

Chicago Fed Letter

Growth in worker quality

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Improvements in the quality of workers due to changes in the distribution of education and work experience are among the key determinants of the economy's potential rate of growth. The rate of such improvements is thus of substantial interest to monetary and fiscal policymakers concerned with maintaining balance between aggregate supply and demand. It also is of importance to officials charged with planning the future of programs such as Social Security, whose projected financial condition is highly sensitive to assumptions about long-term economic growth.

In this *Chicago Fed Letter*, we provide estimates and forecasts of the rate of improvement in quality of the work force up through 2000, the latest data available. Consistent with previous research, we find that changes in the distribution of workers' education and work experience levels account for a significant portion of the growth in labor productivity. In particular, of the 2.7% average growth rate in labor productivity since 1965, we find that about 0.22 of a percentage point is attributable to the growth of labor quality. This contribution has fluctuated significantly over the last 35 years. For instance, as recently as the late 1980s and early 1990s improvements in worker skill levels were adding about 0.40 percentage points per year to the growth of output. However, by the end of the 1990s, this figure had fallen to about 0.18 percentage points. Our forecasts call for a further decline to about 0.05 percentage points by 2010.¹

What is worker quality?

Our measure of worker quality relies on economic models of human capital. Workers invest in productivity-increasing skills through formal education and on-the-job training. Moreover, firms hire additional labor until workers' marginal productivity coincides with their wage rate. This allows us to infer the effects of worker characteristics on productivity, which are not directly observable, from their effects on predicted wages. We use statistical models of wage determination to value additional years of education, experience, and other forms of human capital. Applying these value estimates to the changing distributions of human capital indicators yields estimates of the growth in average worker quality.

The last 35 years have seen several major shifts in the distribution of human capital characteristics of the labor force, most notably an increase in the share of college-educated workers and an influx of relatively inexperienced women and baby boomers in the 1970s. In addition, the nature of the skills learned through formal education and on-the-job training have changed, with, in particular, a tremendous increase in workers with computer skills in the 1980s and 1990s. Human capital models quantify the extent to which these transformations have caused the growth of total labor input to differ from that of raw hours worked. This difference is known as worker quality growth. It is positive when total labor input is growing faster than the raw total of hours worked.

Trends in human capital accumulation

We begin by documenting some of the broad trends in human capital accumulation that underlie estimates

of worker quality growth. We concentrate on the two most important factors: increases in educational attainment and fluctuations in the age distribution.

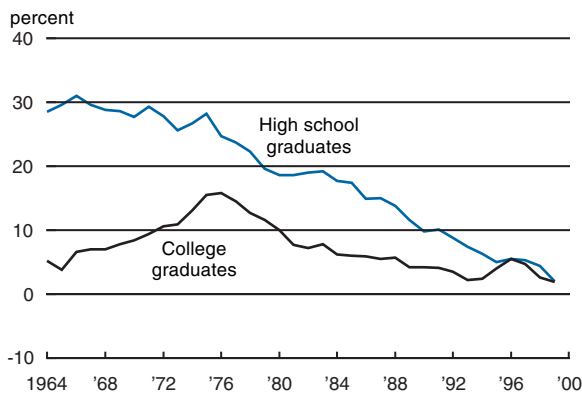
Education

U.S. levels of formal education have expanded greatly over the last century. During this period, high school graduation went from a rarity to the norm. College attendance and graduation rates also rose rapidly during the twentieth century, especially after World War II with the introduction of the GI Bill and increased growth in federal funding of higher education. Increasing graduation rates have led to a corresponding increase in the percentage of workers with high school and college education. In 1964, the beginning year for the data we use for this study, less than 58% of workers had completed high school or had a GED (general equivalency diploma).² By 2000, this figure was over 90%. In 1964, less than 12% of workers had college degrees. By 2000, more than 28% did. There were also healthy increases over the same period in the share of workers with at least some college education and with postgraduate education.

Though still significant, growth in average levels of education has slowed since its high point in the early 1960s and late 1970s. The increase in high school graduation rates has fallen relatively steadily from around 1.7 percentage points per year at its peak in the early 1970s to only about 0.1 percentage points in the last several years. Increases in college graduation rates have also declined over time, but the drop has been smaller.

The increase in average educational levels comes about for two reasons. First, younger workers entering the

1. Difference in worker graduation rates



Note: Graph shows difference in worker graduation rates, age 25 to 29 minus age 55 to 59.
 Source: Authors' calculations based on data from U.S. Department of Labor, Bureau of Labor Statistics, *Current Population Survey*, 1964–2000.

labor force are constantly replacing older workers reaching retirement age. The younger workers typically have more education. Second, some of those in the age ranges typically associated with working choose to acquire more education, often while continuing to work part or full time.

Figure 1 suggests that the effect of new entrants replacing retiring workers may be declining. Figure 1 plots the difference in high school and college graduation rates between those near the end of their careers (55 to 59 year olds) and those near the beginning of their careers (25 to 29 year olds). As the graph shows, in the 1960s, there was a more than 30-percentage-point difference between the high school graduation rates of older and younger workers. Likewise, the expansion of college graduation rates in the 1970s led to a more than 15-percentage-point difference between the college graduation rates of older and younger workers. These large gaps between workers entering and leaving the work force were a major factor behind the rapid growth of average educational attainment during those periods. But those differences, and their resulting implications for labor quality growth, had all but disappeared by 2000. This is one of the factors underlying the slower growth in average labor quality growth in the 1990s.³

Work experience

Workers' labor market experience is a second important determinant of skill levels. Until they reach their early 50s, workers' wage rates and, thus by inference, their productivity, tend to increase with age. These increases presumably reflect skills learned over time in the labor market. As a rough indication of the trends in labor market experience, figure 2 shows the average age of workers between 1890 and

2000. Consistent with greater life expectancies and lower birth rates, the average age of workers grew from 35 at the turn of the century to over 40 at its apex in the mid-1960s. However, starting in the late 1960s, the first of the large Baby Boom cohorts entered the labor force, causing the average age to drop for the next 20 years, reaching a bottom at around 37.5 in the early 1980s. As we show later, this drop in experience levels partially offsets the labor quality improvements arising from the tremendous gains in formal education during the 1970s. Since the early 1980s, the aging of the Baby Boom generation has helped to push the average age of the working population back to about 39.5, roughly where it was in the early 1970s.

The Worker Quality Index

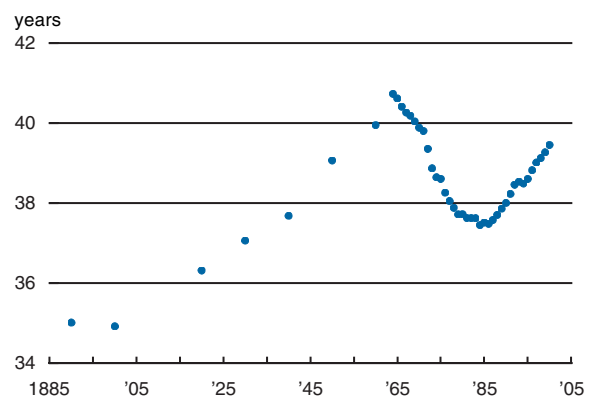
When we put these trends together, along with other changes in the composition of the working population, we come up with estimates of labor quality growth. Figure 3 displays these estimates for 1965 to 2000.

There are several notable features of figure 3. First, labor quality is somewhat countercyclical; peaks in the data occur near the troughs of recessions in November 1970, March 1975, November 1982, and March 1991. This is consistent with firms reacting to economic downturns by first dismissing low-quality workers, resulting in an increase in the aggregate quality of the working population (but not the full population). We would certainly expect to see a similar situation in 2001 and 2002.

However, as hiring heats up during expansions, low-productivity workers find employment more readily and labor quality drops. Typically, toward the end of expansions, we might expect to see labor quality growth slow even further, as the pool of available human capital is drained. This seems to have happened somewhat in the 1990s but not during the 1980s expansion.

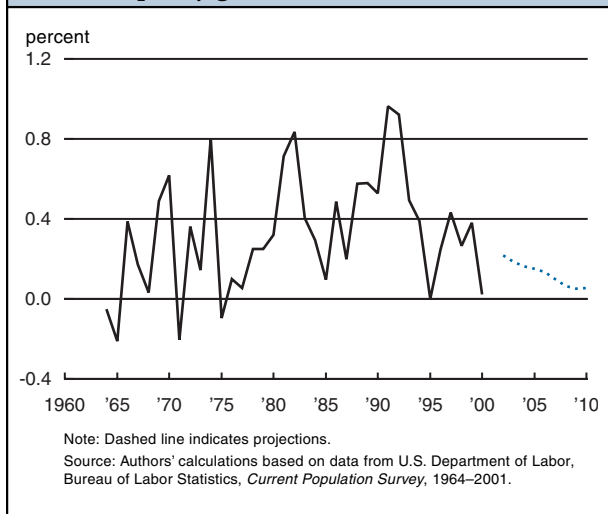
The extraordinary increase in educational attainment during the 1970s and 1980s offset any cyclical effect from the declining pool of high human capital. This brings us to the second notable feature of the data: the deceleration, acceleration, and deceleration of labor quality over the last three decades. During the late 1960s and 1970s, labor quality grew by approximately 0.2% per year. This coincides with the beginning of the post-1973 productivity slowdown,

2. Average age of the labor force



Source: Authors' calculations based on data from U.S. Department of Commerce, Bureau of the Census (1975) and U.S. Department of Labor, Bureau of Labor Statistics, *Current Population Survey*, 1964–2000.

3. Labor quality growth



which lasted for two decades. But the slowdown in labor quality did not last long. Beginning in the early 1980s, the U.S. experienced a sizable acceleration in labor quality growth, rising to 0.4% per year from 1979 to 1987 and close to 0.6% per year from 1988 to 1995. Since 1995, labor quality has decelerated to 0.27% per year, although there was a mild upturn (0.37% per year) from 1997 to 1999. In 2000, labor quality growth fell to 0. We can decompose the growth of overall labor quality into contributions due to education and experience, as well as other measurable changes, including gender, race, marital status, and part-time work.⁴ The overall trends in education and experience that we saw in figures 1 and 2 are readily apparent when we do this. The improvement in education attainment in the 1970s and 1980s was the sole positive contributor to labor quality growth, adding 0.54% per year between 1965 and 1985. The slowdown in education, particularly the lack of further progress in reducing the fraction of high school dropouts, resulted in a decelerating education component of labor quality growth of 0.30% per year after 1985 and 0.18% per year after 1995. The modest increase from 1997 to 1999 is the main contributor to the pickup in overall labor quality observed in that period.

Offsetting the big increases in education during the 1970s and 1980s was

effects of two long-running demographic trends, the continuing increase in the education levels of the labor force and the movement of workers toward experience levels associated with higher wages and productivity, partially offset by the typical pattern in a business-cycle expansion, the relatively faster employment growth of low-education and low-experience workers.

Figure 3 also shows our projections of labor quality growth. These are based on projections of the labor force. Thus, they are free from any variation due to changes in the level of unemployment. Consequently, they do not factor in the current economic slowdown. Although we believe there will be a temporary (unreported in the graph) increase in labor quality due to the cycle, we expect labor quality to decline as the decade progresses. By 2010, our estimate is for labor quality growth of only 0.07%, much below the average of the previous 35 years. Our forecast of a declining growth contribution from worker quality derives from two sources. First, we expect a slight decline in the rate of educational gains. Second, and more important, as the decade progresses, a significant portion of the Baby Boom generation will move beyond the highest earnings years that most workers experience in their early 50s. Indeed, by the end of the decade, the leading edge of the Baby Boom will

the drop in work experience resulting from the entry of the baby boomers. This cut 0.34 percentage points per year off labor quality growth from 1965 to 1980. However, as those workers moved into age ranges associated with higher relative earnings after 1980, the contribution of labor market experience averaged a positive 0.09 percentage points per year. Thus, the recent history up through 2000 represents the combined

be at an age associated with lower than average wage rates. At the same time, the age ranges associated with maximum wages and productivity will become populated with the smaller cohorts born in the late 1960s and early 1970s. As a result, changes in experience levels will turn from a positive to a negative factor for worker quality growth.

Conclusion

The characteristics of the labor force have changed significantly over the last 35 years. Combining these trends with shorter-run fluctuations associated with the business cycle, we provide information about growth in the quality of the work force from 1964 to 2000. We also forecast a slow demise in labor quality over the next decade. Fluctuations in labor quality growth have had a significant impact on trends in output growth. Thus, by quantifying the expected future gains in labor quality, we can improve forecasts of potential output growth. In addition, quantifying past gains in labor quality is vital to producing productivity growth estimates that constitute a meaningful measure of our economy's progress.

⁴For more detailed discussion and analysis, see Daniel Aaronson and Daniel Sullivan, 2001, "Growth in worker quality," Federal

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Reserve Bank of Chicago, *Economic Perspectives*, Vol. 25, No. 4, pp. 53–74. Other recent work on labor quality includes M. Ho and D. Jorgenson, 1999, “The quality of the U.S. work force, 1948–95,” Harvard University, mimeo, and U.S. Department of Labor, Bureau of Labor Statistics, 1993, *Labor Composition and U.S. Productivity Growth, 1948–90*, bulletin, No. 2426. Our methodology and data differ somewhat from these papers. This leads to some differences in

estimates of labor quality growth. However, the broad contours of our results agree reasonably well with earlier work for periods in which our results overlap.

²Data come from the March supplements to the *Current Population Survey*.

³In our *Economic Perspectives* article, we also discuss the importance of fluctuations in the size of birth cohorts and increased

educational attainment later in workers’ careers for changes in the growth of education levels.

⁴Of the latter measures, the increase in female labor force participation since the 1970s is the most dramatic change in the labor force. But even this has little overall impact on our labor quality growth estimates, cutting only about 0.03 percentage points per year over the full period.

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