Dropouts Need Not Apply: The Minimum Wage and Skill Upgrading

Jeffrey Clemens, Lisa B. Kahn, and Jonathan Meer*

September 3, 2018

Abstract:

We explore whether minimum wage increases result in substitution from lower-skilled labor to slightly higher-skilled labor. Exploiting statutory minimum wage increases from 2011-2016 and American Community Survey data, we show that workers employed in low-paying jobs are older and less likely to be high school dropouts following a minimum wage hike. We then examine the Burning Glass Technologies job vacancy postings dataset to better understand how firm behavior impacts these changes. We find that job ads in minimum wage occupations are more likely to require a high school diploma following a minimum wage hike, consistent with the evidence of employed workers. We see substantial adjustments to skill requirements even within firms.

*Clemens: University of California at San Diego, Economics Department, 9500 Gilman Drive #0508, La Jolla, CA 92093-0508. Telephone: 1-509-570-2690. E-mail: *clemens.jeffrey@gmail.com*. Kahn: University of Rochester, Department of Economics, 280 Hutchison Rd, PO Box 270156, Rochester, NY, 14627. Telephone: 1-585-275-1871. E-mail: *lisa.kahn@rochester.edu*. Meer: Texas A&M University, TAMU 4228, College Station, TX 77843. Telephone: 1-979-845-7309. E-mail: *jmeer@tamu.edu*. We thank Brad Hershbein, and seminar participants at Ben Gurion University, the Brookings Institution, the China Summer Institute of Public Economics at Tsinghua University, Copenhagen Business School Workshop on University Education and Innovation, Cornell University, Federal Reserve Board of Governors, George Mason University, George Washington University, University of Maryland, Southwestern University of Finance and Economics, Tel Aviv University, World Bank, Yale University, and the IFS/CEP Conference on Wages, Labour Market Policy and the Safety Net. We are especially indebted to Dan Restuccia, Jake Sherman, and Bledi Taska for providing the Burning Glass Technologies data.

1 Introduction

The minimum wage remains a hotly debated topic among economists, policymakers, and the public. Most research focuses on the equilibrium employment effects of increases in wage floors, though there is recognition that other margins of adjustment may play a role.[1] One important avenue by which firms may adjust in the face of minimum wage increases is through substitution towards higher-skilled labor. The underlying mechanism is straightforward: if the minimum wage exceeds the value of a worker's output, a firm can eliminate their job or, potentially, find a replacement worker whose productivity meets or exceeds the floor.[2] This phenomenon of "labor-labor substitution" can reduce the impact of minimum wage changes on equilibrium employment levels.

Labor-labor substitution can complicate efforts to asses the social welfare implications of minimum wage increases. To the extent that jobs do shift towards higher skilled workers, those who are replaced (or never hired) may be disproportionately from already disadvantaged groups, such as the young, low-skilled, uncredentialed, and those living in low-income households. Evidence on transitions from minimum wage jobs to higher earnings (Smith and Vavrichek, 1992; Even and Macpherson, 2010) and on the returns to early career labor-market experience (Lemieux, 2006; Kahn, 2010) implies that increased difficulty in finding a first job can have long-run impacts (Neumark and Nizalova, 2007).

We examine labor-labor substitution in response to minimum wage increases in two ways. First, using American Community Survey (ACS) data, we document that high school dropouts and young adults fall as a share of employment after minimum wage increases. Our difference-in-differences identification strategy exploits the many statu-

[1] See Clemens, Kahn, and Meer (2018), Vistnes, Simon, and Gooptu (2018), and Simon and Kaestner (2004) on non-wage compensation; Aaronson and Phelan (2017), Lordan and Neumark (2018), Chen (2018); Hirsch, Kaufman, and Zelenska (2015) on other aspects of the production function; Basker, Foster, and Klimek (2017) on customer-labor substitution; Adams, Meer, and Sloan (2018) on supply-side responses.

[2] Substitution of capital for labor can play a role as well (Hamermesh, 1996; Aaronson and Phelan, 2017; Lordan and Neumark, 2018; Chen, 2018), though this process is likely to be slower (Sorkin, 2015).

tory minimum wage increases that occurred from 2014-2016, and results are robust to the inclusion of extensive controls, including occupation-by-time and occupation-by-state fixed effects. We categorize individuals that are more exposed to minimum wage increases based on the pay distribution of their occupation (Clemens, Kahn, and Meer, 2018). Indeed we find that effects are concentrated among individuals employed in low-wage occupations who are, on average, a quarter of a year older and 4 to 5 percent less like to be a young adult (age 16 to 21) or high school dropout, following statutory minimum wage increases that total around $1.70 over the full time period. We see no impacts on employment shares for other demographic groups, including groups defined by race, gender, and country of birth.

Second, because the ACS measures the stock of employment, as do other standard household and employer survey data sets, we explore the evolution of skill requirements in vacancy postings following minimum wage increases. Using data collected by Burning Glass Technologies (BGT), containing the near universe of online job postings in the United States between 2011 and 2016, we show that the prevalence of requirements for a high school diploma increase following minimum wage hikes. The effect is concentrated among postings for low-wage occupations, where the diploma requirement increases by about 10 percent. Reassuringly, we find no effects for higher levels of education, like college degrees, that should be unaffected by minimum wage increases. We also find little impact on experience and other skill requirements.

Previous literature has explored employment impacts of the minimum wage on multiple population subgroups with a goal of understanding whether losses for one group are offset by increases for others.[3] Recent work highlights that more detailed data may

[3]This discussion goes back at least as far as Smith (1907). Early 20th century empirical work found that the introduction of minimum wages for experienced female workers led to "the dismissal of particular women rather than others, because they... must be paid a higher wage if retained" (Obenauer and von der Nienburg, 1915). More recently, Neumark and Wascher (1996), Ahn, Arcidiacono, and Wessels (2011), and Dube, Lester, and Reich (2016) focus on teenagers and Luttmer (2007) examines effects by skill groups.

be required to estimate labor-labor substitution with precision since coarse demographic groupings do a poor job of tracking minimum wage workers (Clemens and Wither, 2017; Horton, 2017).

We contribute to this literature by going beyond equilibrium employment outcomes to provide an in-depth look at the demand-side response for labor. Using job posting data allows us to examine the flow of jobs rather than the stock, which can be slow to reflect these effects (Meer and West, 2016). The flow of new positions is more likely to be impacted by changes in employer preferences, since current workers may have firm-specific human capital and terminating existing employees is often bad for morale and productivity (Burke and Nelson, 1997). Further, it is difficult to know whether these equilibrium changes are driven by supply- or demand-side responses, changes in the composition of firms, or changes in the nature of an occupation even if it retains the same categorization code. The BGT data allows us to include an extensive set of fixed effects, including at the firm level. We find that changes in high school diploma requirements occur within firm and are not entirely driven by a change in the composition of firms that post for jobs. Our within-firm analysis expands on the existing body of research that analyzes in-depth surveys on small groups and/or administrative data on individual firms (Card and Krueger, 1995; Fairris and Bujanda, 2008; Hirsch, Kaufman, and Zelenska, 2015; Giuliano, 2013).

This paper proceeds as follows. Section 2 describes the minimum wage changes we analyze and our approach to estimating their effects. Section 3 presents our analysis on worker skills using ACS data and section 4 presents our analysis of skill requirements using BGT data. Section 5 concludes.

2 General Approach

We examine data from 2011-2016, a period during which there is variation in statutory minimum wage policies that also avoids the Great Recession. In section 2.1, we describe variation in states' minimum wage policies over this time period. In section 2.2 we describe our approach to identifying minimum wage occupations. In section 2.3 we present our estimation framework.

2.1 Minimum Wage Variation

As in Clemens, Kahn, and Meer (2018), we focus our attention on state-level minimum wage changes that occur after 2011.[4] There was a lull in minimum wage policy making between the Great Recession and 2013 (Clemens and Strain, 2017). From 2011 through 2013, all minimum wage increases were linked to inflation indexing provisions. Since January 2013, over a dozen states have increased their minimum wages through new legislation. Data from 2011 to 2013 thus provide a base period after which states' minimum wage policies diverged substantially.

Table 1 summarizes minimum wage changes by state, listing the minimum wage change across the full time period for each state that had a change. We also list the number of years in which a change occurred and the year of the first change. For example, Alaska's $2.00 minimum wage increase from 2011-2016 occurred through two consecutive $1 increases, in January 2015 and January 2016.

The table distinguishes between states whose increases stem from new legislation (top panel) and those with inflation indexing provisions.[5] For example, from panel B,

[4]The sources underlying our minimum wage series include Meer and West (2016), Vaghul and Zipperer (2016) and Clemens and Strain (2017), and are further described in Clemens, Kahn, and Meer (2018).

[5]The importance of distinguishing between new statutory increases and forecastable increases driven by inflation indexing provisions is highlighted by Strain and Brummund (2016).

Arizona's minimum wage increased by $0.70 over the time period, through changes of $0.10 to $0.30 in almost every year. Minimum wage indexers tend to have many more wage change events that are much smaller in magnitude and better-anticipated. Also, all states in the table had multiple increases over the time period. Even for statutory increasers, at least the second wage change would have been well-anticipated. For these reasons, we pursue an event-style analysis centering around the first wage change for a given state, and also distinguish between indexers and legislative increasers in our regression analysis. Since it is not clear when these changes might have impacted employers, we also explore the timing of any impacts we find in the event analysis.[6]

2.2 Occupation Groups

Our analysis focuses on groups of occupations that are most likely to be impacted by minimum wage legislation. Our occupation-based approach follows Clemens, Kahn, and Meer (2018), and is well suited for investigating the phenomenon of labor-labor substitution.[7] Using the 2006 wave of the Occupational Employment Statistics (OES) data, we classify occupations based on the 10th percentile of their occupation-specific wage distributions.[8] We choose 2006 because it predates both the minimum wage increases we study and the Great Recession. Our analysis focuses on the bottom 10 percent of occupations (again, as sorted based on the 10th percentile of each occupation's 2006 wage distribution). These occupations are most likely to be impacted by minimum wage

[6]Two states, Vermont and Rhode Island, switched from indexed to statutory increases over the time period we study. For the purposes of the summary table and our main regression analysis, we focus on only the statutory increases, using the first year with a statutory increase as the first year with any increase.

[7]It is also a necessity for our analysis of the Burning Glass data, which contain sparse data on pay and no data on demographics.

[8]We classify occupations based on their four-digit SOC occupation code, balancing the need for granularity against sample size constraints.

law, as they are particularly low-earning.[9] We henceforth refer to the lowest decile as "low-wage occupations." For most of our analysis, we group higher-paying occupations into "modest wage" (deciles 2-4), "medium wage" (deciles 5-7) and "high wage" (deciles 8-10) categories, though we also explore more fine groupings.

Table 2 lists the low-wage occupations in order of their 10th percentile wage in 2006. The low-wage occupations include those typically associated with minimum wage jobs, such as waiters, retail clerks, cleaners, etc. The table also illustrates how the minimum wage increases enacted over this time period compare to prevailing wages, restricting attention to statutory increasers. For each state-occupation, we calculate the gap between wages in the 2013 OES wave and the state minimum wage in 2016.[10] We summarize this gap for the 10th, 25th, and 50th percentile of wages. We average across states using OES employment weights and imputing zeros for gaps that are negative. This gives us the amount that, say, the 10th percentile wage needs to increase in a given occupation to be in mechanical compliance with the eventual minimum wage, averaged across all states with statutory increases. Note that these estimates do not take into account any nominal wage growth that might have otherwise occurred in the time period and are merely meant to illustrate the occupations for which we should expect to see minimum wage increases having the largest effects.

In panel A, we see that low-wage occupations should see sizable wage increases at the lower half of their wage distribution. These amounts should be benchmarked against the actual minimum wage increases that occurred over this time period: among statutory increasers, the average increase was $1.68. For food and beverage serving workers (soc code 3530), for example, the 10th percentile wage would need to rise by

[9]The categories we describe here are slightly different than in Clemens, Kahn, and Meer (2018) to better align with categories found in the BGT data. See below for more discussion and robustness to other definitions.

[10]OES data are three-year rolling averages, so the 2013 wave corresponds to the 2011-2013 "pre" period in our data before any statutory legislation.

an average of $1.27 to be in compliance with the average increase. This is only three-quarters of the actual minimum wage increase because in some locations workers were earning slightly above the prevailing minimum wage in 2013. At the 25th percentile, wages in this occupation would only need to increase by $0.87; at the median the gap is just $0.30. Across low-wage occupations, the 10th percentile necessitates increases ranging from $0.38 to $1.34, while expected increases at the median are almost always close to zero. Later, we will also focus on the three lowest-paying occupations (food and beverage serving, other food preparation and serving, and entertainment attendants) because they exhibit substantial exposure to the minimum wage across a larger range of their occupation-specific wage distributions.

Panel B presents summary statistics on the wage distributions for each of the broader occupation groups. For most occupation groups and for most parts of the pay distribution, pre-period wages are already well above the eventual minimum wage. Low-wage occupations stand out as the most likely to be impacted directly by minimum wage legislation.

2.3 Methodology

We estimate regressions of the form specified in equation 1, for an individual, i, working in an occupation, o, in state, s, and time period, t, separately for each occupation group listed above. For BGT job ads data, we aggregate to the occupation-state-month, explained in more detail in section 4.

$$Y_{iost} = \alpha + [after_{st} \times MWgroup_s]\beta + I^o + I^s + I^t + \boldsymbol{X_{st}}\gamma + \epsilon_{iost} \tag{1}$$

Y is the outcome of interest, described in more detail below. $\boldsymbol{MWgroup_s}$ is a vector of indicators for the type of state according to its minimum wage law over the time period: statutory increaser or indexer, with no minimum wage change as the omitted

category (see Table 1). State categories are fixed throughout our sample period. $after_{st}$ is an indicator equaling 1 if the time period is on or after the first minimum wage change in the state. We always include occupation, state, and date fixed effects (I^o, I^s, and I^t, respectively) but also explore a range of additional controls. β is therefore a vector of difference-in-differences estimates (one for each minimum wage group) of the effect of changes in the minimum wage on outcome, Y. This most basic specification accounts for national-level time shocks and baseline differences in outcomes across states and occupations. The identifying assumption is that the outcome of interest would have followed similar trends across states if not for differential changes in their minimum wage policy regimes. Standard errors are clustered by state.

We augment the basic specification with controls for state-by-occupation and occupation-by-year fixed effects, which allow for baseline differences in outcomes across states for a given occupation and for differentially trending occupations at the national level, respectively. We further include a range of controls that vary at the state-time level ($\boldsymbol{X_{st}}$). Specifically, we control for state-level employment rates (obtained from the BLS), log income per capita (from the Bureau of Economic Analysis), and a median house price index (from the Federal Housing Finance Agency). We also control for multiple factors related to the evolution of health insurance markets across states.[11] We estimate regressions separately for each of the occupation groups outlined in Table 2.

The difference-in-differences regression in Equation (1) treats all observations within

[11]Specifically, we control for states' decisions regarding the Affordable Care Act's (ACA) Medicaid expansion by allowing for an indicator equalling one if an ACA Medicaid expansion is in effect in the given year, and we include a second indicator that allows this effect to vary after 2013, when the ACA's key coverage provisions were in effect. We also control for state-time variation in market concentration across the providers of insurance to both large and small employers from Kaiser: https://www.kff.org/state-category/health-insurance-managed-care/insurance-market-competitiveness/. These controls are used in Clemens, Kahn, and Meer (2018) where we show that these same minimum wage hikes reduce the likelihood that workers in low-wage occupations have employer provided health insurance. The benefits environment is important to control for here as well because, as we have shown, the interaction of minimum wages and benefits provision is complex.

a pre- or post-period the same, and all minimum wage increases within the statutory or indexer groups the same, regardless of the size of or distance in time from the increase. We explore alternative approaches later in the paper, including a linear specification for the minimum wage, as well as allowing the effects of minimum wage increases to unfold with more flexible time dynamics. All approaches have both advantages and disadvantages.

3 The Minimum Wage and Worker Skills

In this section, we explore the impact of state-level minimum wage changes on the skill level of employed workers using American Community Survey (ACS) data. We describe the dataset, provide results on worker demographics, and explore employment effects.

3.1 Data

The ACS is a household-based survey of sufficient size to permit relatively large samples, even within state-time-occupation cells. We restrict attention to the years 2011-2016 to better align with availability of the Burning Glass data on job vacancies and the timing of the state-level minimum wage changes. We also limit the sample to those between the ages of 16 and 64. We link ACS data for a given year to the state-level minimum wage applicable in July.[12]

The primary focus of our ACS analysis is on characterizing observable proxies for

[12]Respondents in the ACS may be surveyed at any time during the calendar year, but the survey date is not available in the public-use files. Since we cannot pinpoint with certainty what the prevailing minimum wage was at the time a respondent was surveyed, we impute with the midpoint of the year. We believe this problem is small, since all but a handful of minimum wage changes over this time period were in January of a given year.

skill (age and education) of the individuals employed in low-wage occupations.[13] The top panel of Table 3 provides summary statistics for our key outcomes, by occupation group. Age and education levels rise, as one would expect, moving from low- to high-wage occupations. In low-wage occupations, the average age is 35, roughly 20 percent of workers are aged 16 to 21 or lack a high school degree, and 10 percent have completed a college education. In high-wage occupations, the average age is 43, only 1 percent of workers are aged 16 to 21 or lack a high school degree, and 65 percent have completed a college education.

3.2 Results on Worker Skills

Figure 1 gives a general sense of the relationship between state-level minimum wage changes and changes in one of our key outcome variables: the average age of the employed. Each panel presents this relationship for one of the four occupation groups. The changes are calculated from the period before a given state enacted its first minimum wage increase to the period from the first change onwards (see Table 1). For states with no minimum wage changes, the dividing point is 2014, which is the modal year in which states with statutory increases implemented their first change.

For low-wage occupations (top left), the best-fit line relating minimum wage changes to age changes of the employed is upward sloping. States with larger minimum wage increases saw increases in worker age for these low-wage occupations. In contrast, age decreased, on average, in states with no minimum wage change. The remaining panels show that the slope of the relationship between minimum wage changes and age is essentially flat for higher-paid occupation groups. These relationships are consistent with our expectation that labor-labor substitution effects will be concentrated among

[13] Aaronson and Phelan (2017) similarly focus their analysis on occupations in an investigation of the relationship between minimum wage increases and technological substitution.

workers who are earning close to the minimum wage.

Table 4 presents regression estimates of Equation (1), for those employed in low-wage occupations. The five panels correspond to different dependent variables: age and indicator variables for young adults (age 16-21), older adults (age 50-64), high school dropouts, and for individuals with a high school degree or some college (but no college degree). The specification in column 1 controls for state, year, and occupation fixed effects. Column 2 adds two-way fixed effects at the occupation-by-year and occupation-by-state levels. Column 3 adds macroeconomic and health insurance market controls.

States with statutory increases in the minimum wage see the average age increase in these occupations. The average age of individuals employed in low-wage occupations rises by about a quarter of a year following a minimum wage hike. Panel B shows that the age effect primarily manifests through a nearly 1 percentage point drop (5 percent off a base of 21 percent) in the young adult employment share. From panel C, we find that about half of that offset comes from an increase in employment of older adults (age 50 plus), implying that the remainder is split among prime-age workers. These age effects are generally significant at the 1 percent level and remain fairly consistent in magnitude with the addition of more controls.

We also find that statutory minimum wage increases are followed by changes in the educational attainment of workers in low-wage occupations. Specifically, low-wage workers are less likely to be high school dropouts and more likely to have a high school diploma or some college education following a minimum wage hike. This decline in dropout employment share is just over half of a percentage point (4 percent on a base of 17 percent). The estimated effect on high school dropouts is significant at the 5 percent level in each of our specifications.

In contrast, coefficients for inflation-indexed minimum wage changes tend to be small and insignificant. The one exception is for high school dropouts, where the point esti-

mate is positive. As in Strain and Brummund (2016), it is clear that states operating under inflation indexing regimes have had different experiences than states implementing new statutory increases. Consequently, estimates that pool inflation-indexed minimum wage changes with statutory minimum wage changes will tend to be attenuated relative to estimates of the effects of new legislation. This can be seen in Appendix Table A.1, which reports results from a linear and contemporaneous specification of variation in states' minimum wage rates. In the linear specification, age effects remain strongly statistically distinguishable from 0, while estimates of effects on the education levels of individuals employed in low-wage occupations are attenuated to the point of statistical insignificance.

Importantly, the effects of inflation-indexed minimum wage changes and new statutory minimum wage changes may differ both because the former would have been more fully anticipated and because the latter are larger in magnitude. In Figure 2, we explore whether effects vary with the size of the minimum wage increases. We divide states into tertiles by their total minimum wage change from 2011-2016. We then estimate a specification with an interaction between each tertile and the indicator for the "after" period. We plot the coefficients for three dependent variables: Age, Young Adult, and Dropout. The other outcomes (Older Adult and High School/Some College) mirror these. Coefficients are uniformly significant for the largest increases. Consistent with the non-linearities discussed above, estimates for the smallest increases tend to be insignificantly different from the omitted category of no change. Also, point estimates are similar for the 2nd and 3rd tertile indexer groups, with the latter only a little bit larger than the former and not statistically distinguishable in any case.

Table 5 shows results for the remaining occupation groups. We focus on the specification with full controls (from column 3 of table 4). Occupations that earn well above the minimum wage see no effect. This is reassuring in that if states that implement min-

imum wage hikes were already seeing broad-based skill increases, we would expect to see these trends in these other occupations as well.

We next estimate a version of Equation (1) that tracks the dynamics of the relationship between minimum wage changes and the characteristics of low-wage workers. Specifically, we allow for interactions between state group ($\boldsymbol{MWgroup_s}$) and indicators for each year in event time before and after the first minimum wage change. The omitted category is the year prior to the first minimum wage change. For all outcomes, effects widen with time since the first minimum wage increase took effect. It could be that the employment stock in particular may update more slowly than, say, new hires, or because firms take time to adopt different production technologies that necessitate more-skilled workers. Effects may also widen because minimum wage policy compounds – each state had at least two increases over this time period.

Figure 4 presents estimates separately for each wage decile. We disaggregate the low-wage group into the bottom three occupations ("very low") and the remainder (labeled with "1"). We estimate Equation (1) separately for each group using the full set of controls. The very low and the remainder of the low-wage occupations exhibit pronounced responses, with magnitudes for the very low wage group roughly double the magnitudes for the remainder. For high deciles, the estimates are, with few exceptions, very close to zero. For the modest, middle, and high wage groups, the figure confirms that we lose little information by aggregating occupations across multiple deciles.

Finally, Appendix Table A.2 reports results for other outcomes. We explore a range of demographic characteristics, including race, gender, foreign-born status, and whether the individual recently migrated from another U.S. state. With few exceptions, estimates are very small in magnitude and statistically insignificant.

3.3 Employment

We have presented evidence of modest upskilling among those employed in low-wage jobs. However, these results could be driven not only by labor-labor substitution, but by truncation from employment losses by the least-skilled. That is, the average skill level of individuals in low-wage occupations could rise either because the least-skilled are replaced with higher skilled workers or because jobs held by the least skilled individuals simply disappear.

Table 6 presents evidence that the impacts of the minimum wage on employment, hours, and weeks worked in each of the occupation groups.[14] These results suggest that substitution plays a greater role than truncation; the impacts of the minimum wage on each of the outcomes are small and statistically insignificant. In Panel A, we explore the population share of those employed in a given occupation group. There is a marginally significant positive effect for low-wage occupations; the magnitude is small and we can rule out employment declines of fairly small magnitudes. This is accompanied by a small decline in employment within modest wage occupations.[15] Panel B shows that, among the employed, low-wage occupations do not lose their employment share following minimum wage increases. It also gives some indication that the more-skilled workers found in low-wage occupations might be coming from those previously employed in modest-wage occupations, since the latter lose employment share, though the magnitudes are small. Panels C and D show that, conditional on being employed, workers in low-wage occupations do not lose on hours or weeks worked throughout the year.

[14]We include full controls except the employment rate and occupation fixed effects, since the dependent variables in this analysis involve occupation-specific employment.

[15]This is consistent with a supply-side force emphasized by Phelan (2016), whereby minimum wage increases lead workers to prefer jobs in which wages rise to jobs which previously had modestly higher wages but worse non-wage amenities.

4 The Minimum Wage and Skill Requirements in Vacancy Postings

Results from the ACS data indicate a shift in the composition of the low-wage workforce. However, these outcomes are equilibrium effects on the stock of employment. Minimum wage increases may have effects on the supply of workers as well as employers' labor market practices (Acemoglu, 2001; Flinn, 2006), so the underlying mechanisms are unclear. There is also little information on the firms that employ these workers, making it difficult to examine whether within- or across-firm changes are driving the results. Further, the flow of new employees is more likely to be affected, and the annual nature of the ACS makes it difficult to explore dynamics. By focusing on job postings, we are able to examine a first response of employer decision-making.

4.1 Burning Glass Data

Our data consist of over 100 million electronic job postings in the United States between 2011 and 2016. These job postings were collected and assembled by Burning Glass Technologies, an employment analytics and labor market information firm. BGT examines some 40,000 online job boards and company websites to aggregate the job postings, parse and deduplicate them into a systematic, machine-readable form, and create labor market analytic products. Thanks to the breadth of this coverage, BGT believes the resulting database captures a near-universe of jobs that were posted online. The posting-level data were first used by Hershbein and Kahn (2016) to study changes in skill requirements and production technology following the Great Recession.[16]

[16]The dataset used in the current paper was provided in April 2017. Although BG's algorithms for removing duplicates and coding ad characteristics changes over time, each iteration is applied to all postings in the data. The database also includes years 2007 and 2010 (but unfortunately lacks postings from 2008 and 2009). We focus on the window around the recent statutory minimum wage increases that

The key advantages of our data are its breadth and detail. The BGT data contain some 70 possible fields for each vacancy. We exploit detailed information on occupation, geography, skill requirements, and firm identifiers. The codified skills include stated education and experience requirements, as well as thousands of "key word" skills standardized from open text in each job posting.[17]

The BGT data are not, however, without disadvantages. First, vacancy postings represent the stated preferences of firms rather than details of the process by which the position was actually filled. We view these data as capturing a potential first line of firms' responses to minimum wage policy.

A second issue to consider is representativeness. That the BGT data only cover postings on the internet is a drawback, though by 2014 between 60 and 70 percent of all job postings could be found online (Carnevale, Jayasundera, and Repnikov, 2014).[18] Vacancies in general will be somewhat skewed towards certain areas of the economy since they overrepresent growing firms (Davis, Faberman, and Haltiwanger, 2013). However, two-thirds of hiring is replacement hiring (Lazear and Spletzer, 2012), and, especially in these high-churn low-paying occupations, we have a good deal of coverage.

Hershbein and Kahn (2016) discuss the representativeness of the BGT data in their data appendix. They show that there are some differences between the distribution of industries in BGT, compared to vacancies in the Job Openings and Labor Turnover survey,

---

also avoids the Great Recession and its early recovery. Results are similar if we include the 2010 data.

[17]For example, an ad might ask for a worker who is bilingual or who can organize and manage a team. BGT cleans and codes these and other skills into a taxonomy of thousands of unique but standardized requirements. Beginning with a set of pre-defined possible skills, BGT uses machine learning technology to search text in an ad for an indication that the skill is required.

[18]Carnevale, Jayasundera, and Repnikov (2014) show that the occupation-industry composition of the BGT data are similar to that of the Conference Board's Help Wanted Online Index. Moreover, the authors audited a sample of job postings in the BGT database and compared them to the actual text of the postings, finding that the codings for occupation, education, experience were at least 80 percent accurate. This figure should be higher in our extract since BGT regularly revises and attempts to improve its algorithms, applying them retroactively on the complete historical database of postings.

and differences in occupations compared to the stock and flow of employment as measured by the OES and the Current Population Survey, respectively. Across industries, BGT is overrepresented in health care and social assistance, as well as in finance and insurance and education. It is underrepresented in accommodation and food services and construction. Across occupations, BGT is overrepresented in computer and mathematical occupations, management, healthcare practitioners, and business and financial operations. It is underrepresented in transportation, food preparation and serving, production and construction occupations. However, Hershbein and Kahn (2016) show that the distribution of ads across occupations is fairly stable over time.

Figure 5 shows the occupation distribution of BGT compared to the employment distribution in OES over the same years. Of course, stock of employment does not necessarily equal vacancy postings for a number of reasons, but it gives some intuition for where BGT might be lacking in coverage. Note that low-wage occupations (indicated with red triangles) are below the 45-degree line, meaning they are underrepresented in BGT relative to OES employment. However, they still have a large presence: for example, retail sales make up nearly 5 percent of all ads posted. Importantly, panel B shows that there are few changes to the composition of the data over time. Here, we map the 2011-13 deviation of occupation share between BGT and OES on the 2014-16 deviation share. If representation has remained constant over the two time periods, points will line up on the 45 degree line. For the most part, this is exactly what we see. That there are not large shifts in the BGT occupation distribution, relative to OES employment, over our time period is reassuring that results using BGT are internally valid.

With ad-level data, we can measure the relationship between skill requirements and the minimum wage at fairly high frequencies. We aggregate to the monthly level and continue to classify occupations at the four-digit SOC level; that is, each observation is a state-month-occupation cell. We therefore link minimum wage variables on a monthly

basis. In our regression analysis, we weight observations in a cell by their ad share within the cell times occupation-state-year employment as measured in the OES. The former allows for more precision by upweighting data points based on more ads and also allows us to estimate a regression specifications at any level of aggregation and obtain the same result. The OES weights allow us to peg the BGT sample more closely to the ACS results and allow us to isolate changes in skill requirements in response to the minimum wage, rather than changes in vacancy composition – an issue we will explore directly in future work.

We restrict our main BGT sample to ads with non-missing employers. We further restrict to employers that regularly post jobs in low-wage occupations, defined as those that post in at least 20 months and 20 states.[19] These criteria do not impact our main results, but are helpful for interpreting specifications in which we include firm fixed effects.

The bottom panel of Table 3 summarizes skill requirements found in the BGT data. BGT codes education and experience requirements.[20] We also explore some of the key-word requirements that we believe might be relevant. Three such skills, "Customer Service", "Cognitive", and "Non-cognitive" are taken from the Deming and Kahn (2018) categorization that distills the tens of thousands of BGT key words into 10 general skills. To these we add an English-language requirement and a computer skill requirement.[21]

---

[19]The former restriction drops 30 percent of low-wage ads, and the latter drops 19 percent of the remaining ads. Ads with a missing firm are likely posted by a recruiter's website.

[20]Ads can specify a minimum requirement and a preferred requirement. We use the minimum, as it is much more prevalent, and classify an ad to a single category based on the minimum necessary (e.g., an ad for a job requiring a Ph.D. will not also be coded as requiring a high school diploma).

[21]Customer Service requirement includes any ad with one of the following key words: "customer", "sales", "client", "patient". Non-cognitive skill requirement includes the key words "organized", "detail-oriented", "multi-tasking", "time management", "meeting deadlines", "energetic". Computer requirement is a range of programs and languages that BGT classifies. Cognitive skill requirements involve the keywords "research," "analy*," "decision," "solving," "math," "statistic," or "thinking." English requires the ad to have the keyword "English".

There is a clear positive correlation between the likelihood of an education requirement and the occupation's position in the wage distribution; for example, 30.4 percent of low-wage job ads have an explicitly-stated education requirement, while 69.2 percent of high-wage jobs have one. Furthermore, Hershbein and Kahn (2016) show that education requirements and the education level of employed workers are strongly correlated at the occupation and MSA levels. At the same time, requirements that appear in job postings may not translate one-for-one into the requirements imposed in practice. Firms may both impose requirements that do not appear in their postings and hire workers who lack the requirements that their postings include.

The bottom rows of Table 3 give cell sizes and the number of ads posted overall and within each occupation-state-month cell. For low-wage occupations, we have over 37,000 cells, nearly 5.7 million ads, and an average of 150 ads per cell.

Our empirical analysis focuses primarily on the high school diploma requirement, though we present results for other skill requirements as well. The high school education requirement has substantial relevance to minimum wage occupations. Further, it is less subject to misinterpretation than some of the BGT data's more qualitative requirements. Finally, it translates directly into the demographics analyzed in the ACS: increases in an enforced high school education requirement will both reduce employment by high school dropouts and reduce employment among individuals 18 and younger.

4.2 Results on Skill Requirements

Figure 6 presents the raw relationship between states' minimum wage increases and changes in the prevalence of the high school education requirement. A positive correlation is most evident for low-wage occupations; states with large minimum wage increases saw larger increases in the prevalence of the high school education requirement, on average, than either states with small minimum wage increases or states with

no minimum wage increases. The best-fit lines are fairly flat for the modest-, middle-, and high-wage groups, as presented in the remaining panels.

We next present estimates of equation (1) for the BGT data, where each observation is a occupation-state-month cell. Table 7 shows the results, with high school requirement as the dependent variable. For low-wage occupations (panel A) there is a large, positive, and statistically significant increase in the prevalence of the high school diploma requirement in states that enacted new statutory minimum wage increases. With occupation, state, and date (month-year) fixed effects, that group sees, on average, an increase of 1.9 percentage points in the share of jobs with that requirement. Adding occupation-by-date and occupation-by-state fixed effects and macroeconomic controls increases the coefficient to 3.2 percentage points (or 12 percent of baseline), significant at the 1% level. The effects for indexers, whose minimum wage increases are smaller and more frequent, are much smaller in absolute value and statistically insignificant.

Panels B, C, and D report equivalent estimates for occupations higher in the wage distribution, which are less likely to be directly affected by minimum wage increases. Coefficients are smaller than for low-wage occupations and tend to be statistically insignificant. The average point estimate across these higher-skilled groups is less than one-fifth of the point estimate associated with the low-wage occupations and has a t-statistic of less than 1.

Figure 7 shows the event study version of equation (1) for high school requirements, restricting attention to low-wage occupations. To reduce noise, we aggregate to the quarter level. The omitted category is the quarter prior to the first minimum wage change. There are no obvious trends prior to that first change, but there is a marked increase immediately following that first change. The elevated level is consistent through the full range of the post-increase data, 20 months. That effects are fairly constant here, but impacts on worker skill in the ACS increased with time since the first minimum

wage increase (Figure 3) is consistent with the interpretation that the stock variables take time to reflect changes in employment flows.

Figure 8 explores how effects vary with the size of the minimum wage increase, focusing on low-wage occupations. Effects level off with the middle tertile of minimum wage increases, and there is no effect for the bottom tertile compared to states with no minimum wage change. As with our ACS estimates, the evidence suggests that the minimum wage's effects are non-linear. Nonetheless, we report results from a linear specification in Appendix Table A.1. With the full set of controls included, a one-dollar increase in the minimum wage is associated with a statistically significant increase of 1.4 percentage points in the share of low-wage job postings that require a high school degree.

Figure 9 shows estimates separately by decile of the occupation's 10th percentile wage. We again break the bottom three occupations out into a "Very Low" category. Effects are concentrated at the bottom of the distribution, with the largest impact seen among bottom-decile occupations excluding those we classify as "Very Low." One possible explanation is that high school diploma requirements are a less important screening mechanism for those three lowest-ranked occupations, as evidenced by their lower prevalence at baseline. Only about 16 percent of Very Low wage occupations post a high school requirement, compared to 31 percent for the remainder.

Appendix Table A.3 examines other outcomes. We find that the prevalence of customer service requirements tend to increase in response to the minimum wage, a result that is robust to different sets of controls and specifications. However, other requirements – like non-cognitive and cognitive skills, English, and computer skills – show no consistent patterns. Given the increased emphasis on social skills in the labor force (Deming, 2017), it is sensible that employers demand more customer service skills in response to changes in labor market regulations. Cognitive, computer and English requirements

are comparatively rarely found in job ads for low-wage occupations, so there may only be a narrow slice of employers that are marginal on these dimensions. However, we did not have strong hypotheses on which skills would be most affected by minimum wage increases and, given the lack of consistent evidence for the other requirements, we choose not to emphasize the customer service outcomes. We also do not find evidence of increases in experience requirements.

There are several potential explanations for these results. First, employers may be trying to find more-productive employees in response to increased labor costs and using high school degrees as a proxy for skills that are valuable in low-wage occupations. Second, there may be a "truncation" effect in the job ads, if the least skilled jobs are no longer posted for. Third, firm postings could respond to anticipated changes in labor supply, either to avoid a flood of applications from the low-skilled now that the job pays more or because more-skilled workers broaden their search. Fourth, there may also be a change in the composition of firms posting jobs. For example, firms using low-skill labor that does not need a high school degree may be replaced by firms who employ workers in the same occupations but whose technologies necessitate more skills. This mechanism can, of course, be viewed as an outcome of minimum wage increases in and of itself.

To understand whether the increase in high school degree requirements is being driven by changes within or across firms, we explore a range of firm-level controls. We disaggregate the data to state-month-occupation-firm cells. In Table 8, we estimate Equation 1, beginning with the full controls specification that was discussed previously – a 3.2 percentage point increase in the prevalence of high school requirements for statutory increasers. We then add, in turn, firm, firm-by-state, and firm-by-year fixed effects. These controls will account for variation in firm-specific job postings, differences in firms' postings across states, and the evolution of firm-specific differences over time, respectively.

In all three specifications, the estimate of the impact of a statutory minimum wage increase on the prevalence of high school requirements is about 1 percentage point. While smaller than the estimate without firm fixed effects, it is statistically significant and economically meaningful. There does appear to be some shifting of job postings across firms, but these results are strong evidence of a shift to more productive workers even within firms.

5 Conclusion

We investigate whether changes in firms' skill requirements are channels through which labor markets respond to minimum wage increases. We present evidence on two sets of outcomes: observable skill proxies and the skill requirements firms include in online job postings. Data from the American Community Survey show that recent minimum wage changes have resulted in increases in the average age and education of the individuals employed in low-wage jobs. Data on job vacancy postings provide evidence on the mechanisms through which these changes have occurred. Vacancies in states that have increased their minimum wage rates have become less hospitable to high school dropouts as the prevalence of high school graduation requirements has increased.

Given the poor labor market outcomes of individuals without high school diplomas, these findings have substantial policy relevance – a possibility that was recognized well over a century ago by Smith (1907), who noted that the "enactment of a minimum wage involves the possibility of creating a class prevented by the State from obtaining employment." Further, negative effects may be exacerbated for minority groups in the presence of labor market discrimination (Becker, 2010; Agan and Starr, 2017; Doleac and Hansen, 2016).

Our analysis of employment stocks is limited in at least two respects. First, ACS

data provided a fairly coarse look at the demographic characteristics of the employed, and may thus miss many interesting margins along which employment patterns change. Second, like most analyses of employment stocks, our ACS analysis is inevitably limited to capturing short-to-medium run responses of margins that may take years to fully unfold.

While our data on vacancy postings allows us to shed light on a unique aspect of firms' hiring behavior, there are limitations here as well. While they are substantial in scope, they are unable to provide a perfectly representative picture of the job-vacancy landscape. Key difficulties in interpreting vacancy postings have long been recognized. There is no guarantee that firms' hiring processes will, in practice, implement the requirements their job postings list, though it is also possible that firms introduce these requirements informally, without adding them to job postings.

These limitations not withstanding, the evidence suggests that labor-labor substitution has been an important margin of firms' responses to recent minimum wage increases. In Clemens, Kahn, and Meer (2018), we showed that these same minimum wage increases resulted in lower provision of employer provided health insurance in low-wage occupations. Our estimates imply that savings from reductions in coverage offset about 10 percent of wage increases generated by the minimum wage hikes, leaving a sizable role for the shifting of rents to workers. However, successful labor-labor substitution implies that productivity in minimum wage jobs would have also increased. We estimate that these effects can account for an addition offset of roughly 50 percent, based on standard Mincerian returns to education or experience. Additional research on firms' hiring processes, production processes, and compensation packages has the potential to take us farther beyond the current literature's understanding of firms' responses to minimum wage increases.

References

Aaronson, D., and B. J. Phelan (2017): "Wage Shocks and the Technological Substitution of Low-Wage Jobs," *The Economic Journal*.

Acemoglu, D. (2001): "Good Jobs versus Bad jobs," *Journal of Labor Economics*, 19(1), 1–21.

Adams, C., J. Meer, and C. W. Sloan (2018): "The Minimum Wage and Search Effort," *Working Paper*.

Agan, A., and S. Starr (2017): "The effect of criminal records on access to employment," *American Economic Review*, 107(5), 560–64.

Ahn, T., P. Arcidiacono, and W. Wessels (2011): "The distributional impacts of minimum wage increases when both labor supply and labor demand are endogenous," *Journal of Business & Economic Statistics*, 29(1), 12–23.

Basker, E., L. Foster, and S. Klimek (2017): "Customer-employee substitution: Evidence from gasoline stations," *Journal of Economics & Management Strategy*, 26(4), 876–896.

Becker, G. S. (2010): *The economics of discrimination*. University of Chicago press.

Burke, R. J., and D. L. Nelson (1997): "Downsizing and restructuring: lessons from the firing line for revitalizing organizations," *Leadership & Organization Development Journal*, 18(7), 325–334.

Card, D., and A. B. Krueger (1995): *Myth and measurement: the new economics of the minimum wage*. Princeton University Press.

Carnevale, A. P., T. Jayasundera, and D. Repnikov (2014): "The Online College Labor Market: Where the Jobs Are.," *Georgetown University Center on Education and the Workforce*.

Chen, Y. (2018): "Capital-Labor Substitution in Low-Skilled Labor-Intensive Manufacturing Industries in the United States," *Working Paper*.

Clemens, J., L. B. Kahn, and J. Meer (2018): "The Minimum Wage, Fringe Benefits, and Worker Welfare," *NBER Working Paper 24635*.

Clemens, J., and M. R. Strain (2017): "Estimating the Employment Effects of Recent Minimum Wage Changes: Early Evidence, an Interpretative Framework, and a Pre-Commitment to Future Analysis," *NBER Working Paper 23084*.

Clemens, J., and M. Wither (2017): "Additional Evidence and Replication Code for Analyzing the Effects of Minimum Wage Increases Enacted During the Great Recession," *Mimeo*.

Davis, S. J., R. J. Faberman, and J. C. Haltiwanger (2013): "The establishment-level behavior of vacancies and hiring," *The Quarterly Journal of Economics*, 128(2), 581–622.

Deming, D., and L. B. Kahn (2018): "Skill requirements across firms and labor markets: Evidence from job postings for professionals," *Journal of Labor Economics*, 36(S1), S337–S369.

Deming, D. J. (2017): "The growing importance of social skills in the labor market," *The Quarterly Journal of Economics*, 132(4), 1593–1640.

Doleac, J. L., and B. Hansen (2016): "Does ban the box help or hurt low-skilled workers? Statistical discrimination and employment outcomes when criminal histories are hidden," *NBER Working Paper 22469*.

Dube, A., T. W. Lester, and M. Reich (2016): "Minimum wage shocks, employment flows, and labor market frictions," *Journal of Labor Economics*, 34(3), 663–704.

Even, W. E., and D. A. Macpherson (2010): "The Teen Employment Crisis: The Effects of the 2007-2009 Federal Minimum Wage Increases on Teen Employment," *Employment Policies Institute, Washington, DC*.

Fairris, D., and L. F. Bujanda (2008): "The dissipation of minimum wage gains for workers through labor-labor substitution: evidence from the Los Angeles living wage ordinance," *Southern Economic Journal*, pp. 473–496.

Flinn, C. J. (2006): "Minimum wage effects on labor market outcomes under search, matching, and endogenous contact rates," *Econometrica*, 74(4), 1013–1062.

Giuliano, L. (2013): "Minimum wage effects on employment, substitution, and the teenage labor supply: evidence from personnel data," *Journal of Labor Economics*, 31(1), 155–194.

Hamermesh, D. S. (1996): *Labor Demand*. Princeton University Press.

Hershbein, B. J., and L. B. Kahn (2016): "Do Recessions Accelerate Routine-Biased Technological Change? Evidence from Vacancy Postings," *Upjohn Institute Working Paper 16-254*.

Hirsch, B. T., B. E. Kaufman, and T. Zelenska (2015): "Minimum wage channels of adjustment," *Industrial Relations: A Journal of Economy and Society*, 54(2), 199–239.

Horton, J. (2017): "Price Floors and Employer Preferences: Evidence from a Minimum Wage Experiment," Discussion paper, CESifo Group Munich.

Kahn, L. B. (2010): "The long-term labor market consequences of graduating from college in a bad economy," *Labour Economics*, 17(2), 303–316.

Lazear, E. P., and J. R. Spletzer (2012): "Hiring, churn, and the business cycle," *American Economic Review*, 102(3), 575–79.

Lemieux, T. (2006): "The Mincer Equation Thirty Years After Schooling, Experience, and Earnings," *Jacob Mincer A Pioneer of Modern Labor Economics*, pp. 127–145.

Lordan, G., and D. Neumark (2018): "People versus machines: the impact of minimum wages on automatable jobs," *Labour Economics*, 52, 40–53.

Luttmer, E. F. (2007): "Does the minimum wage cause inefficient rationing?," *The BE Journal of Economic Analysis & Policy*, 7(1).

Meer, J., and J. West (2016): "Effects of the Minimum Wage on Employment Dynamics.," *Journal of Human Resources*, 51(2).

Neumark, D., and O. Nizalova (2007): "Minimum wage effects in the longer run," *Journal of Human resources*, 42(2), 435–452.

Neumark, D., and W. Wascher (1996): "The Effects of Minimum Wages on Teenage Employment and Enrollment: Estimates from Matched CPS Data," *Research in Labor Economics*, pp. 25–64.

Obenauer, M. L., and B. M. von der Nienburg (1915): "Effect of Minimum-wage Determinations in Oregon," *Bulletin of the US Bureau of Labor Statistics*, July(176).

Phelan, B. J. (2016): "Hedonic-Based Labor Supply Substitution and the Ripple Effect of Minimum Wages," Discussion paper, Discussion paper, DePaul University.

Simon, K., and R. Kaestner (2004): "Do minimum wages affect non-wage job attributes? Evidence on fringe benefits," *ILR Review*, 58(1), 52–70.

Smith, H. L. (1907): "Economic theory and proposals for a legal minimum wage," *The Economic Journal*, pp. 504–512.

Smith, R. E., and B. Vavrichek (1992): "The wage mobility of minimum wage workers," *Industrial and Labor Relations Review*, pp. 82–88.

Sorkin, I. (2015): "Are there long-run effects of the minimum wage?," *Review of Economic Dynamics*, 18(2), 306–333.

Strain, M., and P. Brummund (2016): "Real and permanent minimum wages," Discussion paper, American Enterprise Institute.

Vaghul, K., and B. Zipperer (2016): "Historical state and sub-state minimum wage data," *Washington Center for Equitable Growth. http://equitablegrowth.org/workingpapers/historical-state-and-sub-state-minimum-wage-data*.

Vistnes, J., K. Simon, and A. Gooptu (2018): "The Impact of Minimum Wage Increases on the Provision of Employer-Sponsored Fringe Benefits," *Working Paper*.

Figures and Tables

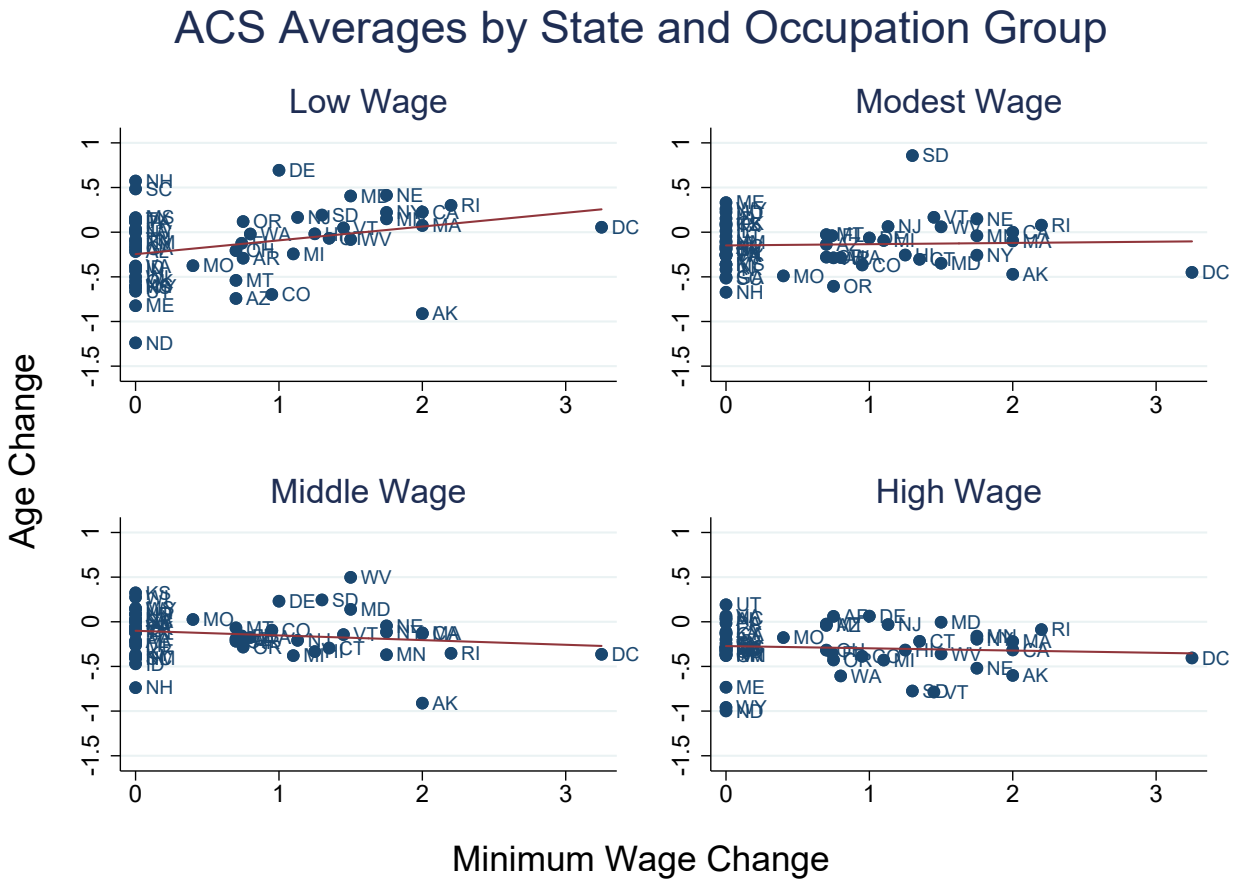

Figure 1: **The Minimum Wage and Average Age of Employed**
Note: The figure presents scatter plots of the state-level change in average age of employed workers on the state-level change in the minimum wage, separately by occupation group, using American Community Survey (ACS) data. Changes refer to the period on or after the first minimum wage increase for the state (see table 1) minus the period before any minimum wage changes. For states with no minimum wage change, we use the modal change date of statutory increasers, 2014. We group occupations based on their decile of the 10th percentile wage distribution, as measured in the 2006 Occupational Employment Statistics. "Low", "Modest", "Medium", and "High" wage occupations correspond to the 1st, 2-4, 5-7, and 8-10 deciles, respectively; see Table 2.

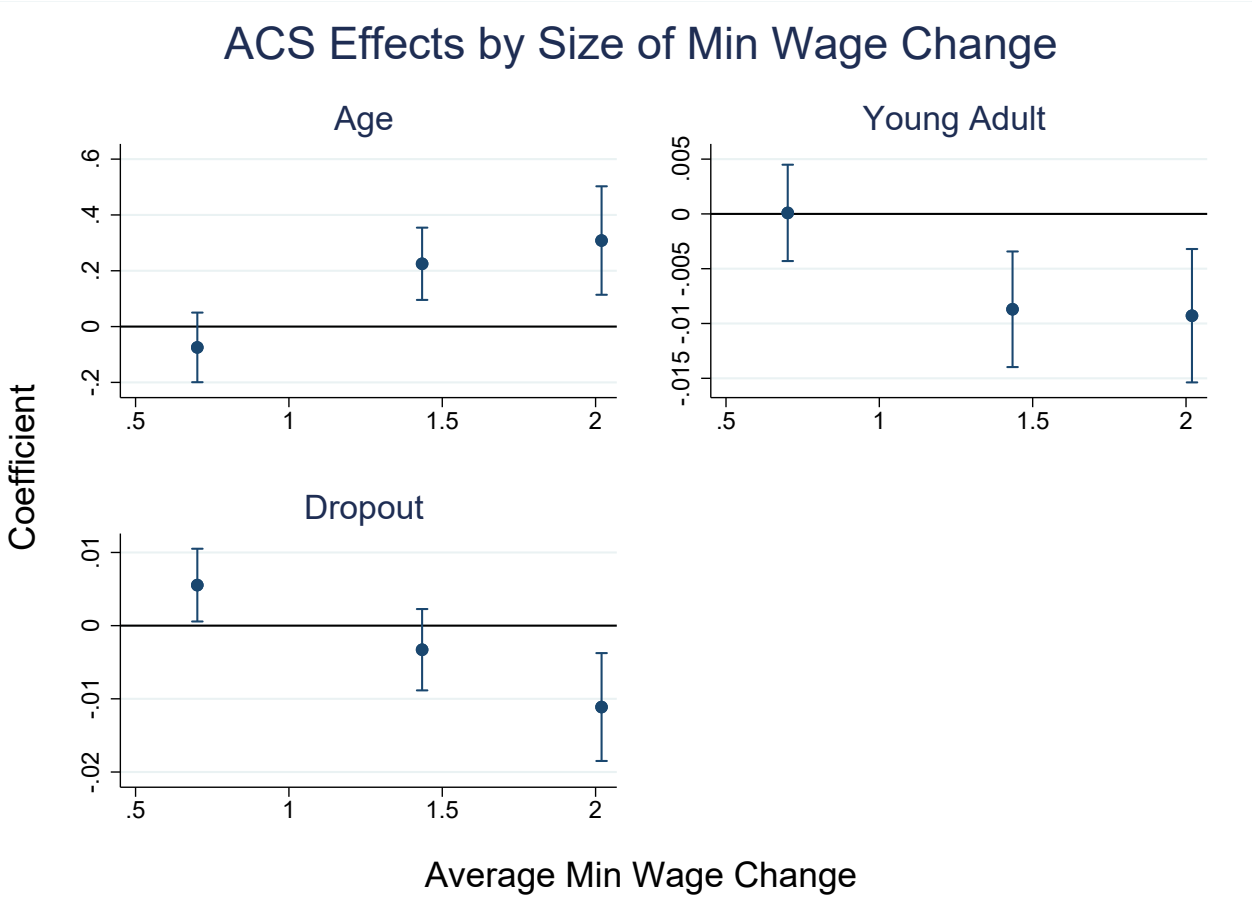

Figure 2: **Minimum Wage and Worker Skills by Size of Minimum Wage Increase**
Note: The figure reports results of Equation (1), allowing interactions between "after" and indicators for each tertile of state minimum wage increases over the full time period, with no change as the omitted category. We restrict to workers in low-wage occupations and estimate specifications with full controls, using American Community Survey (ACS) data. We plot coefficients for the interaction terms on the average minimum wage change in each tertile.

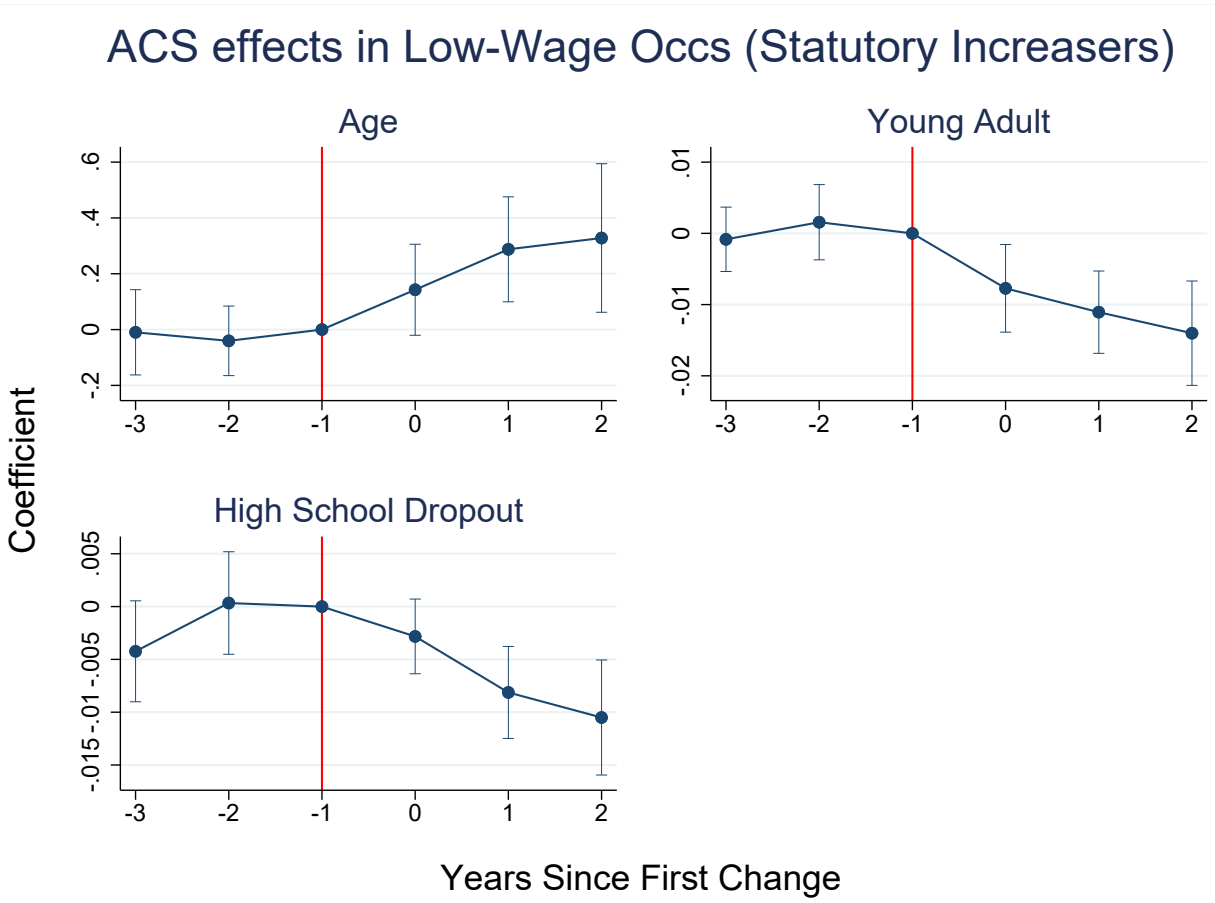

Figure 3: **Minimum Wage and Worker Skills by Time Since First Increase**
Note: The figure reports results of Equation (1), with the full set of controls described in the text, that allows for interactions between minimum wage type and each year before and after the first minimum wage hike. The omitted category is the year before the first change. We plot coefficients and 90% confidence bars for statutory increase states, restricting the sample to low-wage occupations, using American Community Survey (ACS) data.

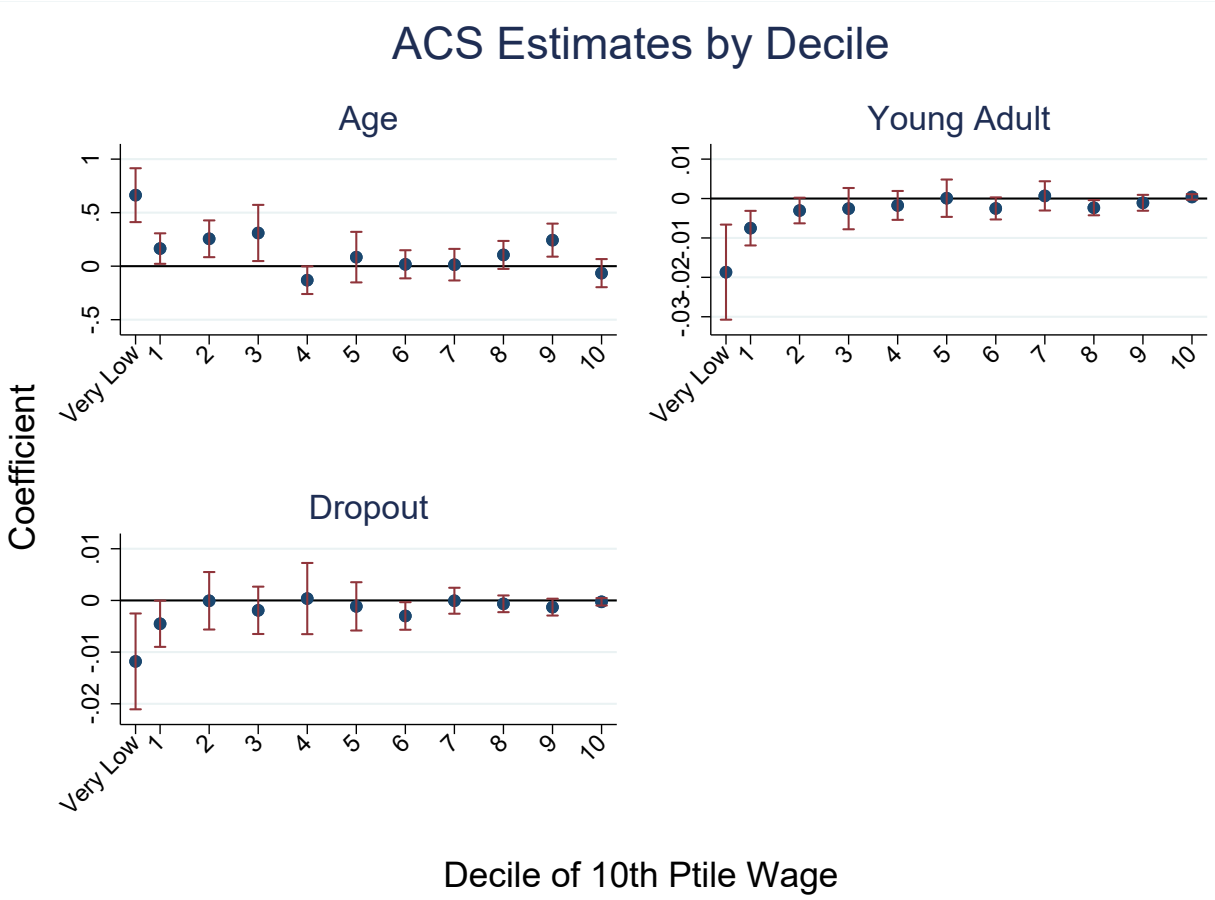

Figure 4: **Worker Skill Outcomes across Deciles**
Note: The figure reports results of Equation (1), estimated separately by decile of their 10th percentile wage (the bottom decile is split into the lowest three occupations, "very low", and the remainder in the low category, "1"). We include full controls in all regressions and use American Community Survey (ACS) data.

Figure A

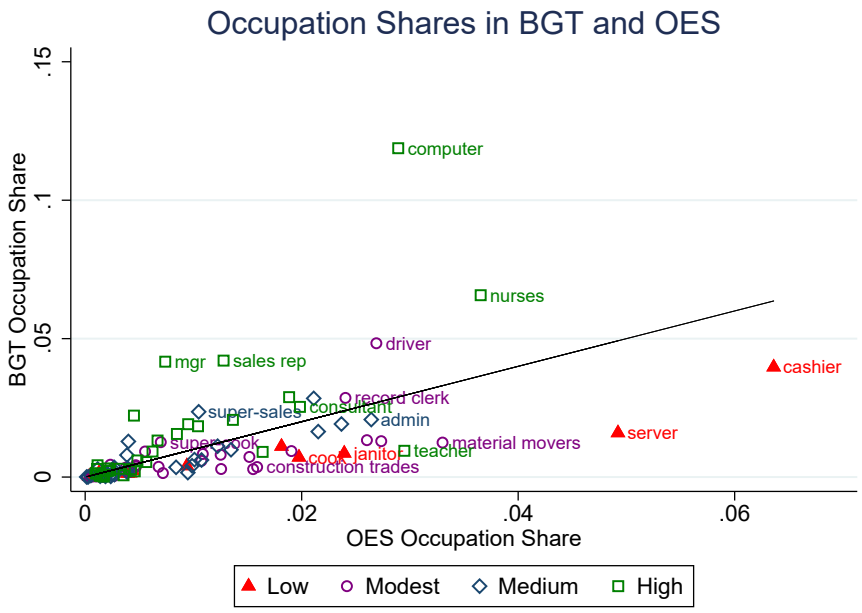

Figure B

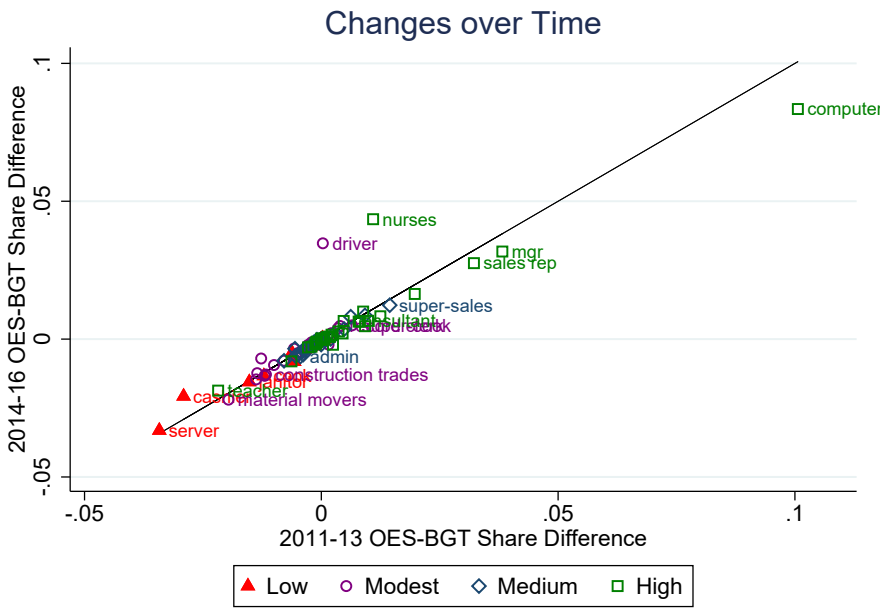

Figure 5: **Occupation Distributions in BGT and OES and Changes over Time**
Note: Figure A plots occupation shares in Burning Glass (BGT) on occupation shares in Occupational Employment Statistics (OES) for four-digit SOC occupations codes, averaged from 2011-2016. Figure B plots the average deviation between OES and BGT in 2014-16 occupation shares on the average deviation in 2014-16. Both figures include a 45 degree line.

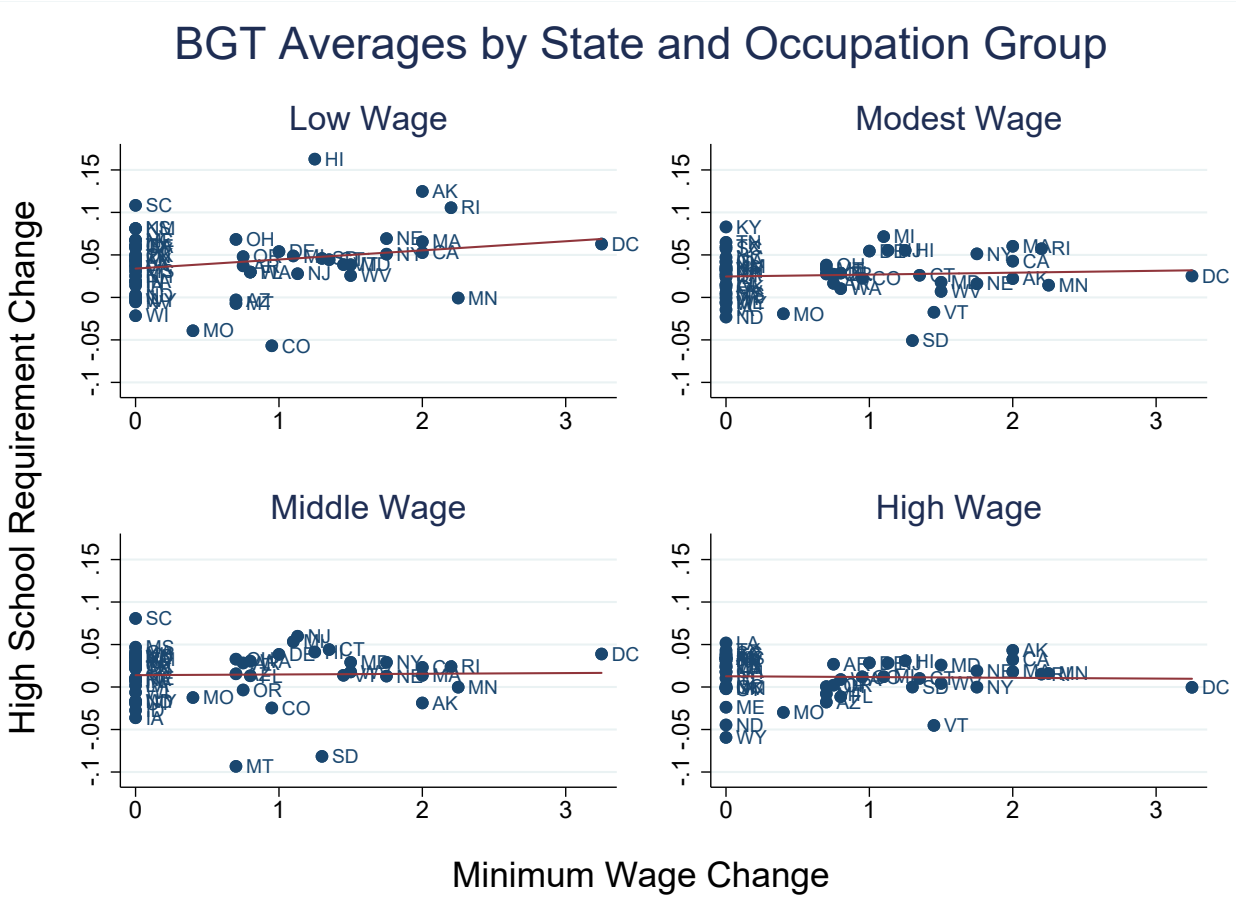

Figure 6: **The Minimum Wage and High School Requirements**
Note: The figure presents scatter plots of the state-level change in the prevalence of high school requirements from Burning Glass (BGT) on the state-level change in the minimum wage, separately by occupation group. Changes refer to the period on or after the first minimum wage increase for the state (see Table 1) minus the period before any minimum wage changes. For states with no minimum wage change, we use the modal change date of statutory increasers, 2014. We group occupations based on their decile of the 10th percentile wage distribution, as measured in the 2006 Occupational Employment Statistics. "Low", "Modest", "Medium", and "High" wage occupations correspond to the 1st, 2-4, 5-7, and 8-10 deciles, respectively; see table 2.

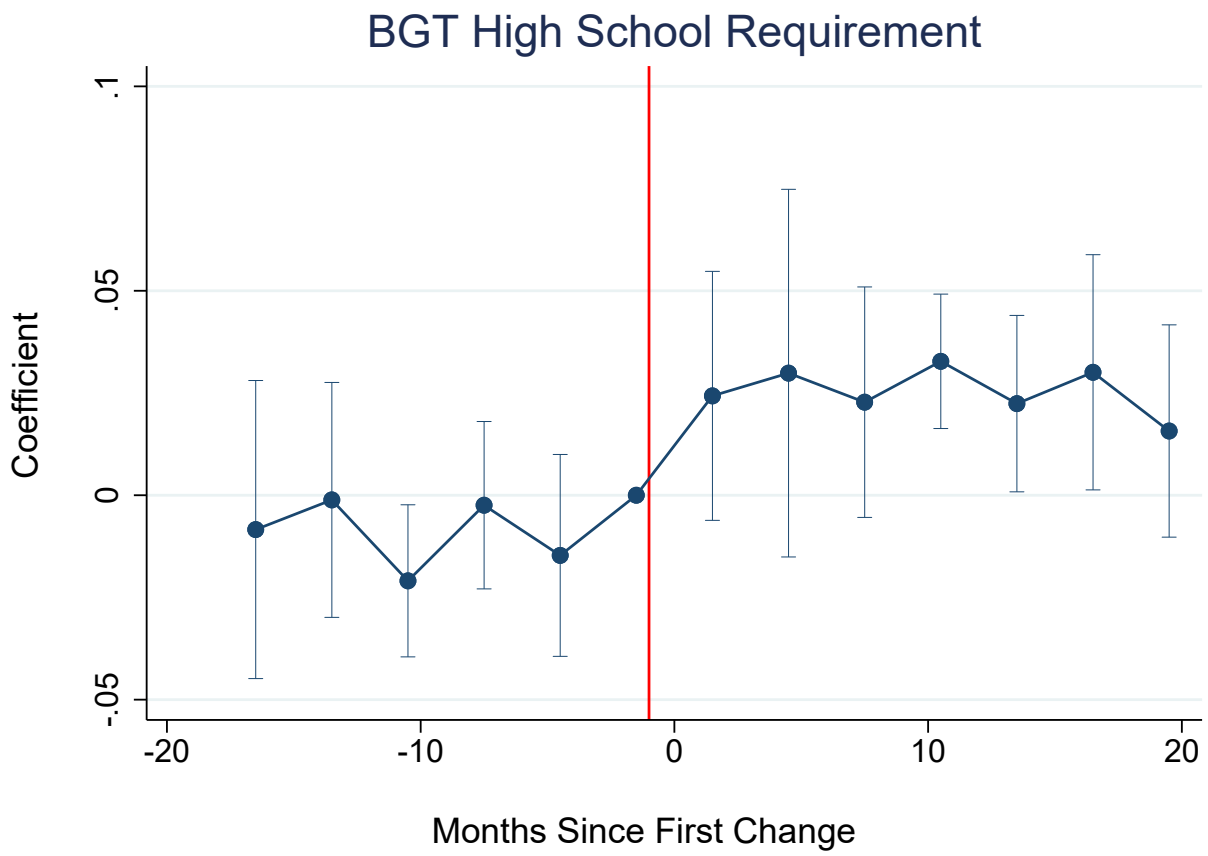

Figure 7: **Minimum Wage and Job Ad Skill Requirements by Time Since First Increase**
Note: The figure reports results of an expanded version of Equation (1) with full controls that allows for interactions between minimum wage type and each quarter before and after the first minimum wage hike. The omitted category is the quarter before the first change. We plot coefficients and 90% confidence bars for statutory increase states, restricting the sample to low-wage occupations in Burning Glass Technologies (BGT) data. We display point-estimates for each quarter at their midpoint month in event time.

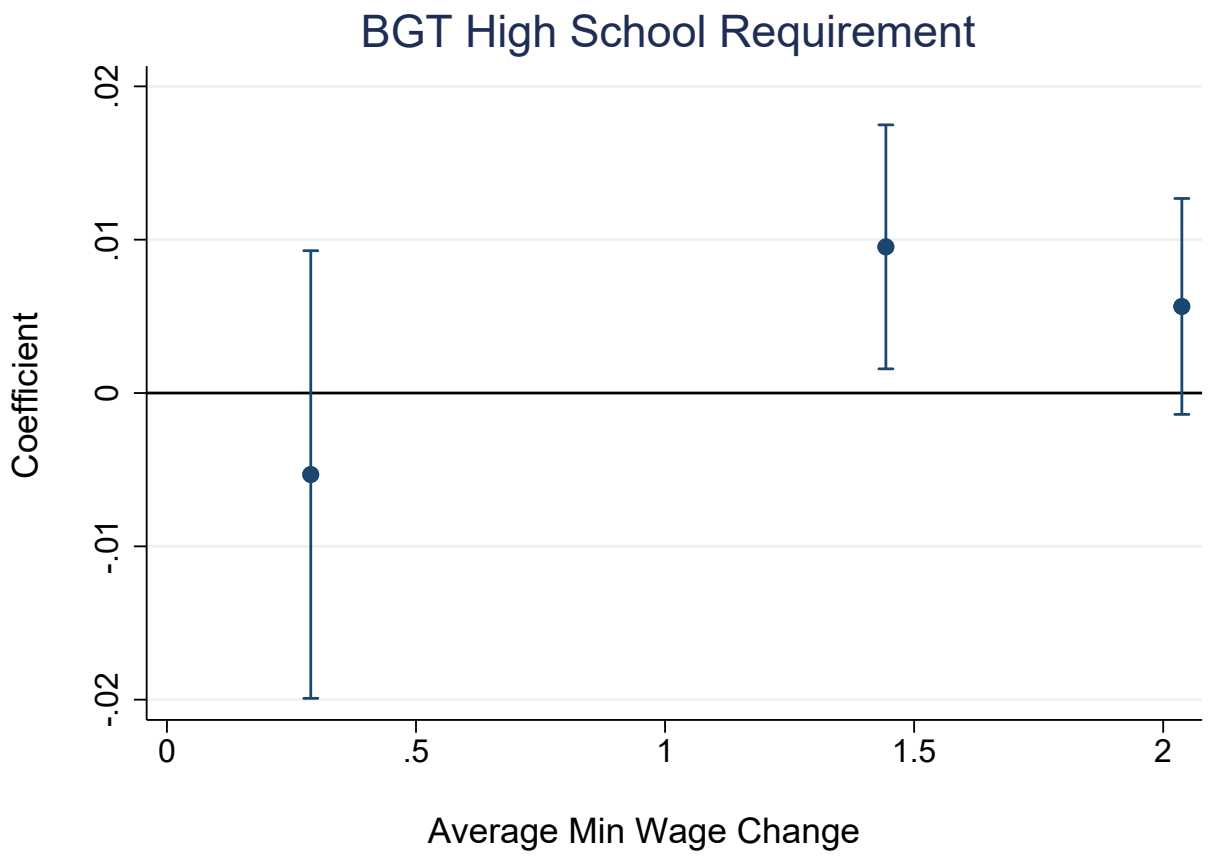

Figure 8: **Minimum Wage and Skill Requirements by Size of Minimum Wage Increase**
Note: The figure reports results of equation (1), allowing interactions between "after" and indicators for each tertile of state minimum wage increases over the full time period, with no change as the omitted category. We restrict to ads in low-wage occupations and estimate specifications with full controls in Burning Glass Technologies (BGT) data. We plot coefficients for the interaction terms on the average minimum wage change in each tertile.

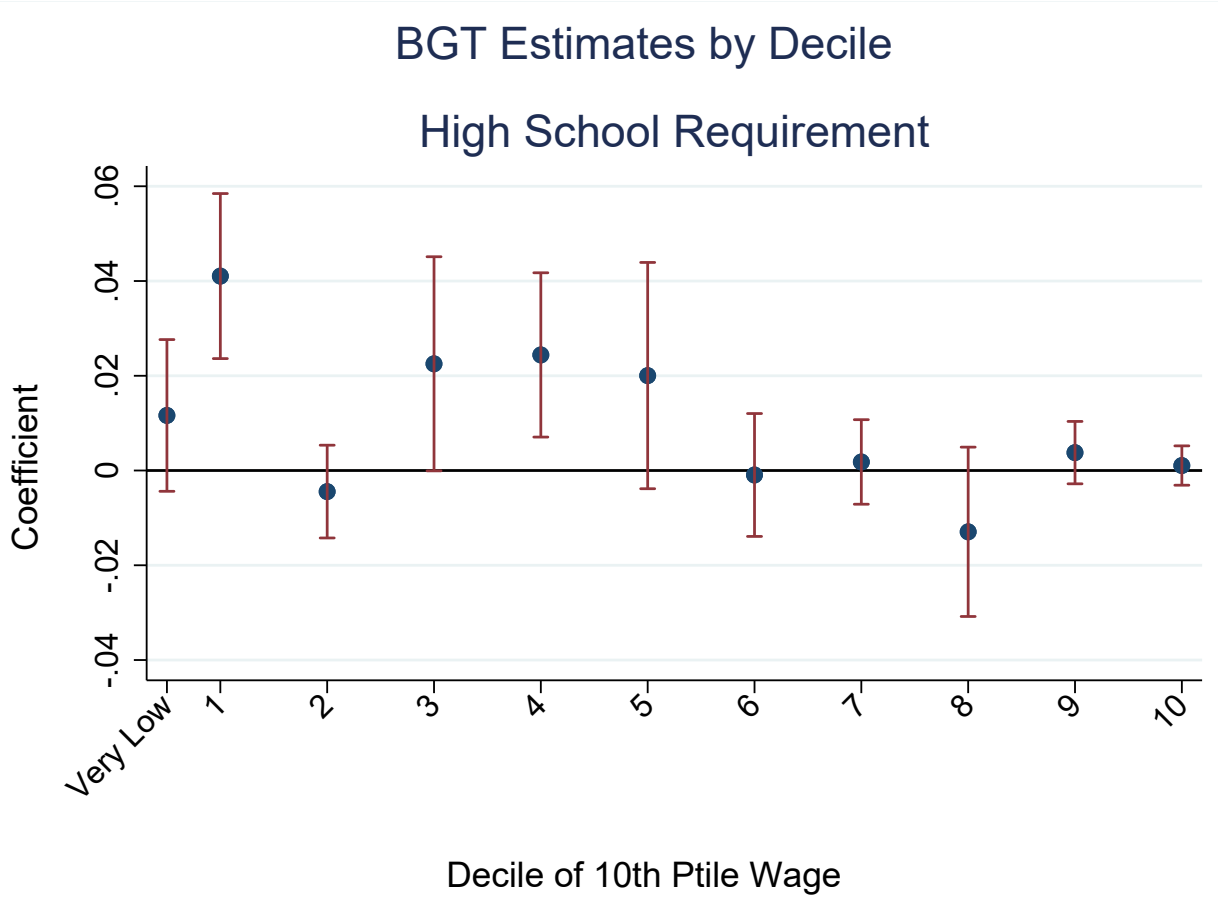

Figure 9: **Job Ad Skill Requireemnts across Deciles**
Note: The figure reports results of equation (1), estimated on Burning Glass Technologies (BGT) data separately by decile of their 10th percentile wage (the bottom decile is split into the lowest three occupations, "Very Low", and the remainder in the "Low" category). We include full controls in all regressions.

Table 1: **States with Minimum Wage Changes 2011-2016**

State	Total Change ($)	# Changes	Year of First Change
Panel A: Statutory Increasers			
Alaska	2.00	2	2015
Arkansas	0.75	2	2015
California	2.00	2	2014
Connecticut	1.35	3	2014
Delaware	1.00	2	2014
District of Columbia	3.25	3	2014
Hawaii	1.25	2	2015
Maryland	1.50	2	2015
Massachusetts	2.00	2	2015
Michigan	1.10	2	2015
Minnesota	1.75	2	2015
Nebraska	1.75	2	2015
New Jersey	1.13	2	2014
New York	1.75	3	2014
Rhode Island	1.60	2	2015
South Dakota	1.30	2	2015
Vermont	0.87	2	2015
West Virginia	1.50	2	2015
Mean	1.68	2.22	2014
Panel B: Inflation Indexers			
Arizona	0.70	4	2012
Colorado	0.95	5	2012
Florida	0.74	4	2012
Missouri	0.40	3	2013
Montana	0.70	4	2012
Ohio	0.70	4	2012
Oregon	0.75	4	2012
Washington	0.80	4	2012
Mean	0.72	3.99	2012
Overall mean	1.34	2.84	2014

Note: The table summarizes minimum wage changes among states that had any change between 2011 and 2016, distinguishing between minimum wage changes that are through statutory legislation (panel A) or because of inflation indexing (panel B). The first column lists the total change across the full time period. The second column lists the number of years within the time period where the July minimum wage of that year differed from the July minimum wage in the preceding year. The last column provides the year of the first minimum wage change within the time period. Rhode Island and Vermont were inflation indexers before their statutory legislation was enacted in 2015. For these states, we primarily focus on the statutory increases. Means are based on American Community Survey sample weights.

Table 2: **Description of Low-Wage Occupations**

Occupation (SOC code)	10th Ptile Wage	Effective Min Wage Change		
		10th Ptile	25th Ptile	50th Ptile
Panel A: Low Wage Occupations				
Food and Beverage Serving (3530)	$5.85	$1.27	$0.87	$0.30
Other Food Prep/Serving (3590)	$6.00	$1.34	$0.95	$0.39
Entertainment Attendants (3930)	$6.04	$1.16	$0.64	$0.01
Other Personal Care/Service (3990)	$6.40	$0.62	$0.03	$0
Cooks and Food Prep (3520)	$6.41	$0.90	$0.34	$0
Retail Sales (4120)	$6.57	$1.05	$0.47	$0
Animal Care and Service (3920)	$6.65	$1.03	$0.38	$0
Building Cleaning/Pest Control (3720)	$6.66	$0.80	$0.18	$0
Personal Appearance (3950)	$6.71	$0.94	$0.29	$0
Tour and Travel Guides (3970)	$6.74	$0.45	$0.09	$0
Baggage Porters/Bellhops/Concierges (3960)	$6.79	$0.38	$0.02	$0
Textile/Apparel/Furnishing (5160)	$7.13	$0.89	$0.28	$0
Panel B: Aggregated Occupation Groups				
Low-Wage Occupations	$6.39	$1.01	$0.47	$0.08
Modest-Wage Occupations	$8.17	$0.18	$0.05	$0.02
Medium-Wage Occupations	$10.83	$0.01	$0	$0
High-Wage Occupations	$18.52	$0	$0	$0
All	$11.40	$0.22	$0.09	$0.02

Note: We group occupations based on their decile of the 10th percentile wage distribution, as measured in the 2006 Occupational Employment Statistics (OES). "Low" wage occupations correspond to the bottom decile, "Modest" to the 2-4th deciles, "Medium" to the 5-7th deciles, and 'High" to the 8-10th deciles. Panel A lists each 4-digit occupation in the "Low" group, and the 10th percentile wage of that occupation in 2006 (from OES). We also provide the "Effective Minimum Wage Change", which gives the mechanical amount that wages need to increase from their 2011-13 average level to comply with 2016 minimum wage levels. Specifically, for state-occupation pairs, we calculate the gap between the OES 2013 wage and the minimum wage in 2016 (or impute zero if wages in 2013 are already above the eventual minimum wage in 2016), then average across states using OES employment weights. Panel B summarizes these estimates for each occupation group. We choose 2013 as the benchmark year because OES data reflect 3-year rolling averages and thus our benchmark year represents the 2011-2013 period.

Table 3: **Summary Statistics**

Occupation Group	Low	Modest	Middle	High
Panel A: ACS Variables				
Age	35.47	39.43	41.58	42.86
	(14.07)	(13.11)	(12.21)	(11.51)
Young adult (16-21)	0.211	0.0900	0.0358	0.0126
	(0.408)	(0.286)	(0.186)	(0.112)
Older adult (50+)	0.218	0.276	0.310	0.328
	(0.413)	(0.447)	(0.462)	(0.469)
High Dropout	0.175	0.126	0.0534	0.0146
	(0.380)	(0.332)	(0.225)	(0.120)
High or Some College	0.721	0.730	0.678	0.333
	(0.448)	(0.444)	(0.467)	(0.471)
Observations	1224134	2188901	1832915	2660420
Panel B: BGT Variables				
Any Education Requirement	0.304	0.462	0.549	0.692
	(0.184)	(0.217)	(0.210)	(0.174)
HS Requirement	0.260	0.366	0.366	0.154
	(0.154)	(0.198)	(0.212)	(0.183)
College Requirement	0.0248	0.0690	0.124	0.369
	(0.0575)	(0.121)	(0.163)	(0.234)
Any Experience Requirement	0.242	0.349	0.562	0.616
	(0.146)	(0.189)	(0.203)	(0.174)
Customer Service Requirement	0.483	0.392	0.410	0.355
	(0.334)	(0.254)	(0.277)	(0.248)
Non-Cognitive Skill Requirement	0.247	0.274	0.306	0.285
	(0.134)	(0.186)	(0.202)	(0.173)
Computer Requirement	0.0935	0.256	0.350	0.403
	(0.0946)	(0.206)	(0.223)	(0.204)
Cognitive Skill Requirement	0.138	0.206	0.293	0.397
	(0.109)	(0.153)	(0.198)	(0.214)
English Requirement	0.0965	0.117	0.0704	0.0724
	(0.0984)	(0.122)	(0.0947)	(0.0968)
Number of Cells	37402	88747	91347	98365
Number of Ads	5654233	6149536	5510750	8162036
Ads per Cell	151.2	69.3	60.3	83.0

Note: This table presents means and standard deviations (in parentheses) for key dependent variables, by occupation group. We group occupations based on their decile of the 10th percentile within-occupation wage distribution, as measured in the 2006 Occupational Employment Statistics. "Low", "Modest", "Medium", and "High" wage occupations correspond to the 1st, 2-4, 5-7, and 8-10 deciles, respectively. American Community Survey (ACS) variables are restricted to employed respondents and summarized using sample weights. Burning Glass (BGT) data on job vacancy postings are at the 4-digit occupation-state-date (year-month) level and summarized using the ad share of cell times OES state-occupation-year employment weights. Customer service, non-cognitive skill, computer, cognitive skill, and English requirements are defined in the manuscript; see Deming and Kahn (2018) for additional details.

Table 4: **ACS Worker Skills and Minimum Wages: Low Wage Occupations**

	Low Wage Occupations		
	(1)	(2)	(3)
Panel A:		Age	
Statutory*After	0.301***	0.259***	0.262***
	(0.0796)	(0.0741)	(0.0785)
Indexer*After	-0.108	-0.0927	-0.105
	(0.0809)	(0.0824)	(0.0786)
Panel B:		Young Adult (16-21)	
Statutory*After	-0.00886***	-0.00814***	-0.00972***
	(0.00229)	(0.00226)	(0.00265)
Indexer*After	0.00124	0.000746	0.00144
	(0.00337)	(0.00345)	(0.00288)
Panel C:		Older Adult (50-64)	
Statutory*After	0.00648***	0.00552***	0.00554**
	(0.00231)	(0.00204)	(0.00232)
Indexer*After	-0.00426	-0.00410	-0.00471
	(0.00338)	(0.00326)	(0.00295)
Panel D:		High School Dropout	
Statutory*After	-0.00622**	-0.00615**	-0.00589**
	(0.00293)	(0.00287)	(0.00270)
Indexer*After	0.00666**	0.00631**	0.00732***
	(0.00299)	(0.00304)	(0.00269)
Panel E:		High School or Some College	
Statutory*After	0.00710*	0.00745*	0.00482*
	(0.00370)	(0.00375)	(0.00278)
Indexer*After	-0.00247	-0.00210	-0.00294
	(0.00338)	(0.00332)	(0.00292)
Observations	1,224,134	1,224,132	1,224,132
Occ, State, and Year FE	Yes	Yes	Yes
Occ-by-Yr, Occ-by-State FE	No	Yes	Yes
Macroeconomic Controls	No	No	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. Each panel reports a different dependent variable for regressions of the form specified in equation 1. Observations are from the ACS 2011-16 waves, restricted to those age 16-64 who are employed in low-wage occupations (see table 2). "Statutory*After" ("Indexer*After") is an indicator equalling one if the state has any minimum wage increase through statutory legislation (inflation indexing) AND the current year is on or after the first such increase. Macroeconomic controls are the log of personal income, a housing price index, the employment rate in the state-year, an indicator for whether an ACA Medicaid expansion is in effect in the state-year, the expansion indicator interacted with an after 2013 indicator, and the health insurance market concentration for providers to large and small firms. Standard errors are clustered at the state level.

Table 5: **ACS Worker Skills and Minimum Wages: Higher Paying Occupations**

Occupation Group	Modest	Medium	High
		Wage Occupations	
	(1)	(2)	(3)
Panel A:		Age	
Statutory*After	0.107	0.0353	0.0571
	(0.0715)	(0.0521)	(0.0610)
Indexer*After	-0.184**	-0.0497	-0.0814
	(0.0769)	(0.0462)	(0.0516)
Panel B:		Young Adult (16-21)	
Statutory*After	-0.00243	-0.000737	-0.000727*
	(0.00177)	(0.00134)	(0.000425)
Indexer*After	0.00263	0.000832	-0.000664
	(0.00266)	(0.00109)	(0.000541)
Panel C:		Older Adult (50-64)	
Statutory*After	0.00186	0.00327	0.00398*
	(0.00223)	(0.00200)	(0.00220)
Indexer*After	-0.00576***	0.00130	-0.00219
	(0.00183)	(0.00212)	(0.00149)
Panel D:		High School Dropout	
Statutory*After	-0.000217	-0.00154	-0.000605*
	(0.00305)	(0.00115)	(0.000344)
Indexer*After	0.00763***	0.00296***	0.000843*
	(0.00247)	(0.000967)	(0.000463)
Panel E:		High School or Some College	
Statutory*After	-0.000428	0.00256	0.000996
	(0.00262)	(0.00305)	(0.00202)
Indexer*After	-0.00458*	-0.00614***	0.000629
	(0.00260)	(0.00228)	(0.00266)
Observations	2,188,897	1,832,908	2,660,420
Full Controls	Yes	Yes	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. See table 4. Column 1 restricts to workers employed in modest-wage occupations; column 2 restricts to medium-wage occupations; column 3 to high-wage (see Table 2 for definitions). Dependent variables are indicated in the panel headings.

Table 6: **ACS Effects on Extensive and Intensive Margins of Employment**

Occupation Group	Low	Modest	Medium	High
			Wage Occupations	
	(1)	(2)	(3)	(4)
Panel A:		Employment Probability in the Population		
Statutory*After	0.00121*	-0.00275**	0.00134	0.000529
	(0.000714)	(0.00119)	(0.000954)	(0.00125)
Indexer*After	-0.00101	0.00201**	0.00166	0.00124
	(0.000742)	(0.000961)	(0.00133)	(0.00111)
Observations	11,936,824	11,936,824	11,936,824	11,936,824
Panel B:		Employment Share among the Employed		
Statutory*After	0.00159	-0.00387***	0.00189	0.000228
	(0.00103)	(0.00118)	(0.00126)	(0.00166)
Indexer*After	-0.00253*	0.00136	0.00100	1.17e-05
	(0.00148)	(0.000995)	(0.00167)	(0.00147)
Observations	7,939,968	7,939,968	7,939,968	7,939,968
Panel C:		Usual Hours Worked Conditional on Employment		
Statutory*After	-0.0683	-0.0408	-0.0614	-0.00539
	(0.110)	(0.0704)	(0.0707)	(0.0501)
Indexer*After	-0.0353	0.0970	-0.00957	-0.0429
	(0.0977)	(0.0724)	(0.0740)	(0.0509)
Observations	1,224,134	2,188,901	1,832,915	2,660,420
Panel D:		Weeks Worked Conditional on Employment		
Statutory*After	0.196**	0.00504	0.00639	-0.0643**
	(0.0848)	(0.0665)	(0.0393)	(0.0281)
Indexer*After	-0.121	0.0512	0.0876*	0.0519
	(0.122)	(0.0650)	(0.0455)	(0.0312)
Observations	1,224,134	2,188,901	1,832,915	2,660,420
Full Controls	Yes	Yes	Yes	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. See Table 4. The table reports estimates of Equation (1). The dependent variable in panel A is an indicator equalling 1 if the individual is employed in the indicated occupation group and zero otherwise – column 1 is Low, column 2 modest, column 3 medium, column 4 high wage occupations (see table 2). It is estimated on the full American Community Survey sample (age 16-64). In panels B, C and D, the samples are restricted to employed individuals. Panel B estimates employment shares for the indicated occupation group, within the sample of employed. Panels C and D estimate hours and weeks worked conditional on employment in the indicated occupation group. Because the dependent variables in this table involve employment, we exclude the aggregate employment rate in the control set, as well as all controls involving occupation fixed effects, but include all other controls from column 4 of table 4.

Table 7: **BGT High School Requirements and Minimum Wages**

Dependent Variable	High School Diploma Requirement		
	(1)	(2)	(3)
Panel A:	Low-wage occupations		
Statutory*After	0.0186**	0.0200**	0.0322***
	(0.00733)	(0.00779)	(0.00731)
Indexer*After	-0.00558	-0.00604	-0.00412
	(0.0182)	(0.0180)	(0.0194)
Observations	37,402	37,402	37,402
Panel B:	Modest-wage occupations		
Statutory*After	0.0159**	0.00947	0.00694
	(0.00648)	(0.00602)	(0.00657)
Indexer*After	-0.00298	-0.00287	-0.00225
	(0.00772)	(0.00809)	(0.00866)
Observations	88,747	88,711	88,711
Panel C:	Medium-wage occupations		
Statutory*After	0.00775	0.00669	0.00972*
	(0.00537)	(0.00580)	(0.00526)
Indexer*After	-0.0177**	-0.0179**	-0.0163*
	(0.00866)	(0.00841)	(0.00918)
Observations	91,347	91,339	91,339
Panel D:	High-wage occupations		
Statutory*After	0.000870	0.00384	-0.00380
	(0.00635)	(0.00663)	(0.00460)
Indexer*After	-0.0130*	-0.0127*	-0.0152***
	(0.00703)	(0.00664)	(0.00506)
Observations	98,365	98,364	98,364
Occ, State, and Date FE	Yes	Yes	Yes
Occ-by-Date, Occ-by-Date FE	No	Yes	Yes
Macroeconomic Controls	No	No	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. We report results for regressions of the form specified in Equation 1, for occupation-state-date (year-month) observations in the 2011-2016 waves of Burning Glass Technologies (BGT) job vacancy data. Each panel reports results for a different occupation group (see Table 2). The dependent variable is the probability that an ad has a high school diploma requirement.

Table 8: **BGT High School Requirements and Minimum Wages: Firm Fixed Effects**

	High School Diploma Requirement			
	(1)	(2)	(3)	(4)
Panel A:	Low Wage Occupations			
Statutory*After	0.0322***	0.00988**	0.0119**	0.0108**
	(0.00723)	(0.00491)	(0.00566)	(0.00493)
Indexer*After	-0.00412	-0.00913	0.000280	-0.00534
	(0.0192)	(0.00812)	(0.00860)	(0.00565)
Observations	917,892	917,892	911,839	911,627
Full Controls	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	Yes	Yes	Yes
Firm-by-State FEs	No	No	Yes	Yes
Firm-by-Year FEs	No	No	No	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. We report results for regressions of the form specified in Equation 1, for occupation-state-date-firm observations in the 2011-2016 waves of Burning Glass Technologies (BGT) job vacancy data, restricted to ads posted in low-wage occupations. Observations are weighted by the ad share within state-occupation-date times OES occupation-state-year employment.

A Appendix Tables and Figures

Table A.1: **Worker Skills/Requirements and Minimum Wages: Linear Specification**

	Low Wage Occupations		
	(1)	(2)	(3)
Panel A:	ACS – Age		
Minimum Wage	0.218***	0.183***	0.160**
	(0.0635)	(0.0618)	(0.0707)
Panel B:	ACS – Young Adult (16-21)		
Minimum Wage	-0.00574***	-0.00512***	-0.00632***
	(0.00188)	(0.00189)	(0.00180)
Panel C:	ACS – Older Adult (50-64)		
Minimum Wage	0.00421**	0.00334**	0.00227
	(0.00163)	(0.00148)	(0.00174)
Panel D:	ACS – High School Dropout		
Minimum Wage	-0.00373	-0.00352	-0.00282
	(0.00248)	(0.00240)	(0.00210)
Panel E:	ACS – High School or Some College		
Minimum Wage	0.00464	0.00473	0.00228
	(0.00295)	(0.00292)	(0.00212)
Observations	1,224,134	1,224,132	1,224,132
Panel F:	BGT – High School Diploma Requirement		
Minimum Wage	0.0104	0.0113*	0.0136*
	(0.00637)	(0.00649)	(0.00682)
Observations	37,402	37,402	37,402
Occ, State, and Date FE	Yes	Yes	Yes
Occ-by-Date, Occ-by-Date FE	No	Yes	Yes
Macroeconomic Controls	No	No	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. See tables 4 and 7. Panels A-E present ACS results on the skill of workers employed in low-wage occupations. Panel F presents results on the high school diploma requirement in BGT for low-wage occupations.

Table A.2: **ACS Worker Demographics and Minimum Wages**

Occupation Group	Low	Modest	Medium	High
		Wage Occupations		
	(1)	(2)	(3)	(4)
Panel A:		Black		
Statutory*After	0.00203	-0.00235	0.00298***	0.000926
	(0.00173)	(0.00225)	(0.00103)	(0.00134)
Indexer*After	0.00770***	0.00252	-0.000498	3.26e-05
	(0.00220)	(0.00154)	(0.00139)	(0.00129)
Panel B:		Hispanic		
Statutory*After	0.000224	0.00195	-0.000579	-0.000783
	(0.00249)	(0.00155)	(0.00250)	(0.00141)
Indexer*After	-0.000594	0.00593*	0.00384	0.00182
	(0.00270)	(0.00340)	(0.00347)	(0.00335)
Panel C:		Female		
Statutory*After	4.17e-05	-0.00119	0.000308	-0.00240
	(0.00292)	(0.00135)	(0.00199)	(0.00160)
Indexer*After	-0.00238	-0.00455	0.00329**	-0.00216
	(0.00288)	(0.00365)	(0.00156)	(0.00187)
Panel D:		Foreign Born		
Statutory*After	0.00378	0.00340	0.00208	-0.000723
	(0.00389)	(0.00295)	(0.00193)	(0.00180)
Indexer*After	-0.00385	0.00479	0.00500	-0.00334**
	(0.00313)	(0.00321)	(0.00449)	(0.00164)
Panel E:		Migrated from Another State		
Statutory*After	-0.00188	-0.00156*	-0.000853	-0.00216**
	(0.00117)	(0.000905)	(0.000757)	(0.000994)
Indexer*After	0.00168	0.00357***	0.000696	0.000178
	(0.00123)	(0.00127)	(0.00113)	(0.00109)
Observations	1,224,132	2,188,897	1,832,908	2,660,420
Full Controls	Yes	Yes	Yes	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. Column 1 restricts to workers employed in low-wage occupations; column 2 to modest-wage occupations; column 3 to medium-wage occupations; column 4 to high-wage (see table 2 for definitions). Outcomes are the share of worker employed in the indicated occupation group who belong to the group indicated in the panel heading. See Table 4.

Table A.3: **BGT Skill Requirements and Minimum Wages**

Occupation Group	Low	Modest	Medium	High
		Wage Occupations		
	(1)	(2)	(3)	(4)
Panel A:		College Requirement		
Statutory*After	0.000755	0.000686	0.00209	0.0115*
	(0.00191)	(0.00165)	(0.00293)	(0.00679)
Indexer*After	-0.000282	-0.00213	-0.00310	0.00418
	(0.00153)	(0.00281)	(0.00414)	(0.00554)
Panel B:		Any Experience Requirement		
Statutory*After	0.00666	-0.00867	-0.00571	0.00562
	(0.00953)	(0.00704)	(0.00393)	(0.00653)
Indexer*After	-0.00937	-0.00588	-0.00462	-0.00301
	(0.0120)	(0.00694)	(0.0124)	(0.0135)
Panel C:		Customer Service Skill Requirement		
Statutory*After	0.0193**	0.00305	0.00717*	0.00186
	(0.00725)	(0.00453)	(0.00394)	(0.00539)
Indexer*After	-0.00108	0.00462	-0.00626	-0.00199
	(0.00634)	(0.00562)	(0.00762)	(0.00510)
Panel D:		Non-Cognitive Skill Requirement		
Statutory*After	-0.00220	0.00391	-0.00134	0.0108**
	(0.00570)	(0.00342)	(0.00455)	(0.00452)
Indexer*After	0.00525	-0.00295	0.000447	-0.000113
	(0.00839)	(0.00470)	(0.00623)	(0.00873)
Panel E:		English Requirement		
Statutory*After	0.00200	0.00236	-0.00423*	-0.00820
	(0.00664)	(0.00614)	(0.00249)	(0.00696)
Indexer*After	0.000201	-0.00193	0.000622	-0.00370
	(0.00907)	(0.00495)	(0.00335)	(0.00482)
Panel F:		Computer Requirement		
Statutory*After	-0.00875*	0.00904*	-0.00130	0.00565
	(0.00457)	(0.00534)	(0.00609)	(0.00488)
Indexer*After	-0.000227	0.00182	0.0112	0.00480
	(0.00723)	(0.00874)	(0.0118)	(0.00931)
Panel G:		Cognitive Skill Requirement		
Statutory*After	-0.0155**	-0.000678	0.0106**	0.00225
	(0.00607)	(0.00363)	(0.00498)	(0.00357)
Indexer*After	0.00180	0.00240	-0.00170	0.00152
	(0.00681)	(0.00779)	(0.00698)	(0.00786)
Observations	36,900	87,588	89,868	97,518
Full Controls	Yes	Yes	Yes	Yes

Note: *, **, and *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels respectively. Column 1 restricts to workers employed in low-wage occupations; column 2 to modest-wage occupations; column 3 to medium-wage occupations; column 4 to high-wage (see table 2 for definitions). Outcomes are the ads for the indicated occupation group that require the skill indicated in the panel heading using Burning Glass Technologies (BGT) data. Customer service, non-cognitive skill, computer, cognitive skill, and English requirements are defined in the manuscript; see Deming and Kahn (2018) for additional details.