Education, Earnings Inequality, and Future Social Security Benefits: A Microsimulation Analysis

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Over the last three decades, earnings have grown faster for college graduates than for workers without a 4-year college degree. Such wage-growth differentials could affect the Social Security benefits and other retirement income of future retirees. A Social Security Administration microsimulation model, Modeling Income in the Near Term (MINT), can estimate the distributional effects of Social Security reform proposals under alternative economic scenarios. We use MINT to estimate the effect of wage-growth differentials by educational attainment on the future earnings and Social Security benefits of individuals born during 1965–1979, sometimes referred to as "Generation X." For those individuals, we find that different rates of wage growth by educational attainment would substantially increase the gap in annual earnings between college graduates and nongraduates. Differences in Social Security benefits would increase by a smaller proportion because of Social Security's long-term averaging of earnings and its progressive benefit calculation formula.

Introduction

Social Security benefits are the most widely received source of income among Americans aged 65 or older, and they are the largest source of income for more than half of aged beneficiaries (Social Security Administration [SSA] 2014). In light of Social Security's importance to current and future retirees, economic trends that could affect workers' retirement benefits are of interest to SSA, Congress, and the public. One such trend is growing inequality in earnings.

In general, Social Security benefits increase with career-average earnings, and earnings increase with education and work experience.[1] Many personal, social, and economic variables affect lifetime earnings, but social scientists have long recognized the central role played by educational attainment. More than a half-century ago, economists Jacob Mincer (1958) and Gary Becker (1964) proposed theories of human capital in which the knowledge, skills, and abilities acquired through formal education strongly influence both employment and earnings. Those theories continue to inform much research in economics, sociology, and public policy today.

Economists and other social scientists typically are cautious about attributing causation to relationships that may be mere correlations. Nevertheless, the empirical evidence gathered over more than 50 years is so compelling that asserting a cause-and-effect relationship between education and earnings would likely encounter little disagreement among those who study labor markets (Card 1999, 2002; Heckman, Lochner, and Todd 2003).[2]

The rapidly rising cost of higher education might call into question whether attending college continues

Selected Abbreviations

AIME	average indexed monthly earnings
AWI	average wage index
FRA	full retirement age
MINT	Modeling Income in the Near Term
PIA	primary insurance amount

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Selected Abbreviations—*Continued*

SIPP	Survey of Income and Program Participation
SSA	Social Security Administration

to be worth the expense. However, recent research suggests that earning a 4-year college degree remains a good investment for the average student. Researchers at the Federal Reserve Bank of San Francisco found that college graduates fully recoup the costs of higher education by age 40, on average; and that in inflation-adjusted terms, "a college graduate can expect to earn $830,800 more than a high school graduate over the course of a lifetime" (Daly and Bengali 2014). The authors found that the lifetime earnings premium for college graduates resulted not just from higher annual salaries, but also from lower rates of unemployment, even during times of recession. A separate analysis by researchers at the Federal Reserve Bank of New York found that the financial return of a college education "has remained high in spite of rising tuition and falling earnings because the wages of those without a college degree have also been falling, keeping the college wage premium near an all-time high while reducing the opportunity cost of going to school" (Abel and Deitz 2014).

If the earnings of college graduates rise more rapidly (or fall more slowly) than the earnings of workers without a 4-year degree, earnings inequality will increase—all else being equal. However, earnings inequality in itself is not necessarily bad. Indeed, if earning a college degree did not produce higher lifetime earnings for the typical graduate, acquiring a college degree would not be a worthwhile investment of time and money. In some respects, earnings inequality is like the extra weight that many of us carry around: What matters is how much you have, where you have it, and how fast it is growing.

Abundant research indicates that the United States has more earnings inequality than other developed nations, that the inequality is evident throughout the earnings distribution (not just between the top 1 percent and everyone else), and that it has grown substantially in recent years (Bowlus and Robin 2004; Lemieux 2006; Goldin and Katz 2007; Autor, Katz, and Kearney 2008; Favreault 2009; Favreault and Haaga 2013; Autor 2014; Mitchell 2014). One dimension along which U.S. earnings inequality has grown is the difference in annual and lifetime earnings between workers with a 4-year college degree and those without (Abel and Deitz 2014; Daly and Bengali 2014; Pew Research Center 2014).

Increasing earnings inequality could have implications for Social Security benefits and income disparity in retirement. Higher rates of earnings growth for college graduates compared with nongraduates would presumably increase income inequality among future retirees.[3] If the earnings of college nongraduates continue to grow more slowly than economywide earnings, those workers will be less able to save for retirement in 401(k) plans and other retirement accounts. In such a scenario, the role played by Social Security in helping lower-earning workers achieve an adequate standard of living in retirement would be even greater than it is today.

The method established by Congress for calculating Social Security benefits indexes a worker's highest 35 years of annual earnings to the year the worker reaches age 60, with the index based on the growth in the national average wage. By design, the benefit formula replaces a higher percentage of career-average earnings for workers with low lifetime earnings than it does for workers with relatively high earnings. Together, these program characteristics distribute Social Security benefits more narrowly around the average benefit than annual earnings are distributed. In other words, there is less inequality in Social Security benefits than there is in earnings. Nevertheless, growing inequality in current earnings inevitably will result in greater inequality in future Social Security benefits. One of our goals is to illustrate the extent of that increase under two specific sets of economic assumptions.

In this article, we present estimates of the impact of earnings growth differentials between college graduates and nongraduates on projected annual earnings and Social Security benefits. We aim to estimate how the disparity in real earnings growth between college graduates and nongraduates affects future annual earnings and Social Security benefits for persons born from 1965 through 1979, sometimes referred to as "Generation X." Favreault (2009) estimated the retirement-income distributional effects of higher rates of earnings growth for high-wage workers than for low-wage workers. To the best of our knowledge, however, our analysis is the first attempt to estimate future Social Security benefits that accounts for the effects of earnings growth differentials between college graduates and nongraduates.

Data and Methodology

We developed our estimates using an SSA microsimulation model called Modeling Income in the Near Term (MINT). Microsimulation models are widely used by government agencies to analyze the distributional effects of public policy proposals. These models use information about a sample of "micro units" such as individuals, families, or households to estimate how changes in their circumstances, characteristics, or behavior will affect the entire population or a population subset such as workers or retirees. Smith and Favreault (2013a) observe that microlevel data "combined with detailed representations of program rules can inform policy by revealing interactions and trends that more aggregate analyses may fail to capture."

SSA began developing MINT in the 1990s to estimate the future retirement income of current workers and the distributional effects of proposed Social Security reforms. SSA directed the development of MINT with assistance from the Brookings Institution, the RAND Corporation, and the Urban Institute. MINT can simulate the effects of a wide range of policy alternatives and economic scenarios on individual and family income by linking longitudinal survey data from the Census Bureau's Survey of Income and Program Participation (SIPP) to Social Security earnings records. MINT combines the rich social and demographic data available from the SIPP with the accuracy of SSA's earnings records.

The simulation results we present were produced using MINT version 7 (MINT7). MINT7 simulations start with a representative sample of the population aged 31 or older in 2010. The model matches records from the 2004 and 2008 panels of the SIPP to Social Security earnings records through 2010.[4] We restricted our analysis to individuals born from 1965 through 1979 whose records from the 2004 and 2008 panels of the SIPP were successfully matched to Social Security earnings records, a sample consisting of 23,868 persons. The SIPP data include the demographic characteristics of survey respondents during the period 2004–2010, when most members of Generation X were in their 30s and 40s.

For each individual, MINT independently projects employment status, earnings, marital status, fertility, onset of disability, retirement status, and retirement income (Smith and Favreault 2013b). MINT projections account for the earnings distributions both within and between birth cohorts. In addition to earnings and Social Security benefits, MINT projects family income from sources such as interest, dividends, pensions, Supplemental Security Income payments, income from nonspouse coresident family members, noncash income, and imputed rental income.[5] The model projects the sources and amounts of retirement income from age 55 until the projected date of death, emigration, or nursing home entry.

To simulate future employment and earnings, MINT requires detailed information about workers' past earnings, their marital and fertility histories, and other characteristics such as education and disability status. In addition, the model requires assumptions about future inflation and interest rates, wage growth, and trends in mortality and disability rates. MINT7 uses Social Security records through 2010 as its source information about workers' past earnings. It incorporates assumptions about future demographic and economic trends from the intermediate-cost projections presented in the *2012 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds* (Board of Trustees 2012), hereafter called the *Trustees Report.* The SIPP provides data on the demographic traits of the U.S. population.[6]

SSA's Office of the Chief Actuary prepares annual estimates for the Board of Trustees of the revenues and expenditures of the Social Security trust funds over the next 75 years. MINT7 uses the projected interest rates, inflation rates, wage growth, and mortality and disability rates that appear in the *Trustees Report.* The Chief Actuary prepares these estimates under three sets of economic and demographic assumptions, referred to as the low-, intermediate-, and high-cost scenarios.[7] The *Trustees Report* describes the intermediate-cost assumptions as reflecting the Trustees' best estimate of future experience, with the low-cost and high-cost alternative demographic and economic assumptions included "to show a wide range of possible outcomes, because assumptions related to these factors are subject to uncertainty" (Board of Trustees 2012, 35).

Economic projections in the *Trustees Report* include the real (inflation-adjusted) rate of growth in the national average wage index (AWI).[8] For the period 2020–2050, the intermediate-cost projection in the *2012 Trustees Report* assumes an average annual inflation rate of 2.8 percent and average annual real wage growth of 1.2 percent. The low-cost scenario assumes 1.8 percent inflation and 1.8 percent real annual wage growth. The high-cost scenario assumes 3.8 percent inflation and 0.6 percent real annual wage

growth. MINT7 incorporates the intermediate-cost assumptions in its baseline simulation, and the low- and high-cost scenarios establish suitable boundaries for assumptions that could be used in alternative simulations.

MINT projects annual earnings in one of two ways, depending on the earner's age. For persons aged younger than 55, MINT matches the subject individual's earnings record with that of another individual who has similar characteristics but is 5 years older. The model splices the earnings from the older person's record onto that of the younger person, then wage-indexes annual earnings within each 5-year band to the 5-year period for which it has matched the person-records of the earnings "donor" and "recipient." For persons aged 55 or older, MINT uses a multivariate regression equation to project earnings. In the baseline simulation, the AWI grows at the rate assumed under the intermediate-cost assumptions in the *Trustees Report.* We report the results of that simulation as well as those of an alternative scenario in which we assume the earnings of college graduates grow faster than the AWI and the earnings of workers without a college degree grow more slowly than the AWI.[9]

Although MINT7 includes all participants in the 2004 and 2008 panels of the SIPP who were born in the period 1926–1979, we restrict our analysis to persons born 1965–1979, or Generation X.[10] Those individuals were 31–45 years old in 2010, and thus were still 17–31 years away from first eligibility for Social Security retired-worker benefits at age 62. With a projection period of that length, alternative rates of earnings growth could have a substantial impact on our simulations of future earnings and Social Security benefits.

In our baseline simulation, we project real earnings to grow at an annual rate of 1.2 percent. In our alternative simulation, we adjust future rates of earnings growth to reflect above-average growth rates for college graduates and below-average growth rates for workers without a 4-year college degree. We selected rates of growth for the two groups that maintain, when weighted by the 2010 distribution of earnings by educational attainment, the 1.2 percent overall average rate of real earnings growth that we assume in the baseline simulation. In both simulations, we assume a 2.8 percent annual rate of inflation, following the intermediate-cost projections in the *2012 Trustees Report.* In each simulation, we project earnings for members of the 1965–1979 birth cohorts in 2011 and later. We present results for 2020 (at ages 41–55), 2030 (at ages 51–65), 2040 (at ages 61–75), and in 2050 (when the youngest members of these birth cohorts will attain age 71).

For our analysis, we divide the population into two groups: those who have a 4-year college degree and those who do not. The first group includes individuals with advanced degrees as well as those with no more than a bachelor's degree. The second group comprises individuals who did not finish high school; high school graduates; and individuals with some college, including associate's degree holders. Using two broad education categories simplifies the presentation of our results without materially affecting the outcomes of our simulations.[11]

Although choosing alternative rates of earnings growth for college graduates and nongraduates is necessarily somewhat arbitrary, we establish several constraints to assure that the alternative rates we choose are reasonable. First, the rates must fall within the range of real earnings growth rates assumed in the *2012 Trustees Report* under the low-cost projection (0.6 percent) and the high-cost projection (1.8 percent). Second, we choose rates that, when weighted by the 2010 distribution of earnings between college graduates and nongraduates, would result in a weighted average annual growth rate of 1.2 percent for all workers in the 1965–1979 birth cohorts—the same rate that we assume for all workers in the baseline simulation.[12] Consequently, any differences in real annual earnings between the baseline and alternative simulations can be attributed to differences in the rates of earnings growth between the two educational-attainment groups, and not to differences in the overall national average rate of earnings growth in the two simulations. Finally, from the possible combinations of earnings growth rates for college graduates and nongraduates that satisfy the first two conditions, we choose the two rates that, when rounded to the nearest 0.1 percent, would produce the greatest difference between college graduates and nongraduates.

Because MINT7 includes actual earnings from Social Security records through 2010, the first year for which the model simulates earnings is 2011. Our alternative simulation differs from the baseline only in that for each year from 2011 forward, we apply annual rates of real wage growth of 1.6 percent and 0.7 percent, respectively, to the projected earnings of college graduates and nongraduates. We present projections of earnings covered by Social Security in 2020, 2030, 2040, and 2050—that is, after 10, 20, 30, and 40 years of different rates of wage growth for college graduates

and nongraduates.[13] The model projects that by 2050, when the youngest members of Generation X will be 71 years old, only 21 percent of the surviving members of these cohorts will be working. Therefore, we focus our discussion on earnings in 2020, 2030, and 2040, for which the model projects employment rates of 82 percent, 72 percent, and 43 percent, respectively, for Generation X.

Simulation Results

In this section, we present model results for three related measures. First, we examine earnings. Then, we look at two primary components of the Social Security benefit calculation. Finally, we address Social Security benefits themselves.

Effect on Annual Earnings

Table 1 shows projected median earnings of college graduates and nongraduates in the baseline and alternative simulations, expressed as ratios of the national average wage. The ratios can be converted to 2012 dollars by multiplying each ratio by the national AWI for the appropriate year.[14] For example, under the baseline simulation, MINT projects the median earnings of college graduates in 2020 to be 1.38 times the real national average wage of $52,817—or $72,887—in 2012 dollars.[15] We focus on median earnings because mean earnings values are skewed by a relatively small percentage of workers with very high earnings. For example, among all workers born from 1965 through 1979, the top 1 percent of earners received 10 percent of all earnings in Social Security–covered employment in 2010. Median earnings—which represent the worker in the middle of the earnings distribution—are more representative of the earnings of the typical worker because the median is not skewed by outliers.

In the baseline simulation, the ratio of the median earnings of college graduates to the median earnings of nongraduates is projected to be 2.00 in 2020, 2.14 in 2030, and 1.87 in 2040.[16] In the alternative simulation, MINT projects this ratio to be 2.17 in 2020, 2.55 in 2030, and 2.44 in 2040. The ratio of the median earnings of college graduates to the median earnings of nongraduates in the alternative simulation is higher than that in the baseline simulation by 8.5 percent for 2020, 19.2 percent for 2030, and 30.5 percent for 2040.

Chart 1 illustrates how the gap in median earnings between college graduates and nongraduates widens in the alternative simulation compared with that of the baseline. The two solid lines show median earnings in the baseline simulation for college graduates (blue) and nongraduates (red). MINT projects the median earnings of college graduates to be 1.38 times the national average wage in 2020, compared with 0.69 times the average wage for nongraduates. In the alternative simulation (broken lines), the model projects relatively higher median earnings for college graduates in 2020, at 1.43 times the national average wage (blue), and relatively lower median earnings (0.66 times the average wage) for nongraduates (red).

Table 1 also shows the projected median earnings ratios by educational attainment separately for men and women. The projected median earnings of male college graduates exceed those of female college graduates in both the baseline and alternative simulations. Likewise, median male college nongraduates' earnings are projected to exceed median female nongraduates' earnings in all years under both simulations. Chart 2 presents projected median earnings by educational attainment for men and women, respectively, in the baseline and alternative simulations. Both charts also illustrate the extent to which the gap in median earnings between college graduates and nongraduates in the alternative simulation exceeds that of the baseline projection.

Because the alternative simulation projects the same rates of earnings growth for college graduates and nongraduates regardless of sex, its gap in earnings between college graduates and nongraduates extends the baseline scenario's gap by roughly the same percentage for men and women; differences mainly reflect the effects of rounding. For example, Table 1 shows that for 2020, the ratio of the median earnings of male college graduates to nongraduates is 2.10 in the baseline simulation and 2.29 in the alternative simulation, a difference of 9.0 percent. Likewise, the ratio of the projected median earnings of female college graduates to nongraduates in 2020 is 1.95 in the baseline simulation and 2.11 in the alternative simulation, a difference of 8.2 percent. For 2030, the projected ratio of college graduate-to-nongraduate median earnings for men is 2.36 in the baseline simulation and 2.82 in the alternative simulation, a 19.5 percent difference. Among women, the corresponding ratios are 1.98 in the baseline and 2.41 in the alternative simulation, a 21.7 percent difference.

Faster earnings growth for college graduates would increase the difference in earnings not just for workers near the middle of the earnings distribution, but also for workers closer to the top or the bottom of the

Table 1.
Median earnings relative to the national AWI for college graduates and nongraduates born 1965–1979, by sex: Baseline and alternative projections, decennially 2020–2050

Educational attainment and sex	2020	2030	2040	2050
National AWI (in 2012 dollars)	52,817	58,674	65,778	73,438
Workers with earnings (%)	82	72	43	21
		Baseline simulation		
		Total		
Ratio of median earnings to national AWI for college—				
Graduates	1.38	1.37	0.84	0.80
Nongraduates	0.69	0.64	0.45	0.54
Ratio of college graduate-to-nongraduate median earnings	2.00	2.14	1.87	1.48
		Men		
Ratio of median earnings to national AWI for college—				
Graduates	1.74	1.72	0.96	0.88
Nongraduates	0.83	0.73	0.49	0.60
Ratio of college graduate-to-nongraduate median earnings	2.10	2.36	1.96	1.47
		Women		
Ratio of median earnings to national AWI for college—				
Graduates	1.07	1.09	0.75	0.74
Nongraduates	0.55	0.55	0.43	0.43
Ratio of college graduate-to-nongraduate median earnings	1.95	1.98	1.74	1.72
		Alternative simulation		
		Total		
Ratio of median earnings to national AWI for college—				
Graduates	1.43	1.48	0.95	0.93
Nongraduates	0.66	0.58	0.39	0.44
Ratio of college graduate-to-nongraduate median earnings	2.17	2.55	2.44	2.11
Difference from baseline projection of college graduate-to-nongraduate median-earnings ratio (%)	*8.5*	*19.2*	*30.5*	*42.6*
		Men		
Ratio of median earnings to national AWI for college—				
Graduates	1.81	1.86	1.08	1.03
Nongraduates	0.79	0.66	0.42	0.49
Ratio of college graduate-to-nongraduate median earnings	2.29	2.82	2.57	2.10
Difference from baseline projection of college graduate-to-nongraduate median-earnings ratio (%)	*9.0*	*19.5*	*31.1*	*42.9*
		Women		
Ratio of median earnings to national AWI for college—				
Graduates	1.12	1.18	0.84	0.86
Nongraduates	0.53	0.49	0.37	0.35
Ratio of college graduate-to-nongraduate median earnings	2.11	2.41	2.27	2.46
Difference from baseline projection of college graduate-to-nongraduate median-earnings ratio (%)	*8.2*	*21.7*	*30.5*	*43.0*

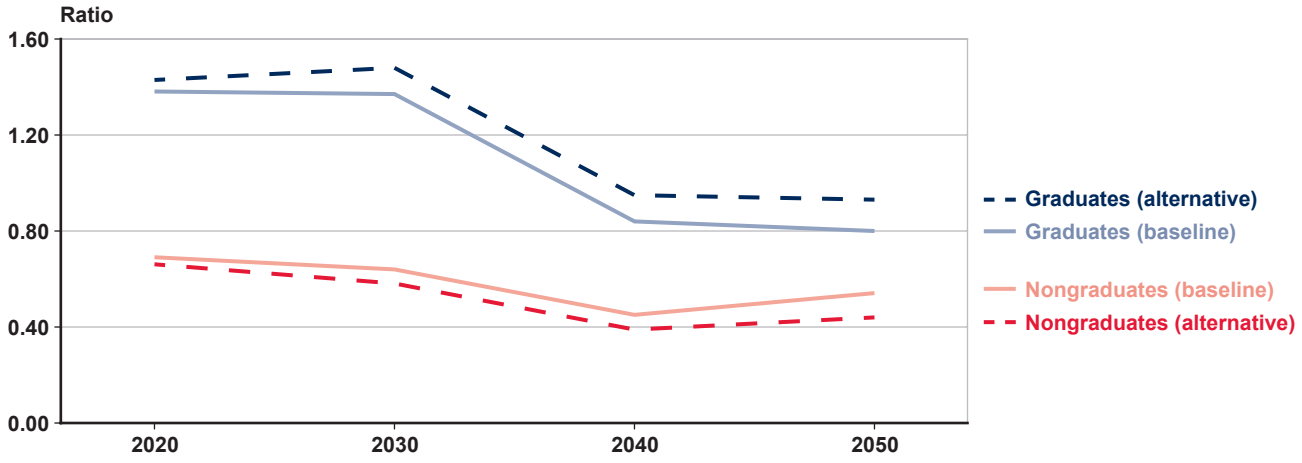
SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Chart 1.
Ratio of median earnings to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2020–2050



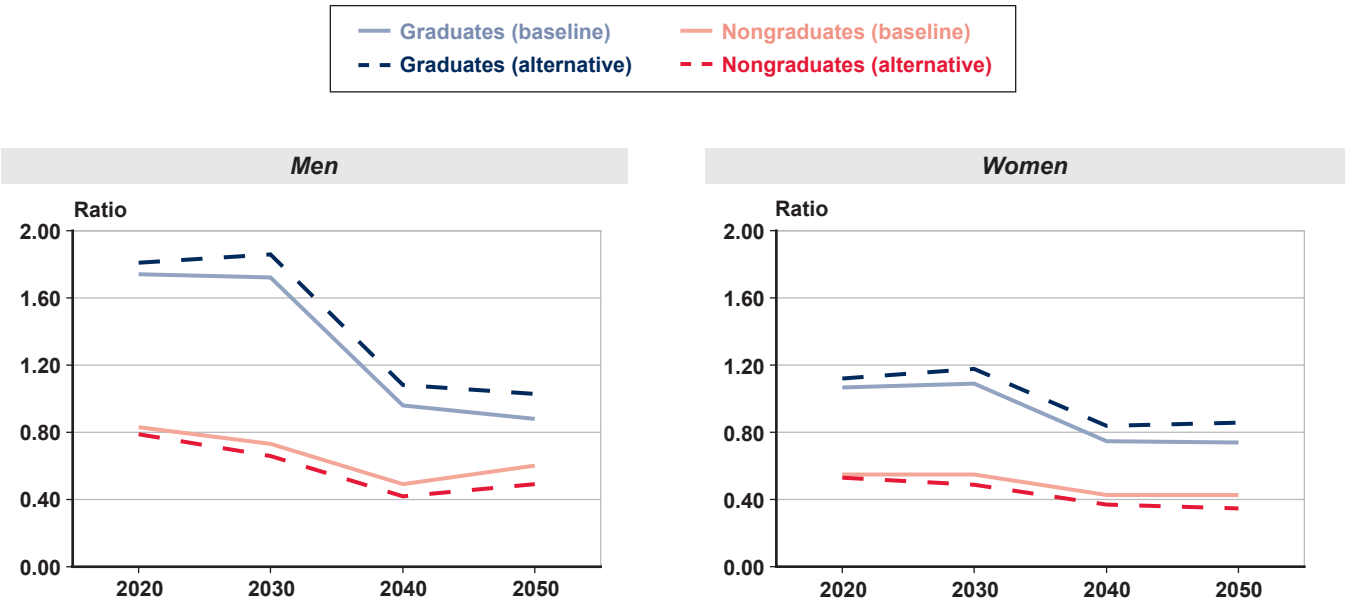
SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Chart 2.
Ratio of median earnings to the national AWI for college graduates and nongraduates born 1965–1979, by sex: Baseline and alternative projections, decennially 2020–2050



SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

distribution. Table 2 shows earnings (relative to the national average wage) at the 75th percentile and the 25th percentile for college graduates and nongraduates under the baseline and alternative simulations. In the baseline simulation, MINT projects a college graduate with earnings at the 75th percentile (among college graduates) to have earnings equal to 2.26 times the national average wage in 2020. The model projects a college nongraduate with earnings at the 75th percentile (among workers without a college degree) to have earnings equal to 1.14 times the national average wage. Thus, at the 75th earnings percentiles of their respective educational-attainment groups, college graduates would earn almost twice as much as workers without a college degree. MINT projects this ratio to increase to 2.08 in 2030 and then fall to 1.95 in 2040. In the alternative simulation, the ratio of college graduate-to-nongraduate earnings at the 75th percentile is higher than the baseline ratio in all years of the simulation, increasing from 2.16 in 2020 to 2.47 in 2030 and 2.55 in 2040. These are differences from the baseline projection of 8.8 percent, 19.1 percent, and 30.7 percent, respectively. The first panel in Chart 3 illustrates the ratios of earnings to the national average wage for college graduates and nongraduates at their respective 75th earnings percentiles under the baseline and alternative simulations.

Table 2.
Earnings at the 75th and 25th percentiles relative to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2020–2050

Educational attainment and earnings percentile	2020	2030	2040	2050
National AWI (in 2012 dollars)	52,817	58,674	65,778	73,438
Workers with earnings (%)	82	72	43	21
		Baseline simulation		
		75th percentile		
Ratio of 75th-percentile earnings to national AWI for college—				
Graduates	2.26	2.18	1.49	1.38
Nongraduates	1.14	1.05	0.76	1.05
Ratio of college graduate-to-nongraduate 75th-percentile earnings	1.98	2.08	1.95	1.31
		25th percentile		
Ratio of 25th-percentile earnings to national AWI for college—				
Graduates	0.69	0.72	0.42	0.33
Nongraduates	0.34	0.32	0.20	0.12
Ratio of college graduate-to-nongraduate 25th-percentile earnings	2.03	2.25	2.10	2.75
		Alternative simulation		
		75th percentile		
Ratio of 75th-percentile earnings to national AWI for college—				
Graduates	2.35	2.35	1.68	1.59
Nongraduates	1.09	0.95	0.66	0.84
Ratio of college graduate-to-nongraduate 75th-percentile earnings	2.16	2.47	2.55	1.89
Difference from baseline projection of college graduate-to-nongraduate 75th-percentile earnings ratio (%)	*8.8*	*19.1*	*30.7*	*44.0*
		25th percentile		
Ratio of 25th-percentile earnings to national AWI for college—				
Graduates	0.72	0.78	0.48	0.39
Nongraduates	0.32	0.29	0.17	0.09
Ratio of college graduate-to-nongraduate 25th-percentile earnings	2.25	2.69	2.82	4.33
Difference from baseline projection of college graduate-to-nongraduate 25th-percentile earnings ratio (%)	*10.9*	*19.5*	*34.5*	*57.6*

SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

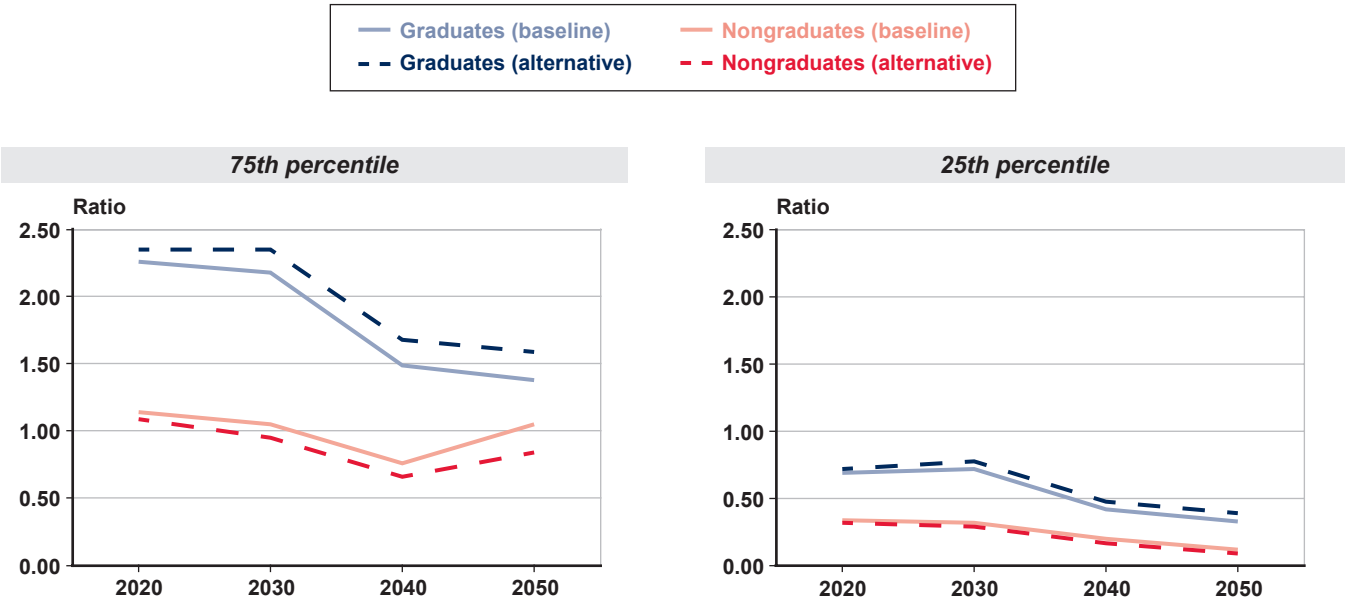
Similar trends are projected for the ratio of the earnings of college graduates to those of nongraduates at the 25th earnings percentile. In the baseline simulation, MINT projects that a college graduate with earnings at the 25th percentile among college graduates will have earnings equal to 0.69 times the national average wage in 2020. The model projects that a nongraduate with earnings at the 25th percentile among nongraduates will have earnings equal to just 0.34 times the national average wage. Thus, among workers earning at the 25th percentile of their respective educational-attainment groups, college graduates would earn twice as much as nongraduates. As shown in Table 2, MINT projects that ratio to increase to 2.25 in 2030 and then fall slightly to 2.10 in 2040. In the alternative simulation, the ratio of college graduate-to-nongraduate earnings at the 25th percentile is projected to be 2.25 in 2020, 2.69 in 2030, and 2.82 in 2040. These are differences of 10.9 percent, 19.5 percent, and 34.5 percent, respectively, from the baseline-projected ratios. The second panel in Chart 3 illustrates the ratios of earnings to the national average wage for college graduates and nongraduates at their respective 25th percentiles under the baseline and alternative simulations.

Effect on Components of the Social Security Benefit Calculation

Social Security retired-worker benefit amounts are calculated using average indexed monthly earnings (AIME). Only earnings up to the maximum amount subject to Social Security payroll taxes each year are included in the AIME computation.[17] Amounts earned in years before reaching age 60 are indexed to growth in the national average wage, and earnings at age 60 and later are entered into the computation at their nominal values. AIME is computed by dividing the sum of the worker's 35 highest indexed annual earnings amounts by 420, the number of months in 35 years. Some workers have fewer than 35 years with covered earnings; the AIME calculation simply treats years with no covered earnings as zero-earnings years.

The worker's AIME is used to calculate the benefit to which he or she would be entitled at the age of eligibility for full benefits, the full retirement age (FRA).[18] This benefit is called the primary insurance amount (PIA). The monthly benefit a retired worker actually receives will be less than the PIA if he or she claims benefits before reaching the FRA and more than the

Chart 3.
Ratio of 75th- and 25th-percentile earnings to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2020–2050



SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

PIA if he or she claims after reaching the FRA. The method prescribed by law for calculating the PIA is designed to replace a higher percentage of AIME for workers with low career-average earnings than it does for workers with above-average career earnings.[19] For example: For 2015, the PIA formula multiplies the first $826 of AIME by 0.90; each dollar of AIME from $827 to $4,980 is multiplied by 0.32, and the result is added to the product of the first computation; each dollar of AIME above $4,980 is multiplied by 0.15, and that result is added to the sum of the first two products.

Because AIME is a 35-year average that is wage-indexed to age 60, and because the PIA formula produces higher earnings replacement rates for workers with below-average career earnings, the alternative simulation's projections of median AIME and PIA differ less from the baseline scenario than its median-earnings projections do. Table 3 shows the median AIME and PIA for college graduates and nongraduates in the baseline and alternative simulations. MINT computes AIME and PIA as of the age at which the model simulates an individual's first Social Security benefit receipt. Because the people in our sample will receive their initial benefit in different years, we have indexed all AIME and PIA values in Table 3 to 2012 dollars.[20]

In the baseline simulation, the median AIME of college graduates is $6,010, or 1.87 times the median AIME of workers without a college degree ($3,220). In the alternative simulation, the median AIME of college graduates is $6,250, or 4.0 percent higher than the baseline value, while the median AIME of less-educated workers ($3,100) is 3.7 percent lower than the baseline. Consequently, the ratio of the college graduate-to-nongraduate median AIME is 1.87 in the baseline simulation and 2.02 in the alternative simulation, a difference of 8.0 percent. Because of the progressive PIA formula, the baseline simulation projects a median PIA of college graduates ($2,530) that is only 1.54 times that of workers without a college degree ($1,640). In the alternative simulation, the median PIA of college graduates ($2,590) is 2.4 percent higher than the baseline amount, and that of nongraduates ($1,600) is 2.4 percent lower than the baseline. The ratio of the median college graduate-to-nongraduate PIA is 1.54 in the baseline and 1.62 in the alternative simulation, a difference of 4.9 percent.

The differences between the baseline and alternative projections of median AIME are mostly smaller, on a percentage basis, than those for the earnings projections shown in Table 1—whether for college graduates or nongraduates. The same is true for the differences between the baseline and alternative projections of median PIA. The long-term average that is used to compute AIME, the indexing of prior earnings to the national average wage at the time a worker reaches age 60, and the progressive PIA formula combine to reduce the effect of annual earnings growth differentials between college graduates and nongraduates on their AIME and PIA.

Table 3 also shows median AIME and PIA separately for men and women. Median AIME and PIA for male college graduates are higher than those for female college graduates in both the baseline and alternative simulations. Likewise, median AIME and PIA are higher in both the baseline and alternative simulations for men without a college degree than for women without a college degree. These results reflect higher annual average earnings and more years with earnings for men than for women. The baseline differences in AIME and PIA between college graduates and nongraduates are higher among men than among women, reflecting a greater disparity in earnings among men. For men, the ratio of college graduate-to-nongraduate AIME in the baseline simulation is 1.96, while for women the ratio is 1.81. Among men, the baseline PIA for college graduates is 1.53 times the PIA for workers without a college degree. Among women, the baseline PIA ratio is 1.46.

Under the alternative simulation, the ratios of college graduate-to-nongraduate median AIME and PIA differ from the baseline more for women than for men. The AIME ratio for men is 2.10, or 6.8 percent higher than the baseline AIME ratio. The PIA ratio among men is 1.59, or 3.8 percent higher than the baseline ratio. Among women, the ratio of college graduate-to-nongraduate AIME is 1.98 in the alternative simulation, a difference of 9.1 percent from the baseline. The PIA ratio for women is 1.55, or 5.6 percent higher than the baseline ratio. The main reason the baseline and alternative college graduate-to-nongraduate AIME and PIA ratios differ less for men than for women is that in each year, more men have earnings over the maximum annual amount subject to Social Security payroll taxes, and amounts above the annual taxable maximum are not included in the AIME and PIA calculations. Therefore, less of the simulated faster increase in earnings for college graduates is accounted for in the calculation of AIME for male college graduates than it is in that for female college graduates.

Table 3.
Median AIME and PIA at age of entitlement (62) for college graduates and nongraduates born 1965–1979, by sex: Baseline and alternative projections (in 2012 dollars)

Educational attainment and sex	AIME	PIA
	Baseline simulation	
	Total	
Median amount for college—		
Graduates	6,010	2,530
Nongraduates	3,220	1,640
Ratio of college graduate-to-nongraduate median amount	1.87	1.54
	Men	
Median amount for college—		
Graduates	7,830	2,880
Nongraduates	3,990	1,880
Ratio of college graduate-to-nongraduate median amount	1.96	1.53
	Women	
Median amount for college—		
Graduates	4,610	2,080
Nongraduates	2,540	1,420
Ratio of college graduate-to-nongraduate median amount	1.81	1.46
	Alternative simulation	
	Total	
Median amount for college—		
Graduates	6,250	2,590
Nongraduates	3,100	1,600
Ratio of college graduate-to-nongraduate median amount	2.02	1.62
Difference from baseline projection of college graduate-to-nongraduate ratio (%)	*8.0*	*4.9*
	Men	
Median amount for college—		
Graduates	8,070	2,910
Nongraduates	3,850	1,830
Ratio of college graduate-to-nongraduate median amount	2.10	1.59
Difference from baseline projection of college graduate-to-nongraduate ratio (%)	*6.8*	*3.8*
	Women	
Median amount for college—		
Graduates	4,830	2,150
Nongraduates	2,440	1,390
Ratio of college graduate-to-nongraduate median amount	1.98	1.55
Difference from baseline projection of college graduate-to-nongraduate ratio (%)	*9.1*	*5.6*

SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Effect on Social Security Benefits

Table 4 shows projected Social Security benefits relative to the national average wage in 2030, 2040, 2050, and 2060 under both simulations.[21] These projections include auxiliary (spouse and survivor) benefits as well as retired-worker benefits. (All auxiliary benefits are based on the earnings of an insured worker.) For 2030, MINT projects that only 11 percent of the members of Generation X—the youngest of whom will be in their early 50s—will receive benefits that year. By 2040, however, members of the youngest cohort will have reached age 61, and MINT projects that 64 percent of the members of Generation X will be receiving benefits.

In the baseline simulation, MINT projects the median Social Security benefit received in 2040, 2050, and 2060 by college graduates born 1965–1979 to be equal to 38–39 percent of the national average wage. The projected median benefit received by individuals without a college degree in those years is equal to 25–26 percent of the national average wage. The projected ratios of college graduate-to-nongraduate median benefits are 1.52 in 2040, 1.50 in 2050, and 1.46 in 2060. In the alternative simulation, projected median benefits as a percentage of the average wage are 1 percentage point higher than the baseline projection in each of those years for college graduates and 1 percentage point lower for nongraduates. These alternative projections represent a difference from the baseline of less than 3 percent for college graduates and about minus 4 percent for beneficiaries without a college degree. As was the case with AIME and PIA, the differences between the baseline and alternative projections of median benefits are smaller on a percentage basis than are the differences in the projected median earnings shown in Table 1, both for college graduates and for nongraduates. Chart 4 illustrates how modestly the median benefits of college graduates and nongraduates differ between the baseline and alternative simulations.

Table 4 also shows median-benefit ratios by college-graduate status separately for men and women. The median-benefit ratio of male college graduates exceeds that of female college graduates in both the baseline and alternative simulations, although the difference is projected to narrow from 2040 to 2060. Likewise, the median male college nongraduate's benefit ratio is projected to exceed the median female college nongraduate's benefit, with that difference also narrowing slightly over the projection period. The projected narrowing of the differences in benefits between men and women reflects long-term trends of rising employment rates and earnings among women. As a percentage of the average wage, the median benefit for both male and female college graduates is projected to be 1 percentage point higher in the alternative simulation than in the baseline for 2040–2060, and the median benefit for male and female nongraduates is projected to be no more than 2 percentage points lower.

In the alternative simulation, the ratio of the median college graduate-to-nongraduate benefit increases slightly less rapidly from 2030 to 2050 for women than for men, mainly because the projected median benefit of male college nongraduates is 1 to 2 percentage points lower than that of the baseline projection while the projected median benefit of female nongraduates remains unchanged. The benefits of female college nongraduates would be less affected by slower earnings growth than would those of male nongraduates because of women's relatively lower benefit level in the baseline simulation. Chart 5 illustrates the projected median benefits by college-graduate status for men and women under both simulations.

Table 5 shows projected benefits at the 75th and 25th percentiles relative to the national average wage for college graduates and nongraduates under the baseline and alternative simulations. As with median benefits, faster earnings growth for college graduates does not translate to an equivalent effect on benefits at the 75th and 25th percentiles. Compared with the baseline projection, benefits as a percentage of the average wage in the alternative simulation are about 1 percentage point higher for college graduates at both the 75th and 25th percentiles. The benefits projected in the alternative simulation are therefore about 2 percent higher than the baseline projection at the 75th percentile and 3 percent higher at the 25th percentile. Among beneficiaries without a college degree, projected benefits in the alternative simulation are 1–2 percentage points lower than the baseline projections at the 75th percentile and no more than 1 percentage point lower at the 25th percentile. The benefits projected in the alternative simulation are thus about 3 percent lower than the baseline projections for those at the 75th percentile and 0–5 percent lower for those at the 25th percentile. Chart 6 illustrates the benefit-to-average-wage ratios of college graduates and nongraduates at the 75th and 25th percentiles in the baseline and alternative simulations.

Table 4.
Median Social Security benefit amounts relative to the national AWI for college graduates and nongraduates born 1965–1979, by sex: Baseline and alternative projections, decennially 2030–2060

Educational attainment and sex	2030	2040	2050	2060
National AWI (in 2012 dollars)	58,674	65,778	73,438	81,703
Percentage receiving benefits [a]	11	64	87	94
		Baseline simulation		
		Total		
Ratio of median benefit to national AWI for college—				
Graduates	0.27	0.38	0.39	0.38
Nongraduates	0.21	0.25	0.26	0.26
Ratio of college graduate-to-nongraduate median benefit	1.29	1.52	1.50	1.46
		Men		
Ratio of median benefit to national AWI for college—				
Graduates	0.31	0.44	0.44	0.42
Nongraduates	0.24	0.28	0.29	0.27
Ratio of college graduate-to-nongraduate median benefit	1.29	1.57	1.52	1.56
		Women		
Ratio of median benefit to national AWI for college—				
Graduates	0.24	0.33	0.35	0.35
Nongraduates	0.18	0.22	0.23	0.24
Ratio of college graduate-to-nongraduate median benefit	1.33	1.50	1.52	1.46
		Alternative simulation		
		Total		
Ratio of median benefit to national AWI for college—				
Graduates	0.27	0.39	0.40	0.39
Nongraduates	0.21	0.24	0.25	0.25
Ratio of college graduate-to-nongraduate median benefit	1.29	1.63	1.60	1.56
Difference from baseline projection of college graduate-to-nongraduate median-benefit ratio (%)	*0.0*	*6.9*	*6.7*	*6.7*
		Men		
Ratio of median benefit to national AWI for college—				
Graduates	0.31	0.45	0.45	0.43
Nongraduates	0.24	0.27	0.27	0.26
Ratio of college graduate-to-nongraduate median benefit	1.29	1.67	1.67	1.65
Difference from baseline projection of college graduate-to-nongraduate median-benefit ratio (%)	*0.0*	*6.1*	*9.8*	*6.3*
		Women		
Ratio of median benefit to national AWI for college—				
Graduates	0.24	0.34	0.36	0.36
Nongraduates	0.18	0.22	0.23	0.23
Ratio of college graduate-to-nongraduate median benefit	1.33	1.55	1.57	1.57
Difference from baseline projection of college graduate-to-nongraduate median-benefit ratio (%)	*0.0*	*3.0*	*2.9*	*7.3*

SOURCE: Authors' calculations using MINT7.

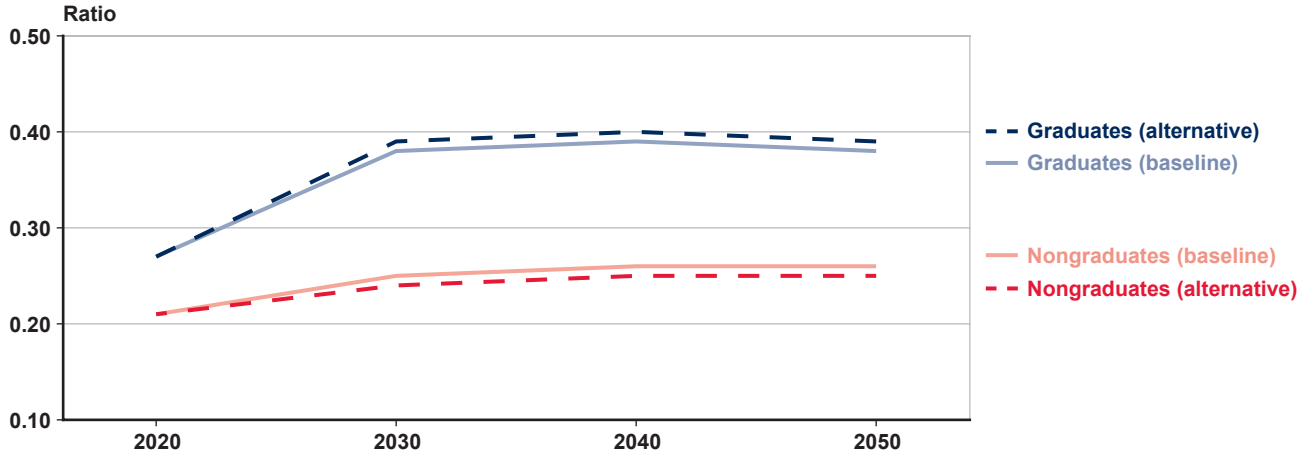
NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

a. Includes workers, spouses, and widow(er)s.

Chart 4.
Ratio of median Social Security benefit amounts to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2030–2060



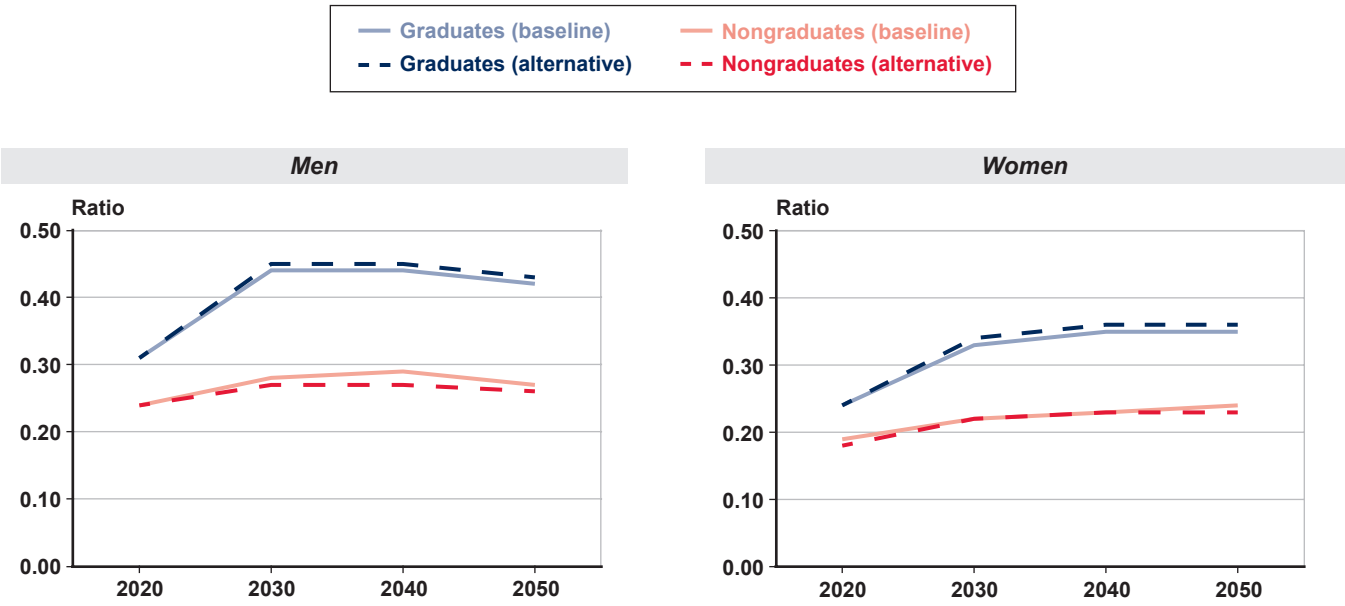
SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Chart 5.
Ratio of median Social Security benefit amounts to the national AWI for college graduates and nongraduates born 1965–1979, by sex: Baseline and alternative projections, decennially 2030–2060



SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Table 5.
Social Security benefit amounts at the 75th and 25th percentiles relative to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2030–2060

Educational attainment and sex	2030	2040	2050	2060
National AWI (in 2012 dollars)	58,674	65,778	73,438	81,703
Percentage receiving benefits [a]	11	64	87	94
		Baseline simulation		
		75th percentile		
Ratio of 75th-percentile benefit to national AWI for college—				
Graduates	0.38	0.49	0.48	0.46
Nongraduates	0.28	0.34	0.35	0.34
Ratio of college graduate-to-nongraduate 75th-percentile benefit	1.36	1.45	1.39	1.35
		25th percentile		
Ratio of 25th-percentile benefit to national AWI for college—				
Graduates	0.18	0.27	0.29	0.28
Nongraduates	0.15	0.18	0.19	0.19
Ratio of college graduate-to-nongraduate 25th-percentile benefit	1.20	1.50	1.50	1.47
		Alternative simulation		
		75th percentile		
Ratio of 75th-percentile benefit to national AWI for college—				
College degree	0.38	0.50	0.49	0.47
No college degree	0.28	0.33	0.33	0.32
Ratio of college graduate-to-nongraduate 75th-percentile benefit	1.36	1.51	1.47	1.45
Difference from baseline projection of college graduate-to-nongraduate 75th-percentile benefit ratio (%)	*0.0*	*4.1*	*5.9*	*7.1*
		25th percentile		
Ratio of 25th-percentile benefit to national AWI for college—				
College degree	0.18	0.27	0.30	0.29
No college degree	0.15	0.18	0.19	0.18
Ratio of college graduate-to-nongraduate 25th-percentile benefit	1.20	1.53	1.60	1.57
Difference from baseline projection of college graduate-to-nongraduate 25th-percentile benefit ratio (%)	*0.0*	*2.3*	*6.5*	*6.7*

SOURCE: Authors' calculations using MINT7.

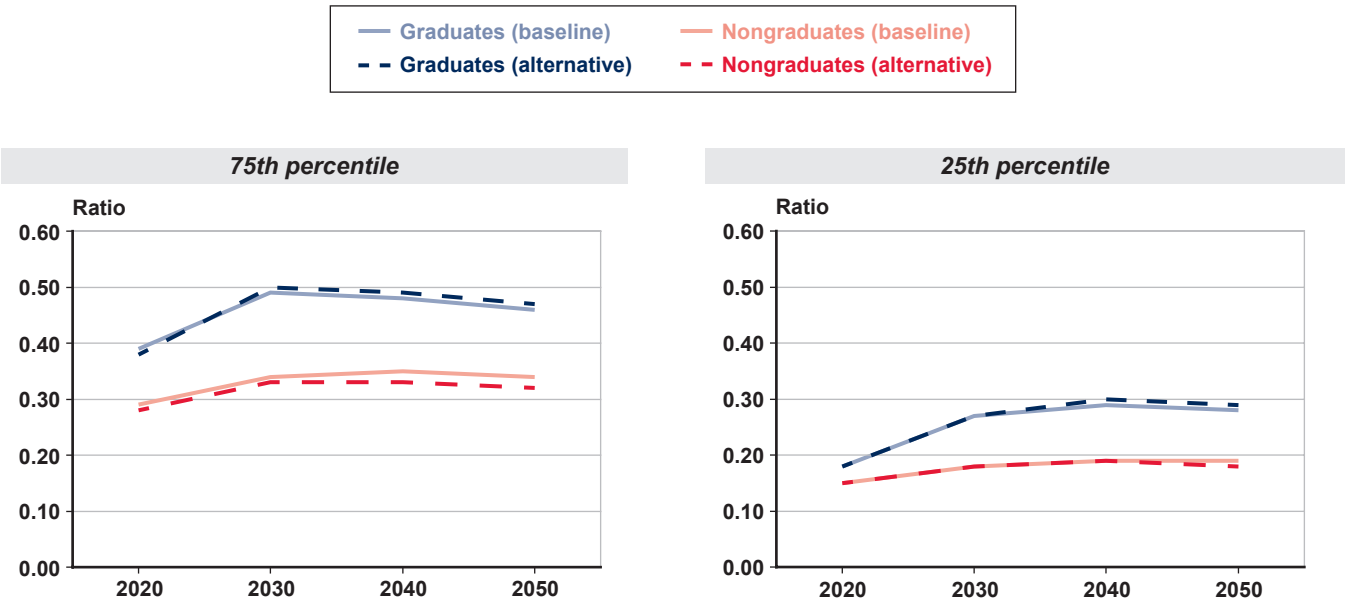
NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

a. Includes workers, spouses, and widow(er)s.

Chart 6.
Ratio of 75th- and 25th-percentile Social Security benefit amounts to the national AWI for college graduates and nongraduates born 1965–1979: Baseline and alternative projections, decennially 2030–2060



SOURCE: Authors' calculations using MINT7.

NOTES: "College" refers to 4-year institutions.

The baseline simulation assumes that the AWI grows at 1.2 percent per year for all workers. The alternative simulation assumes annual AWI growth rates of 1.6 percent for college graduates and 0.7 percent for nongraduates.

Projections are restricted to workers with covered earnings.

Summary and Conclusion

In our simulations, we estimate the impact on projected earnings and Social Security benefits of different rates of earnings growth for college graduates and nongraduates born 1965–1979, the cohorts known as Generation X. We estimate the effect on future annual earnings, career-average earnings, and Social Security benefits if the real earnings of college graduates grow by 1.6 percent per year and the real earnings of college nongraduates grow by 0.7 percent per year through 2050. When weighted by the distribution of earnings across educational-attainment levels in 2010, those growth rates are consistent with the overall national average real wage growth rate of 1.2 percent, as assumed in the intermediate-cost projections of income and expenditures from the Social Security trust funds in the *2012 Trustees Report.*

Compared with the baseline simulation, a real rate of earnings growth for college graduates that continually exceeds the rate for nongraduates would obviously lead to substantially greater differences in annual earnings between the two groups. By 2030, the twentieth year of our simulation, the projected median annual earnings of college graduates would be about 8 percent higher than those projected in the baseline, while the earnings of nongraduates would be 9 percent lower. The ratio of the median earnings of college graduates to the median earnings of nongraduates in 2030 is 2.14 in the baseline scenario and 2.55 in the alternative simulation, a difference of 19 percent. In other words, a typical college nongraduate would earn about 47 percent as much as the typical college graduate under the baseline scenario (1/2.14), but only 39 percent as much under the alternative scenario (1/2.55).

The difference in projected Social Security benefits between college graduates and nongraduates in our alternative simulation is less pronounced than the difference in their projected annual earnings. From the baseline simulation to the alternative scenario, median AIME differs by 4.0 percent for college graduates and by minus 3.7 percent for workers without a college degree. The ratio of the median AIME of college graduates to the median AIME of nongraduates differs by 8.0 percent. Median PIA values differ even less

than median AIME values in the alternative simulation, by only 2.4 percent for college graduates and by minus 2.4 percent for nongraduates. The ratio of the median PIA of college graduates to the median PIA of nongraduates is 4.9 percent higher in the alternative simulation than in the baseline scenario.

Earnings growth differentials between college graduates and nongraduates produce comparatively smaller differences in Social Security benefits because of the methods prescribed under the Social Security Act to determine a worker's AIME and PIA. In particular, the indexing of past earnings to the wage levels in place when the worker attains age 60 and the progressive formula used to calculate the PIA moderate the effects of low career-average earnings on Social Security benefits. In the MINT simulations of slower earnings growth for workers without a college degree, that group's Social Security benefits fall both in absolute terms and relative to the benefits of college graduates; however, the gap in Social Security benefits does not increase as much as the gap in annual earnings. From these results, we can infer that even if earnings inequality continues to increase, inequality in Social Security benefits, and thus in total retirement income, will not increase at the same rate.

Over time, if the earnings of college nongraduates continue to grow more slowly than the national average wage, their relative standard of living will decline and they will be less able to save for retirement. A reduction in retirement saving would increase the importance of Social Security income in retirement. Of course, the preferred outcome would be robust earnings growth across the earnings distribution and improved employment opportunities for workers of all skill and education levels. Although a discussion of the public policies that could contribute to that outcome is beyond the scope of this article, such a discussion can benefit from estimates of the effect of earnings inequality on retirement income, which MINT and other microsimulation models are ideally suited to provide.

Notes

[1] Social Security benefits are a concave piecewise linear function of average indexed monthly earnings calculated using the highest 35 years of covered earnings, capped at the annual maximum taxable earnings amount. We summarize the benefit calculation procedure later; for complete information, see SSA (2015).

[2] Although we concede the central influence of education on lifetime earnings, we believe that few social scientists would minimize the importance of other personal characteristics such as innate ability, perseverance, and social skills. Nor would many, we believe, deny the critical importance of luck.

[3] Throughout the article, we assign all levels of educational attainment to one of two broad categories. We refer to all individuals who have earned a 4-year college degree, including those with graduate degrees of any level, as college graduates. We refer to all others, including high school graduates with no postsecondary education, those with some college but no degree, and those with 2-year degrees or technical certificates—as well as high school dropouts— collectively as college nongraduates. An analysis using four educational-attainment categories produced broadly similar results.

[4] For the 2004 SIPP panel, 88 percent of survey records were matched to their Social Security earnings records. The match rate for the 2008 panel was more than 90 percent.

[5] Imputed rental income is the return that homeowners receive from owning instead of renting, minus costs of homeownership. MINT7 estimates it as a 3.0 percent annual real return on home equity.

[6] The SIPP represents the civilian noninstitutionalized resident population of the 50 states and the District of Columbia. It does not include residents of nursing homes or prisons, military personnel living on base, or residents of U.S. territories. Because the Social Security area population includes those groups, it is about 3.0 percent to 3.5 percent larger than the SIPP population. For further information about the SIPP, see http://www.census.gov/sipp/.

[7] The low-, intermediate-, and high-cost scenarios are sometimes referred to as alternative I, alternative II, and alternative III, respectively.

[8] The national AWI is based on wages subject to federal income taxes and contributions to deferred compensation plans. It includes earnings in covered and noncovered employment, below and above the annual maximum amount subject to Social Security payroll taxes.

[9] In our alternative simulation, we do not adjust earnings by educational attainment until after any model-projected changes in marital status, onset of disability, retirement, and Social Security claiming. Therefore, the earnings adjustments do not affect the model's projections of those events, which are unchanged from the baseline simulation.

[10] MINT7 can project income through 2099 by simulating post-1979 birth cohorts and immigrants. Our simulations included only persons born before 1980 who participated in the SIPP in 2004 or 2008, representing the civilian noninstitutional resident U.S. population aged 31 or older in 2010.

[11] Historically, the earnings of workers with advanced degrees have grown more rapidly than the earnings of those who have only 4-year degrees, and the earnings of workers with some college have grown faster than the earnings

of workers who never attended college. Nevertheless, our objective is to estimate the effect of earnings growth differentials on future Social Security benefits, not to estimate the future rates of earnings growth by education. Therefore, assigning average rates of earnings growth to each of two educational groups is sufficient for our purpose.

[12] According to the SIPP, in 2010, 32 percent of people born 1965–1979 had earned a 4-year college degree and 68 percent had not; however, the college graduates received 52 percent of that population's earnings while the nongraduates received 48 percent.

[13] We focus on covered earnings because they are the earnings on which Social Security benefits are based.

[14] In this article, we use "average wage" and "AWI" interchangeably, although the two are not technically identical. Unlike an index that expresses the value for a given year as a ratio or percentage of the value for a reference year, the AWI expresses values as earnings levels. AWI values closely approximate, but do not precisely match, actual average wages. For further details, see http://www.socialsecurity.gov/OACT/COLA/AWI.html.

[15] All tables present data only for individuals projected to have positive earnings in the given year.

[16] Within each educational-attainment category, the trend in the ratio of median earnings to AWI over time reflects interactions between employment rates, hours of work, and hourly earnings at each age among workers in each annual birth cohort.

[17] See maximum taxable earnings amounts for 1937 to 2014 at http://www.socialsecurity.gov/planners/maxtax.htm.

[18] As legislated in 1983, an individual's FRA depends on his or her year of birth; for example, for individuals reaching FRA in 2015, it is 66. For a list of FRAs, see http://www.socialsecurity.gov/planners/retire/retirechart.html.

[19] The formulas for calculating both AIME and PIA are established in law by Congress at 42 U.S.C. §415. See http://www.law.cornell.edu/uscode/text/42/415.

[20] To isolate the effects of the simulations on retired workers, we included AIME and PIA projections in Table 3 only for individuals claiming Social Security benefits at age 62 or older. Because we adjusted earnings by educational attainment after the model-simulated retirement decision, mean and median claiming ages were the same in both simulations.

[21] Both the baseline and alternative simulations reflect *scheduled benefits* under current law. The *2012 Trustees Report* estimates that the Social Security trust funds will be depleted in 2033. Absent remedial action by Congress in the interim, Social Security tax revenue will be sufficient to pay about 75 percent of scheduled benefits after the trust funds are depleted. Favreault (2009) discusses how different rates of wage growth might affect the trust fund balances.

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