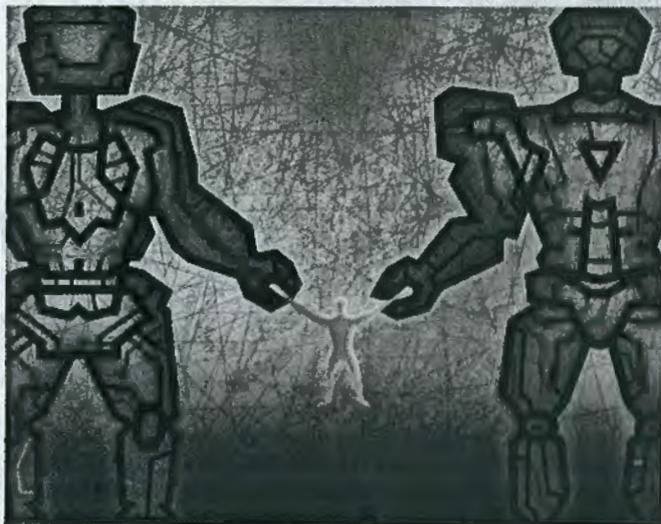


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Robots are getting more powerful. That need not be bad news for workers



WATSON, an IBM supercomputer, spectacularly beat its human rivals in a 2011 edition of "Jeopardy!", an American quiz show. It has got smarter since then. Its components have shrunk from room-size to briefcase-size; its processing speed has more than tripled. The sleeker, faster Watson is now being put to commercial use: its first application is suggesting treatments in cancer clinics. Many people fear that Watson exemplifies a trend toward the displacement of human workers by machines.

In a 2011 e-book called "Race against the Machine", Erik Brynjolfsson and Andrew McAfee of the Massachusetts Institute of Technology (MIT) worried that human workers would fail to adapt to the quickening pace of technological change. "The Lights in the Tunnel", a 2009 book by Martin Ford, a software entrepreneur, painted a bleaker picture still. Mr Ford noted that about 40% of Americans work in old-fashioned occupations—as nurses, book-keepers and the like. He argued that innovation will soon allow firms to eliminate millions of jobs, like the 3m-plus cashiers whose positions are threatened by automated cash registers, but will create few new opportunities for displaced workers.

But plenty of research suggests that innovation need not translate into a shrinking role for human labour. In a new paper David Autor, also of MIT, argues that the standard "production functions" used by economists to describe how things get made need sprucing up. These functions treat labour and capital like separate elements in a recipe: mix a tablespoon of skilled work with a dose of capital to produce a helping of GDP. In the real world, however, the distinction is blurred.

Mr Autor describes an alternative approach in which production is modelled as a series of tasks. A firm's challenge is to decide how to allocate them between capital and workers of varying skills, according to their respective comparative advantages. Assignments evolve over time as costs and technologies shift: an innovation may displace humans from some jobs, for instance, but make them more productive in others.

As technology improves, Mr Autor writes, a pattern emerges. Machines take over routine tasks like repeated number-crunching or the welding of car parts. Such jobs can be programmed into machines using detailed, specific instructions. Displaced human workers are then reassigned to do more improvisational or intu-

itive work. At airline check-in counters, say, computers are displacing employees from mundane tasks like printing boarding passes. That makes it easier for the humans to respond to unexpected problems like cancelled flights or changed itineraries.

Machines serve as both a substitute for, and a complement to, labour in other industries. Watson is initially assisting doctors to make cancer-treatment decisions, by providing options along with the associated degrees of confidence; it may eventually replace doctors in some diagnostic work. In other cases, robots may raise demand for doctors' services. A recent article in the *Journal of the American Medical Association* notes that though robotically assisted surgeries do not necessarily bring better results than minimally invasive human-only surgeries, it is much easier for doctors to learn and master robotically assisted techniques. Robot-aided surgery could therefore make some procedures cheaper and more widely available.

Historically, technological advances have been relatively benign for workers. Labour-market trends through the 19th and 20th centuries show surprising continuity, according to Lawrence Katz of Harvard University and Robert Margo of Boston University. In recent decades, for example, computerisation and automation have displaced "middle-skilled" workers at the same time as employment among high- and low-skilled workers has increased. This "hollowing out" is not new, Messrs Katz and Margo note. Early industrialisation had similar effects. Middle-skilled artisans, like trained weavers, were put out of work by industrial textile production, but the fortunes of less-skilled factory workers and white-collar factory managers steadily improved. Mechanisation's insatiable appetite for routine work of all types has yet to create mass unemployment. Quite the opposite.

The worry is that technology now has its sights set on non-routine tasks as well as mundane ones. Yet Mr Autor notes that just because a skilled job can be automated does not mean it will be. The number of workers used to build Nissan vehicles varies a lot between Japan, where labour is expensive, and India, where it is abundant and cheap. The relative cost of different types of workers matters for firms as they choose how to deploy new technologies.

The road to HAL

The incentives facing firms may also be changing, according to Daron Acemoglu of MIT, Gino Gancia of the Centre de Recerca en Economia Internacional in Barcelona and Fabrizio Zilibotti of the University of Zurich. They reckon that rich-world firms reacted to globalisation by using cheap labour abroad and investing in technologies that helped skilled workers at home. Apple, for example, has used skilled American engineers to design its products and low-cost foreign workers to make them.

Rising wages in emerging markets are now making it less attractive to send unskilled work abroad. The authors suggest this could mean a sharp change in the influence of innovation on labour markets. Firms may find it more attractive to invest in technologies that boost the productivity of less-skilled domestic labour, pushing up their wages. One day, clever robots may change this. But as long as humans retain the edge on cognitive flexibility, firms will keep putting willing workers to good use. ■

* Studies cited in this article can be found at www.economist.com/robots13