

The potential to automate low-wage jobs in the U.S. and its impact on workers

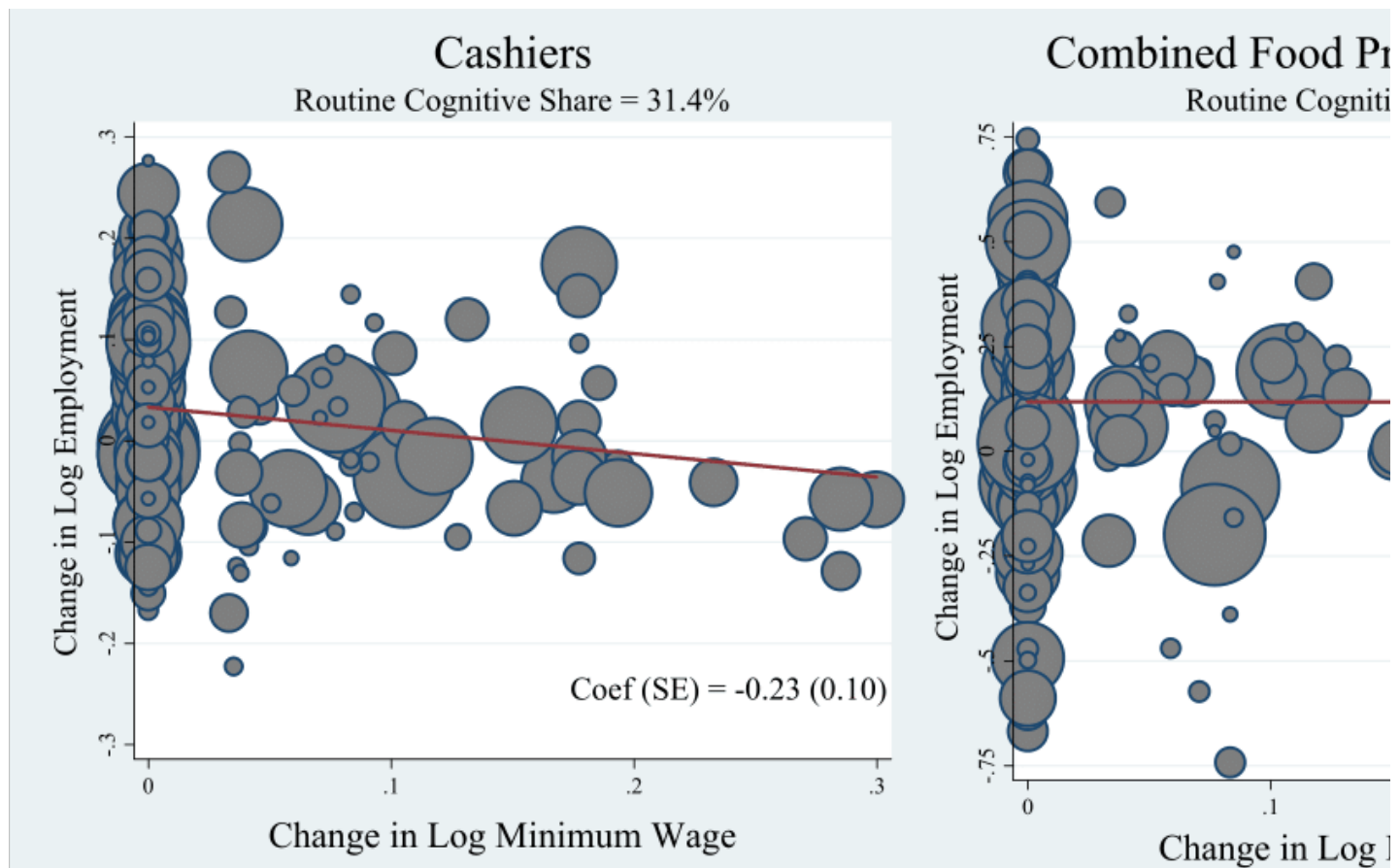


The extent to which firms can substitute labour with technology is a longstanding question that has grown in policy importance as automation technology spreads to a larger range of jobs. In our forthcoming paper, we contribute to this important issue by quantifying the potential to automate low-wage jobs in the U.S. labour market and examining its impact on low-wage workers.

Using changes in U.S. minimum wage laws between 1999 and 2009, which increase the cost of low-wage labour and make technology relatively more affordable, we find that minimum wage hikes expedite technological substitution in occupations that are especially intensive in routine cognitive tasks, like cashiers and clerks. However, the loss of such jobs is largely offset by employment growth in other similarly paid jobs – primarily low-wage occupations intensive in non-routine interpersonal tasks. Moreover, we find no evidence of technological substitution in occupations that are especially intensive in routine manual tasks, like food preparation and equipment operation. Thus, we find that the total short-run impact of automation on low-wage employment may be economically small even when technological substitution is taking place.

Figure 1 illustrates our core findings using two occupations that often work together in the same establishment: cashiers (left hand side) and food preparation workers (right hand side). For each of these occupations, we plot the change in the log of the minimum wage on the horizontal axis against the change in log of the employment level on the vertical axis, where the employment change covers a four-year period – allowing for some delay in the way firms respond to the minimum wage change. Each observation represents a state-year (e.g. California in 2003), with the size of the dot corresponding to the employment level. The figure shows that a 10 per cent increase in the minimum wage lead to an economically and statistically significant 2.3 per cent employment decline among cashiers. By contrast, we find no measurable effect among food preparation workers.

Figure 1. Employment effect of a minimum wage hike (cashiers vs combined food prep workers)



Notes: Using Occupation Employment Statistics data over the period 1999-2009 from the US Bureau of Labor Statistics, the figures plot the change in the log of occupational employment from four years prior against the one-year change in the minimum wage from three years prior. This structure allows minimum wage changes to have lagged effects on employment. Each observation is a state-year weighted by employment levels in the base year. Minimum wage hikes less than 0.03 log points are excluded from the figures.

Why would employment in these two occupations react differently to a change in the wage rate? We believe that this divergent set of results can be explained by the introduction of an automation technology that replaces jobs intensive in routine cognitive tasks but may be too costly to supplant occupations intensive in routine manual tasks. Moreover, we posit that the introduction of this new automation technology may actually require additional non-routine labour in order to be productive. This follows from the nature of automating low-wage jobs, which often moves some of the tasks previously performed by the employee onto the customer.

For example, the insertion of self-scanners at retail markets requires the customers to scan, bag, and complete the payment for their items. Thus, the new technology replaces cashiers but it also creates new jobs that require workers to assist or monitor customer usage with the technology. In such a setting, technological substitution stemming from a minimum wage hike will be characterised by falling employment at highly routinised low-wage jobs. But the total short-run employment effect is ambiguous due to the increased usage of non-routine positions. This prediction is consistent with many studies that find a small loss in jobs immediately following an increase in the minimum wage.

We test these predictions using data on all low-wage occupations between 1999 and 2009 from the U.S. Bureau of Labor Statistics' Occupation Employment Statistics. We find that the divergent employment experiences for cashiers and food prep workers are part of a more general pattern. Minimum wage hikes decrease employment in occupations that typically require a larger proportion of time spent on routine cognitive tasks. But we find no evidence of an employment response based on the extent to which an occupation is manually routine and we show that overseas outsourcing cannot explain these employment declines. At the same time, we find that the net employment effects of a minimum wage hike are indistinguishable from zero, which means that there is growth in other low-wage employment that is offsetting the decline in routine cognitive jobs. Consistent with our theoretical framework of low-wage automation, we find that the offsetting employment growth occurs in jobs that are intensive in interactive tasks and associated with helping customers such as Social and Human Service Assistants and Customer Service Representatives.

Finally, we see similar results when we examine the experiences of individuals in a second dataset, the U.S. Current Population Survey. We find that minimum wage hikes cause individuals employed in low-wage jobs to move to occupations with fewer routine cognitive tasks. However, the cost of this reallocation on individual workers appears to be relatively small with only mildly lower probabilities of subsequent employment and mildly lower wages compared to otherwise similar low-wage workers.

In summary, our results suggest that higher labour costs expedite technological substitution in low-wage occupations that are intensive in routine cognitive tasks. However, unlike the automation of middle-income occupations, low-wage automation does not appear to be nearly as costly to individual workers due to the offsetting employment growth of similar paying jobs. There are several important caveats worth stressing, however. First, the labour market dynamics that we describe are short-run in nature and there is growing evidence that minimum wages have larger disemployment effects in the longer-run. Second, as the cost of automation technology falls, including the growing acceptance of new technology by interfacing customers, it is possible that the disemployment effects of a minimum wage hike may become larger. We are in the process of replicating our analysis using data since 2010 to see if such a change is visible in the U.S.

Disclaimer: The views expressed in this blog post are not necessarily those of the Federal Reserve Bank of Chicago or the Federal Reserve System.



Notes:

- This blog post is based on the authors' paper [Wage Shocks and the Technological Substitution of Low-Wage Jobs](#), *Economic Journal*, 2018, forthcoming.
- The post gives the views of its authors, not the position of LSE Business Review or the London School of Economics.
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