

What happens to people's careers when demand for their occupations declines, often as a result of technological change? **Guy Michaels** and colleagues' analysis of detailed occupational data on Swedish workers over several decades indicates that while average losses in earnings and employment are relatively moderate, low-earners lose significantly more.

When machines replace people:

individual consequences of occupational decline



On average, workers in declining occupations lose between 2% and 5% of cumulative earnings, compared with other similar workers

How costly is it for workers when demand for their occupations declines? As new technologies replace human labour in a growing number of tasks, employment in some occupations invariably falls. Until recently, technological change mostly automated routine production and clerical work (Autor et al, 2003). But machines' capabilities are expanding, as recent developments include self-driving vehicles and software that outperforms professionals in some tasks.

There have been many high-profile contributions to debates about the labour market implications of these new technologies (for example, Brynjolfsson and McAfee, 2014; and Acemoglu and Restrepo, 2018). But it is important to ask not only 'will robots take my job?', but also 'what would happen to my career if robots took my job?'

Much is at stake. Occupational decline may hurt workers and their families, and may also have broader consequences for economic inequality, education, taxation and redistribution. If it exacerbates differences in outcomes between economic winners and losers, populist forces may gain further momentum (Dal Bo et al, 2019).

In our research, we explore the consequences for workers' careers of large declines in employment in certain occupations. We assemble a dataset with

forecasts of occupational employment changes, which allow us to identify unanticipated declines; population-level administrative data spanning several decades; and a highly detailed occupational classification. These data allow us to compare outcomes for similar workers who perform similar tasks and have similar expectations of future occupational employment trajectories, but experience different actual occupational changes.

Our approach is distinct from previous work that contrasts career outcomes of routine and non-routine workers (for example, Cortes, 2016), since we compare workers who perform comparable tasks and whose careers would be likely to have followed similar paths were it not for occupational decline. Our work is also distinct from studies of mass lay-offs (for example, Jacobson et al, 1993), since workers who experience occupational decline may take action before losing their jobs.

In our analysis, we follow individual workers' careers for almost 30 years and find that on average, workers in declining occupations lose 2-5% of cumulative earnings, compared with other similar workers. Workers with low initial earnings (relative to others in their occupations) lose more: about 8-11% of average cumulative earnings.

These earnings losses reflect both lost years of employment and lower earnings conditional on employment. Some of the employment losses are due to increased time spent in unemployment and retraining – and low earners spend more time in both.

Consequences of occupational decline

We begin by assembling data from the Occupational Outlook Handbooks (OOH), published by the US Bureau of Labor Statistics (BLS), which cover more than 400 occupations. In our main analysis, we

Workers with low initial earnings lose between 8% and 11% of average cumulative earnings

define occupations as declining if their employment fell by at least a quarter between 1984 and 2016.

The OOH also provides information on technological change affecting each occupation, and forecasts of employment over time. Using these data, we can separate technologically driven declines as well as unanticipated declines. Occupations that declined include typists, telephone operators, drafters, assemblers and various machine operators.

We then match the OOH data to detailed Swedish occupations. This allows us to study the consequences of occupational decline for workers who in 1985 worked in occupations that declined over the subsequent decades. We verify that occupations that declined in the United States also declined in Sweden, and that BLS employment forecasts for the United States have predictive power for employment changes in Sweden.

Detailed administrative micro-data, which cover all Swedish workers, allow us to address two potential concerns for identifying the consequences of occupational decline: that workers in declining occupations may have differed from other workers; and that declining occupations may have differed even in the absence of occupational decline.

To address the first concern, about individual sorting, we control for gender, age, education and location, as well as 1985 earnings. Once we control for these characteristics, we find that workers in declining occupations were no different from others in terms of their cognitive and non-cognitive test scores and their parents' education and earnings.

To address the second concern, about occupational differences, we control for occupational earnings profiles (calculated using the 1985 data), the BLS forecasts and other occupational and industry characteristics.

Assessing the losses and where they fall

We find that prime age workers (those aged 25-36 in 1985) who were exposed to occupational decline lost two to six months of employment over 28 years, compared with similar workers whose occupations did not decline. The higher end of the range refers to our comparison between similar workers, while the lower end of the range compares similar workers in similar occupations. The employment loss corresponds to around 1-2% of average cumulative employment.

The corresponding earnings losses were larger and amounted to around 2-5% of average cumulative earnings. These average losses may seem moderate given the large occupational declines, but the average outcomes do not tell the full story. The bottom third of earners in each occupation fared worse, losing around 8-11% of average earnings when their occupations declined.

The earnings and employment losses that we document reflect increased time spent in unemployment and government-sponsored retraining – more so for workers with low initial earnings. We also find that older workers who faced occupational decline retired a little earlier.

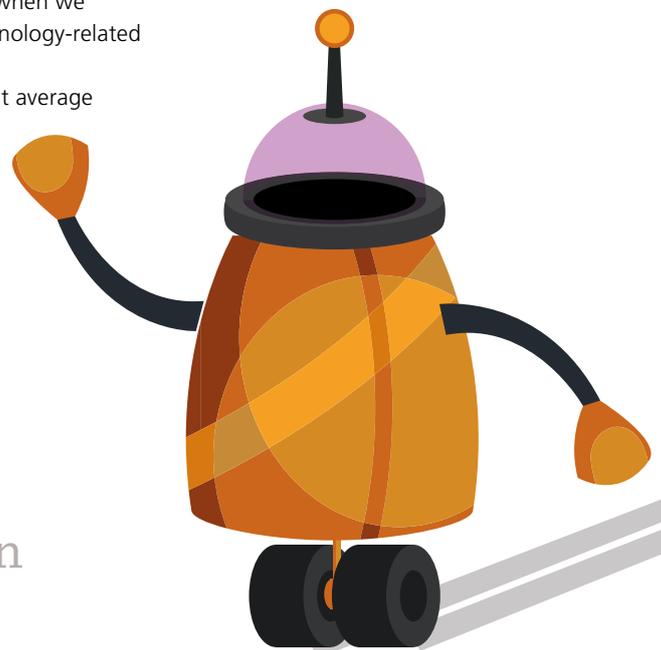
In addition, workers in occupations that declined after 1985 were less likely to remain in their starting occupation. It is quite likely that this reduced supply to declining occupations contributed to mitigating the losses of the workers that remained.

We show that our main findings are essentially unchanged when we restrict our analysis to technology-related occupational declines.

Further, our finding that average earnings and employment losses from occupational decline are small is not unique to Sweden. We

Workers aged 25-36 exposed to occupational decline lost two to six months of employment over the next 28 years

The earnings and employment losses reflect more time spent in unemployment and retraining



find similar results in a smaller panel dataset on US workers, using the National Longitudinal Survey of Youth 1979.

Conclusions

There is a vivid academic and public debate on whether we should fear the takeover of human jobs by machines. New technologies may replace not only factory and office workers but also drivers and some professional occupations.

Our study compares similar workers in similar occupations over 28 years. We show that although average losses in earnings and employment for those initially working in occupations that later declined are relatively moderate (2-5% of earnings and 1-2% of employment), low-earners lose significantly more.

The losses that we find from occupational decline are smaller than those suffered by workers who experience mass lay-offs. Because the occupational decline that we study took years or even decades, its costs for individual workers were likely to have been mitigated through retirement, reduced entry into declining occupations and increased job-to-job exits to other occupations. Compared with large, sudden shocks, such as plant closures, the decline may also have less pronounced effects on local economies.

While the losses we find are on average moderate, there are several reasons why future occupational decline may have adverse impacts. First, while we study unanticipated declines, the declines were nevertheless fairly gradual. Costs may be larger for sudden shocks following, for example, rapid evolution of machine learning.

Second, the occupational decline that we study mainly affected low- and middle-skilled occupations, which require less human capital investment than those that may be affected in the future. As a result, switching occupations may be more costly.

Finally, and perhaps most importantly, our findings show that low-earning individuals are already suffering considerable (pre-tax) earnings losses, even in Sweden, where institutions are geared towards mitigating those losses and facilitating occupational transitions. Helping these workers stay productive when they face occupational decline remains an important challenge for governments.

This article summarises 'Individual Consequences of Occupational Decline' by Per-Anders Edin, Tiernan Evans, Georg Graetz, Sofia Hernnäs and Guy Michaels, CEPR Discussion Paper No. 1629 (<http://cep.lse.ac.uk/pubs/download/dp1629.pdf>).

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Further reading

Daron Acemoglu and Pascual Restrepo (2018) 'The Race Between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment', *American Economic Review* 108(6): 1488-1542.

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.

Erik Brynjolfsson and Andrew McAfee (2014) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, WW Norton.

Guido Matias Cortes (2016) 'Where Have the Middle-Wage Workers Gone? A Study of Polarization Using Panel Data', *Journal of Labor Economics* 34(1): 63-105.

Ernesto Dal Bo, Frederico Finan, Olle Folke, Torsten Persson and Johanna Rickne (2019) 'Economic Losers and Political Winners: Sweden's Radical Right', working paper.

Louis Jacobson, Robert LaLonde and Daniel Sullivan (1993) 'Earnings Losses of Displaced Workers', *American Economic Review* 83(4): 685-709.



Helping workers stay productive when they face occupational decline is an important challenge for governments