absenteeism) will not be captured in these estimates.

The results in Table 8 suggest that an increase in the minimum wage shifts low-SES teens' time allocation from work to education-related activities. For low-SES teens on weekdays, the results (Column 4-6) imply that a 10% increase in the minimum wage results in a 13 minute per day (22%) reduction in work time (imprecise), a null effect on leisure time (imprecise), and a 36 minute per day (14%) increase in education-related time (significant at the 5 percent level).[35]

[33]Prior to 2007, teens were not linked to their parents in the data obtained from IPUMS. Because of this limited sample size, my preferred specification for this analysis does not include state-specific time trends, though Table 9 includes state-specific linear trends.

[34]I use the measures of time use categorized by the Bureau of Labor Statistics.

[35]Table A8 shows the similar estimates for the subsample of currently enrolled teens. Though the

These estimates translate to a substantial increase in time spent on education of 3 hours per school week or 108 hours per school year.[36,37]

For high-SES teens, the results tell a slightly different story of their response to an increase in the minimum wage. They suggest that high-SES teens reduce their time spent on work by more than low-SES teens (statistically significant), but increase education-related time by roughly the same amount and increase leisure time by substantially more, 25 minutes per day (8%) on weekdays (statistically significant). Thus, it appears that while high-SES teens reduce their time spent on work by more than low-SES teens, they re-allocate more of that time to leisure than low-SES teens.

The time-use results suggest that a minimum wage increase leads to a shift in time allocation from work to education for low-SES teens, but does this occur through an income effect on labor supply or a reduction in labor demand? Table 10 presents estimates of the effect of a minimum wage increase on a variety of labor market outcomes using data from the CPS and SIPP samples. Column 1-5 show estimates of $\beta_1$ and $\beta_3$ from Equation 1 using the CPS sample with state-specific cubic time trends. Column 6-10 show the same estimates using the SIPP sample with individual fixed effects.[38] The CPS estimates in Columns 2,3, and 5 imply that a 10% increase in the minimum wage reduces low-SES teen employment by a statistically insignificant 0.4 pp (2%), hours worked per week by a statistically significant 0.2 (3%), and the likelihood of working more than 20 hours per week by a statistically significant 0.6 pp (6%). The SIPP individual fixed effect estimates in Columns 7,8, and 10 imply that a 10% increase in the

estimated effect on education-related activity time is no longer statistically significant for low-SES teens, the results are broadly similar. This suggests that the estimates in Table 8 are not driven soley by increases changes in enrollment status but also by time reallocation among those who remain enrolled.

[36]These back-of-the-envelope calculations assume a 180 day school year and do not include any effects of minimum wage on education-related time spent on weekends or during the school day.

[37]Table 9 shows estimates of the impact of minimum wage changes on time spent on education-related activities with and without state-specific linear trends for various sample restrictions. The magnitude of the results vary by specification, but all are large and positive and most are statistically significant at the 5 percent level.

[38]Since labor market outcomes are observed for every month (unlike educational outcomes), I use a monthly panel for this analysis.

minimum wage does not statistically significantly affect low-SES teen employment or hours worked per week, but reduces the likelihood of working more than 20 hours per week by a statistically significant 1.3 pp (8%). Taken together, these results show a substantial reduction in the upper tail of the hours distribution for low-SES teens.

Columns 1 and 6 of Table 10 help to distinguish between an hours effect that is driven primarily by an income effect of the minimum wage on labor supply and an hours effect that is driven primarily by a labor demand effect. Columns 1 and 6 show small and insignificant reductions in weekly earnings in the CPS sample and monthly earnings in the SIPP sample.[39,40] These negative earnings estimates are unlikely if the minimum wage is affecting hours and education outcomes primarily through an income effect on teen labor supply.[41]

## VI. Conclusion

The long-run cost of a teen's decision to drop out of high school is public as well as private. A high school dropout yields less tax revenue, uses more social safety net benefits, and is more likely to be arrested or incarcerated. According to one estimate, the lifetime cost to the government of a high school dropout is $200,000 higher than a high school graduate (Levin et al., 2007). Externalities of this magnitude suggest that effects on high school graduation, even if indirect, may have dramatic consequences for the social welfare effects of labor market policies such as the minimum wage.

Using three individual-level datasets and two distinct sources of variation, I

[39] Both dependent variables are in 2012 dollars.

[40] Jardim, et al. (2017) also find hours and earnings reductions from large minimum wage increases in Seattle.

[41] I test for an income effect from a minimum wage increase that is transmitted to the teen through an impact on her family's earnings using CPS and SIPP samples and similar specifications to Table 10. For the CPS I actually find a significant reduction in household earnings (excluding teen) while for the SIPP I find an imprecise and small increase of $60 (2%) in monthly earnings (excluding teen). This discrepancy may reflect the differences in structure and timeframe of the two datasets or the different variation that is leveraged to estimate the minimum wage effect (within-state vs. within-individual). In any case, these results suggest that any parental income effects are not likely to be large enough to drive the observed work and education responses of low-SES teens.

find that an increase in the minimum wage substantially lowers the likelihood of dropping out for low-SES teens, but has no observed effect on other teens. My estimates suggest that an increase in the federal minimum wage from $7.25 to $9, a level supported by the majority of Republicans and Democrats in recent polling (Kull et al. 2017), would lead to a 1-2 percentage point decrease in the likelihood that a low-SES teen will drop out of high school, roughly 10-24% of the rate for this group.[42] Examining the mechanism for this dropout effect, I find evidence consistent with minimum wage increases reducing labor demand for low-SES teens and causing them to shift their time from work to school. Taken together, my results suggest that the current minimum wage literature's focus on teen employment neglects important aspects of the policy's broader effects on the later-life outcomes of teens and the associated spillover effects on society at large.

[42]This would be an upper bound for the impact of a federal minimum wage increase to $9, since fewer than half of states in the U.S. have an effective minimum wage of $7.25.

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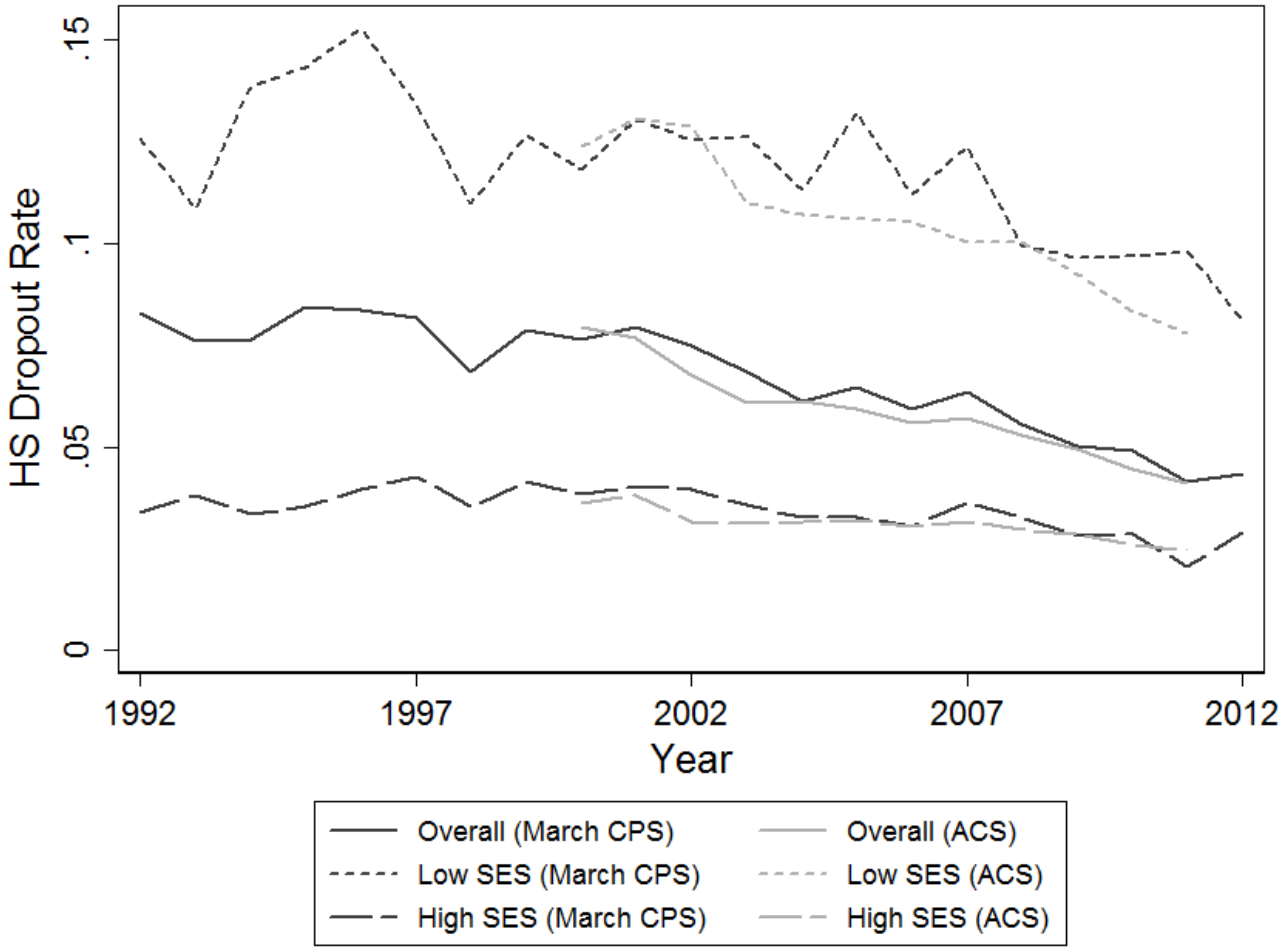


Figure 1. HS Dropout Rate by SES (CPS 1992-2012, ACS 2000-2011)

*Note:* Figure shows the high school dropout rate for teens aged 16-18 by year and by socio-economic status (SES) using the March Current Population Survey and the 2000 Census and the American Community Survey 2001-2011. A teen is considered a high school dropout if he/she is not currently enrolled and does not have a H.S. diploma or GED. High SES defined as having all parent/guardians with a high school diploma (or equivalent).

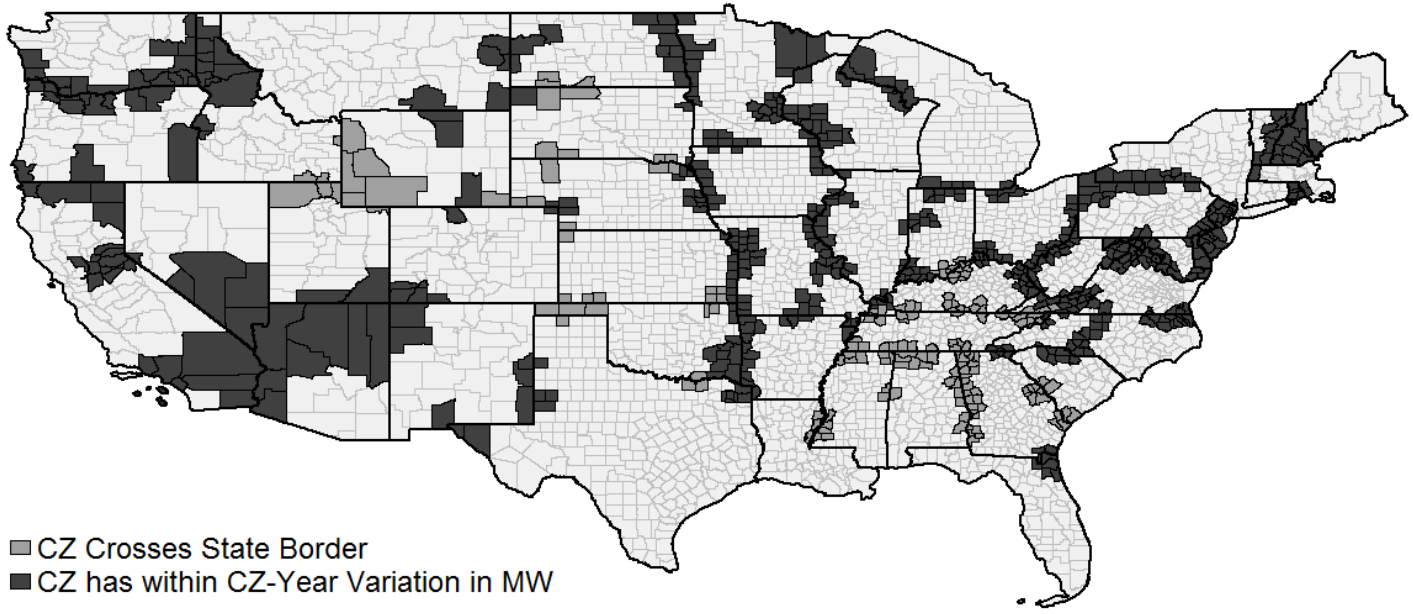


Figure 2. Within Commuting Zone (CZ) by Year Minimum Wage Variation (2005-2011)

*Note:* All commuting zones stradling state borders are shaded. Commuting zones where there is CZ-Year variation in the minimum wage during the 2005-2011 time period are shaded dark gray. Commuting zone data was obtained from Autor and Dorn (2013). State minimum wage data was obtained from the Tax Policy Center at the Urban Institute and Brookings Institution.

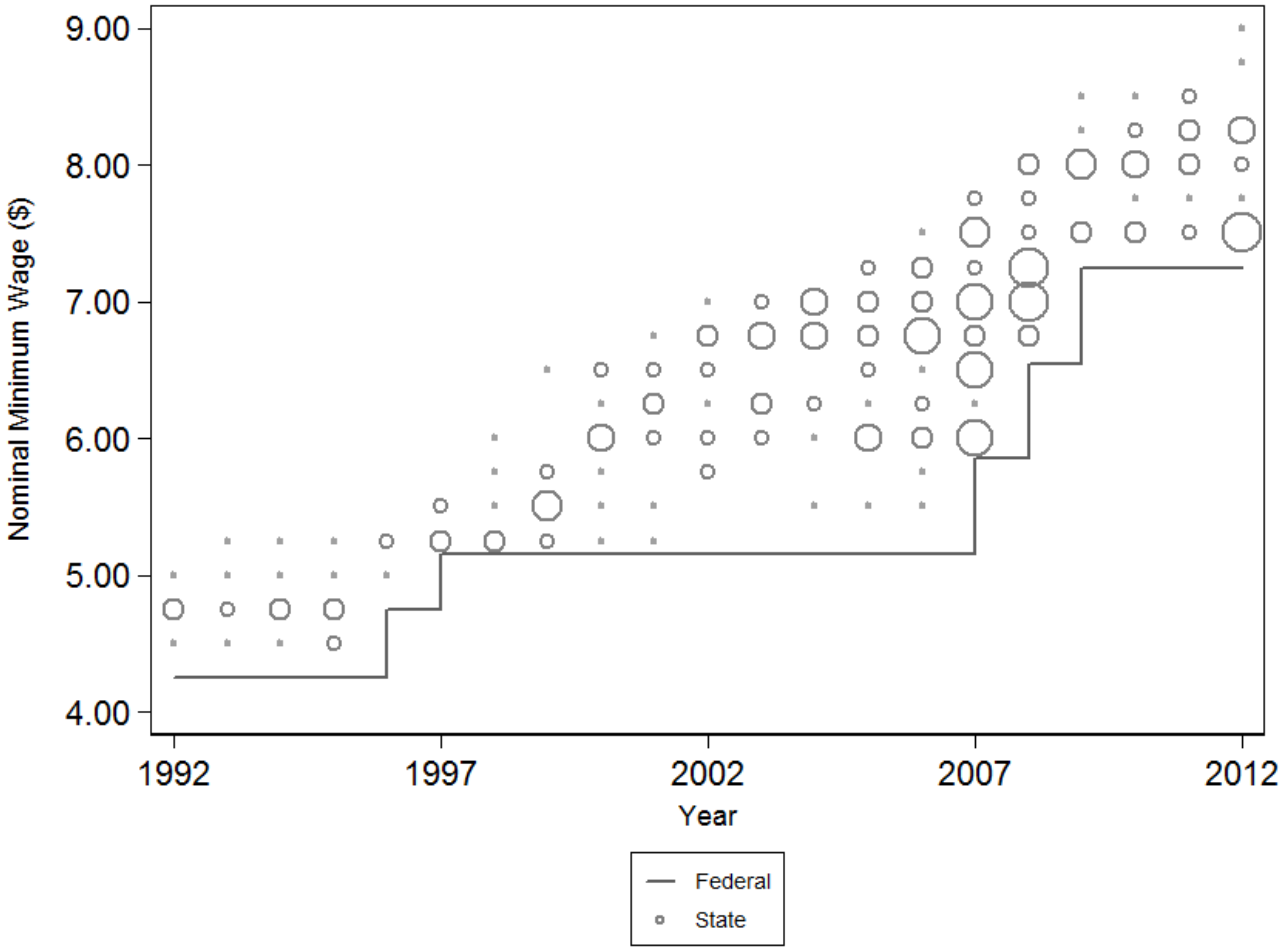


FIGURE 3. STATE AND FEDERAL MINIMUM WAGES (1992-2012)

*Note:* State minimum wages that exceed the federal minimum wage are grouped into $0.25 bins. Bubble size denotes the number of states in the given minimum wage bin (dot denotes one state). State minimum wage data was obtained from the Tax Policy Center at the Urban Institute and Brookings Institution.

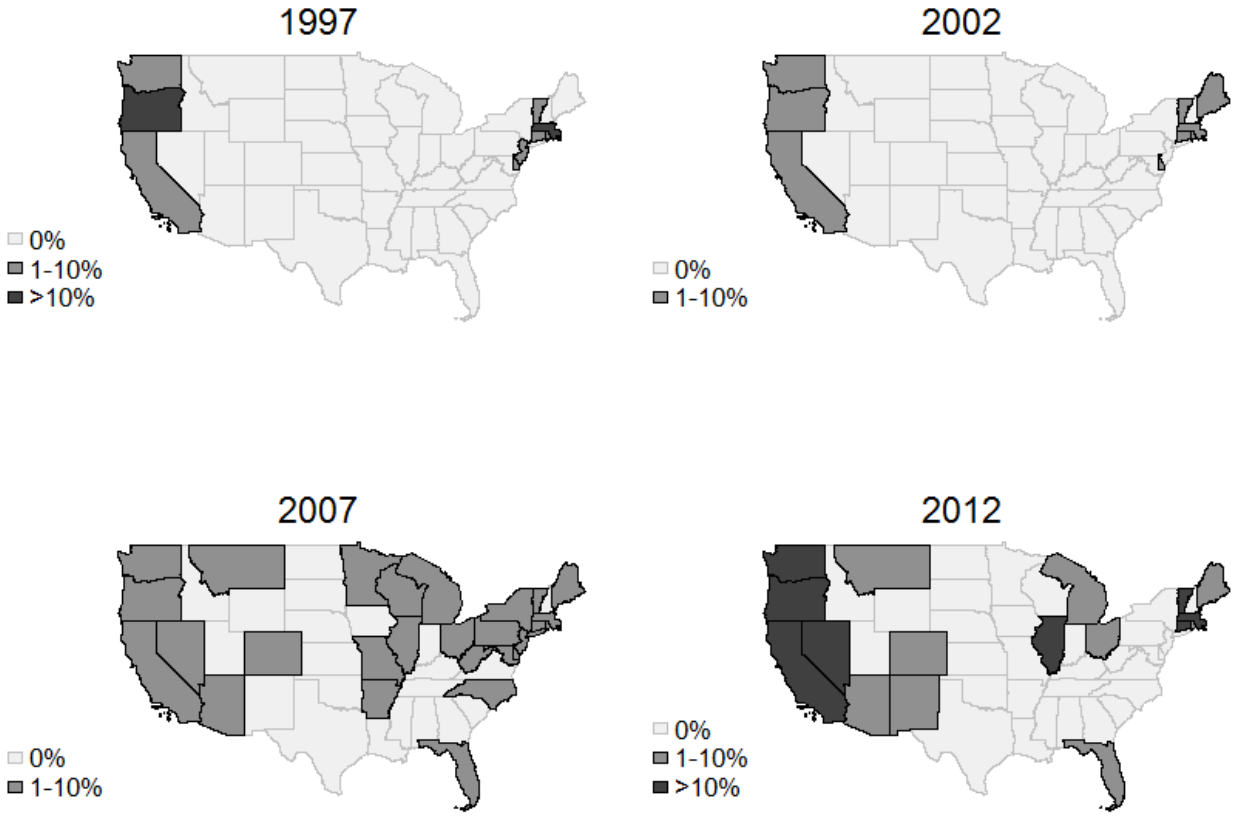


Figure 4. Geographic Minimum Wage Variation Over Time

*Note:* States are shaded according to the percent by which their minimum wage exceeds the federal minimum wage in each year. State minimum wage data was obtained from the Tax Policy Center at the Urban Institute and Brookings Institution.

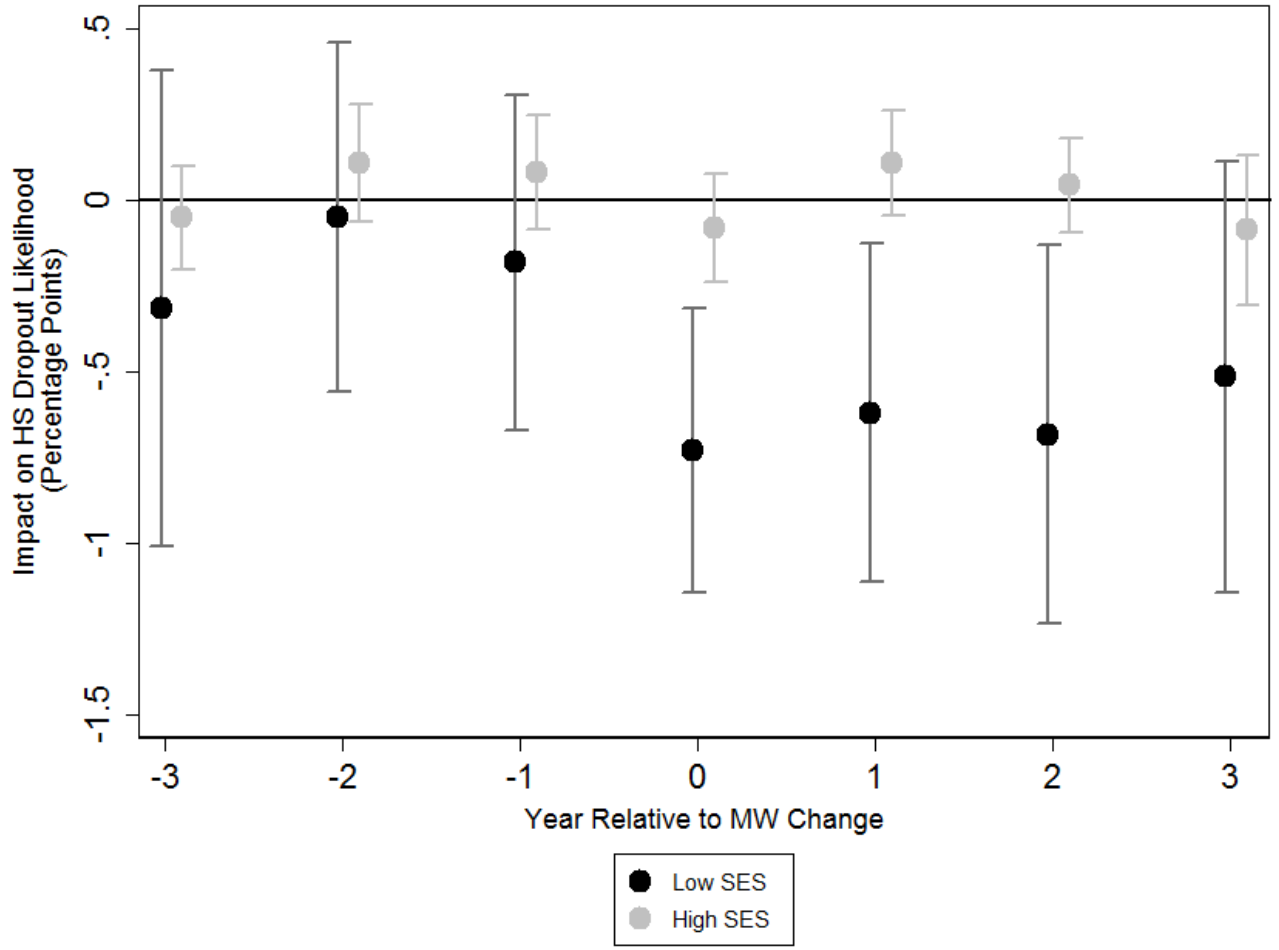


FIGURE 5. EFFECT OF 10% INCREASE IN MIN WAGE IN YEAR T ON HS DROPOUT IN YEARS T-3 TO T+3

*Note:* Figure depicts the "effect" of a 10% increase in the minimum wage between 3 years prior to the increase and 3 years after the increase. It shows estimates and 95% confidence intervals for $\alpha_\tau$ (Low SES) and $\alpha_\tau + \delta_\tau$ (High SES) from Equation 1 using the ACS sample. See text for details.

Table 1—Overview of Select Data Samples

| Sample Name | Years | Frequency | Geography Used | Source/Construction |
|---|---|---|---|---|
| ***CPS*** | 1992-2012 | Monthly Cross-Section | State | IPUMS - Outgoing Rotation Groups (excluding summer months) |
| ***SIPP*** | 1996-2012 | Individual Panel (3 Observations per Annum) | State | SIPP 1996, 2001, 2004, and 2008 panels appended |
| ***ACS*** | 2000-2011 | Annual Cross-Section | State | IPUMS - Census 2000 & ACS 2001-2011 |
| ***ACS-P*** | 2005-2011 | Annual Cross-Section | State, PUMA | IPUMS - ACS 2005-2011 |
| ***ACS-C*** | 2005-2011 | Annual Cross-Section | State, County | IPUMS - ACS 2005-2011 (county of residence observed) |
| ***ACS-CZ*** | 2005-2011 | Annual Cross-Section | State, PUMA, Commuting Zone | Probabilistic match of IPUMS - ACS 2005-2011 PUMAs to CZs (observations weighted by proportion of PUMA in each CZ) |

*Note:* Each sample is restricted to individuals aged 16-18 for whom parent/guardian education is observed.

Table 2—Summary Statistics

| | CPS (1) | SIPP (2) | ACS (3) | ACS-P (4) | ACS-C (5) | ACS-CZ (6) |
|---|---|---|---|---|---|---|
| Fraction Missing SES | 0.08 | 0.02 | 0.14 | 0.14 | 0.14 | 0.14 |
| Fraction High-SES (of Observed) | 0.79 | 0.82 | 0.80 | 0.81 | 0.79 | 0.81 |
| Low-SES Dropout Rate | 0.12 | 0.13 | 0.11 | 0.10 | 0.08 | 0.10 |
| | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) |
| High-SES Dropout Rate | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) |
| *Observations* | *313,571* | *161,135* | *1,690,820* | *892,351* | *499,467* | *1,323,146* |
| *Individuals* | *313,571* | *41,694* | *1,690,820* | *892,351* | *499,467* | *892,362* |
| *PUMA/Counties* | . | . | . | *2,066* | *373* | *2,066* |
| *Commuting Zones* | . | . | . | . | . | *741* |

*Note:* Each column presents select summary statistics for a different data sample. All samples are restricted to individuals aged 16-18. High SES indicator is equal to one if all of a teen's parent/guardians have a high school diploma (or equivalent), it is missing if parent/guardian education is not observed. Dropout indicator is equal to one if the teen is not currently enrolled and has no H.S. diploma or GED. Standard errors for dropout rates are in parentheses.

Table 3—Effect of Minimum Wage on Teen Dropout

| | CPS (1) | SIPP (2) | ACS (3) | ACS-P (4) | ACS-C (5) | ACS-CZ (6) |
|---|---|---|---|---|---|---|
| Ln(State Min Wage) | -0.052 | -0.053 | -0.096 | -0.084 | -0.078 | -0.076 |
| | (0.016) | (0.030) | (0.023) | (0.011) | (0.015) | (0.024) |
| Ln(State Min Wage) x High SES | 0.069 | 0.072 | 0.101 | 0.083 | 0.091 | 0.088 |
| | (0.009) | (0.021) | (0.024) | (0.008) | (0.013) | (0.010) |
| Obs | 244,710 | 158,525 | 1,455,883 | 764,535 | 430,298 | 1,365,826 |
| R-Sqr | 0.04 | 0.05 | 0.04 | 0.04 | 0.03 | 0.05 |
| Mean Dropout Rate: | | | | | | |
| Low SES | 0.12 | 0.13 | 0.11 | 0.09 | 0.08 | 0.12 |
| High SES | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 |
| Specification: | | | | | | |
| *Fixed Effects* | *State Year Month* | *State X Panel Year Month* | *State Year* | *PUMA Year* | *County Year* | *PUMA CZ X Year* |
| *State-Specific Time Trend* | *Cubic* | *Linear* | *Linear* | *Linear* | *Linear* | |
| *Years* | *1992-2012* | *1996-2012* | *2000-2011* | *2005-2011* | *2005-2011* | *2005-2011* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate (and county unemployment rate in column 5). High SES indicator is equal to one if all of a teen's parent/guardians have high school diploma (or equivalent). See text for descriptions of CPS, SIPP, ACS, ACS-P, ACS-C, and ACS-CZ data samples. Standard errors clustered at the state level for column 1 and 3, at the individual-level for column 2, at the PUMA-level for columns 4, at the county-level for column 5, and at the commuting zone by year level for column 6 are in parentheses.

Table 4—Effect of Minimum Wage on Teen Dropout with Various SES Definitions

| | All Parent's Education | | Houeshold Income Percentile | | | |
|---|---|---|---|---|---|---|
| | HS Diploma | Some College | 20+ | 30+ | 40+ | 50+ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **CPS (1992-2012)** | | | | | | |
| *State, Month, and Year FE, State Cubic Trend* | | | | | | |
| Ln(State Min Wage) | -0.052 | -0.014 | -0.088 | -0.074 | -0.055 | -0.041 |
| | (0.016) | (0.013) | (0.020) | (0.019) | (0.019) | (0.019) |
| Ln(State Min Wage) x High SES | 0.069 | 0.040 | 0.123 | 0.112 | 0.100 | 0.089 |
| | (0.009) | (0.004) | (0.010) | (0.010) | (0.011) | (0.011) |
| Obs | 244,710 | 244,710 | 180,881 | 180,881 | 180,881 | 180,881 |
| **SIPP (1996-2012)** | | | | | | |
| *State-Panel, Month, and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | -0.048 | -0.025 | -0.052 | -0.050 | -0.033 | -0.030 |
| | (0.029) | (0.022) | (0.025) | (0.024) | (0.023) | (0.022) |
| Ln(State Min Wage) x High SES | 0.067 | 0.051 | 0.070 | 0.078 | 0.058 | 0.059 |
| | (0.021) | (0.010) | (0.015) | (0.012) | (0.011) | (0.010) |
| Obs | 634,159 | 634,159 | 633,911 | 633,911 | 633,911 | 633,911 |
| **ACS (2000-2011)** | | | | | | |
| *State and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | -0.096 | -0.033 | -0.069 | -0.056 | -0.047 | -0.042 |
| | (0.023) | (0.008) | (0.012) | (0.011) | (0.011) | (0.010) |
| Ln(State Min Wage) x High SES | 0.101 | 0.041 | 0.069 | 0.061 | 0.055 | 0.054 |
| | (0.024) | (0.007) | (0.008) | (0.007) | (0.007) | (0.007) |
| Obs | 1,455,883 | 1,455,883 | 1,578,768 | 1,578,768 | 1,578,768 | 1,578,768 |
| **ACS-P (2005-2011)** | | | | | | |
| *PUMA and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | -0.084 | -0.031 | -0.052 | -0.043 | -0.038 | -0.033 |
| | (0.011) | (0.008) | (0.011) | (0.009) | (0.009) | (0.009) |
| Ln(State Min Wage) x High SES | 0.083 | 0.034 | 0.053 | 0.049 | 0.047 | 0.046 |
| | (0.008) | (0.004) | (0.007) | (0.006) | (0.005) | (0.005) |
| Obs | 764,535 | 764,535 | 826,679 | 826,679 | 826,679 | 826,679 |
| **ACS-CZ (2005-2011)** | | | | | | |
| *PUMA and CZ X Year FE* | | | | | | |
| Ln(State Min Wage) | -0.076 | -0.022 | -0.021 | -0.015 | -0.008 | -0.002 |
| | (0.024) | (0.022) | (0.027) | (0.027) | (0.027) | (0.027) |
| Ln(State Min Wage) x High SES | 0.088 | 0.034 | 0.059 | 0.056 | 0.049 | 0.048 |
| | (0.010) | (0.005) | (0.007) | (0.006) | (0.005) | (0.005) |
| Obs | 1,365,826 | 1,365,826 | 1,512,356 | 1,512,356 | 1,512,356 | 1,512,356 |

*Note:* Each panel-column combination shows coefficients from separate least squares regression using relevant population weights. Each column presents a different definition of SES, while each panel represents a different data sample and preferred specification. Column 1 replicates estimates from Table 3. See text for descriptions of CPS, SIPP, ACS, ACS-P, ACS-C, and ACS-CZ data samples. Columns 3-6 for the CPS panel use the Annual Social and Economic Supplement of the CPS rather than the Outgoing Rotation Group. The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate (and county unemployment rate in column 5). High SES indicator is equal to one if all of teenager's parent/guardians have a high school diploma (or equivalent). From top panel to bottom panel (respectively), standard errors clustered at the state-level, individual-level, state-level, PUMA-level, and commuting zone by year-level are in parentheses.

Table 5—Effect of Minimum Wage on Dropout (CPS Robustness Checks)

| | CPS Sample (ORG) | | | | Alternative CPS Sample (March) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Ln(State Min Wage) | -0.059 | -0.055 | -0.051 | -0.052 | -0.070 | -0.064 | -0.067 | -0.054 |
| | (0.012) | (0.014) | (0.016) | (0.016) | (0.020) | (0.022) | (0.021) | (0.023) |
| Ln(State Min Wage) x High SES | 0.069 | 0.069 | 0.069 | 0.069 | 0.065 | 0.065 | 0.065 | 0.065 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.014) | (0.015) | (0.015) | (0.015) |
| Obs | 244,710 | 244,710 | 244,710 | 244,710 | 166,045 | 166,045 | 166,045 | 166,045 |
| R-Sqr | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Mean Dropout Rate: | | | | | | | | |
| Low SES | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| High SES | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| *State FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *Year FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *State-Specific Trend* | | *Linear* | *Quad* | *Cubic* | | *Linear* | *Quad* | *Cubic* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have a high school diploma (or equivalent). Columns 1-4 use the primary CPS sample of outgoing rotation groups (ORG) while columns 5-8 use the Annual Social and Economic Supplement. In the CPS, students on summer vacation are counted as not enrolled (in the last week), therefore I exclude summer months (June, July, and August) from the ORG sample. See text for description of CPS sample. Standard errors clustered at the state-level are in parentheses.

TABLE 6—EFFECT OF MINIMUM WAGE ON TEEN DROPOUT (SIPP ROBUSTNESS CHECKS)

| | All 16-18 Year Olds | | | | | | 16-18 Year Olds Observed in First Wave | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Ln(State Min Wage) | -0.053 | -0.063 | -0.062 | -0.057 | -0.058 | -0.039 | -0.049 | -0.059 | -0.058 | -0.054 | -0.055 | -0.044 |
| | (0.030) | (0.030) | (0.030) | (0.028) | (0.028) | (0.030) | (0.031) | (0.031) | (0.031) | (0.028) | (0.029) | (0.031) |
| Ln(State Min Wage) x High SES | 0.072 | 0.071 | 0.071 | 0.077 | 0.074 | 0.073 | 0.072 | 0.072 | 0.072 | 0.077 | 0.075 | 0.073 |
| | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) |
| Obs | 158,525 | 158,525 | 158,525 | 158,525 | 158,525 | 158,525 | 145,002 | 145,002 | 145,002 | 145,002 | 145,002 | 145,002 |
| R-Sqr | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 |
| Mean Dropout Rate: | | | | | | | | | | | | |
| Low SES | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| High SES | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| *State X Panel FE* | *X* | *X* | *X* | | | | *X* | *X* | *X* | | | |
| *State FE* | | | | *X* | *X* | *X* | | | | *X* | *X* | *X* |
| *State-Specific Trend* | | *Linear* | *Quad* | | *Linear* | *Quad* | | *Linear* | *Quad* | | *Linear* | *Quad* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for trimester, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of teenager's parent/guardians have a high school diploma (or equivalent). See text for description of SIPP data sample. Standard errors clustered at the individual-level are in parentheses.

Table 7—Effect of Minimum Wage on Teen Dropout (ACS Robustness Checks)

| | 2000-2011 | | | | 2005-2011 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Ln(State Min Wage) | -0.094 | -0.096 | -0.085 | -0.080 | -0.080 | -0.084 | -0.081 | -0.078 | -0.076 | -0.080 |
| | (0.023) | (0.023) | (0.022) | (0.022) | (0.010) | (0.011) | (0.014) | (0.015) | (0.024) | (0.027) |
| Ln(State Min Wage) x High SES | 0.102 | 0.101 | 0.096 | 0.096 | 0.083 | 0.083 | 0.090 | 0.091 | 0.088 | 0.088 |
| | (0.024) | (0.024) | (0.008) | (0.008) | (0.008) | (0.008) | (0.013) | (0.013) | (0.010) | (0.010) |
| Obs | 1,455,883 | 1,455,883 | 2,347,074 | 2,347,074 | 764,535 | 764,535 | 430,298 | 430,298 | 1,365,826 | 1,365,826 |
| R-Sqr | 0.04 | 0.04 | 0.06 | 0.06 | 0.04 | 0.04 | 0.03 | 0.03 | 0.05 | 0.05 |
| Mean Dropout Rate: | | | | | | | | | | |
| Low SES | 0.11 | 0.11 | 0.12 | 0.12 | 0.09 | 0.09 | 0.08 | 0.08 | 0.12 | 0.12 |
| High SES | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| *Fixed Effects* | *State Year* | *State Year* | *PUMA CZ X Year* | *PUMA CZ X Year* | *PUMA Year* | *PUMA Year* | *County Year* | *County Year* | *PUMA CZ X Year* | *PUMA CZ X Year* |
| *State-Specific Trend* | | *Linear* | | *Linear* | | *Linear* | | *Linear* | | *Linear* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have a high school diploma (or equivalent). 2001-2004 are not available for ACS-CZ sample. See text for descriptions of ACS, ACS-P, ACS-C, and ACS-CZ data samples. See text for descriptions of ACS, ACS-P, ACS-C data samples. Standard errors clustered at the state level for columns 1-2, at the commuting zone-year-level for columns 3-4 and 9-10, at the PUMA-level for columns 5-6, and at the county-level for columns 7-8, are in parentheses.

Table 8—Effect of Minimum Wage on Teen Time-Use

| | Work (1) | Leisure (2) | Education (3) | Work (4) | Leisure (5) | Education (6) |
|---|---|---|---|---|---|---|
| Ln(State Min Wage) | -97.7 | -70.3 | 257.4 | -131.1 | -54.7 | 361.3 |
| | (101.6) | (89.5) | (105.4) | (114.6) | (123.2) | (161.4) |
| Ln(State Min Wage) x High SES | -423.6 | 191.7 | 95.9 | -593.7 | 256.7 | -23.9 |
| | (173.4) | (124.5) | (209.0) | (175.3) | (141.0) | (272.0) |
| Obs | 2,669 | 2,669 | 2,669 | 1,306 | 1,306 | 1,306 |
| R-Sqr | 0.10 | 0.15 | 0.30 | 0.14 | 0.15 | 0.22 |
| Mean Dropout Rate: | | | | | | |
| Low SES | 60.2 | 350.7 | 203.9 | 60.5 | 323.7 | 267.1 |
| High SES | 93.3 | 343.9 | 107.1 | 106.1 | 312.0 | 132.9 |
| *Weekday Only* | | | | *X* | *X* | *X* |

*Note:* Each column shows a seperate regression using a sample of 16-18 year olds from the American Time-Use Survey (ATUS) for 2007-2012 (prior to 2007 teens could not be linked to their parents in order to define SES measure). The dependent variable is the number of minutes in a given 24 hour period spent on each activity category (defined by Bureau of Labor Statistics). Each regression includes state, year, quarter, and day-of-the-week fixed effecs and indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have a high school diploma (or equivalent). Standard errors are clustered at the state-level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9—Effect of Minimum Wage on Teen Education-Related Time (Robustness Checks)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Ln(State Min Wage) | 257.4 | 579.2 | 361.3 | 869.1 | 140.4 | 486.1 | 286.0 | 781.9 |
| | (105.4) | (193.1) | (161.4) | (282.8) | (131.8) | (232.9) | (203.9) | (358.7) |
| Ln(State Min Wage) x High SES | 95.9 | 115.6 | -23.9 | 34.1 | 167.1 | 116.5 | 181.1 | 96.7 |
| | (209.0) | (203.8) | (272.0) | (252.4) | (260.5) | (287.1) | (277.6) | (357.7) |
| Obs | 2,669 | 2,669 | 1,306 | 1,306 | 1,917 | 1,917 | 920 | 920 |
| R-Sqr | 0.30 | 0.32 | 0.22 | 0.26 | 0.37 | 0.39 | 0.18 | 0.22 |
| Mean Dropout Rate: | | | | | | | | |
| Low SES | 203.9 | 203.9 | 267.1 | 267.1 | 270.0 | 270.0 | 357.1 | 357.1 |
| High SES | 107.1 | 107.1 | 132.9 | 132.9 | 117.3 | 117.3 | 149.9 | 149.9 |
| *State-Specific Linear Trend* | | *X* | | *X* | | *X* | | *X* |
| *Weekday Only* | | | *X* | *X* | | | *X* | *X* |
| *Excluding Summer* | | | | | *X* | *X* | *X* | *X* |

*Note:* Each column shows a seperate regression using a sample of currently enrolled 16-18 year olds from the American Time-Use Survey (ATUS) for 2007-2012 (prior to 2007 teens could not be linked to their parents in order to define SES measure). The dependent variable is the number of minutes in a given 24 hour period spent on education-related activities (defined by Bureau of Labor Statistics). Each regression includes state, year, quarter, and day-of-the-week fixed effecs and indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have high school diploma (or equivalent). Standard errors are clustered at the state-level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10—Effect of Minimum Wage on Teen Hours Worked and Earnings

| | CPS (1992-2012) | | | | | SIPP (1996-2012) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Earnings | Employed | Hrs Worked | 10+ Hrs | 20+ Hrs | Earnings | Employed | Hrs Worked | 10+ Hrs | 20+ Hrs |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Ln(State Min Wage) | -2.963 | -0.041 | -1.715 | -0.047 | -0.055 | -116.613 | 0.016 | -2.772 | -0.004 | -0.126 |
| | (2.719) | (0.036) | (0.664) | (0.027) | (0.016) | (88.894) | (0.068) | (2.468) | (0.067) | (0.060) |
| Ln(State Min Wage) x High SES | -0.322 | -0.040 | -0.280 | -0.031 | 0.014 | 117.603 | -0.019 | 1.387 | 0.007 | 0.063 |
| | (1.019) | (0.010) | (0.247) | (0.009) | (0.007) | (96.698) | (0.074) | (2.642) | (0.073) | (0.065) |
| Obs | 730,103 | 970,384 | 970,824 | 970,824 | 970,824 | 477,337 | 477,337 | 477,337 | 477,337 | 477,337 |
| R-Sqr | 0.03 | 0.10 | 0.09 | 0.08 | 0.06 | 0.51 | 0.61 | 0.58 | 0.59 | 0.51 |
| Mean: | | | | | | | | | | |
| Low SES | 14.50 | 0.24 | 5.44 | 0.20 | 0.10 | 218.47 | 0.25 | 7.80 | 0.24 | 0.16 |
| High SES | 16.61 | 0.32 | 5.65 | 0.23 | 0.08 | 239.55 | 0.33 | 8.42 | 0.29 | 0.15 |
| *State FE* | *X* | *X* | *X* | *X* | *X* | | | | | |
| *State-Specific Cubic Time-Trend* | *X* | *X* | *X* | *X* | *X* | | | | | |
| *Individual FE* | | | | | | *X* | *X* | *X* | *X* | *X* |

*Note:* Each column shows a seperate regression with a labor market outcome as the dependent variable, using a sample of 16-18 year olds from the CPS (Columns 1-5) or SIPP (Columns 6-10). See text for details of sample constructions. All regressions include calendar month, year, age, and whether the individual is above the state compulsory schooling age fixed effects, as well as state unemployment rate. CPS regressions also include state, race, and sex fixed effects, while SIPP regressions include individual fixed effects. The summer months of June, July and August are excluded in all regressions. Earnings are adjusted to 2012 dollars and are weekly in the CPS and monthly in the SIPP. Standard errors are clustered at the state-level for CPS and the individual-level for SIPP are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

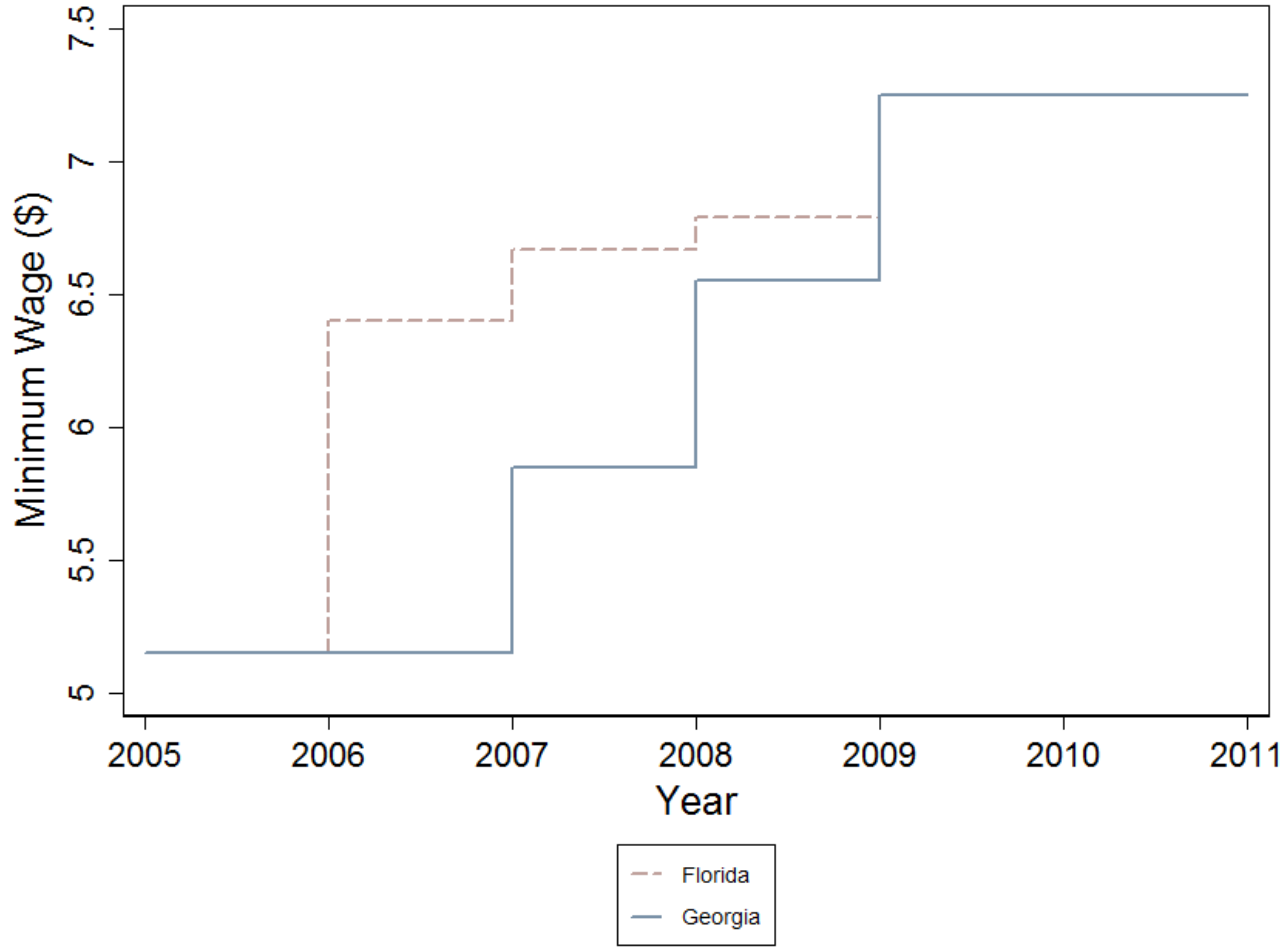


Figure A1. Example of Within CZ-Year Variation - Jacksonville, FL

Table A1—Effect of Minimum Wage on Teen Enrollment

| | CPS (1) | SIPP (2) | ACS (3) | ACS-P (4) | ACS-C (5) | ACS-CZ (6) |
|---|---|---|---|---|---|---|
| Ln(State Min Wage) | 0.049 | 0.039 | 0.080 | 0.083 | 0.082 | 0.083 |
| | (0.024) | (0.036) | (0.022) | (0.013) | (0.017) | (0.029) |
| Ln(State Min Wage) x High SES | -0.060 | -0.069 | -0.088 | -0.086 | -0.088 | -0.094 |
| | (0.012) | (0.023) | (0.022) | (0.009) | (0.013) | (0.011) |
| Obs | 244,710 | 158,525 | 1,455,883 | 764,535 | 430,298 | 1,365,826 |
| R-Sqr | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.17 |
| Mean Enrollment Rate: | | | | | | |
| Low SES | 0.83 | 0.81 | 0.84 | 0.85 | 0.86 | 0.78 |
| High SES | 0.92 | 0.91 | 0.93 | 0.93 | 0.93 | 0.89 |
| Specification: | | | | | | |
| *Fixed Effects* | *State Year Month* | *State X Panel Year Month* | *State Year* | *PUMA Year* | *County Year* | *PUMA CZ X Year* |
| *State-Specific Time Trend* | *Cubic* | *Linear* | *Linear* | *Linear* | *Linear* | |
| *Years* | *1992-2012* | *1996-2012* | *2000-2011* | *2005-2011* | *2005-2011* | *2005-2011* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is an enrollment indicator. All regressions include indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate (and county unemployment rate in column 5). High SES indicator is equal to one if all of a teen's parent/guardians have high school diploma (or equivalent). See text for descriptions of CPS, SIPP, ACS, ACS-P, ACS-C, and ACS-CZ data samples. Standard errors clustered at the state level for column 1 and 3, at the individual-level for column 2, at the PUMA-level for columns 4, at the county-level for column 5, and at the commuting zone by year level for column 6 are in parentheses.

Table A2—Effect of Minimum Wage on Teen Enrollment for Various SES Definitions

| | All Parent's Education | | Houeshold Income Percentile | | | |
|---|---|---|---|---|---|---|
| | HS Diploma | Some College | 20+ | 30+ | 40+ | 50+ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **CPS (1992-2012)** | | | | | | |
| *State, Month, and Year FE, State Cubic Trend* | | | | | | |
| Ln(State Min Wage) | 0.049 | 0.017 | 0.128 | 0.114 | 0.091 | 0.078 |
| | (0.024) | (0.020) | (0.020) | (0.021) | (0.020) | (0.021) |
| Ln(State Min Wage) x High SES | -0.060 | -0.034 | -0.132 | -0.119 | -0.101 | -0.095 |
| | (0.012) | (0.006) | (0.017) | (0.015) | (0.016) | (0.015) |
| Obs | 244,710 | 244,710 | 180,830 | 180,830 | 180,830 | 180,830 |
| **SIPP (1996-2012)** | | | | | | |
| *State-Panel, Month, and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | 0.053 | 0.040 | 0.052 | 0.058 | 0.043 | 0.036 |
| | (0.034) | (0.029) | (0.031) | (0.030) | (0.029) | (0.028) |
| Ln(State Min Wage) x High SES | -0.060 | -0.058 | -0.053 | -0.071 | -0.051 | -0.043 |
| | (0.023) | (0.013) | (0.017) | (0.014) | (0.013) | (0.012) |
| Obs | 634,159 | 634,159 | 633,911 | 633,911 | 633,911 | 633,911 |
| **ACS (2000-2011)** | | | | | | |
| *State and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | 0.080 | 0.020 | 0.071 | 0.053 | 0.045 | 0.038 |
| | (0.022) | (0.011) | (0.017) | (0.016) | (0.015) | (0.014) |
| Ln(State Min Wage) x High SES | -0.088 | -0.025 | -0.077 | -0.063 | -0.058 | -0.055 |
| | (0.022) | (0.007) | (0.012) | (0.010) | (0.011) | (0.009) |
| Obs | 1,455,883 | 1,455,883 | 1,578,768 | 1,578,768 | 1,578,768 | 1,578,768 |
| **ACS-P (2005-2011)** | | | | | | |
| *PUMA and Year FE, State Linear Trend* | | | | | | |
| Ln(State Min Wage) | 0.083 | 0.029 | 0.061 | 0.044 | 0.038 | 0.032 |
| | (0.013) | (0.010) | (0.013) | (0.012) | (0.011) | (0.011) |
| Ln(State Min Wage) x High SES | -0.086 | -0.037 | -0.074 | -0.061 | -0.059 | -0.056 |
| | (0.009) | (0.006) | (0.009) | (0.007) | (0.007) | (0.006) |
| Obs | 764,535 | 764,535 | 826,679 | 826,679 | 826,679 | 826,679 |
| **ACS-CZ (2005-2011)** | | | | | | |
| *PUMA and CZ X Year FE* | | | | | | |
| Ln(State Min Wage) | 0.083 | 0.030 | 0.050 | 0.038 | 0.031 | 0.023 |
| | (0.029) | (0.027) | (0.033) | (0.033) | (0.033) | (0.033) |
| Ln(State Min Wage) x High SES | -0.094 | -0.042 | -0.082 | -0.072 | -0.068 | -0.067 |
| | (0.011) | (0.007) | (0.010) | (0.009) | (0.008) | (0.007) |
| Obs | 1,365,826 | 1,365,826 | 1,512,356 | 1,512,356 | 1,512,356 | 1,512,356 |

*Note:* Each panel-column combination shows coefficients from separate least squares regression using relevant population weights. Each column presents a different definition of SES, while each panel represents a different data sample and preferred specification. Column 1 replicates estimates from Table 3. See text for descriptions of CPS, SIPP, ACS, ACS-P, ACS-C, and ACS-CZ data samples. Columns 3-6 for the CPS panel use the Annual Social and Economic Supplement of the CPS rather than the Outgoing Rotation Group. The dependent variable for all regressions is an enrollment indicator. All regressions include indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate (and county unemployment rate in column 5). High SES indicator is equal to one if all of a teen's parent/guardians have high school diploma (or equivalent). From top panel to bottom panel (respectively), standard errors clustered at the state-level, individual-level, state-level, PUMA-level, and commuting zone by year-level are in parentheses.

Table A3—Effect of Minimum Wage on Teen Enrollment (CPS Robustness Checks)

| | CPS Sample (ORG) | | | | Alternative CPS Sample (March) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Ln(State Min Wage) | 0.064 | 0.051 | 0.038 | 0.049 | 0.104 | 0.104 | 0.089 | 0.079 |
| | (0.020) | (0.022) | (0.023) | (0.024) | (0.026) | (0.027) | (0.022) | (0.027) |
| Ln(State Min Wage) x High SES | -0.061 | -0.061 | -0.061 | -0.060 | -0.066 | -0.066 | -0.066 | -0.066 |
| | (0.013) | (0.012) | (0.012) | (0.012) | (0.016) | (0.016) | (0.016) | (0.016) |
| Obs | 244,710 | 244,710 | 244,710 | 244,710 | 166,001 | 166,001 | 166,001 | 166,001 |
| R-Sqr | 0.09 | 0.09 | 0.09 | 0.09 | 0.07 | 0.07 | 0.07 | 0.07 |
| Mean Enrollment Rate: | | | | | | | | |
| Low SES | 0.83 | 0.83 | 0.83 | 0.83 | 0.84 | 0.84 | 0.84 | 0.84 |
| High SES | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.93 | 0.93 | 0.93 |
| *State FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *Year FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *State-Specific Trend* | | *Linear* | *Quad* | *Cubic* | | *Linear* | *Quad* | *Cubic* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is an enrollment indicator. All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have high school diploma (or equivalent). Columns 1-4 use the primary CPS sample of outgoing rotation groups (ORG) while columns 5-8 use the Annual Social and Economic Supplement. In the CPS, students on summer vacation are counted as not enrolled (in the last week), therefore I exclude summer months (June, July, and August) from the ORG sample. See text for more details on CPS sample. Standard errors clustered at the state-level are in parentheses.

Table A4—Effect of Minimum Wage on Teen Dropout (Alternate CPS Time Period: 1992-2007)

| | CPS Sample (ORG) | | | | Alternative CPS Sample (March) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Dependent Variable: Dropout* | | | | | | | | |
| Ln(State Min Wage) | -0.027 | -0.019 | -0.013 | -0.010 | -0.060 | -0.065 | -0.031 | -0.046 |
| | (0.020) | (0.028) | (0.027) | (0.026) | (0.027) | (0.030) | (0.033) | (0.037) |
| Ln(State Min Wage) x High SES | 0.045 | 0.046 | 0.046 | 0.045 | 0.061 | 0.060 | 0.059 | 0.059 |
| | (0.018) | (0.019) | (0.019) | (0.019) | (0.024) | (0.024) | (0.025) | (0.025) |
| Obs | 186,330 | 186,330 | 186,330 | 186,330 | 118,002 | 118,002 | 118,002 | 118,002 |
| *Dependent Variable: Enrollment* | | | | | | | | |
| Ln(State Min Wage) | 0.047 | 0.029 | 0.026 | 0.042 | 0.096 | 0.101 | 0.055 | 0.095 |
| | (0.023) | (0.030) | (0.026) | (0.031) | (0.032) | (0.033) | (0.034) | (0.040) |
| Ln(State Min Wage) x High SES | -0.056 | -0.056 | -0.056 | -0.056 | -0.072 | -0.071 | -0.069 | -0.070 |
| | (0.017) | (0.017) | (0.016) | (0.016) | (0.021) | (0.021) | (0.021) | (0.021) |
| Obs | 186,330 | 186,330 | 186,330 | 186,330 | 117,971 | 117,971 | 117,971 | 117,971 |
| *State FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *Year FE* | *X* | *X* | *X* | *X* | *X* | *X* | *X* | *X* |
| *State-Specific Trend* | | *Linear* | *Quad* | *Cubic* | | *Linear* | *Quad* | *Cubic* |

*Note:* Each column by panel shows a pair of coefficient estimates from a separate least squares regression using relevant population weights. Dependent variable for is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED) and an enrollment indicator for the bottom panel. All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of teenager's parent/guardians have high school diploma (or equivalent). See text for description of CPS data sample. Standard errors clustered at the state-level are in parentheses.

TABLE A5—EFFECT OF MINIMUM WAGE ON TEEN ENROLLMENT (SIPP ROBUSTNESS CHECKS)

| | All 16-18 Year Olds | | | | | | 16-18 Year Olds Observed in First Wave | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Ln(State Min Wage) | 0.039 | 0.050 | 0.035 | 0.051 | 0.054 | 0.028 | 0.034 | 0.045 | 0.030 | 0.048 | 0.051 | 0.030 |
| | (0.036) | (0.036) | (0.037) | (0.031) | (0.032) | (0.036) | (0.037) | (0.037) | (0.038) | (0.032) | (0.033) | (0.037) |
| Ln(State Min Wage) x High SES | -0.069 | -0.069 | -0.068 | -0.075 | -0.072 | -0.069 | -0.069 | -0.069 | -0.068 | -0.073 | -0.071 | -0.069 |
| | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) | (0.023) |
| Obs | 158,525 | 158,525 | 158,525 | 158,525 | 158,525 | 158,525 | 145,002 | 145,002 | 145,002 | 145,002 | 145,002 | 145,002 |
| R-Sqr | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| Mean Enrollment Rate: | | | | | | | | | | | | |
| Low SES | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 |
| High SES | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| *State X Panel FE* | *X* | *X* | *X* | | | | *X* | *X* | *X* | | | |
| *State FE* | | | | *X* | *X* | *X* | | | | *X* | *X* | *X* |
| *State-Specific Trend* | | *Linear* | *Quad* | | *Linear* | *Quad* | | *Linear* | *Quad* | | *Linear* | *Quad* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is an enrollment indicator. All regressions include indicators for trimester, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of teenager's parent/guardians have high school diploma (or equivalent). See text for description of SIPP sample. Standard errors clustered at the individual-level are in parentheses.

TABLE A6—EFFECT OF MINIMUM WAGE ON TEEN ENROLLMENT (ACS ROBUSTNESS CHECKS)

| | 2000-2011 | | | | 2005-2011 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Ln(State Min Wage) | 0.078 | 0.080 | 0.066 | 0.062 | 0.084 | 0.083 | 0.088 | 0.082 | 0.083 | 0.077 |
| | (0.021) | (0.022) | (0.027) | (0.026) | (0.011) | (0.013) | (0.016) | (0.017) | (0.029) | (0.029) |
| Ln(State Min Wage) x High SES | -0.088 | -0.088 | -0.082 | -0.082 | -0.086 | -0.086 | -0.086 | -0.088 | -0.094 | -0.094 |
| | (0.022) | (0.022) | (0.010) | (0.010) | (0.009) | (0.009) | (0.013) | (0.013) | (0.011) | (0.011) |
| Obs | 1,455,883 | 1,455,883 | 2,347,074 | 2,347,074 | 764,535 | 764,535 | 430,298 | 430,298 | 1,365,826 | 1,365,826 |
| R-Sqr | 0.08 | 0.08 | 0.17 | 0.17 | 0.09 | 0.09 | 0.08 | 0.08 | 0.17 | 0.17 |
| Mean Enrollment Rate: | | | | | | | | | | |
| Low SES | 0.84 | 0.84 | 0.77 | 0.77 | 0.85 | 0.85 | 0.86 | 0.86 | 0.78 | 0.78 |
| High SES | 0.93 | 0.93 | 0.88 | 0.88 | 0.93 | 0.93 | 0.93 | 0.93 | 0.89 | 0.89 |
| *Fixed Effects* | *State* | *State* | *PUMA* | *PUMA* | *PUMA* | *PUMA* | *County* | *County* | *PUMA* | *PUMA* |
| | *Year* | *Year* | *CZ X Year* | *CZ X Year* | *Year* | *Year* | *Year* | *Year* | *CZ X Year* | *CZ X Year* |
| *State-Specific Trend* | | *Linear* | | *Linear* | | *Linear* | | *Linear* | | *Linear* |

*Note:* Each column shows coefficient estimates from a separate least squares regression using relevant population weights. The dependent variable for all regressions is an enrollment indicator. All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of a teen's parent/guardians have a high school diploma (or equivalent). See text for descriptions of ACS, ACS-P, ACS-C data samples. Standard errors clustered at the state level for columns 1-2, at the commuting zone-year-level for columns 3-4 and 9-10, at the PUMA-level for columns 5-6, and at the county-level for columns 7-8, are in parentheses.

Table A7—Effect of Min Wage on Teen Dropout(ACS and ACS-CZ Split Sample)

| | ACS<br>(1) | ACS-P<br>(2) | ACS-CZ<br>(3) |
|---|---|---|---|
| Low-SES Only | -0.033 | -0.031 | -0.075 |
| | (0.019) | (0.020) | (0.078) |
| Obs | 292,382 | 137,352 | 247,990 |
| Mean Dropout Rate | 0.11 | 0.09 | 0.12 |
| High-SES Only | -0.006 | -0.007 | 0.019 |
| | (0.005) | (0.005) | (0.020) |
| Obs | 1,163,501 | 627,183 | 1,117,836 |
| Mean Dropout Rate | 0.03 | 0.03 | 0.03 |
| *Fixed Effects* | *State*<br>*Year* | *PUMA*<br>*Year* | *PUMA*<br>*CZ X Year* |
| *Years* | *2000-2011* | *2005-2011* | *2005-2011* |

*Note:* Each panel-column combination shows the coefficient estimate from a separate least squares regression using relevant population weights. Each column presents a different data sample (and preferred specification), while each panel represents a SES-level sample restriction (high or low). A teenager is defined as high SES if all of her parent/guardians have high school diploma (or equivalent). The dependent variable for all regressions is HS dropout (equal to 1 if not currently enrolled and have no H.S. diploma or GED). All regressions include indicators for calendar month, age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. See text for descriptions of ACS, ACS-P, and ACS-CZ data samples. Standard errors clustered at the state level for column 1, at the PUMA-level for column 2, and at the commuting zone by year level for column 3 are in parentheses.

Table A8—Effect of Minimum Wage on Teen Time-Use (Enrolled Only)

| | Work (1) | Leisure (2) | Education (3) | Work (4) | Leisure (5) | Education (6) |
|---|---|---|---|---|---|---|
| Ln(State Min Wage) | -127.3 | -5.3 | 194.5 | -188.7 | 1.3 | 250.6 |
| | (129.0) | (96.8) | (120.7) | (148.3) | (136.7) | (174.0) |
| Ln(State Min Wage) x High SES | -809.4 | 504.2 | 518.8 | -899.6 | 521.2 | 500.3 |
| | (379.6) | (194.5) | (452.7) | (380.9) | (176.7) | (522.9) |
| Obs | 1,944 | 1,944 | 1,944 | 949 | 949 | 949 |
| R-Sqr | 0.11 | 0.16 | 0.33 | 0.16 | 0.16 | 0.25 |
| Mean Dropout Rate: | | | | | | |
| Low SES | 63.7 | 351.3 | 197.3 | 63.4 | 324.0 | 260.1 |
| High SES | 83.3 | 313.2 | 127.9 | 100.5 | 279.2 | 148.9 |
| *Weekday Only* | | | | *X* | *X* | *X* |

*Note:* Each column shows a seperate regression using a sample of enrolled 16-18 year olds from the American Time-Use Survey (ATUS) for 2007-2012 (prior to 2007 teens could not be linked to their parents in order to define SES measure). The dependent variable is the number of minutes in a given 24 hour period spent on each activity category (defined by Bureau of Labor Statistics). Each regression includes state, year, quarter, and day-of-the-week fixed effecs and indicators for age, race, sex, and whether the individual is above the state compulsory schooling age, as well as state unemployment rate. High SES indicator is equal to one if all of teenager's parent/guardians have high school diploma (or equivalent). Standard errors are clustered at the state-level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A9—Effect of Minimum Wage on Teen Hours Worked and Earnings (Enrolled Only)

| | CPS (1992-2012) | | | | | SIPP (1996-2012) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Earnings | Employed | Hrs Worked | 10+ Hrs | 20+ Hrs | Earnings | Employed | Hrs Worked | 10+ Hrs | 20+ Hrs |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Ln(State Min Wage) | -0.863 | -0.039 | -1.202 | -0.043 | -0.037 | -143.665 | 0.010 | -5.361 | -0.057 | -0.189 |
| | (3.021) | (0.038) | (0.602) | (0.028) | (0.012) | (95.175) | (0.091) | (2.746) | (0.089) | (0.074) |
| Ln(State Min Wage) x High SES | -1.966 | -0.037 | -0.441 | -0.029 | 0.007 | 210.662 | -0.001 | 5.371 | 0.108 | 0.156 |
| | (1.125) | (0.011) | (0.207) | (0.010) | (0.004) | (102.273) | (0.097) | (2.909) | (0.095) | (0.078) |
| Obs | 671,327 | 876,905 | 877,244 | 877,244 | 877,244 | 331,644 | 331,644 | 331,644 | 331,644 | 331,644 |
| R-Sqr | 0.03 | 0.09 | 0.08 | 0.07 | 0.03 | 0.52 | 0.63 | 0.57 | 0.59 | 0.48 |
| Mean: | | | | | | | | | | |
| Low SES | 9.50 | 0.21 | 3.87 | 0.16 | 0.06 | 139.94 | 0.19 | 5.09 | 0.18 | 0.09 |
| High SES | 13.51 | 0.31 | 4.80 | 0.20 | 0.06 | 194.79 | 0.31 | 7.09 | 0.26 | 0.12 |
| *State FE* | *X* | *X* | *X* | *X* | *X* | | | | | |
| *State-Specific Cubic Time-Trend* | *X* | *X* | *X* | *X* | *X* | | | | | |
| *Individual FE* | | | | | | *X* | *X* | *X* | *X* | *X* |

*Note:* Each column shows a seperate regression with a labor market outcome as the dependent variable, using a sample of 16-18 year olds from the CPS (Columns 1-5) or SIPP (Columns 6-10) restricted to individuals enrolled in school. See text for details of sample constructions. All regressions include calendar month, year, age, and whether the individual is above the state compulsory schooling age fixed effects, as well as state unemployment rate. CPS regressions also include state, race, and sex fixed effects, while SIPP regressions include individual fixed effects. The summer months of June, July and August are excluded in all regressions. Earnings are adjusted to 2012 dollars and are weekly in the CPS and monthly in the SIPP. Standard errors are clustered at the state-level for CPS and the individual-level for SIPP are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$