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ECONOMY

Robots Seem to Be Improving Productivity, Not Costing Jobs

by Mark Muro and Scott Andes

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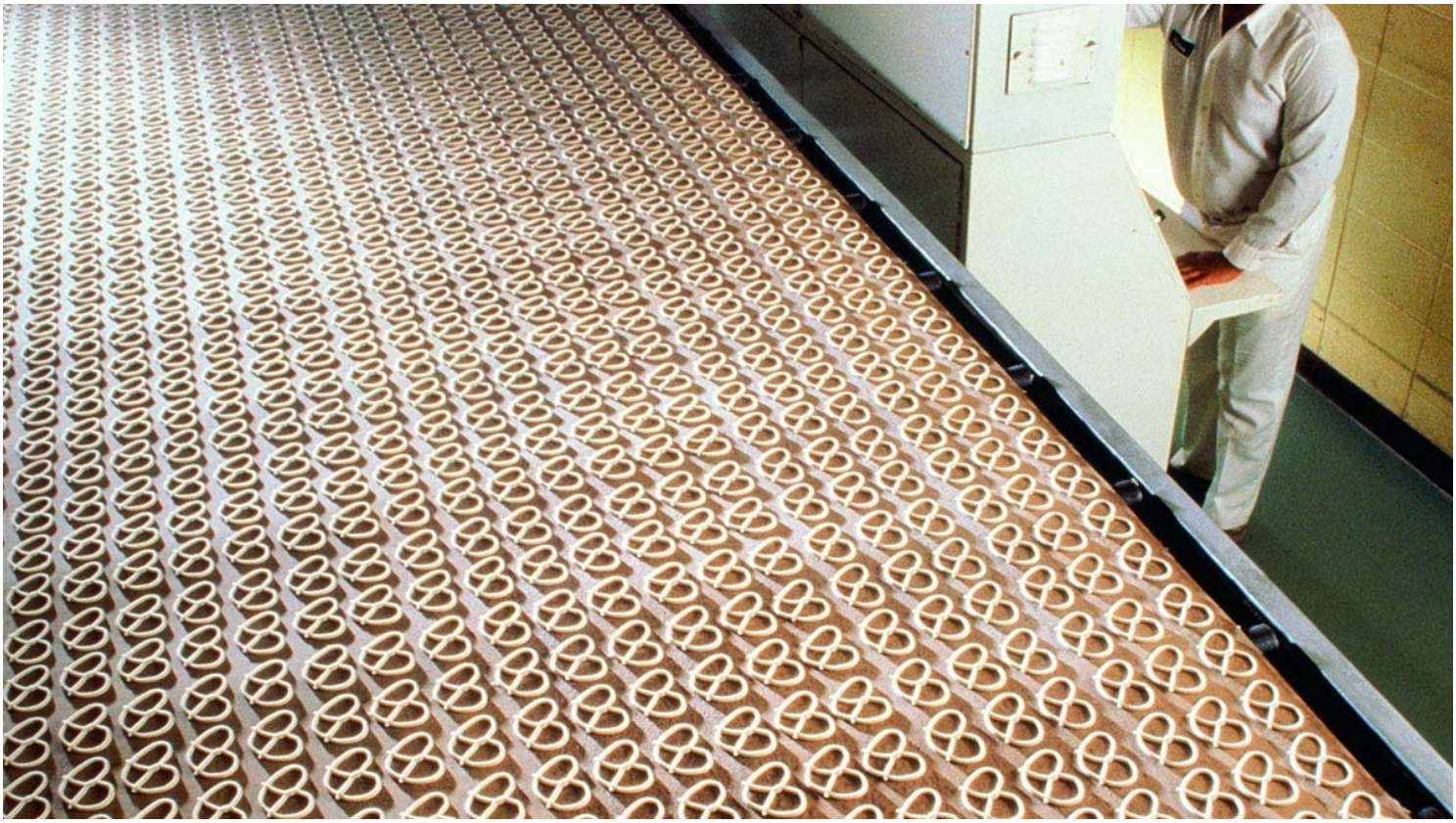


Nearly 30 years ago, in 1987, the Nobel-winning economist Robert Solow surveyed the impact of IT on the economy and concluded that "you can see the computer age everywhere but in the productivity statistics."

Solow's quip crystallized a frustrating disconnect in the 1980s. Why did an observed technology boom coincide with a prolonged slump in the productivity data? Companies were using computers, but they didn't seem to be getting any more productive.

Strangely, it took another seven years for U.S. productivity growth to surge. At last, the computers Solow and everyone else saw around them had become visible in the statistics. It just took a while.

Well, here we go again. Now robots are everywhere — but they are also an object of confusion.

In early April the think tank Third Way published research by Henry Siu and Nir Jaimovich that blamed robots and automation for the fact that many repetitive jobs have all but vanished from the economic recovery. And yet, as Larry Summers noted recently, for all of the anecdotal evidence that automation is prompting mass layoffs and presumably increasing productivity, the "productivity statistics over the last dozen years are dismal."

Again, something is failing to compute. And what's more, the fact that there hasn't been much macroeconomic research on the impact of robots has only added to the confusion. Commentators have largely been forced to rely on anecdote.

However, empirical evidence is beginning to trickle in that could begin to clear up the current paradox. Provided in a new paper from London's Center for Economic Research, the analysis offered by George Graetz and Guy Michaels of Uppsala University and the London School of Economics, respectively, offers some of the first rigorous macroeconomic research and finds that industrial robots have been a substantial driver of labor productivity and economic growth.

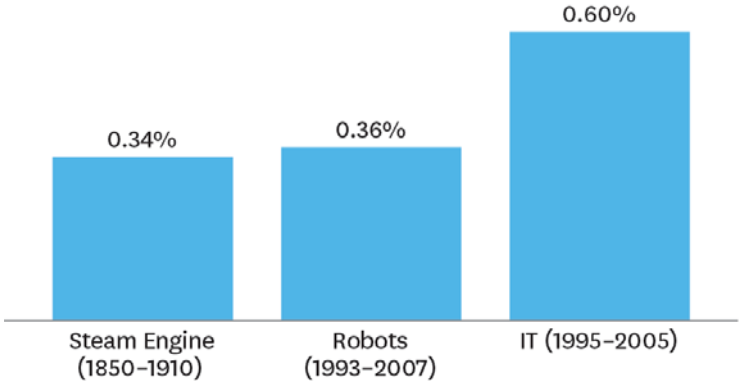
To fuel their analysis, Graetz and Michaels employ new data from the International Federation of Robotics to analyze the use of industrial robots across 14 industries in 17 countries between 1993 and 2007. What do they find? Overall, Graetz and Michaels conclude that the use of robots within manufacturing raised the annual growth of labor productivity and GDP by 0.36 and 0.37 percentage points, respectively, between 1993 and 2007. That might not seem like a lot but it represents 10% of total GDP growth in the countries studied and 16% of labor productivity growth over that time period.

Moreover, to put that gain in context, it's worth noting that the robots' contribution to productivity growth in the 1990s and 2000s is comparable to that of a true "general purpose technology" (GPT) — one that has a pervasive, longstanding impact on a number of dissimilar industries. Graetz and Michaels calculate, for example, that robotics have of late increased labor productivity by about 0.35% annually — or by about the same amount as did the steam engine, a classic example of a GPT, during the years 1850 to 1910.

More recently, other analysis has shown that the pervasive IT revolution supported 0.60% of labor productivity growth and 1.0% of overall growth in Europe, the U.S., and Japan between 1995 and 2005. That's about two to three times the amount contributed by robotics thus far but capital investment rates in IT during those years were also five times higher than those in industrial robots during the 1993 to 2007 period. As many economists have noted, productivity figure are often quite difficult to calculate in new technology categories, and could be larger or smaller than official estimates. Nonetheless, to the extent that one can trust today's flawed productivity data, Graetz and Michaels' work suggests the young robotics revolution is going to be a very big deal.

Robots' Impact on Productivity Is Already Significant Compared to Other Major Technologies

TOTAL PERCENTAGE CONTRIBUTION TO ANNUAL LABOR PRODUCTIVITY GROWTH RATES



SOURCE NICHOLAS CRAFTS, "STEAM AS A GPT: A GROWTH ACCOUNTING PERSPECTIVE," 2004; MARY O'MAHONY AND MARCEL P. TIMMER, "OUTPUT, INPUT, AND PRODUCTIVITY MEASURES AT THE INDUSTRY LEVEL: THE EU KLEMS DATABASE," 2009; GEORGE GRAETZ AND GUY MICHAELS, "ROBOTS AT WORK," 2015 © HBR.ORG

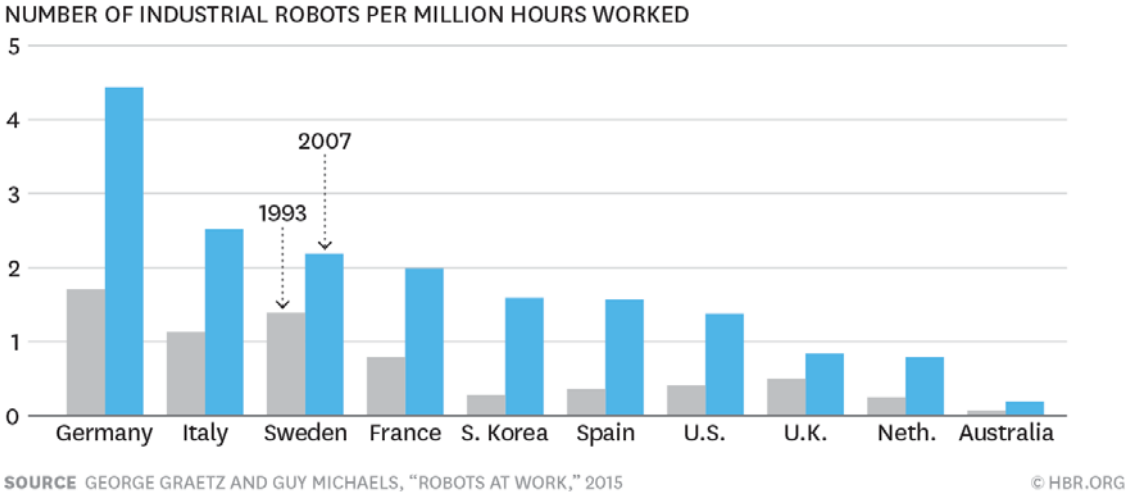
And yet, there is another critical question that needs asking, and that is whether the robots' productivity impacts are resulting in job losses.

Consider that between 1993 and 2007 (the timeframe studied by Graetz and Michaels) the U.S. increased the number of robots in use as a portion of the total hours of manufacturing work (a standard measure of economic output) by 237%. During the same period the U.S. economy shed 2.2 million

manufacturing jobs.

So is there a relationship between the use of industrial robots and job loss? The substantial variation of the degree to which countries deploy robots according to Graetz' and Michaels' data should provide clues. If robots are a substitute for human workers, then one would expect the countries with higher investment rates in automation to have experienced greater employment loss in their manufacturing sectors. For example, Germany deploys over three times as many robots per hour worked than the U.S., according to Graetz and Michaels, largely due to Germany's robust automotive industry, which is by far the most robot-intensive industry (with over 10 times more robots per worker than the average industry). Sweden has 60% more robots per hours worked than the U.S. thanks to its highly technical metal and chemical industries.

Where the Robots Are

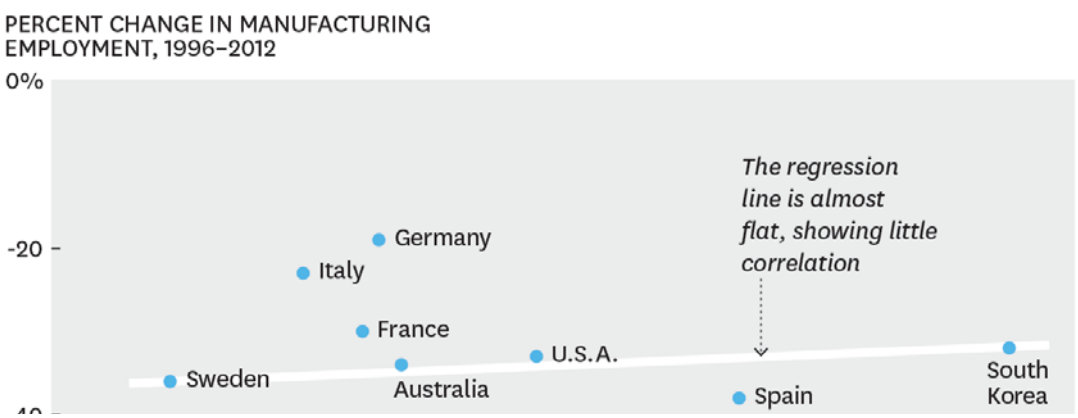


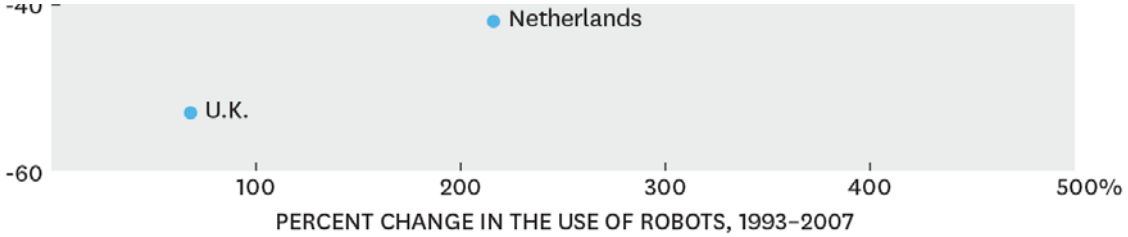
SOURCE GEORGE GRAETZ AND GUY MICHAELS, "ROBOTS AT WORK," 2015 © HBR.ORG

However, these data don't compute with expectations. By our calculations there is, as yet, essentially no visible relationship between the use of robots and the change in manufacturing employment. Despite the installation of far more robots between 1993 and 2007, Germany lost just 19% of its manufacturing jobs between 1996 and 2012 compared to a 33% drop in the U.S. (We introduce a three-year time lag to allow for robots to influence the labor market and continued with the most recent data, 2012). Korea, France, and Italy also lost fewer manufacturing jobs than the United States, even as they introduced more industrial robots. On the other hand, countries like the United Kingdom and Australia invested less in robots but saw faster declines in their manufacturing sectors.

For their part, Graetz and Michaels also see a lot of ambiguity when it comes to robotics' influence on the labor force. They cannot rule out that there is no effect of robot densification on national employment levels. But they do see variegated skill-biased impacts. Specifically, their data suggest that the arrival of robots tended to increase the employment and pay of skilled workers even as it seemed to "crowd out" employment of low-skill and, to a lesser extent, middle-skill workers. So while robots don't seem to be causing net job losses, they do seem to change the sort of workers that

So Far, There's No Relationship Between a Country's Use of Robots and the Percentage of Manufacturing Jobs Lost





SOURCE GEORGE GRAETZ AND GUY MICHAELS, "ROBOTS AT WORK," 2015; ANALYSIS BY MARK MURO AND SCOTT ANDES, BROOKINGS

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are in demand.

In the end, the new data are important because they dispel at least some of the robotics productivity paradox. Assuming more analyses fall into line with Graetz' and Michael's work it will be possible to say that robots have become visible in the productivity data — and that the data and observed realities match up and can be useful. In addition, the scale of the robots' impact — even with technology improvements racing along — suggests that robotics may well be a big thing: a general purpose technology that over time pervades the economy, spawns myriad new innovations, and elevates productivity for years, with major impacts on society. No, we're not there yet, as Summers notes, but the evidence suggests that day is coming. As to the bots' impact on employment, that is less clearly visible, and may be positive, negative, or mixed. Yet if the IT experience is any indicator, full adoption of a powerful technology can take a generation, and come after years of delay. In that sense, while it's early, the advent of the robots is beginning to conform to expectations.

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