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The Low-Skilled Labor Market from 2002 to 2014: Measurement and Mechanisms

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Abstract:

I analyze the evolution of the U.S. labor market from 2002 to 2014. The Great Recession's employment declines fell disproportionately on groups with low levels of observable skills. Compositional changes lead averages to obscure downward movement in real wages over this time period. Traditional measures of wage inequality similarly tend to understate the relative decline in low-skilled individuals' labor market opportunities. To understand the low-skilled labor market's deterioration, I construct wage and employment counterfactuals that capture the distinctive predictions of leading institutions- and markets-centric viewpoints. Institutions-centric counterfactuals, which emphasize weaknesses in workers' bargaining positions, predict that this period's minimum wage increases would have significantly increased the number of low-skilled individuals with wage rates near or below the minimum wage. The data are inconsistent with this prediction. By contrast, counterfactuals that emphasize the effects of trade, technology, and other competitive market forces are able to match long-run employment changes. My framework highlights that the minimum wage's effects evolve with labor market conditions. In addition to their relatively direct effects, labor replacing developments in trade and technology exacerbate the minimum wage's effects on employment. Importantly, this observation holds whether labor markets are competitive or subject to significant bargaining frictions at baseline.

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A long literature uses detailed wage and employment data to describe and attempt to understand the labor market's evolution (Katz and Murphy, 1992; Juhn et al., 1993; DiNardo et al., 1996; Autor et al., 2003, 2008; Beaudry et al., 2013). This paper presents data on wage distributions across industries and skill groups with a similar aim. I focus primarily on individuals with low levels of experience and education, whose outcomes deteriorated markedly between 2002 and 2014.

I make two primary contributions. I first show that the employment and wage rates of low experience, low education individuals deteriorated more dramatically during the Great Recession than is widely recognized. Second, I use the wage distribution's evolution to examine the predictions of alternative views of the labor market. These alternative views generalize the canonical monopsony and competitive market models' textbook intuitions. An assessment of these viewpoints' relevance can be important for the design of policies intended to improve low-skilled individuals' outcomes; this is particularly true of the minimum wage, which plays a prominent role throughout the analysis.

I begin by describing the evolution of the wage distribution across the full working-age population. During the Great Recession, changes in selection into employment obscure significant shifts in the real wage distribution. In a strong form of the composition bias analyzed by Solon et al. (1994), average real wages *grew* during the 2006 to 2010 housing decline and *declined* during the preceding expansion and post-recession recovery. The increase in average real wages between 2006 and 2010 reflects the magnitude of employment declines at the labor market's lower end. I show that, in fact, the real wage distribution across low-skilled individuals shifted significantly downward over this time period. By contrast, employment among those with high experience and education levels declined moderately, while their real wage distribution was relatively stable.

To interpret the wage distribution's evolution, the literature has long emphasized a

traditional set of supply side, demand side, and institutional forces. Traditional supply side forces include educational attainment (Goldin and Katz, 2009), demographics (Card and Lemieux, 2001; Fortin, 2006), and immigration (Borjas and Katz, 1997; Card, 2009). Demand side forces are headlined by technology (Katz and Murphy, 1992; Autor et al., 2003; Acemoglu and Autor, 2011) and competition for domestic labor through trade (Murphy and Welch, 1991; Autor et al., 2013, 2016). Institutional forces include factors that shape firm-worker bargaining, such as labor unions and the minimum wage (Lee, 1999; DiNardo et al., 1996; Card, 2001).

Economists have turned attention to additional economic forces in the context of the Great Recession and subsequent recovery. While analyses of the wage distribution commonly take full employment perspectives, the Great Recession has increased interest in business cycle considerations (Hall, 2014; Aaronson et al., 2014). Finally, this period's policy developments, including unemployment insurance extensions and the Affordable Care Act, have elevated interest in social insurance and redistributive programs (Mulligan, 2012b, 2014).

I develop a descriptive framework that embeds these broad classes of explanations for recent labor market developments. My framework builds from the basic observation that wage distributions result from transactions between workers and firms. An individual works, and thus realizes a non-zero wage, when a firm's offer exceeds his or her reservation wage. Firms' wage offers, in turn, may reflect a combination of competitive market forces and bargaining institutions.¹ The framework highlights the fact that understanding the relative roles of market and institutional forces is essential for assessing the effects of a binding minimum wage.

In order to gauge the relative roles of market and institutional forces, one must de-

¹The framework in Bound and Johnson (1992), which is also developed for the purpose of analyzing developments in the structure of wages, similarly highlights the distinction between market and institutional forces as a first-order division for classifying potential sources of change in labor market outcomes.

velop and test their distinctive predictions. My framework elucidates the following predictions of these viewpoints. When the minimum wage rises, institutions-centric views predict increases in the number of workers making wage rates near or below the new minimum (Harasztosi and Lindner, 2015).² A high minimum wage mechanically affects firms' wage offers to a relatively large fraction of prospective workers. Further, the institutions-centric view is, as in the textbook monopsony model, a view in which minimum wage increases may increase low-wage employment. Declines in low-skilled workers' wages driven by declines in their bargaining power have a similar implication for this aspect of the wage distribution; when eroding bargaining power depresses wages, the number of workers making near or below the minimum will tend to rise.

Markets-centric views have predictions quite different from those of institutions-centric views. As in the textbook model of competitive firms, markets-centric views predict that binding minimum wage increases reduce employment. Similarly, when forces like trade or technology push the expected value of an individual's output below the minimum wage, the individual ceases to receive employment offers. In contrast with institutions-centric views, markets-centric views predict that these developments will have little effect on the number of workers with wages near or below the statutory minimum.

I test these predictions over both short and long run time horizons. The primary challenge involves constructing counterfactual wage and employment distributions from observed labor market outcomes. The observed wage data motivate a simplifying assumption about the counterfactual changes of interest. From period to period, low-skilled groups' wage distributions shift roughly by a constant. That is, the changes in wage rates at low percentiles of low-skilled groups' wage distributions are of nearly the same

²See Saez (2010) and Chetty and Saez (2013) for early applications of "bunching" insights in the context of the tax literature.

dollar amount as the changes observed at high percentiles. The assumption I maintain is thus an assumption of parallel shifts in the within-skill-group distributions of productivity, output prices, and bargaining power.³

Turning to the data, I find that the fraction of individuals with wage rates near or below the minimum wage changed little from 2002 to 2014 in spite of substantial minimum wage increases and stagnant nominal wages within low-skilled groups. Among individuals ages 16 to 30 with less than a high school degree, just over 8 percent were employed at wage rates within 50 cents of or below the minimum wage in 2002. In 2014, the comparable figure was just under 9 percent. Institutions-centric counterfactuals predict increases on the order of 10 percentage points and are thus inconsistent with this feature of the data. The divide between the data and the institutions-centric counterfactual is robust to a variety of modifications to the assumptions underlying the counterfactual's construction. Counterfactuals involving slightly more experienced workers differ less dramatically, though still substantially, from the institutions-centric view's predictions. This improvement in the institutions-centric view's performance suggests that bargaining considerations may play a more prominent role outside of entry and near entry level positions.

The absence of a substantial increase in the fraction of individuals with wage rates near or below the statutory minimum results from declines in low-skilled individuals' employment. From 2002 to 2014, the employment rate among individuals ages 16 to 30 with less than a high school education declined by 13 percentage points.⁴ This decline

³More precisely, I make this assumption about the relevant product of these parameters.

⁴As noted in Clemens (2015), this decline does not primarily reflect a shift between employment and schooling among teenagers. The employment rate among dropouts ages 21 to 25 also declined by 13 percentage points from 2002 to 2014. Among those ages 16 to 24, Clemens and Wither (2014a) show that, from pre- to post-recession, there is no correlation between changes in employment and school enrollment rates across age, sex, and race/ethnicity groups. Further, because the national labor market was at similar tightness in 2014 and 2002, this long run decline in low-skilled individuals' employment should be viewed as a structural rather than cyclical phenomenon.

is within 3 percentage points of the long-run employment predictions of the markets-centric counterfactuals.

These findings complement the large body of research on the economic forces underlying the wage distribution's evolution. Analyses emphasizing the roles of technology and trade have two implications of interest. First, labor replacing developments in trade and technology exacerbate the employment effects of a given minimum wage.⁵ Second, these forces may induce voluntary labor force exit by driving firms' wage offers below individuals' reservation wage rates. Wage and employment patterns suggest that both of these mechanisms played important roles in reducing low-skilled individuals' employment over this time period.

The paper proceeds as follows. Section 1 describes the data I use and presents the evolution of wage distributions across the working age population as well as for specific skill groups. Section 2 considers how the changing composition of employment affects measures of average wages and skill premia. Section 3 describes the evolution of wage distributions across industries. Section 4 presents a framework for assessing how a variety of economic forces may shape the wage distribution's evolution. Section 6 describes my approach to constructing counterfactuals and develops distinctive predictions of the markets- and institutions-centric views of the labor market. Section 7 contrasts the data with the markets- and institutions-centric counterfactuals. Section 8 considers several economic forces' potential contributions to low-skilled individuals' employment declines. Section 9 concludes.

⁵Note that this observation holds whether the labor market is competitive or monopsonistic at baseline. In both textbook diagrams, as well as in my descriptive framework, the employment maximizing wage declines as the value of workers' potential output declines.

1 The Wage Distribution's Recent Evolution

This section provides a descriptive look at the evolution of employment and wage distributions across the working-age population. Its first subsection describes the data and sample selection procedures I employ. Its second subsection presents wage distributions for the full working age population. Its third subsection describes the evolution of wage distributions across skill groups. Its fourth subsection describes the minimum wage's relevance at the wage distribution's lower tail.

1.1 Wage Data from the Current Population Survey

I present wage distributions constructed using data from the Merged Outgoing Rotation Groups of the Current Population Survey (CPS-MORG). Specifically, I use the CPS-MORG files as processed by the National Bureau of Economic Research (NBER). When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as weekly earnings divided by hours ("earnwke/hours").

For most of this paper's analysis, I present wage distributions for states that were fully or close to fully bound by the federal minimum wage increases enacted between 2007 and 2009. Graphical presentations of these states' wage distributions are informative in part because they shared a common minimum wage and because their minimum wage increases were concentrated over a small number of years. This sample of states is the same as the sample of "bound" states, as analyzed in Clemens and Wither (2014b) and Clemens (2015).⁶ Towards the paper's conclusion, I show that my core findings

⁶Specifically, the designation is based on whether a state's January 2008 minimum wage was less than \$6.55, rendering it partially bound by the July 2008 increase from \$5.85 to \$6.55 and fully bound by the July 2009 increase from \$6.55 to \$7.25. In practice, these states were fully or close to fully bound by each increment in the federal minimum wage's rise from \$5.15 to \$7.25. On average across these states, which account for just over two-fifths of the U.S. population, the effective minimum wage rose by \$2.04 over the

apply to the full sample of states including Washington, DC.

After constructing nominal wage rates, I take the following steps to generate the presented wage distributions. Within each calendar year, I sort individuals according to their wage rates, with unemployed individuals assigned wage rates of 0. For graphical presentations, I divide the individual-level wage rates for each year into 500 quantiles using the CPS's population weights.⁷ To construct real wage rates, I convert nominal wage rates into constant, July 2009 dollars using the Consumer Price Index (CPI).

In addition to presenting full-population wage distributions, I present wage distributions specific to skill groups and/or industries. The division of workers across skill groups follows the division in Clemens (2015), which is based on the extent to which this period's minimum wage increases bound each skill group's wage distribution. The "Least Skilled" group consists of individuals ages 16 to 30 with less than a high school education. The "Middle Skilled" group consists of individuals ages 16 to 30 with exactly a high school education and individuals ages 31 to 64 with less than a high school education. The "Highest Skilled" group consists of all other individuals between ages 16 and 64, which includes all individuals with at least some college education and relatively experienced individuals with exactly a high school education. In 2002, these groups accounted for 8.7, 29.2, and 62.1 percent, respectively, of the working age population in the samples from "bound" states.

My division of workers across industries is quite broad. A first group consists of retail and wholesale trade industries, which I label Broad Trade (industries for which the first digit of the variable "indo2" is either a 4 or 5). A second group consists of food service establishments, which I label Food Service (industries for which the variable "indo2" equals 8680). A third group contains a variety of goods producing industries, which I

relevant time period.

⁷For the state-specific analysis I divide wage rates into 100 quantiles.

label Construction and Manufacturing (industries for which the variable “*indo2*” equals 0770 or for which the first digit of “*indo2*” is either a 2 or 3). A final group contains the complement of the groups just described. I label this group All Other.

1.2 The Distribution of Wages across All Working Age Individuals

Figure 1 presents the distribution of wages across the full population ages 16 to 64 in the years 2002, 2006, 2010, and 2014. The distributions thus provide views of the labor market prior to the housing bubble, near the housing bubble’s peak, near the labor market’s post-recession nadir, and four years further into the recovery. Panel A presents constant-dollar wage rates while Panel B presents wage rates in nominal terms.

A noticeable feature of the real wage distributions is how little they shift across years. The upper half of the wage distribution is essentially unmoved from one period to the next. The lower half of the wage distribution shifts moderately downward over time. The panels of figure 2 display segments of these distributions at higher scale. Panel A shows that the 25 highest percentiles of the real wage distribution shift little from 2002 to 2014. In panel B, a slight downward shift is detectable by around the 30th percentile. Panels C and D reveal that between 2002 and 2014 the real wage distribution shifted down by more than \$1 per hour for all employed percentiles beyond the 45th.

The data in figures 1 and 2 also provide information about the evolution of paid employment (i.e., employment at non-zero wage rates). After exhibiting stability from 2002 to 2006, the paid employment rate declined by between 5 and 6 percentage points from 2006 to 2010. It recovered by roughly 2 percentage points between 2010 and 2014.

1.3 The Evolution of Wage Distributions across Skill Groups

Figures 3 and 4 present the evolution of real and nominal wage distributions separately across skill groups. In each figure, panel A presents wage distributions across

the Least Skilled individuals, namely those ages 16 to 30 with less than a high school education. Panel B presents distributions for individuals ages 31 to 45 with less than a high school education. Panels C and D present distributions for the Middle Skilled and Highest Skilled individuals as defined in section 1.1.

There is a substantial difference between the evolution of low-skilled groups' employment and wages relative to high-skilled groups' employment and wages. Between 2006 and 2010, employment among the Least Skilled group declined by 12 percentage points, which was nearly 30 percent of its level in both 2002 and 2006. This group's employment exhibited no sign of recovery between 2010 and 2014. By contrast, employment among members of the Middle Skilled group declined by 6 percentage points (just under 10 percent) between 2006 and 2010, while employment among members of the Highest Skilled group declined by 4 percentage points (just under 5 percent). Between 2010 and 2014, these higher-skilled groups' employment rates recovered roughly one fourth of their 2006 to 2010 losses. Panel B of Table 1 presents tabulations of these skill groups' employment rates that include those who report working with no earnings.

Skill groups' wage distributions shift as the full population distributions might lead one to predict. Between 2006 and 2010, the Least Skilled group's real wage distribution shifted downward by \$1.42 at all percentiles at which individuals were employed in both years. This is nearly a 15 percent decline relative to the group's average wage in 2002. While the wage distributions of the Middle Skilled and Highest Skilled groups appear to shift little, there are again hints of downward movement at relatively low-wage percentiles. Figure 5 shows that the lower ends of the Middle Skilled and Highest Skilled wage distributions did indeed shift down in real terms.

1.4 The Minimum Wage's Footprint

The distributions in figures 3, 4, and 5 provide visual evidence that the minimum wage has significantly shaped low-skilled individuals' wages between 2002 and 2014. Wage rates towards the top of the Least Skilled group's wage distribution shifted significantly down over this time period.⁸ Note that the 2002 and 2006 wage distributions show that many low-skilled individuals had reservation wage rates below \$7.25 in 2010 dollars. Such wage rates could not be offered in 2010 following the increase in the federal minimum wage. These low-skilled individuals' wage rates were thus legislatively bound to rise at a time when slightly higher-skilled individuals' wage rates shifted down. Finally, the 2014 wage distribution reveals employment at real wage rates that could not be offered in 2010. That is, there is employment at wage rates made legal by the erosion of the minimum wage's real value.

2 Compositional Shifts and Average Wage Measurement

Over the period under study, employment declined moderately among individuals in high-skilled groups and dramatically among individuals in low-skilled groups. This section considers the implications of across- and within-group compositional shifts for the measurement of average wage changes. The average wage, as measured using the CPS, is a commonly cited metric in discussions of aggregate labor market performance. This measure closely tracks the wage and salary component of the Employment Cost Index (ECI), which is regularly cited by the Federal Open Market Committee in discussions of the labor market's contribution to inflationary pressures (Board of Governors of the Federal Reserve System, 2011). The potential relevance of composition effects to

⁸A body of evidence points to important roles for changes in trade and technology, temporarily offset by the housing boom (Beaudry et al., 2013), as causes of these declines.

these aggregate wage measures was early noted by Stockman (1983) and subsequently quantified by Solon et al. (1994).⁹

Standard measures of average nominal wages exhibited fairly stable growth during the Great Recession. Given this period's substantial employment declines, a greater degree of downward wage flexibility might have been expected. Figure 6 presents 4-quarter changes in three series including the ECI and the average wage in the CPS. Over each 4-quarter period ending between 2003 and 2014, growth in the wage and salary component of the ECI was between 1.5 and 3.5 percent. The average wage conditional on employment, as measured using CPS data, exhibits a bit more variability over time. It exhibits somewhat higher growth during the housing market's upswing as well as during the first two years of its decline.

Table 1 contains several facts that are relevant for assessing the implications of compositional shifts for the evolution of average wage measures between 2002 and 2014. Panel A shows that, conditional on employment, average real wages declined more within each broad skill group than for the working age population as a whole. Across all skill groups, the average real wage declined by \$0.10 between 2002 and 2014, as reported in column 8. Among the Least Skilled workers the comparable figure is \$0.30. The decline was \$0.48 among the Middle Skilled workers and \$0.37 among the Highest Skilled workers. The population weighted average across these broad groups declined by \$0.40, or \$0.31 more than the decline for the population considered jointly. This results from the significant decline in the Least Skilled group's share of total employment.

The intermediate wage changes described in columns 5 through 7 provide further evidence on the relevance of compositional effects. Specifically, they show that the average real wage across the full working age population *increased* during the Great Recession

⁹The potential relevance of composition effects for interpreting recent labor market trends was recently discussed, though not quantified, by (Kudlyak et al., 2015).

and *decreased* during the preceding expansions and subsequent recovery. The \$0.34 increase in average wages across the full population is another bi-product of the fact that the Least Skilled group became a significantly smaller fraction of total employment over this time period. Finally, note that average wage growth was faster during the housing decline than during the recovery even within these skill groups. Within-group compositional effects are thus likely important.

Panel C presents data on the potential magnitude of within-group compositional effects. The exercise undertaken is as follows. For each group considered, I identify the lowest percentile of workers employed at a positive wage rate in 2002, 2006, 2010, and 2014. I then calculate the average wage for individuals at that and higher wage percentiles. This generates what I term the average wage at continuously employed percentiles.

If employment losses occur exclusively among individuals at the lowest percentiles of a given skill group, the average wage at continuously employed percentiles adjusts perfectly for composition. It is likely, however, that at least some job loss occurs among individuals whose wage rates would have placed them higher in the wage distribution. When this is the case, changes in the average wage at continuously employed percentiles will overstate the changes that would be associated with a truly fixed population. The wage changes reported in panels A and C can thus be viewed as upper and lower bounds on fully compositionally adjusted wage changes.

Average wages at continuously employed percentiles declined substantially for each skill group between 2006 and 2010. Across the full working age population, this measure declined by \$0.64 between 2006 and 2010 and by \$0.74 (nearly 4 percent) between 2002 and 2014. Among members of the Least Skilled group, the average real wage at continuously employed percentiles declined by \$1.71, or roughly 15 percent, between 2002 and 2014.

Panel A of Figure 6 shows that the average wage across continuously employed percentiles exhibited much more downward flexibility following the recession than did either the average wage conditional on employment or the wage and salary component of the ECI. Panel B shows that the cumulative rise in the average wage across continuously employed percentiles was 5 percent less than the rise in these other measures between early 2008 and 2011. Inflationary pressures, as manifested in the labor market, may thus have been as much as 1 percentage point lower per year over this time period than one would have inferred from standard ECI and CPS average wage measures.

Finally, within-skill-group compositional shifts can have implications for wage premia analyzed in the literature on inequality's evolution. From 2002 to 2014, for example, the Least Skilled workers' average wage declined by 3.2 log points while the Highest Skilled workers' declined by 1.2 log points. The data on wages at continuously employed percentiles suggest a much larger decline in the Least Skilled group's relative wage rates. By this measure, the Least Skilled group's average wage declined by 17.2 log points while the Highest Skilled group's average wage declined by 4.6 log points. Similarly, while the traditionally measured college wage premium declined marginally, the premium computed using wage rates at continuously employed percentiles increased by 2 log points from 2002 to 2014 and by 5 log points from 2006 to 2010.

3 The Evolution of Wage Distributions across Industries

Figures 7, 8, 9, 10, and 11 present data on industry-specific employment and wage distributions for both the working age population as a whole and for individuals in the Least Skilled group. In figures 7, 8, 9, and 11, Panels A and C present wage distributions for the working age population as a whole. Panels B and D present distributions specific to the Least Skilled group. Panels A and B present wage rates converted to July 2009

dollars and panels C and D present nominal wage distributions. The industry-specific figures are constructed such that “horizontal addition” across the industry groupings yields the all-industry figures presented earlier.

Figure 7 describes wage rates in Broad Trade, which includes retail and wholesale trade industries. Between 2002 and 2014, employment in retail and wholesale trade declined by around 1 percentage point of the full working age population. Employment in these industries among the Least Skilled individuals declined by 4 percentage points. Figure 7’s panel D shows that the nominal wage distribution across these industries’ low-skilled workers was stagnant over this time period. The real wage distribution shifted downward, as shown in panel B.

The federal minimum wage’s increase from \$5.15 to \$7.25 was strongly binding on the distribution of the Least Skilled group’s wage rates in retail and wholesale trade. In 2002 and 2006, roughly 4 percent of individuals in this skill group were employed in retail or wholesale trade at wage rates between \$5.15 and \$7.25. Moving from 2002 to 2014, the fraction of individuals making near or below effective minimum was unchanged, while employment declined substantially.

The Food Service wage distributions presented in Figure 8 exhibit patterns quite different from those in retail and wholesale trade. Panel C shows that the nominal Food Service wage distribution across the full working age population shifted steadily upward over this time period. Across industries, Food Service was among the least adversely affected by the Great Recession in terms of both real wages and employment rates. In the Least Skilled group, 6 percent of individuals were employed in Food Service jobs at wage rates less than \$7.25 in 2006. By contrast with Broad Trade, panel D shows that a significant fraction of the Least Skilled group’s Food Service distribution shifted to the \$7.25 minimum wage in 2010. From 2006 to 2010, the Least Skilled group’s Food Service employment declined by 2 percentage points, while its employment at wage rates near

or below the effective minimum rose by 2 percentage points.

Figure 9 shows employment and wage rates across the Construction and Manufacturing industries. Multiple features of these industries' wage distributions are of interest. First, the Least Skilled group's employment in these industries expanded moderately from 2002 to 2006 and contracted severely from 2006 to 2010. Figure 10 shows that the increase in employment from 2002 to 2006 occurred entirely within construction, which accounts for roughly three quarters of the Least Skilled group's employment in Construction and Manufacturing combined.

Second, while nominal wage distributions in other industries were stagnant from 2006 to 2010, the Construction and Manufacturing wage distribution shifted significantly downward in both real and nominal terms. Figure 10 reveals that, like the housing boom's employment gains, this development occurred primarily in the construction industry. The distribution of the Least Skilled group's wages within the construction industry shifted downward by \$2 in nominal terms from 2006 to 2010. This shift made the \$7.25 minimum wage binding on a large swath of the Least Skilled group's potential wages in these industries. In 2006, nearly 4 percent of the Least Skilled group, accounting for nearly 10 percent of its employment across all industries, was employed in construction at wage rates within \$3 of \$7.25. The Least Skilled group's Construction and Manufacturing employment contracted by 4 percentage points between 2006 and 2010 and was unchanged from 2010 to 2014.

Figure 10's panel B presents data from the Job Openings and Labor Turnover Survey (JOLTS). The figure shows that fluctuations in construction employment were driven by expansions and contractions in the number of new hires rather than by quits and layoffs. Declines in construction employment thus involved a dramatic contraction in the availability of entry-level opportunities.

The distribution of wages in All Other sectors, as shown in figure 11, exhibits patterns

similar to those observed in retail and wholesale trade. From 2002 to 2014, the Least Skilled group's nominal wage distribution was largely stagnant in these sectors. This group's employment in these sectors declined moderately from 2002 to 2006, declined substantially from 2006 to 2010, and again declined moderately from 2010 to 2014. In 2002, roughly 5 percent of the Least Skilled group was employed at wage rates between \$5.15 and \$7.25 in these sectors. The fraction working at wage rates near or below the effective minimum moved negligibly throughout this time period.

4 Interpreting the Wage Distribution's Evolution

This section develops a descriptive framework for interpreting movements in employment rates and wage distributions. My objective is for the framework to incorporate reduced form representations of a broad range of factors emphasized in standard accounts of the period under analysis. After presenting the basic framework in subsection 4.1, I describe how it embeds various explanations for the wage distribution's evolution in subsection 4.2.

4.1 What Underlies Observed Wage Distributions?

Observed wage rates result from transactions in which a firm's wage offer exceeds an individual's reservation wage. Let individual i have reservation wage $v_{i,t}$ at time t .¹⁰ Individual i has underlying productivity such that his or her expected output is $a_{i,t}$ per hour. The revenue associated with this production depends further on $p_{i,t}$, the resulting output's price.

Firms' wage offers to individual i reflect a combination of competitive market forces

¹⁰A variety of factors, including the generosity of social insurance programs, may determine $v_{i,t}$. It could incorporate aversion reductions in wage rates from prior periods, for example, which would introduce a source of rigidity.

and bargaining power. Absent binding minimum wage regulation, firms offer workers wage rates equal to fraction $\theta_{i,t} \leq 1$ of the value of their expected output, or $\theta_{i,t}p_{i,t}a_{i,t}$. The parameter $\theta_{i,t}$ summarizes the strength of individual i 's bargaining position. It may move cyclically, with values approaching 1 in tight labor markets and lower values in slack labor markets. It may depend on additional factors like whether the individual belongs to a union.

The final determinant of wage offers is the statutory minimum wage, w_t^{min} . If the value of the individual's expected output exceeds the legal minimum wage ($p_{i,t}a_{i,t} \geq w_t^{min}$), firms will offer the worker w_t^{min} when $\theta_{i,t}p_{i,t}a_{i,t} < w_t^{min}$. When $p_{i,t}a_{i,t} < w_t^{min}$, on the other hand, firms will opt not to offer the individual employment. The framework thus incorporates channels through which the minimum wage's intended and unintended effects may be realized.

Taken together, observed wage rates, $w_{i,t}$, can be described as follows:

$$w_{i,t} = \begin{cases} \theta_{i,t}p_{i,t}a_{i,t} & \text{if } \theta_{i,t}p_{i,t}a_{i,t} > w_t^{min} \text{ and } \theta_{i,t}p_{i,t}a_{i,t} \geq v_{i,t} \\ w_t^{min} & \text{if } w_t^{min} > v_{i,t} \text{ and } \theta_{i,t}p_{i,t}a_{i,t} < w_t^{min} \text{ and } p_{i,t}a_{i,t} \geq w_t^{min} \\ 0 & \text{if } p_{i,t}a_{i,t} < w_t^{min} \\ 0 & \text{if } \theta_{i,t}p_{i,t}a_{i,t} < v_{i,t}. \end{cases} \quad (1)$$

The first two rows describe wage rates among the employed while rows three and four describe sources of unemployment. Row four describes the voluntary unemployment that occurs when individuals are unwilling to work at the wage rates firms offer. This source of unemployment is two-sided in the sense that it can be ascribed to a combination of supply and demand side forces; firms are unwilling to pay above the individual's reservation wage and the individual is unwilling to work at the wage firms offer. Row three describes the minimum wage's unintended consequence, namely the involuntary unemployment that occurs when the legal minimum exceeds the value of an individual's

expected output. Conversely, row two describes the minimum wage's intended effects. It describes individuals paid the minimum who would otherwise receive less as a result of their bargaining position. Finally, row one describes individuals whose wage offers exceed their reservation values and are unbound by the legal minimum.

4.2 How Economic Forces Enter the Framework

The framework above embeds channels through which a broad range of economic forces might shift employment and wage rates at the individual level, across broad skill groups, and across the labor market as a whole. In this subsection I overview several forces thought to have impacted the labor market in recent years. I consider these forces' implications for both employment and observed wage rates and I link each force to the parameter through which it enters the framework.

4.2.1 Implications of Trade and Technology

The early literature on wage inequality emphasizes technology's role as a driver of changes in firms' demands for different skill sets (Katz and Murphy, 1992; Bound and Johnson, 1992; Acemoglu, 1998; Acemoglu and Autor, 2011; Autor et al., 2008). Relatively recent work has developed complementary evidence of an important role for trade (Autor et al., 2013, 2016). Trade and technology have analytically quite similar implications for the evolution of employment and wage distributions. Technology and foreign labor are potential inputs in alternative modes of production. When such alternatives reduce the cost of bringing a good to market, competitive product-market conditions will encourage their adoption; a lone adopter would be positioned to undercut competitors' prices while pricing above its own costs. Competitive conditions thus lead "skill biased" technology and trade to enter the framework by reducing $p_{i,t}$, the price associated with a low-skilled individual's potential output.

Skill biased technology and trade may influence low-skilled individuals' employment through two channels. First, these forces may drive some individuals' wage offers below their reservation wages. Second, a firm's unconstrained wage offer to a low-skilled individual may fall below the legal minimum. If the minimum wage is below the expected value of this individual's output, it has its desired effect. That is, in such cases the minimum wage prevents further wage declines without leading firms to cease offering employment. If technology and trade shift the expected value of an individual's output below the minimum wage, however, firms will cease offering that individual employment.

4.2.2 Implications of Macroeconomic Factors

The Great Recession heightened interest in the business cycle's effects on both short- and longer-run labor market developments. The business cycle's short-run labor market implications can be viewed as the result of declines in the value of workers' output through either an aggregate demand channel or through productivity shocks. As with trade and technology, the aggregate demand channel enters the framework through declines in $p_{i,t}$, the price of output. Productivity shocks enter through declines in $a_{i,t}$.

Recent work has also pointed to channels through which a recession's effects may alter long-run wage and employment outcomes. Blanchard and Summers (1986), for example, raise the possibility that extended unemployment spells may permanently depress an individual's productivity.¹¹ A "lemons" problem (Akerlof, 1970) may augment real skill deterioration's effects on firms' expectations for the long-term unemployed's potential output (Kroft et al., 2013; Pallais, 2014). Such effects enter the descriptive framework through reductions in $a_{i,t}$.

The U.S. federal minimum wage is set in nominal terms. Inflation is thus a significant

¹¹Kahn (2010) shows that effects of this sort can be quite long lasting for recent college graduates.

determinant of where the minimum wage falls in relation to productivity distributions. Inflation maps directly into changes in $p_{i,t}$.

4.2.3 Implications of Social Insurance and Redistributive Programs

Mulligan (2012a) raises the possibility that recent employment declines have been driven by increases in the generosity of social insurance and redistributive programs. Relevant developments include the Affordable Care Act (Mulligan, 2014), increases in food stamp generosity (Hall, 2014), and unemployment insurance extensions (Rothstein, 2011; Farber and Valletta, 2013). These changes enter the framework through increases in the value of individuals' outside options, and thus of their reservation wage rates $v_{i,t}$. Under some forms of firm-worker bargaining, increases in individuals' reservation wages may also increase firms' wage offers.

4.2.4 Implications of Bargaining Institutions

Finally, recent policy discussions emphasize the possibility that stagnant wage growth, in particular for low-skilled workers, reflects a deterioration in the bargaining position of workers relative to firms (Reich, 2015). Such developments enter the framework through declines in $\theta_{i,t}$. Declines in $\theta_{i,t}$ will tend to shift observed wage distributions downward. The nature of firm-worker bargaining may determine whether wage offers dip below individuals' reservation wages.¹² Changes in bargaining power thus may or may not alter observed employment rates. Their implications for wages, by contrast, are unambiguous.

¹²Whether such cases emerge can depend on the applicable wage determination model (Manning, 2011). Consider, for example, the ex-post Nash bargaining model of wage determination. In such a model the wage offer will be between the individual's reservation wage and the value of his or her output to the firm so long as the latter exceeds the former, implying gains from trade. In this model, changes in the bargaining weight will not lead firms to offer a wage rate below an individual's reservation wage.

5 Implications of Market and Institutional Forces for Minimum Wage Policy

The economic forces discussed above encompass a broad range of factors that may have contributed to the labor market's evolution from 2002 to 2014. This subsection considers the relevance of understanding these factors' relative contributions. I emphasize that different hypotheses regarding recent developments' causes can have different implications for the effects of redistributive policy interventions.

The minimum wage's potential costs and benefits vary quite starkly with alternative models of the labor market. This is commonly captured through the difference between the textbook monopsony and competitive market models (Stigler, 1946; Card and Krueger, 1994; Manning, 2003). In the competitive market model, a binding minimum wage's employment effects are unambiguously negative. In the monopsony model, the minimum wage's effects depend on how skillfully it is set. There are ranges over which minimum wage increases may either increase or decrease employment.

The bargaining parameter in my descriptive framework has similar implications. It generates the possibility that skillfully implemented minimum wage increases can increase low-skilled workers' wages without adversely affecting employment. It further retains the monopsony model's possibility that a minimum wage increase may increase employment. In this framework, minimum wage increases may increase employment by bringing firms' wage offers above the reservation values of those at the margin.

The framework points to a more novel observation, which is that the economic forces underlying *changes* in labor market outcomes have implications analogous to bargaining power's baseline balance. Suppose the Least Skilled group's wage distribution shifts downward due to a decline in their bargaining power ($\theta_{i,t}$). In this scenario, the minimum wage effectively "holds the line" against firms' ability to increase their share of

workers' output. If only $\theta_{i,t}$ has changed, the gross value of each initially employed individual's output is stable. In this scenario, the minimum wage's increasing bite prevents firms from decreasing wages without reducing employment. Further, declines in bargaining power increase the wage gains generated by an incremental minimum wage increase without increasing the associated decline in employment.

By contrast, suppose the Least Skilled group's wage distribution shifts downward due to declines in the market value of its members' output (through either $p_{i,t}$ or $a_{i,t}$). In this scenario, increases in the minimum wage's bite may reduce firms' ability to offer wage rates commensurate with the value of a worker's output. When this occurs, there is an increase in the adverse employment effect of a fixed value of the minimum wage. Further, the decline in employment associated with an incremental increase in the minimum wage will tend to rise.¹³

6 Developing Wage and Employment Counterfactuals

This section describes my approach to assessing the extent to which the institutions- and markets-centric views of the labor market match the data we observe. The key inputs for the counterfactual comparisons are estimated shifts in the distribution of firms' unconstrained wage offers: $\theta_{i,t}p_{i,t}a_{i,t}$. The primary challenge is that inferences about changes in the distribution of $\theta_{i,t}p_{i,t}a_{i,t}$ must be made on the basis of wages observed among the employed. This section's first subsection discusses the assumptions underlying the inferences I make from the observed wage data. The second subsection provides more detail on the mechanics of implementation. The third subsection elaborates on the implied tests of the markets- and institutions-centric views of the labor market.

¹³This assumes that the density of $p_{i,t}a_{i,t}$ is increasing in the neighborhood of w_t^{min} . This seems likely given the 2002 and 2006 wage distribution's shape near the \$5.15 minimum wage.

6.1 Counterfactual Preliminaries

The observed wage data motivate a simplifying assumption regarding changes in the framework's key parameters, namely $\theta_{i,t}$, $p_{i,t}$, and $a_{i,t}$. Observed shifts in both the all-industry and industry-specific wage distributions among low-skilled workers are essentially parallel. That is, from one period to the next, the change in the wage rates at high percentiles of the distribution are quite close in dollar terms to the change at low percentiles. I thus assume that wage shocks, whether due to changes in $\theta_{i,t}$, $p_{i,t}$, or $a_{i,t}$, are constant across percentiles of the Least Skilled group's wage distribution.

A second issue involves the distribution of reservation values. When wage offers decline, individuals may voluntarily exit employment. It is relevant to know how the individuals who voluntarily exit are distributed across the baseline distribution of $\theta_{i,t}p_{i,t}a_{i,t}$ among the employed. Some high $a_{i,t}$ individuals, for example, may also be high $v_{i,t}$ individuals, making them marginal participants as wage offers decline due to declines in the underlying $p_{i,t}$, $a_{i,t}$, or $\theta_{i,t}$.

I consider two alternative assumptions about the distribution of $v_{i,t}$. On one extreme, I assume that $v_{i,t}$ is a group-wide constant $v_{g(i),t}$. In this case, individuals self select out of the labor market in accordance with the ordering of $\theta_{i,t}p_{i,t}a_{i,t}$. Under this assumption, changes in average wages among continuously employed percentiles perfectly capture the average change due to the product of $\theta_{i,t}$, $p_{i,t}$, and $a_{i,t}$ across a hypothetically fixed set of individuals within the skill group.

I also consider the more realistic possibility that declining wage offers lead to selection out of the labor market across the full distribution of baseline levels of $\theta_{i,t}p_{i,t}a_{i,t}$. Selection of this form leads changes in average wages among continuously employed percentiles to exceed the underlying change in $\theta_{i,t}p_{i,t}a_{i,t}$ across a fixed population. If such selection is present, observed wage changes among continuously employed percentiles must be adjusted towards zero to recover the underlying changes of interest.

6.2 Counterfactual Mechanics

I now describe the procedure through which I develop counterfactual wage distributions. Let $w_{p,g,t}$ denote the wage at percentile p of the wage distribution across members of group g in year t . Let $t = base$ denote the base year relative to which projected wage distributions will be constructed. I estimate changes in the distribution of firms' unconstrained wage offers relative to $base = 2006$, which marks the housing market's peak across the years I analyze.¹⁴

The observed wage data motivate a simplifying assumption about shocks to the Least Skilled group's wage distribution. Absent minimum wage changes, I assume that $\theta_{i,t}p_{i,t}a_{i,t}$ at each percentile of the year $t = post$ distribution equals the wage in year $base$ plus a level shift $\Delta w_{g,post-base}$. For each percentile p in group g 's wage distribution, I construct $w_{p,g,post} = w_{p,g,base} + \Delta w_{g,post-base}$.

I construct the counterfactual shifts $\Delta w_{g,post-base}$ using observed shifts in wage distributions among the employed. The goal in constructing $\Delta w_{g,post-base}$ is to approximate changes in the product of $p_{i,t}$, $a_{i,t}$, and $\theta_{i,t}$ to which minimum and near-minimum wage workers within skill group g were exposed. The wage data I use reflect a balance of competing factors. First, the percentiles used to estimate $\Delta w_{g,post-base}$ ought not to include those affected directly by minimum wage changes. I thus only include workers at percentiles for which $w_{p,g,post} > w_{post}^{min}$ and $w_{p,g,base} > w_{post}^{min}$. For the Least Skilled group, the cutoff corresponds with the 20th percentile. At the same time, the goal of approximating the changes in $p_{i,t}$, $a_{i,t}$, and $\theta_{i,t}$ that affect minimum and near minimum wage workers recommends using data on relatively low wage percentiles. Using percentiles beyond a threshold, $p > \underline{p}$, I construct

¹⁴A goal in this analysis is to project distributions containing the potential counterfactual wages of all individuals who might desire employment at plausibly available wage rates. To accomplish this, it is most attractive to use a year of peak employment as the base.

$$\Delta w_{g,post-base} = E([w_{p,g,post} - w_{p,g,base}] | w_{p,g,post} > w_{post}^{min}, w_{p,g,base} > w_{post}^{min}, p > \underline{p}). \quad (2)$$

When examining the all-industry wage distribution, I set $\underline{p} = 0.08$. Across all industries, the Least Skilled group's average nominal wage between the 8th and 20th percentiles was \$7.43 in 2002, \$8.05 in 2006, \$7.68 in 2010, and \$7.86 in 2014. The projected distributions of $\theta_{i,t}p_{i,t}a_{i,t}$ in 2002, 2010, and 2014 are thus the nominal 2006 wage distribution shifted by -\$0.62, -\$0.37, and -\$0.19. The shifts of -\$0.62, -\$0.37, and -\$0.19 are changes of 7.7, 4.6, and 2.3 percent respectively on the 2006 base of \$8.05. The decline in nominal wage rates from 2006 to 2010 is driven in large part by the construction and manufacturing industries, in which the downward nominal shift was nearly \$2.

Counterfactuals based directly on $\Delta w_{g,post-base}$ embed the assumption that $v_{i,t}$ is a group-wide constant $v_{g(i),t}$, so that individuals self select out of the labor market in accordance with the ordering of $\theta_{i,t}p_{i,t}a_{i,t}$. For my second set of counterfactuals I allow for the possibility that, due to selection, observed shifts in $\theta_{i,t}p_{i,t}a_{i,t}$ overstate the underlying changes across a fixed population. For these counterfactuals, I assume that the underlying change across a fixed population is $\psi\theta_{i,t}p_{i,t}a_{i,t}$. In practice I set the selection adjustment ψ equal to one half.

6.3 Contrasting the Institutions- and Markets-Centric Views

The markets- and institutions-centric views differ with regards to the role of the bargaining parameter $\theta_{i,t}$. This applies to both $\theta_{i,t}$'s baseline magnitude and to its contribution to changes in $\theta_{i,t}p_{i,t}a_{i,t}$. When referencing the institutions-centric view, I have two specific claims in mind. The first claim is that the minimum wage is not a significant source of job loss at present levels. This implies that, for many low-skilled workers,

$\theta_{i,t}p_{i,t}a_{i,t} < w_t^{min}$ and $p_{i,t}a_{i,t} > w_t^{min}$. That is, their productivity exceeds the minimum and the firms they encounter have sufficient bargaining power that the minimum wage binds.

The second claim is that the wage distribution's long-run evolution reflects declines in the $\theta_{i,t}$ associated with relatively low-skilled workers.¹⁵ That is, the institutions-centric view captures the possibility that low-skilled workers' nominal wages have been stagnant because declines in bargaining power have reduced the extent to which they share in economy-wide productivity gains. If this view is correct, my framework implies that minimum wage increases may be a powerful tool for offsetting recent real wage declines among relatively low-skilled individuals.

By contrast, the markets-centric view sees stagnant and declining wages as being competitive market outcomes. It views changes in the Least Skilled group's wage distribution as reflecting the effects of forces like trade, technology, or these individuals' underlying productivity levels. The markets-centric view thus sees downward shifts in $p_{i,t}$ or $a_{i,t}$ rather than $\theta_{i,t}$.

At this stage, the distinctive empirical implications of the institutions- and markets-centric views may be readily apparent. In the institutions-centric view, $\theta_{i,t}$ is sufficiently far below one that there is enough distance between $\theta_{i,t}p_{i,t}a_{i,t}$ and $p_{i,t}a_{i,t}$ for increases in w_t^{min} to increase wage rates without reducing employment. As w_t^{min} rises, the institutions-centric view implies that the fraction of workers making precisely w_t^{min} will rise. It similarly implies that the fraction of workers making precisely w_t^{min} will rise when $\theta_{i,t}$ decreases.¹⁶

¹⁵I emphasize this as a long-run phenomenon to stress that the institutions-centric view need not rule out changes in $p_{i,t}$ over the business cycle. Long changes from 2002 through 2014, however, involve little change in labor market tightness. The national unemployment rate was just under 6 percent in 2002 and just over 6 percent in 2014. This is all the more true for changes from 2002 to 2015, when the national unemployment rate averaged 5.3 percent.

¹⁶In the empirical analysis, I include workers making slightly above or below the minimum in addition to those making precisely the minimum. I do this to avoid under counting the relevant fraction of workers

How large of an increase in the fraction making w_t^{min} does the institutions-centric view predict? This depends primarily on the fraction of individuals initially working at wage rates just above the minimum. A second relevant consideration involves selection into or out of employment. When analyzing declines in $\theta_{i,t}$, the expected change in the fraction with wages near w_t^{min} should be adjusted downward to account for voluntary labor force exits. When analyzing increases in w_t^{min} , the expected change in fraction at w_t^{min} should be adjusted upward to account for voluntary labor force entry. Because both factors are at work during the period under analysis, their net effects will partially offset. A straightforward calibration, presented in section 8, shows that either effect's absolute size will be more modest than one might expect. This reflects the fact that existing estimates of plausibly relevant extensive margin labor supply elasticities, as summarized by Chetty et al. (2012), are relatively small.

The markets-centric view has quite different implications. An extreme version of the markets-centric view holds that $\theta_{i,t}$ equals 1. Under this view, binding increases in w_t^{min} reduce employment one-for-one with the fraction of individuals initially working at wage rates between the old and new minimum. Further, in this view observed declines in low-skilled individuals' wage rates are driven by declines in $p_{i,t}a_{i,t}$. As such declines lead the minimum wage to bind, employment reductions follow. It is again important to note that observed employment changes may, in part, result from declines in wage offers to values below workers' reservation wages. Voluntary exits will supplement employment declines linked directly to the minimum wage.

A weaker version of the markets-centric view focuses on changes. That is, it allows $\theta_{i,t} < 1$ at baseline, but assumes that recent declines in wage offers are driven by $p_{i,t}$ or $a_{i,t}$. When $p_{i,t}$ or $a_{i,t}$ decline, individuals for which $p_{i,t}a_{i,t}$ falls below the minimum wage will no longer receive employment offers. The change in the fraction of individ-

due either to measurement error or to minimum wage increases' possible spillover effects.

uals making exactly the minimum wage is ambiguous, since a flow of new workers for which $w_t^{min} > \theta_{i,t} p_{i,t} a_{i,t}$ may partially, fully, or more than fully offset the decline in those receiving job offers. An increase in the minimum wage leads firms to cease offering employment to those for which w_t^{min} rises above $p_{i,t} a_{i,t}$. As before, the magnitude of this decline depends primarily on the fraction of individuals initially earning wage rates between the old and new minimum. Importantly, the framework thus implies that labor replacing developments in trade and technology will increase a given minimum wage's adverse employment effects whether the labor market is competitive or subject to significant bargaining frictions at baseline.

7 Comparing Counterfactuals with the Data

This section contrasts the evolution of employment and wage distributions with the predictions of counterfactuals associated with the institutions- and markets-centric views of the labor market. Subsection 7.1 walks through the steps in the procedure using graphical examples of the counterfactuals underlying the full analysis. Subsection 7.2 presents counterfactuals associated with the institutions-centric view's predictions for the fraction of individuals earning wages near or below the statutory minimum. Subsection 7.3 presents counterfactuals associated with the markets-centric view's predictions for employment.

7.1 Illustration of the Steps in the Counterfactual Comparisons

The steps for conducting counterfactual comparisons are as follows. I first take the base year wage distribution and shift it by $\psi \Delta w_{g, post-base}$, which is constructed as described in subsection 6.2. This generates the projected "post" year wage distribution. Second, I calculate the fraction of workers in the projected wage distribution who have

wage rates near or below the statutory minimum wage. This identifies the fraction of the skill group for which subsequent steps will attempt to account. The third step is to adjust for the expected employment entry and exit due to the wage shocks to which the skill group was exposed. Also relevant at this stage are entry and exit linked to changes in social insurance arrangements or other factors that influence reservation values. Finally, the remainder can be divided into the fraction shifted successfully to the new minimum wage and the fraction involuntarily losing employment.

Figures 12 and 13 present examples of the counterfactuals underlying this section's analysis. Panel A presents the all-industry wage distributions for 2006 and 2010 along with the projected 2010 distribution. The dashed lines indicate the percentiles of the 2006 wage distribution on which I construct $\Delta w_{g,post-base}$. As described in section 6.2, the wage rates along the projected 2010 distribution are simply the wage rates along the actual 2006 distribution shifted by $\Delta w_{g,post-base}$.

Panel B shows the wage distributions implied by the basic institutions- and markets-centric counterfactuals. The basic markets-centric counterfactual presumes that all percentiles with projected 2010 wage rates below the \$7.25 minimum are unable to find employment. The basic institutions-centric counterfactual presumes that all percentiles with projected 2010 wage rates below the \$7.25 minimum have their wages shifted upwards to the \$7.25 new minimum.

It is apparent that neither the basic markets- nor institutions-centric view fits the projected 2010 wage distribution perfectly. A moderate fraction of those with projected wage rates less than \$7.25 appear to be employed at wage rates of precisely \$7.25. A much larger fraction of those with projected wage rates less than \$7.25 are unemployed. Panels C and D show similarly constructed projections and counterfactuals for the Construction and Manufacturing industries. Within these industries, which are of interest in part due to their turbulent experience over this time period, the markets-centric coun-

terfactual fits the data far better than the institutions-centric counterfactual. Figure 13 shows that counterfactual changes from 2002 to 2014 leave an impression quite similar to the relatively short-run counterfactual changes presented in figure 12.

7.2 Are Changes in the Number of Minimum Wage Workers Consistent with Institutions-Centric Views?

Tables 2 and 3 contrast the predictions of institutions-centric counterfactuals with actual labor market data. The key dimension of the data for institutions-centric counterfactuals is the fraction of individuals with wage rates near or below the effective minimum wage. Table 2 presents the most basic counterfactual, in which the inferred shifts in $\theta_{i,t}p_{i,t}a_{i,t}$ across a fixed population are calculated directly as in equation (2). It presents this counterfactual for the wage distribution within specific industries as well as for the distribution across all industries.

Table 3 presents variants on the basic counterfactual. First, it presents counterfactuals that allow for the possibility that observed wage changes across continuously employed percentiles are driven in part by selection. As described above, I adjust for this by assuming that the relevant change in $\theta_{i,t}p_{i,t}a_{i,t}$ across a fixed population is one half of the observed change across continuously employed percentiles. Second, I construct both the basic and adjusted counterfactuals on a population consisting of high school dropouts ages 21 to 35. An issue with analyses including teenagers is that changes in their employment may in part reflect changes in the propensity to remain in high school. By age 21, however, high school dropouts are at least 2 years behind schedule. The evolution of 21 to 35 year old dropouts' labor market outcomes is thus less plausibly subject to this alternative explanation.¹⁷

¹⁷Among non-graduates ages 21 to 24, of whom the CPS's school enrollment questions are asked, self-reported enrollment rose by less than 3 percentage points between 2002 and 2014.

Panel A of table 2 presents data on the fraction of the Least Skilled group employed at wage rates less than or within 50 cents of the statutory minimum. Across all industries, 8.2 percent of individuals in this skill group were employed at such wage rates in 2002. Between 2002 and 2006, the minimum wage remained fixed at \$5.15 while nominal wages improved modestly. By 2006, the fraction making below or within 50 cents of the minimum had declined to 5.4 percent. Between 2006 and 2010 the minimum wage rose from \$5.15 to \$7.25 while the recession adversely affected wages. Over this period, the fraction of the Least Skilled group making below or within 50 cents of the minimum rose to 11.2 percent. Between 2010 and 2014, it declined to 8.6 percent.

Panel B reports the counterfactual changes in the fraction of workers below or within 50 cents of the minimum wage under the institutions-centric view of the labor market. The counterfactual changes in this fraction compare favorably with actual changes over the periods extending from 2002 to 2006 and from 2010 to 2014, during which the minimum wage was constant and overall employment changes moderate. The counterfactual changes differ radically from the data, however, for the period extending from 2006 to 2010. Consequently, they also differ radically from the data for the full period extending from 2002 to 2014.

From 2006 to 2010, the minimum wage rose substantially while nominal wage offers to low-skilled workers declined modestly. In the basic institutions-centric view, these developments would have generated a substantial, 20 percentage point increase in the fraction of individuals making below or within 50 cents of the minimum wage. Just over one fourth of this additional mass actually materialized. For the full time period extending from 2002 to 2014, the basic institutions-centric view predicts an 11 percentage point increase in the fraction of low-skilled individuals making wage rates in this range. In practice, the fraction at such wage rates was essentially unchanged.

The institutions-centric counterfactual appears inconsistent with the data across all

four industry groupings. It comes closest to matching the data in the Food Service industry, where the fraction making within 50 cents of or less than the minimum wage rose by 0.6 percentage point from 2002 to 2014, or one third of what the institutions-centric counterfactual predicts. This is of interest in part because segments of the minimum wage literature have focused exclusively on the Food Service industry. Caution is clearly warranted when using industry-specific results to infer the minimum wage's effects across the labor market as a whole.

Table 3 shows that the institutions-centric view differs more dramatically from the data in the modified counterfactual than in the basic counterfactual. As discussed above, the modified counterfactual effectively smooths out the assumed shocks to which the wage distribution is exposed over time. This adjustment, which likely improves the projected wage distribution's realism, worsens the institutions-centric counterfactual's predictive power; as discussed below, it improves the markets-centric counterfactual's capacity to predict employment dynamics.

In the wage distribution among high school dropouts ages 21 to 35, the fraction of individuals with wages within 50 cents of or below the minimum wage increased by 2.2 percentage points from 2002 to 2014. The basic counterfactual predicts an increase of 7.6 percentage points while the modified counterfactual predicts an increase of 9.0 percentage points. While the divide from the data remains substantial, the institutions-centric counterfactual thus performs better in predicting the evolution of moderately more experienced workers' wage distributions. This is consistent with the view that bargaining considerations play a more prominent role outside of entry and near entry level positions.

As with earlier figures, the data underlying tables 2 and 3 are restricted to individuals in states whose minimum wage rates deviated little from the federal minimum wage throughout this time period. For tables 4 and 5 I relax this restriction. I construct

counterfactuals separately for each state and average across the states' experiences to generate the estimates reported in the tables. Table 4 shows that the estimates from table 3 are affected little by this addition to the sample and alteration of the procedure.

Table 5 addresses a final point. Some evidence suggests that minimum wage increases alter the wage distribution beyond the minimum wage's immediate vicinity (Autor et al., 2010). I thus check whether my estimates of changes in the fraction of workers making below or near the minimum wage are sensitive to allowing the minimum wage's effects to extend farther up the wage distribution. Specifically, I expand my definition of "near" the minimum wage from \$0.50 above the minimum to \$1 above the minimum. The table reveals that the gap between the data and the institutions-centric counterfactual remains similarly sized.

7.3 Are Employment Changes Consistent with Markets-Centric Views?

Tables 6 and 7 contrast the predictions of markets-centric counterfactuals with actual labor market data. The key prediction of the markets-centric counterfactual involves employment. Table 6 mirrors table 2 from the institutions-centric counterfactuals. It presents the most basic counterfactual in which shifts in $\theta_{i,t}p_{i,t}a_{i,t}$ across a fixed population are inferred directly using equation (2). Table 7 similarly mirrors table 3. It presents the modified counterfactual on the Least Skilled group as well as both the basic and modified counterfactuals on high school dropouts between ages 21 and 35.

Panel A of table 6 presents data on employment among individuals ages 16 to 30 with less than a high school education. Across all industries, just over 40 percent of individuals in this skill group were employed in 2002. Between 2002 and 2006, this skill group's employment changed negligibly. Between 2006 and 2010, as the Great Recession affected the labor market and the minimum wage rose, its employment declined by 12 percentage points. Its employment declined further, from 27.6 percent to 27.0 percent

between 2010 and 2014.

Panel B reports counterfactual changes in employment under the basic markets-centric counterfactual. The basic markets-centric counterfactual predicts the long-run employment decline quite well. From 2002 to 2014, the counterfactual predicts a 10.8 percentage point decline in employment. This understates the actual decline by 2.6 percentage points. The basic markets-centric counterfactual does quite poorly, however, in predicting the magnitudes of employment changes over shorter time horizons. Specifically, it predicts moderate increases in employment between 2002 and 2006 and again between 2010 and 2014. These increases are offset by the predicted decline between 2006 and 2010, which is a substantial 20 percentage points.

From 2006 to 2010, the markets-centric view predicts substantial employment declines across all industry groupings. Over this intermediate time horizon, the data match the markets-centric counterfactuals most strongly in Broad Trade and in Construction and Manufacturing. The Food Service industry was more resilient during the housing decline than the markets-centric view predicts. Over the long-run from 2002 to 2014, the basic markets-centric counterfactual performs similarly well across the four industry groupings. It deviates from the realized employment changes by less than 25 percent in each case.

Table 7 shows that the modified counterfactual, which adjusts for selection out of the labor market, improves the markets-centric counterfactual's capacity to predict intermediate employment dynamics. The basic markets-centric counterfactual misses the 2002 to 2006, 2006 to 2010, and 2010 to 2014 employment changes by an average of 7 percentage points. The modified markets-centric counterfactual misses these changes by an average of 3 percentage points. For dropouts ages 21 to 35, the modified counterfactual performs somewhat worse in predicting long-run changes from 2002 to 2014, but again performs much better in predicting intermediate dynamics.

As in tables 4 and 5, table 8 relaxes the restriction of the sample to states that deviate little from the federal minimum wage. I again construct counterfactuals separately for each state and average across the states' experiences to generate the reported estimates. Table 8 shows that the estimates from table 7 are affected little by this addition to the sample and alteration of the procedure for constructing counterfactuals.

8 Decomposing Employment Declines

In section 4's framework, employment rates may change for any of several distinct reasons. The analysis thus far has emphasized the minimum wage, which enters the framework as a potential source of involuntary employment. Voluntary employment declines may also be important. Shocks to $\theta_{i,t}p_{i,t}a_{i,t}$ can result in voluntary labor market exit by bringing wage offers below reservation wages. Voluntary unemployment may similarly rise if social insurance expansions increase low-skilled individuals' reservation wages. I conclude by considering the potential contributions of these explanations for the long-run decline in the Least Skilled group's employment.

The magnitude of voluntary labor force exit due to declines in $\theta_{i,t}p_{i,t}a_{i,t}$ is relatively straightforward to bound. As discussed above, the observed changes in wage rates across continuously employed percentiles place upper bounds on underlying declines in $\theta_{i,t}p_{i,t}a_{i,t}$. For the Least Skilled group, table 1 reports that this decline was roughly 15 percent in real terms. The meta analysis of Chetty et al. (2012) reviews studies of extensive margin labor supply elasticities among plausibly comparable populations. They report that the relevant elasticity estimates range from 0.13 to 0.43 and have a median of 0.25. At the median estimate, the extensive margin response to a 15 percent decline in real wage rates implies an employment response of 3.75 percent. On the Least Skilled group's base employment rate of 40 percent, the implied employment decline is 1.5 per-

centage points. This leaves 11.5 percentage points of the 13 percentage point decline in need of explanation. The upper bound elasticity of 0.43 implies an employment decline of 2.6 percentage points, leaving 10.4 percentage points in need of explanation.

The effects of social insurance expansions are more difficult to calibrate. A proper calibration would require cataloguing the relevant program changes at a level of detail beyond this paper's scope. Figure 14 presents a fact relevant for gauging social insurance's plausible relevance. It shows that the Least Skilled group's employment rate changed negligibly from 2012 through 2015. This is relevant because temporary expansions in the generosity of unemployment insurance and the food stamp program expired during these years. The absence of employment increases in the face of these developments suggests that these particular policy changes had modest effects on the Least Skilled group's employment over this time period.¹⁸ The expiration of the programs noted above may have been offset, however, by the phasing in of key provisions of the Affordable Care Act (ACA). The ACA's implications for the extensive margin of low-skilled individuals' labor supply decisions are far from clear.¹⁹ Research on the ACA's labor market effects will likely be a topic of great interest in coming years.

Returning to the minimum wage, the analyses in Clemens and Wither (2014b) and Clemens (2015) estimate that this period's minimum wage increases account for a 5 to 6 percentage point decline in the Least Skilled group's employment. This accounts for just over 40 percent of the 13 percentage point decline. The current analysis highlights that, even with this contribution from the minimum wage, much of the decline in low-skilled

¹⁸Changes in social insurance arrangements may be more relevant to the labor market experience of older high school dropouts and young to middle aged high school graduates. The key point for present purposes is that social insurance arrangements appear unlikely to underlie a significant share of the decline in employment among teenagers and young high school dropouts.

¹⁹Clemens and Wither (2015), for example, show that many states' adult Medicaid eligibility thresholds make it quite difficult to maintain public insurance coverage and meaningful employment, even at the \$7.25 federal minimum wage. The ACA's Medicaid expansions and subsidies alleviate this barrier to employment and may, as a result, increase labor force participation. By contrast, the phase-outs of these features of the ACA are likely expected to reduce labor force participation on the intensive margin.

individuals' employment remains in need of explanation. The contributions of each of the factors discussed above may thus be understated.

9 Discussion and Conclusion

This paper analyzes the evolution of employment and wage distributions across skill groups, industries, and the U.S. labor market as a whole. Low-skilled individuals experienced a substantial and prolonged decline in employment spanning the Great Recession and subsequent recovery. Compositional effects associated with these employment changes lead average wage measures to understate the labor market's increasing weakness as the recession unfolded. Common inequality metrics similarly tend to understate the erosion of low-skilled individuals' employment opportunities.

Graphical evidence reveals that the minimum wage was a substantial source of downward wage rigidity over this time period. The wage distributions of low experience, low education individuals shifted downward until abutting the minimum wage, which concurrently rose from \$5.15 to \$7.25 at the federal level. Relatively few of these individuals appear to have been lifted to the new minimum wage, as these skill groups' employment declined considerably.

I explore the plausibility of two contrasting views of recent labor market developments. These include an institutional view, which emphasizes workers' bargaining positions in relation to firms, and a view emphasizing competitive market forces. The institutions-centric view predicts that increases in the minimum wage's bite will increase the fraction of individuals with wage rates near the statutory minimum. Over the period I analyze, this view is inconsistent with low-skilled individuals' labor market experiences. From 2002 to 2014, institutions-centric counterfactuals predict a 10 percentage point increase in the fraction of relatively low-skilled individuals earning wage rates

near or below the minimum. In the data this fraction is essentially unchanged.

The markets-centric view emphasizes an important interaction between the minimum wage and long run changes in technology and trade. Labor replacing technology and trade exert downward pressure on low-skilled individuals' wage distributions. These forces thus exacerbate the extent to which a given minimum wage reduces employment. The predictions of this view match long-run employment changes reasonably well.

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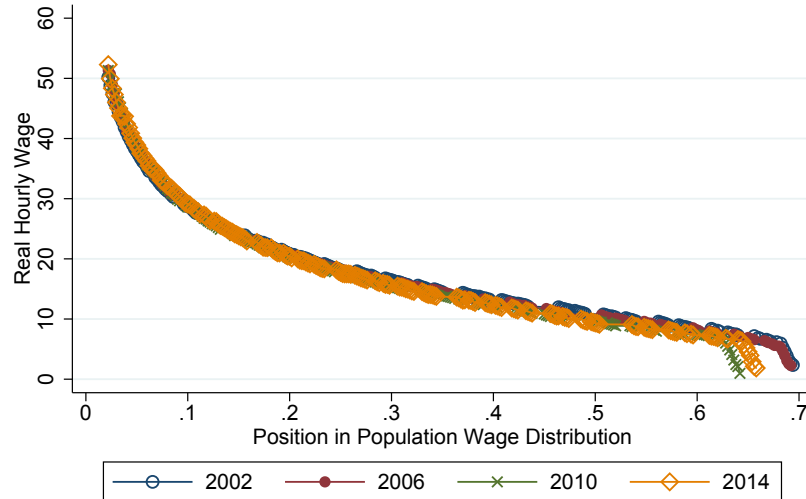
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Figures and Tables

Full Population Wage Distributions

Panel A

Employment and Wages (in 2010 Dollars) All Skill Groups



Panel B

Employment and Wages (Nominal) All Skill Groups



Figure 1: Full Population Wage Distributions: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples are restricted to individuals ages 16 to 64 in states that had January 2008 minimum wage rates below \$6.55. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. The panels present the full wage distribution, in declining order, for workers below the top two percentiles. For Panel A, wage rates for all years are expressed in July 2009 dollars. For Panel B, wage rates for all years are reported in nominal terms.

Full Population Wage Distributions

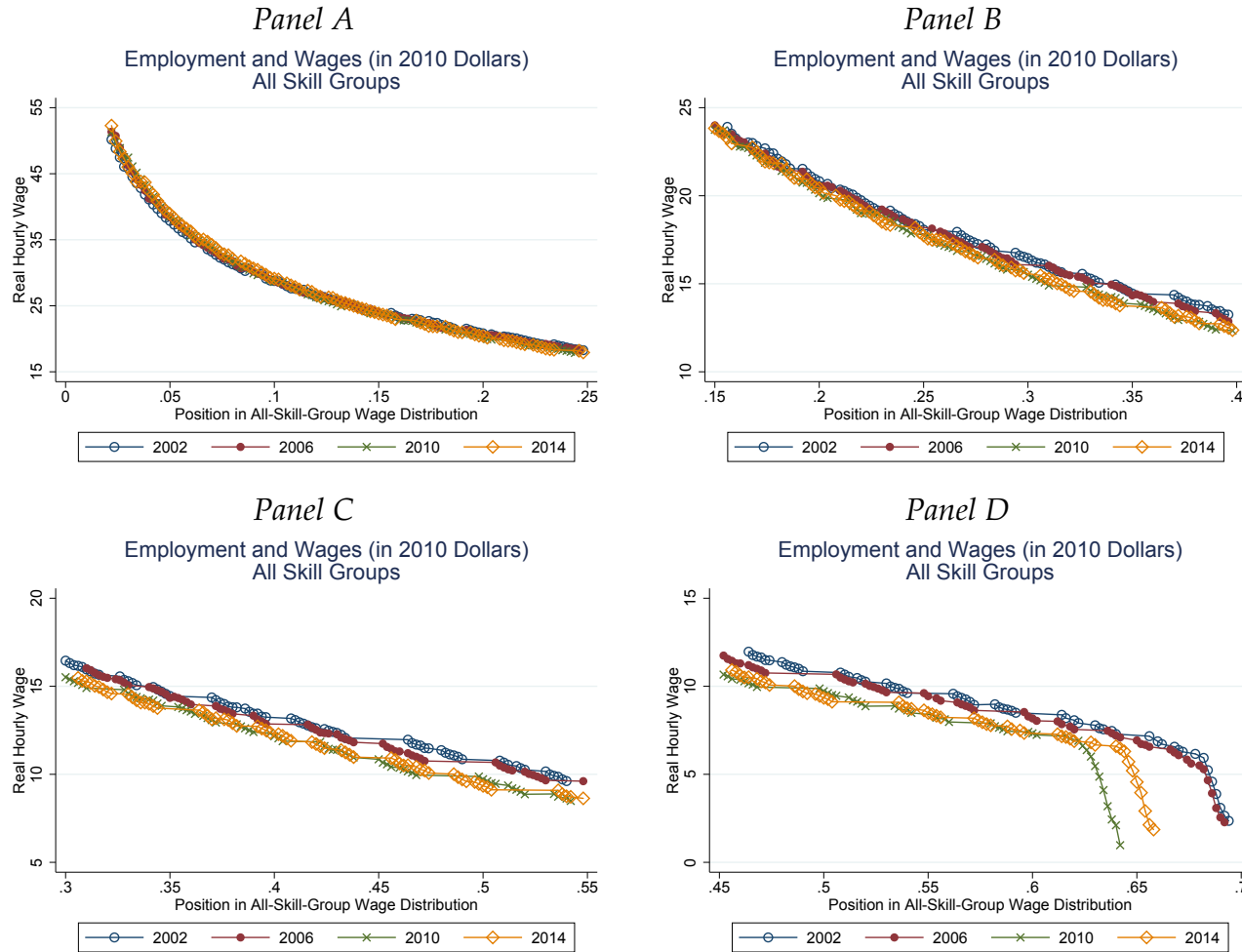


Figure 2: Full Population Wage Distributions: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples are restricted to individuals ages 16 to 64 in states that had January 2008 minimum wage rates below \$6.55. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. Each panel presents a segment of the full population wage distribution. The presented percentiles are indicated by the x-axis values.

Evolution of Real Wage Distributions across Skill Groups

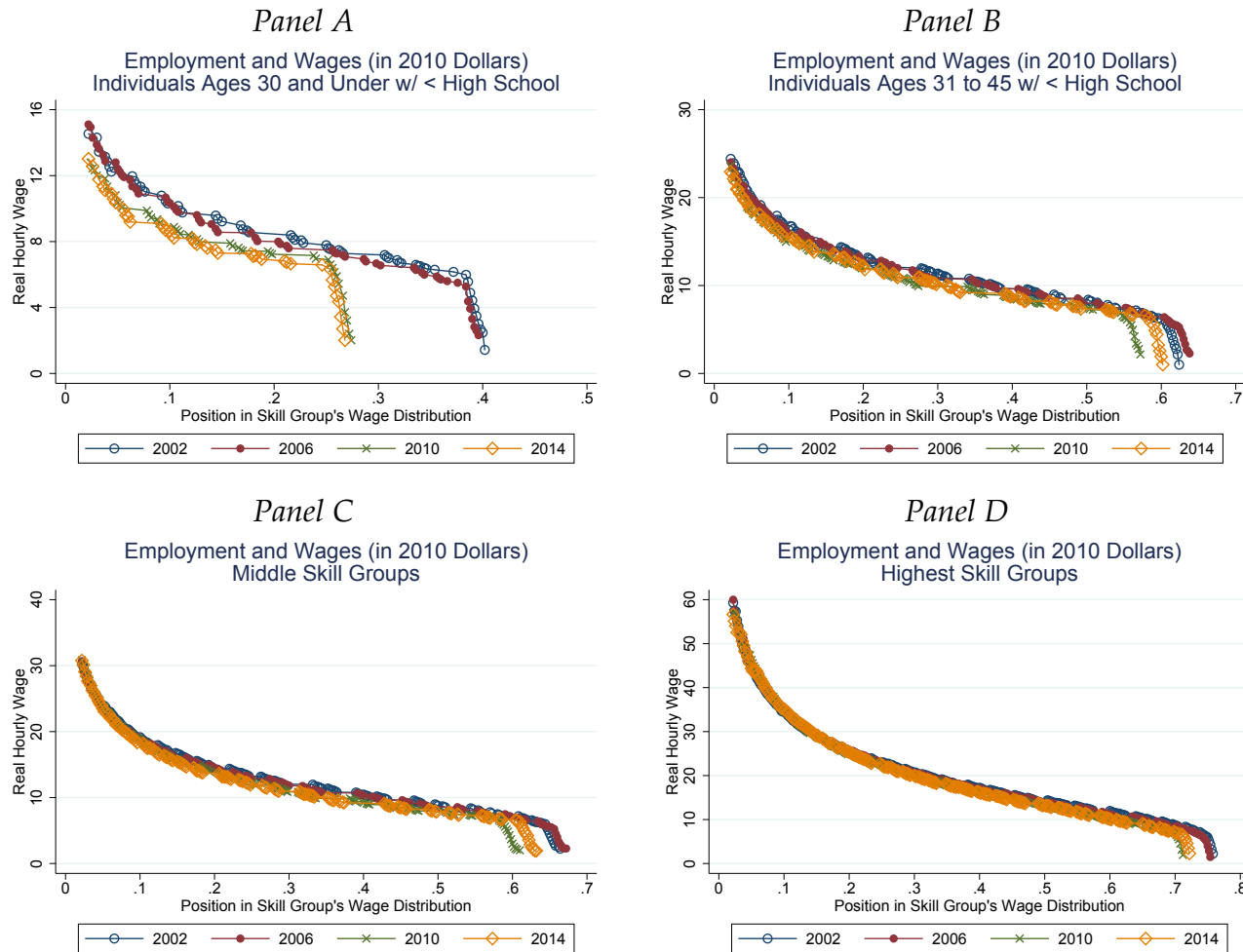


Figure 3: Evolution of Real Wage Distributions across Skill Groups

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The sample in Panel A consists of individuals ages 16 to 30 with less than a high school education. The sample in Panel B consists of individuals ages 31 to 45 with less than a high school education. The samples in Panels C and D contain the Middle Skilled and Highest Skilled individuals, as defined in the main text. All samples are restricted to individuals who reside in states that had January 2008 minimum wage rates below \$6.55. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. Wage rates for all years are expressed in July 2009 dollars.

Evolution of Nominal Wage Distributions across Skill Groups

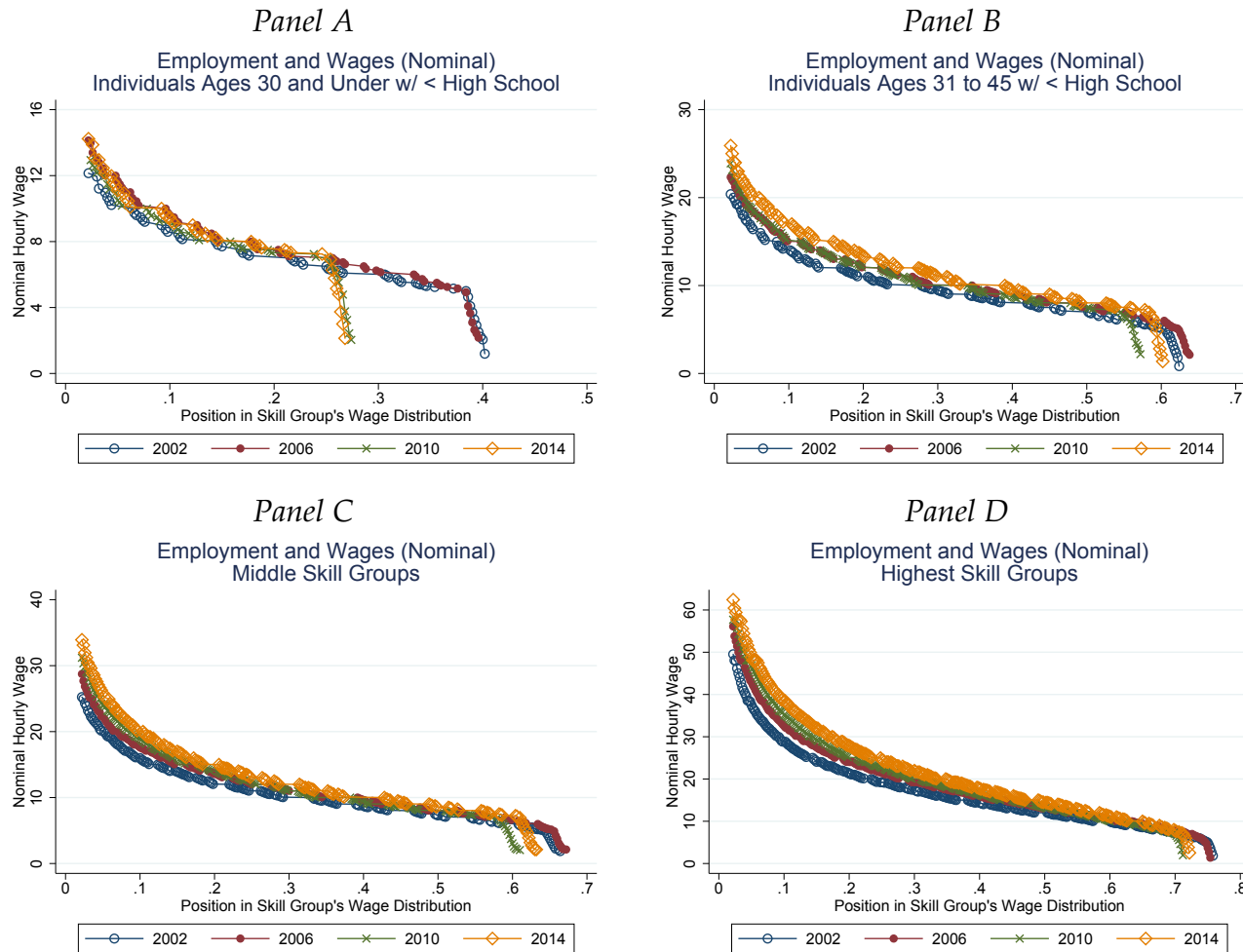


Figure 4: Evolution of Nominal Wage Distributions across Skill Groups

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The sample in Panel A consists of individuals ages 16 to 30 with less than a high school education. The sample in Panel B consists of individuals ages 31 to 45 with less than a high school education. The samples in Panels C and D contain the Middle Skilled and Highest Skilled individuals, as defined in the main text. All samples are restricted to individuals who reside in states that had January 2008 minimum wage rates below \$6.55. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. Wage rates are expressed in nominal terms.

The Lower Tail of Middle and Higher Skilled Groups' Wage Distributions

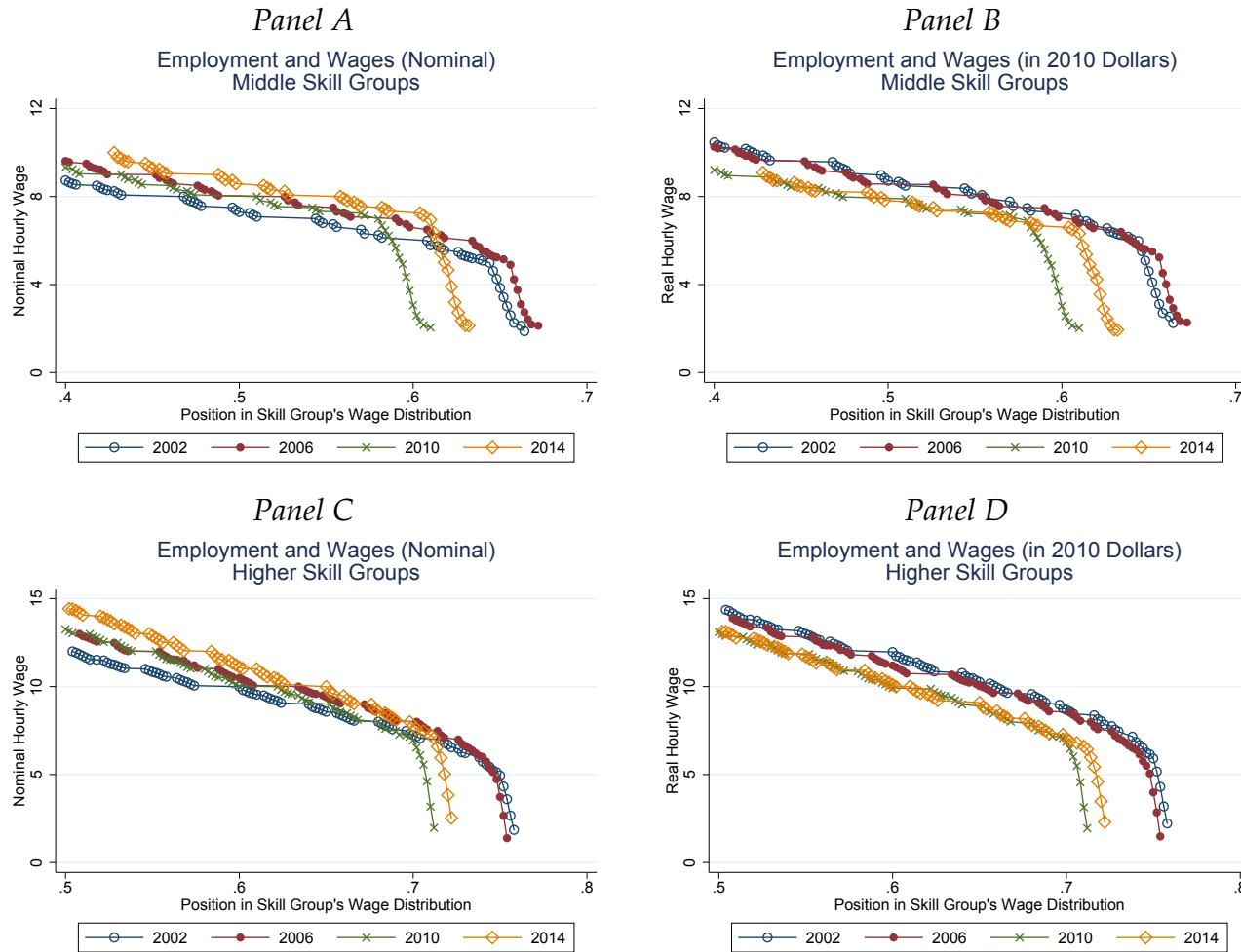
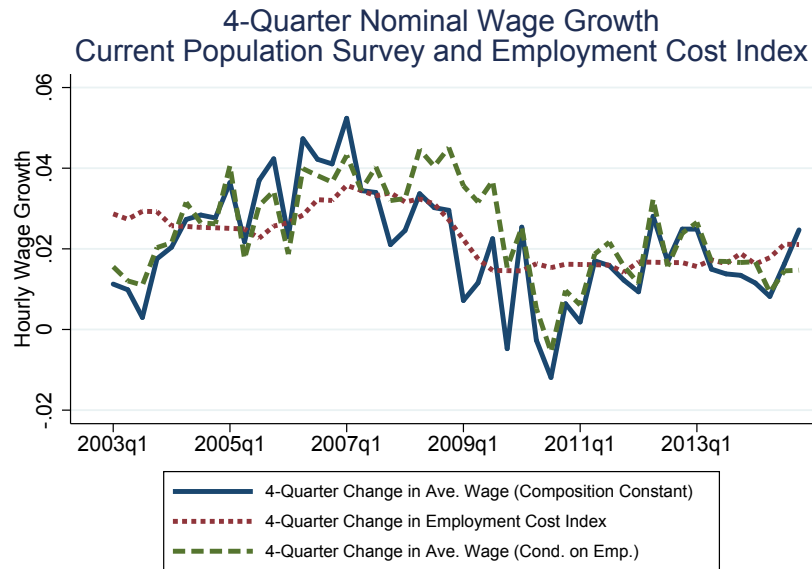


Figure 5: The Lower Tail of Middle and Higher Skilled Groups' Wage Distributions

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples in Panels A and B consist of the Middle Skilled individuals as defined in the main text. The samples in Panels C and D consist of the Highest Skilled individuals as defined in the main text. The data in Panels A and C are presented in 2010 dollars while the data in Panels B and D are presented in nominal terms. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. Each panel presents a segment of relevant skill group's wage distribution. The presented percentiles are indicated by the x-axis values.

Evolution of Average Wages: 2002 through 2014

Panel A



Panel B



Figure 6: Evolution of Average Wages: 2002 through 2014

Note: The figure reports average hourly wage data as estimated using data from BLS's Employment Cost Index series and the NBER's Merged Outgoing Rotation Group extracts of the Current Population Survey (CPS-MORG). For the CPS-MORG series, wages are averaged across employed individuals in the full working age population or across continuously employed percentiles of the full population (see the main text for further explanation). The series in Panel A are 4-quarter nominal growth rates. The series in Panel B are levels for which each series is indexed relative to its value in the first quarter of 2002.

Broad Trade Employment and Wages

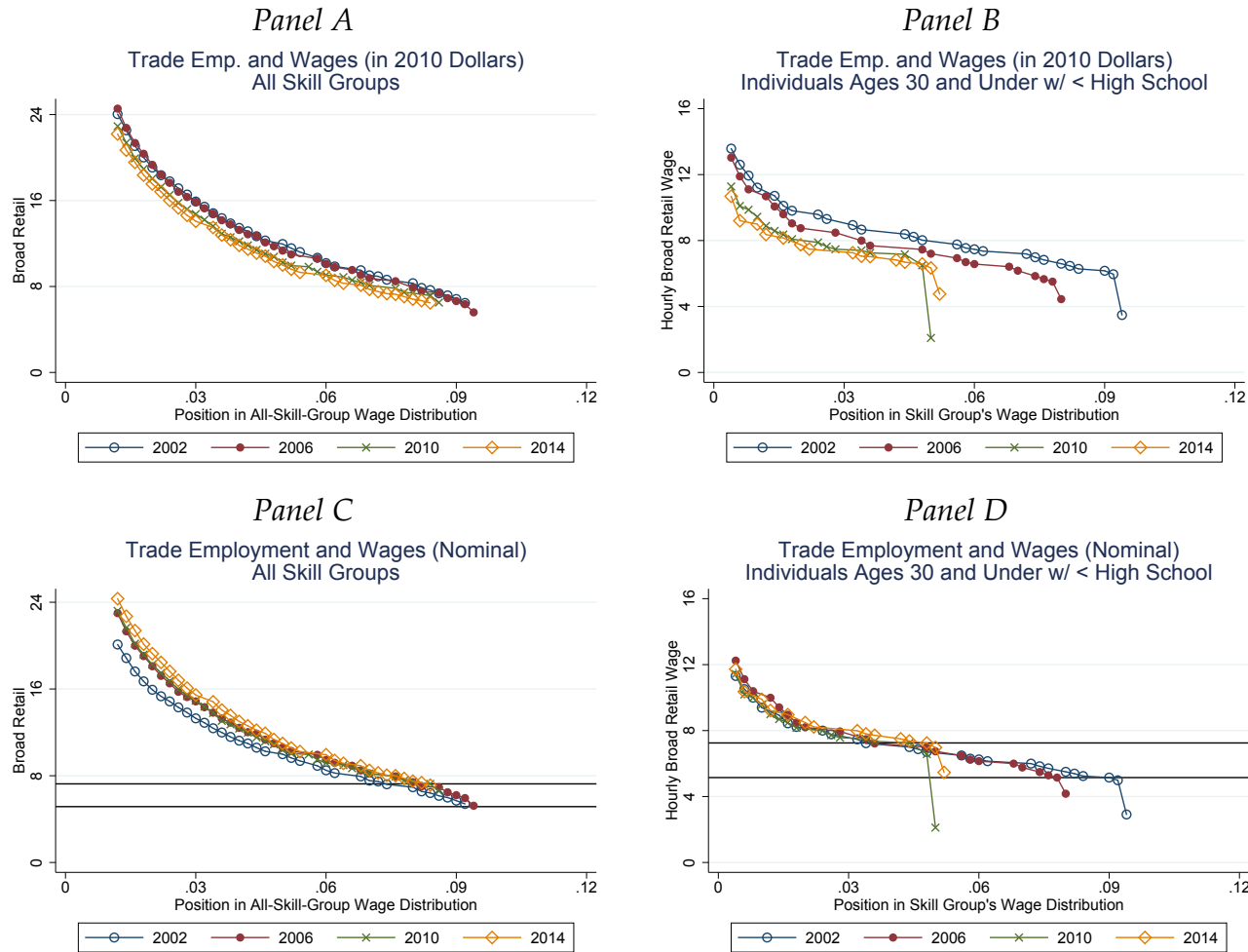


Figure 7: Broad Trade Employment and Wages: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples in Panels B and D consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. The samples in Panels A and C consist of all individuals ages 16 to 64 who reside in states that had January 2008 minimum wage rates below \$6.55. The figure presents distributions of wage rates within Broad Trade industries. Wage rates were thus set to 0 for those who were unemployed or employed in other industries. The retail wage rates for each year were then divided into 500 quantiles. The data in Panels A and B are presented in 2010 dollars while the data in Panels C and D are presented in nominal terms.

Food Service Employment and Wages

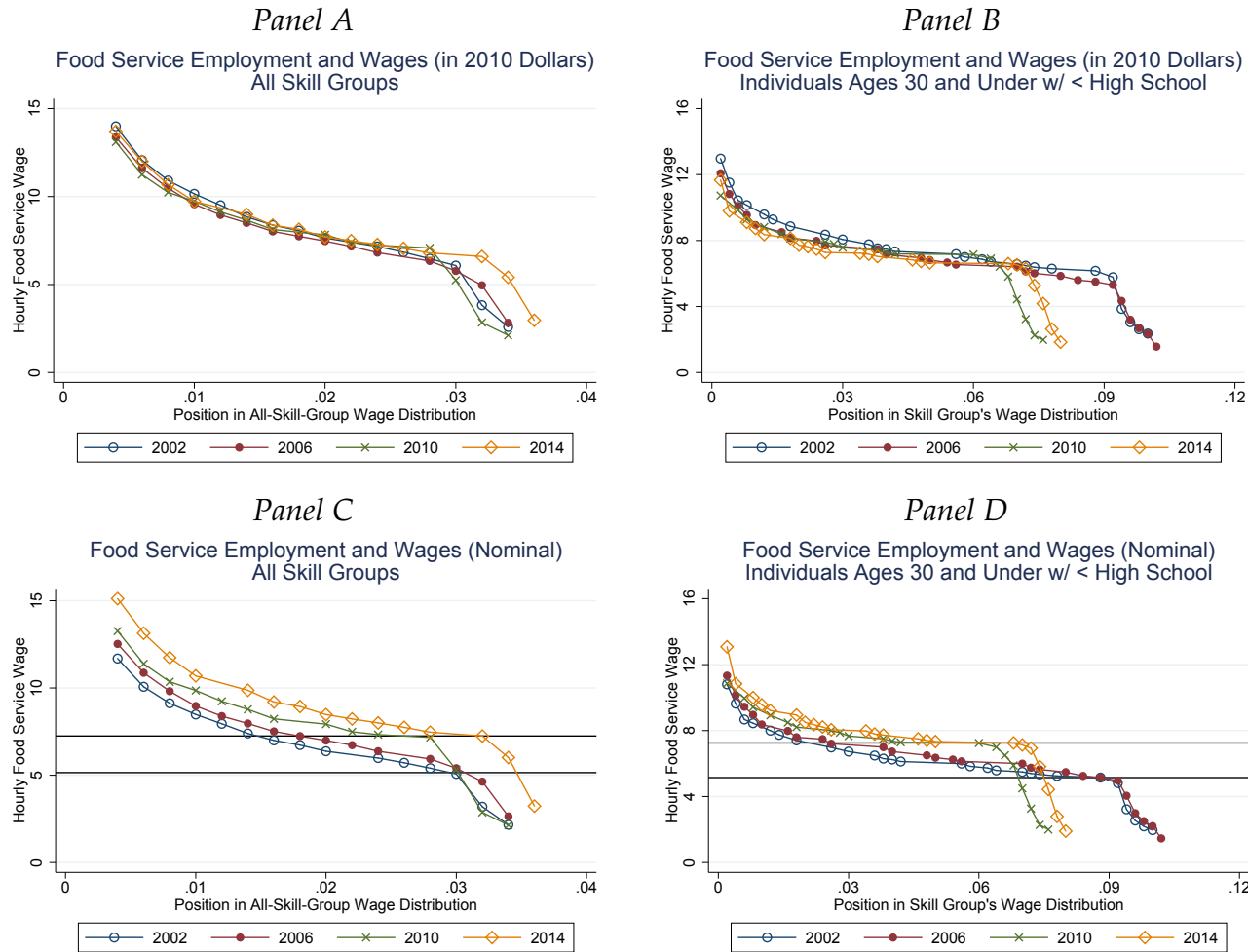


Figure 8: Food Service Employment and Wages: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples in Panels B and D consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. The samples in Panels A and C consist of all individuals ages 16 to 64 who reside in states that had January 2008 minimum wage rates below \$6.55. The figure presents distributions of wage rates within the Food Service industry. Wage rates were thus set to 0 for those who were unemployed or employed in other industries. The retail wage rates for each year were then divided into 500 quantiles. The data in Panels A and B are presented in 2010 dollars while the data in Panels C and D are presented in nominal terms.

Construction and Manufacturing Employment and Wages

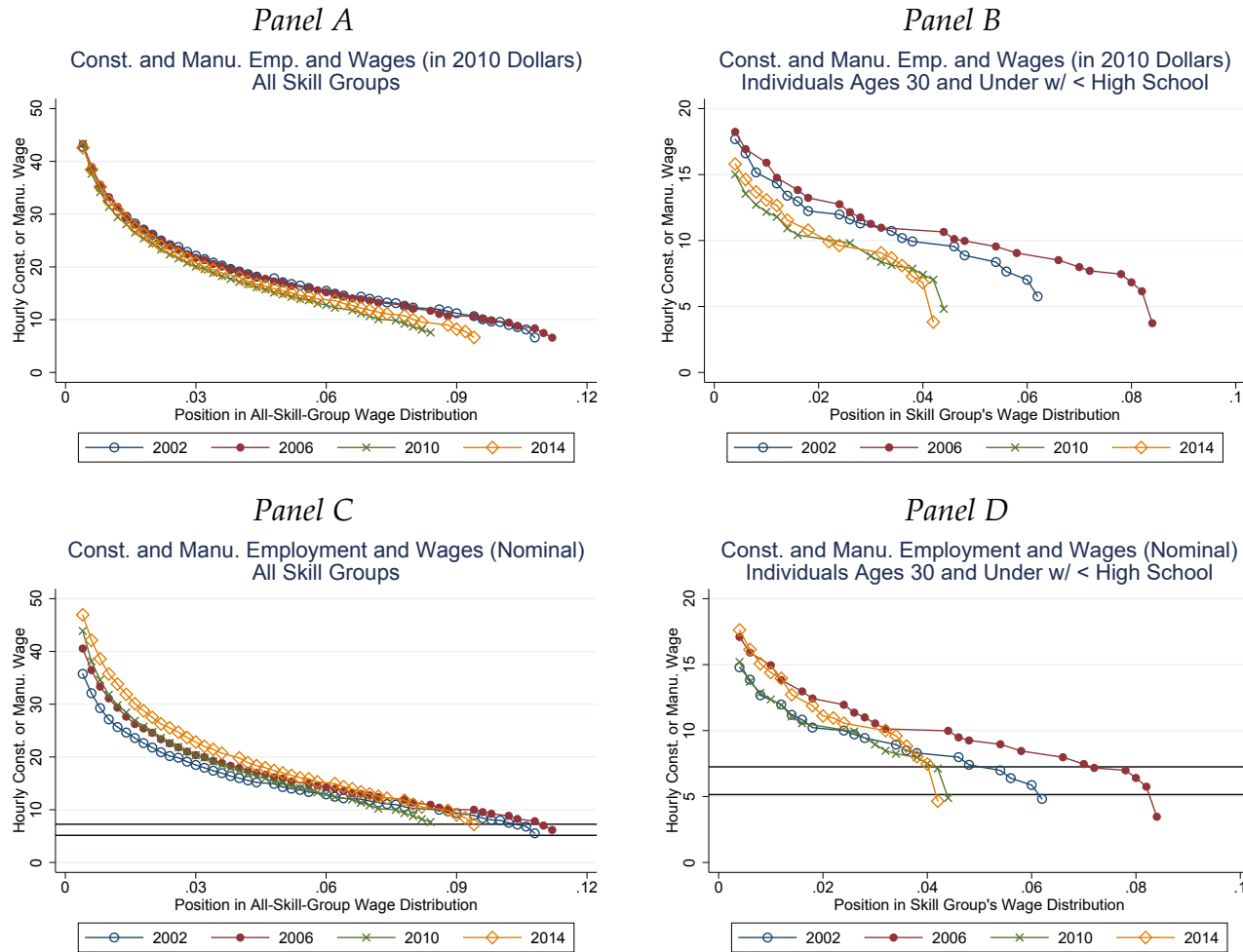
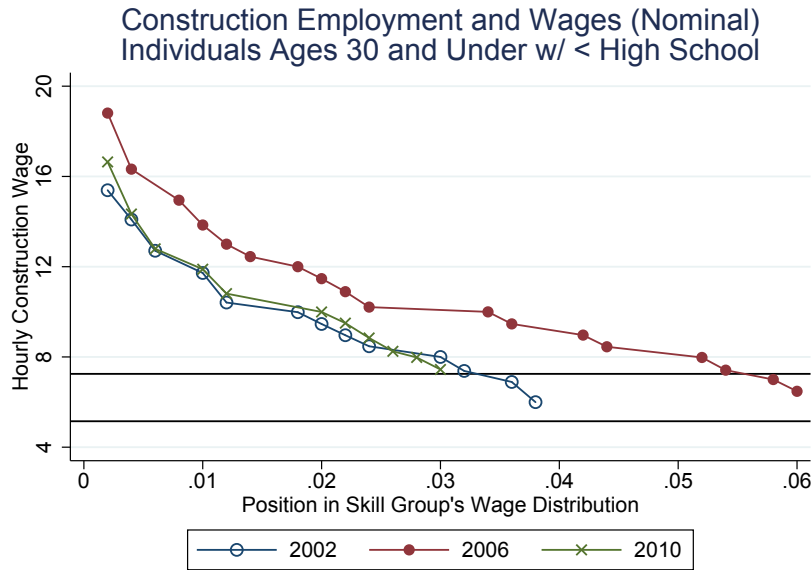


Figure 9: Construction and Manufacturing Employment and Wages: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples in Panels B and D consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. The samples in Panels A and C consist of all individuals ages 16 to 64 who reside in states that had January 2008 minimum wage rates below \$6.55. The figure presents distributions of wage rates within Construction and Manufacturing industries. Wage rates were thus set to 0 for those who were unemployed or employed in other industries. The retail wage rates for each year were then divided into 500 quantiles. The data in Panels A and B are presented in 2010 dollars while the data in Panels C and D are presented in nominal terms.

Construction Wage Distribution and Turnover

Panel A



Panel B

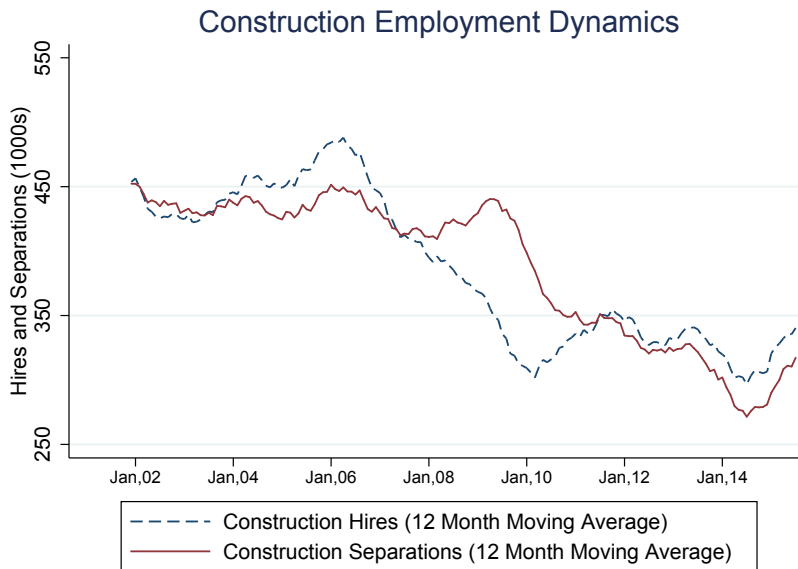


Figure 10: Construction Wage Distribution and Turnover

Note: Panel A presents wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, and 2010. The samples consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. The figure presents distributions of wage rates within the construction industry. Wage rates were thus set to 0 for those who were unemployed or employed in other industries. The construction wage rates for each year were then divided into 500 quantiles. The data in Panel B are 12 month moving averages of new hires and separations in the construction industry as reported in the Job Openings and Labor Turnover Survey (JOLTS).

All Other Employment and Wages

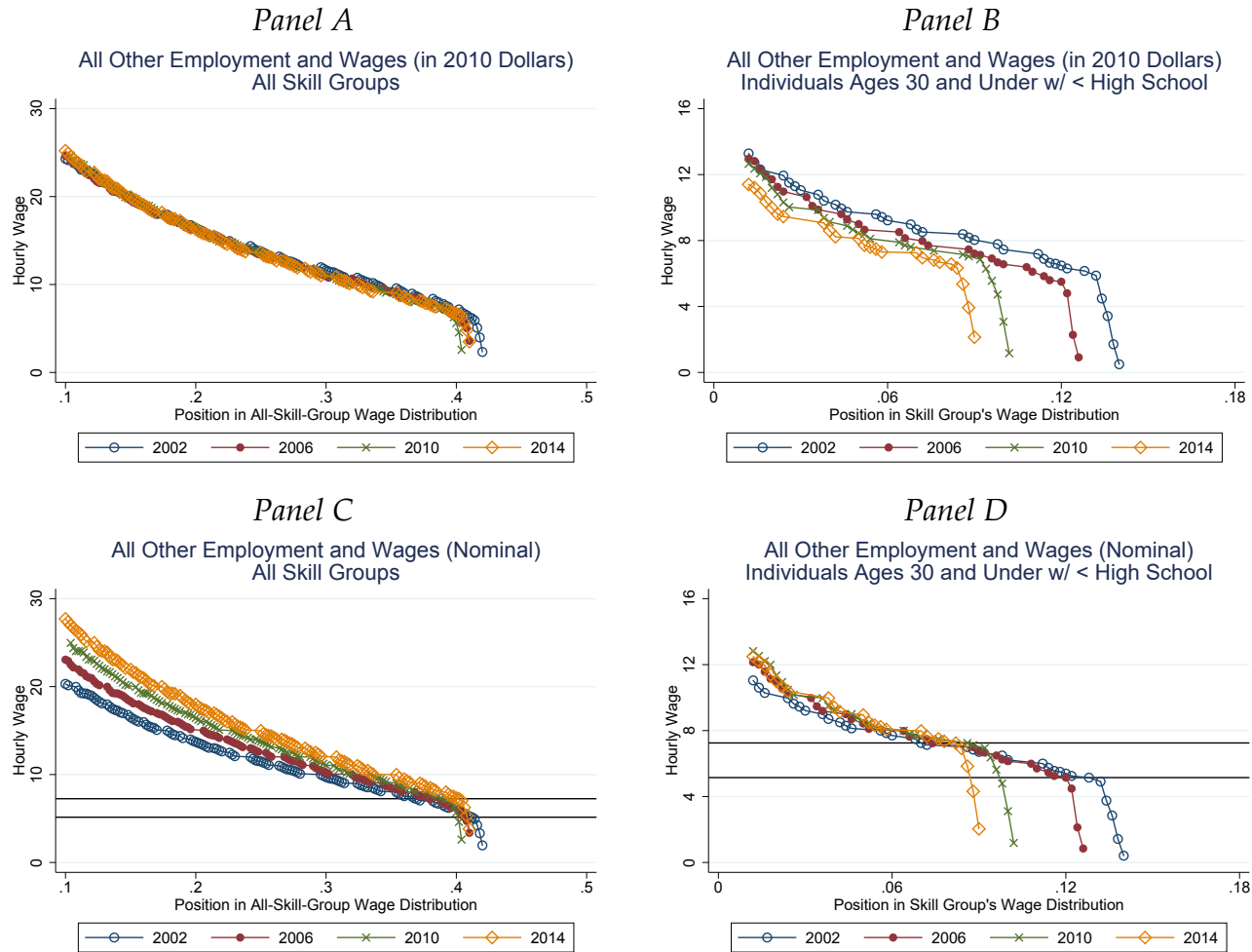


Figure 11: All Other Employment and Wages: 2002, 2006, 2010, and 2014

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. The samples in Panels B and D consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. The samples in Panels A and C consist of all individuals ages 16 to 64 who reside in states that had January 2008 minimum wage rates below \$6.55. The figure presents distributions of wage rates within All Other industries. Wage rates were thus set to 0 for those who were unemployed or employed in other industries. The retail wage rates for each year were then divided into 500 quantiles. The data in Panels A and B are presented in 2010 dollars while the data in Panels C and D are presented in nominal terms.

Examples of Data vs. Counterfactuals During the Recession

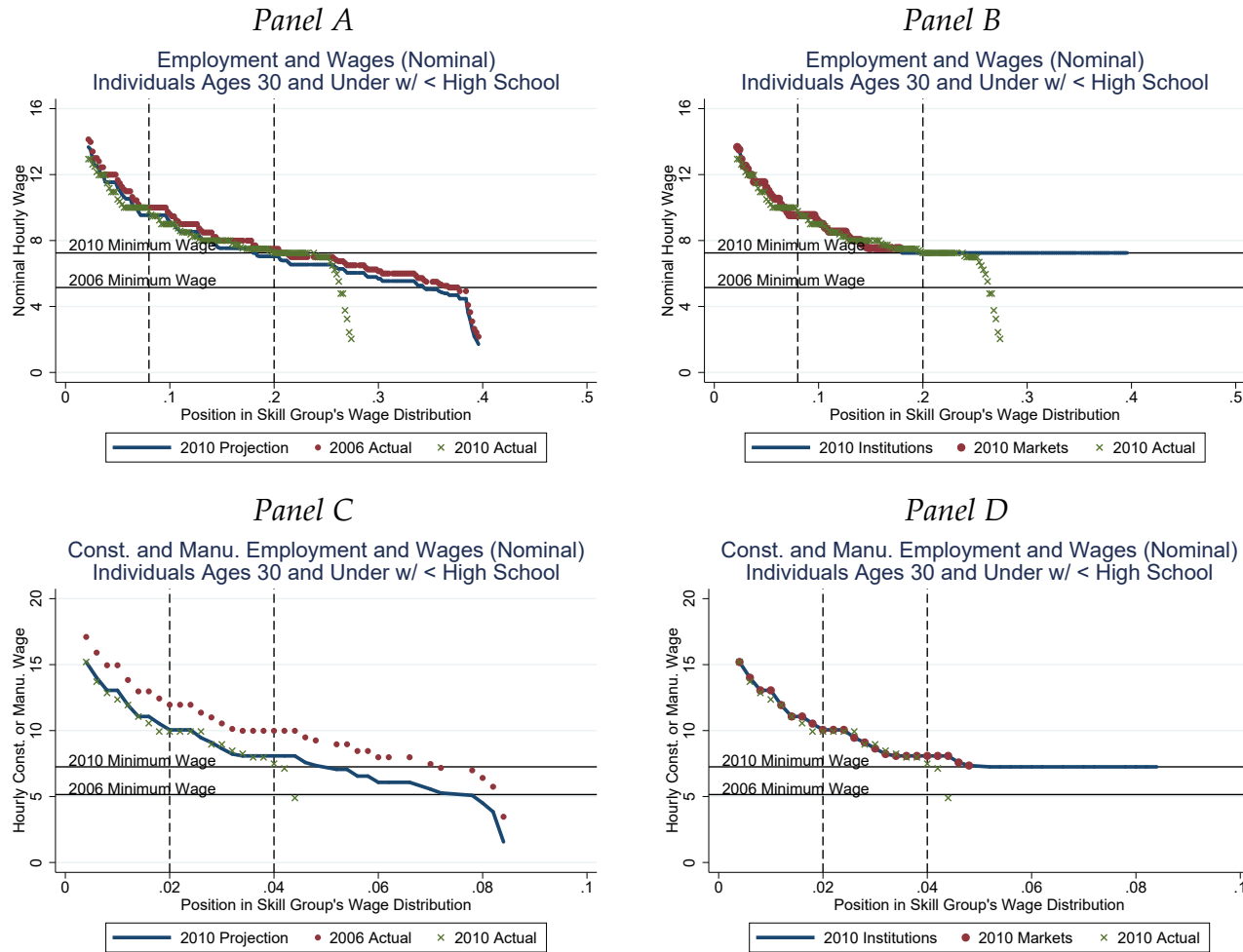


Figure 12: Examples of Data vs. Counterfactuals During the Recession

Note: The panels present wage distributions constructed using data from the NBER's CPS-MORG files for 2006 and 2010, along with several counterfactual distributions for 2010. The samples consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. Panels A and B present distributions of wage rates across all industries, while Panels C and D present distributions of wage rates within the Construction and Manufacturing industries. Wage rates were thus set to 0 for those who were unemployed (or in the case of Panels C and D, those unemployed or employed in other industries). The wage rates for each year were then divided into 500 quantiles. The construction of the "projected" and "counterfactual" wage distributions is discussed in detail in the text.

Examples of Data vs. Counterfactuals Over the Long Run

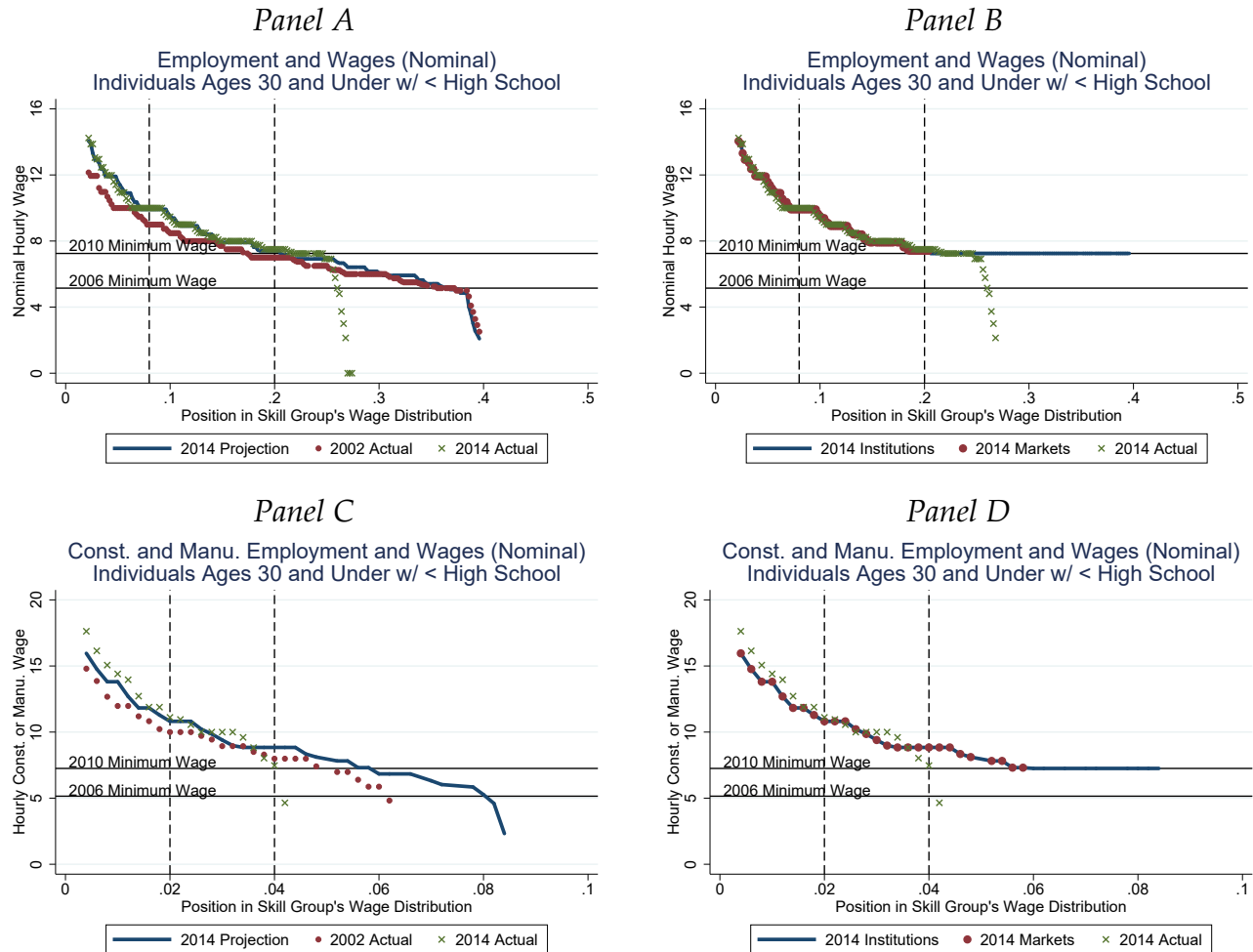


Figure 13: Examples of Data vs. Counterfactuals Over the Long Run

Note: The panels present wage distributions constructed using data from the NBER's CPS-MORG files for 2002 and 2014, along with several counterfactual distributions for 2014. The samples consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. Panels A and B present distributions of wage rates across all industries, while Panels C and D present distributions of wage rates within the Construction and Manufacturing industries. Wage rates were thus set to 0 for those who were unemployed (or in the case of Panels C and D, those unemployed or employed in other industries). The wage rates for each year were then divided into 500 quantiles. The construction of the "projected" and "counterfactual" wage distributions is discussed in detail in the text.

Low-Skilled Individuals' Employment and Wage Distributions in Recent Years

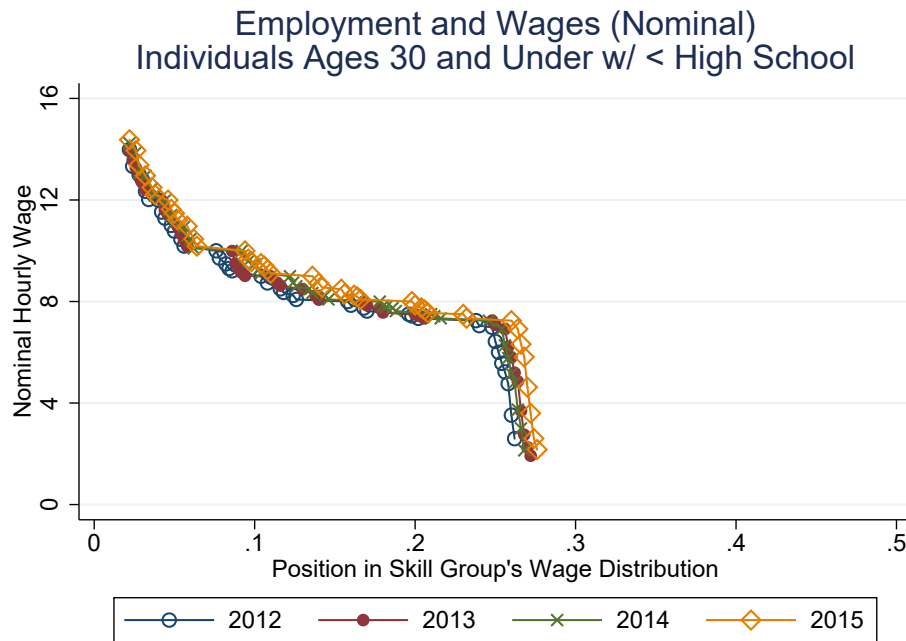


Figure 14: Low-Skilled Individuals' Employment and Wage Distributions in Recent Years

Note: The panels of the figure present wage distributions constructed using data from the NBER's CPS-MORG files for 2012, 2013, 2014, and 2015. The samples consist of individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. Workers were sorted according to their wage rates, with unemployed individuals assigned wage rates of 0. When available, individual-level wage rates are the reported values of the variable "earnhre" divided by 100. When "earnhre" is missing, I impute the individual's wage as "earnwke/hours." The wage rates for each year were then divided into 500 quantiles. The Panels present the full wage distribution, in declining order, for workers below the top two percentiles.

Table 1: Evolution of Average Wages and Employment across Skill Groups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Level by Year				Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i> Average Wages Conditional on Employment (2010 Dollars)								
All Skill Groups	18.71	18.56	18.90	18.61	-0.15	0.34	-0.29	-0.10
Least Skilled	9.40	9.21	9.12	9.10	-0.19	-0.09	-0.02	-0.30
Middle Skilled	13.91	13.67	13.78	13.33	-0.24	0.11	-0.45	-0.48
Highest Skilled	21.78	21.75	21.85	21.51	-0.03	0.10	-0.30	-0.37
<i>Panel B:</i> Fraction Employed								
All Skill Groups	0.724	0.722	0.672	0.685	-0.002	-0.050	0.013	-0.041
Least Skilled	0.414	0.409	0.288	0.278	-0.005	-0.121	-0.010	-0.136
Middle Skilled	0.682	0.691	0.630	0.649	0.009	-0.061	0.019	-0.033
Highest Skilled	0.789	0.785	0.744	0.751	-0.004	-0.041	0.007	-0.038
<i>Panel C:</i> Average Wages at Continuously Employed Percentiles (2010 Dollars)								
All Skill Groups	19.72	19.54	18.90	18.98	-0.18	-0.64	0.08	-0.74
Least Skilled	10.81	10.70	9.28	9.10	-0.09	-1.42	-0.18	-1.71
Middle Skilled (All)	14.72	14.54	13.78	13.71	-0.18	-0.76	-0.07	-1.01
Middle Skilled (Lower Pctiles)	8.71	8.58	7.39	7.81	-0.13	-1.19	0.42	-0.91
Highest Skilled (All)	22.77	22.67	21.85	21.75	-0.10	-0.82	-0.10	-1.02
Highest Skilled (Lower Pctiles)	11.41	11.10	9.83	10.00	-0.31	-1.27	0.17	-1.41

Note: The table presents wage and employment data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Samples were restricted to individuals who reside in states that had January 2008 minimum wage rates below \$6.55. Panel A presents average wages conditional on employment, Panel B presents employment rates, and Panel C presents average data across continuously employed percentiles as defined in the main text. In each panel, the row labeled "All Skill Groups" reports data for all individuals ages 16 to 64. The Least Skilled, Middle Skilled, and Highest Skilled groups are defined in the main text. In Panel C, the "Lower Pctiles" refer to percentiles below the 40th for the Middle Skilled and below the 50th for the Highest Skilled. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively. Wage data for each year have been converted into constant July 2009 dollars.

Table 2: **Basic Institutions-Centric Counterfactual vs. Data**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Level by Year				Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i> Fraction within 50 Cents or Below the Minimum: Actual Data								
All Least Skilled	0.082	0.054	0.112	0.086	-0.028	0.058	-0.026	0.004
Least Skilled in Trade	0.018	0.010	0.026	0.018	-0.008	0.016	-0.008	0.000
Least Skilled in Food Service	0.036	0.028	0.018	0.042	-0.008	-0.010	0.024	0.006
Least Skilled in Const. or Manu.	0.002	0.002	0.006	0.004	0.000	0.004	-0.002	0.002
Least Skilled in All Other	0.022	0.014	0.034	0.020	-0.008	0.020	-0.014	-0.002
<i>Panel B:</i> Fraction within 50 Cents or Below the Minimum: Naive Bargaining Institution Counterfactual								
All Least Skilled	0.106	0.054	0.252	0.218	-0.052	0.198	-0.034	0.112
Least Skilled in Retail	0.010	0.010	0.052	0.052	0.000	0.042	0.000	0.042
Least Skilled in Food	0.036	0.030	0.074	0.064	-0.006	0.044	-0.010	0.028
Least Skilled in Const. or Manu.	0.012	0.002	0.038	0.030	-0.010	0.036	-0.008	0.018
Least Skilled in All Other	0.022	0.014	0.058	0.058	-0.008	0.044	0.000	0.036
<i>Panel C:</i> Actual Data Net of Naive Bargaining Institution Counterfactual								
All Least Skilled	-0.024	0.000	-0.140	-0.132	0.024	-0.140	0.008	-0.108
Least Skilled in Retail	0.008	0.000	-0.026	-0.034	-0.008	-0.026	-0.008	-0.042
Least Skilled in Food	0.000	-0.002	-0.056	-0.022	-0.002	-0.054	0.034	-0.022
Least Skilled in Const. or Manu.	-0.010	0.000	-0.032	-0.026	0.010	-0.032	0.006	-0.016
Least Skilled in All Other	0.000	0.000	-0.024	-0.038	0.000	-0.024	-0.014	-0.038

Note: The table presents tabulations constructed using wage data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Samples were restricted to individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. Panel A presents the fraction of individuals with wages within 50 cents of or below the effective minimum wage. Panel B presents counterfactual projections of this fraction constructed based on the assumptions of the institutions-centric view of wage determination as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 3: **Robustness of Institutions-Centric Counterfactual: Selection Adjustment and Non-Teenage Dropouts**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Level by Year			Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i>		Fraction within 50 Cents or Below the Minimum: Actual Data						
Ages 16 to 30 w/ < High School	0.082	0.054	0.112	0.086	-0.028	0.058	-0.026	0.004
Ages 21 to 35 w/ < High School	0.048	0.032	0.106	0.070	-0.016	0.074	-0.036	0.022
<i>Panel B:</i>		Fraction within 50 Cents or Below the Minimum: Institutions-Centric Counterfactual Robustness						
Basic Ages 16 to 30 w/ < High School	0.106	0.054	0.252	0.218	-0.052	0.198	-0.034	0.112
Basic Ages 21 to 35 w/ < High School	0.062	0.032	0.228	0.138	-0.030	0.196	-0.090	0.076
Modified Ages 16 to 30 w/ < High School	0.060	0.054	0.216	0.220	-0.006	0.162	0.004	0.160
Modified Ages 21 to 35 w/ < High School	0.054	0.032	0.174	0.144	-0.022	0.142	-0.030	0.090
<i>Panel C:</i>		Actual Data Net of Institutions-Centric Counterfactuals						
Basic Ages 16 to 30 w/ < High School	-0.024	0.000	-0.140	-0.132	0.024	-0.140	0.008	-0.108
Basic Ages 21 to 35 w/ < High School	-0.014	0.000	-0.122	-0.068	0.014	-0.122	0.054	-0.054
Modified Ages 16 to 30 w/ < High School	0.022	0.000	-0.104	-0.134	-0.022	-0.104	-0.030	-0.156
Modified Ages 21 to 35 w/ < High School	-0.006	0.000	-0.068	-0.074	0.006	-0.068	-0.006	-0.068

Note: The table presents tabulations constructed using wage data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Samples were restricted to individuals who reside in states that had January 2008 minimum wage rates below \$6.55. As indicated in the row labels, some samples were restricted to individuals ages 16 to 30 with less than a high school education, while others were restricted to individuals ages 21 to 35 with less than a high school education. Panel A presents the fraction of individuals with wages within 50 cents of or below the effective minimum wage. Panel B presents counterfactual projections of this fraction. As indicated in the row labels, some counterfactuals correspond to the "basic" wage projections and others to the "modified" projections as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 4: Robustness of Institutions-Centric Counterfactual: Incorporation of All States

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Level by Year			Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i>		Fraction within 50 Cents or Below the Minimum: Actual Data						
Ages 16 to 30 w/ < High School	0.090	0.086	0.099	0.083	-0.004	0.013	-0.016	-0.007
Ages 19 to 35 w/ < High School	0.057	0.051	0.089	0.075	-0.006	0.038	-0.014	0.018
<i>Panel B:</i>		Fraction within 50 Cents or Below the Minimum: Institutions-Centric Counterfactual Robustness						
Basic Ages 16 to 30 w/ < High School	0.098	0.086	0.207	0.208	-0.012	0.121	0.001	0.110
Basic Ages 19 to 35 w/ < High School	0.082	0.051	0.180	0.150	-0.031	0.129	-0.030	0.068
Modified Ages 16 to 30 w/ < High School	0.080	0.086	0.207	0.214	0.006	0.121	0.007	0.134
Modified Ages 19 to 35 w/ < High School	0.048	0.051	0.162	0.160	0.003	0.111	-0.002	0.112
<i>Panel C:</i>		Actual Data Net of Institutions-Centric Counterfactuals						
Basic Ages 16 to 30 w/ < High School	-0.008	0.000	-0.108	-0.125	0.008	-0.108	-0.017	-0.117
Basic Ages 19 to 35 w/ < High School	-0.025	0.000	-0.091	-0.075	0.025	-0.091	0.016	-0.050
Modified Ages 16 to 30 w/ < High School	0.010	0.000	-0.108	-0.131	-0.010	-0.108	-0.023	-0.141
Modified Ages 19 to 35 w/ < High School	0.009	0.000	-0.073	-0.085	-0.009	-0.073	-0.012	-0.094

Note: The table presents tabulations constructed using wage data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Entries are averages of estimates across the full set of 50 states plus the District of Columbia. As indicated in the row labels, some samples were restricted to individuals ages 16 to 30 with less than a high school education, while others were restricted to individuals ages 21 to 35 with less than a high school education. Panel A presents the fraction of individuals with wages within 50 cents of or below the effective minimum wage. Panel B presents counterfactual projections of this fraction. As indicated in the row labels, some counterfactuals correspond to the "basic" wage projections and others to the "modified" projections as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 5: **Robustness of Institutions-Centric Counterfactual: Allowance for a Larger “Ripple Effect”**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Level by Year			Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i>		Fraction within One Dollar or Below the Minimum: Actual Data						
Ages 16 to 30 w/ < High School	0.129	0.120	0.129	0.113	-0.009	0.009	-0.016	-0.016
Ages 21 to 35 w/ < High School	0.090	0.770	0.131	0.110	0.680	-0.639	-0.021	0.020
<i>Panel B:</i>		Fraction within One Dollar or Below the Minimum: Institutions-Centric Counterfactual Robustness						
Basic Ages 16 to 30 w/ < High School	0.131	0.120	0.246	0.239	-0.011	0.126	-0.007	0.108
Basic Ages 19 to 35 w/ < High School	0.121	0.770	0.222	0.196	0.649	-0.548	-0.026	0.075
Modified Ages 16 to 30 w/ < High School	0.111	0.120	0.240	0.243	0.009	0.120	0.003	0.132
Modified Ages 19 to 35 w/ < High School	0.081	0.770	0.210	0.197	0.689	-0.560	-0.013	0.116
<i>Panel C:</i>		Actual Data Net of Institutions-Centric Counterfactuals						
Basic Ages 16 to 30 w/ < High School	-0.002	0.000	-0.117	-0.126	0.002	-0.117	-0.009	-0.124
Basic Ages 19 to 35 w/ < High School	-0.031	0.000	-0.091	-0.086	0.031	-0.091	0.005	-0.055
Modified Ages 16 to 30 w/ < High School	0.018	0.000	-0.111	-0.130	-0.018	-0.111	-0.019	-0.148
Modified Ages 19 to 35 w/ < High School	0.009	0.000	-0.079	-0.087	-0.009	-0.079	-0.008	-0.096

Note: The table presents tabulations constructed using wage data from the NBER’s CPS-MORG files for 2002, 2006, 2010, and 2014. Entries are averages of estimates across the full set of 50 states plus the District of Columbia. As indicated in the row labels, some samples were restricted to individuals ages 16 to 30 with less than a high school education, while others were restricted to individuals ages 21 to 35 with less than a high school education. Panel A presents the fraction of individuals with wages within one dollar of or below the effective minimum wage. Panel B presents counterfactual projections of this fraction. As indicated in the row labels, some counterfactuals correspond to the “basic” wage projections and others to the “modified” projections as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 6: **Basic Markets-Centric Counterfactual vs. Data**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Level by Year				Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i>	Employment at Non-Zero Wage Rates: Actual Data							
All Least Skilled	0.404	0.398	0.276	0.270	-0.006	-0.122	-0.006	-0.134
Least Skilled in Trade	0.096	0.082	0.052	0.054	-0.014	-0.030	0.002	-0.042
Least Skilled in Food Service	0.102	0.104	0.078	0.082	0.002	-0.026	0.004	-0.020
Least Skilled in Const. or Manu.	0.064	0.086	0.046	0.044	0.022	-0.040	-0.002	-0.020
Least Skilled in All Other	0.142	0.128	0.104	0.092	-0.014	-0.024	-0.012	-0.050
<i>Panel B:</i>	Employment at Non-Zero Wage Rates: Markets-Centric Counterfactual							
All Least Skilled	0.342	0.398	0.200	0.234	0.056	-0.198	0.034	-0.108
Least Skilled in Trade	0.082	0.082	0.040	0.040	0.000	-0.042	0.000	-0.042
Least Skilled in Food Service	0.100	0.102	0.056	0.070	0.002	-0.046	0.014	-0.030
Least Skilled in Const. or Manu.	0.074	0.086	0.048	0.058	0.012	-0.038	0.010	-0.016
Least Skilled in All Other	0.116	0.126	0.082	0.082	0.010	-0.044	0.000	-0.034
<i>Panel C:</i>	Actual Data Net of Markets-Centric Counterfactual							
All Least Skilled	0.062	0.000	0.076	0.036	-0.062	0.076	-0.040	-0.026
Least Skilled in Trade	0.014	0.000	0.012	0.014	-0.014	0.012	0.002	0.000
Least Skilled in Food Service	0.002	0.002	0.022	0.012	0.000	0.020	-0.010	0.010
Least Skilled in Const. or Manu.	-0.010	0.000	-0.002	-0.014	0.010	-0.002	-0.012	-0.004
Least Skilled in All Other	0.026	0.002	0.022	0.010	-0.024	0.020	-0.012	-0.016

Note: The table presents employment data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Samples were restricted to individuals ages 16 to 30 with less than a high school education who reside in states that had January 2008 minimum wage rates below \$6.55. Panel A presents actual employment rates. Panel B presents counterfactual employment rates constructed based on the assumptions of the institutions-centric view of wage determination as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 7: **Robustness of Markets-Centric Counterfactual: Selection Adjustment and Non-Teenage Dropouts**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Level by Year				Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i> Employment at Non-Zero Wage Rates: Actual Data								
Ages 16 to 30 w/ < High School	0.406	0.400	0.278	0.272	-0.006	-0.122	-0.006	-0.134
Ages 21 to 35 w/ < High School	0.616	0.624	0.536	0.542	0.008	-0.088	0.006	-0.074
<i>Panel B:</i> Employment at Non-Zero Wage Rates: Markets-Centric Counterfactual Robustness								
Basic Ages 16 to 30 w/ < High School	0.342	0.398	0.200	0.234	0.056	-0.198	0.034	-0.108
Basic Ages 21 to 35 w/ < High School	0.586	0.622	0.422	0.516	0.036	-0.200	0.094	-0.070
Modified Ages 16 to 30 w/ < High School	0.358	0.398	0.234	0.234	0.040	-0.164	0.000	-0.124
Modified Ages 21 to 35 w/ < High School	0.596	0.622	0.478	0.510	0.026	-0.144	0.032	-0.086
<i>Panel C:</i> Actual Data Net of Markets-Centric Counterfactuals								
Basic Ages 16 to 30 w/ < High School	0.064	0.002	0.078	0.038	-0.062	0.076	-0.040	-0.026
Basic Ages 21 to 35 w/ < High School	0.030	0.002	0.114	0.026	-0.028	0.112	-0.088	-0.004
Modified Ages 16 to 30 w/ < High School	0.048	0.002	0.044	0.038	-0.046	0.042	-0.006	-0.010
Modified Ages 21 to 35 w/ < High School	0.020	0.002	0.058	0.032	-0.018	0.056	-0.026	0.012

Note: The table presents employment data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Samples were restricted to individuals who reside in states that had January 2008 minimum wage rates below \$6.55. As indicated in the row labels, some samples were restricted to individuals ages 16 to 30 with less than a high school education, while others were restricted to individuals ages 21 to 35 with less than a high school education. Panel A presents actual employment rates. Panel B presents counterfactual employment rates. As indicated in the row labels, some counterfactuals correspond to the "basic" projections and others to the "modified" projections as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.

Table 8: Robustness of Markets-Centric Counterfactual: Incorporation of All States

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Level by Year				Changes across Years			
	2002	2006	2010	2014	(2) - (1)	(3) - (2)	(4) - (3)	(4) - (1)
<i>Panel A:</i>					Employment at Non-Zero Wage Rates: Actual Data			
Ages 16 to 30 w/ < High School	0.378	0.374	0.256	0.249	-0.004	-0.118	-0.007	-0.129
Ages 19 to 35 w/ < High School	0.563	0.569	0.461	0.475	0.006	-0.108	0.014	-0.088
<i>Panel B:</i>					Employment at Non-Zero Wage Rates: Markets-Centric Counterfactual Robustness			
Basic Ages 16 to 30 w/ < High School	0.361	0.374	0.252	0.253	0.013	-0.122	0.001	-0.108
Basic Ages 19 to 35 w/ < High School	0.528	0.569	0.433	0.452	0.041	-0.136	0.019	-0.076
Modified Ages 16 to 30 w/ < High School	0.380	0.374	0.252	0.246	-0.006	-0.122	-0.006	-0.134
Modified Ages 19 to 35 w/ < High School	0.564	0.569	0.448	0.459	0.005	-0.121	0.011	-0.105
<i>Panel C:</i>					Actual Data Net of Markets-Centric Counterfactuals			
Basic Ages 16 to 30 w/ < High School	0.017	0.000	0.004	-0.004	-0.017	0.004	-0.008	-0.021
Basic Ages 19 to 35 w/ < High School	0.035	0.000	0.028	0.023	-0.035	0.028	-0.005	-0.012
Modified Ages 16 to 30 w/ < High School	-0.002	0.000	0.004	0.003	0.002	0.004	-0.001	0.005
Modified Ages 19 to 35 w/ < High School	-0.001	0.000	0.013	0.016	0.001	0.013	0.003	0.017

Note: The table presents employment data from the NBER's CPS-MORG files for 2002, 2006, 2010, and 2014. Entries are averages of estimates across the full set of 50 states plus the District of Columbia. As indicated in the row labels, some samples were restricted to individuals ages 16 to 30 with less than a high school education, while others were restricted to individuals ages 21 to 35 with less than a high school education. Panel A presents actual employment rates. Panel B presents counterfactual employment rates. As indicated in the row labels, some counterfactuals correspond to the "basic" projections and others to the "modified" projections as described in the main text. Panel C presents differences between the actual data from Panel A and the counterfactuals from Panel B. Entries in columns 1 through 4 are for 2002, 2006, 2010, and 2014 as indicated in the column headings. Entries in columns 5 through 8 are for changes from 2002 to 2006, changes from 2006 to 2010, changes from 2010 to 2014, and changes from 2002 to 2014 respectively.