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243 Report by Thilo Kroeger and Dominik Boddin

Employment in the context of structural change: same occupations, different sectors

- Loss of manufacturing jobs is overestimated when only the sector of employment is considered
- If workers remain in production-related occupations, income losses tend to be relatively small
- Policymakers should support transitions to similar jobs rather than focusing on preserving the industry

LEGAL AND EDITORIAL DETAILS



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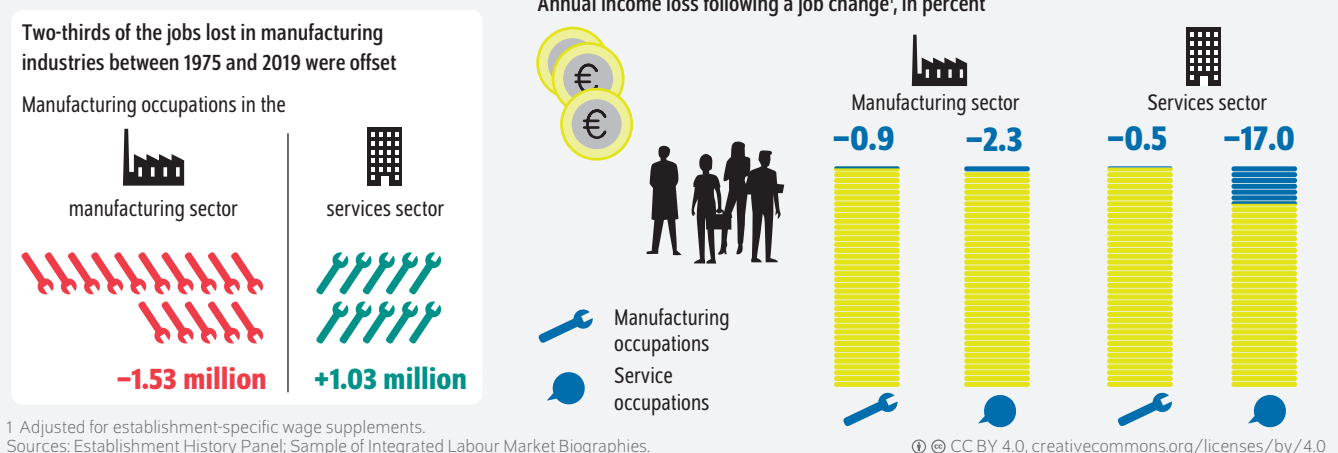
AT A GLANCE

Employment in the context of structural change: same occupations, different sectors

By Thilo Kroeger and Dominik Boddin

- From 1975 to 2019, 1.5 million production-related jobs were lost in the manufacturing sector; however, the decline in the economy as a whole is significantly smaller
- Manufacturing activities are shifting more and more to the service sector—from 1975 to 2019, one million new jobs were created there
- Employment trajectories of those affected by mass layoffs show that income losses depend heavily on where and how they work afterward
- Income losses are lower when job-specific knowledge is retained—regardless of the sector of the new job
- Policymakers should not focus on preserving existing structures but rather support workers early on as they transition to similar jobs in other sectors

Following mass layoffs: income losses among manufacturing workers are high when they switch both to the services sector and to a service occupation



FROM THE AUTHORS

“Structural change does not mean that manufacturing work is lost entirely. Following job changes resulting from mass layoffs, losses in income are low if employees remain in similar occupations—even in the service sector. Differences are primarily due to the characteristics of establishments.”

— Thilo Kroeger —

MEDIA



Audio Interview with Thilo Kroeger (in German)
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Employment in the context of structural change: same occupations, different sectors

By Thilo Kroeger and Dominik Boddin

ABSTRACT

The loss of manufacturing jobs in Germany is often viewed with great concern. While many manufacturing jobs are being lost in the manufacturing sector, new jobs with similar profiles are appearing in service firms. These new jobs offset about two-thirds of those lost in manufacturing industries between 1975 and 2019. If laid-off workers can switch to a new job involving similar tasks, their loss of income is usually minimal—regardless of the sector in which they work. The key is maintaining occupation-specific skills. Therefore, rather than protecting individual industries, the focus should be on skills development, continued employability, and facilitating moves across sectors.

Structural change means that employment increasingly shifts from one sector to another.¹ In advanced economies, employment in the manufacturing sector has been declining over the long term.² However, this decline at the sectoral level does not necessarily translate into a loss of manufacturing jobs of the same magnitude. It may also involve a relocation of such jobs to firms in the services sector. This distinction raises the question of what long-term income effects such sectoral shifts have on employees and whether these effects depend on their ability to retain their initial manufacturing occupation.

Industry-based statistics overestimate the decline in manufacturing work

In Germany, the manufacturing sector's share of total employment fell from 47 percent in 1975 to 23 percent in 2019 (Figure 1, left side). However, the standard method of measuring structural change—based on the number of jobs in manufacturing industries—does not take into account that a significant share of manufacturing jobs has not completely disappeared from the economy.

Standard measurement of structural change classifies employees according to the industry of their establishment. However, this approach—which is widely used in research and politics—implicitly assumes that all workers in a manufacturing establishment are based in production and that all workers in service firms provide services, regardless of the tasks they actually perform. This perspective can be misleading, for example, when analyzing job switches.

The employer-employee data from the Institute for Employment Research (*Institut für Arbeitsmarkt- und Berufsforschung*, IAB) for the years 1975 through 2019 allow

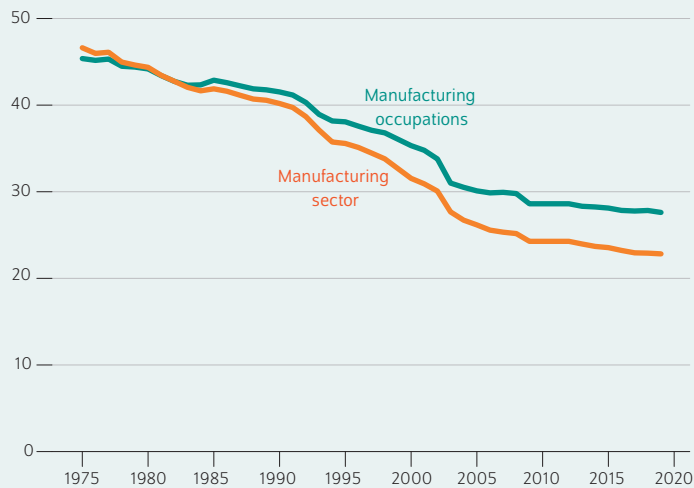
¹ The views expressed in this paper are those of the authors and do not necessarily reflect those of DIW Berlin, the Deutsche Bundesbank, or the Eurosystem. This Weekly Report is based on Dominik Boddin and Thilo Kroeger (2025): Manufacturing Work Beyond Manufacturing Industries: A Reassessment of Structural Change. DIW Discussion Paper no. 2144 (Available online. Accessed July 9, 2026. Unless stated otherwise, this applies to all other online sources cited in this report).

² Thilo Kroeger, Claudia Schaffranka, and Monika Schnitzer (2025): Structural Change in Germany: Challenges for Growth and Productivity. *Intereconomics* 60(5), 290–296.

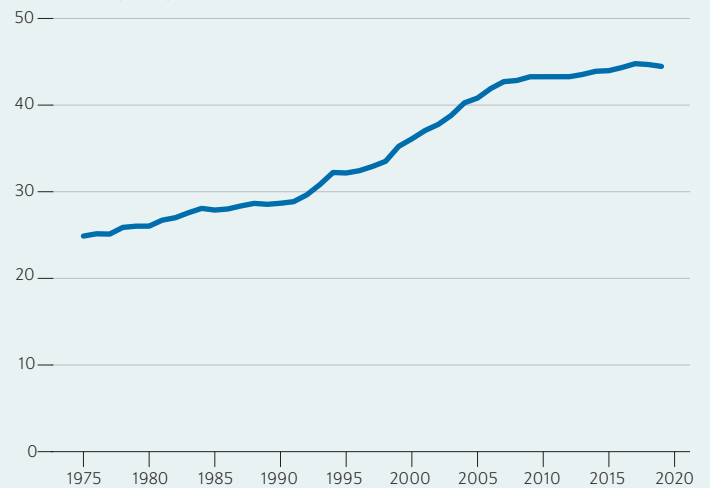
Figure 1

Employment trends in Germany In percent

Share of employment by sector (manufacturing) and occupation (manufacturing)



Share of manufacturing occupations in the services sector out of all manufacturing occupations



Notes: Left side of the figure: share of total employment by industry classification of the establishment and by occupational classification of workers. Right side of the figure: share of workers in manufacturing occupations in services sector establishments.

Sources: Establishment History Panel (BHP) 1975–2019; Statistisches Bundesamt (Federal Statistical Office, DESTATIS).

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Manufacturing occupations are playing an increasingly important role in the services sector.

workers to be classified by occupation instead, while also taking into account the industry of the establishment (Box 1). A distinction is drawn here according to whether activities involve producing/transforming physical goods or providing intangible services. The former refers to manufacturing or skilled-trade occupations, while the latter refers to service occupations.

This occupation-based approach reveals trends that remain hidden in traditional industry-based statistics.

Over time, more and more manufacturing jobs have materialized outside the manufacturing sector. In 2019, 1.7 million more people worked in manufacturing occupations than in manufacturing industries. This means that, in 2019, about 45 percent of all workers in manufacturing occupations worked for firms in the services sector; in 1975, the figure was only 25 percent (Figure 1, right side). As a share of total employment, the number of manufacturing jobs fell by 24 percentage points between 1975 and 2019 according to the industry-based measure. By contrast, the occupation-based measure shows a decline of only 17 percentage points, from 45 percent to 28 percent (Figure 1, left side).

Two-thirds of lost manufacturing jobs have been replaced

Between 1975 and 2019, manufacturing industries lost approximately 1.53 million manufacturing jobs, while service

industries gained approximately 1.03 million manufacturing jobs. As a result, about 68 percent of the manufacturing jobs lost in the manufacturing sector were offset by new jobs in the services sector (Figure 2).

The net decline in manufacturing work—defined on the basis of occupations and the actual tasks performed—amounted to approximately 500,000 jobs over this period. This was significantly smaller than the decline of 1.5 million indicated by the industry-based measure.

In fact, during the 2000s, half of all workers in manufacturing occupations who left manufacturing jobs found new work in service industries while remaining in manufacturing occupations. In the late 1970s, the share was 36 percent.

With regard to income loss following layoffs, occupation is more important than sector

The increase in manufacturing jobs in the services sector raises the question of how the gross income of workers is affected by switching industry.

The effects of labor market structural change on the income of affected workers can be analyzed more closely via their employment trajectories. To this end, we will examine the employment trajectories of workers in manufacturing occupations who lost their jobs through mass layoffs (Box 2).

Box 1

Data base

The study uses two representative administrative datasets from the Institute for Employment Research (*Institut für Arbeitsmarkt- und Berufsforschung, IAB*), which are based on social security records covering the period from 1975 to 2019. The first is the Establishment History Panel (BHP). This contains information on establishments, such as their labor structure, wages, education levels, occupations, and industry classification. The second dataset is the Sample of Integrated Labour Market Biographies (SIAB). This links individual employment trajectories to establishment information and includes, inter alia, details on occupation, hierarchy levels, daily wages, schooling, and tenure. For the analysis, it is crucial that both datasets include both the industry classification of the establishment and the occupation of the workers. This makes it possible to determine whether someone works in a manufacturing or service establishment and whether they do a manufacturing job there. Manufacturing or skilled-trade occupations are defined as activities focused on the production or transformation of physical goods (occupational categories 1, 2, and 3 of the Classification of Occupations (*Klassifikation der Berufe, KldB*) 2010, revised in 2020).¹ Service occupations encompass tasks that involve providing or handling intangible services (roughly equivalent to occupational groups 5 through 9 of the KldB 2010, revised in 2020). This distinction makes it possible to measure structural change not only across industries but also across actual job profiles.

¹ Bundesagentur für Arbeit (2021) *Klassifikation der Berufe 2010–2020 Revised Edition*, Volume 1: Systematic and alphabetical section with explanations. (Available online).

Such layoffs are highly likely to be unrelated to the individual employment performance of those affected.³

Comparing post-layoff employment trajectories by occupation and sector shows that switching occupations is costly. Compared to those unaffected by a mass layoff, laid-off workers experience, on average, long-term declines in income. However, these depend heavily on where they work subsequently (Figure 3). Workers who find a new job in the manufacturing sector and remain in a manufacturing occupation earn around 2.2 percent less than before on average. Workers who switch to service occupations in the manufacturing sector lose about 4.6 percent of their income. Workers who remain in a manufacturing occupation but switch to the services sector experience larger wage losses of approximately 5.9 percent. Workers who switch both occupation and sector are the ones that experience the greatest losses,

with those subsequently working in service occupations within the services sector losing around 29.9 percent on average. This shows that workers who remain in manufacturing occupations—even if they switch to service firms—suffer only relatively moderate losses in income. By contrast, those who are forced to switch to service occupations pay a much higher price.

Establishment-specific wage levels account for a large portion of the losses

The income loss resulting from switching sectors can largely be explained by differences in establishment-specific wage levels—that is, average wage differences across establishments.⁴ When adjusted for establishment-specific wage differences, the wage penalty for workers who switch to the services sector but remain in a manufacturing occupation shrinks from –5.9 percent to –0.5 percent and is no longer statistically significant. By contrast, switching occupations remains costly even after such an adjustment. Workers who switch to service occupations in the services sector continue to experience significant wage losses of approximately 17 percent (table).

These findings suggest that workers in manufacturing occupations who switch to service firms generally move to lower-paying establishments, but not necessarily to lower-paid types of work. The wage gap between sectors therefore reflects establishment characteristics rather than the nature of the work itself.

This interpretation is consistent with other recent studies.⁵ These findings also show that a large share of the decline in income following job losses is attributable to transitions to lower-paying establishments, not merely to differences between sectors.

In the long term, the main driver of wage losses is the loss of occupation-specific human capital, not the shift from the manufacturing to the services sector per se. Workers who have to change occupation—especially those who are forced into service occupations—suffer significant and lasting losses. This is consistent with established findings regarding the occupation-specific component of human capital.⁶ Thus, switching sectors, in and of itself, is not the main risk. The key factor is whether workers can maintain their professional skill set.

⁴ The establishment-specific wage level refers to the average wage difference observed between establishments, but within occupations. Statistically comparable workers in the same occupations therefore earn more at establishments with higher establishment-specific wage levels. John M. Abowd, Francis Kramarz, and David N. Margolis (1999): High Wage Workers and High Wage Firms. *Econometrica* 67(2), 251–333.

⁵ Ines Helm, Alice Kügler, and Uta Schönberg (2023): Displacement Effects in Manufacturing and Structural Change. IZA Discussion Papers no. 16344.

⁶ Gueorgui Kambovov and Iouri Manovskii (2009): Occupational Specificity of Human Capital. *International Economic Review* 50(1), 63–115; Christina Gathmann and Uta Schönberg (2010): How General is Human Capital? A Task-Based Approach. *Journal of Labor Economics* 28(1), 1–49.

³ Louis S. Jacobson, Robert J. LaLonde, and Daniel G. Sullivan (1993): Earnings Losses of Displaced Workers. *American Economic Review* 83(4), 685–709; Johannes F. Schmieder, Till von Wachter, and Jörg Heining (2023): The Costs of Job Displacement over the Business Cycle and Its Sources: Evidence from Germany. *American Economic Review* 113(5), 1208–1254.

Table

Wage effects adjusted for establishment-specific wage differences

First job after layoff	Baseline specification	Adjusted for establishment-specific wage differences
Manufacturing occupation in the manufacturing sector	−0.022***	−0.009***
Manufacturing occupation in the services sector	−0.059***	−0.005
Service occupation in the manufacturing sector	−0.046***	−0.023***
Service occupation in the services sector	−0.299***	−0.170***
Observations	718,116	694,776

Example: After allowing for establishment fixed effects (establishment-specific wage differences), the wage losses for workers who retain their manufacturing occupation and switch to the services sector shrink from −5.9 to −0.5 percent.

Notes: The dependent variable is the logarithm of the daily wage. The table presents static difference-in-difference estimates. The asterisks next to the values indicate the significance level. ***, **, and * indicate significance at the one, five, and ten-percent levels.

Source: Sample of Integrated Labour Market Biographies (SIAB) 7519, 1975–2019.

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Conclusion: Strengthening occupations, facilitating transitions

Data for Germany covering the period from 1975 to 2019 show that the decline in manufacturing employment is overestimated when measured solely on the basis of industry classifications. An occupation-specific analysis paints a more nuanced picture, because the standard method of measuring structural change does not take into account that a significant proportion of manufacturing jobs do not disappear entirely from the economy. Instead, they are offset by jobs at service firms with similar occupational requirements.⁷

Laid-off manufacturing workers do not necessarily have to move to lower-paying service jobs; they often make the switch without changing occupations. In the long term, such transitions involve relatively small wage losses.

Occupation is therefore far more important than the employer's industry for understanding structural change and its consequences for workers. Structural change seems far less disruptive when assessed on the basis of occupations, job profiles, and tasks rather than solely in terms of industries.⁸

This means that labor market policy should focus more on occupations and skills than on industries. The key factor is whether workers can take their occupational tasks with them to new establishments. The pressure on the automotive, mechanical engineering, and metalworking industries, coupled with skilled labor shortages elsewhere, makes it all the more important to take action before mass layoffs begin.

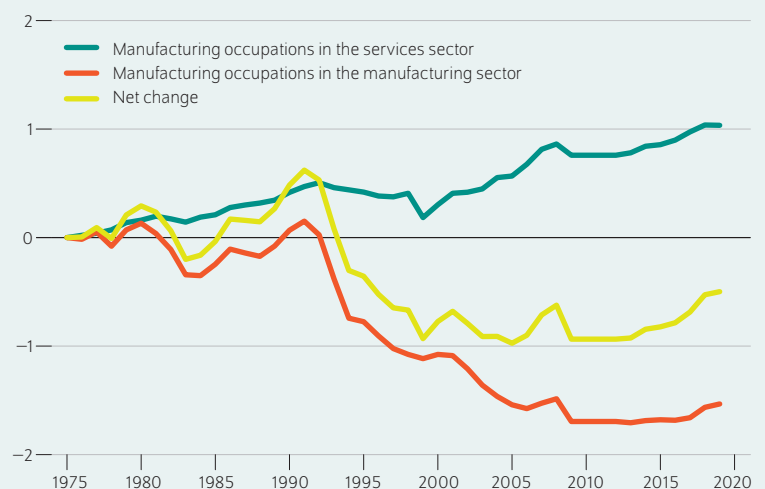
Employment agencies, companies, and social partners should assist at-risk workers early on to find similar jobs in growing establishments and industries. This is particularly

⁷ See also Andrew B. Bernard, Valerie Smeets, and Frederic Warzynski (2017): Rethinking Deindustrialization. *Economic Policy* 32(89), 5–38.

⁸ This trend can also be found in other countries: Georg Duernecker and Berthold Herrendorf (2022): Structural Transformation of Employment by Occupation. *Economica* 89(356), 789–814.

Figure 2

Manufacturing occupations in the sectors Change in the number of workers in millions (1975 = 0)



Source: Establishment History Panel (BHP) 1975–2019.

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While manufacturing jobs disappeared in the manufacturing sector, new ones appeared in the services sector.

important during periods of structural change, as unemployment can become entrenched and technical expertise can quickly lose its value if not used or kept up to date. The labor market hubs operated by the Federal Employment Agency (*Bundesagentur für Arbeit*)—platforms that prevent unemployment by matching workers from establishments reducing their workforce with those that are hiring—are a suitable tool for this purpose.

The services sector is not uniformly made up of low-paying jobs. It also encompasses knowledge-intensive and manufacturing-related areas, such as IT, quality control, design, analytics, logistics, maintenance, technical planning, and other outsourced functions that contribute to value creation

Box 2

Methodology: Identifying the causal effects of displacement

Mass layoffs are used to analyze the individual consequences of job losses for workers in manufacturing occupations. In the case of mass layoffs, it can be assumed that job losses are primarily attributable to operational or market conditions rather than to individual decisions or performance. A mass layoff is defined in accordance with the notification thresholds stipulated in the German employment protection legislation: at least five layoffs by establishments with 21 to 60 employees, layoffs affecting at least 10 percent of employees or 25 workers at establishments with 60 to 500 employees, and at least 30 layoffs by larger establishments.

The affected workers are classified based on the occupation-sector combination applicable to their first employment after layoff: a manufacturing occupation at a manufacturing establishment, a service occupation at a manufacturing establishment, a manufacturing occupation at a service establishment, or a service occupation at a service establishment. The control workers are employed in the same occupational group and same industrial sector during the year prior to layoff, but are not affected by a mass layoff.

To ensure the comparability of the effects, one control worker is matched to one worker from each occupation-sector combination. This creates groups of five workers: one non-laid-off control worker plus one laid-off worker from each of the four destination combinations. The starting point in each case is the smallest destination

group within a given occupation-industry-year combination. Next, using propensity scores and nearest-neighbor matching, suitable control workers are selected first, followed by suitable workers from the remaining destination groups. Each control worker can be used only once. This results in groups whose members exhibit very similar observable characteristics prior to layoff and are given equal weight in the estimation.

The estimation of the effects of layoff and subsequent employment on labor market outcomes—such as wages, which are considered here—follows a difference-in-difference approach. The simplified estimation equation is:

$$y_{ijt} = \sum_{m=1}^4 \gamma_m \mathbb{1}\{i \in M_m\} \cdot Post_t + \beta Post_t + \alpha_i + \theta_t + X'_{it} \xi + \varepsilon_{it}$$

Here, y_{ijt} is the outcome for worker i at establishment j in year t , such as annual income, daily wages, days worked, or number of employers. M_m refers to one of the four destination combinations following layoff. $Post_t$ indicates the years following layoff. The coefficients γ_m measure how the outcomes of laid-off workers in destination group m change after layoff, relative to comparable non-laid-off workers. α_i accounts for time-invariant individual differences, θ_t for common year effects, and X_{it} for time-variant characteristics such as age. For Figure 3, a dynamic version of this equation is estimated, with separate effects for each year before and after the layoff.

in manufacturing.⁹ Further training and job-matching services should capitalize on this. They can help workers with manufacturing experience continue using their skills rather than switch to jobs outside their field, where income losses are significantly greater.

Firms wishing to retain their workers must plan ahead, communicate changes openly, and begin training before the crisis hits. While reduced-hours arrangements (known as “short-time work”) can help bridge periods of economic weakness over the business cycle, they can delay rapid reallocation to new jobs. In the context of longer-term structural change, they should therefore be tied to mandatory further training.¹⁰

Increased competition for labor can facilitate structural change if workers have access to reliable information and realistic alternatives.¹¹ Wage and information transparency can facilitate moves to more productive establishments and limit the market power of individual employers.¹²

At the same time, it makes sense to support the transformation of the manufacturing sector. Transformation projects and uncertain investments should not be nipped in the bud by rigid and excessive regulation. However, a blanket reduction in employment protections is not the right approach for increasing flexibility and mobility. Stable employment relationships provide security, making decisions on training and skills development easier. Moreover, there is little incentive to switch from permanent to temporary employment; the labor market could become too rigid. However, additional flexibility—such as the proposal to allow fixed-term employment without objective grounds for a longer period of up to four years—could be useful where new projects or riskier

⁹ See Susan Houseman (2007): Outsourcing, offshoring and productivity measurement in United States manufacturing. *International Labour Review* 146(1-2), 61–80; Deborah Goldschmidt and Johannes F. Schmieder (2017): The Rise of Domestic Outsourcing and the Evolution of the German Wage Structure. *The Quarterly Journal of Economics*, 132(3), 1165–1217; Jérôme Barthelemy and Dominique Geyer (2001): IT outsourcing: Evidence from France and Germany, *European Management Journal*, 19(2), 195–202.

¹⁰ See Thilo Kroeger, Benedikt Runschke, and Lenard Simon (2025): Arbeitsmarkt im Wandel: Polarisierung, Fachkräftengpässe und Labour Hoarding. *Wirtschaftsdienst* 105(6), 423–427; Enzo Weber (2025): Beschäftigungssicherung: Kurzarbeit plus Qualifizierung. *Wirtschaftsdienst* 105(3), 150; Christina Brinkmann et al. (2025): Short-Time Work Extensions NBER Working Paper no. 33112; Christian Kagerl (2024): The Employment and Windfall Effects of Short-Time Work: Evidence from Germany. IAB Discussion Paper no. 14; Bernd Fitzenberger, Christian Kagerl, and Stefanie Wolter (2026): Transformation angehen statt Kurzarbeit verlängern. IAB Statement no. 3.

¹¹ See Clemens Fuest and Simon Jäger (2023): Können höhere Löhne zur Überwindung des Fachkräftemangels beitragen?. *Wirtschaftsdienst* 103(4), 253–258; David Autor, Arindrajit Dube, and Annie McGrew (2023): The Unexpected Compression: Competition at Work in the Low Wage Labor Market. NBER Working Paper no. 31010.

¹² See Zoë Cullen (2024): Is Pay Transparency Good? *Journal of Economic Perspectives* 38(1), 153–180.

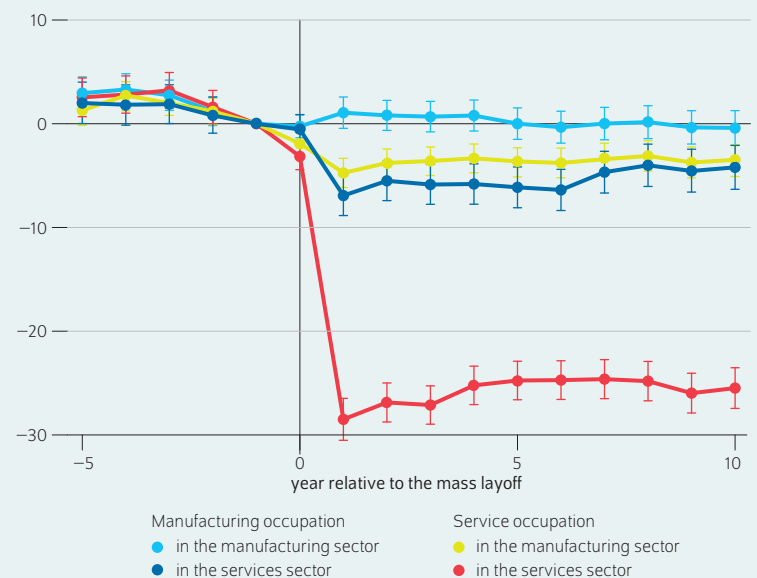
investments would otherwise not proceed.¹³ Nevertheless, such employment should be limited to newly created positions in transformation projects—which would also justify this extension—and converted into permanent employment if successful. In addition, it should be tied to further training, career counseling, and transition support. This will allow for mobility in the labor market without unnecessarily devaluing occupation-specific human capital, and will enable firms in the manufacturing sector to enhance their competitiveness.

¹³ See Enzo Weber (2026) Warum nicht mal Jobwechsel auf Probe? Guest article in Die Zeit, June 30, 2026 (available online).

Figure 3

Gross income effects of job displacement on wage levels

Percentage change in wages



Notes: Effects on wage levels in the first job after layoff. The figure shows the estimated coefficients and 95-percent confidence intervals relative to the time of the mass layoff. The 95-percent confidence interval means that in 95 percent of cases, this interval will capture the unknown true value. Accordingly, the probability of error is five percent. The narrower the interval, the more accurate the estimated effect. Layoff takes place between June 30 of Year zero and June 30 of Year one.

Source: Sample of Integrated Labour Market Biographies (SIAB) 7519, 1975–2019.

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Workers who switch from a manufacturing occupation to a service occupation after losing their jobs are particularly likely to suffer income losses.

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