Technology, Unemployment and Workforce Development in a Rapidly Changing World

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My colleagues from the Richmond Fed and I are in the Greensboro area for several days to meet with local business and community leaders to learn firsthand about emerging economic issues. Trips like these around our District are vital to our understanding of the dynamics of economic growth. In fact, what we have heard at other events and learned from other contacts motivates my talk with you here this evening. Before I begin, however, I need to note that the views I express tonight are my own and are not necessarily shared by my colleagues in the Federal Reserve System.[1]

In recent months, many of our business contacts have reported that although demand is beginning to increase, they are unable to respond as quickly as they would like due to an inability to find skilled workers. While the need for skilled workers may seem obvious in high-tech industries such as biotechnology or nanoscience — two industries that have a strong presence in North Carolina — the shortage of skilled labor appears to be more widespread. Businesses ranging from auto repair shops to hardware stores also have reported difficulty filling open positions.

The increasing demand for skilled workers across many industries is not a new phenomenon. Indeed, one of the first speeches I gave as president of the Richmond Fed was right here in Greensboro in 2005 on the subject of the effect of technology on labor markets.[2] At that time, I discussed the increasing gap in wages between high-skill and low-skill workers — what economists call the "skill premium." Between 1970 and 2000, the skill premium increased significantly, as did overall wage inequality. By 2000, full-time workers in the 90th percentile of wages were earning about four and a half times as much as those in the 10th percentile, compared to three and a half times as much in 1970.[3]

Skill-Biased Technological Change

The increase in the skill premium reflects changes in the supply of and demand for particular types of workers. Typically, an increase in the supply of something (in this case, skilled workers) decreases the price (in this case, the wage). While the number of college graduates grew

significantly in the second half of the 20th century, the price for their labor also continued to increase. [4] This must mean that the relative *demand* for their services was growing even faster than the supply.

Economists have traced the increase in the relative wages of skilled workers to a phenomenon called "skill-biased technological change," which occurs when new technologies increase the productivity of skilled workers relative to less-skilled workers. Many of today's factory floors, for example, feature "computer numeric controlled" machines, which require a specialized knowledge to operate. A worker with these skills can produce more output in less time than a worker operating more traditional manufacturing equipment.

Manufacturing employment has been declining steadily for several decades, which illustrates another feature of skill-biased technological change: It can be disruptive for workers who find that the demand for their skills has declined. Job or wage losses are painful for those workers and communities that are affected. But the continual destruction and creation of jobs is part of the process that Joseph Schumpeter termed "creative destruction," by which the implementation of new technologies raises productivity and standards of living for the economy as a whole.

Recessions disturb that process, as gross job destruction increases sharply and gross job creation initially falls. As the economy recovers, job destruction falls and job creation gradually picks up, leading to a return of net job creation. This certainly characterizes the recession we just went through. Although the job destruction rate is actually *below* its prerecession levels, the job creation rate remains historically low, and thus, net employment gains have been relatively weak over the course of this recovery.

Further research conducted since my 2005 speech has added some nuances to the story of skill-biased technological change. For example, if we define skill by educational attainment, only workers with post-graduate degrees experienced consistent real wage gains since the 1960s. Workers with lower educational attainments saw their wages increase overall since the 1960s, but they also experienced intermittent periods with declining or stagnant wages. If on the other hand, we define skill by the ranking in the income distribution, the wage gap between the 90th and 10th percentiles has continued to increase. But even this comparison between low and high income groups hides changes in the middle of the income distribution. Again, only the upper income groups saw consistent real wage gains for the period since 1960. The pattern for the lower income groups is more complicated. In particular, while the 50/10 gap — the gap between workers at the median and the bottom of the distribution — also increased before the 1990s, it has narrowed since. This apparent "wage polarization" since the mid-1990s — wage gains for the lowest and highest income groups, but stagnant wages for the middle groups — has raised some questions about the simplest models of skill-biased technological change. It suggests a more complex picture that distinguishes between skills, which are inherent to the workers, and tasks, which are inherent to jobs.[5] If technological change makes certain tasks more vulnerable to automation, then the workers assigned to those tasks will be displaced and may have to accept new jobs at lower wages. In this case, mid- or even higher-skilled workers may be adversely affected by technological innovation if their tasks are routine from an IT perspective.

Labor Markets After the Great Recession

As you probably know, this recent recession was the most severe since the Great Depression, and job losses were felt across all skill levels and demographic groups. The unemployment rate rose from about 4-½ percent before the recession to over 10 percent in late 2009. Only in the past six months has the unemployment rate fallen below 9 percent, most recently to 8.1 percent in April. More than 40 percent of those unemployed — approximately 5.1 million people — have been looking for work for more than six months. By historical standards, this recovery has underperformed on net job creation.

Many economists have tried to determine the extent to which elevated unemployment reflects a broad deficiency in spending, which presumably could be offset through monetary policy stimulus or instead reflects changes in economic fundamentals, such as the decline of certain industries, changing technologies or demographic shifts. Sometimes the former is referred to as "cyclical unemployment," and the latter is referred to as "structural unemployment." But these terms can be quite misleading because cyclical downturns are often associated with substantial shifts across economic sectors. Indeed, the proximate cause of the last recession was a collapse in residential construction and related industries, which have yet to recover and are unlikely to recover fully anytime soon, given the substantial remaining overhang in housing inventory. The broader point to bear in mind is that recoveries are not always the mirror image of the contraction that preceded them.

While quantifying the contributions to unemployment of structural economic factors versus spending is quite difficult, our sense is that structural factors are playing a considerable role. As I mentioned earlier, we have heard from a number of employers who are having trouble hiring, despite the large pool of unemployed workers, and surveys by other Reserve Banks have reported this same finding. This suggests that there is some degree of "mismatch" between the skills demanded by employers and the skills available in the pool of potential workers.

Skills Mismatch

This mismatch argument is not based solely on anecdotes, though. One broad quantitative measure of mismatch comes from what's called "the Beveridge curve," which refers to the relationship between unemployment and vacancies. Since the recession ended, that curve has departed from its prerecession position. Typically when the number of vacancies is low, unemployment is high, since workers are competing for a limited number of open positions. Conversely, when vacancies tend to be high, unemployment tends to be low. At present, however, both the unemployment and vacancy rates are relatively high, which suggests that unemployed workers are not finding jobs as rapidly as usual, despite the large number of open positions. This apparent outward shift in the Beveridge curve suggests that labor markets have become less effective at matching workers and vacancies. Empirical estimates suggest that this reduced efficiency could account for between ½ and 1-½ percentage points of unemployment.[6]

What could account for the reduced effectiveness of labor market matching? One widely cited report by New York Fed economists estimates that the misallocation of workers across different

job markets could account for between 0.6 and 1.7 percentage points of the total rise in the unemployment rate.[7] This might seem to be a small difference, but in the context of a 5-½ percentage point increase in the unemployment rate in this recession, 1.7 percentage points is, in fact, sizeable.

It's worth noting that research such as the New York Fed study typically relies on data based on the occupational categories used for government statistical reporting, many of which include a wide range of positions — some of which are in high demand and some of which are not. Aggregating these jobs together can obscure the degree of mismatch that actually exists. Moreover, reports from our contacts suggest that changing skill requirements *within* industry sectors is important as well. Many construction firms, for example, are seeking skilled tradesmen or workers with expertise in new environmental technologies. One widely used metaphor for the existence of mismatch is the costliness of turning construction workers into nurses — but it also may be difficult to turn the construction workers of yesterday into the construction workers of tomorrow.

In this context, the rise in long-term unemployment across a wide range of occupational and industry groups provides additional evidence that mismatch is an important factor restraining labor market performance. Economists at the Richmond Fed have studied the rate at which workers "exit" from unemployment — that is, the likelihood that a given worker finds a job in the next period. Some workers enter unemployment with high exit rates — they are able to find jobs relatively quickly. Some workers enter unemployment with low exit rates.

Using detailed population survey data, our Bank's researchers were able to infer the sizes of these different groups of workers each month as well as the rates at which they find jobs and exit from unemployment. Their results indicate that, similar to past recessions, the increase in unemployment was attributable mainly to the decline in job-finding rates for both groups. But they also found that a large portion of the dramatic rise in long-term unemployment can be explained by the *relative* decline in the exit rates of workers who began unemployment with an inherently low exit rate. Between 1-½ and 2-½ percentage points of increased unemployment in the most recent recession is attributable, in their framework, to the decline in the relative exit rate of hard-to-employ unemployed workers. This is consistent with the idea that many of the long-term unemployed had been working in declining industries or occupations and cannot easily transfer their skills to newly available jobs.[8]

Policy Responses

What does the preceding discussion suggest about possible policy responses to current labor market conditions? One standard option is to increase unemployment insurance benefits in order to offset households' loss of purchasing power. Congress routinely expands such benefits in response to recessions, and this recession has been no exception. It's worth pointing out, however, that as beneficial as such insurance programs can be, they also can affect the incentives to look for work or accept employment offers. Thus, they may actually increase the unemployment rate and the duration of unemployment. These potential costs have to be weighed against our desire to help those who are suffering from job loss. We should also keep these incentive effects in mind when interpreting unemployment rate data. Recent estimates suggest

that between 0.8 and 1.7 percentage points of elevated unemployment may be attributable to extended unemployment benefit programs.[9]

It's worth noting, by the way, that the effects of unemployment insurance benefits together with the effects of labor market inefficiencies could plausibly account for a quite substantial portion of our elevated unemployment rate. The quantitative estimates of labor market mismatch come from independent methods and datasets and, in principle, measure conceptually distinct inefficiencies. We shouldn't necessarily assume these effects are additive, but combining all three together yields a range of 2.9 to 5.9 percentage points, which is sizable relative to the increase in the total unemployment rate of 5-½ percentage points during the recession.

Another option is accommodative monetary policy in an effort to boost aggregate spending. The Fed has kept its target for the federal funds rate at between zero and 25 basis points since the end of 2008 and has engaged in a variety of asset purchase programs in an effort to provide additional stimulus to the economy. Some commentators are urging the Fed to take additional action as long as the unemployment rate remains elevated. But if elevated unemployment reflects largely fundamental factors rather than insufficient spending, such stimulus might have little impact on unemployment and instead just raise the risk of pushing inflation up.

The notion that skills mismatch is constraining labor market improvements suggests a third policy approach: investing in job training and education. While perhaps not a quick resolution to the current unemployment problem, I believe such investments are likely to yield greater benefits for both workers and the economy as a whole than efforts aimed at providing short-term stimulus. As I have noted, improvement in the skill level of the workforce eventually leads to both higher productivity and wages.

However, we should be careful to not simply throw more training dollars at our workforce. Even relatively high levels of education are no guarantee against workforce displacement due to technological change, as demonstrated by the recent deterioration in incomes near the median of the wage distribution. And to the extent that there is mismatch within rather than across sectors, programs designed to turn former mortgage brokers and construction workers into nurses and solar panel installers may not get at the heart of the problem. Instead, we should think carefully about the strategies that are likely to create the best matches between employers and employees.

Workforce Development

One type of education that clearly seems to be effective — although it might not be the first thing that comes to mind when thinking about job training — is early childhood education. Decades of research, including a seminal study conducted at the University of North Carolina at Chapel Hill, have shown that programs that promote cognitive development in early childhood can have a profound impact on lifelong skill attainment. Investments in early education have the potential for compounding, since they enhance the ability of a child to learn throughout his or her lifetime. I believe there is a strong case for making early childhood education affordable and widely available.

The case for federal investment in large-scale job training programs later in life is less clear, because there are questions about the ability of a government agency to independently identify and target the appropriate skills. Instead, we should look to demand-driven programs that are closely linked to local business conditions and labor markets, or that pair investments in human capital with investments in physical capital.

There are many examples of such programs in the Richmond Fed's Fifth District, particularly in North Carolina — which in 1958 became the first state to offer company-specific customized training programs. These programs have been the bread and butter of the state's community college system, and North Carolina remains a national leader in workforce development training.

Guilford Technical Community College, where we'll be visiting tomorrow, works with companies such as Machine Specialties Inc., TIMCO and HondaJet to ensure that the students at its Advanced Manufacturing Training Facility are learning the skills that these employers really need. At Central Piedmont Community College, students in Apprenticeship 2000 complete a four-year training program that ends with the promise of a job at one of the program's partner companies. CPCC is also the first community college in the United States to offer training programs certified by the German Chamber of Commerce and Industry, with the goal of making workers a better match with the 500 German companies in the Carolinas — 200 of which are in the Charlotte area.

Others are also stepping in to support these efforts. The Golden LEAF Foundation, for example, is developing a new "mid-skills" training initiative to prepare students for jobs in high-demand areas such as welding, machining, automation, and industrial systems and maintenance. The Foundation looks to provide up to $8 million in 2012–13 to support community colleges and other direct training providers, and it is working closely with the private sector to ensure that the programs are tied to identifiable employment opportunities.

Training programs like these throughout the Piedmont Triad area and North Carolina provide useful examples of public-private human capital investments that are responsive to changing local economic conditions. Although manufacturing employment in the state has declined nearly 50 percent in the past two decades, we are now seeing an influx of aerospace and other high-tech manufacturers, as well as a host of new workforce development initiatives to complement them.

These are exemplary responses, in my view, to the challenge posed by current labor market conditions. Because they are locally based and paired with investments in physical capital, they seem much more likely to provide training that can lead to productive employment. And the range of coursework provided through the community college system means that technology-specific training can be complemented with more general skill development in science, mathematics and language skills, which can benefit workers beyond their next job.

Labor Markets in a Rapidly Changing World

The unavoidable reality facing modern labor markets is the rapidly changing world in which they function. The astonishing current pace of technological innovation means there is always a risk that skills demanded today will not be demanded tomorrow. But by the same token, new skills

are likely to be needed to implement the innovations that enhance productivity and raise standards of living over time. While this Schumpeterian process can be costly to displaced workers, the microeconomic perspective that I have outlined tonight suggests that additional fillips of aggregate spending are unlikely to be an effective policy response. Sometimes, the best response to an ailing garden is not to simply water more often; sometimes, it's more useful to roll up your sleeves and give each plant the water, nutrients and careful cultivation that match its specific needs.

These emerging models of workforce development might not offer a rapid solution to the problem of elevated unemployment, or immediate relief to the millions of Americans who have been out of work for far too long. Even in the best of circumstances, the process of transferring workers to different occupations and industries takes time. But, the future health of the labor market and the resilience of the economy as a whole are likely to be best served by human capital investments that are well-adapted to the diffuse, local nature of emerging economic opportunities.

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[1] I am grateful to Jessie Romero and Andreas Hornstein for assistance in preparing these remarks.
[2] Jeffrey Lacker, "Technology and Labor Markets." Speech at the University of North Carolina at Greensboro, January 18, 2005.
[3] David Autor and Daron Acemoglu, "Skills, Tasks, and Technologies: Implications for Employment and Earnings," in *Handbook of Labor Economics*, Orley Ashenfelter and David Card, eds., Amsterdam: Elsevier, 2012. Data may differ slightly from those reported in 2005 due to data revisions and sampling methods.
[4] The exception is a few years during the 1970s, a period of especially rapid growth in college attainment, when relative wages for college graduates actually declined.
[5] Autor and Acemoglu.
[6] Mary Daly, Bart Hobijn, Aysegul Sahin, and Rob Valletta, "A Rising Natural Rate of Unemployment: Transitory or Permanent?" Federal Reserve Bank of San Francisco Working Paper, September 2011. Some observers have noted the fact that the Beveridge curve appear to shift out in all recessions and argue, therefore, that such shifts are "cyclical." Shifts in the Beveridge curve represent reduced efficiency in labor market matching, though, even if they occur in conjunction with the business cycle. This illustrates why it is misleading to use the term "cyclical" to refer to spending fluctuations as opposed to fluctuations in fundamental structural factors, since the latter can easily vary over the business cycle as well.
[7] Aysegul Sahin, Joseph Song, Giorgio Topa, and Giovanni Violante, "Measuring Mismatch in the U.S. Labor Market," Federal Reserve Bank of New York Working Paper, October 2011.
[8] Andreas Hornstein and Thomas Lubik, "The Rise in Long-Term Unemployment: Potential Causes and Implications," Federal Reserve Bank of Richmond 2010 *Annual Report.*
[9] Daly, et al.