

The Vanishing Middle: Job Polarization and Workers' Response to the Decline in Middle-Skill Jobs

By Didem Tüzemen and Jonathan Willis

Over the past three decades, the share of middle-skill jobs in the United States has fallen sharply. Middle-skill jobs are those in which workers primarily perform routine tasks that are procedural and repetitive. The decline in the employment share of middle-skill jobs has been associated with a number of sweeping changes affecting the economy, including advancement of technology, outsourcing of jobs overseas, and contractions that have occurred in manufacturing. As the share of middle-skill jobs has shrunk, the share of high-skill jobs has grown, and that trend has drawn considerable attention. Less well known is the fact that the share of low-skill jobs has also risen. This employment phenomenon where job opportunities have shifted away from middle-skill jobs toward high- and low-skill jobs is called “job polarization.”

The impact of job polarization is not well understood. Researchers have offered various theories to explain job polarization and its relation to the business cycle, but there have been only limited studies on the impact of job polarization across industries and across various segments of the population. The knowledge gap to be resolved is how job polarization has affected the structure of the labor market. Understand-

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ing this changing structure of the labor market can help policy makers prescribe policies that will best promote sustainable economic growth.

This article examines three decades of data from the Current Population Survey to characterize structural changes in the labor market due to job polarization. One common assumption is that job polarization has been driven mainly by contraction in a few sectors, such as manufacturing, where a large share of jobs are in the middle-skill category. However, the analysis shows that job polarization has stemmed less from a shift away from any one sector than from shifts in the skill-composition of jobs within each sector. Related to the business cycle, job polarization has occurred consistently over the last three decades, but the pace of job polarization has accelerated during recessions.

The article also finds that workers' response to job polarization has differed depending on their gender, education, and age. Women have obtained more education and moved disproportionately into high-skill jobs, while men have shifted in roughly equal numbers to high- and low-skill jobs. Workers age 55 and older have shifted strongly toward high-skill jobs, as workers in high-skill occupations have delayed retirement. For the youngest segment of the labor market, workers ages 16 to 24 have shifted toward low-skill jobs as a growing segment of this population have delayed entry into the labor market while remaining in school.

Section I describes the course of job polarization over the past three decades in the United States and reviews various theories offered to explain the pattern. Section II shows how job polarization occurred across different sectors of the economy, focusing on the demand side of the labor market. Section III focuses on the supply side of the labor market, finding differences across workers based on gender, education, and age. Section IV explores the relationship between job polarization and the business cycle.

I. JOB POLARIZATION IN THE U.S. LABOR MARKET

The term “job polarization” has been used in studies about both British employment (Goos and Manning) and U.S. employment (Autor and others, 2006) to describe the shift of the workforce toward low- and high-skill occupations. A variety of explanations have been offered for the pattern, including the impact of technology, the rise in

international trade, and the shrinking and weakening of labor unions. These factors have affected the demand side of the labor market, influencing the types of jobs that are in demand at a given time. However, job polarization has also been reflected in the response of workers, corresponding to the supply side of the labor market. Both supply- and demand-side factors are considered in this study.

The shift in the composition of jobs in the U.S. labor market is documented using micro-level data from the Current Population Survey (CPS), commonly referred to as the household survey. The U.S. Census Bureau collects survey data at a monthly frequency from approximately 60,000 households. The data contain detailed demographic information on workers, as well as information on employment by industry and occupation. The analysis in this article is based on annual data from 1983 to 2012, except in the final section where quarterly data are used for the business-cycle analysis.¹

Using the CPS micro-level data, this section first measures the extent of job polarization in the United States over the past thirty years and reviews theories that seek to explain the trend. The section then examines the evidence from wage patterns to explore whether labor supply has shifted to meet new patterns of labor demand.

Explanations for job polarization

Changes in technology and the global economy together have provided the impetus for job polarization. With the adoption of computers and associated technologies, businesses have fundamentally changed the way they operate and the types of workers they require. Simultaneously, international trade has expanded rapidly, leading to new opportunities for some companies and increased competition for others. U.S. industries that were not competitive in the global marketplace have contracted. The decline in labor unions may have also contributed to job polarization through a weakening of the bargaining power of workers predominantly in middle-skill jobs. Job polarization has thus been the product of a wide variety of forces that have shifted employment toward more productive occupations in a perpetually changing economic landscape.

Beginning in the 1980s, technological advancements and the widespread adoption of computers have led to a rise in the relative demand

for workers in high-skill occupations. Workers suitable for these positions are typically highly educated and can perform tasks requiring analytical ability, problem solving, and creativity. They work at managerial, professional, and technical occupations, such as engineering, finance, management, and medicine.² Economists have referred to this demand shift as skill-biased technical change (SBTC) (Goldin and Katz and Krusell and others).

The SBTC hypothesis is successful in explaining the rise in the employment share of workers in high-skill jobs over the past three decades. This hypothesis suggests that new technologies complement the skill sets of highly skilled workers, increasing their relative productivity and leading to the creation of more high-skill jobs.³ More precisely, the employment share of workers in high-skill occupations increased by 11 percentage points from 26 percent in 1983 to 37 percent in 2012 (Chart 1).

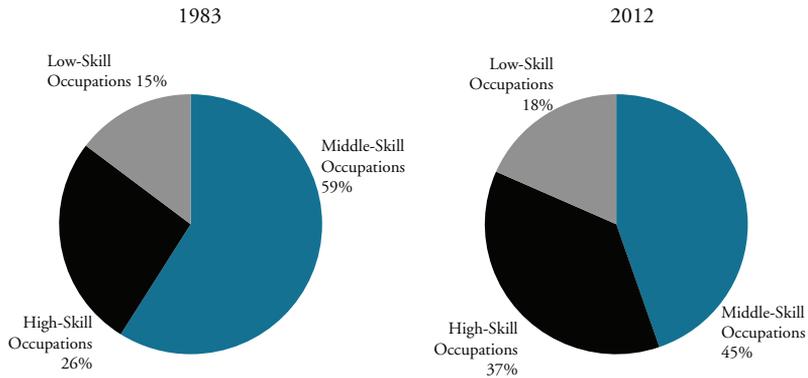
However, the SBTC hypothesis fails to explain the increase in the share of low-skill occupations. Workers in these jobs typically have no formal education beyond high school. They work in occupations that are physically demanding and cannot be automated. Many of these occupations are service oriented, such as food preparation, cleaning, and security and protective services. The SBTC hypothesis predicts that the share of low-skill jobs should have fallen. Instead, the employment share of low-skill occupations rose from 15 percent in 1983 to 18 percent in 2012.

While the employment shares have increased for low- and high-skill occupations, the employment share has declined for middle-skill occupations. These middle-skill occupations include sales, office and administrative support, production, construction, extraction, installation, maintenance and repair, transportation, and material moving. From 1983 to 2012, the employment share of middle-skill occupations dropped by 14 percentage points (from 59 percent to 45 percent).

Technological advancements help explain why the share of workers employed in middle-skill occupations has fallen so sharply. Workers in middle-skill occupations typically perform routine tasks that are procedural and rule-based. Therefore, these occupations are classified as “routine” occupations. The tasks performed in many of these occupations have become automated by computers and machines (Autor and

Chart 1

EMPLOYMENT SHARES BY SKILL LEVEL



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

others, 1998, 2003; Acemoglu and Autor). In contrast, tasks performed in high- and low-skill occupations cannot be automated, making them “non-routine” occupations. Thus, the technical change that boosted the demand for high-skill jobs also contributed to the fall in demand for middle-skill jobs, as computers and machines became cost-effective substitutes for these workers.

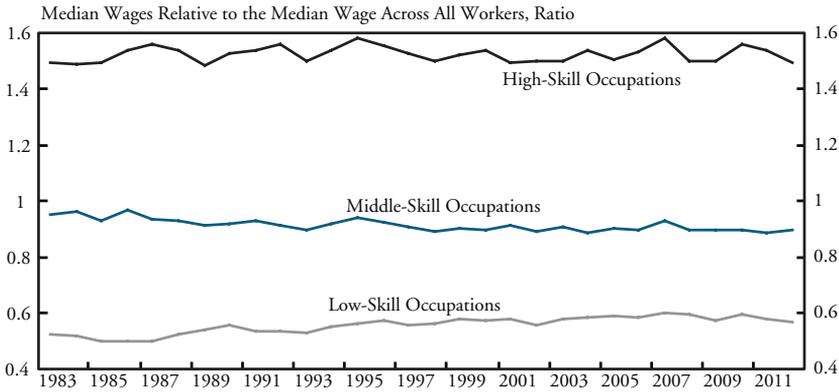
International trade and the weakening of unions have also contributed to the decline in middle-skill occupations. Many jobs in this category, particularly those in manufacturing, have been offshored to countries where workers can perform similar tasks for lower wages (Autor, Goos and others, and Oldenski). In addition, some firms have been contracting out portions of their businesses to workers in foreign countries, a phenomenon known as outsourcing. De-unionization has also potentially contributed to the decline in the employment share of middle-skill jobs (Autor).

Job polarization and wages

Evidence from U.S. wage patterns suggests that the supply of workers, in stride with labor demand, has shifted away from middle-skill occupations. According to the theory of supply and demand, a decrease in the relative demand for workers in middle-skill occupations results in a decline in the relative wage for those workers.

Chart 2

MEDIAN WAGES FOR WORKERS BY SKILL LEVEL



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

Similarly, an increase in the relative demand for workers in low- and high-skill occupations leads to higher relative wages for these workers. Wage dynamics that do not follow these patterns imply shifts in the relative supply of workers. An analysis of wage data finds that relative wages across skill level categories have changed very little over the past 30 years, suggesting that labor supply has moved in the same direction and roughly in line with changes in labor demand.

Based on the earnings information provided by the CPS, wages for occupations in one skill level can be compared with wages for occupations in other skill levels. For each skill category, a measure of the relative wage is constructed by calculating the ratio of the median wage in that category to the median wage for all workers.⁴ As expected, relative wages are closely associated with skill levels (Chart 2). The relative wage for workers in high-skill occupations is the highest. The relative wage for workers in middle-skill occupations is near 1, indicating that the median wage for this skill category is very close to the overall median wage. Relative wages for workers in low-skill occupations are the lowest.

Wage patterns suggest that labor supply has shifted in response to job polarization. For workers in middle-skill occupations, the relative wage has remained very stable despite the 14 percentage-point decrease

in the employment share of these occupations. Without any labor supply response to this decrease, economic theory would predict a significant decline in relative wages. The stability of relative wages for workers in middle-skill occupations suggests that the decline in labor demand has been approximately matched by a decline in labor supply for these occupations.

For workers in low- and high-skill occupations, relative wage patterns are also informative regarding labor supply movements. The employment share of workers in low-skill occupations increased by 3 percentage points, while the employment share of workers in high-skill occupations increased by 11 percentage points over the sample period. The stable patterns for relative wages for both low- and high-skill occupations suggest that the increases in labor demand for these occupations have been accompanied by similar increases in labor supply.

II. CHANGES IN LABOR DEMAND: JOB POLARIZATION ACROSS SECTORS

The shifting of employment away from middle-skill occupations in the aggregate can occur in two ways. First, employment may shift *between* sectors of the economy as some sectors experience increases in demand for their products and respond by hiring workers, while other sectors contract in the face of weakening demand for their products. Worker reallocation contributes to job polarization if the expanding sectors have a larger share of low- or high-skill jobs and the contracting sectors have a larger share of middle-skill jobs.

Second, factors underlying job polarization may also contribute to a shift of employment *within* a sector as middle-skill jobs are eliminated and the shares of low- and high-skill jobs rise. Technological advancements tend to be the primary drivers of this aspect of job polarization, as middle-skill jobs are made obsolete. Examples of within-sector shifts include the replacement of secretaries with computers and the replacement of middle-skill factory jobs with advanced machinery and robots.

Distinguishing between these two types of shifts in employment patterns is important for the efficacy of labor market policy. If job polarization is driven mainly by the contraction of sectors with larger shares of middle-skill jobs, then labor market policy needs to focus on helping displaced workers in shrinking sectors make the transition to other sectors where employment opportunities are proliferating. In

contrast, if job polarization is driven mainly by within-sector shifts in employment, then labor market policy should help provide incentives and opportunities for workers in middle-skill jobs to obtain the necessary skills to become qualified for high-skill jobs.

The initial analysis reveals two important contributors to job polarization. First, the employment shares of sectors that have higher proportions of middle-skill jobs have declined, and the employment shares of sectors with lower proportions of middle-skill jobs have increased. Second, all sectors experienced decreases in the shares of middle-skill jobs from 1983 to 2012.

A decomposition is used to identify whether employment shifts *between* or *within* sectors are most responsible for job polarization. The decomposition indicates that the decline in middle-skill jobs within sectors has contributed more to job polarization than shifts in employment between sectors.

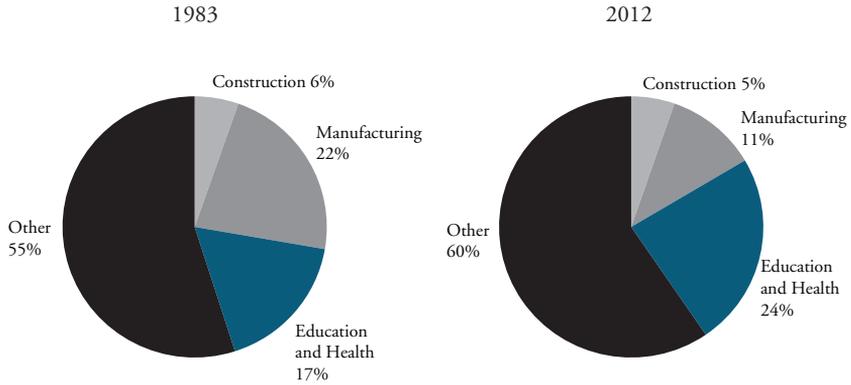
Employment shifts across sectors

Job polarization has taken place during a period of large shifts in employment across industries. Analyzing these shifts in overall employment and the corresponding changes in skill-level compositions of jobs within each industry reveals that overall employment has shifted away from industries with larger shares of middle-skill jobs and toward industries with larger shares of low- and high-skill jobs. Also, the analysis shows that the shares of middle-skill jobs across all industries have declined.

For purposes of analysis, the economy is divided into four sectors. The first two sectors are construction and manufacturing, where middle-skill occupations comprise more than 70 percent of employment. The third sector groups together the education and health services industries, where high-skill occupations account for the largest share of employment. The final sector, labeled “other,” encompasses all other industries, a group in which middle-skill occupations account for 50 percent of employment. This sector includes mining; wholesale and retail trade; transportation and utilities; communication; information; financial activities; other services; public administration; agriculture; and forestry, fishing, and hunting.

From 1983 to 2012, the employment shares of most sectors have shifted markedly. The largest shift has been the decline in manufactur-

Chart 3
EMPLOYMENT SHARES BY SECTOR



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

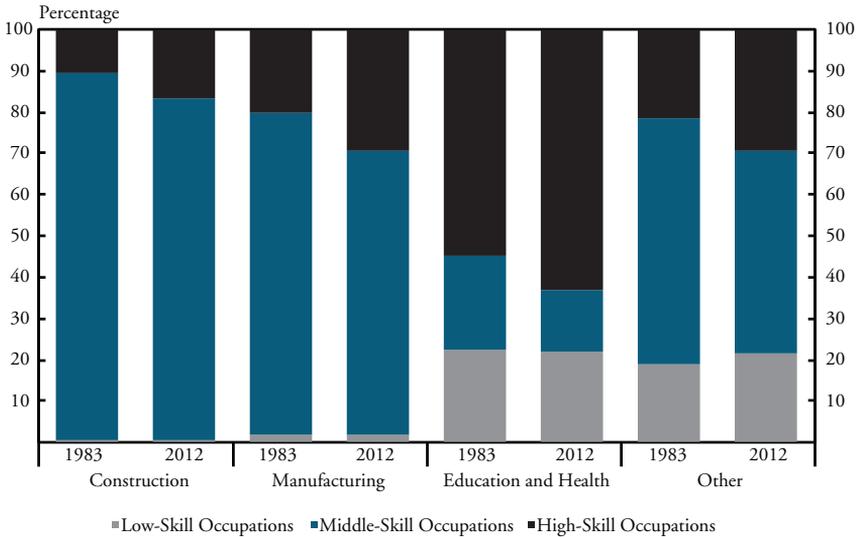
ing, where the employment share fell from 22 percent in 1983 to 11 percent in 2012 (Chart 3). For the education and health services sector, the employment share increased from 17 to 24 percent over the period. The employment share for the “other” sector rose from 55 to 60 percent, while the employment share for the construction sector was basically unchanged.

The share of workers in middle-skill occupations declined across all of these sectors. The declining employment share is measured by tracking the change in the employment shares of occupations within each sector in each of the three skill levels from 1983 to 2012. The sector with the largest decline in middle-skill jobs was the “other” sector, which experienced an 11 percentage-point decrease in the employment share of workers in middle-skill jobs (Chart 4). The remaining three sectors experienced declines in the employment share of workers in middle-skill occupations ranging from 6 to 9 percentage points.

For these three sectors, the decline in the employment share of workers in middle-skill occupations was primarily offset by increases in the share of workers in high-skill occupations. The construction, manufacturing, and education and health services sectors experienced increases in the employment share of workers in high-skill occupations of the same magnitude as the decline of those in middle-skill occupations, while the share of workers in low-skill occupations remained

Chart 4

WITHIN-SECTOR EMPLOYMENT SHARES BY SKILL LEVEL



Note: Employment shares are computed separately for each sector. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

unchanged. For the “other” sector, the share of workers in high-skill occupations increased by 8 percentage points, while the share of workers in low-skill occupations increased modestly.

Decomposing employment shifts within and between sectors

The primary factor contributing to job polarization can be determined by identifying the underlying source of the observed shifts in employment across sectors for workers in each skill level. Specifically, the employment shifts are decomposed into two components: skill-based employment shifts *within* sectors and skill-based employment shifts *between* sectors.

The first component is the portion of job polarization associated with changes in the skill-based composition of jobs *within* each sector. This component captures shifts in the composition of jobs, holding fixed the size of each sector.⁵ It shows how much of the observed change in the employment share of workers in middle-skill jobs in a sector is

Table 1
**CHANGES IN EMPLOYMENT SHARES BY SKILL LEVEL
 AND SECTOR BETWEEN 1983 AND 2012**

	Total	Construction	Manufacturing	Education & Health	Other
Skill level		(5%)	(11%)	(24%)	(60%)
Low-skill occupations	3.7	0.0	-0.2	1.4	2.6
Change due to shifts between sectors	2.1	0.0	-0.2	1.5	0.9
Change due to shifts within sector	1.6	0.0	0.0	-0.1	1.7
Middle-skill occupations	-14.2	-0.4	-9.7	-0.4	-3.8
Change due to shifts between sectors	-4.5	0.0	-8.7	1.5	2.8
Change due to shifts within sector	-9.8	-0.3	-1.0	-1.9	-6.6
High-skill occupations	10.5	0.3	-1.3	5.6	5.9
Change due to shifts between sectors	2.3	0.0	-2.3	3.6	1.0
Change due to shifts within sector	8.2	0.3	1.0	2.0	4.9

Note: The table reports the percentage point change in the employment share for each skill group, where the employment share is measured as the ratio of the skill group's employment to total employment. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. For each sector, the employment share in 2012 is shown in parentheses.
 Source: Current Population Survey and authors' calculations.

due to a reallocation of workers to or from low- and high-skill jobs within that sector.

The second component measures the portion of job polarization associated with shifts in employment *between* sectors. The measure is computed based on the observed change in each sector's share of total employment, holding constant the skill-based composition of jobs within each sector. This component conveys how much of job polarization is due to a reallocation of workers from contracting sectors to expanding sectors.

As the main theme of job polarization is the vanishing of middle-skill jobs, the analysis begins with the decomposition of the decline in the employment share of workers in middle-skill occupations. The later part of the analysis focuses on the decomposition of the corresponding increases in low- and high-skill jobs.

Based on this decomposition, the primary contributor to the decline in middle-skill jobs was the change in the skill-composition of jobs within sectors. The overall decline in the employment share of workers in middle-skill occupations was 14 percentage points from 1983 to 2012 (Table 1). Within-sector changes in the skill composition of jobs

accounted for two-thirds, or 10 percentage points, of this decline. The remaining one-third of the decline was due to shifts in employment between sectors, moving from sectors with higher shares of workers in middle-skill jobs to sectors with lower shares of workers in middle-skill jobs.

Within each sector, job polarization occurred through a decline in the share of workers in middle-skill jobs. The largest contributor was within the “other” sector, where the overall share of workers in middle-skill occupations fell 7 percentage points. The other three sectors contributed less. The combined impact of compositional shifts within these sectors accounted for two-thirds of the reduction in the employment share of workers in middle-skill occupations.

Shifts between sectors were a smaller portion of job polarization. The sharp decline in manufacturing employment led to a decline of 9 percentage points in the overall share of workers in middle-skill jobs from 1983 to 2012. But this sharp decline in middle-skill jobs was partially dampened as employment shifted to middle-skill jobs in the other three sectors. The increase in the employment share of the “other” sector, controlling for compositional shifts of workers in this sector, added 3 percentage points to the overall share of workers in middle-skill jobs. The contribution from expanding employment in the education and health services sector was positive, but smaller, as this sector had a smaller share of workers in middle-skill occupations. On net, the shift of workers over the past three decades away from manufacturing and toward the other three sectors accounted for about one-third of the reduction in the overall share of workers in middle-skill jobs.

Similar to the decline in middle-skill occupations, the increase in the employment share of workers in high-skill occupations was primarily due to within-sector shifts. All sectors experienced within-sector increases in the share of workers in high-skill jobs, with the largest increase occurring in the “other” sector. Shifts in employment between sectors accounted for a smaller increase. As employment shifted away from manufacturing and toward the education and health services sector and the “other” sector, the share of workers in high-skill jobs increased. This was because the latter sectors had higher shares of workers in high-skill jobs than manufacturing.

The share of workers in low-skill occupations rose moderately due to similar contributions from within- and between-sector shifts in the

employment shares. The shift in employment away from manufacturing increased the share of workers in low-skill jobs because the shift was toward sectors with larger concentrations of workers in low-skill jobs. The shifts within the “other” sector also increased the employment share of workers in low-skill occupations.

In summary, job polarization is primarily attributable to within-sector shifts in employment. In all sectors the employment share of middle-skill jobs declined, and the share of high-skill jobs increased. This within-sector shift in employment accounted for two-thirds of the reduction in the share of middle-skill jobs, while the remaining one-third was due to shifts in employment between sectors. The impact of the sharp decline in manufacturing employment on middle-skill jobs was partially offset by an increase in the share of workers in middle-skill jobs in the remaining sectors.

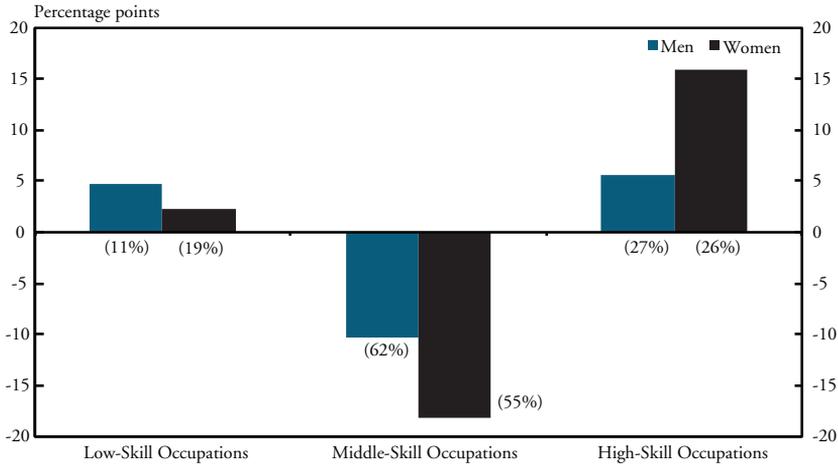
III. CHANGES IN LABOR SUPPLY: WORKERS’ RESPONSE TO JOB POLARIZATION

As job polarization has shifted employment opportunities, workers have responded. Faced with increasing demand for workers in high-skill occupations and decreasing demand for workers in middle-skill occupations, individuals have a strong incentive to attain higher levels of education. But not all individuals respond in the same way. Responses may depend on characteristics such as age, gender, and level of education. Understanding how workers react to job polarization is important for designing and implementing effective labor market policy.

Using the CPS data, a detailed analysis of the labor supply response to job polarization reveals differences across workers. Women have responded to job polarization by attaining higher levels of education and shifting predominantly to high-skill occupations. In contrast, men have responded to the decline in middle-skill jobs with a more modest increase in education and roughly equal shifts toward low- and high-skill jobs. Workers age 55 and over have shifted exclusively to high-skill occupations while prime-age workers, ages 25 to 54, have shifted to both low- and high-skill occupations. Among young people in the labor force, workers ages 16 to 24 have shifted primarily to low-skill occupations. This shift was likely related to the increasing number of

Chart 5

CHANGES IN EMPLOYMENT SHARES BY SKILL LEVEL AND GENDER BETWEEN 1983 AND 2012



Note: The chart reports the percentage point change in the employment share for each skill group, where employment shares are computed separately for each respective gender. Data are restricted to workers ages 6 to 64 who are not self-employed and are not employed in military or agricultural occupations. For each group, the employment share in 1983 is shown in parentheses.

Source: Current Population Survey and authors' calculations.

youth remaining in school longer, and the corresponding delay in the entry into the labor force of those seeking high-skill jobs.

Job polarization and gender

Labor supply responses of male and female workers to job polarization have differed notably over the years. For the population as a whole, the overall shift in the employment shares has been skewed toward high-skill occupations relative to low-skill occupations. For women, the pattern reflects an even more pronounced shift toward high-skill occupations.⁶ In contrast, men have shifted roughly equally into high- and low-skill occupations.

Over the past three decades, the employment shares of women in low- and high-skill occupations have shifted sharply. In 1983, a majority of employed women (55 percent) worked in middle-skill jobs, while the employment shares in high- and low-skill jobs were 31 percent and 19 percent respectively. In 2012, female employment in middle-skill jobs was 18 percentage points lower (Chart 5). This large drop was almost en-

Table 2
EMPLOYMENT SHARES OF OCCUPATIONS BY GENDER

Occupations	Men			Women		
	1983	2012	Change	1983	2012	Change
Management, Business, and Financial	11.9	14.4	2.5	7.8	14.1	6.4
Professional and Related	15.1	18.1	3.0	18.0	27.4	9.5
Service	11.2	16.0	4.8	18.7	20.9	2.3
Sales and Related	9.5	10.0	0.5	11.8	11.0	-0.8
Office and Administrative Support	6.8	7.2	0.3	31.2	20.2	-11.0
Construction, Extraction, Installation, Maintenance, Repair, and Production	37.8	24.1	-13.6	11.9	4.1	-7.7
Transportation and Material Moving	7.7	10.2	2.5	0.8	2.1	1.4

Note: Employment shares are computed separately for each gender and expressed in percentages. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. Source: Current Population Survey and authors' calculations.

tirely reflected in a 16 percentage-point increase in the share of employed women in high-skill jobs. In contrast, during this time period the share of employed women in low-skill jobs increased only modestly.

Unlike women, male employment shares have shifted equally toward low- and high-skill jobs. In 1983, 62 percent of employed men were in middle-skill jobs, while the shares of employed men in low- and high-skill jobs were 27 percent and 11 percent, respectively. By 2012, the share of employed men in middle-skill jobs fell by 10 percentage points, while employment shares of low- and high-skill jobs each rose by 5 percentage points.

To better assess gender differences, it is useful to consider employment shifts among major occupations within each skill group. For women most of the employment gains were in managerial and professional occupations, which are classified as high-skill jobs (Table 2). For men the employment gains in these occupations were modest. Both men and women saw declines in middle-skill jobs, but for different reasons. Middle-skill jobs are in routine occupations such as sales, office and administrative, production, construction, installation, maintenance, and transportation. The main losses in the share of middle-skill employment for women were in office and administrative occupations, likely related to the replacement of many secretarial and clerical jobs with desktop computing. Major employment losses for men were in production occupations, likely related to the decline in manufacturing employment.

For low-skill occupations, the employment gains were skewed toward men. These jobs were primarily in service occupations. For both men and women, services employment increased, but gains were stronger for men.

To summarize, job polarization has affected both men and women, but they have responded differently. For both sexes, the share of employment in middle-skill occupations fell dramatically. This decrease led to equal increases in the shares of male employment in low- and high-skill occupations. However, almost all the decrease in the female employment share in middle-skill occupations was transformed into a large increase in the employment share of women in high-skill occupations, with almost no change in their share in low-skill occupations.

The findings of several recent studies may help explain the different responses of men and women to job polarization. As the share of middle-skill jobs declined, workers were confronted with a choice of taking low-skill jobs or pursuing the skills necessary for high-skill jobs. Here two factors came into play. First, low-skill jobs paid lower wages (Chart 2). Second, employment decisions of men were less sensitive to wages than those of women (Kimmel and Kniesner). Rather than accepting a lower wage, women were more likely to pursue education and obtain employment in high-skill occupations. Moreover, women, and particularly college-educated women, were likely to be more responsive to increased demand for high-skill occupations than men (Black and Juhn).

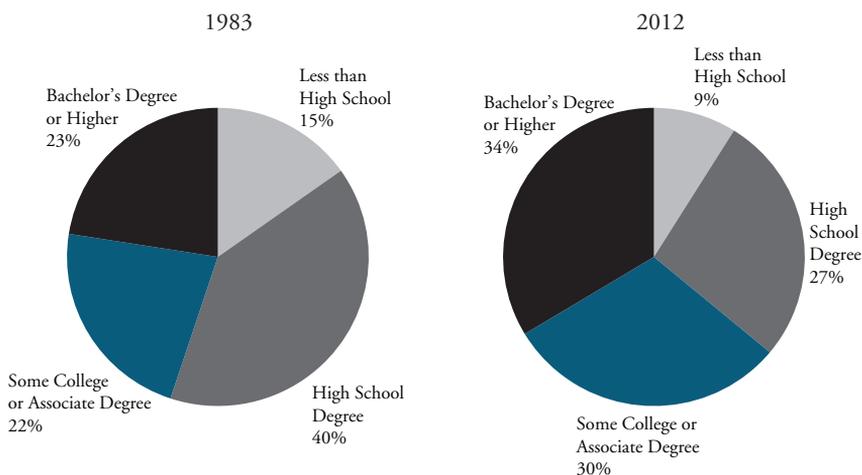
Job polarization and educational attainment

The shift in employment toward high-skill jobs has been associated with an increase in the share of workers obtaining higher levels of education. In 1983, 15 percent of the working population had less than a high school degree (Chart 6). This share declined to 9 percent in 2012. Over the same period, the share of workers with a high school diploma fell from 40 percent to 27 percent. In contrast, for workers with some college education or an associate's degree, the share increased from 22 percent to 30 percent, and for those with a bachelor's degree or more, the share rose from 23 percent to 34 percent.

Job polarization has disproportionately affected workers with less than a bachelor's degree. In 1983, the majority of workers in these educational categories—less than high school, high school degree, and some college or associate degree—were employed in middle-skill occu-

Chart 6

EDUCATIONAL ATTAINMENT OF THE EMPLOYED



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

Table 3

EMPLOYMENT SHARES OF WORKERS BY LEVEL OF EDUCATION

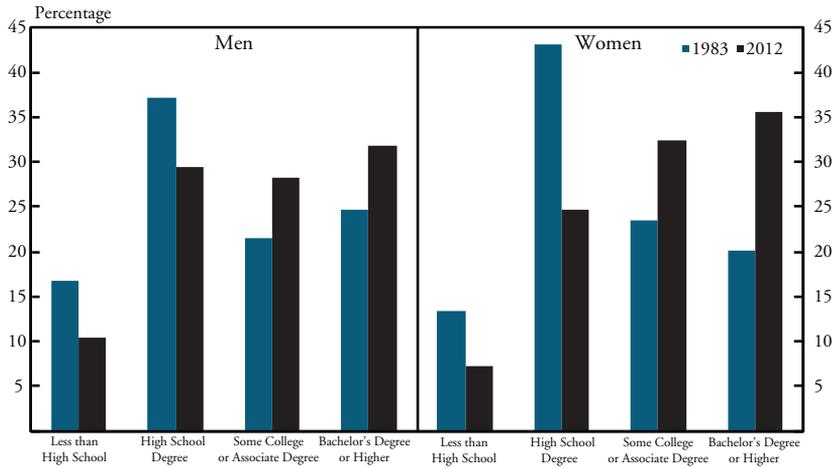
Level of Educational Attainment	Occupation Type	1983	2012	Change
Less Than High School	Low-Skill Occupations	26.9	36.9	10.0
	Middle-Skill Occupations	69.2	58.1	-11.1
	High-Skill Occupations	3.9	5.0	1.1
High School Degree	Low-Skill Occupations	16.3	23.9	7.6
	Middle-Skill Occupations	72.6	62.4	-10.3
	High-Skill Occupations	11.1	13.8	2.6
Some College or Associate Degree	Low-Skill Occupations	13.5	21.1	7.6
	Middle-Skill Occupations	60.7	50.8	-9.9
	High-Skill Occupations	25.8	28.2	2.4
Bachelor's Degree or Higher	Low-Skill Occupations	4.7	6.6	1.8
	Middle-Skill Occupations	26.0	21.4	-4.6
	High-Skill Occupations	69.2	72.0	2.8

Note: Employment shares are computed separately for each respective level of educational attainment and expressed in percentages. Data are restricted to workers between the ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

Chart 7

EDUCATIONAL ATTAINMENT OF THE EMPLOYED BY GENDER



Note: The chart reports levels of educational attainment separately for each respective gender. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. Source: Current Population Survey and authors' calculations.

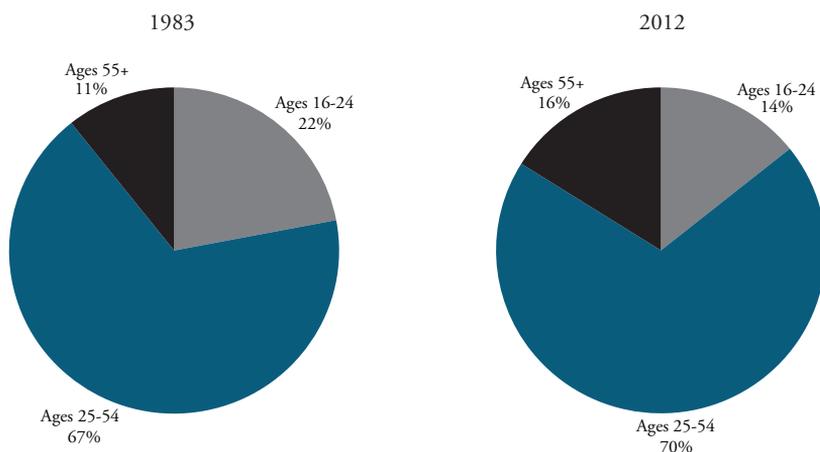
pations (Table 3). By 2012, all three groups in middle-skill occupations experienced employment-share declines of approximately 10 percentage points. Employment gains for these groups were primarily in low-skill occupations as these individuals did not have the education and training required for high-skill occupations.

Workers with a bachelor's degree or higher have been less affected by job polarization. In 1983, only 26 percent of these workers were in low- and middle-skill occupations. From 1983 to 2012, the share of workers with a bachelor's degree or higher in middle-skill jobs declined modestly by 5 percentage points. This decline was accompanied by a small increase in the employment share of these workers in low- and high-skill occupations.

While levels of educational attainment increased for both male and female workers, the change was more pronounced for women. From 1983 to 2012, the share of employed women with a high school degree fell dramatically, from 43 percent to 25 percent (Chart 7). Over the same period, the share of female workers with a bachelor's degree or higher rose. For men, the share of workers with a high school degree fell more modestly, from 38 percent to 29 percent. This decline was accompanied by comparable increases in the share of male workers with some college or an associate's degree and the share with a bachelor's degree or higher.

Chart 8

AGE DISTRIBUTION OF THE EMPLOYED



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

Gender differences in educational attainment line up closely with shifts in the employment shares by skill level. The large increase from 1983 to 2012 in the share of women with a bachelor's degree or higher was accompanied by strong employment gains for women in high-skill occupations. For men, the smaller increase in educational attainment matched the smaller shift of male employment toward high-skill occupations.

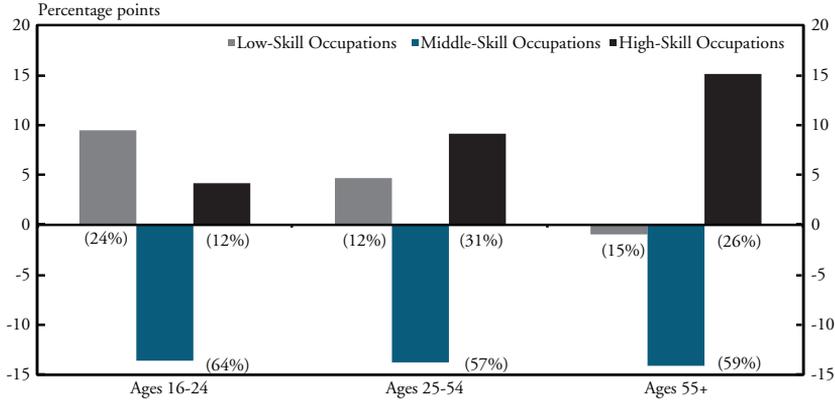
Job polarization and age

Two important trends have changed the age profile of the labor force. First, the aging of the baby boom generation has led to an older workforce. Second, the increase in the demand for workers with higher levels of educational attainment has led younger people to stay in school longer and highly-educated older workers to delay retirement.

These trends have contributed to a decline in the employment share of younger workers and an increase in the employment share of older workers. As younger individuals have spent more time in school, the employment share of workers ages 16 to 24 declined from 22 percent to 14 percent from 1983 to 2012 (Chart 8). Over the same timeframe, the

Chart 9

CHANGES IN EMPLOYMENT SHARES BY AGE AND SKILL LEVEL BETWEEN 1983 AND 2012



Note: The chart reports the percentage point change in the employment share for each skill group, where employment shares are computed separately for each respective age category. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. For each group, the employment share in 1983 is shown in parentheses.

Source: Current Population Survey and authors' calculations.

aging of baby boomers contributed to an increase in the employment share of workers age 55 and older from 11 percent to 16 percent.

The shift in demand away from workers in middle-skill occupations toward workers in high-skill occupations has had a strong impact on the age profile of the work force. Young individuals responded to this shift by remaining in school longer and delaying their entry into the labor force. As a result, young individuals who entered the labor force tended to have less education, helping explain the shift of this group toward jobs primarily in low-skill occupations (Chart 9). Prime-age workers ages 25 to 54 mostly shifted toward high-skill occupations. And workers age 55 and older shifted in large numbers from middle-skill occupations to high-skill occupations. This extreme shift of older workers toward high-skill occupations was likely due to a delay in the retirement of workers who were in the highest demand – those in high-skill occupations. In contrast, older workers in middle-skill occupations might have accelerated their retirement decisions when faced with lower labor demand.

IV. JOB POLARIZATION OVER THE BUSINESS CYCLE

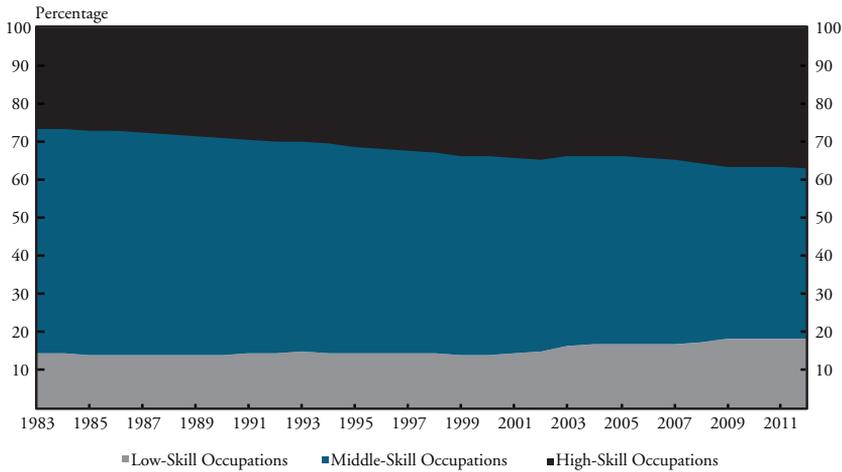
While there is wide agreement among researchers regarding the emergence of job polarization in the U.S. labor market, there is no consensus yet about the relationship between job polarization and the business cycle. If skill-based shifts in the employment shares occurred consistently over time, job polarization may be seen as a structural change that is independent from business-cycle fluctuations. If the shifts have been concentrated in periods of economic contraction or economic expansion, job polarization may be seen as closely tied to the business cycle. This distinction is important because it may lead to an improved understanding of recent patterns in the labor market, such as the emergence of jobless recoveries. The framework of analysis used in this article can provide new insights on this open question.

Thus far, economic studies have presented mixed evidence regarding the connection between job polarization and the business cycle. One recent study found that nearly all of the job losses occurring during periods of economic downturn were in middle-skill occupations, and job losses in middle-skill occupations were concentrated in downturns and sluggish recoveries (Jaimovich and Siu). The study concluded that job polarization was a key driver of recent business cycles and accounted for periods of jobless recovery that have followed the past three recessions. A second study reached a different conclusion, finding that recessions adversely affected all workers, even those in high-skill occupations (Foote and Ryan). This study showed that workers in middle-skill occupations were no more likely to leave the labor force or take low- or high-skill jobs in recessions than they were during economic booms. This evidence suggests that job polarization was more likely a contributor rather than the cause of jobless recoveries.

This article provides new evidence on this debate by examining whether shifts in the employment shares associated with job polarization were concentrated in recessions. For improved detection of business cycle patterns, the CPS data used in preceding sections is converted into quarterly data using the same methodology described in Section 1. The analysis reveals that job polarization occurred continuously and was not concentrated in a few periods (Chart 10).⁷ The findings indicate that over the past three decades skill-based shifts in the employment shares

Chart 10

EMPLOYMENT SHARES BY SKILL LEVEL



Note: Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations.

Source: Current Population Survey and authors' calculations.

occurred consistently across periods of business cycle expansion and contraction. This evidence suggests that job polarization is best seen as a structural phenomenon rather than a phenomenon tied to the business cycle or associated with jobless recoveries.

While job polarization has been predominantly a structural phenomenon, closer analysis reveals some cyclical features. Shifts in the employment shares associated with job polarization have disproportionately taken place during periods of economic recession. Of the 118 quarters spanning the period from the first quarter of 1983 to the third quarter of 2012, the economy was in recession in 11 quarters or 9 percent of the time.⁸ Approximately 35 percent of the observed decline in the employment share of workers in middle-skill occupations occurred during these recessionary quarters. So while the majority (65 percent) of job polarization took place during periods of economic expansion, a disproportionately large share of the shift in the composition of occupations occurred during the few periods of recession.

Taking these numbers together suggests that job polarization occurred at a faster pace during recessions. To measure the speed of job polarization over the business cycle, the rate of change of the

Table 4
CYCLICAL CHANGES IN EMPLOYMENT SHARES BY SKILL LEVEL

	Total	Construction	Manufacturing	Education & Health	Other
Skill level		(5%)	(11%)	(24%)	(60%)
Low-skill occupations					
During recessions (4-quarter rate of change)	0.6	0.0	0.0	0.3	0.3
During expansions (4-quarter rate of change)	0.1	0.0	0.0	0.0	0.1
Middle-skill occupations					
During recessions (4-quarter rate of change)	-1.7	-0.6	-1.1	0.1	-0.3
During expansions (4-quarter rate of change)	-0.3	0.1	-0.2	0.0	-0.1
High-skill occupations					
During recessions (4-quarter rate of change)	1.2	0.0	0.0	0.8	0.3
During expansions (4-quarter rate of change)	0.2	0.0	-0.1	0.1	0.2

Note: This table reports the percentage point change in the employment share for each skill group, where the employment share is measured as the ratio of the skill group's employment to total employment. Data from 1983 to 2012 are used to construct changes in employment shares. Recessionary periods are based on NBER business cycle dates. Data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. For each sector, the employment share in 2012 is shown in parentheses. Source: Current Population Survey and authors' calculations.

employment shares over 4-quarter periods was computed separately for recessions and expansions. During recessions, the employment share of workers in middle-skill occupations declined at a 4-quarter rate of 1.7 percentage points. In contrast, during expansions the employment share of workers in middle-skill occupations declined at a slower rate of 0.3 percentage points. The six-fold acceleration of job polarization during recessions relative to expansions also corresponded to the accelerated increases in the employment shares of workers in low- and high-skill occupations.

The rapid pace of job polarization during recessions can be traced to shifts in the manufacturing and construction sectors. During recessions, the bulk of the decline in the share of middle-skill occupations occurred in the manufacturing sector. The decline stemming from changes in the construction sector was about half as large (Table 4). The "other" sector, which primarily consists of service industries excluding education and

health services, contributed modestly to job polarization. As these three sectors shifted away from middle-skill occupations, the biggest employment share increase during recessions was for workers in high-skill occupations in the education and health services sector. Smaller increases occurred during recessions for the employment shares of workers in low-skill occupations in the education and health services sector and for workers in low- and high-skill occupations in the “other” sector.

During expansions skill-based shifts occurred far more gradually. The shares of workers in middle-skill jobs in the manufacturing and the “other” sectors declined during expansions, while the shares of workers in high-skill jobs in the education and health services sectors gradually increased.

Skill-based shifts accelerated during recessions in the manufacturing, construction, and education and health services sectors. For the manufacturing sector and the education and health services sector, skill-based shifts were in the same direction during recessions and expansions, but the pace of job polarization was six- to eight-times faster during recessions. Construction contributed to job polarization during recessions, but in expansions this sector experienced an increase in the overall share of workers in middle-skill jobs. The “other” sector, in contrast, experienced a steady shift across the business cycle in the overall employment share away from workers in middle-skill jobs, and toward workers in both low- and high-skill jobs.

In summary, job polarization was evident in skill-based shifts in the employment shares in both recessions and expansions, suggesting that it is primarily a structural phenomenon. The continuous nature of shifts in the employment shares associated with job polarization suggests that this phenomenon is neither a key driver of the business cycle nor the primary cause of jobless recoveries. However, job polarization did display some cyclicity in that the pace of job polarization accelerated during recessions. The construction, manufacturing, and education and health services sectors contributed to the faster pace of job polarization during recessions. The “other” sector, which accounts for over half of total employment, exhibited a much more stable pace of job polarization across recessions and expansions.

V. CONCLUSION

As employment in the U.S. economy has expanded over the past three decades, the composition of jobs has shifted markedly. Job polarization has produced strong relative shifts in the employment shares of workers away from middle-skill jobs and toward low- and high-skill jobs.

This article shows that job polarization has been an economy-wide phenomenon, observed in all sectors. Given the sharp decline in manufacturing employment in the past three decades, this sector might appear to have been the main driver of job polarization. However, empirical evidence reveals that job polarization has been primarily due to shifts in the skill-composition of jobs *within* sectors as opposed to the shifts in employment *between* sectors in the economy. All sectors have experienced declines in the within-sector share of workers in middle-skill jobs. The large decline in middle-skill jobs associated with the contraction in manufacturing was not the primarily driver of job polarization because this decline has been partially offset by workers shifting to middle-skill occupations in expanding sectors, such as the education and health services sector. This distinction is important for labor market policy as it suggests that the impact of job polarization has been widespread across the economy rather than concentrated in a single sector, such as manufacturing.

Job polarization has affected male and female workers differently. In response to the decline in the employment share of middle-skill occupations, employment of women has skewed toward high-skill occupations, while employment of men has shifted proportionally toward low- and high-skill occupations. The rising employment share of women in high-skill occupations has been supported by significant increases in educational attainment of women. Educational attainment of men has risen more modestly, in line with the modest shift of male employment toward high-skill jobs. These shifts may have important implications for the skill set of the work force in coming years as the labor force participation rate for men has been falling while the participation rate for women has been stable.

The changing age composition of the workforce has led to employment shifts in different directions. From 1983 to 2012, the employment share of workers age 55 and older in high-skill occupations

increased. This shift was related to the aging of the labor force and the delay in retirement of workers in highest demand – those with higher levels of education. In contrast, among workers ages 16 to 24 the largest increase was in the employment share of workers in low-skill occupations. Compared to the 1980s, younger people have been staying in school longer and postponing their entry into the labor force. These developments have shifted the composition of workers in the labor force and suggest that the retirement of the baby boom workers over the next decade may reduce the supply of highly-skilled workers.

Job polarization has occurred consistently over the past three decades, suggesting that it is an ongoing, structural phenomenon. While the pace of job polarization accelerated during recessions, the continuous shifts in the employment shares suggest that this phenomenon has been neither a key driver of the business cycle nor the primary cause of jobless recoveries.

ENDNOTES

¹For the purposes of this study, the data are restricted to workers ages 16 to 64 who are not self-employed and are not employed in military or agricultural occupations. To construct annual series, monthly observations are averaged for each year. Similarly, quarterly series are constructed by taking averages of monthly observations for each quarter.

²This article follows Acemoglu and Autor and Autor in categorizing occupations by skill level (high, middle and low).

³Acemoglu writes, "...new technologies are not complementary to skills by nature but by design," leading to a related but newer concept of "directed technical change" (Acemoglu 1998, 2002).

⁴In the CPS survey, wage data are collected for only two of the eight months in which a given household is surveyed. The sample size for wages, therefore, is one-fourth the size of the full data sample that is used for constructing employment shares. The analysis in this study uses wage data on workers' weekly earnings. As with the employment data, all observations within a given year are averaged to create an annual series.

⁵The decomposition is computed using the following formula:

$$\frac{E_{i,s,2012}}{E_{2012}} - \frac{E_{i,s,1983}}{E_{1983}} = \frac{E_{i,2012}}{E_{2012}} \left(\frac{E_{i,s,2012}}{E_{i,2012}} - \frac{E_{i,s,1983}}{E_{i,1983}} \right) + \frac{E_{i,s,1983}}{E_{i,1983}} \left(\frac{E_{i,2012}}{E_{2012}} - \frac{E_{i,1983}}{E_{1983}} \right)$$

where E represents employment, i represents the industry sector, and s represents the skill level.

⁶Changes due to job polarization primarily occurred within each gender group rather than across gender groups. The female employment share increased only modestly during the period, rising from 46 percent in 1983 to 48 percent in 2012.

⁷The most noticeable shift occurred following the 2001 recession. However, this episode appears to be a shift in the employment share away from workers in high-skill occupations toward low-skill occupations, which is not the type of shift associated with job polarization.

⁸The periods in which the economy was in recession between 1983 and 2012 were 1990Q4 to 1991Q1, 2001Q2 to 2001Q4, and 2008Q1 to 2009Q2 according to the NBER business cycle dating committee. In total, this represents 11 quarters out of the total of 118 quarters in the sample from 1983Q1 to 2012Q3.

REFERENCES

- Acemoglu, Daron. 2002. "Technical Change, Inequality and the Labor Market." *Journal of Economic Literature*, 40 (1): 7-72.
- Acemoglu, Daron. 1998. "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality." *The Quarterly Journal of Economics*, 113 (4): 1055-1089.
- Acemoglu, Daron, and David H. Autor. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings" in Orley Ashenfelter and David Card (Eds.). *Handbook of Labor Economics*, 4B: 1043-1171. Elsevier.
- Autor, David H. 2010. "The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings." Center for American Progress and the Hamilton Project.
- Autor, David H., Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *The Quarterly Journal of Economics*, 118 (4): 1279-1333.
- Autor, David H., Lawrence F. Katz, and Alan B. Krueger. 1998. "Computing Inequality: Have Computers Changed the Labor Market," *The Quarterly Journal of Economics*, 113 (4): 1169-1213.
- Autor, David H., Lawrence F. Katz, Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review Papers and Proceedings*, 96 (2): 189-194.
- Black, Sandra E., and Chinhui Juhn. 2000. "The Rise of Female Professionals: Are Women Responding to Skill Demand?" *The American Economic Review* 90 (2): 450-455.
- Foote, Christopher, and Richard W. Ryan. 2012. "Labor-Market Polarization Over the Business Cycle." Federal Reserve Bank of Boston Public Policy Discussion Series No. 12-8.
- Goldin, Claudia, and Lawrence F. Katz. 1998. "The Origins of Technology-Skill Complementarity," *The Quarterly Journal of Economics*, 113 (3): 693-732.
- Goos, Maarten, Alan Manning, and Anna Salomons. 2011. "Explaining Job Polarization: The Roles of Technology, Offshoring, and Institutions." University of Leuven, Center of Economic Studies Discussion Paper Series 11.34
- Goos, Maarten, and Alan Manning. 2007. "Lousy and Lovely Jobs: The Rising Polarization of Work in Britain." *The Review of Economics and Statistics*, 89 (1): 118-133.
- Jaimovich, Nir, and Henry Siu. 2012. "The Trend is the Cycle: Job Polarization and Jobless Recoveries," NBER working paper 18334.
- Kimmel, Jean, and Thomas J. Kniesner. 1998. "New Evidence on Labor Supply: Employment Versus Hours Elasticities by Sex and Marital Status," *Journal of Monetary Economics*, 42 (2): 289-301.
- Krusell, Per, Lee E. Ohanian, Jose-Victor Rios-Rull, and Giovanni L. Violante. 2000. "Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis," *Econometrica*, 68 (5): 1029-1053.
- Oldenski, Lindsay. 2012. "Off-Shoring and the Polarization of the Labor Market," mimeo, Georgetown University.