Center for American Progress

THE HAMILTON PROJECT

The Polarization of Job Opportunities in the U.S. Labor Market

Implications for Employment and Earnings

David Autor, MIT Department of Economics and National Bureau of Economic Research

April 2010

Center for American Progress

THE HAMILTON PROJECT

The Polarization of Job Opportunities in the U.S. Labor Market

Implications for Employment and Earnings

David Autor, MIT Department of Economics and National Bureau of Economic Research

April 2010

A paper jointly released by The Center for American Progress and The Hamilton Project

THE CENTER FOR AMERICAN PROGRESS is a nonpartisan research and educational institute dedicated to promoting a strong, just and free America that ensures opportunity for all. We believe that Americans are bound together by a common commitment to these values and we aspire to ensure that our national policies reflect these values. We work to find progressive and pragmatic solutions to significant domestic and international problems and develop policy proposals that foster a government that is "of the people, by the people, and for the people."

THE HAMILTON PROJECT seeks to advance America's promise of opportunity, prosperity, and growth. The Project offers a strategic vision and produces innovative policy proposals about how to create a growing economy that benefits more Americans. The Hamilton Project's economic strategy reflects a judgment that long term prosperity is best achieved by fostering economic growth and broad participation in that growth, by enhancing individual economic security, and by embracing a role for effective government in making needed public investments.

The Hamilton Project is an economic policy initiative at The Brookings Institution.

Contents

Introduction and summary

Between December 2007, when the U.S. housing and financial crises became the subject of daily news headlines, and March of 2010, the latest period for which data are available, the number of employed workers in the United States fell by 8.2 million, to 129.8 million from 138.0 million. In the same interval, the civilian unemployment rate nearly doubled, to 9.7 percent from 5.0 percent, while the employment-to-population ratio dropped to 58.6 percent from 62.7 percent—the lowest level seen in more than 25 years. Job losses of this magnitude cause enormous harm to workers, families, and communities.[1]

A classic study by economists Lou Jacobson, Robert LaLonde, and Daniel Sullivan found that workers involuntary displaced by plant downsizings in Pennsylvania during the severe recession of the early 1980s suffered annual earnings losses averaging 25 percent, even six years following displacement.[2] The nonpecuniary consequences of job losses due to the Great Recession may be just as severe. Studying the same group of workers with the benefit of 15 more years of data, labor economists Daniel Sullivan and co-author Till Von Wachter[3] show that involuntarily job displacement approximately doubled the short-term mortality rates of those displaced and reduced their life expectancy on average by one to one and a half years. Thus, long after the U.S. unemployment rate recedes into single digits, the costs of the Great Recession will endure.

Despite the extremely adverse U.S. employment situation in 2010, history suggests that employment will eventually return and unemployment will eventually subside. But the key challenges facing the U.S. labor market—almost all of which were evident prior to the Great Recession—will surely endure. These challenges are two-fold. The first is that for some decades now, the U.S. labor market has experienced increased demand for skilled workers. During times like the 1950s and 1960s, a rising level of educational attainment kept up with this rising demand for skill. But since the late 1970s and early 1980s, the rise in U.S. education levels has not kept up with the rising demand for skilled workers, and the slowdown in educational attainment has been particularly severe for males. The result has been a sharp rise in the inequality of wages.

A second, equally significant challenge is that the structure of job opportunities in the United States has sharply polarized over the past two decades, with expanding job opportunities in both high-skill, high-wage occupations and low-skill, low-wage occupations, coupled with contracting opportunities in middle-wage, middle-skill white-collar and blue-collar jobs. Concretely, employment and earnings are rising in both high-education professional, technical, and managerial occupations and, since the late 1980s, in low-education food service, personal care, and protective service occupations. Conversely, job opportunities are declining in both middle-skill, white-collar clerical, administrative, and sales occupations and in middle-skill, blue-collar production, craft, and operative occupations. The decline in middle-skill jobs has been detrimental to the earnings and labor force participation rates of workers without a four-year college education, and differentially so for males, who are increasingly concentrated in low-paying service occupations.

This paper analyzes the state of the U.S. labor market over the past three decades to inform policymaking on two fronts. The first is to rigorously document and place in historical and international context the trajectory of the U.S. labor market, focusing on the evolving earnings, employment rates, and labor market opportunities for workers with low, moderate, and high levels of education. The second is to illuminate the key forces shaping this trajectory, including:

- The slowing rate of four-year college degree attainment among young adults, particularly males
- Shifts in the gender and racial composition of the workforce
- Changes in technology, international trade, and the international offshoring of jobs, which affect job opportunities and skill demands
- Changes in U.S. labor market institutions affecting wage setting, including labor unions and minimum wage legislation

The causes and consequences of these trends in U.S. employment patterns are explored in detail below, but the main conclusions can be summarized as follows:

- Employment growth is polarizing, with job opportunities concentrated in relatively high-skill, high-wage jobs and low-skill, low-wage jobs.
- This employment polarization is widespread across industrialized economies; it is not a uniquely American phenomenon.
- The key contributors to job polarization are the automation of routine work and, to a smaller extent, the international integration of labor markets through trade and, more recently, offshoring.
- The Great Recession has quantitatively but not qualitatively changed the trend toward employment polarization in the U.S. labor market. Employment losses during the recession have been far more severe in middle-skilled white- and blue-collar jobs than in either high-skill, white-collar jobs or in low-skill service occupations.
- As is well known, the earnings of college-educated workers relative to high school-educated workers have risen steadily for almost three decades.
- Less widely discussed is that the rise in the *relative* earnings of college graduates are due both to rising *real* earnings for college workers and falling *real* earnings for noncollege workers—particularly noncollege males.
- Gains in educational attainment have not generally kept pace with rising educational returns, particularly for males. And the slowing pace of educational attainment has contributed to the rising college versus high school earnings gap.

While these points are fleshed out in the body of the paper, I briefly unpack each of them here.

Employment growth is "polarizing" into relatively high-skill, high-wage jobs and low-skill, low-wage jobs

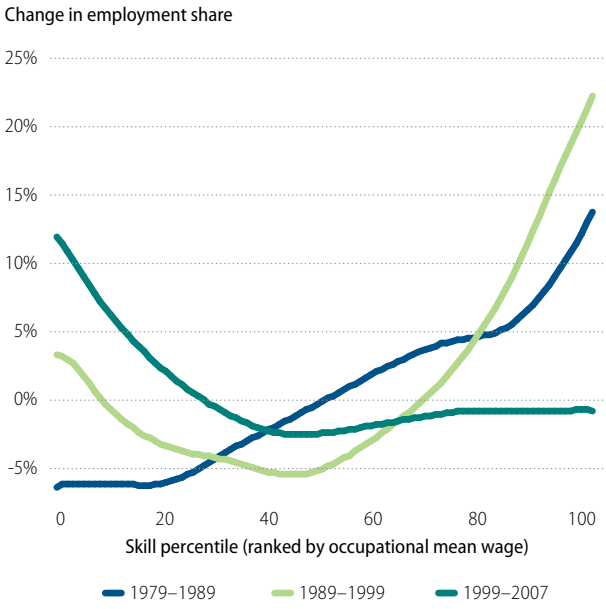
Secular shifts in labor demand have led to a pronounced "polarization" of job opportunities across occupations, with employment growth concentrated in relatively high-skill, high-wage and in low-skill, low-wage jobs—at the expense of "middle-skill" jobs. This polarization is depicted in Figure 1, which plots the change in the share of U.S. employment in each of the last three decades for 326 detailed occupations encompassing all of U.S. employment.[4]

These occupations are ranked on the x-axis by skill level from lowest to highest, where an occupation's skill level (or, more accurately, its skill rank) is approximated by the average wage of workers in the occupation in 1980.[5] The y-axis of the figure corresponds to the change in employment at each occupational percentile as a share of total U.S. employment during the decade. Since the sum of shares must equal one in each decade, the change in these shares across decades must total zero. Consequently, the figure measures the growth in each occupation's employment relative to the whole.

This figure reveals a "twisting" of the distribution of employment across occupations over three decades, which becomes more pronounced in each period. During the 1980s (1979 to 1989), employment growth by occupation was almost uniformly rising in occupational skill; occupations below the median skill level declined as a share of employment, while occupations above the median increased. In the subsequent decade, this uniformly rising pattern gave way to a distinct pattern of polarization. Relative employment growth was

FIGURE 1

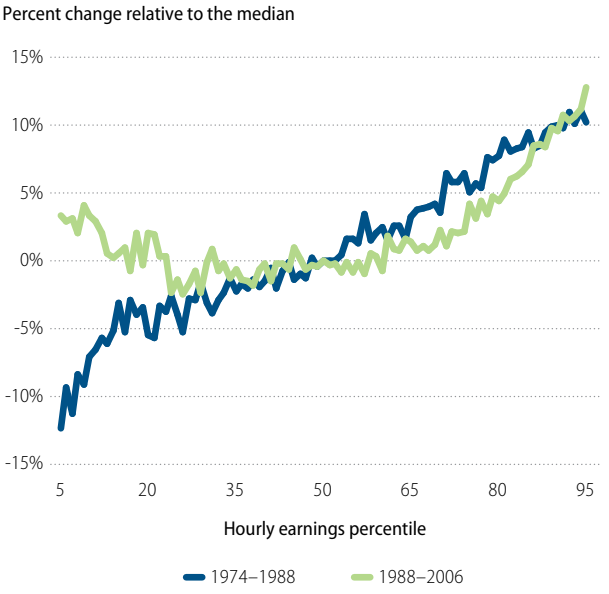
Smoothed changes in employment by occupational skill percentile, 1979–2007



Source: Data are Census IPUMS 5 percent samples for years 1980, 1990, and 2000, and U.S. Census American Community Survey 2008. All occupation and earnings measures in these samples refer to prior year's employment. The figure plots log changes in employment shares by 1980 occupational skill percentile rank using a locally weighted smoothing regression (bandwidth 0.8 with 100 observations), where skill percentiles are measured as the employment-weighted percentile rank of an occupation's mean log wage in the Census IPUMS 1980 5 percent extract. Mean education in each occupation is calculated using workers' hours of annual labor supply times the Census sampling weight. Consistent occupation codes for Census years 1980, 1990, and 2000, and 2008 are from Autor and Dorn (2009a).

FIGURE 2

Percent changes in male and female hourly wages relative to the median



Source: May/ORG CPS data for earnings years 1973-2009. Each year comprises a three-year moving average (e.g. 1974 contains May/ORG data from 1973, 1974, and 1975), with years equally weighted. The real log hourly wage is computed by year for each percentile between the 5th and 95th percentiles. In every year, real log hourly wages are adjusted such that they equal zero at the respective year's median (50th percentile). The percent change represents the difference in the log wages values (relative to the median) at each percentile between the relevant years.

See Data Appendix for more details on treatment of May/ORG CPS data.

most rapid at high percentiles, but it was also modestly positive at low percentiles (10th percentile and down) and modestly negative at intermediate percentiles.

Fast forward to the period 1999 to 2007. In this interval, the growth of low-skill jobs comes to dominate the figure. Employment growth in this period was heavily concentrated among the lowest three deciles of occupations. In deciles four through nine, growth in employment shares was negative. In the highest decile of occupations, employment shares were flat. Thus, the disproportionate growth of low-education, low-wage occupations becomes evident in the 1990s and accelerates thereafter.

Notably, this pattern of employment polarization has a counterpart in wage growth. This may be seen in Figure 2, which plots changes in real hourly wages relative to the median by wage percentile for all U.S. workers over two time periods: 1974 to 1988 and 1988 to 2006.[6] In the 1974 through 1988 period, wage growth was consistently increasing in wage percentile; wages at percentiles above the median rose relative to the median while wages below the median fell. From 1988 forward, however, the pattern was U-shaped. Wages both above *and* below the median rose relative to the median.

In short, wage gains in the middle of the distribution were smaller than wage gains at either the upper or lower reaches of the wage distribution. This simultaneous polarization of U.S. employment and wage growth suggests an important theme, explored in detail below—labor demand appears to be rising for both high-skill, high-wage jobs and for traditionally low-skill, low-wage jobs.

Employment polarization is widespread across industrialized economies

The polarization of employment across occupations is not unique to the United States, but rather is widespread across industrialized economies. Evidence of this fact is presented

below through a comparison of the change in the share of employment between 1993 and 2006 in 16 European Union economies within three broad sets of occupations—low, middle, and high wage—covering all nonagricultural employment and grouped according to average wage level.[7]

This comparison reveals that in all 16 countries, middle-wage occupations declined as a share of employment during this 13-year period. Simultaneously, low-wage occupations increased as a share of employment in 11 of 16 countries, while high-wage occupations increased in 13 of 16 counties. Notably, in all 16 countries, low-wage occupations increased in size relative to middle-wage occupations.

The comparability of these occupational shifts across a large set of developed countries—the United States among them—makes it likely that a common set of forces contributes to these shared labor-market developments. Simultaneously, the substantial differences among countries apparent in the data underscores that no single factor or common cause explains the diversity of experiences across the United States and the European Union.

The Great Recession has quantitatively but not qualitatively changed the direction of the U.S. labor market

The four major U.S. labor market developments referenced above and documented below—the polarization of job growth across high- and low-skill occupations, rising wages for highly educated workers, falling wages for less-educated workers, and lagging labor market gains for males—all predate the Great Recession. But the available data suggest that the Great Recession has reinforced these trends rather than reversing or redirecting them. In particular, job and earnings losses during the recession have been greater for low-education males than low-education females, and these losses have been most concentrated in middle-skill jobs. Indeed, there was essentially no net change in total employment in both high-skill professional, managerial and technical occupations and in low-skill service occupations between 2007 and 2009. Conversely, employment fell by 8 percent in white-collar sales, office, and administrative jobs and by 16 percent in blue-collar production, craft, repair, and operative jobs.

Key contributors to job polarization are the automation of routine work and the international integration of labor markets

Measuring employment polarization is easier than determining its root causes, but researchers are making progress in understanding the operative forces behind the data. A leading explanation focuses on the consequences of ongoing automation and offshoring of middle-skilled "routine" tasks that were formerly performed primarily by workers with moderate education (a high school diploma but less than a four-year college degree). Routine tasks as described by economists David Autor, Frank Levy, and Richard Murnane are job activities that are sufficiently well defined that they can be carried out successfully by either a computer executing a program or, alternatively, by a comparatively less-educated worker in a developing country who carries out the task with minimal discretion.[8]

Routine tasks are characteristic of many middle-skilled cognitive and production activities, such as bookkeeping, clerical work, and repetitive production tasks. The core job tasks of these occupations in many cases follow precise, well-understood procedures. Consequently, as computer and communication technologies improve in quality and decline in price, these routine tasks are increasingly codified in computer software and performed by machines or, alternatively, sent electronically to foreign worksites to be performed by comparatively low-wage workers.

This process raises relative demand for nonroutine tasks in which workers hold a comparative advantage. As detailed below, these nonroutine tasks can be roughly subdivided into two major categories: abstract tasks and manual tasks. These tasks lie at opposite ends of the occupational-skill distribution.

Abstract tasks require problem solving, intuition, and persuasion. Workers who are most adept in these tasks typically have high levels of education and analytical capability. Manual tasks, by contrast, require situational adaptability, visual and language recognition, and in-person interactions. Examples of workers engaged in these tasks include janitors and cleaners, home health aides, construction laborers, security personnel, and motor vehicle operators. Manual tasks demand workers who are physically adept and, in some cases, able to communicate fluently in spoken lan-

guage. Yet they appear to require little in the way of formal education, at least relative to a setting where most workers have completed high school.

In brief, the displacement of jobs—and, more broadly, occupations—that are intensive in routine tasks contributes to the polarization of employment into relatively high-skill, high-wage and low-skill, low-wage jobs, with a concomitant decline in middle-skill jobs.

Technology, trade, and offshoring are not by any means the only potential explanation for employment polarization—nor is it necessarily the case that any one explanation accounts for the entirety of the phenomenon. Another frequently discussed explanation for the changing structure of employment and earnings in the U.S. focuses on shifts in labor market institutions, in particular, declining labor union penetration and a falling real minimum wage. There is little doubt that labor unions and the minimum wage contribute to changing employment and wage patterns, but it appears unlikely their role is paramount.

In the case of labor unions, their impact is largely confined to manufacturing and public sector employment, neither of which comprises a sufficiently large share of the aggregate economy to explain the overall polarization phenomenon. Moreover, polarization of employment into high-skill, high-wage and low-skill, low-wage jobs occurs across all sectors of the U.S. economy and is not confined to union-intensive manufacturing industries. This makes it unlikely that de-unionization or the decline of manufacturing employment is primarily responsible for employment polarization.

Nevertheless, the loss of middle-skill, blue-collar jobs in manufacturing—many at unionized firms paying relatively high wages—has likely been particularly harmful to the employment and earnings of less-educated males. The job opportunities available to males displaced from manufacturing jobs, particularly those displaced at midcareer, are likely to be primarily found in lower-paying service occupations. While these job losses may be primarily attributable to automation of routine production work and growing international competition in manufactured goods rather than to de-unionization per se, the magnitude of the income losses for males is surely magnified by the fact that the job losses are in union-intensive industries.

An often-discussed explanation for changes in the structure of U.S. wages and employment is the federal minimum wage. The minimum wage can affect *wage inequality* by boosting (or failing to boost) wages in low-paying jobs. But changes in the federal minimum wage over the last several decades appear an unlikely candidate for explaining the polarization of *employment*—that is, the growth of both low- and high-skill jobs—particularly because the timing of this explanation does not fit the main polarization facts. The federal minimum wage declined sharply in real terms (after adjusting for inflation) during the 1980s, which might in theory have led to a rise in low-skill, low-wage employment. Yet, as shown in Figure 1, the opposite occurred. From the late 1980s forward, the real federal minimum wage stabilized and then subsequently rose. We might therefore have expected low-skill employment to stagnate or decline. Instead, it grew rapidly.[9]

The earnings of college-educated workers relative to high school-educated workers have risen steadily for almost three decades

After three decades of sustained increases, the return to skills as typically measured by the earnings ratio of college graduates relative to high school graduates is at a historic high. In 1963, the hourly wage of the typical college graduate was approximately 1.5 times the hourly wage of the typical high school graduate. By 2009, this ratio stood at 1.95. The entirety of this 45 percentage point rise occurred after 1980. In fact, the college-to-high- school earnings ratio declined by 10 percentage points in the 1970s.

Moreover, this simple comparison of the wage gap between college and high school graduates probably understates significantly the real growth in compensation for college graduates relative to high school graduates in recent decades. College graduates work more hours per week and more weeks per year than high school graduates, spend less time unemployed, and receive a disproportionate share of nonwage fringe benefits, including sick and vacation pay, employer-paid health insurance, pension contributions, and safe and pleasant working conditions. And these gaps in nonwage benefits between high- and low-education workers have each grown over the past several decades.[10]

One important proximate cause for the rising relative earnings of college graduates is the slowdown in the rate of entry of new college graduates into the U.S. labor market starting in the early 1980s. Although this slowdown is by no means the only cause of changes in U.S. employment and earnings patterns—and, moreover, a cause whose genesis is not entirely understood—it is nevertheless a critical and often overlooked factor.

Rising relative earnings of college graduates are due both to rising real earnings for college workers and falling real earnings for noncollege workers—particularly noncollege males

The high and rising wage premium that accompanies a college education conveys the positive economic news that educational investments offer a high wage return. But this trend also masks a discouraging truth: The rising *relative* earnings of college graduates are due not just to rising *real* earnings for college workers but also to falling real earnings for noncollege workers. Real hourly earnings of college-educated workers rose anywhere from 10 to 37 percent between 1979 and 2007, with the greatest gains among workers with a postbaccalaureate degree.

Simultaneously, real earnings of workers with high school or lower educational levels either stagnated or declined significantly. These declines were especially steep among males: 12 percent for high school graduates and 16 percent for high school dropouts. The picture is generally brighter for females, but there was essentially no real earnings growth among females without at least some college education over this three-decade interval.

Though it is sometimes asserted that the "real" earnings declines of less-educated workers are overstated because they do not account for the rising value of employer-provided in-kind benefits such as healthcare, careful analysis of representative, wage, and fringe benefits data conducted by U.S. Bureau of Labor Statistics economist Brooks Pierce refutes this notion. Net of fringe benefits, real compensation for low-skilled workers fell in the 1980s. Further, accounting for fringe benefits, total compensation for high-skilled workers rose by more than did wages, both in absolute terms and relative to compensation for low-skilled workers.[11]

Gains in educational attainment have not generally kept pace with rising educational returns, particularly for males

Given the steep rise in wages for college graduates relative to noncollege graduates over the past three decades, one might have anticipated a substantial rise in college attainment among young adults. Yet, the actual increase in four-year college attainment was fairly muted, particularly for males. Between 1970 and 2008, four-year college attainment among white male young adults ages 25 through 34 rose only modestly, from 20 percent in 1970 to 26 percent in 2008.[12] Remarkably, among white females of the same age range, college attainment nearly tripled, to 34 percentage points from 12 percentage points. Thus, in three decades the white male-female gap in college attainment went from positive 8 to negative 8 percentage points!

Among young African-American adults, this picture is also mixed. The *proportional* gains in four-year college completion between 1970 and 2008 were substantially greater for blacks than for whites. Indeed, college completions rose more than two-fold among black males and more than three-fold among black females. Despite these gains, the levels of college completion for blacks remain substantially below that of whites. The black-white gap in college completion closed by only 2 percentage points among males in this period, and expanded by 6 percentage points among females.

The only ethnic category for which gains in educational attainment have been truly spectacular was "other nonwhites," a category that includes many Asian Americans.[13] In 2008, more than half of male and female young adults in this category had completed a four-year college degree. This is an increase since 1970 of 22 percentage points among males and 32 percentage points among females.

Roadmap of the analysis

The remainder of the paper is structured as follows. The next section provides further details on the polarization of U.S. employment, both for the labor market as a whole and as it has unfolded differentially among sex and education groups. This section then considers four major potential causes of polarization discussed briefly above: technological change,

trade and offshoring, de-unionization, and a falling minimum wage. The section that follows further documents that the polarization of employment is not unique to the U.S. but rather is widespread among European Union economies.

The paper then steps back from this detailed portrait of polarization to explore the overriding role of labor demand shifts in explaining the sharp changes in earnings and employment levels by education and sex. This section shows that the rising wages of college-educated workers relative to high school-educated workers can in large part be explained by a long-term, secular rise in the demand for college workers coupled with a sharp decline in the entry of new college workers in the U.S. labor market starting in the late 1970s. This section highlights that a major proximate cause of this slowdown is the sharp deceleration in the rate of college attainment among young males starting in the late 1970s, the reasons for which are only poorly understood.

The final section explores earnings by education level in greater detail to document that the simple college versus high school earnings dichotomy masks a highly consequential development: The rising demand for "education" appears to be limited to very high levels of education. Workers with less than a four-year college education, and particularly non-college males, experienced stagnant or in some cases declining earnings over the past three decades. I link these striking wage developments to the polarization of employment, arguing that declining opportunities in middle-skill jobs help to explain why wages are rising for highly educated workers whiles wages for middle- and low-educated workers are growing less rapidly and, moreover, converging toward one another. The paper then offers concluding observations.

Why is employment polarizing?

Facts and hypotheses

What explains the polarization of employment? This section first offers a closer look at the polarization of employment growth across occupations. It next reviews several potential contributors to this phenomenon, including:

- Routine tasks replacing technological change
- International trade and offshoring of goods and services
- Declining private sector labor union penetration
- The falling real value of the minimum wage

Polarization: A closer look

Job growth in the U.S. economy is increasingly concentrated at the tails of occupational skill distribution, in both high-education, high-wage occupations and low-education, low-wage occupations, as show in Figure 1 on page 3.[14] This phenomenon is documented in greater detail in Figure 3, which plots changes in employment by decade for 1979 through 2009 for 10 major occupational groups encompassing all of U.S. non-agricultural employment.[15]

These occupations divide neatly into three groups. On the left-hand side of the figure are managerial, professional, and technical occupations. These are highly educated and highly paid occupations. In 2009, between 45 percent and 75 percent of workers in these occupations had at least a four-year college degree, and fewer than 20 percent had no college education. Employment growth in these high-skill occupations was robust throughout the past three decades. Even in the current recession, these occupations experienced almost no decline in employment.

The subsequent four columns display employment growth in a set of middle-educated and middle-paid occupations, among them:

- Sales
- Office and administrative
- Production, craft, and repair
- Operators, fabricators, and laborers

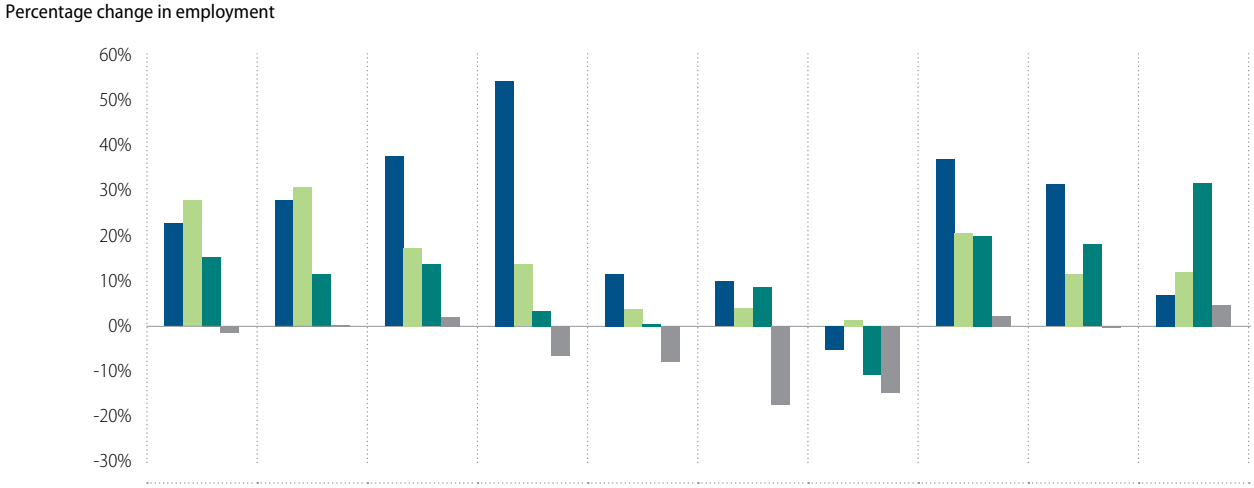
While employment growth in these occupations is positive in each interval prior to 2000 though 2007, their growth rate lags the economywide average and, moreover, generally slows in each subsequent time interval. These occupations were also particularly hard hit by the Great Recession, with absolute declines in employment ranging from 7 percent to 17 percent.

The final three columns of Figure 3 depict employment trends in service occupations. Service occupations are defined by the Census Bureau as jobs that involve helping, caring for or assisting others.[16] The majority of workers in service occupations have no post-secondary education, and average hourly wages in service occupations are in most cases below the other seven occupation groups.[17]

Despite their low educational requirements and low pay, employment growth in service occupations has been robust over the past three decades. All three broad categories of service occupations—protective service, food preparation and cleaning services, and personal care—expanded by double digits in the both the 1990s and the pre-recession years of the past decade (1999 to 2007).

FIGURE 3

Percentage point change in employment by occupation, 1979–2009



	Managers	Professionals	Technicians	Sales	Office and admin	Production, craft, and repair	Operators, fabricators, and laborers	Protective services	Food prep, building and grounds cleaning	Personal care and personal services
1979–1989	22%	28%	37%	54%	11%	10%	-5%	36%	31%	7%
1989–1999	27%	30%	17%	14%	3%	4%	1%	20%	11%	12%
1999–2007	15%	11%	14%	4%	1%	8%	-11%	20%	18%	31%
2007–2009	-1%	0%	2%	-7%	-8%	-17%	-15%	2%	0%	5%

Source: May/ORG CPS data for earnings years 1979-2009. The data include all persons ages 16-64 who reported having worked last year, excluding those employed by the military and in agricultural occupations. Occupations are first converted from their respective scheme into 328 occupation groups consistent over the given time period. From these groups, occupations are then consolidated into the 10 broad categories presented in the figure. The occupation share is the percentage of all workers employed in that occupation.

Notably, even during the recessionary years of 2007 through 2009, employment growth in service occupations has been modestly positive—more so, in fact, than the three high-skilled occupations (professional, managerial, and technical occupations) on the left-hand side of figure. Although not shown in Figure 3, service occupations actually *contracted* as a share of employment in the 1970s. Thus, their rapid growth since 1980 marks a sharp trend reversal.[18]

Cumulatively, these two trends—rapid employment growth in both high and low-education jobs—have substantially reduced the share of employment accounted for by middle-skill jobs. In 1979, the four middle-skill occupations—sales, office and administrative workers, production workers, and operators—accounted for 57.3 percent of employment. In 2007, this number was 48.6 percent, and in 2009, it was 45.7 percent. This sizable shift in job composition reflects three decades of employment growth at the tails of the occupational distribution.

One can quantify the consistency of this pattern by correlating the growth rates of occupations across multiple decades, which essentially means calculating on a scale from negative one to positive one how similar two sets of numbers are. Comparing the 1979 to 1989 and 1989 to 1999, the correlation between occupational growth rates in these two periods is 0.53. For the decades of 1989 to 1999 and 1999 to 2009, this correlation is 0.74.

Perhaps most remarkably, the correlation between occupational growth rates during 1999 to 2007 period and 2007 to 2009—that is, *prior to* and during the current recession—is 0.76.[19] In summary, the Great Recession dramatically reduced overall employment in the U.S. economy but did not fundamentally alter the direction of occupational change prevailing throughout this period.[20]

Sex differences in job polarization

The polarization of employment into low- and high-skill occupations has unfolded with increasing velocity over the past two decades. But this polarization did not occur evenly among the sexes, as is shown in Figure 4.

The first set of columns in Figure 4 plot the change between 1979 and 2007 in the share of employment in high-, middle-, and low-skill occupations among each sex. The share of male employment in middle-skill occupations dropped by 7.0 percent. For females, the fall was even larger at 15.8 percent. Yet this "hollowing out" of the occupational distribution had different consequences for the sexes. Females moved dramatically upward in the occupational distribution as they departed the center. Male employment instead moved in roughly equal measures to the tails of the distribution—that is, to high-wage, high-skill and low-wage, low-skill jobs.

The second set of bars in Figure 4 breaks these patterns by education group, showing that the share of males with no more than a high school education employed in middle-skill occupations dropped by 3.9 percent between 1979 and 2007. More than the entirety of this decline is accounted for by a corresponding rise in employment in low-skill service occupations.

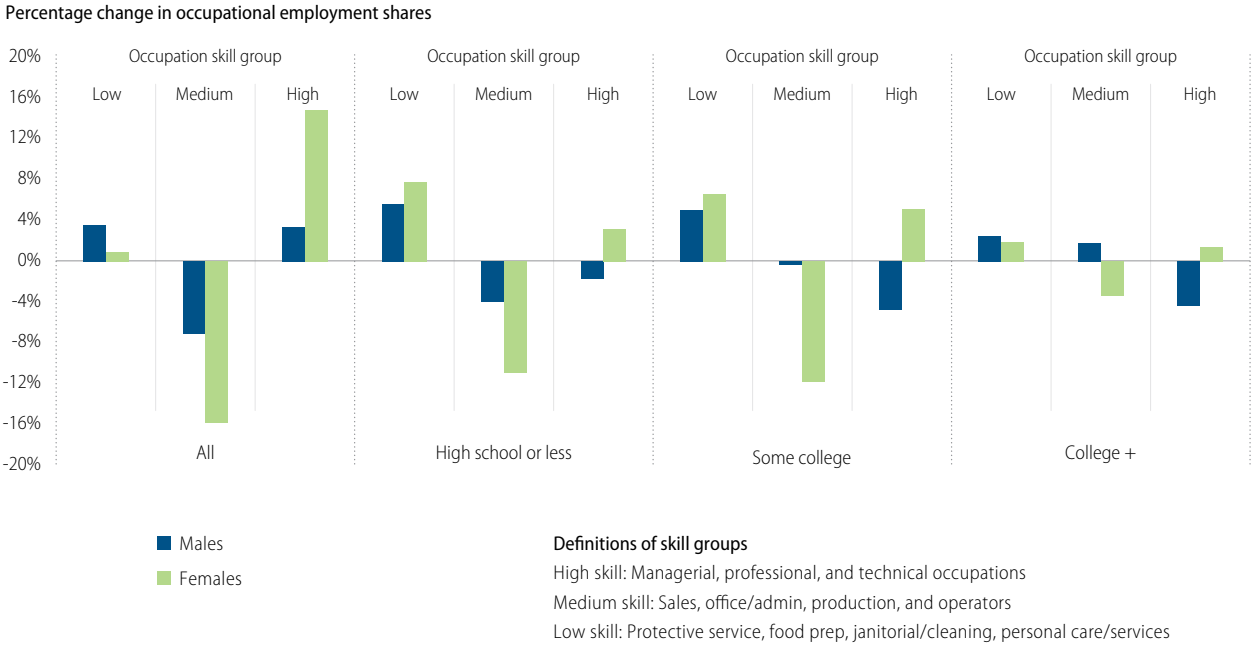
Simultaneously, the share of employment among males with some college education declined in both middle- and high-skill occupations. Even among males with a four-year college degree, employment in high-wage occupations declined noticeably, with the slack taken up approximately evenly by middle- and low-skill occupations.

Some portion of this occupational shift is arguably mechanical. As the share of workers with higher educations rises, it is inevitable that some subset will take traditionally noncollege jobs. Put simply, when a third of the workforce is college educated, not *all* college-educated workers will be managers or professionals. Nevertheless, the decline of middle-skill jobs has clearly displaced males toward the tails of the occupational distribution. And the net effect is an increase in the share of males in low-skill occupations compared to the share of males in high-skill occupations.

Figure 4 paints a more encouraging picture for females. Women with less than a four-year college degree experienced

FIGURE 4

Changes in occupational employment shares by education and sex, 1979–2007



Source: May/ORG CPS data for earnings years 1979-2007. See note to Figure 12. The 10 broad occupations are classified as belonging to one of three broad skill groups.

substantial—indeed, dramatic—declines in the share of their employment in middle-skill occupations between 1979 and 2007. This decline was 11 percentage points for females with high school or lower education, and 12 percentage points for females with some college. Unlike for men, these losses in middle-skill occupations were substantially offset by employment gains in high-skill occupations, and this is true for both high school- and some-college-educated females.

In short, while female employment in middle-skill occupations declined by 16 percentage points between 1979 and 2007, female employment in low-skill occupations rose by only 1 percentage point—with the remainder accounted for by employment gains in high-skill occupations.

Gains in female occupational attainment are not, however, simply due to "demand shifts" favoring female workers. Women have entered professional, managerial, and technical fields by attaining expertise and education in technical and professional fields such as law and medicine, and by gaining skills, experience, and seniority on the job through higher rates of labor force attachment. Conversely, the share of women in traditional female career jobs such as teaching and nursing has declined. The net effect of these changes is that women more successfully adapted to shifts in demand that have eroded employment opportunities in middle-skill clerical, administrative, and production jobs (though the latter had very limited female employment to begin with).

These patterns of occupational change by sex and education have their counterparts in trends in real earnings growth by sex and education, as I discuss in the last section of this report. Before doing so, I consider potential causes of employment polarization.

Potential cause 1: Routine task-replacing technological change

A leading, though surely incomplete, explanation for job polarization focuses on the changing demand for job tasks spurred by the advent of workplace computerization. As is evident to anyone who owns a television, uses a mobile phone, drives a car, or takes a photograph, the price of information technology has fallen at a remarkable pace in recent years.

A recent paper by Yale economist William Nordhaus estimates that the real cost of performing a standardized set of computational tasks using information technology fell by roughly one-third to one-half *annually* over the past six decades, leading to a cumulative decline of at least a *trillion-fold* in the cost of computing.[21] Processing tasks that were unthinkably expensive 30 years ago—such as searching the full text of a university's library for a single quotation—are now trivially cheap.

This rapid, secular price decline creates enormous economic incentives for employers to substitute information technology for expensive labor in performing workplace tasks. Simultaneously, it creates significant advantages for workers whose skills become increasingly productive as the price of computing falls.

This observation raises the question: For which tasks are computers a substitute, and for which tasks are they a complement? Stated differently, what are the tasks in which workers of various education levels have a comparative advantage over information technology?

Although computers are everywhere, they don't do everything. Rather, computers—or, more precisely, symbolic processors that execute stored instructions—have a very specific set of capabilities and limitations. Ultimately, their ability to accomplish a task is dependent upon the ability of a programmer to write a set of procedures or rules to tell the machine what to do at each possible contingency. For the task to be machine-executable, it must be sufficiently well defined, or "canned," so that a nonsentient machine can execute it successfully without the aid of "common sense" by rapidly and accurately following the steps set down by the programmer. Consequently, computers are highly productive and reliable at performing the things that people can program them to do—and inept at everything else.

Computer programs, for example, can play an unbeatable game of checkers and a nearly unbeatable game of chess. These games follow well-described rules and so are reasonably straightforward to program. In the workplace, computers accomplish countless data processing and clerical activities, such as sorting, filing, calculating, storing, retrieving, and manipulating information. Similarly, computers now handle many of the repetitive assembly and monitoring tasks on the factory floor. Using the terminology from the introduction, I refer to these procedural, rule-based activities as *routine* tasks.[22]

Routine tasks are characteristic of many middle-skilled cognitive and manual activities, such as bookkeeping, clerical work,

and repetitive production tasks. Because the core job tasks of these occupations follow precise, well-understood procedures, they are increasingly codified in computer software and performed by machines or, alternatively, sent electronically to foreign worksites. Thus, the substantial declines in clerical and administrative occupations depicted in Figure 4 on page 10 are almost certainly a direct consequence of the falling price of machine substitutes for these tasks. Notably, the central *tasks* performed by these occupations—organizing, filing, retrieving, and manipulating information—are dramatically more prevalent in 2010 than they were in 1970. But these tasks are now largely handled by machines.

This process of automation raises the relative demand for nonroutine tasks in which workers hold a comparative advantage. These nonroutine tasks can be roughly subdivided into two major categories, abstract and manual tasks, which lie at opposite ends of the occupational skill distribution. Abstract tasks require problem-solving capabilities, intuition, and persuasion. These tasks employ workers with high levels of education and analytical capability.

In contrast, manual tasks require situational adaptability, visual and language recognition, and in-person interactions. These tasks are characteristic of the jobs performed by janitors and cleaners, home health aides, construction laborers, security personnel, and motor vehicle operators. They demand workers who are physically adept and, in some cases, able to communicate fluently in spoken language. They appear to require little in the way of formal education, however, at least relative to a labor market where most workers have completed high school.

This latter observation applies with particular force to service occupations. Tasks such as food preparation and serving, cleaning and janitorial work, grounds cleaning and maintenance, in-person health assistance by home health aides, and numerous jobs in security and protective services, are highly intensive in nonroutine manual tasks. These activities demand interpersonal and environmental adaptability yet little in the way of formal education. These are precisely the job tasks that are challenging to automate because they are nonroutine. Also noteworthy is that these jobs are difficult to outsource because, in large part, they must be produced and performed in person (at least for now).[23] Yet, as emphasized above, these jobs generally do not require formal education beyond a high school degree nor, in most cases, extensive training. Consequently, the potential supply of workers who can perform these jobs is very large—and this is likely to mute the potential for rapid wage growth in these occupations even in the face of rising demand.[24]

In short, the displacement of jobs that are intensive in routine tasks probably contributes to the polarization of employment by reducing job opportunities in middle-skilled clerical, administrative, production, and operative occupations. Jobs that are intensive in either abstract or manual tasks are much less susceptible to this process, however. Since these jobs are found at opposite ends of the occupational skill spectrum—in professional, managerial, and technical occupations on the one hand, and in service and laborer occupations on the other—the consequence may be a partial "hollowing out" or polarization of employment opportunities.

A rapidly growing body of research appears to confirm the relevance of this task-based approach to explaining occupational change over time and across countries.[25] Interestingly, employment projections from the U.S. Bureau of Labor Statistics also support the view that low-education service jobs are likely to be a major contributor to U.S. employment growth going forward. The BLS forecasts that employment in service occupations will increase by 4.1 million, or 14 percent, between 2008 and 2018.[26] The only major occupational category with greater projected growth is professional occupations, which are predicted to add 5.2 million jobs, or 17 percent.[27]

Like all forecasts, these should of course be treated as tentative. Historically, the BLS has underpredicted the growing demand for professional and managerial occupations.[28]

Potential cause 2: International trade and offshoring of goods and services

Although I have focused the discussion so far on the labor market consequences of rapidly advancing information and communication technology, one can offer similar observations about the consequences of international trade and offshoring for domestic labor demand. Many of the tasks that are "routine" from an automation perspective are also relatively easy to package as discrete activities that can be accomplished at a distant location by comparatively low-skilled

workers for much lower wages. Cases in point: Bill processing, data entry, tax preparation, and many repetitive production tasks in assembly are commonly offshored.

Moreover, a number of articles by economist Alan Blinder and his coauthors make a broader claim about the scope of international offshoring.[29] This body of work argues that any job that does not need to be done in person (face to face) can eventually be outsourced, regardless of whether the tasks that make up the job are largely routine, manual, or abstract. An iconic example of this form of offshoring is foreign call centers, which provide customer support to clients of domestic firms, including credit card merchants and software vendors.

The job tasks performed by call-center workers are clearly not (entirely) subject to automation at present. But the tasks they perform have recently become tradable due to both unprecedented declines in the cost of high-speed communications, and growing ranks of literate, numerate, English-speaking workers worldwide who are connected to high-speed networks.[30]

In reality, there are many examples of tasks that can currently be offshored but not automated (such as staffing call centers or reading x-rays) and, conversely, tasks that can currently be automated but not offshored, such as vacuuming floors or picking stock items from warehouse shelves. Thus, it is clearly not the case that computerization and the combination of trade and offshoring have identical implications for domestic labor demand. Nevertheless, there is enough overlap between these two forces that it is quite difficult to assess the separate contribution of each.

Short of such an assessment, four broad points appear relevant. First, offshoring is in large part a consequence of information technology. It would be inconceivable for firms to coordinate critical components of production in real time among groups of workers spread throughout the globe without the connective tissue of computers and high-speed communications that allow close coordination over vast distance. Thus, the distinction between the "effect" of technology and the "effect" of offshoring on domestic labor demand is to some extent moot. Offshoring would be irrelevant were it not for advancing information technology. At the same time, these technological advances would have somewhat different—and arguably less sweeping—labor market consequences were it not for the substantial supply of literate, English-speaking, and technically skilled (in many cases) workers in developing countries eager to work at highly competitive wages.

Second, extensive economic analysis conducted in the 1990s strove to distinguish between the role of international *goods* trade (not offshoring) and the role of computer technology in fomenting earnings inequality in advanced economies in that period. Though this analysis was not entirely conclusive, the consensus view at the end of the 20th century was that trade flows were simply too small to explain the vast changes in skill demands and wage structures that unfolded in many industrialized economies during the 1980s and 1990s.[31] Instead, economists generally reached the conclusion that technological change was a far more important factor than trade in explaining labor market developments in those two decades.

Third, a more recent body of work argues that trade integration between the United States and China in particular has become so extensive over the past 15 years that it may be an important factor at present. This conclusion is controversial, but it is not without distinguished adherents, among them the economist Paul Krugman. [32]

The final observation relevant to this discussion concerns offshoring specifically. Offshoring has captured the imagination of policymakers as a major economic force. Indeed, the image of Indian call centers servicing U.S.-based Dell customers and Pakistani radiology technicians reading American CT scans taken at the local community hospital are emblazoned in all of our minds. These examples, however, mainly speak to the *potential* of offshoring to open formerly nontradable occupations and tasks to international competition. The evidence is that the scope of offshoring is limited so far.[33]

But past is not prologue. The potential disruptive nature of offshoring cannot be ignored. While many economists would agree that offshoring is not *yet* a substantial driver of labor market developments in industrialized economies, it is likely to have a more substantial effect on domestic labor demand over the coming decade. As the prevalence of offshoring increases, it appears likely that "routine" tasks will be most susceptible to offshoring. But as the examples of call center workers and radiology technicians suggest, offshoring will not be limited to routine tasks.

Potential cause 3: Declining private sector labor union penetration

There are numerous social institutions that affect the labor market, including legislation, regulatory and oversight bodies, payroll and income taxes, collective bargaining rules, and social norms such as tipping and shared notions of fairness in pay setting. Among these many complex institutions, two that economists have focused on particularly are labor unions and minimum wage laws. Both are important, but as noted in the introduction, neither is likely to be a central explanation for the patterns of employment and wage polarization documented above. I discuss them briefly here in turn.

As is well known, labor unions represent a far smaller share of private sector workers at present than in the past. Data assembled by Barry Hirsch of Georgia State University and David MacPherson of Trinity University shows that private sector union membership among U.S. workers declined from 21.2 percent in 1979 to 7.2 percent in 2009.[34] The operative question, then, is whether the decline of labor unions can explain the labor market polarization documented above.

There are several reasons to think that the decline of labor unions is not primarily responsible for *employment* polarization. First, unions bargain with employers over wages, benefits, and working conditions, but have very limited ability to affect employment levels. Since job polarization primarily reflects changes in the structure of employment—in particular, declines in middle-skill occupations and growth in low- and high-skill occupations—it is unlikely that the decline of unions directly plays a central role in this phenomenon.

Moreover, employment polarization—in particular the decline in middle-skill jobs—occurs throughout the U.S. economy; it is not confined to manufacturing, trade-exposed, or historically union-intensive sectors. Finally, as detailed further below, the fact that job polarization is widespread among European economies, many of which have not experienced significant declines in union representation or bargaining power, further suggests that the decline of U.S. labor unions is unlikely to be a primary cause of U.S. employment polarization.

To say that de-unionization is not responsible for employment polarization does not imply that the two phenomena are independent, however. Advancing domestic production technology, increasing trade flows, easier offshoring of production tasks, and vast improvements in the quality of developing country manufacturers have led to reduced U.S. manufacturing employment and, in some cases, lower profitability.

This is especially true in large heavily unionized subsectors of U.S. manufacturing such as steel, passenger cars, aircraft, and electronics. These technological, trade-based, and competitive forces reduce union penetration by directly eliminating union jobs and also making it less feasible for unions to negotiate generous wages and benefits for their members. Thus, de-unionization is to a significant extent a consequence rather than a cause of the technological and international forces that have spurred job polarization—though it would be erroneous to say that these are the only factors responsible for declining union penetration.[35]

Though de-unionization has contributed little to employment polarization, it has arguably had a greater role in wage polarization. As discussed in two recent papers by Sergio Firpo, Nicole Fortin, and Thomas Lemieux of Escola de Economia de São Paulo and the University of British Columbia, labor unions appear not only to raise the wages of the workers that they represent—typically, middle-educated blue-collar production workers—but also tend to decrease inequality among these workers by compressing the distribution of earnings.[36] Hence, a decline in union penetration may cause a decline in wages of middle-skill workers and a rise in the wages of both high- and low-skill workers.

Nevertheless, the hypothesis that declining union membership can adequately explain wage polarization must be qualified on two grounds. First, the interaction between union and nonunion wages is complex; unions may reduce inequality among their members while raising inequality overall. Thus, the net effect is ambiguous.

Second, the period of wage polarization documented above is most pronounced from 1989 forward. Yet, 9 percentage points of the 14 percentage point decline in private sector union penetration that occurred over the past three decades took place in the 1980s. Union penetration fell only 3 percentage points in the 1990s and 2 further percentage points thereafter. This discrepancy in timing also suggests that declining union penetration is unlikely to be central to recent wage structure changes.

Potential cause 4: The declining real value of the federal minimum wage

A final key U.S. institutional development of potential relevance to the discussion is federal and state minimum wage laws, which tend to compress the lower tail of the earnings distribution and may also reduce unemployment in low-skill jobs—though robust evidence supporting this simple theoretical prediction is surprisingly hard to come by.

The U.S. minimum wage declined substantially in real terms over the past three decades. In constant 2008 dollars, it fell by almost one-third, from $7.50 per hour to $5.29 per hour between 1979 and 1989. The minimum wage then fluctuated in the range of $5.45 to $6.50 per hour between 1989 and 2006, and did not experience another fall comparable to the 1980s.[37] There is consensus among economists that the sharp decline in the federal minimum wage in the 1980s contributed to declining lower-tail wages in that period—especially for women—though the extent of this contribution is a matter of some debate.[38] Thus, as with labor unions, it is conceivable that the minimum wage has contributed to the polarized wage patterns discussed in this paper.[39]

But the fluctuations in the real minimum wage are an unlikely candidate to explain the polarization of employment. As with de-unionization, a key argument against the minimum wage as a primary causal factor is that the timing of the explanation does not fit the central facts. The sharp decline in the real federal minimum wage during the 1980s might in theory have spurred a rise in low-skill, low-wage employment because it would have made it cheaper for employers to hire low-skilled workers. Yet, as shown in Figure 1 on page 3, the opposite occurred. Then, from the late 1980s forward, when the real federal minimum wage stabilized or rose modestly, one might have predicted that low-skill employment would stagnate or decline. Instead, it grew rapidly.

Is polarization a uniquely American phenomenon?

If the above explanations for employment polarization have any force, they should be far more broadly applicable than just the U.S. labor market. Clearly, the same technologies and many of the same trading opportunities available in the United States are ubiquitous among industrialized economies. While a detailed test of this hypothesis is beyond the scope of this paper, I provide an initial exploration of the comparability of occupational changes in the United States and Europe here. I use Eurostat data to construct nonagricultural occupational employment series for years 1992 through 2008 for 10 European economies and the United States.[40] The eight occupational categories provided by Eurostat are coarser than (even) the broad categories used above in the U.S. data. I further aggregate the U.S. data for comparison.

Figure 5 plots employment shares in the United States and Europe for these eight Eurostat occupations. Panel A of the figure focuses on workers under age 40. This focus is useful because changes in occupational composition are typically first evident among younger workers.[41] The plot reveals a striking commonality in employment trends in the United States and European Union: high-education occupations (managers, professionals, and technicians) are increasing; middle-education occupations (clerks, crafts and trades, and operators and assemblers) are in decline; and low-education service occupations (which unfortunately are aggregated with sales occupations by Eurostat) are also growing.[42]

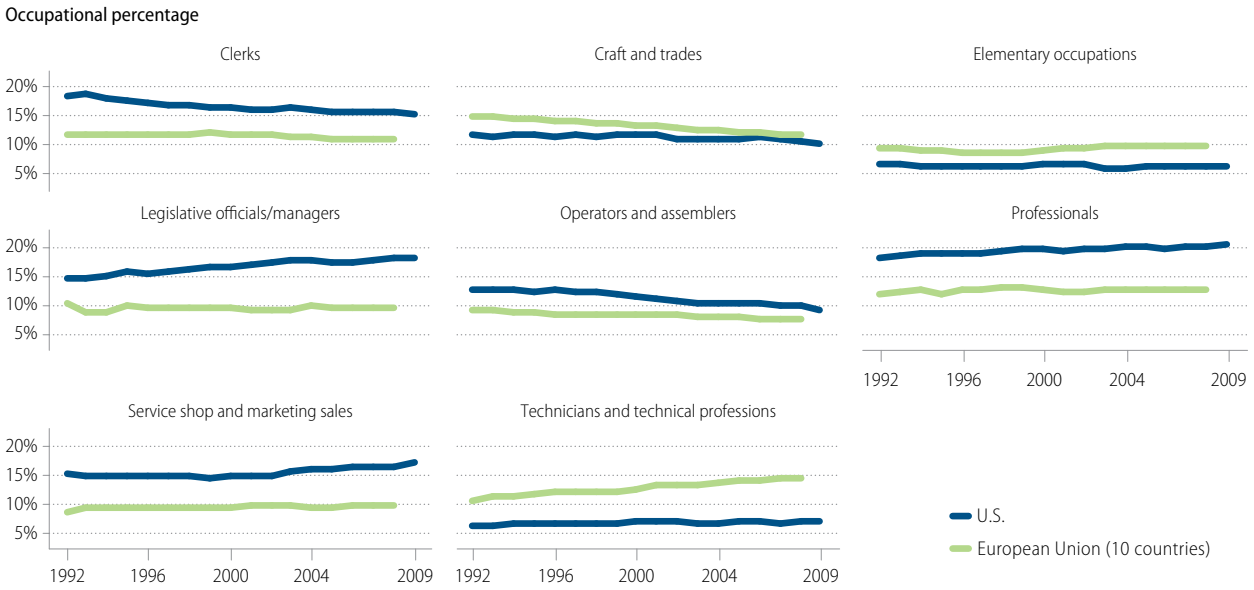
Figure 5b presents analogous plots for workers ages 40 and above. For older workers, the growth in service employment is less pronounced than for the young in both the United States and Europe, reflecting the comparative stability of occupational composition among workers who are well along in their careers. Nevertheless, the correlation of U.S. and E.U. changes in employment shares by occupation are relatively high. For the younger group, this correlation is 0.63. For older workers, it is 0.41.

These simple comparisons are of course merely suggestive of a significant commonality in the composition of occupations—or, more abstractly, tasks—demanded by employers in the United States and Europe. Recent research papers provide far more detailed comparisons of employment trends across the European Union, and relate them to measures of technology, capital deepening, and offshoring.[43] Their analyses strongly support the hypothesis that routine-task intensive occupations are in sharp decline across much of industrialized Europe.

Figure 6, based on a recent paper by Maarten Goos, Alan Manning, and Anna Salomons of the London School of Economics and the Katholieke Universiteit Leuven, plots the change in the share of overall employment in each of 16 European countries for years 1993 through 2006 accounted for by three sets of occupations grouped according to average wage level.[44] Middle-wage occupations declined as a share of employment in all 16 countries during this 13-year period. The largest declines occurred in France and Austria, 12 and 14 percentage points, respectively, and the smallest in Portugal (1 percentage point). The unweighted average decline across countries was 8 percentage points. Conversely, high-wage occupations increased their share of employment in 13 of 16 countries, with an average gain of 6 percentage points. Finally,

FIGURE 5A

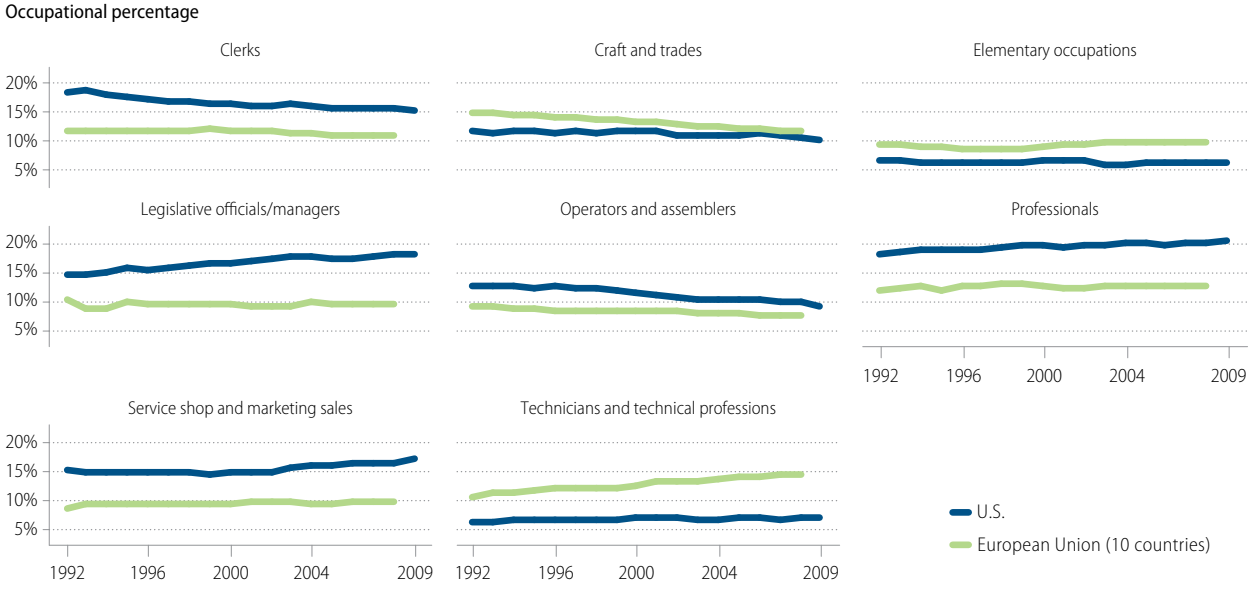
United States and European Union occupation percentages, age 39 or below



Source: The Eurostat data are based on the harmonized European Labor Force survey, and are available for download at www.eurostat.org. The ten countries included in the series in the paper are Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and the United Kingdom. The Eurostat data include many additional EU countries, but not on a consistent basis for this full time interval. The series presented in Figures 4a and 4b are weighted averages of occupational shares across these ten countries, where weights are proportional to the average share of EU employment in each country over the sample period. The Eurostat data include workers ages 15-59 while the U.S. sample includes workers 16-64.

FIGURE 5B

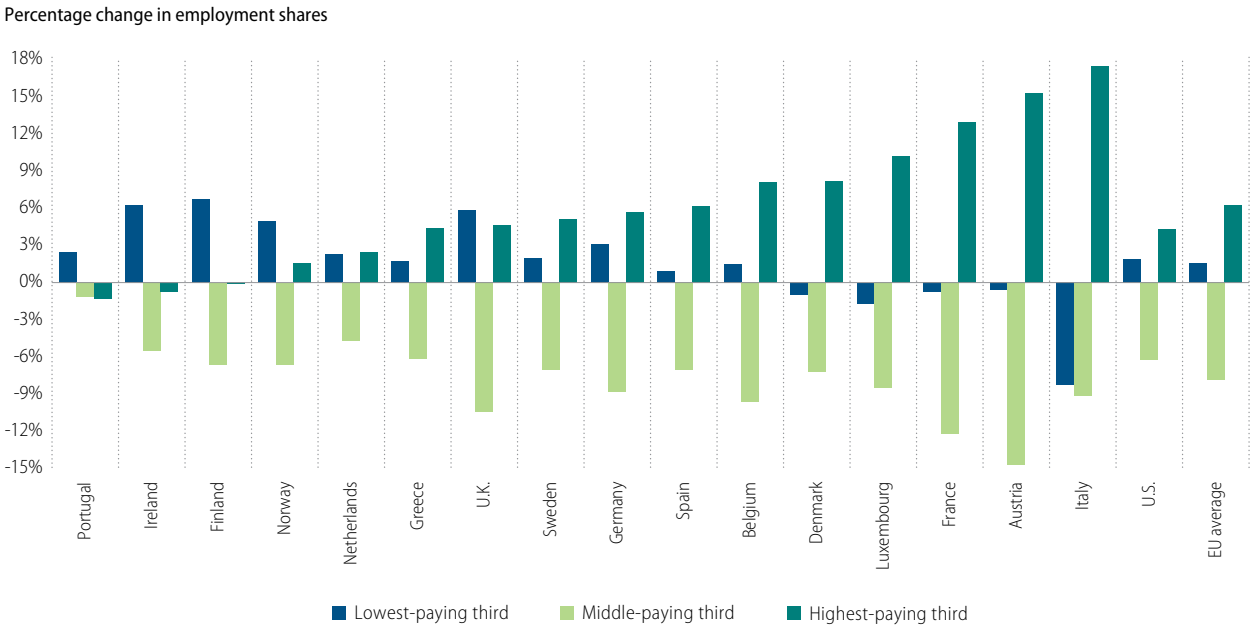
United States and European Union occupation percentages, age 40 or above



Source: The Eurostat data are based on the harmonized European Labor Force survey, and are available for download at www.eurostat.org. The ten countries included in the series in the paper are Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and the United Kingdom. The Eurostat data include many additional EU countries, but not on a consistent basis for this full time interval. The series presented in Figures 4a and 4b are weighted averages of occupational shares across these ten countries, where weights are proportional to the average share of EU employment in each country over the sample period. The Eurostat data include workers ages 15-59 while the U.S. sample includes workers 16-64.

FIGURE 6

Change in employment shares by occupation in 16 European countries Occupations grouped by wage tercile: Low, middle, high, 1993–2006



Source: Data on EU employment are from from Goos, Manning and Salomons, 2009a.

U.S. data are from the May/ORG CPS files for earnings years 1993-2006. The data include all persons ages 16-64 who reported having worked last year, excluding those employed by the military and in agricultural occupations. Occupations are first converted from their respective scheme into 328 occupation groups consistent over the given time period. These occupations are then grouped into three broad categories by wage.

low-wage occupations increased as a share of employment in 11 of 16 countries. Notably, in all 16 countries, low-wage occupations increase in size relative to middle-wage occupations. The average increase in employment in low-wage relative to middle-wage occupations was 10 percentage points.

To facilitate comparison with the United States, the final columns of Figure 6 plot the average change in the share of national employment in high-, middle-, and low-age occupations in all 16 European Union economies alongside a similar set of occupational shift measures for the United States. The similarity between the United States and the European Union is striking—indeed, the polarization evident in the United States is at least as pronounced in the European Union.

While further analysis is required to understand in detail the relationship between occupational composition, wages, and technological changes across industrialized economies, these preliminary analyses unambiguously confirm that the phenomenon of employment polarization is not unique to the United States. The comparability of these occupational shifts across a large set of developed countries makes it likely that a common set of forces contributes to these shared labor market developments. Simultaneously, as stressed above, the substantial differences among countries apparent in the data underscores that no single factor or common cause explains the diversity of experiences across the United States and the European Union.

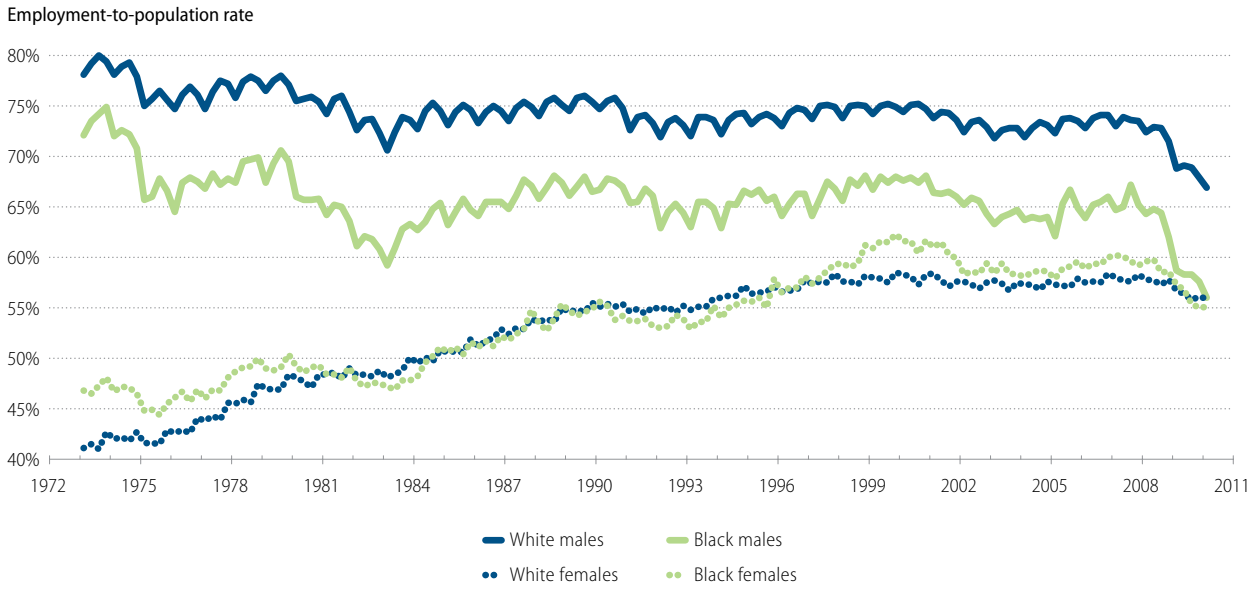
Declining labor force participation

The role of labor demand shifts

The explanation proposed above for employment polarization—which focuses on technological change, trade, and offshoring—is what economists call a "demand-side" explanation. That's because it points the causal arrows toward changes in employers' *demands* for skills rather than changes in the available *supply* of skills that might result from changes in educational attainment or shifts in workers' willingness to participate in the labor market. This section provides a straightforward test of the plausibility of this argument by asking whether the patterns of changing employment *and* wages among demographic groups can both be explained by changes in employers' demands for workers of various education and experience levels. After establishing that the data are broadly consistent with a demand-side explanation of employment polarization, I subsequently show in the next section that demand shifts are not the *entire* story. Indeed, an important part of the growth in the college versus high school gap is explained by fluctuations in college attainment.

FIGURE 7

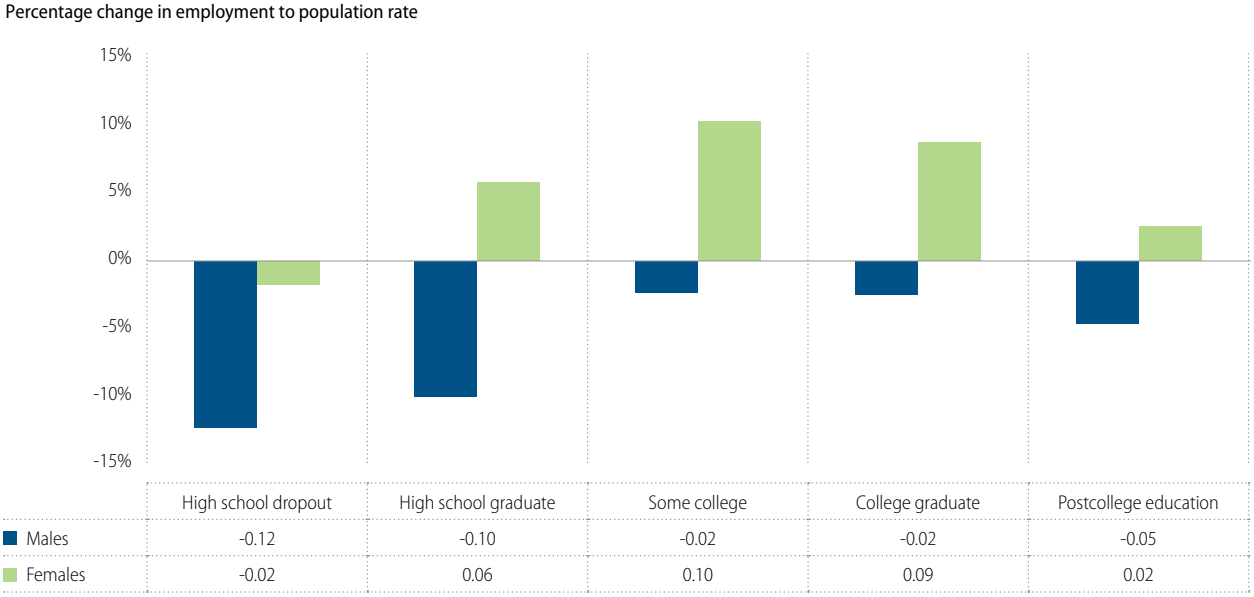
Employment-to-population rates among black and white males and females, ages 20+, 1973–2010



Source: Bureau of Labor Statistics.

FIGURE 8A

Changes in employment to population rates by education and sex, 1979–2007



	High school dropout	High school graduate	Some college	College graduate	Postcollege education
Males	-0.12	-0.10	-0.02	-0.02	-0.05
Females	-0.02	0.06	0.10	0.09	0.02

Source: May/ORG Current Population Survey 1973-2009. See note to Table 1.

A key starting point for this discussion, depicted in Figure 7, is that while employment-to-population rates necessarily fluctuate upward and downward with the business cycle, the last several decades have witnessed a long-term downward trend in the employment-to-population rate of males and an even more striking upward trend among females. The panels of Figures 8a and 8b provide further detail on these aggregate patterns by plotting changes in employment-to-population rates by education group, gender, and race, focusing on the period between 1979 and 2007. These years are chosen because they are high water marks of their respective business cycles.

During this interval, male employment-to-population rates declined modestly for all education levels and among all race groups. But these declines are most pronounced for less-educated males—those with high school or lower levels of education—and particularly for less-educated minority males. In contrast, the employment-to-population rates of females rose among all but the least-educated group over this same period.

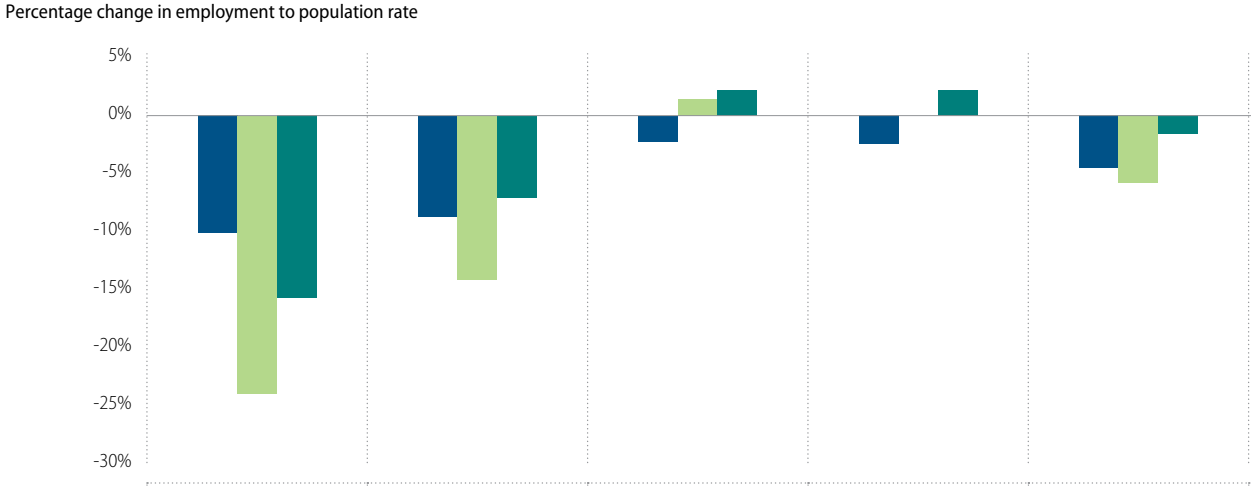
Do these large changes in employment-to-population rates augur good or bad news about the state of the labor market? The answer depends in large part on whether these changes are driven by supply or demand shifts—that is, by increased desire for leisure by potential workers (a labor supply shift) or by reduced demand for labor by potential employers (a labor demand shift).

We can differentiate these explanations by asking whether a fall in employment for a demographic group is accompanied by a rise in its wages—which would occur if the group had reduced its labor supply to the market—or whether instead a fall in employment for a demographic group is accompanied by a fall in its wages, which would occur if employer demand for that group's skills had declined. Thus, a simple "Economics 101" test of whether changes in employment are primarily demand driven rather than supply driven is whether earnings are declining for groups with declining employment (a demand shift) or whether they are instead rising for groups with declining employment (a supply shift).

To implement this simple test, I calculate the change in each decade in the employment-to-population ratio and average real hourly wage (expressed in logarithms) of 80 demographic groups, as defined by two sexes (male and female), three race categories (white, black, and nonwhite other), four age groups (16 to 24, 25 to 39, 40 to 54, and 55 to 64), and five education groups (high school dropout, high school

FIGURE 8B

Changes in male employment to population rates by race group, 1979–2007



	High school dropout	High school graduate	Some college	College graduate	Postcollege education
White	-0.10	-0.09	-0.02	-0.02	-0.05
Black	-0.24	-0.14	0.01	0.00	-0.06
Nonwhite other	-0.16	-0.07	0.02	0.02	-0.02

Source: May/ORG Current Population Survey 1973-2009. See note to Table 1.

graduate, some college, college graduate, and greater than college). The change in the employment-to-population rate over the respective time period is then regressed on the change in the mean logarithmic hourly wage over the same time period.

Details of these regressions are relegated to Appendix Tables 1 and 2 on page 34. A summary conclusion is that changing real earnings and changing employment-to-population rates are strongly and significantly positively correlated in each of the last three decades (1979 to 1989, 1989 to 1999, and 2000 to 2009), as well as before and during the current recession (2000 to 2007 and 2007 to 2009). Over the entire 1979-to-2009 period, a 10 percent increase in wages for a demographic group was robustly associated with a 5.8 percentage point rise in its employment to population rate.

Conversely, a 10 percent decline in wages is associated with a 5.8 percentage point decline in employment to population. Column 5 of the table also separately performs this regression analysis using exclusively the three most recent years for which data are available, 2007 to 2009. This regression detects exactly the pattern seen in the 1980s, 1990s, and pre-recession years of the 2000's: During the current recession, demographic groups that saw the largest drops in employment also suffered the largest declines in earnings. This result underscores a point made in the introduction: The Great Recession has reinforced prevailing labor market trends that were underway long before the recession.

Appendix Table 2 further shows that this robust positive relationship between wage and employment changes is detected for all demographic subgroups: both sexes, all race groups, both younger and older workers, and both college and non-college workers. Demographic groups with declining earnings over the past three decades also experienced declining employment-to-population rates, and vice versa for groups with rising earnings.[45]

This evidence supports the viewpoint that the changing patterns of employment and earnings documented above—most saliently, employment polarization—are driven to a substantial extent by changes in employers' *demand* for workers of various skill levels and occupational specialties, rather than by changes in the *supply* of workers to the labor market.

The slowing rate of college attainment and the rising college wage premium

If the changing patterns of labor force participation in the United States are to a substantial extent caused by changes in wages, this raises the question of why wages have risen by so much more for some groups than others—in particular, for highly educated workers relative to less-educated workers. It turns out that one crucial explanatory factor is the sharp deceleration in the relative supply of college-educated workers in the United States beginning in the late 1970s.

From the end of World War II to the late 1970s, the relative supply of college-educated workers versus noncollege-educated workers rose robustly and steadily, with each cohort of workers entering the labor market boasting a proportionately higher rate of college education than the cohort that preceded it. This intercohort pattern is seen in Figure 9, which plots the relative supply of college-educated versus noncollege-educated workers from 1963 to 2009.

From 1963 through 1982, the relative supply of college-educated workers rises steadily. But in 1983, this growth in relative supply sharply decelerates. Cohorts of workers entering the labor market after 1982 are *somewhat* more educated on average than their predecessors, but the rate of intercohort increase slows markedly.

This deceleration is particularly evident when we focus in Figure 9 on young adults with fewer than 10 years of experience—the cohorts of recent labor market entrants in each period. While the supply of young college-educated males relative to young high school-educated males increases rapidly in the 1960s and early 1970s—and indeed throughout the postwar period—this rising tide reaches an apex in 1974, from which it barely budges for the better part of the next 30 years. Among young females, the deceleration in supply is not as abrupt or as complete as for males. Nevertheless, it is readily apparent from Figure 9 that the relative supply of young female college graduates decelerates, along with males, in 1974 and then decelerates further in 1982.[46]

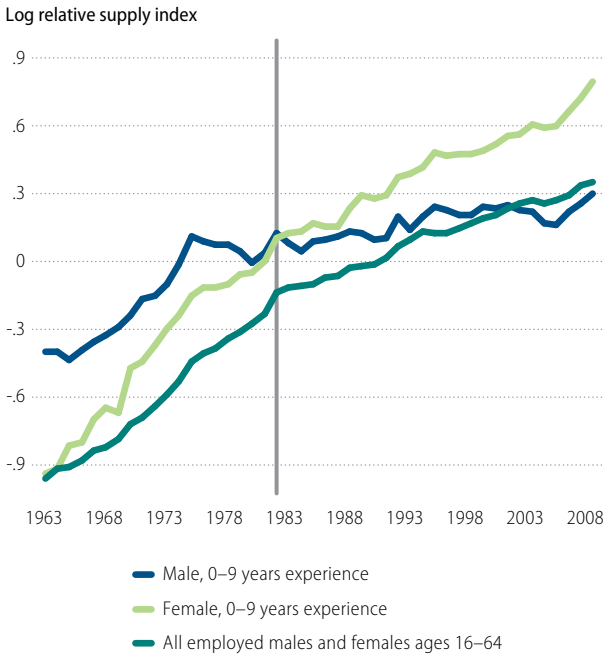
The counterpart to this deceleration in the growth of relative supply of college-educated workers is the steep rise in the college-versus-high-school earnings ratio that commenced in the early 1980s and continues to the present, depicted in Figure 10.

Concretely, when the influx of new college graduates slowed, the premium that a college education commanded in the labor market increased. The remarkably tight correspondence between the relative supply of college-educated workers on the one hand and their relative earnings on the other is depicted in Figure 11, which plots in each year from 1963 to 2008 the college-versus-high-school earnings ratio (in blue) alongside the college-versus-high-school supply measure (in green).

To facilitate this comparison both measures in Figure 11 have been de-trended; thus, an upward movement in either series reflects an acceleration in supply or relative wages and conversely a downward movement reflects a deceleration in supply or relative wages. Notice that when the relative supply (green) measure decelerates (trends down), the relative wage (blue) measure accelerates (trends up). The clear and robust inverse relationship between these two quantities—the relative supply

FIGURE 9

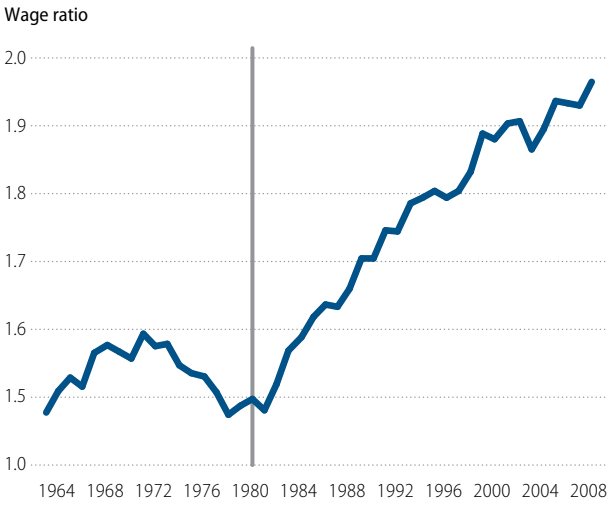
College degree vs. high school diploma log relative supply, 1963–2008



Source: March CPS data for earnings years 1963-2008. Labor supply is calculated using all persons ages 16-64 who reported having worked at least one week in the earnings years, excluding those in the military. The data are sorted into sex-education-experience groups of two sexes (male, female), five education groups (high school dropout, high school graduate, some college, college graduate, and greater than college) and 49 experience groups (0-48 years of potential experience). Number of years of potential experience is calculated by subtracting the six (the age at which one begins school) and the number of years of schooling from the age of the individual. This number is adjusted to the assumption that an individual cannot begin work before age 16. If this calculation is less than zero, the years of experience are set to equal zero. The labor supply for college and high school groups, by experience level, is calculated using efficiency units. Efficiency units are the mean labor supply for broad college (including college graduates and greater than college) and high school (including high school dropouts and high school graduate) categories, weighted by fixed relative average wage weights for each cell. The labor supply of the "some college" category is divided equally between the broad college and high school categories. The fixed set of weights for 1963-2008 are constructed using the average wage in each of the 490 cells (two sexes, five education groups, 49 experience groups) over this time period, relative to the reference wage of a male high school graduate with 10 years of experience.

FIGURE 10

College degree vs. high school diploma weekly wage ratio, 1963–2008



Source: March CPS data for earnings years 1963-2008. Log weekly wages for full-time, full-year workers are regressed in each year on four education dummies (high school dropout, some college, college graduate, greater than college), a quartic in experience, interactions of the education dummies and experience quartic, and two race categories (black, nonwhite other). The composition-adjusted mean log wage is the predicted log wage evaluated for whites at the relevant experience level (5, 15, 25, 35, 45 years) and relevant education level (high school dropout, high school graduate, some college, college graduate, greater than college). The mean log wage for college and high school is the weighted average of the relevant composition adjusted cells using a fixed set of weights equal to the average employment share of each group. The exponentiated ratio of mean log wages for college and high school graduates for each year is plotted.

See Data Appendix for more details on treatment of March CPS data.

and relative wages of college versus high school graduates—demonstrates the key role played by the decelerating supply of college workers in driving the rising college premium.

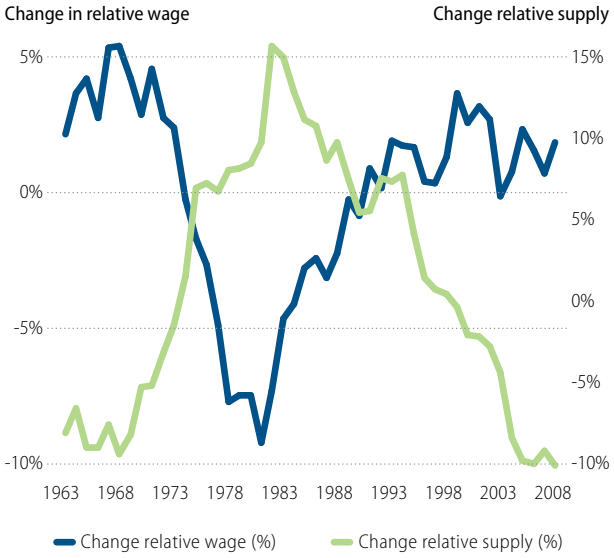
This explanation for the college wage gap may appear almost too simple. After all, we are just comparing two time series, one of relative wages, another of relative supplies. But a host of rigorous studies confirm the remarkable explanatory power of this simple supply-demand framework for explaining trends in the college-versus-high-school earnings gap over the course of nine decades of U.S. history, as well as across other industrialized economies (most notably, the United Kingdom and Canada), and among age and education groups within countries.[47]

Yet, if this framework is to be taken seriously, two questions need particular attention. First, why does a mere *deceleration* in the relative supply of college-educated workers lead to a rise in college wages? After all, there are still relatively more college graduates than there used to be; it is only that their rate of increase has slowed. The answer to this question—explored in rich detail by economists Claudia Goldin and Lawrence Katz in their 2008 book *The Race between Education and Technology*—is that the relative demand for college-educated labor has increased for decades, at least since the end of the *first* World War.[48]

The secularly rising demand for literate, numerate, and analytically capable workers stems from the changing job requirements of a rapidly technologically advancing economy. In each successive decade, the United States and other industrialized economies became increasingly reliant on scientific, engineering, and managerial expertise, as well as on vast amounts of capital, to produce goods and services. These technological forces increased demand for highly educated workers more

FIGURE 11

Detrended changes in college degree vs. high school diploma relative supply and relative wages



Source: March CPS data for earnings years 1963-2008. See notes to Figure 1 and Figure 9. The detrended supply and wage series are the residuals from separate OLS regressions of the relative supply and relative wage measures on a constant and a linear time trend.

or less continuously.[49] Thus, when steadily rising demand for college workers confronted decelerating supply in the early 1980s, an inevitable economic result was rising relative earnings of college workers.

But this explanation raises a second puzzle. Why did the supply of college-educated workers decelerate in the early 1980s? And why has it not rebounded in light of the rising returns from a college degree? Four factors are particularly relevant, as detailed by David Card of the University of California Berkeley and Thomas Lemieux of the University of British Columbia.[50] These authors' first observation is that the Vietnam War artificially boosted college attendance during the 1970s. The reason is that for most of the war, males enrolled in postsecondary schooling were permitted to defer military service. When the Vietnam War ended in the early 1970s, college enrollment rates dropped sharply, particularly among males, leading to a decline in college completions half a decade later. This is evident in the slowdown in college supply in 1974 (a year after the war's end) depicted in Figure 9.

A second important factor identified by Card and Lemieux is that the college wage premium fell by more than 10 percentage points during the 1970s due to the rapid influx of college-educated workers into the labor force, as show in Figure 10. This downturn in relative college earnings probably discouraged high school graduates from enrolling in college. Indeed, economist Richard Freeman famously argued in his 1976 book, *The Overeducated American*, that the supply of college-educated workers in the United States had so far outstripped demand that the net social return of sending more high school graduates to college was negative.[51]

A third partial explanation for this development is that the cohorts entering the labor market after 1982 were substantially smaller than their immediate predecessors, who in turn were the youngest Baby Boomers. Accordingly, even if these new cohorts entering the workplace brought comparatively high levels of education to the labor market, their entry would not have raised the college share as rapidly as preceding cohorts simply due to their relatively smaller numbers.[52]

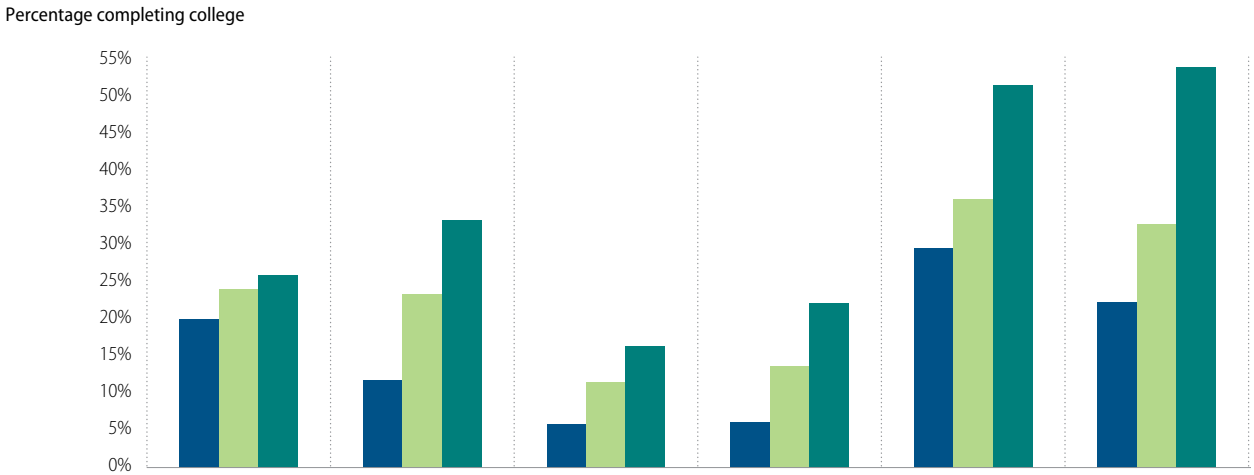
Yet the most important cause—and a deeper mystery—is that while females have robustly increased their rate of college completion since the 1980s, males have not, as shown in Figure 12. While the data in that figure only covers the era from 1970 to the present, the slow growth of college attainment depicted there is even more startling against a longer historical backdrop. Between 1940 and 1980, the fraction of young adults ages 25 to 34 who completed a four-year college degree at the start of each decade increased three-fold among both sexes, from 5 percent and 7 percent among males and females, respectively, in 1940 to 20 percent and 27 percent, respectively, in 1980.

After 1980, however, this trajectory shifted differentially by sex. College completion among young adult females slowed in the 1980s, but then rebounded in the subsequent two decades. For males, however, college attainment among young adults fell sharply after the end of the Vietnam War in 1974, and has taken nearly three decades to return to its mid-1970s high water mark. Looking forward, it is clear that females will be the more educated sex for many years to come.

Thus, a major proximate explanation for why the wage gap between college-educated workers and high school-educated

FIGURE 12

College completion rates of young adults, ages 25–34, by gender and race, 1970–2008



	White male	White female	Black male	Black female	Other nonwhite male	Other nonwhite female
1970	20	12	6	6	30	22
1990	24	24	12	14	36	33
2008	26	34	16	22	52	54

Source: Census Data 1970-2000 and U.S. Census American Community Survey 2008. Education rates are calculated using all person ages 25-34. College-going for 1970 and 1980 is considered the completion of four or more years of college. College-going for 1990 onward is considered the completion of a bachelor's degree or more, or, five+ years of college.

workers has expanded sharply over the past three decades is that male four-year college attainment stagnated throughout this interval. And although female four-year college attainment rose substantially, the net effect of male and female changes in college-going was a slowdown in the entry of new college graduates into the U.S. labor market.

Of course, the skill demands of the U.S. economy did not stand still over the course of these decades even as college completion rates slowed. Consequently, college graduates are increasingly scarce relative to the set of jobs seeking them.

The flattening and steepening of the payoff to education

Although the college versus high school premium is a convenient measure of the economic payoff to higher education, focusing on it alone masks three important nuances that are particularly relevant to the evolution of wages in the U.S. labor market since 1979.

The first, portrayed in Figure 13, is that a sizable share of the increase in wages for college-educated workers relative to noncollege-educated workers since 1980 is explained by rising wages for workers with postbaccalaureate degrees. Real earnings for this group increased steeply and nearly continuously from at least the early 1980s to the present. In contrast, earnings growth among those with exactly a four-year college degree was much more modest. For instance, real wages for males with exactly a four-year degree rose by only 10 percent between 1979 and 2007. This is an anemic performance compared to those males with postbaccalaureate degrees, who experienced real wage gains of 26 percent over the same period.

A second nuance is that a major proximate cause of the growing college/high school earnings gap is not steeply rising college wages but rapidly declining wages for the less educated—especially less-educated males. Real earnings of males with less than a four year-college degree fell steeply between 1979 and 2007—by 4 percent and 12 percent, respectively, for some-college and high school males, and by 16 percent for high school dropouts.

For females, the picture is qualitatively similar but the levels are decidedly more favorable. Wages for females without at least some college education were largely stagnant between 1979 and 2007, but unlike among males, they did not sharply decline. Meanwhile, real earnings of females with some college education, four-year college degrees, and postcollege education rose substantially—in all cases by more than for males of the same education categories.

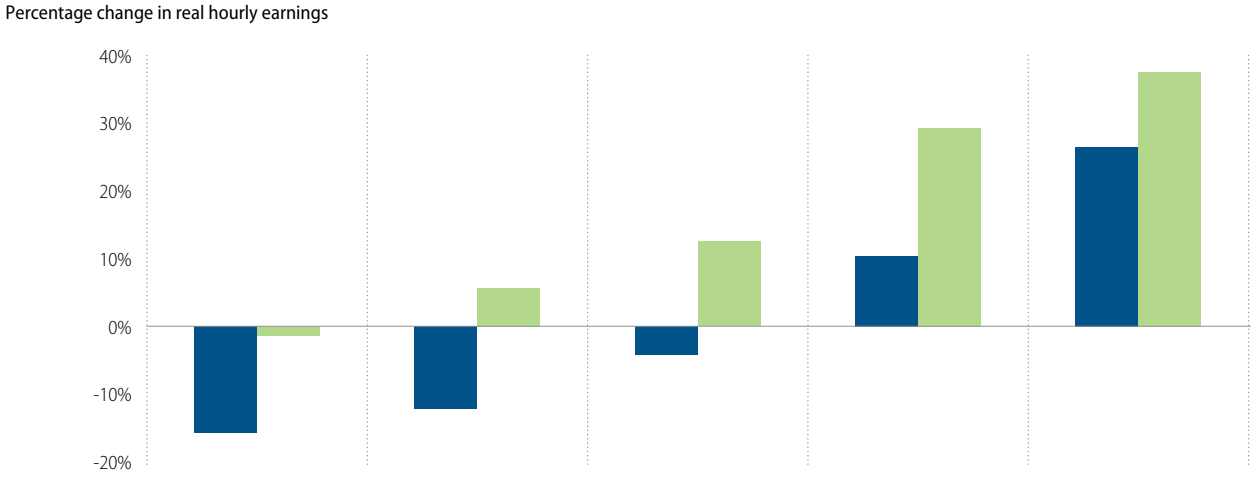
This rise in female earnings does not merely reflect a change in the labor market "price" of female labor, of course; it also stems from an increase in the skills and labor market experience of female workers who entered professional, managerial, and technical fields in large numbers over this period while reducing their rate of entry into traditionally female-dominated occupations such as teaching and nursing.[53]

A third nuance, evident in the most recent two decades, is that while the earnings gaps among workers with some college education, workers with a high school degree, and workers who dropped out of high school expanded sharply in the 1980s, these gaps stabilized thereafter. Increasingly, the wages of high school dropouts, high school graduates, and those with some college education moved in parallel—as if they were three "sizes" of the same underlying bundle of skill.[54]

The net effect of these three trends—rising wages for college- and postbaccalaureate-educated workers, stagnant and falling real wages for those without a four-year college degree, and the stabilization of the wage gaps among noncollege workers—is that the wage gains for additional years of schooling have become much steeper for very high levels of schooling and somewhat flatter for low levels of schooling. This can be seen in Figure 14, which plots the median percentage

FIGURE 13

Percent changes in real hourly earnings by education, 1979–2007



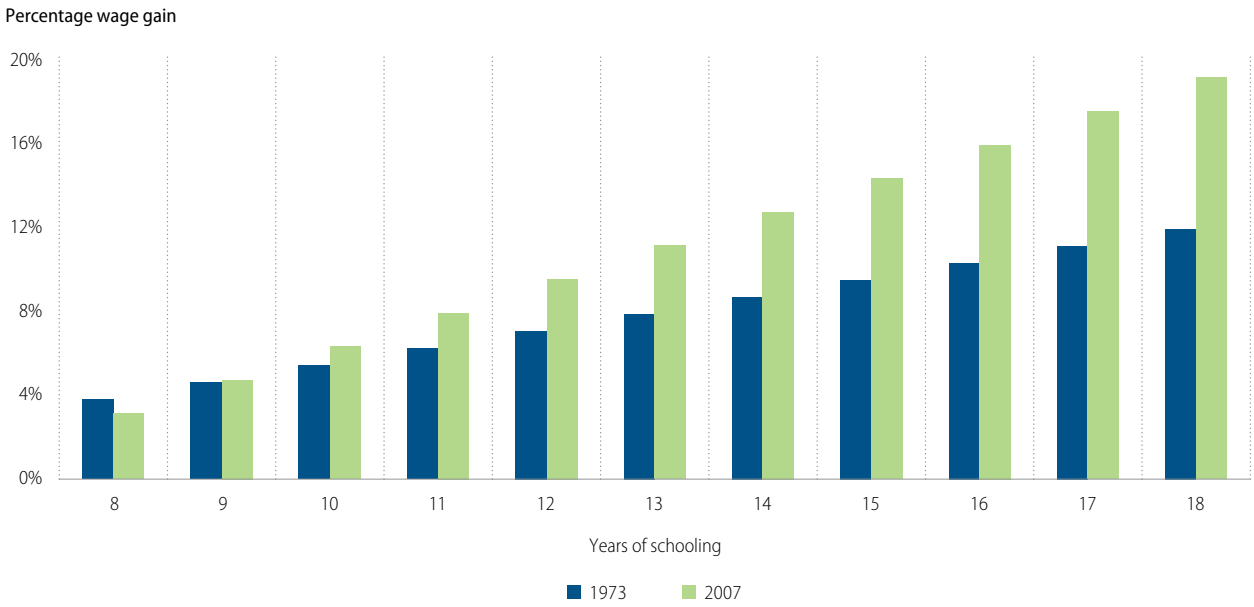
	High school dropout	High school graduate	Some college	College graduate	Postcollege education
Males	-0.16	-0.12	-0.04	0.10	0.26
Females	-0.01	-0.06	-0.12	0.29	0.37

Source: May/ORG CPS data for earnings years 1973-2009. The data are sorted into sex-race-age-education groups of two sexes (male/female), three race categories (white, black, nonwhite other), four age groups (16-24, 25-39, 40-54, 55-64), and five education groups (high school dropout, high school graduate, some college, college graduate, and greater than college). The mean log wage for each gender-education group presented in the figure is the weighted average of the relevant cells using a fixed set of weights equal to the average employment share of each group. The percent change is calculated using exponentiated mean log wages for 1979 and 2007.

See Data Appendix for more details on treatment of May/ORG CPS data.

FIGURE 14

Median hourly wage gain by years of schooling, 1973 and 2007



Source: May/ORG CPS data for earnings years 1973-2009. For each year, a quantile regression of the median real log hourly wage is estimated. Log hourly wages for all workers, excluding the self-employed and those employed by the military, are regressed on a quadratic in education (eight categories), a quartic in experience, a female dummy, and interactions of the female dummy and the quartic in experience. Predicted real log hourly wages from the median quantile regression are computed in 1973 and 2007 for each of the years of schooling presented. See Data Appendix for more details on treatment of May/ORG CPS data.

increase in hourly wages associated with each additional year of schooling in 1973 and in 2007.[55]

In 1973, the wage return for a year of college education was somewhat larger than for a year of postsecondary education, but the difference was relatively modest. The last year of high school increased earning power by approximately 7 percent while the first year of college increased it by about 10 percent. Fast forward to the present and the curvature of the schooling-to-earnings relationship becomes dramatically more pronounced. In 2007, the data imply that the last year of high school raises earnings by approximately 9.5 percent while the completion of a four-year college degree raises earnings by 16 percent![56]

Thus, large payoffs from schooling are increasingly associated with the attainment of four-year and postcollege degrees. Intermediate years of college study below a four-year degree do not appear to generate proportionate gains in earnings. The upshot: Workers with less than a college education cluster relatively closer together in the earnings distribution while the most educated groups pull away.

These patterns of wage growth by gender and education mirror the patterns of occupational change depicted in Figure 4 on page 10. As shown in Figure 13, wage growth for males has been sluggish or negative since 1980 for all but the most highly educated workers, those with at least a four-year college degree. This pattern also is reflected in the downward occupational movement of noncollege males. [57]

Conversely, real wage growth for females has been modestly to strongly positive for all education groups except high school dropouts. Paralleling these wage trends, female occupational composition has shifted favorably; as middle-skill occupations have contracted, females have found employment both in low-skill services and high-skill professional, managerial, and technical occupations.

Even the increased "clustering together" of noncollege workers is plausibly a consequence of occupational polarization. If there are fewer middle-skill jobs for middle-educated workers—those with a high school degree or some college—this makes it likely that middle- and low-education workers increasingly compete for similar opportunities in comparatively low-skill, low-wage services. Indeed, a recent paper by economist Christopher Smith of the Federal Reserve Board of Governors documents increased competition among adults and teenagers for low-skill service jobs.[58]

In summary, the occupational polarization documented above finds a clear counterpart in the marked divergence in real earnings among gender and education groups that have been more or less adversely affected by the polarization of job opportunities. As middle-skill blue- and white-collar jobs have declined, demographic groups that have maintained their occupational stature or moved upward in the occupational distribution have seen real wage growth. These groups include males with at least a four-year college degree and females with at least some college education, and to a lesser degree females with a high school diploma. Conversely, groups that have moved downward in the occupational skill distribution as middle-wage employment opportunities have declined have seen their wages stagnate or fall. Downward occupational mobility and concomitant declines in earnings have been most pronounced for males with only a high school degree, and for high school dropouts of both sexes.

Conclusions

Although the U.S. labor market will almost surely rebound from the Great Recession, this paper presents a somewhat disheartening picture of its longer-term evolution. Rising demand for highly educated workers, combined with lagging supply, is contributing to higher levels of earnings inequality. Demand for middle-skill jobs is declining, and consequently, workers that do not obtain postsecondary education face a contracting set of job opportunities.

Perhaps most alarmingly, males as a group have adapted comparatively poorly to the changing labor market. Male educational attainment has slowed and male labor force participation has secularly declined. For males without a four-year college degree, wages have stagnated or fallen over three decades. And as these males have moved out of middle-skill blue-collar jobs, they have generally moved downward in the occupational skill and earnings distribution.

The obvious question, as Scrooge asks the Ghost of Christmas Yet to Come is: "[A]nswer me one question. Are these the shadows of the things that Will be, or are they shadows of things that May be, only?" Is the labor market history of the last three decades inevitably our destiny—or is it just that it could end up being our destiny if we do not implement forward-looking policy responses?

While this paper is intended as a spur to policy discussion rather than a source of policy recommendations, I will note a few policy responses that seem especially worthy of discussion.

First, encouraging more young adults to obtain higher education would have multiple benefits. Many jobs are being created that demand college-educated workers, so this will boost incomes. Additionally, an increased supply of college graduates should eventually help to drive down the college wage premium and limit the rise in inequality.

Second, the United States should foster improvements in K-12 education so that more people will be prepared to go on to higher education. Indeed, one potential explanation for the lagging college attainment of males is that K-12 education is not adequately preparing enough men to see that as a realistic option.

Third, educators and policymakeres should consider training programs to boost skill levels and earnings opportunities in historically low-skilled service jobs—and more broadly, to offer programs for supporting continual learning, retraining, and mobility for all workers.

Finally, another potential policy response is to consider R&D and infrastructure investments that will have broadly distributed benefits across the economy. Examples might include expanding job opportunities in energy, the environment, and health care. The return of the classic manufacturing job as a path to a middle-class life is unlikely. But it may be that various service jobs grow into attractive job opportunities, with the appropriate complementary investments in training, technology, and physical capital. Perhaps these could be the shadows of what is yet to come.

Data appendix

May/Outgoing Rotation Groups Current Population Survey

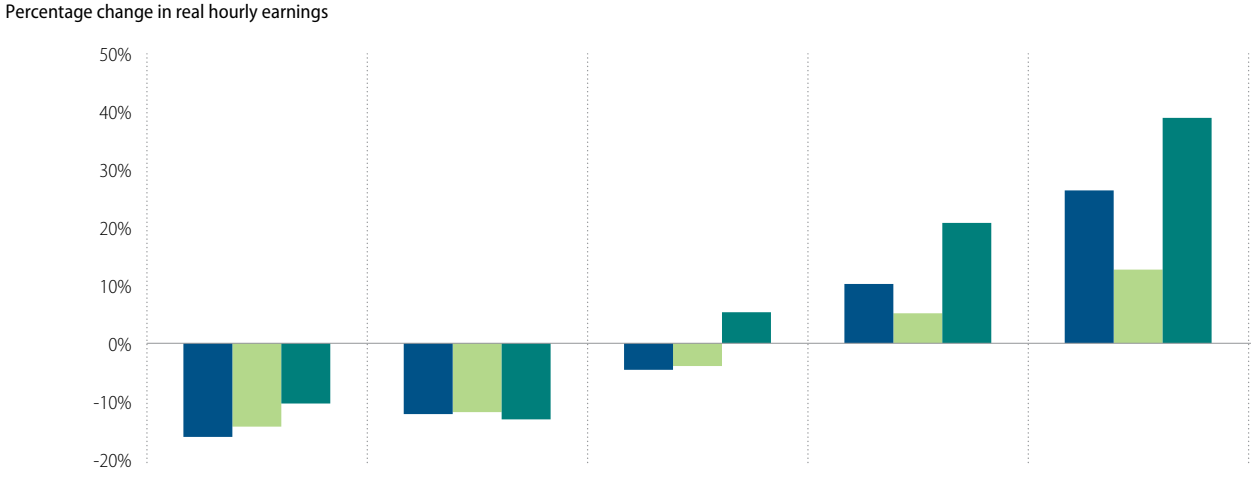
Wages are weighted by CPS sample weights. Hourly wages are equal to the logarithm of reported hourly earnings for those paid by the hour and the logarithm of usual weekly earnings divided by hours worked last week for nonhourly workers. Top-coded earnings observations are multiplied by 1.5. Hourly earners of below $1.675/hour in 1982 dollars ($3.41/hour in 2008 dollars) are dropped, as are hourly wages exceeding 1/35th the top-coded value of weekly earnings. All earnings are deflated by the chain-weighted (implicit) price deflator for personal consumption expenditures, or PCE. Allocated earnings observations are excluded in all years, except where allocation flags are unavailable (January 1994 to August 1995).

March Current Population Survey

Wages are calculated using March CPS data for earnings years 1963–2008, for full-time, full-year workers ages 16-64, excluding those who are in the military or self-employed. Full-time, full-year workers are those who usually worked 35 or more hours per week and worked 40 or more weeks in the previous year. Weekly earnings are calculated as the logarithm of annual earnings divided by weeks worked. Calculations are weighted by CPS sampling weights and are deflated using the personal consumption expenditure (PCE) deflator. Earnings of below $67/week in 1982 dollars ($136/week in 2008 dollars) are dropped. Allocated earnings observations are excluded in earnings years 1967 forward using either family earnings allocation flags (1967–1974) or individual earnings allocation flags (1975 earnings year forward).

APPENDIX FIGURE 1A

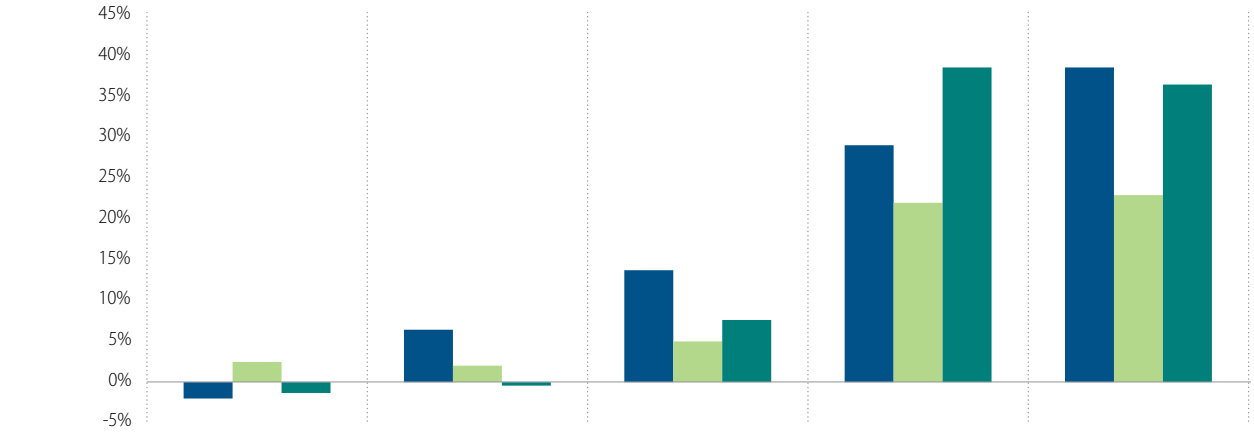
Percent changes in real hourly earnings by education and race, 1979–2007, males



	High school dropout	High school graduate	Some college	College graduate	Postcollege education
White	-0.16	-0.12	-0.05	0.10	0.26
Black	-0.14	-0.12	-0.04	0.05	0.13
Nonwhite other	-0.10	-0.13	0.05	0.21	0.38

APPENDIX FIGURE 1B

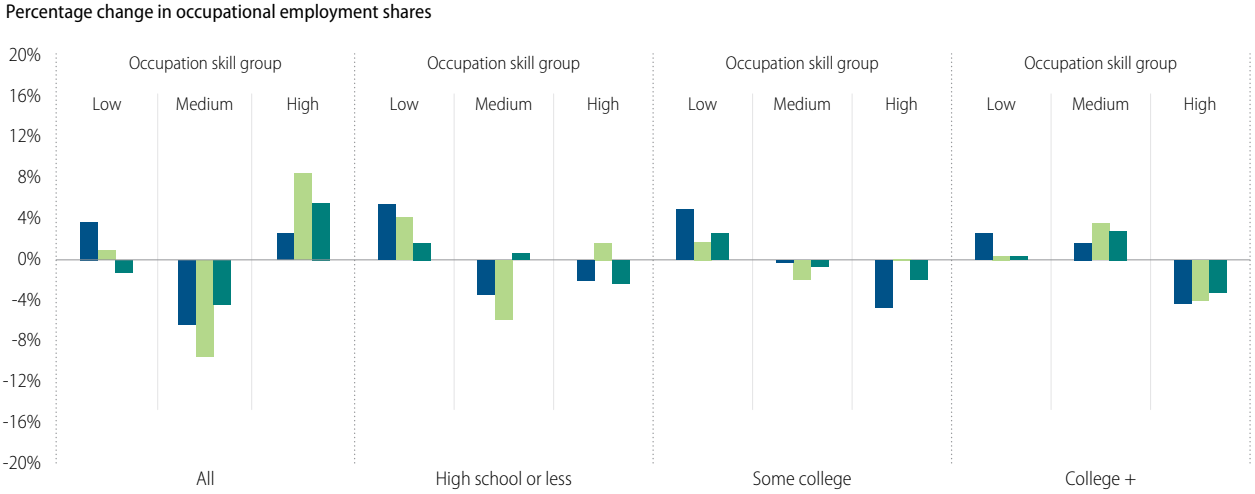
Percent changes in real hourly earnings by education and race, 1979–2007, females



	High school dropout	High school graduate	Some college	College graduate	Postcollege education
White	-0.02	0.06	0.14	0.29	0.39
Black	0.02	0.02	0.05	0.22	0.23
Nonwhite other	-0.01	0.00	0.08	0.39	0.37

APPENDIX FIGURE 2A

Changes in occupational employment shares by education and race, 1979–2007, males

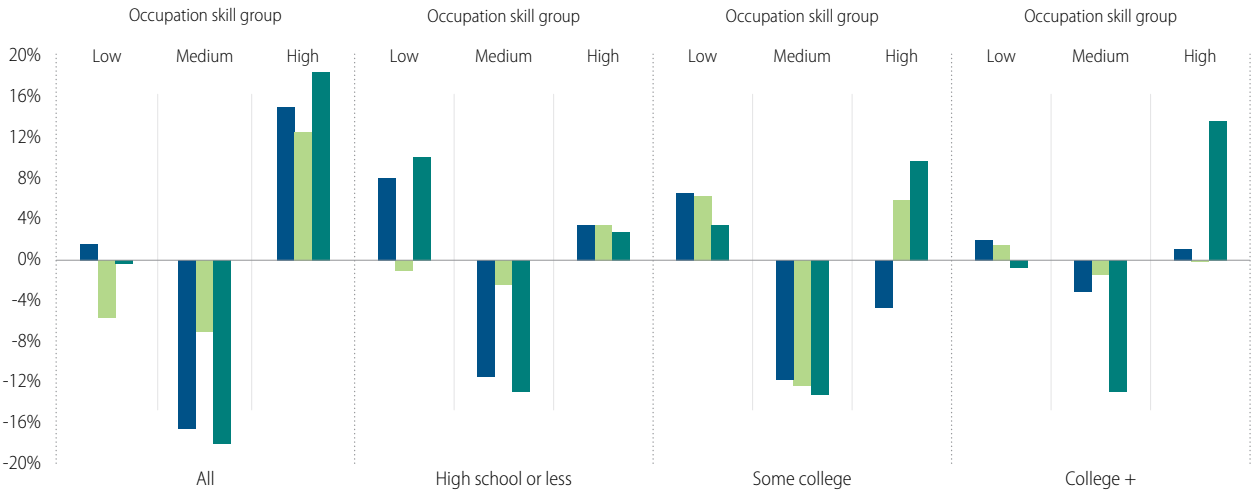


Definitions of skill groups

High skill: Managerial, professional, and technical occupations
Medium skill: Sales, office/admin, production, and operators
Low skill: Protective service, food prep, janitorial/cleaning, personal care/services

APPENDIX FIGURE 2B

Changes in occupational employment shares by education and race, 1979–2007, females



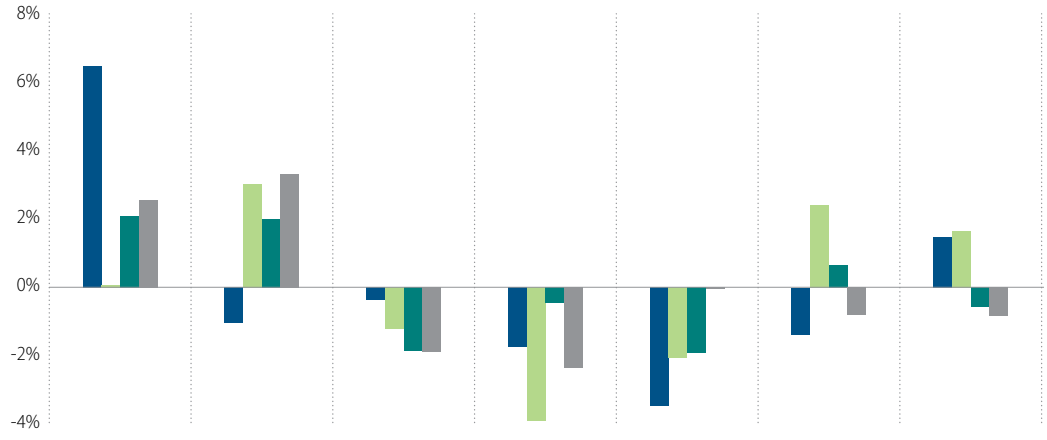
Definitions of skill groups

High skill: Managerial, professional, and technical occupations
Medium skill: Sales, office/admin, production, and operators
Low skill: Protective service, food prep, janitorial/cleaning, personal care/services

APPENDIX FIGURE 3A

Change in occupation share by country, 1992–2008, males

Percentage change in occupation share

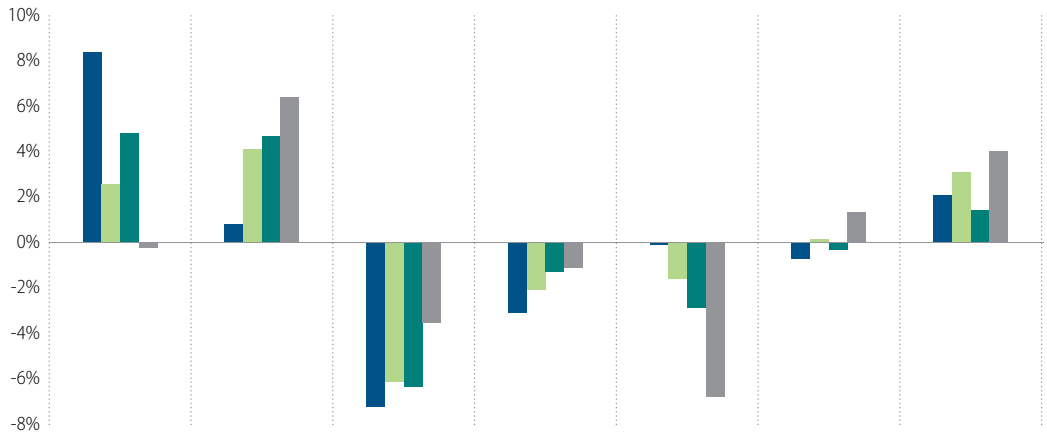


	Officials, managers, professionals	Technicians and tech professionals	Clerks	Craft and trades	Operators and assemblers	Elementary occupations	Service shop and market sales
U.S.	6.50	-1.06	-0.36	-1.72	-3.47	-1.35	1.47
France, Germany, U.K.	0.07	3.04	-1.20	-3.93	-2.06	2.42	1.64
Denmark, Ireland, Netherlands	2.10	2.01	-1.83	-0.44	-1.91	0.65	-0.57
Spain, Italy, Portugal, Greece	2.58	3.32	-1.88	-2.36	-0.03	-0.79	-0.83

APPENDIX FIGURE 3B

Change in occupation share by country, 1992–2008, females

Percentage change in occupation share



	Officials, managers, professionals	Technicians and tech professionals	Clerks	Craft and trades	Operators and assemblers	Elementary occupations	Service shop and market sales
U.S.	8.30	0.78	-7.17	-3.09	-0.13	-0.73	2.04
France, Germany, U.K.	2.52	4.05	-6.07	-2.07	-1.60	0.13	3.04
Denmark, Ireland, Netherlands	4.74	4.62	-6.31	-1.32	-2.81	-0.33	1.40
Spain, Italy, Portugal, Greece	-0.23	6.31	-3.53	-1.10	-6.75	1.33	3.96

TABLE 1

Regression results: Relationship between the change in employment-to-population ratios and changes in real log hourly wages 1979–2009

	1979-1989	1989-1999	1999-2009	1999-2007	2007-2009	1979-2009
Change in log hourly wage	0.33***	0.17***	0.70***	0.29***	0.41***	0.58***
t-statistic	6.31	3.4	6.36	3.31	3.74	12.69
Constant	0.04***	-0.01**	-.09***	-0.03***	-0.04***	-.066***
t-statistic	7.25	-2.36	-15.15	-7.54	-15.19	-9.14
Observations	120	118	118	118	120	120
R-squared	0.25	0.09	0.26	0.09	0.11	0.58

Source: May/ORG Current Population Survey. The population sample includes all persons ages 16-64, excluding those in the military. The employment sample includes all persons ages 16-64, who reported having worked last year, excluding those employed by the military. Wages are calculated using all hourly workers excluding agricultural occupations, military occupations, and the self-employed, for earnings years 1973-2009. The data are sorted into sex-race-age-education groups of two sexes (male/female), three race categories (white, black, non-white other), four age groups (16-24, 25-39, 40-54, 55-64), and five education groups (high school dropout, high school graduate, some college, college graduate, and greater than college). For each of these sex-race-age-education cells, I calculate the employment to population rate and the mean log hourly wage, weighted by CPS sample weights. The change in the employment to population rate over the respective time period is then regressed on the change in the mean log hourly wage over the same time period for each demographic breakdown presented above. See the Data Appendix for more detailed information on the treatment of May/ORG wages.

TABLE 2

Regression results: Relationship between employment-population ratios and wages by demographic group, 1979–2009

	Gender		Race			Age		Education	
	Male	Female	White	Black	Nonwhite other	16–39	40–64	High school graduate and below	College graduate and above
1979-2009									
Change in log hourly wage	0.36***	0.47***	0.61***	0.55***	0.27***	0.57***	0.58***	0.85***	0.40***
t-statistic	5.75	6.60	8.26	4.42	3.53	7.74	9.45	9.01	7.12
Constant	-0.11***	-.02*	-.06***	-.10***	-.08***	-.07***	-.06***	-.05***	-.04***
t-statistic	-12.57	-1.72	-5.02	-7.26	-5.68	-6.65	-5.69	-4.58	-4.24
Observations	60	60	40	40	40	60	60	48	72
R-squared	0.36	0.43	0.64	0.34	0.25	0.51	0.61	0.64	0.42

Source: May/ORG Current Population Survey. See note to Table 1 and Data Appendix.

References

Acemoglu, Daron. 1999. "Changes in Unemployment and Wage Inequality: An Alternative Theory and Some Evidence." *American Economic Review*, 89, 1259-1278.

Acemoglu, Daron and David H. Autor. 2010. "Technology, Skills and Wages." draft chapter in Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics, Vol. 4*, Holland: Elsevier.

Autor, David and David Dorn. 2009a. "This Job is Getting Old: Measuring Changes in Job Opportunities using Occupational Age Structure." *American Economic Review Papers and Proceedings*, 99(2).

Autor, David and David Dorn. 2009b. "Inequality and Specialization: The Growth of Low-Skilled Service Employment in the United States." NBER WP No. 15150.

Autor, David H., Christopher L. Smith and Alan Manning. 2009. "The Minimum Wage's Role in the Evolution of US Wage Inequality over three decades: A Modest Reassessment." MIT Mimeograph, April.

Autor, David H., Frank Levy and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics*, 116(4).

Autor, David H., Lawrence F. Katz and Melissa S. Kearney. 2005. "Rising Wage Inequality: The Role of Composition and Prices." NBER Working Paper No. 11628, September.

Autor, David H., Lawrence F. Katz and Melissa Schettini Kearney. 2008. "Trends in U.S. Wage Inequality: Re-Assessing the Revisionists." *Review of Economics and Statistics*, 90(2), 300-323.

Bishop, John H. and Shani Carter, 1991, "How Accurate are Recent BLS Occupational Projections?" *Monthly Labor Review*, Vol. 114, No. 10, October, 37–43.

Black, Sandra E. and Alexandra Spitz-Oener. 2010. "Explaining Women's Success: Technological Change and the Skill Content of Women's Work." *The Review of Economics and Statistics*, 92(1), 187-194.

Baumol, William J. 1967. "Macroeconomics of Unbalanced Growth: Anatomy of an Urban Crisis."*American Economic Review*, 57(3), June, 415-426

Blau, Francine and Lawrence Kahn (1997), "Swimming Upstream: Trends in the Gender Wage Differential in the 1980s," *Journal of Labor Economics* 15 (January, Part 1), 1-42.

Blinder, Alan. 2007. "How Many U.S. Jobs Might be Offshorable?" Princeton University Center for Economic Policy Studies Working Paper No. 142, March.

Blinder, Alan and Alan B. Krueger. 2008. "Measuring Offshorability: A Survey Approach." Princeton University Working Paper, October.

Card, David and Thomas Lemieux. 2001a. "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis." *Quarterly Journal of Economics*, 116(2), 705 – 746.

Card, David and Thomas Lemieux. 2001b. "Dropout and Enrollment Trends in the Postwar Period: What Went Wrong in the 1970s?" in Risky Behavior among Youths: An Economic Analysis. Jonathan Gruber (Editor), Chicago: University of Chicago Press, chapter 9.

Card, David and Thomas Lemieux. 2001c. "Going to College to Avoid the Draft: The Unintended Legacy of the Vietnam War." *American Economic Review Papers and Proceedings*, 91(2), 97-102.

Ellwood, David. 2002. "The Sputtering Labor Force of the Twenty-First Century: Can Social Policy Help?" in Alan B. Krueger and Robert M. Solow (eds.) *The Roaring Nineties: Can Full Employment be Sustained?* New York: Russell Sage Foundation and Century Foundation Press.

Firpo, Sergio, Nicole Fortin and Thomas Lemieux. 2009a. "Occupational Tasks and Changes in the Wage Structure." UBC Working Paper, September.

Firpo, Sergio, Nicole Fortin and Thomas Lemieux. 2009b. "Unconditional Quantile Regressions." *Econometrica*, 77(3), 953-973.

Freeman, Richard B. 1976. *The Overeducated American*, New York: Academic Press.

Freeman, Richard B. 2006, "Is a Great Labor Shortage Coming?

Replacement Demand in the Global Economy," NBER Working Paper No. 12541, September.

Goldin, Claudia and Lawrence Katz. 2008. *The Race between Education and Technology*. Cambridge: Harvard University Press.

Goos, Maarten and Alan Manning. 2007. "Lousy and Lovely Jobs: The Rising Polarization of Work in Britain." *Review of Economics and Statistics* 89(1), 118-133.

Goos, Maarten, Alan Manning and Anna Salomons. 2009a. "The Polarization of the European Labor Market." *American Economic Review Papers and Proceedings*, 99(2).

Goos, Maarten, Alan Manning and Anna Salomons. 2009b. "Recent Changes in the European Employment Structure: The Roles of Technological Change, Globalization and Institutions." Katholieke Universiteit Leuven mimeo (see D. Autor for PDF).

Hamermesh, Daniel. 1999. "Changing Inequality for Workplace Amenities," *Quarterly Journal of Economics*, 114, 1085 – 1123.

Holzer, Harry J. and Robert I. Lerman. 2009. "The Future of Middle-Skill Jobs." Brookings Insitution, Center on Children and Families Brief #41, February.

Katz, Lawrence F. and Kevin M. Murphy. 1992. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics*, 107, 35-78.

Katz, Lawrence F. and David H. Autor. 1999. "Changes in the Wage Structure and Earnings Inequality." in Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics, Vol. 3A*, Holland: Elsevier.

Krugman, Paul. "Technology, trade and factor prices." *Journal of International Economics*, 50(1), 2000, 51 – 71.

Krugman, Paul. 2008. "Trade and Wages, Reconsidered." Brookings Papers on Economic Activity, Volume 1.

Lee, David. 1999. "Wage Inequality in the U.S. During the 1980's: Rising Dispersion or Falling Minimum Wage." *Quarterly Journal of Economics*, 114(4), 1999, 941 – 1024.

Lemieux, Thomas. 2006a. "Increased Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?" *American Economic Review*, 95(2), 461-498.

Lemieux, Thomas. 2006b. "Post-Secondary Education and Increasing Wage Inequality." NBER Working Paper No. 12077, March.

Levy, Frank and Richard J. Murnane. 2005. *The New Division of Labor*. New Jersey: Princeton University Press.

Mulligan, Casey and Yona Rubinstein.2008. "Selection, Investment, and Women's Relative Wages over Time" *Quarterly Journal of Economics*, 123(3), 1061-1110.

Nordhaus, William D. 2007. "Two Centuries of Productivity Growth in Computing." *Journal of Economic History*, 67(1), 128-159.

Pierce, Brooks. 2001. "Compensation Inequality." *Quarterly Journal of Economics*, 116(3), 2001, 1493-1525.

Pierce, Brooks. 2008. "Recent Trends in Compensation Inequality." Bureau of Labor Statistics Working Paper, July.

Piketty, Thomas, "Les Créations d'EmpLoi en France et aux Etats-Unis: 'Services de Proximité Contre 'Petits Boulots,'" *Notes de la Fondation Saint-Simon*, 1997.

Smith, Christopher L. 2008. "Implications of Adult Labor Market Polarization for Youth Employment Opportunities." MIT working paper, July 2008.

Endnotes

U.S. Bureau of Labor Statistics. 2010. *Occupational Outlook Handbook*, 2006–2007 edition, available at www.bls.gov/oco.

1 Statistics refer to the U.S. civilian labor force ages 16 and above and are seasonally adjusted. Source: U.S. Bureau of Labor Statistics (www.bls.gov, accessed on 4/11/2010).

2 A recent study by Couch and Placzek confirms these results but puts the longer-term earnings losses at 12 to 15 percent. Kenneth A. Couch and Dana W. Placzek, "Earning Losses of Displaced Workers Revisited," *American Economic Review* 100 (1) (2010): 572-589.

3 Daniel Sullivan and Till von Wachter, "Job Displacement and Mortality: An Analysis using Administrative Data," *Quarterly Journal of Economics* 124 (3) (2009): 1265-1306.

4 Daron Acemoglu and David H. Autor, "Technology, Skills and Wages." In Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics*, Vol. 4, (North Holland: Elsevier, 2010) (Forthcoming).

5 Although economists would typically view the wages paid to a job as the best summary measure of the job's skill requirements, lay readers may take some assurance that wages as a skill measure are highly correlated with logical alternatives, such as education and experience. Moreover, the ranking of occupational skills based on either wage or educational levels is quite stable over time. Thus, the conclusions here are not sensitive to the skill measure (wages, education-experience) nor the choice of base year for skill ranking (here, 1980).

6 The reason for using a different data source and time period for this figure from the prior figure is that the Census data have large enough sample sizes to be useful for the occupation level exercise, but they are less than ideal for measuring hourly wages. I use the May/ORG data for hourly wages, which are a superior source.

7 This figure is based on Maarten Goos, Alan Manning, and Anna Salomons, "Job Polarization in Europe," *American Economic Review* 99 (2) (2009): 58-63. The choice of time period reflects the availability of consistent data (unavailable prior to 1993). The ranking of occupations by skill level is invariant across countries, as necessitated by data limitations. The authors report, however, that the ranking of occupations by wage level is highly correlated across EU countries.

8 David Autor, Frank Levy, and Richard J. Murnane, "The Skill Content of Recent Technological Change: An Emperical Exploration," *The Quarterly Economic Journal* 118 (4) (2003): 1279-1333.

9 Adjusting for inflation using the Personal Consumption Expenditure deflator, the real minimum wage in constant 2008 dollars was $7.50 in 1979, $5.29 in 1989, $6.41 in 1999, and $5.47 in 2006, and $6.53 in 2009. Thus, the real federal minimum wage declined dramatically between 1979 and 1989. It fluctuated modestly in real terms until 2006, when it rose sharply over three years.

10 Daniel Hamermesh, "Changing Inequality for Workplace Amenities," *Quarterly Journal of Economics* 114 (4) (1999): 1085-1123. Brooks Pierce, "Compensation Inequality," *Quarterly Journal of Economics* 116 (3) (2001): 1493-1525. Brooks Pierce,"Recent Trends in Compensation Inequality." Working Paper (Bureau of Labor Statistics, 2008).

11 Pierce, "Compensation Inequality," Pierce, "Recent Trends in Compensation Inequality."

12 Notably, the college completion rate for this group was higher in 1990 (29 percent) than in 2008 or 2008 (24 percent and 27 percent).

13 Unfortunately, the Current Population Survey data used for this analysis do not report Hispanic ethnicity until the year 1995. For consistency over time, I am therefore limited to distinguishing among white, black, and "other" race groups. Hispanics are likely to be found in all three categories, though probably least commonly among blacks.

14 Acemoglu (1999) was one of the first researchers to call attention to this phenomenon in a paper studying the role of a rising supply of educated workers on job creation by skill level. Autor, Levy and Murnane (2003) offer a theoretical model of task-biased technical change which predicts a hollowing out of the occupational distribution due to automation of repetitive cognitive and production tasks. Goos and Manning (2007), Autor, Katz and Kearney (2008), and Goos Manning and Salomons (2009a and 2009b) document the 'polarization' of employment in the United States, the United Kingdom, and across the OECD. Autor and Dorn (2009a and 2009b) document the critical role played by service occupations in the growth of low-skill, low-wage employment by region, education and age group, and explore the determinants of this phenomenon at the level of local labor markets. See References, page 35, for citations.

15 I exclude agricultural workers because employment and wage data in this occupation are unreliable due to the substantial share of undocumented workers. Agricultural occupations account for 2.5 percent of employment in 1979 in the CPS data and 1.4 percent in 2009.

16 It is critical to distinguish *service occupations*, a relatively narrow group of low-education occupations that accounted for 17.7 percent of employment in 2009, from the *service sector*, a very broad category of industries ranging from health care to communications to real estate and comprising 85.3 percent of nonfarm employment in 2009 according to the U.S. Bureau of Labor Statistics, the largest categories of service occupations are food preparation and food service, health service support (a category that excludes registered nurses and other skilled medical personnel), and buildings and grounds cleaning and maintenance. See "U.S. Bureau of Labor Statistics, Current Employment Statistics," available at http://www.bls.gov/ces/ (accessed March 2010).

17 An exception to this statement is protective service occupations, which include police officers and other public safety officials. These public sector workers typically have some postsecondary education and earn commensurately higher wages. Private security workers such as security guards and attendants, by contrast, have low education and earnings.

18 Figure 4 excludes the 1970s to reduce clutter.

19 These correlations are weighted by occupational mean employment shares over 1979 through 2009. Interestingly, the correlation between occupational employment growth rates in 1973-1979 and 1979-1989 is also quite high (0.65). One important difference between the 1970s and the decades that followed, however, is that service occupations were declining in the 1970s as a share of employment while clerical and administrative occupations were growing. These patterns sharply reversed thereafter, as shown in Table 2.

20 A recent study by Holzer and Lerman (2009) observes that middle-skill jobs are disproportionately occupied by workers who are relatively close to retirement. The study concludes that this fact augurs auspicious news about coming job opportunities in these occupations since pending retirements will lead to replacement hiring. A contemporaneous study by Autor and Dorn (2009a) offers a different perspective on these same facts. These authors observe that the disproportionate representation of older workers in middle-skill occupations reflects the reality that firms are *not* hiring into these jobs as incumbents exit. Indeed, it is precisely replacement hiring that typically keeps an occupation's average age from rising faster than the overall workforce. Under this interpretation, the over-representation of older workers in middle-skill occupations does not indicate that replacement hiring is imminent. Rather, it suggests that employment opportunities in these occupations are declining. Autor and Dorn (2009a) explore this conjecture rigorously by documenting that it is precisely the occupations that have grown most slowly in the last 25 years where the workforce has aged disproportionately rapidly relative to the U.S. workforce as a whole. Not by coincidence, these are largely middle-skilled, routine task-intensive occupations. See References, page 35, for citations.

21 William D. Nordhaus, "Two Centuries of Productivity Growth in Computing," *Journal of Economic History* 67 (1) (2007): 128-159.

22 An alternative to codifying a highly complex task into machine instructions is to simplify the

task by reducing the number of contingencies and discretionary steps that a machine will face. For example, industrial robots on automobile production lines can typically recognize and install windshields on one or two specific models of motor vehicle models. Unlike the workers on the same production lines, these robots would be helpless to install a windshield on a new vehicle model without receiving further programming.

23 Frank Levy and Richard J. Murnane, *The New Division of Labor* (New York: Russell Sage, 2005).

24 William Baumol, "Macroeconomics of Unbalanced Growth: Anatomy of an Urban Crisis," *American Economic Review* 57 (3) (1976): 415-426. Starting with the work of William Baumol in 1967, economists asked what determines wage growth in low-technology, labor-intensive services that tend to have slow productivity growth over time, such as haircutting, cleaning, personal care, and classroom teaching. A major conclusion of this body of work is that wage growth in these services is largely dependent on productivity growth in the rest of the economy. The reason, in effect, is that workers performing these services need to be compensated for not working in another occupation. Concretely, if wages of barbers do not roughly rise with the wages of other similarly educated workers, we would ultimately have an economy with a surplus of truck drivers and electricians but no barbers. See also David Autor and David Dorn, "This Job is Getting Old: Measuring Changes in Job Opportunities using Occupational Age Structure," *American Economic Review Papers and Proceedings* 99 (2) (2009).

25 Examples include Autor, Levy and Murnane (2003), Goos and Manning (2007), Autor and Dorn (2009a and 2009b), Goos, Manning and Salomons (2009a and 2009b), and Firpo, Fortin and Lemieux (2009). See References, page 35, for citations.

26 "U.S. Bureau of Labor Statistics, Current Employment Statistics," available at http://www.bls.gov/ces/ (accessed March 2010).

27 The BLS category of professional occupations excludes managerial occupations and so is more disaggregated than the U.S. Census category of professional and managerial occupations. Combined growth in professional and managerial jobs is projected at 6.9 million, or 15 percent.

28 John H Bishop and Shani Carter, "How Accurate are Recent BLS Occupational Projections?" *Monthly Labor Review* 114 (10) (1991): 37-43. Richard B. Freeman, "Is a Great Labor Shortage Coming? Replacement Demand in the Global Economy." Working Paper No. 12541 (National Bureau of Economic Research, 2006).

29 Alan Blinder, "How Many U.S. Jobs Might be Offshorable?" Working Paper No. 142 (Princeton University Center for Economic Policy Studies, 2007). Alan Blinder and Alan B. Krueger, "Measuring Offshorability: A Survey Approach." (Princeton University Working Paper, 2008).

30 Though the Blinder argument is clearly on point, I suspect that it does not take full account of the fact that many "abstract" tasks are not self-contained and hence are not readily unbundled. For example, most professionals work in costly, central offices along with colleagues and support staff, suggesting that the production process in which they engage benefits from productive complementarities among workers—even though the outputs of these offices are typically nothing more than information, documents, and transactions that can be transmitted from any location.

31 Paul Krugman, "Technology, Trade and Factor Prices," *Journal of International Economics* 50 (1) (2000): 51-71.

32 Paul Krugman, "Trade and Wages, Reconsidered" (Washington: Brookings Institution, 2008).

33 Frank Levy and Kyoung-Hee Yu, "Offshoring Radiology Services to India," *British Journal of Industrial Relations (Forthcoming)*. See for example the analysis of offshoring of radiological services by economists Frank Levy and Kyoung-Hee Yu (forthcoming), which concludes, "The importance of tacit knowledge leads to long training periods, a limited global supply of radiologists and heavy government regulation, all of which are obstacles to a "flat world". Computerization of low-end diagnostic radiology ultimately poses a bigger threat to the profession than offshoring."

34 "Union Membership and Coverage Database from the Current Population Survey," Data available at http://www.unionstats.com/.

35 Even this analysis is too simple on a number of fronts. Union penetration also depends on enforcement actions by the National Labor Relations Board, which is widely perceived to have weakly enforced collective bargaining rules over the last three decades. Conversely, there has been substantial growth in relative employment in non-unionized manufacturing in the U.S. For example, Toyota of America operates nine non-unionized automobile assembly plants in the U.S. South (and one in California). These developments speak directly to the competitiveness of traditional, unionized U.S. manufacturers rather than to either advancing technology or the rising productivity and quality of foreign producers.

36 Sergio Firpo, Nicole Fortin and Thomas Lemieux, "Occupational Tasks and Changes in the Wage Structure." Working Paper (University of British Columbia, 2009). Sergio Firpo, Nicole Fortin, and Thomas Lemieux, "Unconditional Quantile Regressions," *Econometrica* 77 (3) (2009): 953-973.

37 These numbers are adjusted for inflation using the U.S. Bureau of Economic Analysis' Personal Consumption Expenditure Deflator.

38 David Lee, "Wage Inequality in the U.S. During the 1980s: Rising Dispersion or Falling Minimum Wage," Quarterly Journal of Economics 114 (4) (1999): 941-1024.

39 Though even here, there are important paradoxes. Low-education female workers comprised the vast majority of minimum wage workers at the start of the 1980s. Yet, their earnings fared far better than those of low-education males throughout the 1980s, during which the minimum wage was rapidly declining.

40 "Eurostat," available at http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/. The Eurostat data are based on the harmonized European Labor Force survey, and are available for download. The 10 countries included in the series in the paper are Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and the United Kingdom. The Eurostat data include many additional EU countries, but not on a consistent basis for this full-time interval. The series presented in Figures 11a and 11b are weighted averages of occupational shares across these 10 countries, where weights are proportional to the average share of EU employment in each country over the sample period. The Eurostat data include workers ages 15-59 while the U.S. sample includes workers 16-64.

41 David Autor and David Dorn, "Inequality and Specialization: The Growth of Low-Skilled Service Employment in the United States." Working Paper 15150 (Massachusetts Institute of Technology, 2009).

42 Thomas Piketty, "Les Créations d'EmpLoi en France et aux Etats-Unis: 'Services de Proximité Contre 'Petits Boulots,'" Notes de la Fondation Saint-Simon (93) (1997): 55. The level of service occupation employment in the U.S. is considerably higher than in Europe, as was first noted by Piketty.

43 Maarten Goos, Alan Manning, and Anna Salomons, "The Polarization of the European Labor Market," *American Economic Review Papers and Proceedings* 99 (2) (2009): 58-63

44 This ranking is invariant across countries as constructed, as necessitated by data limitations. The authors also report that the ranking of occupations by wage level is highly correlated across EU countries.

45 Sophisticated readers may object that since we cannot observe the wages of the workers who are *not* working, how do we know what they would have earned had they worked? This objection is valid, but the bias it introduces in this case generally works against the findings in Table 1. If, plausibly, it is the lowest-earnings workers in a demographic cell who exit the labor force when wages decline and also the lowest-earnings workers in a cell who re-enter the labor force when wages rise, then the observed wage changes in a cell will tend to *understate* the actual gain in potential earnings that would have been observed had there not been a change in employment in that cell. These potential biases work against finding a strong relationship between changes in earnings and changes in employment. The fact that this relationship is nevertheless highly evident suggests that the underlying demand forces are substantial or that the biases are modest.

46 The figure also contains some good news: the growth of relative supply of both male and female college graduates accelerates after 2003. Unfortunately, this uptick is driven in part by declining relative employment of noncollege workers (that is, a fall in the denominator rather than a rise in the numerator) during the recent economic slowdown and subsequent recession. The nonemployed are not usually counted in supply calculations such as Figure 9 because they are typically viewed as voluntary nonparticipants—though the plausibility of that assumption clearly differs in booms and busts.

47 Lawrence F. Katz and Kevin M. Murphy, "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *Quarterly Journal of Economics* 107 (1) (1992): 35-78. Lawrence F. Katz and David H. Autor, "Changes in the Wage Structure and Earnings Inequality." In Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics, Vol. 3A*, (Holland: Elsevier, 1999). David Card and Thomas Lemieux, "Going to College to Avoid the Draft: The Unintended Legacy of the Vietnam War," *American Economic Review Papers and Proceedings* 91 (2) (2001): 97-102. David H. Autor, Lawrence F. Katz, and Melissa S. Kearney, "Rising Wage Inequality: The Role of Composition and Prices." Working Paper No. 11628 (National Bureau of Economic Research, 2005). Claudia Goldin and Lawrence Katz. *The Race between Education and Technology* (Cambridge: Harvard University Press, 2008).

48 Goldin and Katz, 2008

49 Thus, despite a four-fold increase in the share of the workforce that is college educated between 1940 and 2008, the premium to college education increased in almost every decade. Had demand for college labor instead been static, the college wage premium would have collapsed in the face of this abundance.

50 David Card and Thomas Lemieux, "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis," *Quarterly Journal of Economics* 116 (2) (2001): 705-746. David Card and Thomas Lemieux, "Dropout and Enrollment Trends in the Postwar Period: What Went Wrong in the 1970s?" In Jonathan Gruber, ed., *Risky Behavior among Youths: An Economic Analysis* (Chicago: University of Chicago Press, 2001).

51 Richard B. Freeman, *The Overeducated American*. (New York: Academic Press, 1976). It is not entirely fair to blame the rise in U.S. earnings inequality on Richard Freeman, however. His book correctly predicted that the college glut was temporary: demand would subsequently surpass supply growth, leading to a rebound in the college wage premium.

52 David Ellwood, "The Sputtering Labor Force of the Twenty-First Century: Can Social Policy Help?" In Alan B. Krueger and Robert M. Solow, eds., *The Roaring Nineties: Can Full Employment be Sustained?* (New York: Russell Sage Foundation and Century Foundation Press, 2002)

53 The dramatic rise in female relative to male wages for all but post-college educated workers over the last three decades is not fully understood. In part, it reflects rising female skill and experience levels (even within education and age categories) due to higher labor force attachment (Blau and Kahn, 1997). In addition, the occupational composition of female jobs has changed substantially, with a larger share employed in professional and managerial positions. Moreover, as discussed below, technological change has arguably raised demand for the types of activities in which females specialize (e.g., interpersonal and analytic tasks) and reduced demand for the set of tasks in which less-educated males traditionally specialize (e.g., emphasizing strength, manual dexterity, and repetitive motion). See Black and Spitz-Oener

(2010) for discussion. Some have also argued that a large part of the female relative wage increase is due to differential movement of high-skilled females into the labor force, rather than rising wages for females of given skill levels per se (Mulligan and Rubinstein, 2008). See References, page 35, for citations.

54 Although this pattern is not visible in Figure 2 since this figure does not delineate wage changes separately by decade, its consequences are evident in Figure 11, discussed below.

55 These wage gains are estimated from a median regression of real hourly earnings on years of completed schooling and its square, a quartic in potential experience, a female dummy, and a full set of interactions between the female dummy and the experience quartic. The heights of the bars in Figure 11 correspond to the fitted slope of the quadratic education term in this regression.

56 Thomas Lemieux, "Postsecondary Education and Increasing Wage Inequality," *American Economic Review* 96 (2) (2006): 195-199. This twisting of the gradient between schooling and earnings is documented by Lemieux (2006b) and further explored by Acemoglu and Autor (2010).

57 The dramatic rise in female relative to male wages for all but post-college educated workers over the last three decades is not fully understood. In part, it reflects rising female skill and experience levels (even within education and age categories) due to higher labor force attachment (Blau and Kahn, 1997). In addition, the occupational composition of female jobs has changed substantially, with a larger share employed in professional and managerial positions. Moreover, as discussed below, technological change has arguably raised demand for the types of activities in which females specialize (e.g., interpersonal and analytic tasks) and reduced demand for the set of tasks in which less-educated males traditionally specialize (e.g., emphasizing strength, manual dexterity, and repetitive motion). See Black and Spitz-Oener (2010) for discussion. Some have also argued that a large part of the female relative wage increase is due to differential movement of high-skilled females into the labor force, rather

than rising wages for females of given skill levels per se (Mulligan and Rubinstein, 2008). See References, page 35, for citations.

58 Christopher L. Smith, "Implications of Adult Labor Market Polarization for Youth Employment Opportunities." Working Paper (Massachusetts Institute of Technology, 2008).

About the author

David Autor is a professor of economics at the Massachusetts Institute of Technology, faculty research associate of the National Bureau of Economic Research and Editor in Chief of the *Journal of Economic Perspectives*. Autor received a B.A. in psychology with a minor in computer science from Tufts University in 1989 and a Ph.D. in public policy at Harvard University's Kennedy School of Government in 1999. He is also the recipient of an NSF Career award for his research on labor market intermediation, the Alfred P. Sloan Foundation Fellowship, and the Sherwin Rosen Prize in 2008 for outstanding contributions in the field of labor economics. Prior to obtaining his Ph.D., Autor spent three years directing efforts in San Francisco and South Africa to teach computer skills to economically disadvantaged children and adults. He also pursued two previous careers, one in computer programming and the other in food service.

Acknowledgements

The author thanks Melanie Wasserman for expert research assistance, Maarten Goos for generous assistance with European Union data, and Daron Acemoglu, Michael Greenstone, Lawrence Katz, Ed Paisley, Timothy Taylor, and the staff of The Hamilton Project and the Center for American Progress for valuable suggestions.

The Polarization of Job Opportunities in the U.S. Labor Market

Implications for Employment and Earnings

Summary of findings

Despite the extremely adverse U.S. employment situation in 2010, history suggests that employment will eventually return and unemployment will subside. But two key challenges facing the U.S. labor market—both evident prior to the Great Recession—will endure.

The first is that for many decades, the United States has experienced increased demand for skilled workers. From the end of World War II to the mid-1970s, rising levels of educational attainment generally kept pace with this rising demand for skill. But since the mid-1970s, the rise in U.S. education levels has not kept up with the rising demand for skilled workers, with the slowdown in educational attainment particularly severe for males.

The result is a sharp rise in the inequality of wages over the past several decades. In 1980, workers with a four-year college degree earned about 50 percent more per hour than workers with a high school diploma. In 2008, they earned 95 percent more per hour.

The second challenge—and an important factor behind the rising earnings gap between college-educated and high school-educated workers—is that the structure of job opportunities in the United States has sharply polarized over the past two decades. Job opportunities are increasingly found in both high-skill, high-wage professional, technical, and managerial occupations and in low-skill, low-wage food service, personal care, and protective service occupations.

Conversely, job opportunities are declining in both middle-skill, white-collar clerical, administrative, and sales occupations and in middle-skill, blue-collar production, craft, and operative occupations. The decline in middle-skill jobs has been detrimental to the earnings and labor force participation rates of workers without a four-year college education, and differentially so for males, who are increasingly concentrated in low paying service occupations.

Fast facts

- U.S. employment growth is polarizing, with job opportunities increasingly concentrated in relatively high-skill, high-wage jobs and low-skill, low wage jobs.
- Employment polarization is not a uniquely American phenomenon; it is widespread across industrialized economies.
- Key contributors to job polarization are the automation of routine work and, to a lesser extent, the international integration of labor markets through trade and, more recently, offshoring. The declining penetration of labor unions and the falling real value of the federal minimum wage have played a smaller role.
- The Great Recession quantitatively but not qualitatively changed the trend toward employment polarization in the U.S. labor market. Employment losses during the recent recession were far more severe in middle-skill white- and blue-collar jobs than in either high-skill, white-collar jobs or in low-skill service occupations.
- The earnings of college-educated workers *relative to* high school-educated workers have risen steadily for almost three decades.
- The rise in the relative earnings of college graduates is due both to rising real earnings for college-educated workers and falling real earnings for noncollege-educated workers, particularly noncollege-educated males.
- Gains in educational attainment have not generally kept pace with rising educational returns, particularly for males. And the slowing pace of educational attainment has contributed to the rising college/high school earnings gap.

Center for American Progress
1333 H Street, NW, 10th Floor
Washington, DC 20005
Tel: 202-682-1611 Fax: 202-682-1867
www.americanprogress.org

THE HAMILTON PROJECT
The Brookings Institution
1775 Massachusetts Ave, NW
Washington, DC 20036
Tel: 202.797.4360 Fax: 202.238.3543
www.hamiltonproject.org