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Does the large measured wage differential for on-the-job computer use (see Autor, Katz, and Krueger article summarized in this chapter) represent a true return to computer skills, or does it just reflect the fact that higher-wage workers use computers on their jobs? This article examines three large surveys of German workers, finding that the same techniques used to estimate the computer wage premium also show large wage differentials for using calculators, telephones, pencils, and chairs (i.e. working sitting down). These wage effects cannot represent payment for skill in the use of such common tools, since those skills are universal in Germany. This casts some doubt on the interpretation of computer-related wage differentials as returns to computer use or skill.

THEORETICAL FRAMEWORK AND DATA SETS

Studies estimating the wage differential for computer use (the authors refer primarily to the predecessor of the Autor, Katz, and Krueger article) have relied largely on cross-sectional data. The results of these studies are indirectly consistent with the view that there is a causal effect of computer use and skills on earnings. However, cross-sectional analyses do not provide direct evidence of any causal relationship; they establish an association between computer use and higher wages but not causation. The interpretation of the computer result as causal would be strengthened, however, if the use of more commonplace white-collar tools was not associated with a similar wage premium.

These studies of tools used are made possible by three detailed West German labor force surveys, conducted in 1979, 1985-86, and 1991-92. Each survey has almost 30,000 respondents, representing a cross section of the employed German population aged 16 to 65. Comparison to U.S. data shows that, while computer use was slightly slower to arrive in Germany, the fraction of German workers using computers in 1991 was close to the U.S. figure for 1989. The occupational and demographic patterns of computer use in the two countries are very similar.

WAGE DIFFERENTIALS FOR WORKPLACE TOOLS

Analysis of the wage differential for computer use in Germany, with and without controls for education, experience, gender, and other factors, yields results comparable to those for the U.S. The German wage premium for computer use is slightly lower; in both countries, the premium

increases over time. The similarity is noteworthy since the labor market is more regulated, pay setting more centralized, and the wage structure more compressed in Germany than in the U.S.

The German surveys included questions on the use of many other tools. In 1991, 44% of German workers used a calculator, 58% used a telephone, and more than 65% used a pen or pencil at work. About 30% used manual hand tools such as hammers, screwdrivers, paintbrushes, and hand-operated drills. The earlier two German surveys also asked how often workers sat down when at work.

Analyzing each tool separately leads to estimates of 9 to 14 percent wage differentials for the use of the simpler white-collar tools and for sitting on the job, compared to the 11 to 17 percent wage premium for computer use. Use of the blue-collar hand tools is associated with a 9 to 11 percent lower wage. Controlling for occupation reduces but does not eliminate the differentials; there is a 4 to 7 percent wage increase associated with the use of office tools, even within narrowly defined occupations. Controlling for secondary school grades and for father's occupation has almost no effect on the estimates, noting it less likely that the tools proxy simply for skill for skill.

Simultaneous analysis of the effects of all white-collar tools finds that each has a significant effect. The computer differential remains among the largest, but the differentials for telephone use and for sitting on the job are also substantial. This means that the other tools do not just pick up the effect of computer use when this variable is not included. The computer effect is increasing over time, while the effects of some of the other tools are decreasing, possibly indicating a changing role for computers in the workplace.

BEYOND THE TREATMENT EFFECT

Discussion of the causal effect of computerization on wages often makes the implicit assumption that it is possible to measure the "treatment" effect of computer use. This term is borrowed from the medical literature, where it refers to the change in outcomes if a person is given a treatment, such as a drug. Clinical trials typically involve random assignment of people to the treatment or control groups, allowing identification of the treatment effect as the difference between the outcomes for the two groups. This is not the same as observing the difference in outcomes between people who have chosen to receive the treatment and those who have not, since choices about the treatment may be far from random.

In the case of computers, there is no possibility of randomly assigning computers to a group of previous nonusers and then comparing their wages to a control group. Even if it were logistically possible, such a study would encounter the problems that computers are of value only in some jobs, and in conjunction with some skills. Of course, if people with the appropriate skills seek out and obtain the jobs that use computers, the wage premium could be interpreted as a return to skills; this return was roughly 19 percent in the United States in 1989 and 17 percent in Germany in 1991 (ignoring the controls for all the other factors discussed above).

However, the same logic fails when applied to simpler tools. The basic literacy required for pencil use is essentially universal in Germany, so the estimated return to pencil-using skills

should be zero. Instead, pencil use is associated with a 13 percent wage premium, which is difficult to interpret as a return to a skill. Alternatively, the finding about pencils can be taken "as an indication that there is substantial selection in who uses office tools: they are used predominantly by higher paid workers... [I]f this type of selection is important for pencils or calculators or telephones, then we should probably expect it to be equally important for computers." (301)

One possible response to this problem is to estimate wage growth for workers who start using a computer for the first time. Empirical results in this area are ambiguous; and even a strong positive finding would not rule out the possibility that computer use is a proxy for some other, unrelated skill or job attribute.

In summary, there is no solid proof of the existence of a computer treatment effect -- i.e., there is no evidence that giving someone a computer increases their productivity and wages, holding everything else constant. Computers may nonetheless influence work and wages in many ways. Like other new technologies, the spread of computerization changes the types of work being performed and the skills expected of workers in general. In some cases, computerization of suppliers or customers of a firm may be as important as changes in the technology used by the firm itself. All this can affect the job and the wages of an individual worker, whether or not that worker is using a computer for the first time. "[T]here is no clean link between the influence of technology on wages and the computer treatment effects on workers, even if we can estimate this latter effect consistently." (303)