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Unemployment and Productivity

During the latter half of the 1990s, productivity grew at almost twice the pace of the preceding ten years. Widely attributed to developments in the information technology sector, this surge in productivity was accompanied by an unemployment rate that dropped to unusually low levels. Another example of this relationship between productivity and unemployment—though in the reverse direction—is the decade of the 1970s. Productivity growth slowed sharply in the early 1970s (and stayed low for several decades), while unemployment increased noticeably. While both productivity and unemployment do respond to other changes in the economy, these episodes make one wonder about the impact that independent (perhaps technology driven) changes in productivity might have on the unemployment rate. This *Letter* discusses some of the reasons put forward by economists to explain such a relationship. We begin by describing a theory of unemployment.

The search theory of unemployment

The theory starts with the assumption that workers have different skills and that jobs have different skill requirements. Workers need to find well-paying, desirable jobs, while firms need to find the most productive workers. Neither firms nor workers have all the information they need about the options available to them, so they must engage in search. Since search is costly and time-consuming, both firms and workers must use some of their resources to find a good match.

Workers are assumed to search only when they are unemployed. They face an uncertain environment (just as firms do). When a worker gets a wage offer, for instance, she must decide whether to accept it or continue searching for a better offer. Accepting the offer means forgoing the chance of a higher wage offer later, while continuing the search means losing the wages she would have earned if she had accepted the offer and started working. The wage at which the worker is indifferent between continuing the search and accepting the current job is called the reservation wage. The worker accepts all job offers above this wage and turns down all offers below it.

When a search is successful, that is, when there is a match between the needs of the worker and the firm, the worker leaves unemployment. However, existing matches sometimes fall apart, which leads to the worker becoming unemployed. At the equilibrium unemployment rate, the number of workers leaving unemployment equals the number of workers becoming unemployed.

A temporary effect

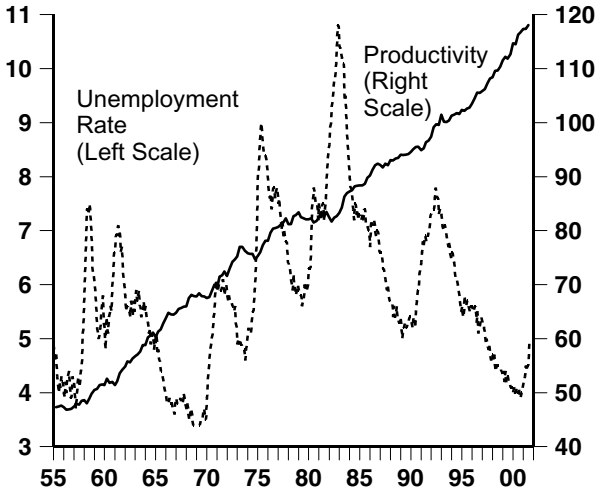
The relative level of the reservation wage is obviously a crucial determinant of the level of unemployment in the economy. If the typical worker's reservation wage is significantly higher than the typical wage offer, she will tend to turn down more offers and spend more time searching for a job. Consequently, the unemployment rate will tend to be higher.

The wage offered by the firm is directly related to the worker's productivity. Assume, now, that there is an economy-wide increase in productivity that workers are not aware of. The higher productivity makes it more attractive for the firm to increase employment and allows it do so by increasing the wage it offers to workers. This, in turn, increases the likelihood that the average worker will find an acceptable job offer and reduces the time she is likely to spend searching. Thus, the unemployment rate will decline in response to the increase in productivity.

This drop in the unemployment rate is unlikely to be permanent, however, even if there is no subsequent decrease in productivity. This is because workers will come to realize that all firms are offering higher wages than before, and, consequently, their reservation wage will gradually adjust to the higher level of wage offers in the economy. As this occurs, the level of unemployment will gradually go back to the level that prevailed before the increase in productivity. Of course, the reservation wage could adjust slowly, and so it could take a while for the unemployment rate to go back up to its original level. Even so, the key implication is that a change in the level of productivity cannot have a permanent effect on the level of the unemployment rate.

A simple, intuitive way to see the force of this argument is to examine the long-run behavior of the unemployment rate relative to the level of productivity. Even if we confine ourselves to the last half of the 20th century, we find that productivity has grown by a large amount, with no evidence of a trend in the unemployment rate (see Figure 1).

Figure 1
Productivity and unemployment



For instance, the unemployment rate in 2000.Q4 was approximately 4%, which is also the level that prevailed in 1956.Q1 and 1967.Q4. By contrast, the level of productivity (as measured by output per hour) in 2000.Q4 was nearly 80% higher than it was in 1967.Q4 and 150% higher than it was in 1956.Q1.

Some reasons to expect a permanent effect

Within the context of the search theory of unemployment, one way in which an improvement in technology could have a long-lasting effect on the unemployment rate is if it led to a permanent increase in the rate at which searching firms and workers "find" the right match. This is exactly what Gomme (1998) suggests that the Internet has done. Firms now routinely post vacancies on the Internet, so that workers can look for jobs in multiple (perhaps remote) locations at almost no cost. Saving (2000) notes that several million resumes are now estimated to be online and that the Internet is available to roughly half the U.S. population. These developments should help reduce the amount of time that firms and households have to spend searching for the right match, and so should help lower the equilibrium unemployment rate.

Changes in the long-run growth rate of the economy also can affect the equilibrium unemployment rate—even without a change in the search technology. The firm's decision to hire a worker involves balancing the costs of hiring that worker against the profits that will accrue once the worker is hired. As Pissarides (2000) points out, the hiring costs are incurred now, while the profits are realized over time. Other things equal, an increase in the trend rate of growth raises future profits and makes it attractive to increase hiring today. Thus, an increase in the trend growth rate will lead to a decrease in unemployment, while a decrease in the trend growth rate will lead to an increase in unemployment.

This result is sensitive to changes in certain assumptions underlying the model. For instance, Aghion and Howitt (1998) point out that technological progress does not occur evenly across sectors and that it tends to destroy old jobs at the same time that it creates new ones. If an increase in the pace of innovation actually increases the rate of job destruction more than it increases the rate of job creation, the equilibrium unemployment rate may actually go up.

Mortensen and Pissarides (1998) look at how technology affects unemployment in a model in which firms are assumed to lock in the existing technology when they create a new job. Because of technical progress, the technology embodied in a particular job becomes obsolete over time. The firm then has a choice of whether to spend the money to update the technology in the existing job (and this may involve retraining the worker) or to destroy the job. In their model, the cost of updating the technology is the key determinant of the relationship between productivity and unemployment. To take one example, if updating costs are prohibitively high, faster technical progress (which makes existing capital obsolete faster) leads to greater job destruction. Note that because job creation and destruction depend upon job updating costs which are likely to vary by firm and by industry, the model does not provide an unambiguous prediction about the relationship between economy-wide productivity growth and unemployment in the data.

The model by Manuelli (2000) provides perhaps the most direct link between the 1970s and the 1990s. In his model, an anticipated (but not yet realized) improvement in technology reduces the market value of existing firms, which causes firms to cut back on investment and job creation. Thus, the unemployment rate goes up. Once the new technology becomes available, firms begin to increase investment and create more jobs, causing the unemployment rate to fall. Manuelli argues that stock markets fell and unemployment rose in the mid-1970s partly because markets realized that new technologies were coming that would make existing ones obsolete. These new technologies (relating to computers and information technology) began to mature sometime in the 1980s, causing unemployment to fall and productivity to rise over time. His model does not predict a productivity slowdown in the 1970s, though others have proposed similar models that do.

Conclusions

Economic theory provides us with a number of reasons why the unemployment rate might be affected by a surge or a fall in the rate of productivity growth that is due to technological developments. However, at this point, we do not have a lot of evidence on the relative importance of the different links emphasized by different models. It will take further research to determine the relevant empirical magnitudes.

It is likely, though, that part of the decrease in unemployment during the second half of the 1990s represents a temporary response to the surge in productivity and the associated boom in the economy. To the extent that this is true, one should expect to see the unemployment rate stabilize above the lows seen during this expansion—even if productivity continues to grow at rates comparable to those achieved during the second half of the 1990s. The development of the Internet as a tool for job search, on the other hand, argues that the level of unemployment at which the economy settles—the equilibrium level—is likely to be lower than before. Once again, at this point it is hard to say how much lower.

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