

in brief...

New technology: who wins, who loses?

Different technologies can have very different effects on the labour market. An empirical study by **John Van Reenen** and colleagues finds that information technologies, which provide access to stored data, tend to empower frontline workers, while communication technologies like email put more power in the hands of senior managers in corporate headquarters.

A century ago, an ambassador to a distant nation would effectively operate as a viceroy, empowered to make decisions including matters of war and peace. But declines in communication costs have transformed this once powerful office into a glorified sales position, requiring the passing of the 'Ferrero Rocher' at parties, but few other important decisions.

The same advances in information and communication technologies (ICT) that diminished the occupation of ambassador have been a godsend for others. The last time you visited your physician's practice, you may well have seen a nurse practitioner rather than a doctor. Thanks to the ICT revolution, a nurse can diagnose a vast number of complaints that previously required a more expensive and highly trained doctor.

How do the same technologies that hurt one job aid another? If they empower nurses, what is it about them that lead to ambassadors losing their influence?

The Janus-faced nature of new technologies


Some economists have assessed the impact of computers as a single technology (for example, Autor et al, 2003). Another strand of research argues that it is necessary to disaggregate the components of ICT to understand their impact on organisational structure and wages (for example, Garicano, 2000; and Caroli and Van Reenen, 2001). These studies analyse two separate effects of ICT stemming from the cost of accessing information stored in machines on the one hand and from the cost of communicating information between individuals on the other.

According to these theories, reductions in the cost of accessing information are a decentralising force, pushing power down the hierarchy and allowing frontline workers to solve more problems and rely less on the training of specialists. Thanks to databases like LexisNexis, para-legal lawyers can search the cases relevant to their clients without consulting overstretched senior partners.

In contrast, improvements in communication technology are a centralising force, pushing power up the corporate ladder. If people can communicate more cheaply, they will rely more on the help of bosses and solve fewer problems themselves. Individuals will specialise further and shopfloor workers will see the knowledge content of their work decrease. Individuals will learn less and ask for more direction. In particular, frontline people will rely more on headquarters.

These two changes will have different effects on wage inequality. Consider frontline workers. When information access is cheaper, they solve more problems and their time is worth more. On the other hand, when communication is cheaper, (for example, through email), they rely more on others and they become more of a 'machine' – their time is worth less.

This means that understanding the impact of technology on inequality requires analysis of whether quality is



Technology has transformed the once powerful office of ambassador into a glorified sales position

increasing more quickly in information technology or in communication technology. So how can we actually observe and separate these two different effects?

Confronting theory with data

In our study, we separate the two effects using firm-level survey data on autonomy and new technologies. We have information on the autonomy of the plant manager compared with the chief executive over key decisions on investment, hiring, sales and innovation, as well as their 'span of control' (how many people report directly to them). We also observe the power of production workers compared with plant managers over the tasks they do and their pace of work.

We explore the impact of different types of technology on decision-making within a firm. The idea we want to test is whether improved information technology increases autonomy whereas improved communication technology reduces autonomy. Two of the indicators of information technologies we look at are software for enterprise resource planning (ERP); and computer assisted design/computer assisted manufacturing (CAD/CAM).

ERP systems – such as those produced by Germany's SAP – are software applications that allow firms to store, retrieve and share information on any aspect of production, sales or other firm process in real time. These systems reduce the cost of acquiring information and, according to our theory, we would expect them to lead to increased decentralisation in favour of local plant managers.

We also expect that workers with access to CAD/CAM will be able to solve a wider range of production problems, and therefore have less need to check with their supervisors. CAD/CAM should increase their autonomy and, by reducing the amount of help they need from plant managers, increase managers' span of control.

A key technological innovation that reduces communication costs is the growth of corporate intranets. We expect these to increase centralisation, with plant managers making more decisions for workers and headquarters making more decisions for managers. We test whether the availability of intranets reduces decision-making autonomy in both the production decisions of workers and the non-production decisions of managers.



Nurses, teaching assistants and medical technicians all benefit from the ICT revolution

We find that the evidence is strongly supportive of the theory. Information technologies like ERP and CAD/CAM increase autonomy whereas communication technologies like intranets reduce autonomy.

What the future holds for workers

Over the next 20 years, different jobs will be affected very differently by ICT depending on their relative intensity in communication and information. If your job is in travelling sales or as the local head of a multinational, expect it to go the way of the ambassador as more and more of it is done at headquarters. On the other hand, if your job is a nurse, a teaching assistant or a medical technician, expect ICT to increase the range of what you do, the knowledge content of your job and its pay and prestige.

This article summarises 'The Distinct Effects of Information Technology and Communication Technology on Firm Organization' by Nicholas Bloom, Luis Garicano, Raffaella Sadun and John Van Reenen, CEP Discussion Paper No. 927 (<http://cep.lse.ac.uk/pubs/download/dp0927.pdf>) and forthcoming in *Management Science*.

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Further reading

David Autor, Frank Levy and Richard Murnane (2003) 'The Skill Content of Recent Technological Change: An Empirical Exploration', *Quarterly Journal of Economics* 118(4): 1279-1333.

Eve Caroli and John Van Reenen (2001) 'Skill-biased Organisational Change? Evidence from British and French Establishments', *Quarterly Journal of Economics* 116(4): 1449-92.

Luis Garicano (2000) 'Hierarchies and the Organization of Knowledge in Production', *Journal of Political Economy* 108: 874-904.