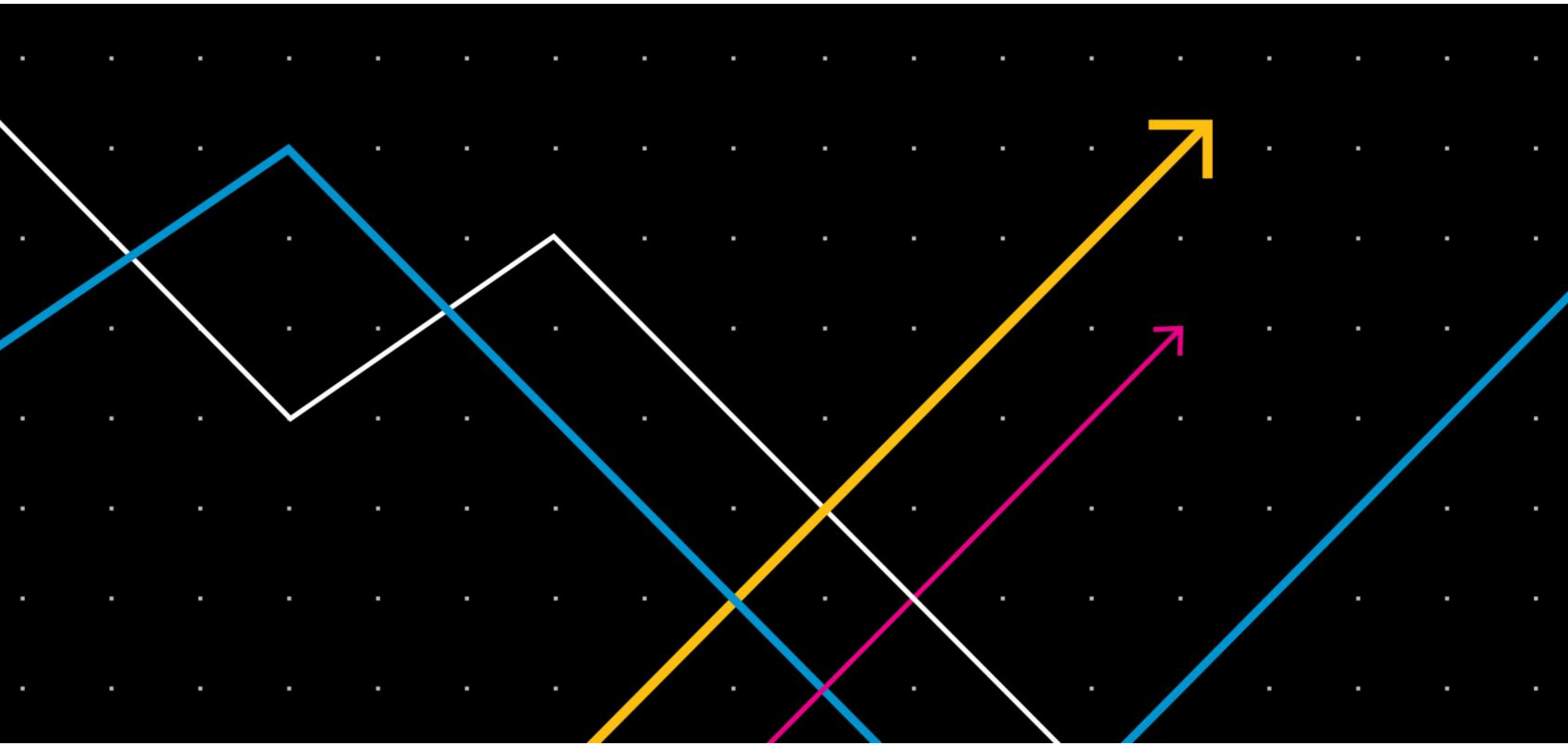

FINAL REPORT

Growing Wage Inequality, the Minimum Wage, and the Future Distribution of Retirement Income

Damir Cosic	*Richard W. Johnson*	*Karen E. Smith*

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Executive Summary

Wage inequality in the United States has been rising since the 1970s. Although its growth has slowed in recent years, the forces driving wage inequality persist. Increased wage inequality has especially hurt workers near the bottom of the wage distribution, where inflation-adjusted earnings have fallen over the past few decades. Changes in the distribution of wages shape workers' lifetime earnings and affect the distribution of retirement income. People who experience high wage inequality during their working years are likely to experience high retirement income inequality, because Social Security benefits are tied to lifetime earnings, and people's ability to save for retirement depends on how much they earn.

This study examines the effect of rising wage inequality on lifetime earnings and future retirement income and evaluates the potential effectiveness of the federal minimum wage in mitigating the distributional consequences of rising wage inequality. The analysis uses the Urban Institute's Dynamic Simulation of Income Model 4 (DYNASIM4) to project future earnings and retirement income over a 70-year period under the assumption that wage inequality continues rising and compares outcomes with the baseline in which wage inequality remains constant at today's level. The study also projects future earnings and retirement income under the assumption that the federal minimum wage increases in 2017 from its current value of $7.25 per hour to $12 per hour and subsequently adjusts with inflation.

The investigators project wage inequality based on recent trends in the growth of the education premium—the hourly wage gap between college-educated workers and those with less education—which has been one of the most significant and persistent drivers of wage inequality. In the projections, the education premium grows at a diminishing rate, peaks around 2070, and remains constant thereafter. At its peak, the education premium raises projected wage inequality about 15 percent above the baseline.

The study compares mean income at ages 67 to 75 by quintiles of lifetime earnings. The income measure adds to cash income the value of imputed rent from owner-occupied housing and the income stream that a household would receive by annuitizing 80 percent of its financial assets and subtracts taxes and Medicare premiums. The measure also divides this amount by two for married couples.

The results show that the effects of rising wage inequality reverberate into retirement. If the hourly wage gap between college and high school graduates continues to grow, our projections show the following for people ages 67 to 75:

- Lifetime earnings in the top fifth of the distribution would rise 2 percent in 2045, 5 percent in 2065, and 8 percent in 2085, relative to projected levels under the baseline when the education premium does not change.
- Annual retirement incomes in the top fifth of the lifetime earnings distribution would rise 3 percent in 2045, 5 percent in 2065, and 7 percent in 2085.
- In the bottom fifth of the distribution, lifetime earnings would fall 2 percent in 2045, 5 percent in 2065, and 9 percent in 2085.
- Annual retirement incomes in the bottom fifth of the lifetime earnings distribution would fall 3 percent in 2045, 6 percent in 2065, and 13 percent in 2085. These losses exceed the percentage decline in lifetime earnings, despite Social Security's progressive benefit formula that replaces a larger share of preretirement earnings for people with limited lifetime earnings than for those with more lifetime earnings.
- The inequality of retirement income would rise over time, pushing the Gini coefficient .03 points higher than under the baseline in 2085.

A higher minimum wage would mitigate but not eliminate the effects of growing wage inequality on future retirement incomes. Immediately raising the federal minimum wage from $7.25 to $12 per hour and subsequently adjusting it for inflation would raise lifetime earnings and future retirement income for people in the bottom two-fifths of the lifetime earnings distribution, but the impact would dissipate over time, despite the built-in inflation adjustment. As average wages grow faster than prices, the share of workers who would otherwise earn less than the minimum wage would fall each decade. For retirees in the bottom fifth of the lifetime earnings distribution, the simulated increase in the minimum wage would offset 57 percent of the retirement income lost to rising wage inequality in 2065 and 37 percent of lost retirement income in 2085.

Boosting the minimum wage and maintaining its value over time as average wages rise would help low-wage workers and improve their retirement prospects, but a broader policy agenda is needed to provide all workers with a path to retirement security. Options include worker training and apprenticeship programs; financial literacy training; tax reforms that would better incentivize retirement savings for low-wage workers; and Social Security reforms, such as creating a meaningful minimum benefit or changing the benefit formula to improve progressivity.

Wage Inequality, the Minimum Wage, and Future Retirement Incomes

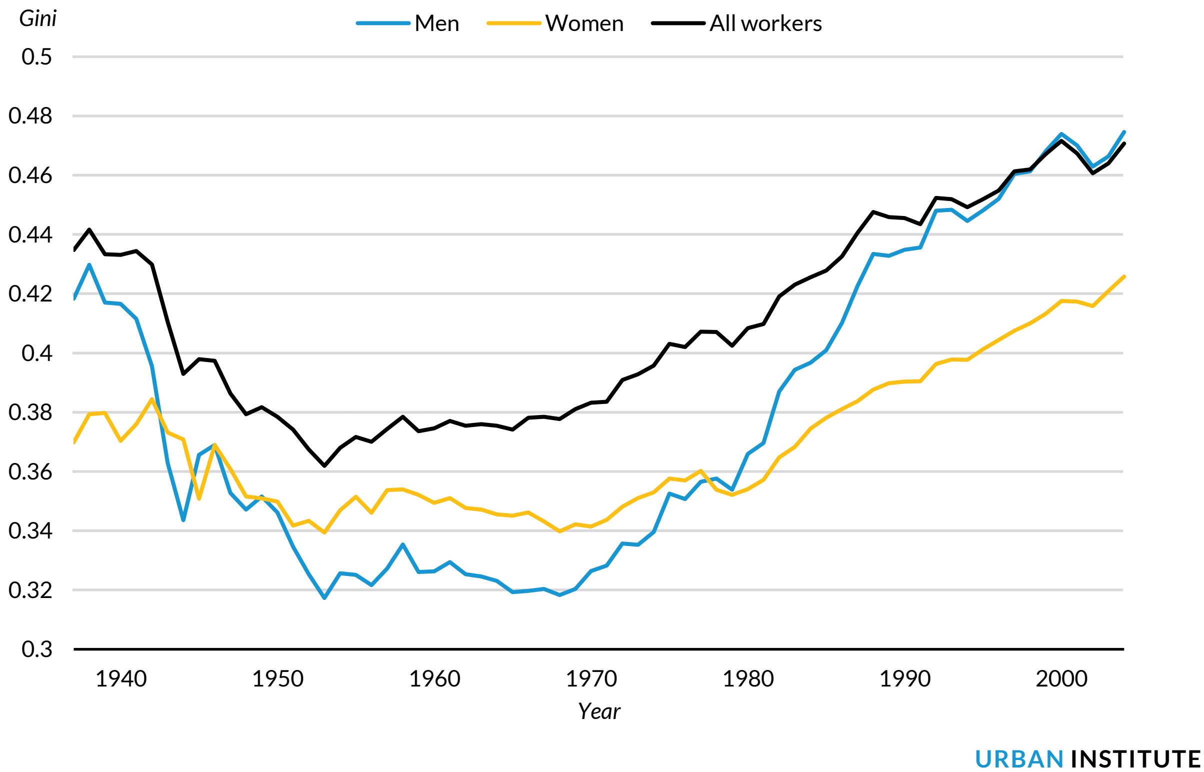
Workers entering the labor force today face historically high rates of wage inequality, and they are likely to continue to rise. The distribution of wages in the United States has changed dramatically since the 1970s. After a period of relative stability throughout the 1950s and 1960s, wage inequality grew rapidly over the following three decades. Inequality is often measured by the Gini coefficient, which ranges from 0, indicating complete equality, to 1, indicating complete inequality, with one person receiving all income or wealth.[1] The Gini coefficient for men's earnings increased 0.8 points between 1950 and 1979 and 10.9 points between 1980 and 2004 (figure 1). Because the drivers of economic inequality, including technological advances, increased international trade, and decreased unionization, persist, inequality will likely continue to rise, despite a recent slowdown in its growth.

Changes in the distribution of wages shape workers' lifetime earnings and future retirement income. Cohorts that experience high wage inequality during their working years are likely to experience high retirement income inequality. The Gini coefficient for income at ages 65 to 70 for the cohort born between 1940 and 1949, who worked throughout the period of rising wage inequality, was just below 0.4, almost four points higher than the Gini coefficient for the cohort born between 1920 and 1929, who experienced rising wage inequality only at the end of their working years (OECD 2017). Future retirees will have worked during periods of even higher wage inequality, suggesting that retirement income inequality will grow, despite the equalizing effect of Social Security's progressive benefit formula (Smith 2003).

Rising wage inequality has been especially detrimental to workers near the bottom of the wage distribution. While the average real wage has been rising, the concentration of gains among higher-wage workers has reduced wage growth for lower-wage workers. One of the main reasons for this deterioration has been the growing demand for highly skilled workers, which raises their real wages and reduces wages for other workers. Autor (2014) found that the rise in the premium to postsecondary education accounted for about two-thirds of the observed increase in wage inequality between 1980 and 2005. The steady pace of technological progress and the related growth in the demand for highly skilled workers suggest that this education premium will continue to rise.

FIGURE 1

Gini Coefficient of Earnings, 1937–2004



Source: Kopczuk, Saez, and Song (2010).

Another factor that shapes the bottom part of the wage distribution is the minimum wage. The real value of the federal minimum wage fell sharply during the 1980s and has fluctuated ever since. Several studies found that the decrease in the inflation-adjusted value of the federal minimum wage from 1979 to 1988 explained a substantial part of the drop in the ratio of the 10th percentile of the earnings distribution to the 50th percentile over that period (Lee 1999; DiNardo, Fortin, and Lemieux 1996; Autor, Manning, and Smith 2016). Raising the minimum wage could mitigate growing earnings inequality. In addition to boosting current earnings for low-wage workers, raising the minimum wage could improve their future retirement incomes because higher wages would allow workers to accumulate additional Social Security credits, and they might be able to save some of their increased earnings for retirement.

To explore retirement prospects for today's workers and the steps that policymakers might take to improve them, we examined how wage inequality and the federal minimum wage might shape future retirement incomes. Our study addressed two research questions:

- How would rising wage inequality affect retirement incomes for future retirees?
- How much would an increase in the federal minimum wage mitigate the impact of rising wage inequality on the distribution of retirement incomes?

We approached these questions by simulating future retirement incomes based on alternative scenarios of future wage growth and minimum wage levels. Using the Dynamic Simulation of Income Model 4 (DYNASIM4), the Urban Institute's state-of-the-art dynamic microsimulation model, we simulated three scenarios:

1. A baseline scenario that assumed that the current level of wage inequality and the current nominal federal minimum wage of $7.25 continued throughout the simulation period
2. A high-inequality scenario that raised wage inequality over the simulation period while keeping the minimum wage at its current level
3. A policy intervention scenario that raised wage inequality and increased the federal minimum wage to $12.00 in 2017, adjusted for inflation in subsequent years

Our projections highlighted the future distribution of lifetime earnings, retirement savings, and retirement income.

To address the first research question about how rising wage inequality might affect future retirement income, we estimated the difference in the distributions of retirement income under scenarios 1 and 2. Our analysis focused on the future evolution of the education premium, defined as the wage differential between workers with and without a four-year college degree. Raising the earnings growth rate for college graduates in scenario 2, while maintaining the same growth rate for the mean economy-wide wage as in scenario 1, boosted the earnings gap between less-educated workers and their better-educated counterparts. This increase in wage inequality affected the distribution of retirement income through changes in Social Security benefits, employer-sponsored retirement plans, and other retirement savings. Because Social Security benefits are based on workers' lifetime earnings, the distribution of benefits will become more unequal when the distribution of earnings becomes more unequal, although the progressive benefit formula provides some protection to low-wage workers. Similarly, because workers save for retirement out of their earnings, retirement savings inequality will increase as earnings inequality grows. Our analysis considered only the growth in inequality that arises from the increasing education gap in wages, which is the most important source of economic inequality.

We addressed the second research question, about how raising the federal minimum wage might mitigate the impact of growing wage inequality on retirement incomes, by comparing retirement income distributions under scenarios 2 and 3. Although the mean wage grew at the same rate under the two scenarios, an increase in the federal minimum wage under scenario 3 compressed the wage distribution. Working through the same mechanisms as above (Social Security benefits, employer-sponsored retirement plans, and other retirement saving), this change in the wage distribution altered the distribution of retirement income. The difference in the retirement income distributions under the two scenarios indicates how a minimum wage increase would affect the distribution of retirement income and potentially mitigate the impact of rising wage inequality.

Our simulations show that retirement incomes will become increasingly unequal if the earnings gap between college graduates and high school graduates continues to grow. Rising wage inequality would reduce mean incomes for adults ages 67 to 75 in the bottom fifth of the lifetime earnings distribution by 3 percent in 2045, 6 percent in 2065, and 13 percent in 2085, while increasing incomes for those in the top lifetime earnings quintile by 3 percent in 2045, 5 percent in 2065, and 7 percent in 2085. Raising the federal minimum wage to $12 per hour in 2017 and tying it to subsequent price inflation would boost lifetime earnings for low-wage workers and, for older adults in the bottom fifth of the lifetime earnings distribution, offset much of the retirement income they would otherwise have lost to growing wage inequality. However, the minimum wage's impact would erode over time as average real wages grow. In 2045, the minimum wage increase would completely offset the loss in retirement income from rising wage inequality. In 2065, it would offset just less than one-half of the loss, and in 2085, it would offset less than four-tenths of the loss. Raising the minimum wage would be less beneficial for those in the second and third quintiles of the lifetime earnings distribution.

Background

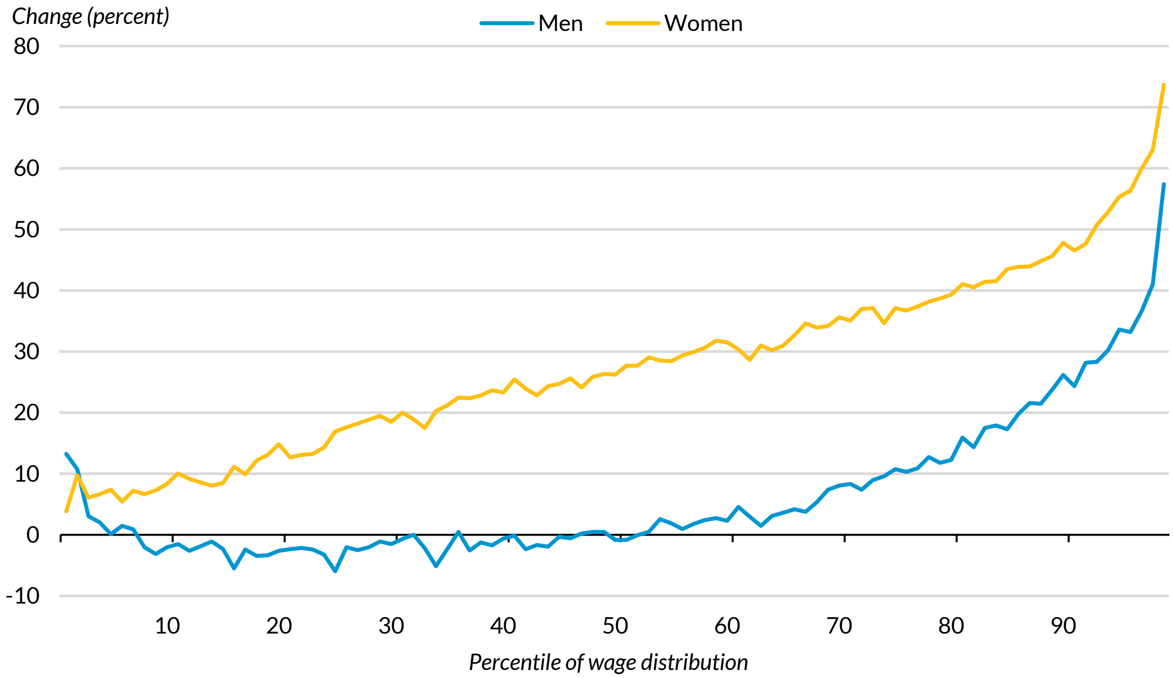
Retirement income depends largely on how much people earned when they were younger. As people earn more over their lifetime, they accumulate more credits toward future employer-sponsored defined benefit (DB) pension benefits—if they are covered by an employer plan—and Social Security benefits, which are both tied to past earnings. In addition, higher earnings generally enable people to save more for retirement through a 401(k)-type retirement plan or another vehicle. Consequently, as earnings become more unequally distributed, retirement income tends to become more unequal. The cumulative advantage theory emphasizes that early life advantages cumulate over the life course, magnifying economic inequality in later life (Ferraro and Shippee 2009; O'Rand 1996, 2003). However, Social Security, which accounts for about half of all income received at ages 65 and older (Bee and Mitchell 2017), replaces a larger share of preretirement earnings for low-earning workers than for high-earning workers, mitigating inequality at older ages. Nonetheless, Crystal and Shea (1990a, 1990b) found that income in the 1980s was more unequally distributed at older ages than younger ages. In a follow-up study, Crystal, Shea, and Reyes (2016) found that later-life inequality was greater in 2010 than in the 1980s, but that the age difference in inequality had fallen.

Recent increases in wage inequality will likely raise future economic inequality at older ages. Although the average real hourly wage has grown over the past 35 years (Board of Trustees 2016), the gains have been concentrated among workers in the top part of the earnings distribution. Figure 2 shows the percentage change in the real hourly wage from 1980 to 2012 by the percentile of the wage distribution and by sex, based on data from the Current Population Survey (CPS). Most of the wage growth was concentrated near the top of the wage distribution for both men and women, while wages in the middle and near the bottom barely changed over the 32-year period, especially for men. About one-half of employed men experienced no real wage growth, and real wages increased by 20 percent or more only for men in the top 15 percent of the wage distribution. Working women in the middle of the wage distribution fared better, with about 7 in 10 experiencing real wage growth of at least 20 percent. The wage gap between women and men declined as gender gaps in education, occupational representation, and union coverage shrank (Blau and Kahn 2016).

The figure does not report growth rates for the top 1 percent of the distribution, however, because the CPS top-codes earnings and undersamples people with the highest incomes. Gains in annual earnings, a slightly different concept, have been concentrated at the very top of the distribution, per data compiled by Piketty and Saez (2006) and their 2012 update. They found that between 1980 and 2011, average earnings increased 135 percent in the top 1 percent, 254 percent in the top 0.1 percent, and 455 percent in the top 0.01 percent.

FIGURE 2

Percentage Change in the Log Real Wage between 1980 and 2012 by Percentile



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Source: Authors' calculations from the 1981 and 2013 CPS.

Notes: The horizontal axis represents percentiles of the wage distribution, and the vertical axis represents the percentage difference in the hourly wage between 1980 and 2012. The sample was restricted to workers ages 16 to 64. Wages were weighted by the survey sampling weight multiplied by the number of hours worked.

Explaining Rising Inequality

Much of the growth in wage inequality can be attributed to the rising earnings gap between workers with and without a college education (Autor 2014), which in turn has been driven by skill-biased technological change. The skill-biased technological change hypothesis, first proposed by Tinbergen (1974) and formalized by Katz and Murphy (1992), assumes that high- and low-skilled labor, each using a distinct type of technology, are imperfect substitutes in the production function. A skill-biased technological change is a technology shift that raises the productivity of high-skilled labor relative to low-skilled labor, increasing the relative demand and wages for high-skilled labor and thus raising the education premium.

The skill-biased technological change hypothesis takes the supply of skilled and unskilled labor as given. Autor (2014) showed that the share of US labor supplied by college-educated workers has been growing steadily. If other factors did not change, this growth would have reduced the education premium. However, Autor found that the demand for skilled labor grew even faster than the supply, raising the education premium over time.

Because this hypothesis assumes that skilled and unskilled labor are partial complements, it predicts that skill-biased technological change raises productivity and wages for unskilled and skilled workers alike. Unskilled wages rise even if only the technology used by skilled labor improves. However, skill-biased technological change does not raise wages as much for unskilled labor as for skilled labor, thus increasing the education premium.

A competing explanation for the observed increase in the education premium focuses on growth in international trade. The manufacturing industry, which employs low-skilled labor relatively intensively, has faced growing competition from developing countries. Standard trade theory predicts that increased competition from imports reduces prices for manufactured goods, lowering relative wages for low-skilled labor while increasing wages for high-skilled labor because of the relative dominance of low-skilled labor in manufacturing (Stolper and Samuelson 1941). Trade theory and the skill-biased technological change theory predict similar impacts on the education premium, except that the international trade explanation implies that wages for low-skilled workers fall.

The first wave of research on the effects of international trade on wage inequality, in the 1990s, concluded that the impact was modest. Leamer (1996) analyzed prices of manufacturing goods and failed to find a significant decrease during the 1980s when wage inequality was rising. Borjas, Freeman, and Katz (1997) estimated that trade accounted for about 20 percent of the increase in the US education premium between 1980 and 1995. More recent trade literature focuses on other mechanisms through which trade affects wages, including intra-industry and locality effects. Helpman (2016) concluded that there is no evidence that trade is the primary driver of the increase in wage inequality. Trade-related wage impacts appear to be strong in industries affected by trade and in areas in which these industries are concentrated (Autor, Dorn, and Hanson 2013; Hakobyan and McLaren 2016).

Unions also affect the wage distribution, and their power has fallen dramatically since the 1980s. Because unions mostly protect low-skilled workers, deunionization tends to reduce their wages. Unionization has declined steadily over the past several decades. Between 1973 and 2017, the share of the US workforce belonging to labor unions fell from 24 to 11 percent (Hirsch and Macpherson 2018). Card (1996) estimated that the decline in unionization during the 1980s accounted for about 20 percent of the increase in men's wage inequality.

Impact of Minimum Wage Increase

Raising the federal minimum wage can increase workers' wages, reduce their chances of being employed, and reduce their work hours. The likely impact varies across the wage distribution. Wages that were below the old minimum rise when the minimum increases but generally remain below the new minimum. Wages for workers earning a subminimum wage generally do not rise to the new minimum because the minimum wage law is not perfectly enforced, and some workers are not covered by minimum wage laws. Neumark, Schweitzer, and Wascher (2004) examined the impact of changes in state and federal minimum wage laws from 1979 to 1997 and estimated the minimum wage elasticity, defined as the percent change in a worker's wage divided by the percent change in the minimum wage. They concluded that, in the first year after the minimum wage increase, the minimum wage elasticity for wages below the old minimum exceeded 1, meaning that the percent increase in the wage paid exceeded the percent increase in the minimum wage. For wages between the old and new minimum, they estimated that the elasticity was less than 1 and fell as wages rose. They also estimated an elasticity of 0.8 for wages close to the minimum wage and an elasticity of 0.26 for wages 30 to 50 percent higher than the old minimum wage.

In addition to directly affecting workers whose wages are below the new minimum, raising the minimum wage can increase wages for some workers paid more than the new minimum because of spillover effects tied to employers' preference to preserve existing wage differentials. CBO (2014) estimated that these spillover effects reach as high as the new minimum wage plus 50 percent of the change in the minimum wage. Neumark and colleagues (2004) estimated that the minimum wage elasticity was 0.16 for wages between one and one-half and two times the old minimum.

Raising the minimum wage can also affect employment. To offset the increase in labor costs that would otherwise result from a minimum wage boost, employers can choose to reduce the number of workers they employ or the number of hours each employee works. In the short run, this response would likely reduce production. In the longer run, many employers may replace low-wage workers affected by the minimum wage with higher-skilled workers or capital. Several studies have investigated how employers generally respond to an increase in the minimum wage, but no consensus has emerged. Estimates of the minimum wage elasticity of employment—the percent change in employment divided by the percent change in the minimum wage—range from nearly -1 to a small positive number, with most studies finding elasticities of employment near 0.[2]

These studies examined relatively small minimum wage hikes and thus may not offer much guidance on how wages and employment would respond to larger increases, such as the one we simulated in this study. A recent increase in Seattle's minimum wage, which rose from $9.47 to $13 over a year, is comparable to one we simulated, but two studies of its effects reached different conclusions. Reich, Allegretto, and Godoey (2017) found effects for the Seattle minimum wage hike similar to previous studies, estimating a wage elasticity between 0.1 and 0.2 and an employment elasticity that was statistically indistinguishable from 0. On the other hand, Jardim and colleagues (2017) estimated a small wage elasticity but an employment elasticity of about -3.

Employers can also respond to a minimum wage increase by raising prices of goods and services to compensate for higher labor costs. While there is some evidence that firms pass an increase in the cost of labor onto consumers in this way, this effect is small even in industries with a high share of low-wage workers, such as the fast-food industry (Aaronson 2001; Card and Krueger 1994). The estimated effect is much smaller in the retail industry (Ganapati and Weaver 2017), where the share of low-wage workers approximates the economy average. Prices of goods and services might also rise because the demand for goods and services rises as the minimum wage boost increases family incomes. If an increase in the minimum wage raises family income, mostly low-income families gain. Because these families have a higher propensity to consume than high-income families, the overall demand for consumption would rise, potentially boosting labor demand and partially offsetting the negative impact of the minimum wage increase. Employers may also choose to absorb the increase in labor costs by taking cuts in their profits.

CBO (2014) found that raising the minimum wage from $7.25 to $10.10—a 39 percent increase—would not change total family income much, but it would redistribute income from high-income families to low- and moderate-income families. Families with incomes below six times the federal poverty level would experience a net gain of $19 billion a year, while families with higher incomes would experience a net loss of $17 billion a year, for an overall increase of $2 billion a year, less than 0.02 percent of total 2016 labor compensation. Such a small change in total family income is unlikely to affect the labor market or the economy much.

Methods

To assess the impact of growing wage inequality and a potential increase in the federal minimum wage on future retirement incomes, we simulated income at ages 67 to 75 over the next seven decades under three scenarios, summarized in table 1. Baseline scenario 1 maintained the existing underlying level of wage inequality (as measured by the education premium) and the current federal minimum wage of $7.25 throughout the simulation period; scenario 2 raised wage inequality and kept the federal minimum wage at its current level; and scenario 3 raised wage inequality and increased the minimum wage to $12 per hour in 2017, adjusting for inflation in subsequent years. Each simulation held state minimum wages at their nominal 2016 level throughout the simulation period. We focused on people who were at least age 67 because they had reached Social Security's full retirement age and thus were likely to be retired and not working. We excluded people older than 75, when mortality rates begin rising sharply.

TABLE 1

Simulation Scenarios

Scenario	Wage inequality	Minimum wage
1. Baseline	Fixed at current level	$7.25 (current nominal level)
2. Rising inequality	Increasing	$7.25 (nominal)
3. Policy intervention	Increasing	$12.00 (adjust with inflation)

Our projections show how potential changes in wage inequality and the federal minimum wage might affect future earnings and, in turn, retirement income. To account for the tendency of married couples to pool their earnings, we computed shared lifetime earnings by summing over a lifetime own inflation-adjusted earnings for each year that a person was single and one-half of own inflation-adjusted earnings plus one-half of a spouse's inflation-adjusted earnings for each year that a person was married. We measured income in retirement as net per capita annuity income. It included Social Security benefits, income from employer-sponsored DB pension plans, earnings, Supplemental Security income (SSI), income from other federal assistance programs, and imputed rent, plus annuitized asset income.[3] This income was calculated as the annual actuarially fair annuity payment a family would receive if it annuitized 80 percent of its retirement accounts and other financial assets using a 3 percent annual real return.[4] Excluding annuitized asset income would understate the financial security provided by defined contribution retirement plans. To obtain a value net of taxes and premiums, we subtracted from total income federal and state income taxes; payroll taxes that fund the old age, survivor, and disability insurance (OASDI) program and Medicare's hospital insurance (HI) program; the Medicare surtax on earnings and investment income for high-income people; and premiums for Medicare Parts B and D. We obtained a per capita measure by dividing married people's family income by two.

The analysis showed how the future distribution of shared lifetime earnings and retirement income would differ under each scenario. We compared mean earnings and retirement income by quintile of shared lifetime earnings and computed Gini coefficients of retirement income from 2015 to 2087. To understand which portion of the retirement income distribution shifted in response to rising wage inequality and an increase in the federal minimum wage, we computed ratios of the 90th to 10th percentiles of retirement income, the 90th to 50th percentiles of retirement income, and the 50th to

10th percentiles of retirement income. We also decomposed changes in retirement income by income source to understand better how changes in lifetime earnings filter through to retirement income.

Changes in the earnings distribution will affect the solvency of the OASDI trust fund, but we ignored this effect and assumed that the trust fund would pay benefits as scheduled under current law. An increase in earnings inequality generally worsens the fund's solvency because it reduces taxable payroll—covered earnings below the Social Security taxable maximum—and thus the trust fund's revenue. Although the reduction in Social Security benefits associated with rising wage inequality would partially offset this revenue loss, benefit reductions would occur much later than revenue losses, and revenue losses would exceed benefit cuts because of the progressivity of the Social Security benefit formula.

DYNASIM4

We projected retirement income under each scenario using DYNASIM4, a dynamic microsimulation model designed to analyze the long-run distributional consequences of retirement and aging issues. The model starts with a representative sample of individuals and families from the 2004 and 2008 Survey of Income and Program Participation and ages them year by year, simulating key demographic, economic, and health events. DYNASIM4 projects that, each year, some people in the sample get married, have a child, or find a job, and other people become divorced or widowed, stop working, begin collecting Social Security, become disabled, or die. These transitions are based on probabilities generated by carefully calibrated equations estimated from nationally representative household survey data. The equations account for important differences by sex, education, earnings, and other characteristics in the likelihood of various experiences. Other equations in DYNASIM4 project annual earnings, savings, and home values. The model uses program rules—combined with projections of lifetime earnings, disability status, and household income and wealth—to project Social Security retirement and disability benefits and Medicaid coverage. For consistency with Social Security's projections about system finances, we generally follow the Social Security and Medicare trustees' assumptions. For more information about DYNASIM, see Urban Institute (2015) and Favreault, Smith, and Johnson (2015).

Projected earnings depend on how fast the simulations assume average wages grow. Between 1966 and 2015, real wage growth averaged 0.81 percent per year, but real wages grew much more slowly during certain decades and much more rapidly in others (Board of Trustees 2016). Annual real wage growth averaged -0.01 percent between 1973 and 1979, 0.47 percent between 1979 and 1989, and 0.45 percent between 2007 and 2015. Between 1989 and 2000, by contrast, real wages grew 1.55

percent per year. Standard DYNASIM4 projections use the intermediate wage growth assumptions adopted by the Social Security trustees, which assume that real average wages will grow 1.2 percent per year from 2026 to 2091 (Board of Trustees 2016). Although these assumed growth rates are higher than some academic-style projections (Fernald 2016; Gordon 2014), they are roughly consistent with CBO (2016)'s assumptions. Our baseline simulations generated under scenario 1 assumed that real wages grow at the same rate over the simulation period for all education groups, maintaining the existing level of wage inequality. Under scenarios 2 and 3, which simulated earnings when wage inequality continued to rise, projected earnings grew more rapidly for college graduates than for workers with less education.

DYNASIM4 simulates annual earnings every year for people ages 16 to 80 as the product of the hourly wage, employment status, and the annual number of hours worked, each of which was simulated independently. The hourly wage equation is based on the education premium model, first proposed and estimated by Katz and Murphy (1992). We used earnings equation parameters from Autor (2014), who reestimated the education premium model using more recent data.

Estimating the Education Premium Model

The education premium model casts the wage bonus associated with a college diploma in terms of relative labor supply and demand. Both relative supply and demand are defined as ratios of labor units associated with college-educated workers relative to those associated with high-school-educated workers. The education premium increases as relative demand rises and relative supply falls. For example, an increase in college attendance and graduation rates would raise the amount of labor units supplied by college-educated workers, depressing their wages relative to wages for workers with only a high school education when other factors are held constant. Conversely, adopting a new technology that makes college-educated workers more productive would increase relative demand for these workers and thus raise the education premium.

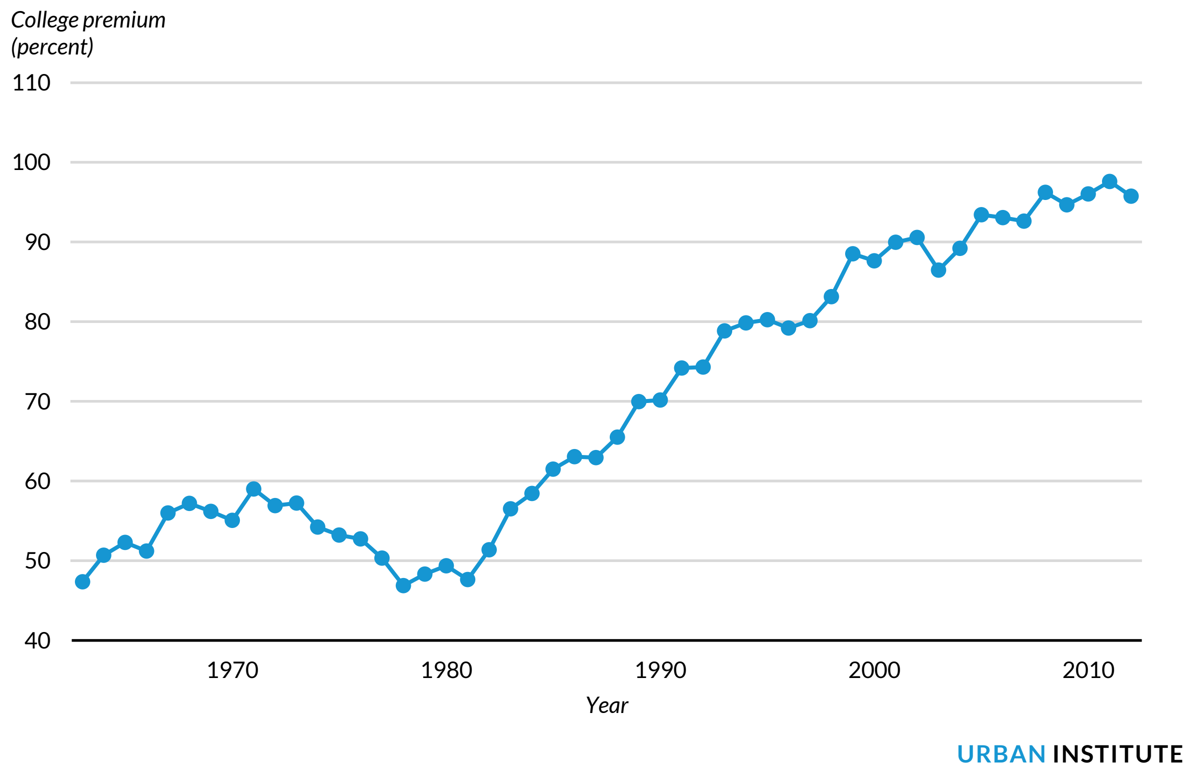
The education premium, Z_t, is the logarithm of the ratio of composition-adjusted mean weekly wages for college-educated workers to wages for high-school-educated workers and can be modeled as:

$$Z_t = \beta_0 + \beta_1 \ln \frac{S_{ct}}{S_{ht}} + \beta_2 t + \beta_3 t^2 + \zeta_t \quad (1)$$

where S_{ct} and S_{ht} are shares of efficiency units—labor hours weighted by the hourly wage—supplied by college and high school graduates, respectively, in year *t*; the linear and quadratic time terms proxy for relative labor demand; and ζ_t is the error term. Autor estimated this equation on cross-sectional CPS data from 1964 to 2013. Figure 3 shows his estimates of the education premium from 1963 to 2012, and figure 4 shows his estimates of the labor supply of college graduates to high school graduates.

FIGURE 3

Wage Gap Associated with Having at Least a College Degree

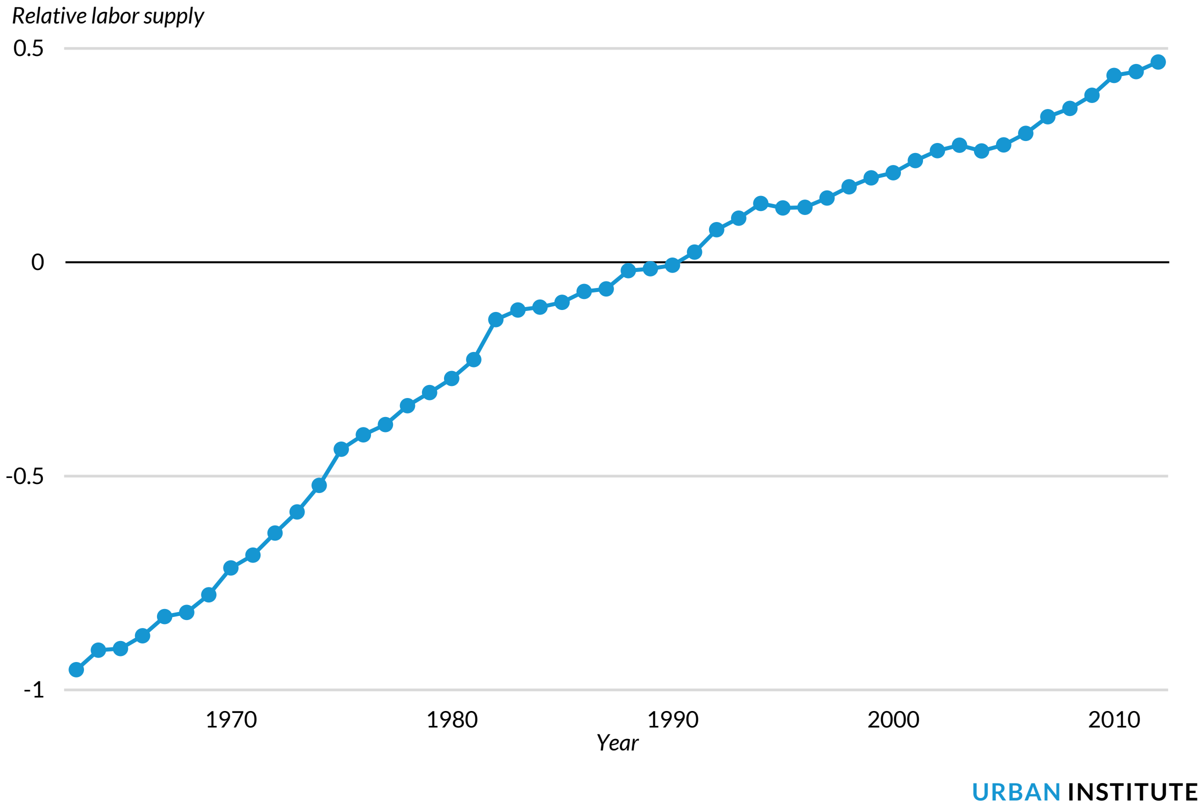


Source: Authors' calculations from Autor (2014).

Notes: Relative supply was measured by efficiency units. Hours of labor supply were weighted by the wage. The relative labor supply was calculated as the logarithm of the ratio of the share of efficiency units provided by college-educated workers to the share of efficiency units provided by workers with no more than a high school diploma. The analysis counted one-half of workers with some college as college-educated labor and the other half as high-school-educated labor.

FIGURE 4

Labor Supply of College Graduates Relative to High School Graduates



Source: Authors' calculations from Autor (2014).

Notes: Relative supply was measured by efficiency units. Hours of labor supply were weighted by the wage. The relative labor supply was calculated as the logarithm of the ratio of the share of efficiency units provided by college-educated workers to the share of efficiency units provided by workers with no more than a high school diploma. The analysis counted one-half of workers with some college as college-educated labor and the other half as high-school-educated labor.

Table 2 reports parameter estimates for equation (1), the education premium, from Autor (2014). As expected, the education premium was negatively correlated with the relative supply of college-educated labor. The coefficients for the time trend indicate that the relative demand for skilled labor increases over time, but at a diminishing rate. We used these parameter estimates to simulate the education premium in DYNASIM4 through 2087 (figure 5).[5] The predictions of the education premium generated by Autor's (2014) wage equation aligned closely with the education premium observed in CPS data from 1963 to 2013, and the education premium simulated by DYNASIM4 followed the same trajectory as the historical one.

TABLE 2

Estimated Parameters for the Education Premium Equation

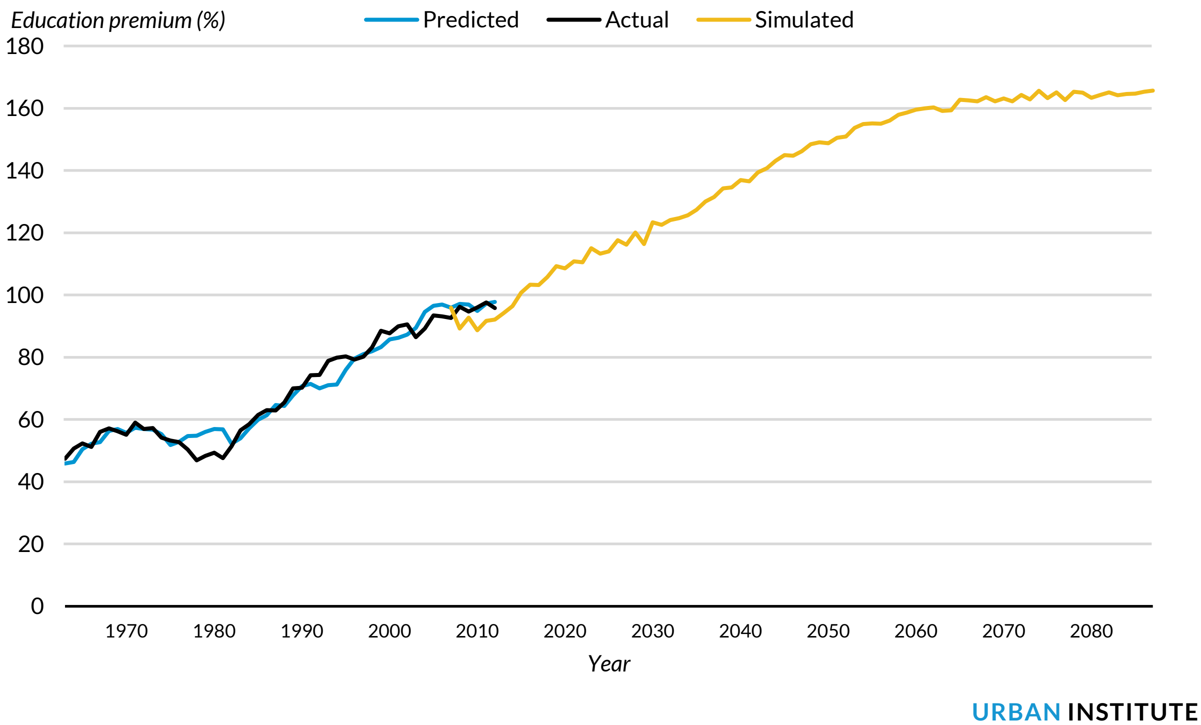
	Coefficient
Time	0.0306***
	(0.00468)
Time squared/100	-0.0144***
	(0.00421)
Relative labor supply	-0.588***
	(0.0922)
Constant	-0.213**
	(0.0972)
Observations	50
Adjusted R-squared	0.947

Source: Autor (2014).

FIGURE 5

Wage Premium Associated with Having at Least a Four-Year College Degree

Actual, predicted, and simulated values



Sources: Autor (2014) and DYNASIM4 ID942B.

Estimating the Wage Model

A well-known challenge when estimating a wage equation is sample selection bias. The dependent variable is truncated because wages cannot be observed for nonworkers, and selection into the observed sample is nonrandom, biasing ordinary least squares estimates of the regression coefficients (Heckman 1976). The sample selection bias arises from the correlation between the residual and regressors in the equation, both of which are correlated with the sample selection process. To generate unbiased estimates of our regression coefficients, we applied Heckman's (1979) two-stage estimation procedure. The first-stage employment equation estimated a new variable, the so-called inverse Mills ratio, which entered the second-stage wage equation as a regressor.

Equations (2) and (3) describe our two estimating equations:

$$p_{it} = \theta V_{it} + \mu_{it} \quad (2)$$
$$w_{it} = \alpha \overline{w}_t + \beta X_{it} + \gamma C_{it} Z_t + \pi \hat{\lambda}_{it} + \varepsilon_{it} \quad (3)$$

Our first-stage estimation model (2) was a probit in which the dependent variable p_i was an indicator variable that equaled 1 if person i was employed in the year of the survey (0 otherwise), θ was a vector of coefficients, V_{it} was a vector of individual characteristics, and μ_{it} was the error term. In the second stage, we used an ordinary least squares regression of the real hourly wage on $\overline{w}_t$, the average real hourly wage in year *t;* X_{it}, the vector of individual characteristics; Z_t, the education premium in year *t*, which was multiplied by an indicator variable for a four-year college degree; and $\hat{\lambda}_{it}$, the inverse Mills ratio. $\varepsilon_{i,t}$.was the error term.[6]

The individual characteristics included in both X_{it} and V_{it} were indicator variables for marital status, Hispanic ethnicity, three geographic regions (South, Northeast, and West, with Midwest as the reference group), and four educational attainment levels (high school graduate, some college but less than four years, four-year college degree, and graduate education, with not a high school graduate as the reference group). In addition, we included age splines (with kinks at ages 25, 30, 40, 50, and 60), and their interactions with both the college and high school graduate indicators. Vector V_{it} also included indicator variables for foreign origin; health status; and receipt of Social Security income; and nonbinary variables equal to the number of children (total and those younger than age 5); spouse's log real income; and a fifth-degree polynomial of time, which we excluded from vector X_{it}. Vector X_{it} included 16 five-year birth cohorts (with 1901–05 as the reference category).

The regression coefficients were estimated on a pooled cross-sectional sample of the civilian population ages 17 to 81 from the 1976 to 2012 releases of the CPS.[7] We excluded self-employed workers and those employed in the private household sector. Our dependent variable was the logarithm of the real hourly wage, calculated by dividing reported annual earnings by the product of the number of weeks worked in the prior year and the usual number of hours worked per week, adjusting for the change in the consumer price index. Because these variables referred to the year prior to the survey, the effective ages of sample individuals ranged from 16 to 80.

We estimated equation (2) on the entire sample, stratified by race and sex. Appendix table 1 reports parameter estimates. We used the estimated coefficients $\hat{\theta}$ to calculate the inverse Mills ratio, $\hat{\lambda}_{it} = \phi(\hat{\theta}V_{it})/\Phi(\hat{\theta}V_{it})$, where ϕ is the standard normal density and Φ is the standard normal cumulative distribution function. This variable was included as a regressor in equation (3). The average annual hourly wage, calculated as a weighted mean of hourly wages for all workers in the CPS, stratified by sex and race, increased the regression's adjusted R^2 and improved the fit of predicted wages over the entire sample period, in that our projected wage distributions from the beginning of the projection period, from 2006 through the mid-2010s, were quite similar to the observed historical distributions. Improved predictive power is an important consideration when generating projections. Appendix table 2 reports parameter estimates.

To simulate future hourly wages, we first statistically matched respondents from the Panel Study of Income Dynamics to DYNASIM4's Survey of Income and Program Participation input file. We then used equation (3) to predict past wages, computed the difference between predicted and actual wages, and used a fixed effects model to regress the predicted error term on its lagged value to decompose the error into an individual-specific permanent term and a transitory term. Based on those regression results, reported in appendix table 3, and our estimates of α, β, and γ from (3), we used equation (4) to simulate future hourly wages:

$$w_{it} = \alpha\overline{w}_t + \gamma C_{it}Z_t + X'_{it}\beta + u_i + \varepsilon_{it} \qquad (4)$$

where u_i is an individual-specific permanent error term that represents unobservable individual characteristics, ε_{it} is a transitory disturbance modeled as a first order autoregressive process $\varepsilon_{i,t} = \rho\varepsilon_{i,t-1} + \xi_{i,t}$, and the other parameters are as described in (3). The autoregressive coefficient ρ in the transitory error model was estimated as the coefficient on the lagged error term in appendix table 3, and the standard deviation of the transitory error reported in the appendix table was used to generate the random contemporaneous term.

To simulate hourly wages in DYNASIM4 for an individual in a particular year, we retrieved the appropriate vector of the individual's characteristics, the permanent error term, and the previous year's transitory error term from the individual's record. The contemporaneous transitory error term was calculated from a randomly generated number and last year's transitory error. The vector of individual characteristics was multiplied by the vector of estimated coefficients. This value and the permanent and transitory error terms were added together to obtain the simulated value. In scenario 1, we set the education premium in equation (4) equal to its 2006 value throughout the simulation period. In scenarios 2 and 3, the education premium varied with time and the relative supply of college-education labor.

DYNASIM's Employment and Hours Model

To project annual earnings, DYNASIM4 combines simulated hourly earnings with simulated employment status and simulated annual hours of employment. The simulation equations for l_{it}, labor employment status, and h_{it}, hours of work, resemble the earnings equation and are depicted below:

$$l_{it} = X'_{1it}\beta_2 + u_{1i} + \varepsilon_{1it} \quad (5)$$

$$h_{it} = X'_{2it}\beta_3 + u_{2i} + \varepsilon_{2it} \quad (6)$$

X_{kit} are vectors of observable individual characteristics, β_k are vectors of associated coefficients, u_{ki} are individual-specific permanent error terms that represent unobservable individual characteristics, and ε_{kit} are transitory disturbances that are modeled as first order autoregressive processes $\varepsilon_{k,i,t} = \rho\varepsilon_{k,i,t-1} + \xi_{k,i,t}$, with $k = 1$ *and* 2.

As with the earnings equations, these equations were estimated and simulated separately for non-black women, black women, non-black men, and black men. The employment equation controlled for age, education, age-education interactions, school enrollment, disability, health status, marital status, immigrant status, number of minor children, spouse's labor income, the state unemployment rate, Social Security beneficiary status, region, five-year birth cohort, and indicators for head of household or the head's spouse. The hours equation included the hourly wage, age, education, age-education interactions, school enrollment, disability, divorced status, number of minor children, spouse's labor income, the state unemployment rate, region, and five-year birth cohort.

The employment status equation was estimated as a random effects probit, and the hours worked equation was estimated as a tobit, using panel data from the National Survey of Youth 1979 and 1997 for people ages 25 and younger, and the Panel Study of Income Dynamics from 1981 to 2011 for people ages 26 and older. We used these equations to project employment status and annual hours, following the techniques we used to project the hourly wage.

Simulating the Minimum Wage

Scenario 3 simulated earnings under the assumption that the federal minimum wage increased in 2017 from $7.25 per hour to $12, a 66 percent jump, and subsequently adjusted with inflation. As noted earlier, this increase would affect wages and employment for covered workers, depending on how much a worker earned.

The first step was to identify workers exempt from the federal minimum wage.[9] Because no nationally representative dataset, to our knowledge, asks respondents whether they are covered by minimum wage legislation, we had to infer exempt status. We classified wage and salary workers as exempt from federal and state minimum wage laws if they were paid hourly and received a wage that was less than the effective minimum in the state where they lived. We assumed that the effective minimum wage was the higher of the state and federal minimum wage and that the federal minimum-wage exemption rules applied for all state minimums. A shortcoming of this approach is that it leaves out exempt workers who were paid an hourly rate that exceeded the minimum wage.

To identify exempt workers in DYNASIM4 simulations, we estimated a logistic model of the likelihood that a worker was exempt, in which the dependent variable was an indicator that equaled 1 if a worker was exempt, and 0 otherwise. Our independent variables were four dummy variables for educational attainment (high school diploma, some college, four-year college diploma, and a graduate school diploma); a dummy for marital status; a dummy for Hispanic ethnicity; six age splines (at 16, 19, 25, 50, 60, and 65) and their interactions with dummies for high school diploma and college diploma (for college graduates, interactions with the 16- and 19-year splines are replaced by an interaction with the 22 spline); 16 dummies for birth cohorts (five-year cohorts between 1906 and 1996); and 50 dummies for states of residence. We estimated the model separately for black and non-black women, and black and non-black men.

We estimated the model on the CPS Merged Outgoing Rotation Group (CPS-MORG) dataset, which provides more reliable information on the hourly wage than most other datasets. CPS-MORG asked employed respondents who were paid hourly about their hourly wage, whereas the CPS's Annual Social and Economic Supplement asked respondents only about their annual earnings. For other workers, we calculated the hourly wage by dividing the weekly wage by the usual number of hours worked per week. Appendix table 4 reports estimated parameters. We calibrated the share of workers in DYNASIM4 assumed to be exempt from the minimum wage to the share of workers in CPS-MORG who earned less than the federal minimum wage in 2016, which was 2.4 percent. For each worker in DYNASIM4, we independently simulated the hourly wage and the likelihood that a worker was exempt from the minimum wage law. We then increased the simulated wage for covered workers if their initial simulated wage fell below the effective minimum wage.

When the minimum wage increases from $7.25 to $12 per hour, we assumed that all wages below the new minimum would rise. Additionally, based on CBO (2014), we assumed that spillover effects would affect wages only up to $14.37, the new minimum wage plus one-half the increase in the minimum wage. We constructed a function that maps preincrease wages into postincrease wages consistent with estimates in the literature of wage elasticities with respect to the minimum wage, as reported in table 3 for selected wages.[10] We assumed that initial wages for covered workers that fell below the old minimum increased by the full dollar change in the minimum, which implies an elasticity greater than 1. Wages that fell between the old minimum wage and the upper bound on the spillover effect would increase by an amount that falls linearly as the wage rises until it reaches 0 at the upper bound. The minimum wage increase would not change higher simulated wages.

TABLE 3

Assumptions about the Wage Impact of Increasing the Minimum Wage from $7.25 to $12

Old wage	New wage	Change	Elasticity
5.00	9.75	4.75	1.450
6.00	10.75	4.75	1.208
7.00	11.75	4.75	1.036
7.25	12.00	4.75	1.000
8.00	12.25	4.25	0.811
9.00	12.58	3.58	0.608
10.00	12.92	2.92	0.445
11.00	13.25	2.25	0.312
12.00	13.58	1.58	0.201
13.00	13.92	0.92	0.108
14.00	14.25	0.25	0.027
14.38	14.38	0.00	0.000

Source: Authors' calculations.

Raising the minimum wage can also affect employment. We used estimates from CBO (2014) to simulate the impact of a minimum wage increase on employment rates and estimates from Neumark and colleagues (2004) to simulate the impact on work hours (table 4). The minimum wage elasticities in the table represent the total effect of a minimum wage increase on employment for all workers. However, because the increase affects only a fraction of workers and many of them receive a wage increase that is smaller than the increase in the minimum wage that caused it, elasticities with respect to the minimum wage must be converted to elasticities with respect to the wage. To do that, we used the conversion multiplier of 4.5 estimated by CBO (2014) using CPS data from 1979 to 2009. For example, if an adult worker who was paid $10 per hour received an increase of $2—or 20 percent—when the minimum wage increased, the likelihood of employment for this worker would decrease by 0.2 x 4.5 x 0.025 = 0.0225 or 2.25 percent, and, if the worker remained employed, he or she would work 0.2 x 4.5 x 0.3 = 0.27 or 27 percent fewer hours.

TABLE 4

Assumptions about the Minimum Wage Elasticities of Employment and Hours Worked

2017 inflation-adjusted dollars

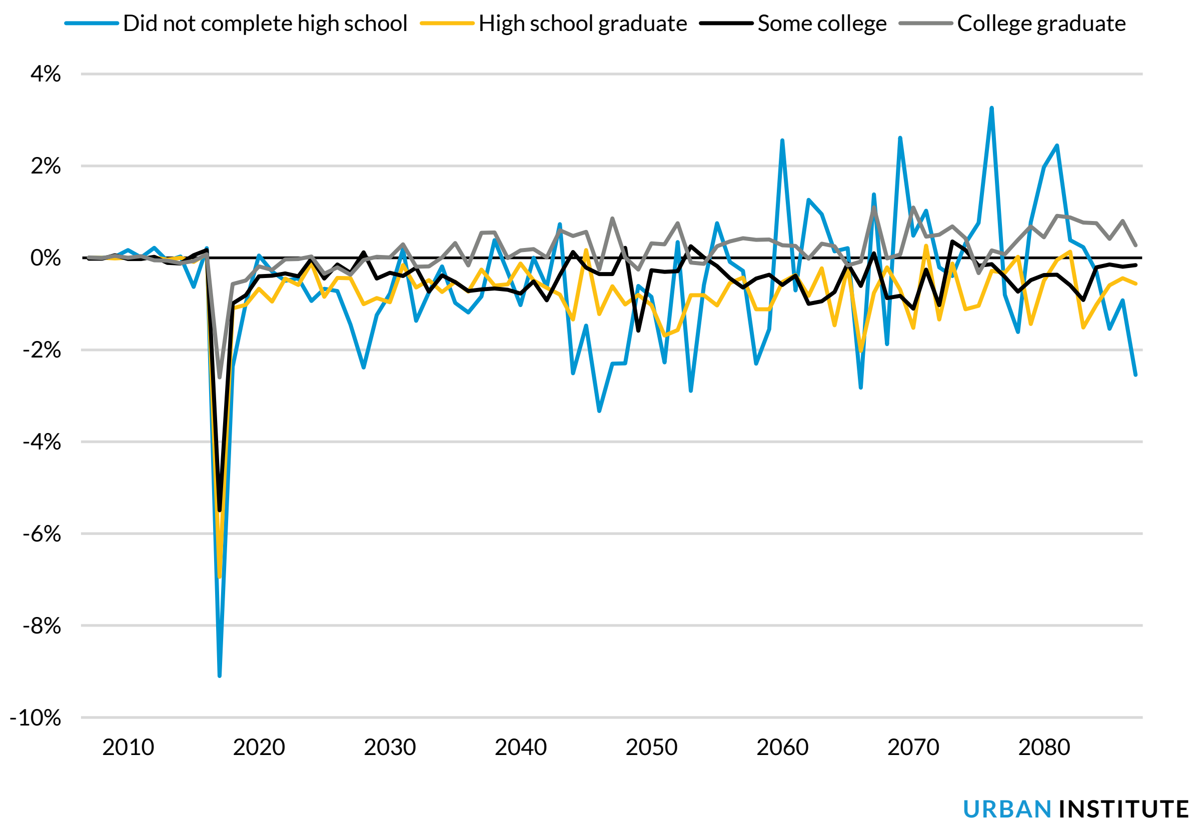
Wage range	Elasticity of employment (teenagers)	Elasticity of employment (adults)	Elasticity of hours worked
Less than or equal to $12.00	-0.075	-0.025	-0.3
More than $12.00	0.0	0.0	0.0

Sources: CBO (2014); Neumark et al. (2004).

The simulated minimum wage hike in 2017 initially reduced employment levels, especially for adults with limited education, but the effects dissipated over time (figure 6). Compared with baseline scenario 1, mean annual hours worked in 2017 for adults ages 25 to 69 in scenario 3 was 9 percent lower for those who did not complete high school, 7 percent lower for those with a high school diploma who did not attend college, 6 percent lower for those who attended college but did not obtain a four-year degree, and 3 percent lower for those with at least a four-year college degree. These observed declines reflect both a drop in the share of adults employed and in hours worked for those employed. Employment quickly returned to the baseline level for college graduates and remained a bit below the baseline for others.

FIGURE 6

The Effect of the Increase in Minimum Wage on Employment by Education



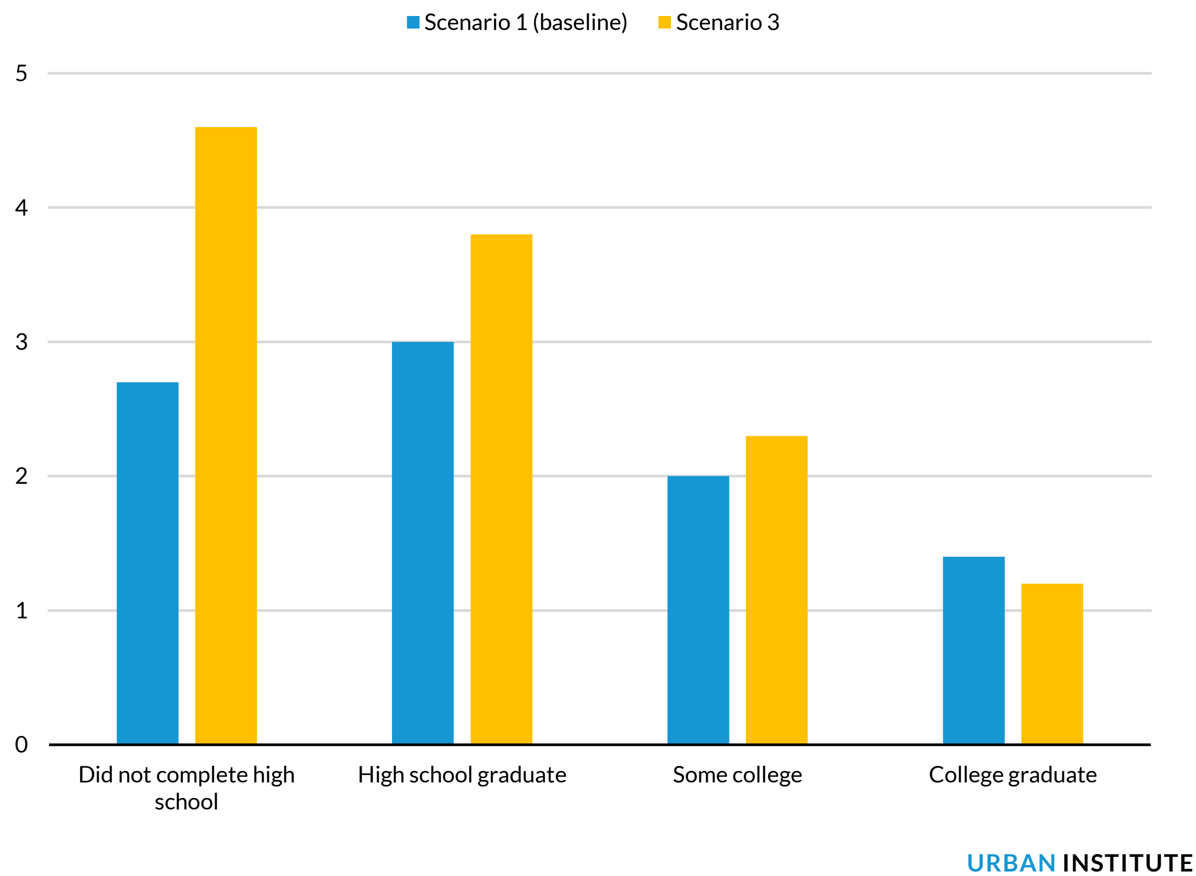
Source: Authors' estimates from DYNASIM ID942 and ID942C.
Note: The figure shows the percentage difference in mean annual hours worked between scenario 3 and the baseline scenario 1 for adults ages 25 to 69.

The minimum wage hike boosted 2017 earnings for adults with limited education, more than offsetting the employment drop (figure 7). In 2017, annual earnings for adults ages 25 to 69 who did not complete high school were 4.6 percent higher than in 2016 under scenario 3, but only 2.7 percent higher under baseline scenario 1, which kept the minimum wage at its current level. Average earnings also increased more under the minimum wage hike scenario than the baseline for high school graduates, and they did not change much for adults who attended college.

FIGURE 7

Annual Earnings Growth by Simulation Scenario and Educational Attainment, 2017 (%)

Adults ages 25 to 69



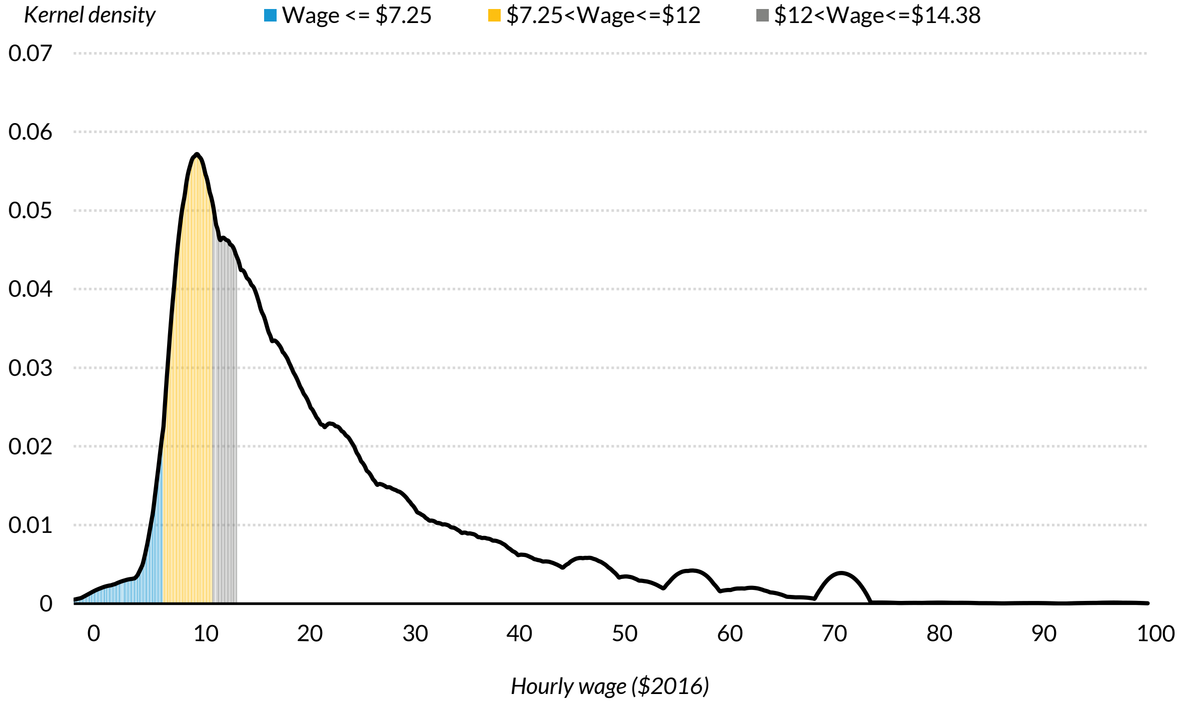
Source: Authors' estimates from DYNASIM ID942 and ID942C.

Notes: Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and increased wage inequality, as described in the text.

More than a third of workers could be affected by raising the federal minimum wage to $12 per hour. Figure 8 shows the 2016 distribution of hourly wages for civilian workers ages 16 to 64. The shaded areas represent wages that would rise if the minimum wage were increased from $7.25 to $12. The blue area represents the 2.4 percent of workers who were paid less than $7.25 per hour. The gray area represents the 25.5 percent of workers paid between $7.25 and $12 per hour, and the yellow area represents the 9 percent of workers earning between $12 and $14.38 per hour who would be affected by spillover effects.

FIGURE 8

Distribution of Hourly Wages in 2016



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Source: Authors' estimates from CPS-MORG 2016.

Notes: The horizontal axis represents hourly wage in 2016 dollars, and the vertical axis represents probability density. The sample was restricted to workers ages 16 to 64. Wages were weighted by the earnings weight. Shaded areas represent the share of workers who would be affected by an increase in the federal minimum wage from $7.25 to $12, directly or through spillover effects.

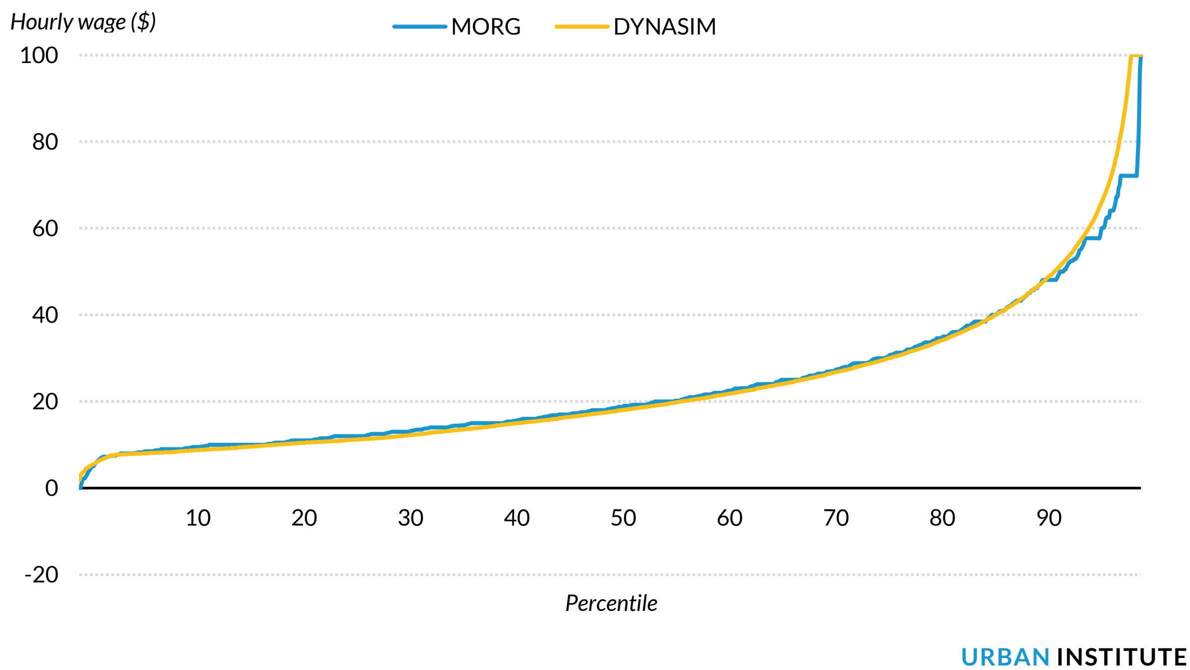
Our simulations did not explicitly incorporate price or profit responses to an increase in the minimum wage, which could reduce real incomes for high-earning families. Nonetheless, our methods led to lower real wages for high earners when the minimum wage increased. DYNASIM4's earnings simulations were calibrated to the Social Security trustees' projections of future annual earnings. Since we used the same projections in all three scenarios, the minimum wage increase did not change total economy-wide earnings. When wages increased for low-wage workers, high earners received a pay cut so that total earnings paid did not change. This process emulated the decrease in real wages that would occur when price levels rise in response to a minimum wage increase. Because the low-wage workers whose wages increase with the minimum wage make up a small share of the workforce, the pay cut distributed among higher-wage workers was relatively small.

Validating Simulation Outcomes

To validate DYNASIM4's earnings model, we compared simulated hourly earnings with CPS data in years in which both were available. Figure 9 shows inverse cumulative distribution functions for hourly wages in 2016. The blue line represents the distribution estimated from CPS-MORG 2016 data, and the black line represents the distribution simulated by DYNASIM4 under scenario 2 in 2016, the tenth year of the simulation. The simulated distribution exhibits a good fit, especially at the bottom of the wage distribution near the minimum wage, which is important because our analysis focuses on how boosting the minimum wage might help low-income workers. The two distributions diverge somewhat in the upper decile, where the simulation overshoots the historic data.

FIGURE 9

Cumulative Distribution of Simulated and Historical Hourly Wages, 2016

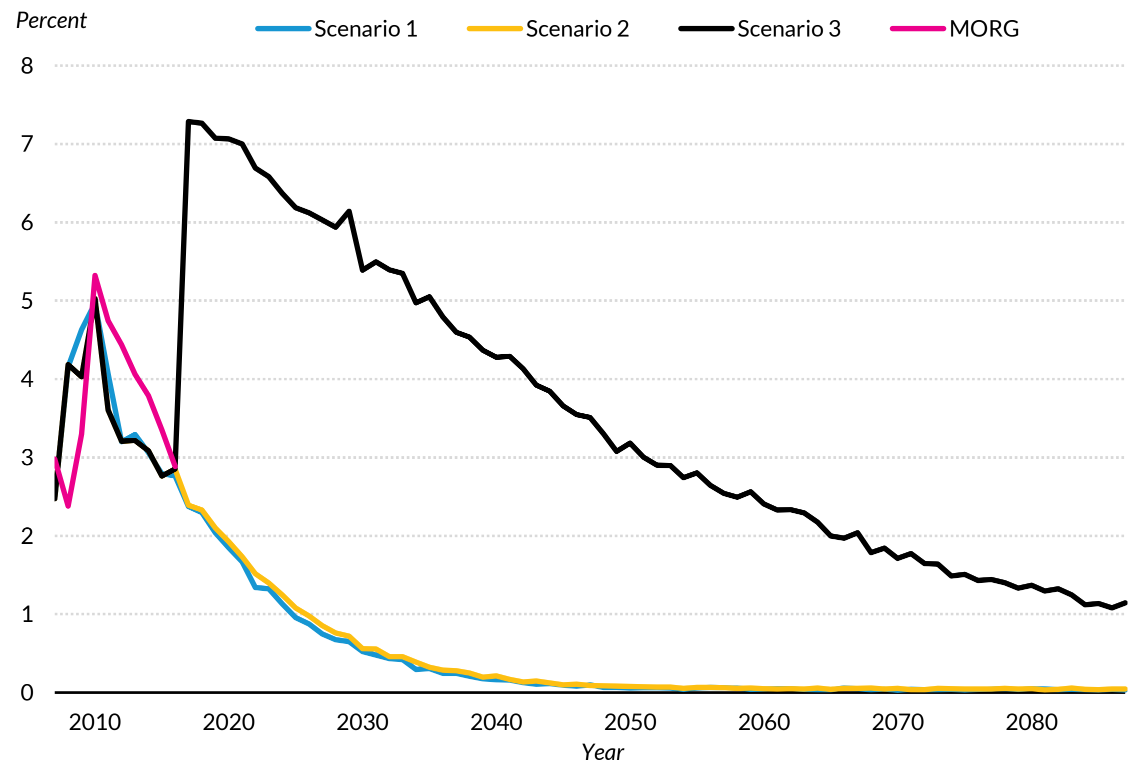


Sources: Authors' estimates from CPS-MORG (2016) and DYNASIM ID942B.
Notes: For the CPS-MORG, we set hourly wages equal to reported wages for workers paid hourly; otherwise, hourly wages were estimated as weekly wages divided by hours worked per week. Distributions were truncated at $100 per hour.

The most challenging test for the minimum wage model is how it performs over time. As the minimum wage changes—through legislation or because inflation reduces its real value—the share of wages at or below the minimum wage also changes. Figure 10 shows the share of hourly wages that are at or below the federal minimum wage over time under the three simulation scenarios and in the CPS-MORG. The blue, black, and yellow lines represent values simulated by DYNASIM4 under scenarios 1, 2, and 3, respectively; the magenta line represents values estimated from CPS-MORG data from 2007 to 2016. The three consecutive increases in the federal minimum wage in 2007 (from $5.15 to $5.85), 2008 (from $5.85 to $6.55), and 2009 (from $6.55 to $7.25) sharply increased the share of wages below the minimum wage in those years. The minimum wage has since remained fixed, and the share of wages at or below the minimum fell as inflation eroded its real value.

FIGURE 10

Percentage of Total Wages at or below the Federal Minimum Wage by Simulation Scenario, 2006–85



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Sources: Authors' estimates from CPS-MORG (2007–16) and DYNASIM ID942, ID942B, and ID942C.
Notes: Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

In the projection years, the share of wages at or below the minimum wage continued to fall under scenarios 1 and 2, as the nominal value of the minimum wage remained fixed at $7.25 and inflation eroded its real value. Under scenario 3, however, the minimum wage increased to $12 in 2017, and the share of wages below the minimum wage surged to more than 7 percent. A 66 percent increase in the minimum wage caused a 156 percent increase in the share of wages at or below the minimum wage.

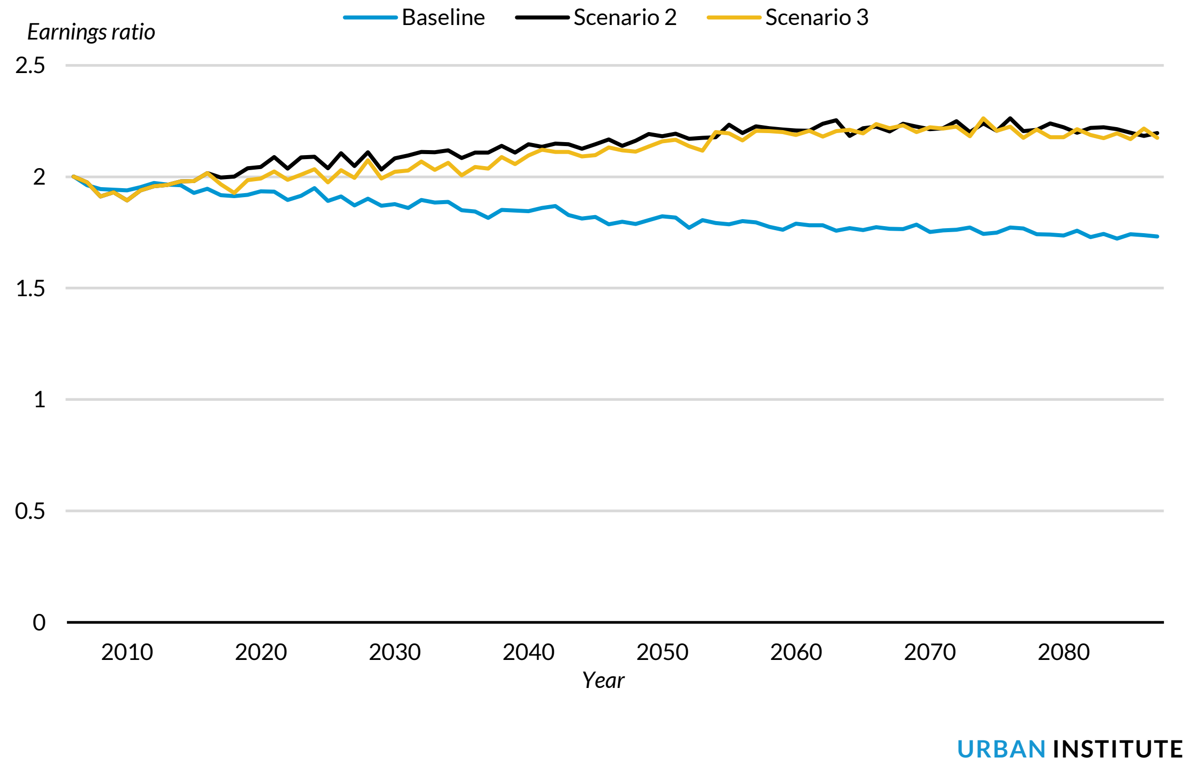
These effects are comparable to those observed in the 2000s, when the minimum wage increased by 41 percent over three years and raised the share of wages at or below the minimum by 124 percent. After 2017, the minimum wage was indexed for inflation, which slowed but did not eliminate the decline of the share of wages at or below the minimum.

Results

The three simulation scenarios generated three distinct trajectories of the earnings distribution. Under the baseline, the earnings ratio of college graduates to high school graduates declined over time (figure 11). Even though the baseline scenario held the education premium in the wage model constant, other factors, such as an increase in the share of college graduates and changes in their demographics, reduced the earnings gap between college and high school graduates. Under scenario 2, the rising wage inequality scenario, the earnings ratio grew steadily, from 2.0 in 2017 to 2.1 in 2046, 2.2 in 2058, and 2.3 in 2077. By the end of the simulation period in 2087, the earnings ratio was 27 percent higher under scenario 2 than under the baseline. Raising the minimum wage in 2017 reduced the pay advantage for college graduates, as the earnings ratio fell to 1.9 in 2019. The higher minimum wage, which was tied to price inflation, kept the earnings ratio lower than it otherwise would have been for about two decades. However, the minimum wage became less effective over time, diminishing its impact, because wages grew faster than prices.

FIGURE 11

Earnings Ratio, College Graduates to High School Graduates by Simulation Scenario, 2006–88



Source: Authors' estimates from DYNASIM ID942, ID942B, and ID942C.
Notes: Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at the current level of $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

Shared Lifetime Earnings Projections

Each scenario projected that shared lifetime earnings will increase substantially over time, as wages are predicted to grow faster than prices (table 5). For adults ages 67 to 75, DYNASIM4 projected that under baseline scenario 1, mean inflation-adjusted shared lifetime earnings in the middle quintile of the shared lifetime earnings distribution will grow from $1.5 million in 2025 to $2.0 million in 2055, a 33 percent increase. By 2085, the mean value for the middle fifth of the distribution will reach $3.0 million under the baseline scenario, 50 percent more than in 2055 and twice as much as in 2025. The baseline scenario, which holds the education premium constant over time, projected that lifetime earnings will grow at similar rates throughout the distribution, although lifetime earnings levels differed sharply. In 2055, for example, projected mean shared lifetime earnings for adults ages 67 to 75 was only about one-third as much for the bottom quintile of the distribution as for the middle quintile, while mean lifetime earnings were more than twice as high in the top quintile as in the middle quintile.

TABLE 5

Projected Mean Shared Lifetime Earnings for Adults Ages 67 to 75 by Scenario, Year, and Quintile

Thousands of 2015 inflation-adjusted dollars

		Year						
Quintile	**Scenario**	**2025**	**2035**	**2045**	**2055**	**2065**	**2075**	**2085**
Bottom	Baseline	499	534	620	660	736	869	1,037
	2	499	527	607	632	701	801	944
	3	500	536	625	670	751	870	970
Second	Baseline	1,079	1,126	1,284	1,419	1,561	1,811	2,128
	2	1,077	1,119	1,261	1,367	1,488	1,692	1,943
	3	1,079	1,128	1,276	1,386	1,527	1,744	1,958
Third	Baseline	1,534	1,605	1,794	2,021	2,243	2,588	2,953
	2	1,532	1,600	1,775	1,985	2,178	2,510	2,789
	3	1,533	1,599	1,768	1,984	2,181	2,485	2,776
Fourth	Baseline	2,067	2,178	2,452	2,764	3,043	3,540	3,904
	2	2,068	2,181	2,474	2,770	3,106	3,569	3,924
	3	2,063	2,171	2,446	2,758	3,048	3,523	3,896
Top	Baseline	3,282	3,892	4,300	4,842	5,422	6,255	6,421
	2	3,303	3,932	4,378	4,977	5,673	6,587	6,904
	3	3,292	3,913	4,323	4,937	5,583	6,456	6,974

Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

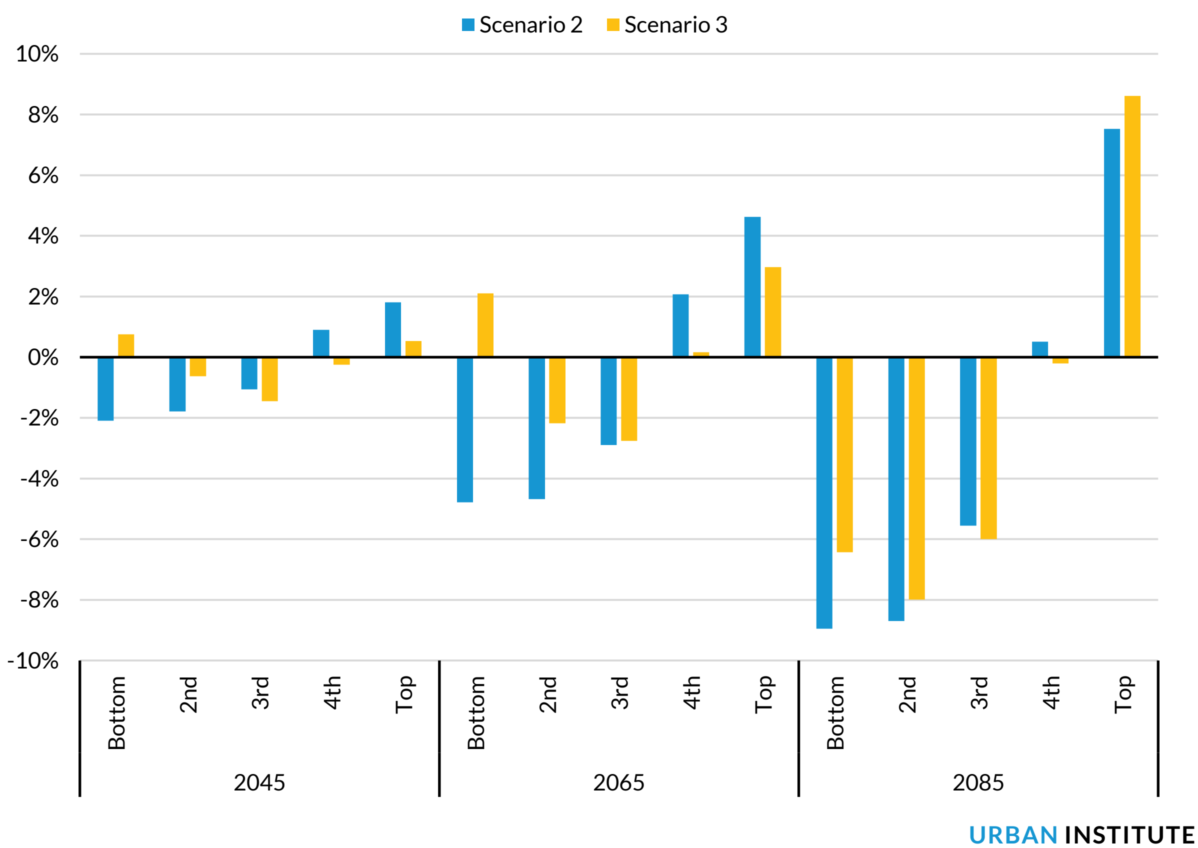
Notes: Shared lifetime earnings were calculated by summing over a lifetime own earnings for each year that a person was single and one-half of own earnings plus one-half of spouse's earnings for each year that a person was married. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

As expected, our simulations show that rising wage inequality would boost shared lifetime earnings in the top portion of the distribution, especially in the top fifth, and would reduce shared lifetime earnings in the bottom portion of the distribution (figure 12). Average wages grew at the same rate under the rising wage inequality scenario—scenario 2—and baseline scenario 1, but wages for college graduates grew faster in scenario 2 than the baseline, reducing wage growth and lifetime earnings for less-educated workers in scenario 2. Because scenario 2 did not begin to diverge from scenario 1 until 2006 and the effects cumulated over time, projected differences in shared lifetime earnings for adults ages 67 to 75 did not become substantial for several decades. Relative to the baseline scenario, mean shared lifetime earnings for the top quintile under scenario 2 were 2 percent higher in 2045, 5 percent higher in 2065, and 8 percent higher in 2085. In the bottom quintile, mean shared lifetime earnings under scenario 2 fell short of the baseline mean by 2 percent in 2045, 5 percent in 2065, and 9 percent in 2085. Shared lifetime earnings were also lower in scenario 2 than in the baseline for the second and third quintiles of the shared lifetime earnings distribution. In 2085, projected mean shared lifetime earnings for the second quintile were 9 percent lower under scenario 2 than scenario 1.

FIGURE 12

Effects of Rising Wage Inequality and An Increase in the Minimum Wage on Shared Lifetime Earnings by Quintile, 2045, 2065, and 2085

Adults ages 67 to 75



Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

Notes: The figure shows the percentage change in mean shared lifetime earnings by quintile of shared lifetime earnings, relative to baseline scenario 1. Shared lifetime earnings were calculated by summing over a lifetime own earnings for each year that a person was single and one-half of own earnings plus one-half of spouse's earnings for each year that a person was married. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

Raising the minimum wage offsets the lifetime earnings lost through rising wage inequality for adults near the bottom of the earnings distribution. Through 2075, mean shared lifetime earnings for adults ages 67 to 75 in the bottom quintile were higher under scenario 3—which combined rising wage inequality with an increase in the minimum wage—than under baseline scenario 1. For adults in the second quintile, the minimum wage increase partly offset the earnings losses associated with rising wage inequality, but mean shared lifetime earnings remained lower under scenario 3 than the baseline scenario. Moreover, in both of the bottom two quintiles, the protections afforded by the minimum wage hike diminished over time, as rising real wages eroded the value of the minimum wage. Raising the minimum wage also reduced some of the lifetime earnings gains that the top two quintiles experienced as wage inequality grew, because some of the wage gains shifted to the bottom part of the distribution.

Net Per Capita Annuity Income at Ages 67 to 75

DYNASIM4 projected that retirement incomes will grow significantly over time as lifetime earnings grow, but mean retirement incomes will grow more slowly than mean lifetime earnings. Under the baseline scenario, mean inflation-adjusted net per capita annuity income at ages 67 to 75 for people in the middle quintile of the shared lifetime earnings distribution will increase from $39,500 in 2025 to $44,700 in 2055, a 13 percent increase (table 6). In 2085, the mean value for the middle fifth of the distribution will reach $57,500, 29 percent more than in 2055 and 46 percent more than in 2025. The baseline scenario projected that retirement incomes will grow throughout the lifetime earnings distribution, although they will increase somewhat more slowly for those near the top of the distribution than for those near the middle or bottom. Moreover, retirement income under the baseline was projected to grow only about half as fast as lifetime earnings.

TABLE 6

Projected Mean Net Annuity Income for Adults Ages 67 to 75 by Year and Quintile of Shared Lifetime Earnings

2015 inflation-adjusted dollars

	Year						
	2025	2035	2045	2055	2065	2075	2085
Bottom quintile							
Baseline	10,400	10,100	10,700	11,400	11,700	13,300	15,200
Scenario 2	10,400	10,200	10,400	10,600	11,000	12,000	13,300
Scenario 3	10,400	10,300	10,700	11,400	11,400	12,900	14,000
Second quintile							
Baseline	25,000	24,500	25,500	28,300	30,200	33,900	37,700
Scenario 2	24,700	24,300	25,200	27,700	29,100	32,500	35,100
Scenario 3	24,900	24,500	25,400	28,000	29,400	32,800	35,700
Third quintile							
Baseline	39,500	39,300	40,200	44,700	47,600	53,100	57,500
Scenario 2	39,200	38,800	39,800	44,200	47,100	51,400	54,900
Scenario 3	39,400	39,000	39,800	44,400	47,100	51,400	56,000
Fourth quintile							
Baseline	60,200	59,700	62,200	68,400	72,100	80,900	85,300
Scenario 2	59,900	59,500	63,000	68,100	72,900	79,200	85,300
Scenario 3	60,200	59,100	62,700	68,100	72,300	80,200	85,000
Top quintile							
Baseline	119,900	127,000	136,300	138,700	146,100	162,500	162,800
Scenario 2	120,400	128,000	139,900	143,300	152,900	167,100	173,900
Scenario 3	119,600	126,100	136,700	141,300	149,900	165,100	173,800

Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

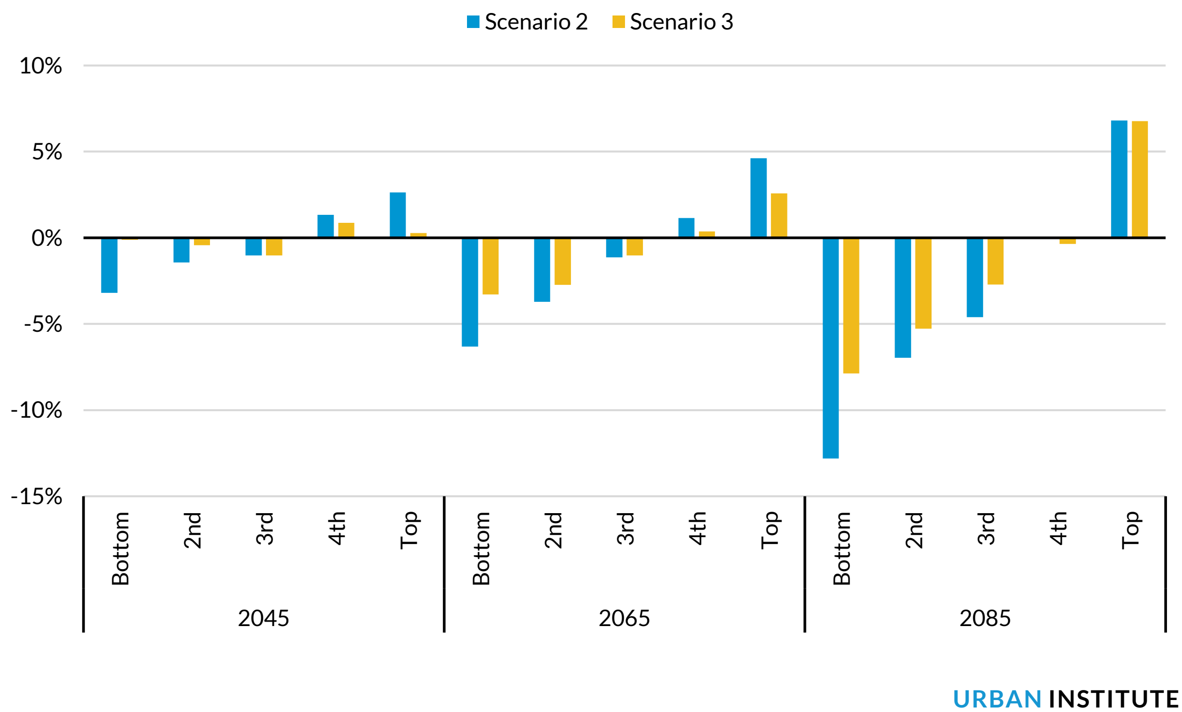
Notes: Net per capita annuity income included Social Security, DB pension, annuitized asset income, SSI, earnings, imputed rent, and federal assistance programs, less federal and state income taxes, payroll taxes, and Medicare Parts B and D premiums. Shared lifetime earnings were calculated by summing over a lifetime own earnings for each year that a person was single and one-half of own earnings plus one-half of spouse's earnings for each year that a person was married. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

The projections show that rising wage inequality will reduce simulated net per capita annuity income at ages 67 to 75 for people near the bottom of the shared lifetime earnings distribution and increase income for people near the top (figure 13). As with lifetime earnings, the effects on income at ages 67 to 75 grew over time. Compared with the baseline scenario, mean income at ages 67 to 75 for people in the bottom quintile of the lifetime earnings distribution was 3 percent lower in 2045, 6 percent lower in 2065, and 13 percent lower in 2085. These percentage declines exceeded those observed for shared lifetime earnings. Mean incomes in the second and third shared lifetime earnings quintiles were also lower under scenario 2, which raised wage inequality, than the baseline, but the reductions were smaller than for the bottom quintile. In the top shared lifetime earnings quintile, mean income at ages 67 to 75 under scenario 2 exceeded the baseline mean by 3 percent in 2045, 5 percent in 2065, and 7 percent in 2085, similar to the increases we simulated for shared lifetime earnings.

FIGURE 13

Effects of Rising Wage Inequality and an Increase in the Minimum Wage on Net Per Capita Annuity Income by Quintile of Shared Lifetime Earnings

Adults ages 67 to 75



Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.
Notes: The figure shows the percentage change in mean per capita annuity income by quintile of shared lifetime earnings relative to baseline scenario 1. Net per capita annuity income included Social Security benefits, DB pension benefits, SSI, earnings, annuitized asset income, imputed rent, and federal assistance programs net of taxes and Medicare premiums. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

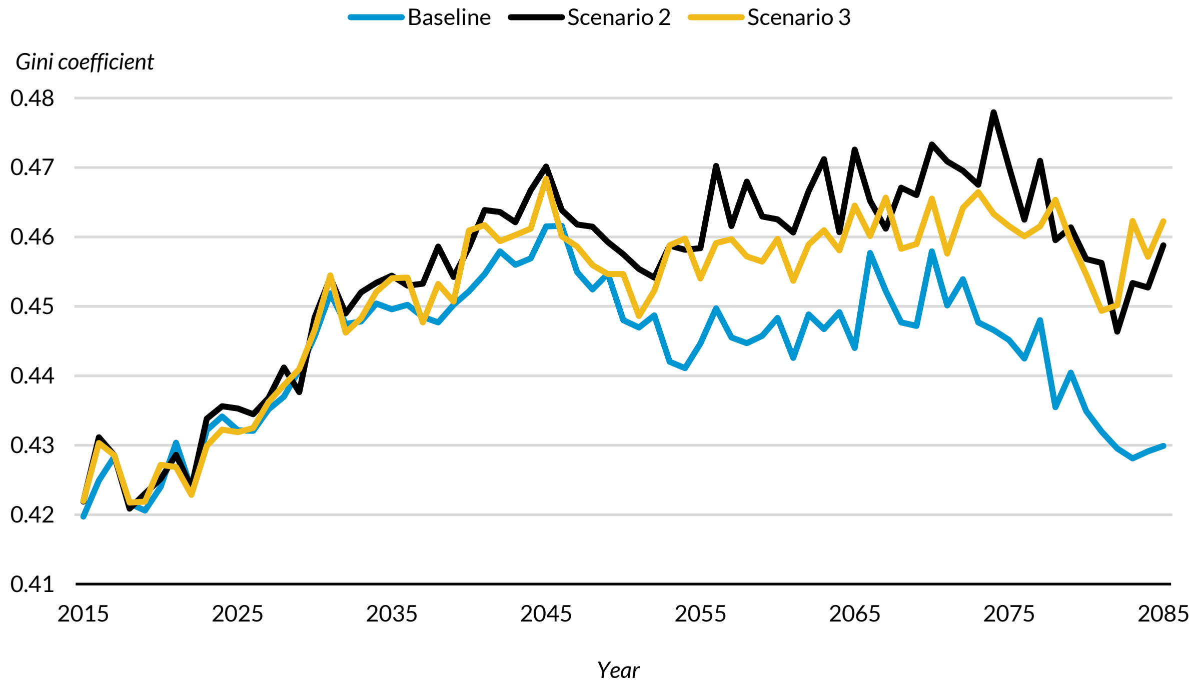
Raising the minimum wage offset much of the retirement income losses in the bottom two lifetime earnings quintiles that resulted from growing wage inequality. Compared with the baseline scenario simulations, 2045 mean net per capita annuity income at ages 67 to 75 under scenario 3 was only 0.1 percent lower for the bottom quintile and 0.4 percent lower for the second quintile. Raising the minimum wage did not affect retirement incomes much in the third or fourth lifetime earnings quintiles, but it reduced retirement incomes in the top income quintile, offsetting much of the gains the quintile experienced as wage inequality increased. The impact of the minimum wage on retirement incomes diminished over the decades, as real wage growth eroded the value of the simulated minimum. Among retirees in the bottom fifth of the lifetime earnings distribution, a higher minimum wage would offset about 57 percent of the income at ages 67 to 75 lost to rising wage inequality in 2065 and 37 percent of lost retirement income in 2085.

Changes in the wage distribution under scenarios 2 and 3 slowly raised overall retirement income inequality. Under scenario 2 that raised wage inequality, the Gini coefficient of net per capita annuity income at ages 67 to 75 began to exceed the baseline Gini around year 2035 (figure 14). The gap in the Gini grew over the simulation period, reaching 0.03 at the end of the simulation. The minimum wage increase under scenario 3 partially offset the effect of wage inequality, but its effect diminished over the simulation period. By the end of the simulation, the Gini coefficients under scenarios 2 and 3 were virtually indistinguishable.

FIGURE 14

Gini Coefficient of Net Per Capita Annuity Income

Adults ages 67 to 75



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Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

Notes: Net per capita annuity income included Social Security benefits, DB pension benefits, SSI, earnings, annuitized asset income, imputed rent, and federal assistance programs net of taxes and Medicare premiums. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour, adjusted for inflation thereafter, and kept wage inequality at the same level as in scenario 2.

Comparing incomes at various points of the distribution is another way to measure income inequality and identifies the portion of the distribution in which incomes differ most. The ratio of the 90th to the 10th percentiles of the net per capita annuity income distribution at ages 67 to 75 follows a similar time pattern under the three scenarios—it rises until 2065 and then falls towards the end of the simulation (table 7). Its values, however, differ under each scenario, reflecting different levels of income inequality. The ratio of the 90th to the 10th percentile is highest under scenario 2, which raises the education premium; the ratio increases from 8.60 in 2025 to 11.07 in 2065. Scenario 3, which raises the federal minimum wage, reduced the ratio to the range it had under the baseline until 2065, offsetting the effects of the increase in the education premium. In subsequent years, the ratio grew faster under scenario 3 than under the baseline, as inflation eroded the value of the minimum wage.

TABLE 7

Income Ratios for Net Per Capita Annuity Income by Year and Measure

Adults Ages 67 to 75

	Year			
	2025	**2045**	**2065**	**2085**
Ratio of 90th to 10th percentiles				
Baseline	8.48	9.07	10.30	8.99
Scenario 2	8.60	9.62	11.07	10.56
Scenario 3	8.38	9.22	10.38	10.00
Ratio of 90th to 50th percentiles				
Baseline	2.50	2.77	2.77	2.65
Scenario 2	2.54	2.87	2.91	2.86
Scenario 3	2.50	2.80	2.82	2.81
Ratio of 50th to 10th percentiles				
Baseline	3.39	3.27	3.72	3.39
Scenario 2	3.39	3.36	3.80	3.70
Scenario 3	3.35	3.30	3.68	3.57

Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

Notes: Net per capita annuity income included Social Security benefits, DB pension benefits, SSI, earnings, annuitized asset income, imputed rent, and federal assistance programs net of taxes and Medicare premiums. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour and kept wage inequality at the same level as in scenario 2.

Under each scenario, the ratio of the 90th to the 50th percentiles of the net per capita annuity income distribution at ages 67 to 75 was about 2.5 in 2025. It increased over time as strong lifetime earnings growth for high-wage workers raised future retirement incomes near the top of the distribution. Raising the federal minimum wage in scenario 3 did not change the ratio much, because it did not raise lifetime earnings much for people in the middle of the income distribution. The ratio of the 50th to the 10th percentiles of net per capita income was substantially lower under scenario 3 than under scenario 2, however, as the increase in the federal minimum wage raised lifetime earnings and retirement incomes for low-wage workers.

One measure of wellbeing by which the minimum wage increase could successfully offset rising wage inequality is the poverty rate. Rising wage inequality led to a modest increase in the projected poverty rate among adults ages 67 to 75 relative to the baseline (table 8). In some years, the minimum wage increase not only canceled the effect of wage inequality, but it reduced the poverty rate below the baseline poverty rate, probably because the minimum wage increase was most effective near the bottom of the wage distribution and consequently the bottom of the retirement income distribution, where people face the highest risk of poverty. The effect of rising wage inequality was weaker than the minimum wage effect at the very bottom of the wage and retirement income distribution, even though it was stronger overall.

TABLE 8

Poverty Rates at Ages 67 to 75 by Year and Projection Scenario

	2025	2045	2065	2085
Baseline	6.4	4.6	4.2	3.1
Scenario 2	6.7	4.8	4.3	3.2
Scenario 3	6.5	4.5	3.8	3.1

Source: Authors' estimates from DYNASIM4 ID942, ID942B, and ID942C.

Rising wage inequality and an increase in the minimum wage affected net retirement income through various income sources and taxes. To understand how these changes affect different types of income and taxes, we decomposed net per capita annuity income in 2065 by type of income and tax, for each shared lifetime earnings quintile (table 9). The top panel shows the effects of rising wage inequality on each type of income and tax as the difference between mean outcomes under scenario 2 and the baseline. The bottom panel shows the effects of the increase in the minimum wage as the difference between outcomes under scenarios 3 and 2. The difference for each category is expressed relative to net income under the baseline, so that the decomposition terms sum to the total effect.

TABLE 9

Effects of Growing Wage Inequality and Raising Minimum Wage on Income among People Ages 67 to 75 in 2065 by Income Source, Tax Category, and Shared Lifetime Earnings Quintile

Percent

	Bottom quintile	Second quintile	Third quintile	Fourth quintile	Top quintile
Effects of growing wage inequality (scenario 2 – scenario 1)					
Total pre-tax income	-6.3	-4.2	-1.3	0.8	10.7
Social Security benefits	-3.4	-2.7	-0.3	0.2	0.6
SSI	-0.1	0.0	0.0	0.0	0.0
Annuitized financial income	-1.8	-1.0	-1.2	0.6	2.2
DB pension income	0.1	-0.2	-0.1	-0.6	0.0
Earned income	0.1	0.3	0.1	-0.3	7.0
Imputed rental income	-1.3	-0.4	0.0	0.9	0.9
Federal assistance programs	0.0	-0.2	0.1	0.1	-0.1
Total tax	0.0	-0.5	-0.2	-0.3	6.1
Federal income tax	0.0	-0.3	-0.1	-0.2	4.3
State income tax	0.0	-0.1	-0.1	0.0	1.0
OASDI tax	0.0	0.0	0.0	0.0%	0.2
HI tax	0.0	0.0	0.0	0.0	0.1
Medicare surtax	0.0	0.0	0.0	0.0	0.5
Medicare Part B premium	0.0	-0.1	0.0	0.0%	0.0
Medicare Part D premium	0.1	-0.1	0.0	0.0	0.0
Net income	**-6.3**	**-3.7**	**-1.1**	**1.2**	**4.6**
Effects of raising the minimum wage (scenario 3 – scenario 2)					
Total pretax income	2.6	1.3	0.3	-0.8	-6.2
Social Security benefits	2.0	1.1	-0.8	-0.6	-0.3
SSI	-0.1	0.0	0.0	00	0.0
Annuitized financial income	-0.7	0.1	0.1	-0.3	0.6
DB pension income	-0.2	0.3	0.0	0.3	0.0
Earned income	0.3	0.2	1.4	0.8	-5.6
Imputed rental income	1.3	-0.5	-0.2	-0.9	-1.0
Federal assistance programs	0.0	0.0	-0.3	-0.1	0.1
Total tax	-0.4	0.3	0.2	0.0	-4.2
Federal income tax	-0.3	0.1	0.1	0.0	-2.8
State income tax	0.0	0.0	0.0	0.1	-0.8
OASDI tax	0.0	0.0	0.1	0.1	-0.1
HI tax	0.0	0.0	0.0	0.0	-0.1
Medicare surtax	0.0	0.0	0.0	0.0	-0.4
Medicare Part B premium	0.0	0.1	0.0	-0.1	0.0
Medicare Part D premium	-0.1	0.0	0.0	0.0	0.0
Net income	**3.0**	**1.0**	**0.1**	**-0.8**	**-2.0**

Source: DYNASIM4 ID942, ID942B, and ID942C

Notes: The top panel reports mean income and taxes under scenario 2 minus mean income and taxes under baseline scenario 1, and the bottom panel reports mean income and taxes under scenario 3 minus mean income and taxes under scenario 2, both expressed as a percentage of the baseline. Scenario 1 kept wage inequality at the 2006 level and the federal minimum wage at the current level of $7.25 per hour. Scenario 2 raised wage inequality, as described in the text, and maintained the federal minimum wage at $7.25 per hour. Scenario 3 raised the federal minimum wage to $12.00 per hour and kept wage inequality at the same level as in scenario 2.

The main mechanism through which rising wage inequality affected income at ages 67 to 75 in the bottom two quintiles of the shared lifetime earnings distribution was Social Security benefits, which accounted for slightly more than one-half of the reduction in mean incomes in each quintile. Total pretax income fell 6.3 percent in the bottom quintile, and lower Social Security benefits reduced pretax income by 3.4 percent. In the second quintile, total pretax income fell by 4.2 percent, and Social Security benefit cuts reduced pretax income by 2.7 percent. The remaining income loss came mostly from reductions in annuitized financial income and imputed rental income. Taxes played virtually no role in the bottom quintile, and reduced taxes from rising wage inequality increased net income by only 0.5 percent in the second quintile. Increased Social Security benefits also drove the retirement income growth for these two quintiles that resulted from the increase in the minimum wage. Social Security benefits contributed two-thirds of the overall growth in net income in the bottom quintile and more than 100 percent of the net income growth in the second quintile. In the third and fourth quintiles, individual income sources and taxes changed income by small amounts—in most cases by less than 1 percent—and therefore were difficult to interpret confidently.

In the top quintile of the shared lifetime earnings distribution, the impact of both rising wage inequality and the minimum wage increase worked mostly through changes in earnings. Rising wage inequality increased total pretax income in the top quintile by 10.7 percent, as higher earnings raised pretax income by 7.0 percent and higher annuitized asset income raised pretax income by 2.2 percent. Higher taxes offset many of these gains, however, reducing income by 6.1 percent, for a net gain of 4.6 percent. Most of the additional tax obligation came from federal income taxes, although state income tax and the Medicare surtax also played a role. The simulated minimum wage hike reduced earnings in this quintile, causing total pretax income to fall by 6.2 percent. However, tax reductions, mostly from lower federal and state income taxes, offset much of top-quintile income losses from the minimum wage increase, resulting in a net income reduction of 2.0 percent. The combined impact of rising wage inequality and a minimum wage hike increased net income for the top quintile by 2.6 percent.

Conclusions

Wage inequality, which has been rising in the United States for decades, affects income throughout the life course. If the hourly wage gap between college and high school graduates continues to grow at its current pace, the top fifth of lifetime earnings at ages 67 to75 would increase 2 percent in 2045, 5 percent in 2065, and 8 percent in 2085. At the same time, lifetime earnings in the bottom fifth of the distribution would fall 2 percent in 2045, 5 percent in 2065, and 9 percent in 2085. The impact would reverberate into retirement, because Social Security benefits are tied to lifetime earnings, and how much people can save for retirement depends on how much they earn. Our projections show that mean income at ages 67 to 75, measured broadly to account for the value of owner-occupied housing and retirement savings and excluding tax and Medicare premium payments, would increase in the top fifth of the distribution by 3 percent in 2045, 5 percent in 2065, and 7 percent in 2085. In the bottom fifth of the distribution, it would fall by 3 percent in 2045, 6 percent in 2065, and 13 percent in 2085. These losses exceed the percentage decline in lifetime earnings, despite Social Security's progressive benefit formula that replaces a larger share of preretirement earnings for people with limited lifetime earnings than for those with more lifetime earnings.

A higher minimum wage could mitigate but not eliminate the effects of growing wage inequality on future retirement incomes. Immediately raising the federal minimum wage from $7.25 to $12 per hour and subsequently adjusting it for inflation would raise lifetime earnings and future retirement income for people in the bottom two-fifths of the lifetime earnings distribution, but the impact would dissipate over time, despite the built-in inflation adjustment. As average wages grow faster than prices, the share of workers who would otherwise earn less than the minimum wage would fall each decade. For retirees in the bottom fifth of the lifetime earnings distribution, the simulated increase in the minimum wage would offset 57 percent of the retirement income lost to rising wage inequality in 2065 and 37 percent of lost retirement income in 2085.

Our projections of rising wage inequality focus solely on changes over time in the education premium—the wage gap between college graduates and workers with less education. The increase in the education premium can account for much of the past growth in wage inequality, and it is closely associated with other sources of wage inequality, such as the increase in international trade and decline in labor unions. However, our focus on the education premium excludes some important drivers of growing wage inequality, particularly the recent surge in wages in the top 1 percent of the distribution. Although only a very small share of the population collects these very high earnings, their size and rapid growth limit wage gains for other workers. Because our projections do not account for these increases at the very top of the wage distribution, our estimates may understate the future growth in wage inequality.

How earnings and retirement incomes actually evolve over the coming decades will depend on many factors. A key determinant will be the growth in average wages. Our analysis relies on assumptions developed by Social Security's Board of Trustees (2016), who anticipate 1.2 percent annual inflation-adjusted growth in wages. This assumed growth rate is significantly higher than the historic average annual rate of 0.81 percent from 1963 to 2015. Deviations from our assumed wage growth rate could significantly affect future earnings and retirement income. New patterns in marriage, employment, earnings, health, and savings that emerge over the coming decades will also determine outcomes. Policy choices will shape those patterns and help set future retirement incomes. A key determinant will be how policymakers respond to Social Security's long-run financing shortfall. Our projections assume that future retirees will receive full benefits scheduled under current law. The Social Security's Board of Trustees (2016), however, project that the system will only have enough funds to pay about three-fourths of scheduled benefits after the mid-2030s. Cuts to Social Security could reshape the distribution of future retirement income.

Boosting the minimum wage and maintaining its value over time as average wages rise would help low-wage workers and improve their retirement prospects, but a broader policy agenda is needed to ensure financial security across the lifespan (Ellwood and Patel 2018). Worker training and apprenticeship programs could boost lifetime earnings for less-skilled workers. Social Security reforms, such as creating a meaningful minimum benefit or changing the benefit formula to improve progressivity, could raise benefits for retirees with low lifetime earnings. Policy options to boost retirement savings include financial literacy training and federal or state mandates requiring employers that do not offer a pension plan to allow workers to automatically divert a portion of their paycheck to a retirement account. Tax reforms could raise savings incentives for low-wage workers who do not benefit much from income tax deductions, the primary savings incentive in the current tax code. Together, these programs could provide all workers with a path to retirement security even as wage inequality grows.

Appendix

APPENDIX TABLE 1

Estimated Coefficients and Standard Errors in the Labor Force Participation Equation by Sex and Race

	Black men	Non-black men	Black women	Non-black women
Married	0.780***	0.654***	0.0568***	-0.192***
	(0.0167)	(0.00781)	(0.0117)	(0.00579)
Divorced	0.237***	0.192***	0.234***	0.227***
	(0.0237)	(0.0120)	(0.0155)	(0.00854)
Disability limits work	-1.301***	-1.153***	-1.225***	-0.944***
	(0.0200)	(0.00753)	(0.0179)	(0.00697)
Hispanic	0.0239	-0.0256***	-0.207***	-0.0696***
	(0.0448)	(0.00737)	(0.0323)	(0.00481)
Region				
South	0.162***	-0.124***	0.103***	-0.166***
	(0.0152)	(0.00565)	(0.0121)	(0.00373)
Northeast	0.0295	-0.0736***	0.0399***	-0.0823***
	(0.0191)	(0.00600)	(0.0150)	(0.00396)
West	-0.0181	-0.142***	-0.0288	-0.134***
	(0.0234)	(0.00605)	(0.0187)	(0.00399)
Educational attainment				
High school graduate	0.325***	0.358***	0.559***	0.542***
	(0.0594)	(0.0269)	(0.0581)	(0.0179)
Some college	0.465***	0.418***	0.780***	0.719***
	(0.0601)	(0.0270)	(0.0584)	(0.0180)
College graduate	0.555***	0.311***	0.961***	0.994***
	(0.0894)	(0.0331)	(0.0746)	(0.0222)
Graduate school	0.645***	0.409***	1.090***	1.283***
	(0.0950)	(0.0340)	(0.0779)	(0.0230)
Number of children	0.0387***	0.0737***	-0.0212***	-0.0830***
	(0.00539)	(0.00233)	(0.00370)	(0.00134)
Number of children younger than 5	-0.00452	-0.0415***	-0.225***	-0.378***
	(0.0167)	(0.00647)	(0.0114)	(0.00316)
Spouse's log real income	0.0187***	-0.0104***	0.00211	-0.101***
	(0.00453)	(0.00139)	(0.00397)	(0.00147)
Foreign born	0.0414*	-0.0620***	-0.146***	-0.329***
	(0.0235)	(0.00862)	(0.0177)	(0.00552)
Foreign born missing	0.278***	0.141***	0.0821***	0.0157*
	(0.0386)	(0.0131)	(0.0305)	(0.00903)
Health				
Excellent	0.674***	0.544***	0.474***	0.275***
	(0.0322)	(0.0116)	(0.0262)	(0.00829)
Very good	0.622***	0.536***	0.492***	0.340***
	(0.0298)	(0.0110)	(0.0245)	(0.00811)
Good	0.439***	0.396***	0.370***	0.262***
	(0.0285)	(0.0108)	(0.0236)	(0.00818)

	Black men	Non-black men	Black women	Non-black women
Fair	0.115***	0.0932***	0.104***	0.0187*
	(0.0308)	(0.0122)	(0.0255)	(0.00967)
Receives Social Security	-1.233***	-1.395***	-0.801***	-0.781***
	(0.0199)	(0.00695)	(0.0162)	(0.00617)
Age splines				
Age 25	-0.0237	-0.00602	0.0264*	0.00292
	(0.0146)	(0.00635)	(0.0138)	(0.00429)
Age 30	0.0307*	-0.00626	-0.0226	-0.00111
	(0.0187)	(0.00807)	(0.0169)	(0.00537)
Age 40	-0.00414	0.000523	-0.0218***	-0.0310***
	(0.00974)	(0.00418)	(0.00764)	(0.00274)
Age 50	-0.0421***	-0.0269***	-0.0136*	-0.0162***
	(0.00900)	(0.00375)	(0.00701)	(0.00269)
Age 60	0.0101	0.00435	-0.0414***	0.00762
	(0.0133)	(0.00522)	(0.0120)	(0.00472)
Age 65	-0.0321**	-0.0361***	0.0123	-0.0425***
	(0.0127)	(0.00482)	(0.0130)	(0.00520)
Interactions of age splines educational attainment				
Age 25 X college graduate	0.0265	0.0503***	0.0128	-0.0466***
	(0.0247)	(0.00918)	(0.0198)	(0.00572)
Age 30 X college graduate	-0.0279	-0.0488***	-0.0220	0.0185***
	(0.0318)	(0.0118)	(0.0247)	(0.00706)
Age 40 X college graduate	-0.00613	-0.00388	0.0204*	0.0625***
	(0.0174)	(0.00616)	(0.0122)	(0.00353)
Age 50 X college graduate	-0.0316*	-0.0479***	-0.0538***	-0.0632***
	(0.0171)	(0.00553)	(0.0124)	(0.00376)
Age 60 X college graduate	0.0555**	0.0794***	0.0127	-0.00573
	(0.0263)	(0.00754)	(0.0223)	(0.00711)
Age 65 X college graduate	-0.0289	-0.0282***	0.00848	0.0370***
	(0.0264)	(0.00709)	(0.0246)	(0.00810)
Age 25 X high school graduate	0.0221	-0.00315	-0.0113	-0.0317***
	(0.0166)	(0.00736)	(0.0152)	(0.00473)
Age 30 X high school graduate	-0.0306	0.00327	0.01000	0.0322***
	(0.0213)	(0.00938)	(0.0188)	(0.00593)
Age 40 X high school graduate	-0.00108	0.00146	0.00478	0.00947***
	(0.0114)	(0.00489)	(0.00879)	(0.00305)
Age 50 X high school graduate	-0.00846	-0.0323***	-0.0165*	-0.0278***
	(0.0110)	(0.00447)	(0.00846)	(0.00305)
Age 60 X high school graduate	0.0108	0.0440***	0.00410	0.0131**
	(0.0174)	(0.00626)	(0.0152)	(0.00538)
Age 65 X high school graduate	0.0167	-0.0121**	-0.00414	-0.00300
	(0.0175)	(0.00587)	(0.0169)	(0.00600)
Time terms				
Time	-2.910***	-1.977***	-1.990***	-1.333***
	(0.338)	(0.124)	(0.263)	(0.0817)
Time^2/100	19.21***	13.34***	13.99***	9.626***
	(2.389)	(0.882)	(1.872)	(0.585)
Time^3/1000	-5.997***	-4.278***	-4.594***	-3.208***
	(0.809)	(0.300)	(0.636)	(0.200)
Time^4/10000	0.892***	0.654***	0.715***	0.503***
	(0.131)	(0.0488)	(0.103)	(0.0327)
Time^5/100000	-0.0511***	-0.0385***	-0.0427***	-0.0302***
	(0.00817)	(0.00305)	(0.00647)	(0.00205)

	Black men	Non-black men	Black women	Non-black women
Constant	16.45***	12.07***	10.44***	8.395***
	(1.845)	(0.675)	(1.428)	(0.440)
Observations	**91969**	**945650**	**117846**	**1147207**

Source: Authors' estimates from CPS (1976–2012).

Notes: Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

APPENDIX TABLE 2

Estimated Coefficients and Standard Errors in the Second-Stage Ordinary Least Squares Regression of Log Hourly Wage by Sex and Race

	Black men	Non-black men	Black women	Non-black women
Mean log real hourly wage	0.577***	0.832***	0.621***	0.564***
	(0.0550)	(0.0202)	(0.0626)	(0.0236)
College premium	0.751***	0.809***	0.428***	0.805***
	(0.0824)	(0.0193)	(0.0658)	(0.0223)
Married	0.191***	0.221***	0.0568***	0.0568***
	(0.00794)	(0.00282)	(0.00452)	(0.00233)
Hispanic	-0.0123	-0.144***	-0.0160	-0.0449***
	(0.0180)	(0.00230)	(0.0158)	(0.00249)
Region				
South	-0.117***	-0.0208***	-0.0814***	0.00408**
	(0.00639)	(0.00177)	(0.00588)	(0.00195)
Northeast	0.0118	0.0647***	0.0778***	0.0996***
	(0.00790)	(0.00182)	(0.00705)	(0.00202)
West	0.0251***	0.0407***	0.0565***	0.0563***
	(0.00960)	(0.00190)	(0.00900)	(0.00212)
Educational attainment				
High school graduate	0.134***	0.151***	0.103***	0.188***
	(0.0312)	(0.00930)	(0.0348)	(0.0118)
Some college	0.272***	0.270***	0.279***	0.358***
	(0.0314)	(0.00934)	(0.0351)	(0.0119)
College graduate	0.105*	-0.0248*	0.272***	0.130***
	(0.0536)	(0.0136)	(0.0488)	(0.0162)
Graduate school	0.262***	0.0794***	0.486***	0.348***
	(0.0542)	(0.0138)	(0.0500)	(0.0166)
Age splines				
Age 25	-0.00261	0.00711***	0.000386	0.000949
	(0.00789)	(0.00229)	(0.00846)	(0.00291)
Age 30	0.00643	-0.00179	-0.00488	0.0000290
	(0.00987)	(0.00286)	(0.0103)	(0.00357)
Age 40	-0.00627	-0.00575***	0.00774*	-0.000633
	(0.00470)	(0.00145)	(0.00462)	(0.00175)
Age 50	0.00448	-0.00123	-0.00870*	-0.000910
	(0.00455)	(0.00151)	(0.00450)	(0.00191)
Age 60	-0.00747	0.0126***	0.0278***	0.00357
	(0.00937)	(0.00348)	(0.0103)	(0.00459)
Age 65	0.00757	-0.00422	-0.0271*	-0.0104*
	(0.0121)	(0.00448)	(0.0148)	(0.00633)
Interactions of age splines educational attainment				
Age 25 X college graduate	0.0146	0.0323***	0.0209**	0.0314***
	(0.00990)	(0.00268)	(0.00957)	(0.00320)
Age 30 X college graduate	-0.0125	-0.0229***	-0.0113	-0.0355***
	(0.0123)	(0.00333)	(0.0118)	(0.00396)
Age 40 X college graduate	-0.00292	-0.0161***	-0.0159***	-0.00367*
	(0.00600)	(0.00168)	(0.00554)	(0.00200)
Age 50 X college graduate	-0.0128*	0.00137	0.00806	0.00488**
	(0.00668)	(0.00185)	(0.00606)	(0.00228)
Age 60 X college graduate	0.0120	-0.0131***	-0.0144	-0.0182***
	(0.0160)	(0.00466)	(0.0155)	(0.00615)

	Black men	Non-black men	Black women	Non-black women
Age 65 X college graduate	-0.00350	0.0149**	0.00826	0.0193**
	(0.0223)	(0.00652)	(0.0221)	(0.00900)
Age 25 X high school graduate	0.0130	0.0173***	0.0114	0.00720**
	(0.00841)	(0.00244)	(0.00888)	(0.00306)
Age 30 X high school graduate	-0.00963	-0.0149***	-0.00435	-0.00856**
	(0.0105)	(0.00306)	(0.0109)	(0.00378)
Age 40 X high school graduate	-0.00510	-0.00561***	-0.0147***	0.000335
	(0.00509)	(0.00156)	(0.00496)	(0.00186)
Age 50 X high school graduate	-0.00417	-0.00251	0.0104**	-0.000659
	(0.00521)	(0.00166)	(0.00500)	(0.00204)
Age 60 X high school graduate	0.00111	-0.00746*	-0.0244**	-0.0110**
	(0.0116)	(0.00393)	(0.0120)	(0.00501)
Age 65 X high school graduate	0.00344	0.0121**	0.0277	0.0139**
	(0.0158)	(0.00537)	(0.0179)	(0.00704)
Mills ratio	-0.267***	-0.406***	-0.230***	-0.140***
	(0.0160)	(0.00658)	(0.0147)	(0.00492)
Birth cohorts				
1906–10	0.151	-0.0443	-0.0355	-0.110*
	(0.106)	(0.0400)	(0.123)	(0.0616)
1911–15	0.161	0.0243	-0.0567	-0.0673
	(0.0990)	(0.0384)	(0.102)	(0.0553)
1916–20	0.177*	0.0629*	-0.0305	-0.115**
	(0.0973)	(0.0376)	(0.0967)	(0.0547)
1921–25	0.174*	0.0734**	-0.0709	-0.139**
	(0.0956)	(0.0373)	(0.0984)	(0.0543)
1926–30	0.170*	0.0439	-0.0871	-0.177***
	(0.0954)	(0.0373)	(0.0967)	(0.0544)
1931–35	0.161*	-0.00738	-0.110	-0.205***
	(0.0955)	(0.0373)	(0.0965)	(0.0545)
1936–40	0.161*	-0.0486	-0.135	-0.241***
	(0.0955)	(0.0373)	(0.0973)	(0.0547)
1941–45	0.118	-0.0911**	-0.159	-0.252***
	(0.0958)	(0.0373)	(0.0980)	(0.0550)
1946–50	0.0827	-0.154***	-0.187*	-0.273***
	(0.0960)	(0.0373)	(0.0988)	(0.0552)
1951–55	-0.00625	-0.198***	-0.237**	-0.294***
	(0.0962)	(0.0373)	(0.0996)	(0.0555)
1956–60	-0.0730	-0.230***	-0.300***	-0.322***
	(0.0965)	(0.0373)	(0.101)	(0.0558)
1961–65	-0.105	-0.274***	-0.336***	-0.349***
	(0.0971)	(0.0374)	(0.102)	(0.0562)
1966–70	-0.123	-0.312***	-0.360***	-0.381***
	(0.0976)	(0.0374)	(0.103)	(0.0566)
1971–75	-0.153	-0.337***	-0.370***	-0.406***
	(0.0984)	(0.0375)	(0.104)	(0.0570)
1976–85	-0.213**	-0.376***	-0.432***	-0.460***
	(0.0992)	(0.0376)	(0.106)	(0.0575)
1986–96	-0.387***	-0.401***	-0.529***	-0.531***
	(0.114)	(0.0414)	(0.118)	(0.0600)
Constant	0.826***	0.0791	0.970***	1.017***
	(0.177)	(0.0727)	(0.171)	(0.0754)
Observations	**64245**	**732503**	**72274**	**681046**

	Black men	Non-black men	Black women	Non-black women
Adjusted R2	**0.181**	**0.218**	**0.213**	**0.175**

Source: Authors' estimates from CPS (1976–2012).

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

APPENDIX TABLE 3

Estimates of Fixed Effects Regression of the Wage Equation Error Term on Its Lagged Value

	Men		Women	
	Black	**Non-black**	**Black**	**Non-black**
Lagged error term	0.218***	0.262***	0.113***	0.144***
	(0.006)	(0.006)	(0.009)	(0.009)
Constant	0.0164***	0.0443***	-0.0168***	0.0980***
	(0.002)	(0.002)	(0.003)	(0.003)
Observations	**31257**	**37813**	**15087**	**13410**
$\boldsymbol{\sigma_u}$ (standard deviation of permanent error term)	0.413	0.403	0.426	0.436
$\boldsymbol{\sigma_e}$ (standard deviation of transitory error term)	0.382	0.362	0.375	0.380

Source: Authors' estimates from the Panel Study of Income Dynamics (1981–2011).

Notes: The error term was calculated as the difference between the hourly wage recorded by the survey and the value predicted by the model of hourly wage described above. Standard errors are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

APPENDIX TABLE 4

Estimated Coefficients and Standard Errors in the Logistic Regression of Being Exempt from the Minimum Wage Law by Sex and Race

	Black men	Non-black men	Black women	Non-black women
Married	0.246***	0.322***	0.171***	-0.0453***
	(0.0155)	(0.00464)	(0.0140)	(0.00445)
Hispanic	0.127***	-0.305***	0.0759**	-0.272***
	(0.0393)	(0.00741)	(0.0373)	(0.00799)
Educational attainment				
High school graduate	-0.0172	-0.312***	-0.148	-0.220***
	(0.101)	(0.0299)	(0.0993)	(0.0303)
Some college	0.226**	0.0714**	0.115	0.00680
	(0.102)	(0.0300)	(0.0996)	(0.0304)
College graduate	1.414***	1.359***	1.116***	0.769***
	(0.135)	(0.0319)	(0.103)	(0.0294)
Graduate school	1.451***	1.219***	1.024***	0.646***
	(0.138)	(0.0328)	(0.106)	(0.0304)
Birth cohort				
1906–10	0	0.239	-1.320	0.145
	(.)	(0.322)	(0.964)	(0.346)
1911–15	-1.742***	-0.620***	-1.244***	-0.497***
	(0.380)	(0.106)	(0.389)	(0.110)
1916–20	-1.781***	-0.857***	-1.156***	-0.751***
	(0.248)	(0.0693)	(0.253)	(0.0729)
1921–25	-1.730***	-0.917***	-1.218***	-0.714***
	(0.204)	(0.0578)	(0.200)	(0.0589)
1926–30	-1.848***	-0.883***	-1.222***	-0.724***
	(0.180)	(0.0525)	(0.180)	(0.0530)
1931–35	-1.443***	-0.791***	-1.140***	-0.648***
	(0.168)	(0.0502)	(0.170)	(0.0502)
1936–40	-1.431***	-0.769***	-1.070***	-0.552***
	(0.163)	(0.0492)	(0.166)	(0.0489)
1941–45	-1.244***	-0.766***	-1.003***	-0.525***
	(0.161)	(0.0486)	(0.164)	(0.0483)
1946–50	-1.179***	-0.667***	-0.896***	-0.456***
	(0.159)	(0.0483)	(0.163)	(0.0479)
1951–55	-1.007***	-0.512***	-0.737***	-0.344***
	(0.158)	(0.0481)	(0.162)	(0.0477)
1956–60	-0.845***	-0.410***	-0.591***	-0.229***
	(0.158)	(0.0479)	(0.161)	(0.0475)
1961–65	-0.714***	-0.385***	-0.512***	-0.171***
	(0.157)	(0.0478)	(0.161)	(0.0473)
1966–70	-0.614***	-0.325***	-0.447***	-0.175***
	(0.157)	(0.0477)	(0.161)	(0.0472)
1971–75	-0.551***	-0.338***	-0.461***	-0.179***
	(0.155)	(0.0472)	(0.159)	(0.0466)
1976–85	-0.572***	-0.376***	-0.445***	-0.231***
	(0.156)	(0.0474)	(0.160)	(0.0468)
Age splines				
Age 16	-0.0691	-0.0686***	-0.0508	-0.0389***
	(0.0474)	(0.0137)	(0.0474)	(0.0141)
Age 19	0.139**	0.159***	0.0488	0.102***
	(0.0632)	(0.0184)	(0.0640)	(0.0195)

	Black men	Non-black men	Black women	Non-black women
Age 25	-0.0411*	-0.0784***	0.0290	-0.0620***
	(0.0234)	(0.00642)	(0.0242)	(0.00791)
Age 50	-0.00834	-0.000920	0.00346	0.0201***
	(0.0139)	(0.00454)	(0.0149)	(0.00604)
Age 60	0.0262	0.0288**	0.0613	-0.00182
	(0.0379)	(0.0140)	(0.0398)	(0.0179)
Age 65	0.0276	-0.0387**	-0.0451	-0.0152
	(0.0446)	(0.0167)	(0.0455)	(0.0209)
Interactions of age splines educational attainment				
Age 22 X college graduate	0.0455	0.129***	0.140***	0.148***
	(0.0485)	(0.0116)	(0.0380)	(0.0108)
Age 25 X college graduate	-0.0698	-0.130***	-0.166***	-0.152***
	(0.0502)	(0.0121)	(0.0401)	(0.0116)
Age 50 X college graduate	-0.00125	-0.0284***	-0.0116	-0.0169***
	(0.0161)	(0.00486)	(0.0164)	(0.00630)
Age 60 X college graduate	0.0130	-0.00773	-0.0316	0.0345*
	(0.0472)	(0.0151)	(0.0476)	(0.0192)
Age 65 X college graduate	-0.00259	0.0326*	0.0922	-0.0124
	(0.0585)	(0.0184)	(0.0576)	(0.0230)
Age 19 X high school graduate	0.00943	0.0340***	0.0582*	0.0451***
	(0.0319)	(0.00944)	(0.0300)	(0.00944)
Age 22 X high school graduate	0.0497	0.0604***	0.0336	0.0275**
	(0.0421)	(0.0129)	(0.0385)	(0.0125)
Age 25 X high school graduate	-0.0602**	-0.0795***	-0.0930***	-0.0562***
	(0.0303)	(0.00870)	(0.0300)	(0.00997)
Age 50 X high school graduate	0.00200	-0.0175***	-0.0191	-0.0309***
	(0.0148)	(0.00474)	(0.0156)	(0.00619)
Age 60 X high school graduate	-0.00563	-0.0370**	-0.0509	-0.0175
	(0.0426)	(0.0149)	(0.0435)	(0.0186)
Age 65 X high school graduate	-0.0523	0.0248	0.0406	0.0300
	(0.0517)	(0.0180)	(0.0513)	(0.0219)
State				
AK	-0.434***	-0.911***	-0.340**	-0.770***
	(0.130)	(0.0282)	(0.134)	(0.0298)
AZ	0.307***	0.0468*	0.439***	0.0104
	(0.0978)	(0.0252)	(0.0985)	(0.0267)
AR	-0.107	-0.0830***	-0.187***	-0.198***
	(0.0735)	(0.0266)	(0.0698)	(0.0281)
CA	0.204***	-0.0171	0.347***	0.0159
	(0.0549)	(0.0205)	(0.0499)	(0.0219)
CO	0.291***	0.00709	0.472***	0.0411*
	(0.0857)	(0.0231)	(0.0873)	(0.0244)
CT	0.132*	0.166***	0.413***	0.161***
	(0.0757)	(0.0240)	(0.0660)	(0.0250)
DE	0.444***	0.146***	0.640***	0.288***
	(0.0630)	(0.0266)	(0.0558)	(0.0273)
DC	0.550***	0.136***	0.782***	0.693***
	(0.0534)	(0.0288)	(0.0470)	(0.0290)
FL	0.274***	0.307***	0.315***	0.325***
	(0.0539)	(0.0217)	(0.0486)	(0.0227)
GA	0.548***	0.337***	0.601***	0.279***
	(0.0533)	(0.0247)	(0.0474)	(0.0262)
HI	-0.356*	-0.292***	-0.226	-0.00623

	Black men	Non-black men	Black women	Non-black women
	(0.185)	(0.0398)	(0.228)	(0.0404)
ID	0.237	-0.409***	-0.407	-0.554***
	(0.216)	(0.0256)	(0.395)	(0.0280)
IL	0.351***	0.136***	0.651***	0.172***
	(0.0565)	(0.0216)	(0.0490)	(0.0228)
IN	0.0891	-0.228***	0.218***	-0.218***
	(0.0840)	(0.0243)	(0.0748)	(0.0260)
IA	-0.357***	-0.378***	-0.203	-0.451***
	(0.132)	(0.0239)	(0.135)	(0.0253)
KS	0.000388	-0.336***	-0.113	-0.366***
	(0.0850)	(0.0243)	(0.0865)	(0.0260)
KY	-0.215**	-0.306***	-0.259***	-0.360***
	(0.0900)	(0.0255)	(0.0901)	(0.0272)
LA	0.239***	0.106***	0.0739	0.0524*
	(0.0618)	(0.0282)	(0.0555)	(0.0298)
ME	0.0688	-0.530***	0.518**	-0.509***
	(0.186)	(0.0246)	(0.218)	(0.0259)
MD	0.332***	-0.00245	0.473***	0.178***
	(0.0545)	(0.0249)	(0.0485)	(0.0257)
MA	0.141*	0.138***	0.418***	0.154***
	(0.0828)	(0.0230)	(0.0725)	(0.0239)
MI	0.171***	-0.191***	0.139**	-0.197***
	(0.0617)	(0.0221)	(0.0561)	(0.0238)
MN	0.0180	-0.212***	-0.0778	-0.259***
	(0.0877)	(0.0227)	(0.0912)	(0.0240)
MS	-0.0977	-0.0483*	-0.247***	-0.112***
	(0.0612)	(0.0293)	(0.0559)	(0.0310)
MO	0.214***	-0.161***	0.545***	-0.114***
	(0.0760)	(0.0246)	(0.0649)	(0.0258)
MT	-0.743**	-0.626***	-0.540	-0.849***
	(0.340)	(0.0268)	(0.486)	(0.0288)
NE	-0.131	-0.211***	-0.0796	-0.442***
	(0.103)	(0.0240)	(0.105)	(0.0257)
NV	0.270***	-0.0955***	0.234***	-0.0788***
	(0.0792)	(0.0249)	(0.0798)	(0.0266)
NH	0.238*	-0.0705***	0.536***	-0.159***
	(0.142)	(0.0232)	(0.162)	(0.0246)
NJ	0.729***	0.391***	0.904***	0.462***
	(0.0591)	(0.0227)	(0.0526)	(0.0236)
NM	-0.00627	-0.307***	0.350**	-0.323***
	(0.150)	(0.0278)	(0.155)	(0.0291)
NY	0.890***	0.281***	0.962***	0.330***
	(0.0523)	(0.0214)	(0.0460)	(0.0223)
NC	0.114**	0.0716***	0.112**	0.0413*
	(0.0560)	(0.0231)	(0.0505)	(0.0245)
ND	-0.620***	-0.448***	-0.157	-0.628***
	(0.187)	(0.0252)	(0.255)	(0.0266)
OH	-0.0227	-0.202***	-0.0499	-0.205***
	(0.0619)	(0.0217)	(0.0564)	(0.0232)
OK	-0.0812	-0.128***	0.198**	-0.128***
	(0.0885)	(0.0263)	(0.0784)	(0.0278)
OR	0.0106	-0.384***	-0.358*	-0.369***
	(0.150)	(0.0251)	(0.189)	(0.0268)
PA	0.336***	-0.0786***	0.615***	-0.0111

	Black men	Non-black men	Black women	Non-black women
	(0.0630)	(0.0214)	(0.0553)	(0.0227)
RI	0.0340	-0.179***	0.0588	-0.0953***
	(0.0899)	(0.0251)	(0.0890)	(0.0257)
SC	-0.0287	0.0172	-0.0963*	-0.0145
	(0.0614)	(0.0266)	(0.0558)	(0.0281)
SD	-0.700***	-0.430***	-0.783***	-0.635***
	(0.175)	(0.0249)	(0.285)	(0.0264)
TN	0.0285	-0.0433*	0.0766	-0.0531*
	(0.0708)	(0.0258)	(0.0642)	(0.0273)
TX	0.262***	0.224***	0.340***	0.126***
	(0.0535)	(0.0210)	(0.0481)	(0.0224)
UT	-0.0635	-0.211***	-0.0605	-0.411***
	(0.179)	(0.0244)	(0.228)	(0.0271)
VT	-0.168	-0.260***	0.372	-0.271***
	(0.238)	(0.0250)	(0.299)	(0.0258)
VA	0.322***	0.0676***	0.433***	0.159***
	(0.0580)	(0.0240)	(0.0516)	(0.0250)
WA	-0.0256	-0.406***	-0.0514	-0.351***
	(0.104)	(0.0243)	(0.118)	(0.0259)
WV	0.0851	-0.535***	0.0116	-0.436***
	(0.133)	(0.0270)	(0.133)	(0.0285)
WI	-0.294***	-0.365***	-0.206**	-0.419***
	(0.105)	(0.0232)	(0.0959)	(0.0248)
WY	-0.445**	-0.556***	-0.159	-0.660***
	(0.225)	(0.0254)	(0.242)	(0.0276)
Constant	-1.468***	-1.271***	-1.671***	-1.278***
	(0.166)	(0.0510)	(0.166)	(0.0506)
Observations	**100935**	**1230082**	**135019**	**1180499**

Source: Authors' estimates from CPS-MORG (1994–2016).

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

APPENDIX TABLE 5

Projected Mean Net Annuity Income for People Ages 67 to 75 by Educational Attainment

	Years						
	2025	2035	2045	2055	2065	2075	2085
High school dropout							
Baseline	19,894	18,783	18,868	20,829	22,488	25,266	27,072
Scenario 2	19,894	19,242	18,902	19,313	20,732	22,436	23,314
	(0.0%)	(2.4%)	(0.2%)	(-7.3%)	(-7.8%)	(-11.2%)	(-13.9%)
Scenario 3	20,200	19,164	19,182	20,261	20,898	23,299	25,011
	(1.5%)	(2.0%)	(1.7%)	(-2.7%)	(-7.1%)	(-7.8%)	(-7.6%)
High school graduate							
Baseline	38,317	35,728	36,170	39,743	42,933	47,391	50,455
Scenario 2	38,119	35,354	34,849	37,488	40,269	43,689	46,171
	(-0.5%)	(-1.0%)	(-3.7%)	(-5.7%)	(-6.2%)	(-7.8%)	(-8.5%)
Scenario 3	38,039	35,309	34,750	38,399	42,126	43,961	46,069
	(-0.7%)	(-1.2%)	(-3.9%)	(-3.4%)	(-1.9%)	(-7.2%)	(-8.7%)
Some college							
Baseline	49,830	49,324	50,959	52,774	58,231	63,639	66,462
Scenario 2	49,136	48,576	49,076	49,329	55,212	58,110	60,985
	(-1.4%)	(-1.5%)	(-3.7%)	(-6.5%)	(-5.2%)	(-8.7%)	(-8.2%)
Scenario 3	49,482	48,619	49,238	49,702	54,678	57,403	61,964
	(-0.7%)	(-1.4%)	(-3.4%)	(-5.8%)	(-6.1%)	(-9.8%)	(-6.8%)
College graduate							
Baseline	76,990	83,181	83,019	82,834	88,540	97,620	102,409
Scenario 2	77,489	84,262	86,823	88,124	95,769	103,465	112,713
	(0.6%)	(1.3%)	(4.6%)	(6.4%)	(8.2%)	(6.0%)	(10.1%)
Scenario 3	77,243	83,182	85,013	86,656	93,484	104,000	113,288
	(0.3%)	(0.0%)	(2.4%)	(4.6%)	(5.6%)	(6.5%)	(10.6%)

Source: DYNASIM4 ID942, ID942B, and ID942C

Notes: Net per capita annuity income includes earnings, Social Security, DB pension, annuitized asset income, SSI, imputed rent, federal assistance programs, less federal income tax, state income tax, OASDI tax, HI tax, Medicare surtax, and Medicare Part B and Part D premiums. Percentage change relative to the baseline is in parentheses.

APPENDIX TABLE 6

Effects of Growing Wage Inequality and Raising Minimum Wage on Income Among People Ages 67 to 75 in 2065 by Income Source, Tax Category, and Education

Percent

	High school dropout	High school graduate	Some college	College graduate
Effects of growing wage inequality				
Income	-7.9	-8.0	-8.5	15.6
Social Security benefits	-2.1	-2.1	-1.4	1.3
SSI	0.1	0.0	0.0	0.0
Annuitized financial income	-0.6	-2.0	-1.9	3.1
DB pension income	0.1	-0.1	-0.6	0.0
Earned income	-3.6	-3.1	-3.9	9.4
Imputed rental income	-1.8	-0.6	-0.8	1.7
Federal assistance programs	0.0	0.0	0.1	0.0
Tax	-0.1	-1.8	-3.3	7.4
Federal income tax	-0.1	-1.3	-2.3	5.3
State income tax	0.0	-0.1	-0.5	1.1
tax	-0.2	-0.2	-0.1	0.3
HI tax	0.0	0.0	0.0	0.1
Medicare surtax	0.1	-0.1	-0.2	0.5
Medicare Part B premium	0.2	-0.1	-0.2	0.1
Medicare Part D premium	0.1	0.0	-0.1	0.0
Net income	**-7.8**	**-6.2**	**-5.2**	**8.2**
Effects of raising the minimum wage				
Income	-0.1	3.3	-0.1	-5.0
Social Security benefits	1.1	0.7	-0.3	-0.4
SSI	0.0	0.0	0.0	0.0
Annuitized financial income	-0.6	0.7	-0.1	0.3
DB pension income	0.0	-0.1	0.1	0.1
Earned income	-1.4	1.7	0.7	-4.1
Imputed rental income	0.7	0.3	-0.3	-1.0
Federal assistance programs	0.1	0.0	-0.1	0.0
Tax	-0.9	-0.2	0.8	-4.0
Federal income tax	-0.9	-0.2	0.7	-2.7
State income tax	-0.1	0.0	0.2	-0.8
OASDI tax	-0.1	0.2	0.0	-0.1
HI tax	0.0	0.0	0.0	-0.1
Medicare surtax	-0.1	0.0	0.0	-0.3
Medicare Part B premium	0.2	-0.1	-0.1	0.0
Medicare Part D premium	0.0	0.0	0.0	0.0
Net income	**0.8**	**3.4**	**-0.9**	**-1.1**

Source: DYNASIM4 ID942, ID942B, and ID942C

Notes: Net per capita annuity income includes earnings, Social Security, DB pension, annuitized asset income, SSI, imputed rent, federal assistance programs, less federal income tax, state income tax, OASDI tax, HI tax, Medicare surtax, Medicare Part B and Part D premiums. Upper panel shows differences between scenario 2 and the baseline, bottom panel differences between scenarios 3 and 2, both expressed as percentage of the baseline.

Notes

1. For a population of n workers arranged in order of increasing wage income, the Gini coefficient G for wages w can be defined as $G = \frac{1}{n}(n + 1 - 2\frac{\sum_{i=1}^{n}(n+1-i)w_i}{\sum_{i=1}^{n} w_i})$.
2. See Neumark (2017) for an overview of results in the recent literature.
3. DYNASIM4 imputes a 3 percent annual rate of return to housing equity that represents the savings in rent from owning a home, net of interest and home maintenance costs.
4. The annuity factor is recalculated each year to reflect changes in wealth as individuals age, based on DYNASIM4 projections of wealth accumulation and spenddown and changes in life expectancy and marital status. For married couples, DYNASIM4 assumes a 50 percent survivor annuity.
5. Following Autor, we classified one-half of workers with some college but less than a four-year degree, randomly selected, with the college-educated group and the other half with the high-school-educated group.
6. We included the average annual wage in the wage equation to improve the model's predictive power, as described below, an important consideration for a projection model.
7. We performed initial estimates with both the CPS and the Panel Study of Income Dynamics. We preferred the CPS results because they were more precise and had greater predictive power. The CPS likely performed better because it generated a much larger sample, with more than 2.5 million observations, compared with fewer than 200,000 observations in the Panel Study of Income Dynamics, and thus better represented the entire population.
8. This method does not replicate the top of the earnings distribution well. To simulate high earners, we instead randomly drew earnings from a distribution of top earnings obtained from the Social Security Administration. DYNASIM4 adjusts these earnings so that average simulated earnings match average earnings projected by the Social Security's Board of Trustees (2016).
9. The Fair Labor Standards Act defines many categories of employees that are exempt from the federal minimum wage, including executive, administrative, professional and outside sales employees paid on a salary basis, farmworkers, and some workers employed by firms with annual gross volume of sales less than $500,000.
10. The wage elasticity with respect to the minimum wage is the ratio of the percentage change in the hourly wage to the percentage change in the minimum wage.

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About the Authors

Richard Johnson is a senior fellow in the Income and Benefits Policy Center at the Urban Institute, where he directs the Program on Retirement Policy. His current research focuses on older Americans' employment and retirement decisions, long-term services and supports for older adults with disabilities, and state and local pensions. Recent studies have examined job loss at older ages, occupational change after age 50, employment prospects for African Americans and Hispanics over age 50, and the impact of the 2007–09 recession and its aftermath on older workers and future retirement incomes. He has also written extensively about retirement preparedness, including the financial and health risks people face as they approach retirement, economic hardship in the years before Social Security's early eligibility age, and the adequacy of the disability safety net. Johnson's long-term services and supports research focuses on financing options and uses DYNASIM, Urban's dynamic microsimulation model, to project demand for services under current and alternative policies. His other major research thread involves state and local pension plans. He recently directed a team of researchers evaluating public pension plans in all 50 states and the District of Columbia, and he is examining how reforms might affect public-sector employees. Johnson, who writes and speaks frequently about income and health security at older ages, earned his AB from Princeton University and his PhD from the University of Pennsylvania, both in economics.

Damir Cosic is a research associate in the Income and Benefits Policy Center at Urban Institute and part of a group that studies retirement income and benefits. His work focuses on policy evaluation using microsimulation models. Cosic holds a BS in electrical engineering from the University of Zagreb in Croatia and has extensive experience as a software engineer. He received an MA in economics from Hunter College in New York City and PhD in economics from the Graduate Center at the City University of New York. His research focus was income and wealth distribution.

Karen Smith is a senior fellow in the Income and Benefits Policy Center at the Urban Institute, where she is an internationally recognized expert in microsimulation. Over the past 30 years, she has developed microsimulation models for evaluating Social Security, pensions, taxation, wealth and savings, labor supply, charitable giving, health expenditure, student aid, and welfare reform. Smith has played a lead role in the development of the Social Security Administration's Modeling Income in the Near Term microsimulation model, Urban’s Dynamic Simulation of Income microsimulation model, and the Social Security Administration’s Policy Simulation Model. Her recent work includes estimating the impact of the Great Recession on retirement well-being; analyzing income and asset accumulation patterns of the adult population; analyzing the retirement decision; evaluating the effect of disability on earnings and mortality; and using statistical matching to impute earnings, taxes, and spouse characteristics. Smith has written extensively on demographic and economic trends, and their implications for the retirement well-being of current and future cohorts. She has contributed chapters to numerous books, including *Closing the Deficit: How Much Can Later Retirement Help?*; *Redefining Retirement: How Will Boomers Fare?*; *Reshaping Retirement Security: Lessons from the Global Financial Crisis*; and *Social Security and the Family*. She has also published articles in various scholarly journals, including *the Social Security Bulletin*, *National Tax Journal*, and *Journal of Aging & Social Policy*. She has served on advisory panels for the National Academy of Science, Brookings Institution, and Mathematica Policy Research.

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