DIW Weekly Report

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AT A GLANCE

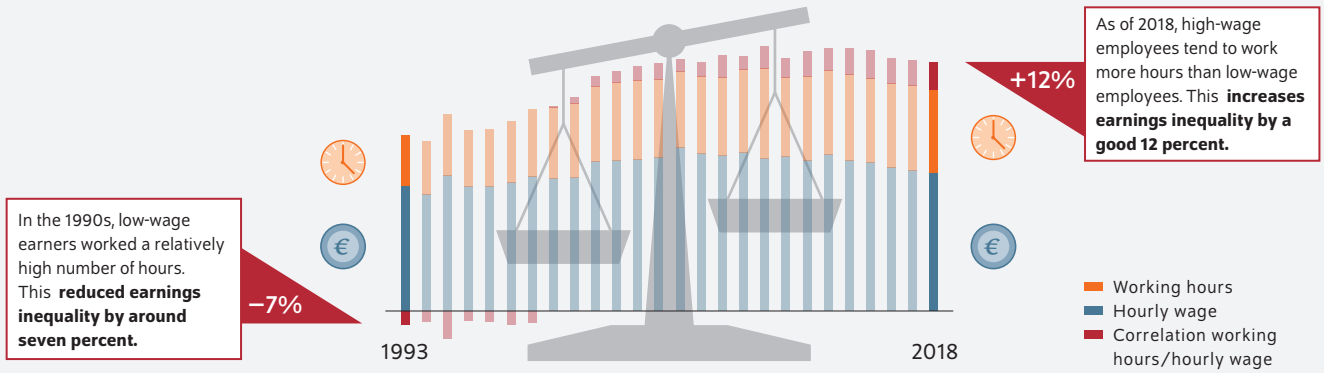
Changes in working hours are driving earnings inequality

By Mattis Beckmannshagen and Carsten Schröder

- Using SOEP data, study investigates the reasons for the increase in earnings inequality since 1993
- Increase is barely due to hourly wages but rather to the development of working hours; low-wage earners work significantly less than previously
- There is often a mismatch between the desired and actual working hours, especially for mothers and first-time and re-employed employees
- If employees had been able to work as much or as little as they wanted, earnings inequality would have risen only half as much
- A better work-life balance and more possibilities for low-wage earners to work more hours could combat this trend

Earnings inequality was significantly higher in 2018 than in 1993, not so much due to hourly wages but rather to working hours

Measure of inequality (MLD)[1]



1 MLD stands for mean logathrimic deviation. In 1993, the total MLD was 0.186: 0.058 for the working hours, 0.143 for the hourly wages, and −0.015 for the correlation between the two. In 2018, the total MLD was 0.285 (0.096 for the working hours, 0.158 for the hourly wages, and 0.031 for the correlation).

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35.

FROM THE AUTHORS

"The fact that changes in working hours are not aligned with employees' preferences is problematic from a social policy perspective. For example, mothers often work fewer hours than they would like. Clearly, there is still a lack of a sufficient work-life balance."

— Carsten Schröder, study author —

MEDIA

Audio Interview with Carsten Schröder (in German)
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Changes in working hours are driving earnings inequality

By Mattis Beckmannshagen and Carsten Schröder

ABSTRACT

According to Socio-Economic Panel (SOEP) data, inequality in gross monthly earnings in Germany increased significantly between 1993 and 2003 and has been stagnating at a high level since 2008. As this Weekly Report shows, the increase is not being driven by higher hourly wage inequality, but rather by working hours: In recent years, employees with a high hourly wage work more than previously compared to employees with a low hourly wage. In particular, this applies to two groups whose share of the workforce has increased significantly in recent years: employed women and service sector employees. Had employees been able to work their desired number of hours, the rise in inequality would have been more moderate. A better work-life balance and more opportunities to increase working hours in the low-wage sector could counteract this trend.

During the working age years, the majority of the population funds their existence primarily via earned income. Not only does it significantly determine one's current financial possibilities, but it also determines future pension entitlements. Earned income depends on two factors, the hourly wage and working hours.[1] Both factors are negotiated between employers and employees or via collective bargaining parties, meaning they do not always correspond with the actual preferences of employees. Several variables can prevent employees from working their desired number of hours, such as a limited number of positions and contract arrangements, earnings ceilings for marginal employees, high bargaining power on the part of employers, or search costs on the part of employees.[2] This can result in systematic mismatches between the actual and desired working hours.

Earnings inequality differs from wage inequality

The hourly wage is an important determinant of earnings inequality. If all employees worked the same number of hours, relative inequality indices,[3] such as the Gini index or the mean log deviation (MLD), would indicate an identical level of inequality for hourly wages and earnings. However, when employees with low hourly wages work fewer hours than employees with high hourly wages, the monthly earnings are more unevenly distributed than the hourly wages.

1 The gross earnings used in this report do not include bonuses or salary components such as company pension plans.

2 See, among others, Joseph G. Altonji and Christina H. Paxson, "Labor Supply, Hours Constraints, and Job Mobility," *Journal of Human Resources* 27, no. 2 (1992); Hans G. Bloemen, "Job search, hours restrictions, and desired hours of work," *Journal of Labor Economics* 26, no. 1 (2008): 137–179; Raj Chetty et al., "Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records," *The Quarterly Journal of Economics* 126, no. 2 (2011): 553–609.

3 Relative indices do not respond when the distribution is multiplied by a constant strictly positive factor. Thus, inequality does not change when employees' hourly wages are multiplied by working hours that are the same for everyone. For these measures, the inequality that results when monthly earnings are used is as high as when these monthly earnings are extrapolated to the quarter by a factor of three.

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Box 1

Decomposition of the mean log deviation (MLD)

The mean log deviation (MLD) is a measure of inequality and a generalized entropy index. The MLD is defined as

$$MLA_y = \frac{1}{N}\sum_{i=1}^{N} \ln\left(\frac{\bar{y}}{y_i}\right),$$

with y_i indicating the earnings of person i, $\bar{y}$ the average income, and N the number of all observed individuals. When all employees earn the same amount (the average income), the MLD is zero. The value of the MLD increases as inequality rises.

The MLD of the monthly income can be decomposed additively into three related components that provide information on how much of the monthly earnings inequality is driven by inequality in the hourly wage distribution (MLA_w) and in the working hours distribution (MLA_h), respectively, and by the covariance between hourly wages and working hours ($Cov(w, h)$):[1]

$$MLA_y = MLA_w + MLA_h + \ln\left(1 + \frac{Cov(w,h)}{\bar{w} \times \bar{h}}\right).$$

In the study[2] which this Weekly Report is based on, this decomposition is generalized so that differences between different subgroups can also be analyzed (decomposition by subgroups).

1 Daniele Checchi, Cecilia García-Peñalosa, and Lara Vivian, "Are changes in the dispersion of hours worked a cause of increased earnings inequality?" *IZA Journal of European Labor Studies* 5, no. 1 (2016): 1–34.

2 Beckmannshagen und Schröder, "Earnings Inequality and Working Hours Mismatch."

Figure 1

Earnings inequality
Mean logarithmic deviation[1]

1 The mean logarithmic deviation (MLD) is a measure of inequality that makes it possible to decompose earnings inequality into three components. The larger the number, the higher the inequality.
2 The covariance term describes the interaction of the hourly wage and working hours and its influence on inequality. For example, in terms of actual earnings inequality, the fact that in 1993 low-wage earners worked more hours than high-wage earners reduced earnings inequality. In 2018, low hourly wages were associated with fewer hour worked and higher wages were associated with more hours worked compared to 1993, increasing earnings inequality.

Legend: In 1993, the total MLD was 0.186: 0.058 for the working hours, 0.143 for the hourly wages, and −0.015 for the correlation between the two.

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35

The earnings inequality would have only increased half as much if employees had been able to work their desired number of hours.

Therefore, earnings inequality depends on
- the hourly wage distribution,
- the working hours distribution, and
- the statistical relationship (correlation) between hourly wages and working hours.

As described above, the actual working hours do not necessarily correspond to the desired working hours. For example, it is possible that the marginally employed, who are restricted to an income limit of 450 euros per month, would like to work more than permitted at their given hourly wage. At the same time, some employees may wish to work fewer hours, such as those with caretaking duties or those who desire a better work-life balance.[4] For a company, such reductions in working hours may be costly or not possible to the desired extent due to organizational reasons.

The importance of mismatches between desired and actual working hours for the income distribution can be determined by comparing the actual earnings distribution with a counterfactual earnings distribution. The counterfactual earnings distribution is obtained by multiplying employees' hourly wage by their desired (rather than actual) working hours.[5]

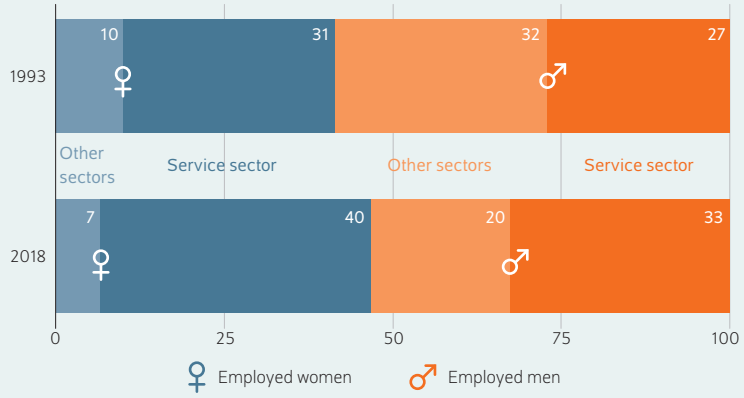
The German Socio-Economic Panel (SOEP) dataset contains all variables needed to determine the actual and counterfactual earnings distribution and to decompose it according to the determinants described above. This Weekly Report,

4 See Travis J. Smith and Tommy Nichols, "Understanding the Millennial Generation," *Journal of Business Diversity* 15, no. 1 (2015).

5 When creating the counterfactual distribution, macroeconomic effects and repercussions of changes in working hours are abstracted. Thus, the implicit assumption is made that a change in working hours would have no effect on hourly wages, but rather that they would remain constant.

Figure 2

Service sector and non-service sector employees
Shares in percent



Note: For a validation of the data using administrative data, see Beckmannshagen and Schröder, "Earnings Inequality and Working Hours Mismatch."

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35.

The share of service sector employees was significantly larger in 2018 compared to 1993.

Box 2

Reweighting

The 1996 method of DiNardo et al.[1] makes it possible to determine to what extent intertemporal changes in distributional statistic is due to structural changes in the composition of the observed sample over time. Individual characteristics are frozen at the level of the starting year and used to calculate counterfactual scenarios. In the study which this Weekly Report is based on, the application examines how earnings inequality would have developed if the share of employed women and service sector employees had not increased but instead remained constant at the 1993 level.

1 John DiNardo, Nicole M. Fortin, and Thomas Lemieux, "Labor Market Institutions and the Distribution of Wages, 1973–1992: A Semiparametric Approach," *Econometrica* 64, no. 5 (1996): 1001–1044.

based on a Beckmannshagen and Schröder study,[6] first describes the long-term development of earnings inequality in Germany between 1993 and 2018. Next, it shows which roles changes to the working hours and hourly wage distributions as well as to the correlation of both variables play in this development. Third, it shows the extent to which shifts over time in the relative size of four groups of employees drove the development of earnings inequality. The four groups under consideration are: employed women and men in the service and non-service sectors. Finally, the actual earnings distribution is compared to the counterfactual earnings distribution.

Lower increase in earnings inequality if employees worked their desired hours

Earnings inequality can be decomposed additively into three components using the mean log deviation (MLD). The first component describes the hourly wage inequality, the second the working hours inequality, and the third the correlation between hourly wages and working hours. In addition, it is possible to determine to what extent different groups of employees influence inequality (Box 1).[7]

According to the MLD, earnings inequality increased from 0.19 to 0.29 between 1993 and 2018 (Figure 1, left side). The majority of this increase occurred before 2003, as inequality has been stagnating at a relatively high level since 2008. Almost 15 percent of the increase was due to increasing hourly wage inequality, almost 40 percent was due to increasing working hours inequality, and nearly 50 percent was due to the growing correlation of hourly wages and working hours: Thus, in 2018, low hourly wages are associated with fewer working hours and higher wages are associated with more working hours than in 1993. In fact, the correlation between hourly wages and hours worked was negative until the 2000s, meaning that the comparatively high number of hours worked by employees with low hourly wages had an equalizing effect on the earnings distribution. Since the 2000s, however, the correlation has been positive and is increasing continuously: Employees with high hourly wages are increasingly also those with the most working hours, which increases earnings inequality.[8]

In the counterfactual distribution based on employees' desired working hours, the increase in earnings inequality is only half as large (Figure 1, right side): Here, the MLD was 0.20 in 1993 (actual earnings distribution: 0.19) and 0.25 in 2018 (actual earnings distribution: 0.29).

As it is assumed that hourly wages do not differ in the actual and counterfactual earnings distributions, the weaker increase must be due to different trends in actual and desired working hours. This result is important for the normative assessment of earnings inequality and its increase over time: Were the increase in inequality due to increasingly different labor preferences of employees, it would be unproblematic from a welfare theory perspective as it would only

6 This Weekly Report is based on Mattis Beckmannshagen and Carsten Schröder, "Earnings Inequality and Working Hours Mismatch," *Labour Economics* 102184 (2022).

7 Such a decomposition is not possible using the more common Gini index. However, trends for the Gini index are similar to those for the MLD. For example, the Gini index of earned income increased from 0.31 in 1993 to 0.37 in 2018. Cf. Figure 11 in Beckmannshagen and Schröder, "Earnings Inequality and Working Hours Mismatch."

8 The increasing strength of the correlation between hourly wages and working hours has other implications for earnings inequality beyond those described here. For example, administrative data often lack information on working hours, which leads researchers to make assumptions regarding the relationship between working hours and hourly wages in minimum wage research. The results of the study on which this Weekly Report is based show that it is important to consider changes in this correlation.

Table 1

Earnings inequality with a constant share of women and service sector employees
Mean logarithmic deviation (MLD)[1]

		Total MLD			Hourly wage MLD			Working hours MLD			Covariance term[2]		
		95 percent CI[3], lower bounds	Point estimator	95 percent CI, upper bounds	95 percent CI, lower bounds	Point estimator	95 percent CI, upper bounds	95 percent CI, lower bounds	Point estimator	95 percent CI, upper bounds	95 percent CI, lower bounds	Point estimator	95 percent CI, upper bounds
Actual working hours inequality	1993	0.178	**0.186**	0.195	0.136	**0.143**	0.150	0.053	**0.058**	0.063	−0.021	**−0.015**	0.009
	2018	0.274	**0.285**	0.296	0.152	**0.158**	0.164	0.090	**0.096**	0.101	0.026	**0.031**	0.037
	2018, share of employed women at 1993 level	0.269	**0.280**	0.291	0.153	**0.159**	0.166	0.086	**0.091**	0.096	0.025	**0.030**	0.035
	2018, share of service sector employees at 1993 level	0.255	**0.265**	0.276	0.149	**0.155**	0.160	0.080	**0.085**	0.090	0.021	**0.026**	0.031
	2018, shares of women and service sector employees at 1993 level	0.254	**0.265**	0.275	0.149	**0.155**	0.161	0.079	**0.084**	0.089	0.020	**0.026**	0.031
Desired working hours inequality	1993	0.189	**0.199**	0.208	0.136	**0.143**	0.150	0.049	**0.053**	0.058	−0.003	**0.002**	0.008
	2018	0.238	**0.248**	0.257	0.152	**0.158**	0.164	0.066	**0.071**	0.075	0.014	**0.019**	0.024
	2018, share of employed women at 1993 level	0.237	**0.246**	0.255	0.153	**0.159**	0.166	0.064	**0.068**	0.072	0.014	**0.018**	0.023
	2018, share of service sector employees at 1993 level	0.226	**0.235**	0.244	0.149	**0.155**	0.160	0.060	**0.064**	0.068	0.012	**0.016**	0.021
	2018, shares of women and service sector employees at 1993 level	0.226	**0.235**	0.244	0.149	**0.155**	0.161	0.059	**0.064**	0.068	0.012	**0.016**	0.021

1 The mean logarithmic deviation (MLD) is a measure of inequality that makes it possible to decompose earnings inequality into three components. The larger the number, the higher the inequality.
2 The covariance term describes the interaction of the hourly wage and working hours and its influence on inequality. For example, in terms of actual earnings inequality, the fact that in 1993 low-wage earners worked more hours than high-wage earners reduced earnings inequality. In 2018, low hourly wages were associated with fewer hour worked and higher wages were associated with more hours worked compared to 1993, increasing earnings inequality.
3 The 95-percent confidence interval indicates the range of the true value with a 95 percent probability.

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35.

reflect changes in employees' work and leisure preferences. However, this is not the case, as inequality and mismatches between desired and actual working hours are increasing.

Increasing shares of employed women and service sector employees

The trends described above are associated with substantial changes in the workforce composition. Above all, the shares of employed women and service sector employees[9] (Figure 2) are increasing: In 1993, 58 percent of employees worked in the service sector, of which 31 percentage points were women and 27 percentage points were men. The share of employees outside of the service sector was at 42 percent. Twenty-five years later in 2018, these figures had changed considerably: Seventy-three percent of employees worked in the service sector (40 percentage points women, 33 percentage points men), while 27 percent of employees worked outside of the service sector.

Workforce composition only explains small share of rising inequality

By statistically reweighting the groups (Box 2), it can be estimated how inequality would have evolved had the workforce composition remained the same over time. This way, it can be seen how earnings inequality would have developed had the shares of employed women, service sector employees, and men and women working in and outside the service sector stayed the same after 1993.[10]

Freezing the share of employed women at the 1993 level decreases the intertemporal increase of the MLD of earnings by only 0.01 points (difference between 0.29 and 0.28). If the share of service sector employees is held constant, the increase in earnings inequality decreases by 0.02 MLD points. If the shares of all four groups are frozen, it is also 0.02 MLD points (Table 1, upper section). Even in the counterfactual distribution, where the assumption is that the desired working hours can be realized if hourly wages remain constant, only a very small part of the increase in inequality can be attributed to the changing shares of these four groups (Table 1, lower section).

9 Here, the service sector is defined broadly to include all industries except agriculture, mining, manufacturing, utilities, and construction.

10 Beckmannshagen und Schröder, "Earnings Inequality and Working Hours Mismatch."

Table 2

Desired and actual weekly working hours
In hours

		Desired working hours	Actual working hours	Discrepancy
Conditional[1] averages	Total, 1993	37.85	40.01	−2.16
	Total, 2018	35.99	37.99	−2.00
	1st wage quintile,[2] 1993	38.27	42.41	−4.14
	1st wage quintile, 2018	32.92	32.30	0.62
	5th wage quintile,[3] 1993	35.77	37.21	−1.45
	5th wage quintile, 2018	35.15	37.65	−2.51
Additional average change	Mothers	−4.74	−6.94	2.19
	First-time and re-employed employees[4]	−4.23	−7.70	3.74

1 Other factors influencing working hours, such as level of education, were already considered here.
2 The first wage quintile is comprised of the 20 percent of the workforce with the lowest wages.
3 The fifth wage quintile is comprised of the 20 percent of the workforce with the highest wages.
4 First-time and re-employed employees are employed individuals who were not employed in the previous year.

Note: For the complete regression results, see Beckmannshagen and Schröder, "Earnings Inequality and Working Hours Mismatch," equation 11, Figure 5, and Table 2.

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35.

These findings suggest that changes to the workforce composition, such as the increased shares of women and service sector employees, are not the main reason for the growing gap between actual and counterfactual earnings inequality.

Low-wage earners, new and returning employees, and mothers in particular are involuntarily underemployed

What actually determines the actual and desired working hours and the difference between the two? What role do workers' personal characteristics play, such as hourly wage, gender, familial status, and how do these relationships change over time?

For all employees, the desired working hours averaged about two hours less than the actual working hours in both 1993 and 2018 (Table 2). In the bottom wage quintile, the 20 percent of individuals with the lowest hourly wages, the desired working hours in 1993 were four hours below the actual (38 to 42) on average. By 2018, this difference had reversed: The desired work hours were slightly above the actual (33 to 32 hours).[11] In the upper wage quintile, the average desired working hours in 1993 were about an hour below the actual (36 compared to 37 hours). This difference has risen slightly and was around three hours (35 to 38 hours) in 2018. The overview of the situation is completed by looking at the shares of the underemployed and overemployed[12] in the wage quintiles in 1993 and 2018: In the lowest wage quintile in 1993, eight percent of workers were underemployed and 44 percent were overemployed (Figure 3). In 2018, the share of the underemployed was significantly higher (23 percent), while the share of the overemployed decreased to 26 percent. In the upper wage quintile, there was no increase in the share of the underemployed. Instead, the share of the overemployed increased from 44 percent in 1993 to 52 percent in 2018.

There is an especially large mismatch between the desired and actual working hours for two groups of employees in particular: First-time or re-employed employees[13] and mothers work significantly fewer hours than they want. While they wish to work fewer hours overall than other employees (mothers and first-time employees wish to work five and four hours less, respectively), their actual working hours are even lower (seven and eight hours lower for mothers and first-time employees).

Possible explanations for why low-wage earners, first-time and re-employed employees, and mothers work fewer hours than desired include declining union power and the Hartz reforms, which have weakened the bargaining position of workers in the low-wage sector.[14] The fact that underemployment frequently affects mothers indicates that reconciling work and family life is still challenging and limits mothers' career prospects and paths.

Conclusion: More working hours flexibility could reduce inequality, increase employee motivation

The rise in earnings inequality between 1993 and 2018 is mostly driven by an increase in both working hours inequality and the correlation between working hours and hourly wages. While hourly wage inequality has slightly decreased over the past years, in part due to the introduction of the minimum wage,[15] this is not reflected one-to-one in the gross earnings distribution due to reductions in working hours.[16]

If employees had been able to work their desired number of hours, earnings inequality would have been lower and its increase over time would have been weaker. This is due to the fact that employees in the upper wage segment increasingly want to work fewer hours over time, while more employees in the lower wage segment want to increase their working hours. The systematic mismatches between desired and actual working hours show that it is difficult for firms to meet their employees' labor preferences. One possible reason for

11 The sharp reduction in average actual working hours in the lower wage quintile from 42 hours in 1993 to 32 hours in 2018 has been accompanied by an expansion of marginal employment, which has been further liberalized, especially in the wake of the Hartz reforms.

12 Underemployed is defined as employees whose actual working hours are at least four hours less than the desired number. Overemployment occurs if the actual working hours are four hours more than the desired hours.

13 First-time or re-employed employees are defined here as all employees who were not employed in the previous year but who are employed in the next.

14 See, among others, Carlos Carrillo-Tudela, Andrey Launov, and Jean-Marc Robin, "The fall in German unemployment: A flow analysis," *European Economic Review* 132, 103658 (2021); Christian Dustmann, Johannes Ludsteck, and Uta Schönberg, "Revisiting the German wage structure," *The Quarterly Journal of Economics* 124, no. 1 (2009): 843-881.

15 See Mario Bossler and Thorsten Schank, "Wage inequality in Germany after the minimum wage introduction," *Journal of Labor Economics* (online, 2022).

16 See Marco Caliendo et al., "The short-term distributional effects of the German minimum wage reform," *Empirical Economics* (forthcoming); Patrick Burauel et al., "The impact of the minimum wage on working hours," *Jahrbücher für Nationalökonomie und Statistik* 240, no. 2-3 (2020): 233-267.

this is that more flexible and parallel working time models increase firms' administrative workload and also result in different requirements for workplace equipment and work processes. However, employers should weigh these possible additional costs against the advantage of higher employee satisfaction and, thus, higher employee motivation.

The German government has tools at its disposal to address underemployment and thereby reduce earnings inequality. In particular, employees at the lower end of the hourly wage distribution are unable to realize their (higher) number of desired working hours. Earnings ceilings for marginal employees coupled with rising wages—for example, by raising the minimum wage to 12 euros—are likely to exacerbate this problem. Raising the earnings ceiling only relocates the problem. Reform proposals therefore range from restricting marginal employment to student workers to abolishing the regulation completely.[17]

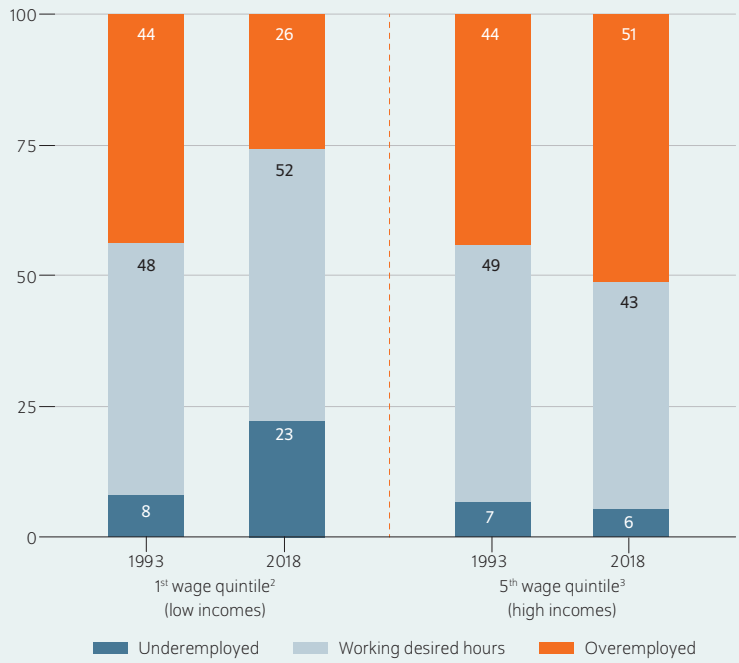
The fact that employed women, especially mothers, would like to work more hours than they actually do suggests that reconciling work and family life still poses a major challenge. This could be remedied by comprehensive childcare services for employees as well as a more balanced distribution of household work between partners.

The problem of under- and overemployment seems to have reached policymakers: Since 2019, Germany has had a law on temporary part-time work (*Brückenteilzeit*), which allows employees at larger companies to reduce their working hours temporarily and return to their previous full-time position later. This arrangement offers many workers more flexibility and could lead to less overemployment.

17 Alexandra Fedorets et al., "Der Makel der Minijobs," *Frankfurter Allgemeine Zeitung*, November 22, 2021 (in German).

Figure 3

Under- and overemployment[1] by wage quintile
Shares in percent



1 Under- and overemployment is defined as a difference of at least four hours per week between the desired and actual number of working hours.
2 The first wage quintile is comprised of the 20 percent of the workforce with the lowest wages.
3 The fifth wage quintile is comprised of the 20 percent of the workforce with the highest wages.

Source: Authors' calculations based on the Socio-Economic Panel (SOEP), v35.

Low-wage earners were significantly more frequently underemployed in 2018 compared to 1993. They are also more frequently underemployed than high-wage earners.

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