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Minimum wage not yet for everyone: on the compensation of eligible workers before and after the minimum wage reform from the perspective of employees

By Patrick Burael, Marco Caliendo, Alexandra Fedorets, Markus M. Grabka, Carsten Schröder, Jürgen Schupp, and Linda Wittbrodt

Calculations based on data from the Socio-Economic Panel (SOEP) show that after the introduction of a statutory minimum wage in Germany in January 2015, the wage growth of eligible employees with low wages accelerated significantly. Before the reform, the nominal growth in contractual hourly wages in the lowest decile, the bottom tenth of the pay distribution, was less than two percent in the long-term two-year average, while from 2014 to 2016 it was around 15 percent. Nevertheless, in the first half of 2016, around 1.8 million employees who were eligible for the minimum wage of 8.50 euros gross per hour still earned contractual hourly wages below this level. In 2015, the count was approximately 2.1 million workers, and in the year before the introduction of the minimum wage, almost 2.8 million. The figures for 2015 and 2016 reported here are thus higher than corresponding figures from company surveys.

Despite the disproportionate increase in wages in the lowest wage decile, many workers are still not earning the minimum wage. The objectives of the German Minimum Wage Act (*Mindestlohngesetz*) are often not being met, especially among the marginally employed. Instruments for better enforcement of the Minimum Wage Act include more frequent inspections, stricter sanctioning, more effective grievance procedures for workers, and stricter requirements for the documentation systems (especially timekeeping).

One objective of the general statutory minimum wage introduced on January 1, 2015, was to increase hourly wages and earnings for workers with low wages and establish an hourly gross minimum wage. Here we examine to what extent these goals were achieved by the first half of 2016. To do so, we describe changes in hourly wages among eligible employees over the period before and after the reform, and calculate the proportion of these persons still earning less than the minimum wage.

The empirical analysis relies on Socio-Economic Panel (SOEP) data collected by DIW Berlin in partnership with Kantar Public (formerly *TNS Infratest Sozialforschung*).¹ The SOEP data² from 2015 and 2016 enable a first look at the development of hourly wages as reported by employees in the German labor market *after* the minimum wage was introduced. The use of SOEP's weighting factors makes it possible to calculate results for the total population (Box 1).

This report differs from analyses that use information provided by companies.³ The Minimum Wage Commission, for example, based its findings heavily on the Structure of Earnings Survey 2014 (VSE 2014), which is man-

¹ SOEP is an annual survey of private households. It began in West Germany in 1984 and expanded its scope to include the new federal states in 1990; cf. Gert G. Wagner, Joachim R. Frick and Jürgen Schupp (2007): The German Socio-Economic Panel Study (SOEP) – Scope, Evolution and Enhancement. *Schmollers Jahrbuch*, Vol. 127(1), 139–169.

² The SOEP survey data for the survey year 2016 were released to the research community in November 2017 by the SOEP Research Data Center at DIW Berlin.

³ Oliver Bruttel, Arne Baumann, and Ralf Himmelreicher, "The Statutory Minimum Wage in Germany: Structure, Distribution and Effects on Employment," *WSI Mitteilungen*, no. 7 (2017): 473–481 (in German).

Box 1

Data basis and restrictions**Data basis**

The SOEP is a representative sample of all people living in private households in Germany, encompassing approximately 15,000 households per year. Since the same households are surveyed every year, the study enables a descriptive look at the individual situation after the minimum wage was introduced on January 1, 2015, and in 2016, as well as a comparison with the situation in previous years.¹

The fieldwork for the SOEP survey begins in February of each year. About half of all households that participated in the 2015 survey had been surveyed by the end of April. The fieldwork in 2016 was already almost 90 percent completed in May.²

Interpretation restrictions

The following information should be taken into account when interpreting the results presented here.

¹ The analyses are based on data from all SOEP sub-samples, which participated in the survey in both 2014 and 2015. The analyses were weighted in each case. For the methodology of the cross-sectional and longitudinal weighting model in SOEP, see: Martin Kroh, Rainer Siegers, and Simon Kühne, "Gewichtung und Integration von Auffrischungstichproben am Beispiel des Sozio-oekonomischen Panels (SOEP)," in *Non-response bias. Qualitätssicherung sozialwissenschaftlicher Umfragen* (Wiesbaden: Springer VS, 2015) 409–444 (in German).

² See Simon Huber, "An Overview of the SOEP Samples," in *SOEP Wave Report 2016* (Berlin, 2017) 28–36 (available online).

First, the results are based on a random sample of all persons living in private households in Germany. Migrants (such as contract workers or agricultural workers (pickers)) are systematically excluded from the analyses, as are people living in institutions or dormitories.

The sample results from the SOEP data are extrapolated to the distribution of the population according to special evaluations of the microcensus. The results presented in the report are based on weighting factors for the years 2014, 2015, and 2016, and include all samples of the SOEP, except for the results of the IAB-BAMF-SOEP sample of refugees first surveyed in 2016.

Second, it should be noted that the SOEP is based on survey data and does not directly ask respondents for information regarding hourly wages. However, the SOEP does ask about monthly wages and weekly working hours. Accordingly, measurement errors (for instance, in contractual or actual working hours, or in the amount of monthly income) or refusals to respond may influence the results. Missing answers to questions on monthly earnings are replaced ("imputed"³) in the SOEP by means of statistical methods. Due to the associated statistical uncertainties, we decided against using imputed incomes in this report. The resulting lower extrapolated case numbers were adjusted by re-scaling.

³ On the various imputation procedures used in the SOEP, see: Joachim R. Frick, Markus M. Grabka, and Olaf Groh-Samberg, "Dealing with incomplete household panel data in inequality research," *Sociological Methods & Research*, no. 41 (2012): 89–123.

datory for employers, and a voluntary Earnings Survey 2015 (VE 2015) conducted by the Federal Statistical Office⁴ (*Statistisches Bundesamt*, Destatis). In 2014, around four million eligible employees earned less than 8.50 euros per hour (see Table 1, first line). In 2015, this figure was around 1.4 million, and in 2016, it was still 1.1 million

⁴ The Earnings Survey 2015 is a voluntary follow-up survey to the Structure of Earnings Survey 2014 that was conducted by the Federal Statistical Office in spring 2014. The official survey for 2015 is based on data from over 6,000 companies and provides detailed information at the individual level of the employees on the basis of information provided by the employer. While there was an obligation to provide information for the Structure of Earnings Survey 2014, the written survey in 2015 was conducted voluntarily with a participation rate of almost 13 percent of all companies contacted. The response rate for the Earnings Survey 2016 only amounts to 6.3 percent (see Federal Statistical Office, "Earnings Survey 2016" (2017) (in German)).

workers.⁵ These numbers have so far played a minor role in the public debate on the effectiveness and impact of the minimum wage.⁶

It is noteworthy that these figures on the high number of employees who were still not paid in accordance with

⁵ The official Earnings Survey reported a lower number of 751,000 employees in 2016. However, this number is based on the fact that employees with wages of only up to 8.45 euros per hour were reported as earning less than minimum wage. Cf. Federal Statistical Office, "Earnings Survey 2016," (2017), 29, table 9 (in German).

⁶ So far, based on empirical studies, awareness of the high non-compliance rates with the statutory minimum wage has only come from the marginally employed. See Spiegel.de, March 23, 2017 (available online) as well as Toralf Pusch and Hartmut Seifert, "Unzureichende Umsetzung des Mindestlohns bei Minijobbern," *Wirtschaftsdienst*, no. 3 (2017): 187–191 (in German).

Table 1

Workers with hourly wages below 8.50 euros

		2014			2015			2016		
		95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound	95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound	95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound
For comparison StaBu¹	Million persons	3.974			1.364			1.055		
Workers eligible for the minimum wage ²										
Contractual hourly wages	Million persons	2.591	2.784	3.068	1.848	2.073	2.335	1.576	1.828	2.045
	Percent	9.9	10.8	11.9	7.3	8.2	9.1	6.1	7.0	7.7
Actual hourly wages	Million persons	3.329	3.574	3.871	2.531	2.791	3.067	2.297	2.559	2.783
	Percent	13.0	13.9	15.0	10.1	11.1	12.1	8.9	9.8	10.7
Workers eligible for the minimum wage and sectors-specific minimum wages ²										
Contractual hourly wages	Million persons	3.035	3.246	3.521	2.352	2.587	2.854	1.951	2.214	2.432
	Percent	10.0	10.7	11.6	7.6	8.5	9.2	6.3	7.1	7.7
Actual hourly wages	Million persons	4.140	4.360	4.688	3.416	3.734	4.019	2.979	3.273	3.513
	Percent	13.6	14.3	15.4	11.2	12.2	13.1	9.6	10.4	11.2
All employed people ²										
Contractual hourly wages	Million persons	5.155	5.447	5.831	4.375	4.741	5.013	3.967	4.366	4.659
	Percent	15.5	16.4	17.4	13.1	14.1	15.0	11.6	12.6	13.4
Actual hourly wages	Million persons	7.535	7.905	8.322	6.767	7.207	7.586	6.233	6.681	7.056
	Percent	19.8	20.7	21.7	17.8	18.8	19.8	15.9	17.0	18.0

1 Source: Information from the Federal Statistical Office based on the 2014 Structure of Earnings Survey and the 2015 and 2016 Earnings Surveys.

2 Source: SOEPv33; own calculations using weighting factors. On the delimitation of the sample and the wage concept, see Boxes 1 and 2.

The percentage of workers who were eligible for the minimum wage but earned less than 8.50 euros per hour was around 10.8 percent before the reform, and fell to seven percent in the first half of 2016.

the law after the minimum wage reform are based on information provided by companies. However, this number can be partly explained by transitional regulations and measurement uncertainties. Violations of the Minimum Wage Law could nonetheless also play an important role.⁷ To investigate this assumption more closely, it is crucial to analyze information provided by employees themselves.

The calculations presented here rely on two wage concepts that can be examined with the SOEP data. We calculate, first, a contractual hourly wage based on the contractual working hours and, second, an actual hourly wage based on actual working hours per week (see Box 2). Actual hourly wages make it possible to record adjustments in the time worked, such as unpaid overtime.

Wage growth in the lower segment has accelerated since the reform

Wage developments in the lower segment of the wage distribution were especially weak in the years prior to the statutory minimum wage. This is evidenced by the nominal development of the contractual hourly wages for eligible employees across the deciles of the wage distribution⁸ and over a period of two years (see Figure 1), such as between 2012 and 2014 or between 2014 and 2016.⁹

The decile-specific wage development between 2014 and 2016 differs significantly from that in the period before the reform. Until 2014, the two-year long-term growth rates in deciles six through ten were around 3.5 percent. The growth rates were under two percent in the lowest

8 To construct the deciles, eligible employees are sorted in ascending order according to their wages and then divided into ten equally sized groups. Then, the average wage for the decile is calculated for a point in time and compared with the average in the same decile two years later.

9 We have chosen two-year windows to allow a direct comparison between 2014 and 2016, and because the annual changes are often very small. Even with a one-year observation, the picture shown does not change.

7 See Federal Statistical Office, "Earnings Survey 2016," (2017) (in German).

Box 2

Hourly wage concepts and eligibility

Calculating hourly wages

The SOEP does not ask respondents to report hourly wages directly because most work contracts specify a monthly wage, not an hourly wage. However, the SOEP does ask for information on both income earned in the previous month and the number of weekly working hours. This can be used to calculate the hourly wage by multiplying the weekly working hours by the average number of weeks in a month¹ and then dividing the monthly gross individual earnings by the result.

A key advantage of the SOEP compared to other data sources is that the individual questionnaire asks employees not only for their monthly income in their main job, but also for their contractual and actual working hours. In contrast to official statistical sources—which, for instance, in the case of the Microcensus only provide contractual working hours—the SOEP allows actual hourly wages to be determined. This makes it possible to identify potential adjustments in response to the minimum wage, such as unpaid overtime work.

The calculation of hourly wages on the basis of actual hours worked,² which is often used in the literature on low incomes, may underestimate wages because it does not take factors such as later payment for overtime work into account. Conversely, basing calculations solely on contractual working hours would ignore overtime work and could lead to an overestimation of hourly wages.

Information on secondary jobs is not included in the present analysis because the data on these jobs do not tell whether the respondent is in dependent employment or self-employed, and only include information on the average actual working hours.

¹ This amounts to 4.3 in the analysis carried out here. In the 2016 Earnings Survey, the Federal Statistical Office used a factor of 4.345.

² Moritz Heumer, Hagen Lesch, and Christoph Schröder, "Mindestlohn, Einkommensverteilung und Armutsrisiko," *IW-Trends*, no. 1 (2013): 19–36 (in German).

Who qualifies for the minimum wage?

A minimum wage of 8.50 euros an hour was introduced across Germany on January 1, 2015. However, the law also provides for a number of exemptions. These exemptions apply mainly to the long-term unemployed, unskilled youths under 18, employees working in industries where there is already a sector-specific minimum wage, and certain groups of interns and trainees. Since the SOEP contains detailed monthly data from the previous year, the long-term unemployed can be identified in the first six months of employment. They are excluded from the eligible population in the analyses. Youths under 18 are also excluded. Trainees and interns are counted as a single group among the exemptions, as the type and duration of the internship cannot be clearly determined in the SOEP. Based on current occupational activity, employees from industries with existing collective wage agreements can also be identified.³ Those working in industries that already have a minimum wage are excluded from the group of eligible employees.⁴ If a sector-specific minimum wage is less than 8.50 euros, it must be adjusted to the statutory minimum by January 1, 2017.

The *eligible* group focused on in this report thus consists of all workers who are neither exempt nor self-employed. Groups that indicate that they are employed in private households are also taken into account in the calculations, unlike in the 2014 earnings survey from Destatis. The same potentially applies to people who have an informal job, as they cannot be distinguished from formally employed persons in the SOEP.

³ In the SOEP, self-reported data are used to classify employees by industry. In this process, information about respondents' field of work and industry information is used. It should be noted, however, that respondents may simplify their job or industry and fail to distinguish it enough to accurately identify industries with specific minimum wages.

⁴ Excluded are individuals in one-euro-jobs, those who work over 50 hours a week, and those who began their job in the last month.

three deciles. Between 2014 and 2016, the two-year wage growth in the lowest three deciles was significantly higher than in the previous periods: Wages in the lowest decile have risen by about 15 percent. The actual hourly wages show a similar trend reversal.

This positive development can also be expressed in euro amounts (see Table 2). While the contractual hourly wage in the lower decile (Q10) averaged 6.63 euros in 2014, it rose to 7.58 euros in 2016. For the lower two deciles,

the corresponding values are approximately 7.90 and 8.70 euros. Actual hourly wages show a similar picture. In the two lower deciles, wages increased from approximately 7.40 euros in 2014 to 8.20 euros in 2016.

Looking at the tail of the wage distribution beneath the threshold value of 8.50 euros in 2014, there was also a positive development for both wage concepts. In terms of the contractual minimum wage, for example, the hourly wage rose from approximately 6.80 to 7.60 euros.

Wage changes can be depicted even more precisely with Pen's parades (Figure 3). These graphs (parades) show the relationship between wage level and position in the hourly wage distribution, with employees sorted in ascending order of their hourly wage. The higher the Pen's parade, the higher the wage at the specified point in the wage distribution.

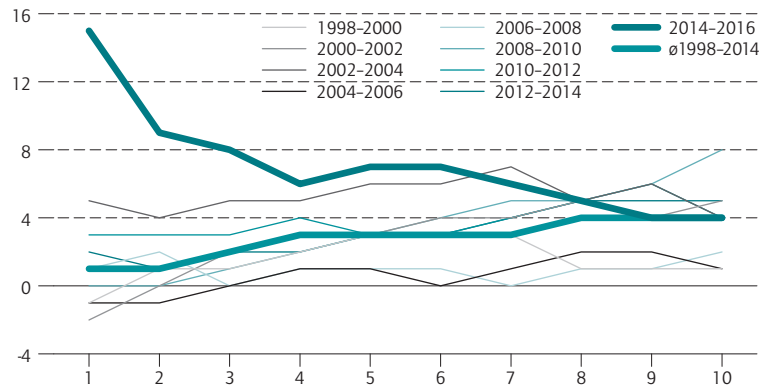
Wage growth in the lower 40 percentiles in the period from 2014 to 2016 was significantly higher than in the period from 2012 to 2014. In particular, employees up to the fifth percentile reported higher wage increases.

Still about 1.8 million employees with contractual hourly wages of less than 8.50 euros in the first half of 2016

Although the average development, irrespective of the wage concept considered, was very positive in the lower range of the wage distribution between 2014 and 2016, about 1.8 million of all eligible employees still earned a contractual hourly wage of less than 8.50 euros per hour (see Table 1, Figure 2) in the first half of 2016, according to SOEP data. This corresponds to a proportion of approximately seven percent of all qualified employees. Although the rate fell again by more than one percentage point from 2015 to 2016, it remained at an unexpectedly high level.

Figure 1

Nominal growth in contractual hourly wages over two years by decile, in percent



Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept see Boxes 1 and 2.

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Between 2014 and 2016, contractual hourly wages for the bottom 20 percent of workers eligible for the minimum wage increased substantially more than in every other two-year period between 1998 and 2014.

Table 2

Average wages in lower quantiles, workers eligible for the minimum wage

In euros per hour

		2014			2015			2016			Change in percent	
		95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound	95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound	95%-confidence interval lower bound	Point estimate	95%-confidence interval upper bound	2014-2015	2015-2016
Contractual hourly wage	Bottom decile	6.54	6.63	6.73	7.03	7.14	7.26	7.44	7.58	7.73	7.71	6.12
	Up to minimum wage in 2014	6.73	6.82	6.92	7.19	7.32	7.43	7.44	7.58	7.73	7.26	3.65
	Bottom two deciles	7.83	7.94	8.04	8.33	8.46	8.59	8.63	8.74	8.84	6.57	3.28
Actual hourly wage	Bottom decile	6.06	6.16	6.24	6.50	6.61	6.73	6.96	7.08	7.20	7.36	7.07
	Up to minimum wage in 2014	6.70	6.78	6.88	7.11	7.24	7.35	7.47	7.57	7.67	6.66	4.62
	Bottom two deciles	7.33	7.43	7.54	7.77	7.89	8.01	8.11	8.21	8.31	6.13	4.09

Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept, see Boxes 1 and 2. Bootstrap confidence interval with 200 repetitions.

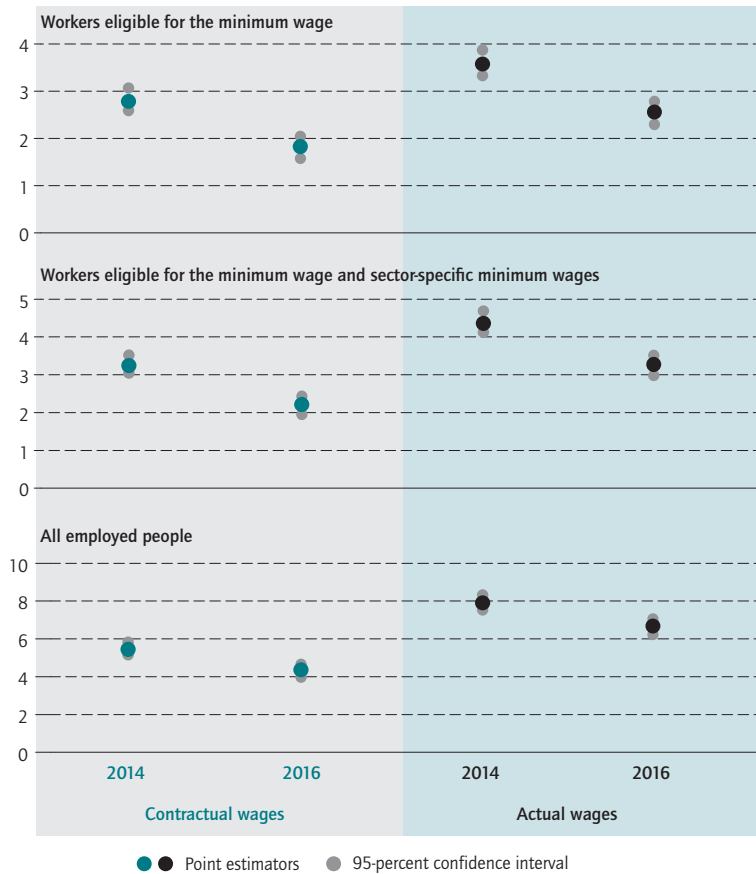
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In 2014, employees in the bottom tenth of the wage distribution who were eligible for the minimum wage earned between 6.44 and 6.66 euros per hour; two year later between 7.31 and 7.62 euros.

Figure 2

Workers with an hourly wage below 8.50 euros

In millions of workers



Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept see Boxes 1 and 2.

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Of all workers eligible for the minimum wage in Germany in 2016, between 1.6 and 2.0 million earn contractual wages less than 8.50 euro an hour.

Looking at actual working hours, the estimated number of eligible workers with a wage less than 8.50 euros—which is always higher than the number according to the contractual wage concept—decreased to approximately 2.6 million in 2016 from approximately 2.8 million in 2015 (2016 rate: around ten percent; 2015 rate: around 11 percent).¹⁰

¹⁰ According to the Panel Study Labor Market and Social Security (*Panel Arbeitsmarkt und Soziale Sicherung*, PASS) of the Federal Employment Agency (*Bundesagentur für Arbeit*, BA), the proportion of minimum-wage employees whose actual hourly wage was under the minimum wage was 19.6 percent in 2014 and 14.4 percent in 2015. Cf. Toralf Pusch and Miriam Rehm "The German Minimum Wage: Effects on Job Quality and Employees' Work Satisfaction," *WSI Mitteilungen*, no. 7 (2017): 491-498 (in German).

Including employees from industries with sector-specific minimum wages, the figure is 2.2 million (around seven percent) for the contractual and 3.3 million (around ten percent) for the actual hourly wage.

Features of the Federal Statistical Office's Earnings Survey and the robustness of SOEP results

The question arises how it is possible that, according to SOEP respondents, between about 1.8 and 2.6 million eligible workers were paid less than minimum wage in the first half of 2016, depending on the wage concept used.

As is well known, survey data may be subject to measurement errors. It can therefore not be ruled out that respondents either overestimate their working hours or underestimate their monthly gross pay.¹¹ However, also according to the Structure of Earnings Survey 2014, approximately four million workers were earning less than 8.50 euros an hour before the reform. This number, which is based on compulsory information from companies, is at a similar level to the SOEP figure of about 4.4 million workers, even if the actual hourly wage concept takes account of employees in industries that are subject to special regulations after the reform according to the Sub-contracted Foreign Workers Act (*Arbeitnehmerentendegesetz*, AEntG).¹² Only after the reform did the case numbers differ significantly based on information provided by companies and employees; the Earnings Survey shows a significantly higher accumulation in the wage group earning the minimum wage or slightly above (8.50 to 8.59 euros).¹³ However, since 2015, the numbers are no longer based on a Structure of Earnings Survey with mandatory participation for companies, but rather on the voluntary Earnings Survey (*Verdiensthebung*, VE). It cannot be ruled out that there was a selection process into participation, especially as only about 13 percent of the companies

¹¹ John Bound, Charles Brown, and Nancy Mathiowetz, "Measurement Error in Survey Data." In *Handbook of Econometrics*, Vol. 5. (Oxford: North-Holland, 2001), 3705-3843 and for the tendency to overestimate income in the lower part of wage distribution see Kim, C., & Tamborini, C. R. (2014). Response Error in Earnings: An Analysis of the Survey of Income and Program Participation Matched With Administrative Data. *Sociological Methods & Research*, 43(1), 39-72.

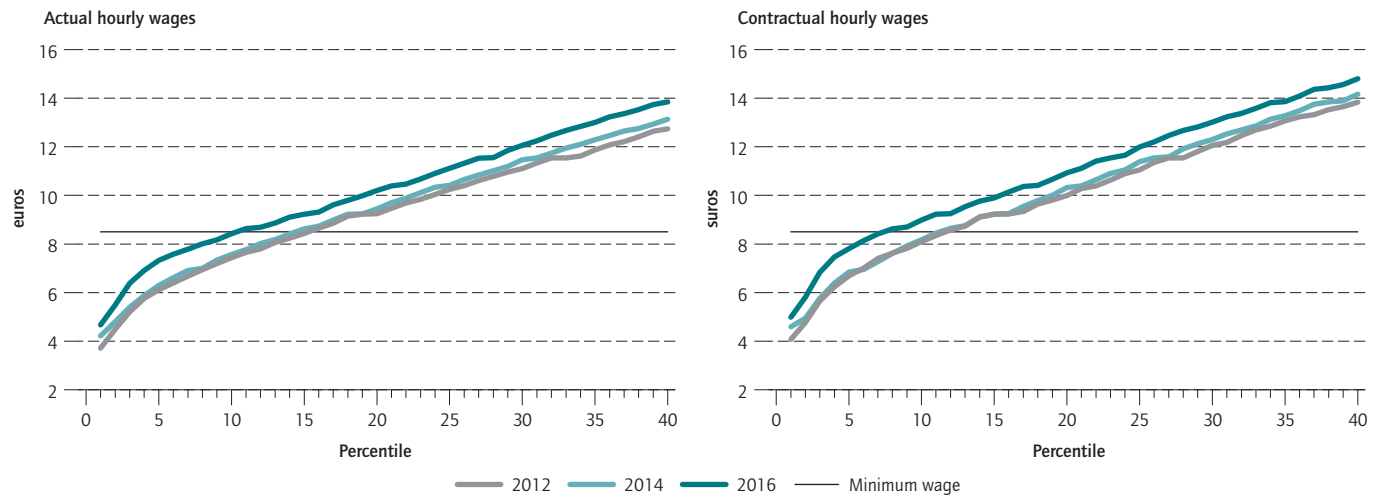
¹² For a comparative discussion of both data sources, see: Matthias Dütsch, Ralf Himmelreicher, and Clemens Ohlert, "Zur Berechnung von Bruttostundenlöhnen—Verdienst(struktur)erhebung und Sozio-oekonomisches Panel im Vergleich," *SOEPpapers on Multidisciplinary Panel Data Research*, no. 911 (2017) (in German).

¹³ According to the Earnings Survey in 2015, 1.712 million employees earned between 8.50 and 8.59 euros an hour; in 2016, it was 1.586 million.

Figure 3

Pen's parades for contractual and actual hourly wages

Average wages in the bottom 40 percentiles of the wage distribution



Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept see Boxes 1 and 2.

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For employees in the lower segment of the wage distribution who are eligible for the minimum wage, contractual and actual hourly wages have risen substantially since the reform.

from the original sample actually participated.¹⁴ Approximately 40 percent of the companies in the VE 2015 reported employees' contractual working hours instead of actual working hours.¹⁵ In addition, information on 2,000 companies without employees subject to social insurance but with marginally paid employees (total number of businesses in the VE 2016: 9,968), "was gathered from data from the Federal Labor Office (*Bundesagentur für Arbeit*, BA) and imputed from the VSE 2014 and VE 2015."¹⁶ This raises the question to what extent calculations based on this voluntary information from companies are indeed generalizable and interpretable as a trend and whether or not they give a clear picture of the implementation of the minimum wage law in employment practice. To obtain reliable information on this question, it would have to be made obligatory

for employers to provide documentation on the start time, end time, and duration of employees' daily working hours that has been confirmed by the employees themselves.

Different approaches to estimating the robustness of the SOEP-based results relating to the sample and possible measurement errors confirm the general findings presented here (see Box 3). Even in a conservative scenario, the contractual hourly wage for employees earning less than 8.50 euros an hour in 2016 results in a confidence band between about 829,000 and 1,148,000 employees.

In addition to the eligible employees, there are other groups of workers who earn less than 8.50 euros gross per hour (see Table 1), including freelancers, family workers, and trainees (see Box 2). Here, the estimate for 2016, depending on the hourly wage concept, is around 4.4 million and 6.7 million employed persons.

Significant differences between different occupational groups

The proportion of eligible employees still earning less than the minimum hourly wage in 2016 varies widely between different occupational and population groups. It is therefore worth taking a more differentiated look at the

¹⁴ See Federal Statistical Office, "Earnings Survey 2015. Abschlussbericht einer Erhebung über die Wirkung des gesetzlichen Mindestlohns auf die Verdienste und Arbeitszeiten der abhängig Beschäftigten" (Wiesbaden) (in German). The response rate was only 6.3 percent for the VE 2016 (Federal Statistical Office, "Earnings Survey 2016," (2017), 6 (in German).

¹⁵ Oliver Bruttel et al., "The Statutory Minimum Wage in Germany: Structure, Distribution and Effects on Employment," *WSI-Mitteilungen*, 7/2017, 473-481 (in German).

¹⁶ Federal Statistical Office, "Earnings Survey 2016," (2017), 7 (in German). Imputation means that missing values are estimated and filled using statistical methods.

Box 3

On the robustness of the results

The finding that based on contractual hourly wages there are around 1.8 million eligible employees in Germany who earn less than 8.50 euros per hour, even after the introduction of the minimum wage, are based on survey data. In such analyses, it should be noted that measurement and memory errors (such as a tendency to round up or down to the closest exact euro amount) may occur, and some participants may refuse to answer. Furthermore, the SOEP is only a subset of the population, which creates a random error.

In order to check the statistical random error and how idiosyncrasies of individual observations affect the results, we tested robustness for key results using a resampling method¹ (bootstrapping). The 95 percent confidence interval for the number of eligible employees with contractual (actual) hourly wages below 8.50 euros in the spring of 2015 is between approximately 1.85 (2.53) and 2.34 (3.07) million, and in the spring of 2016, between 1.58 (2.30) and 2.05 (2.78) million eligible employees (see Table).

¹ See Bradley Efron, "Bootstrapping Methods: Another Look at the Jackknife," *Annals of Statistics*, no. 7 (1979): 1-26.

In order to test how inaccuracies in monthly wages or hourly data affect the results, we have varied the critical value of 8.50 euros (see Table Box 3).

Assuming that persons who, according to our calculations, earn 5 or 10 percent less than 8.50 euros per hour (equivalent to 8.08 or 7.65 euros) are paid according to the minimum wage, the contractually agreed hourly pay shows that in 2015, approximately 1.6 or 1.4 million persons still reported wages below the minimum wage. In 2016, approximately 1.4 or 1 million eligible employees reported they were earning less than 8.50 euros per hour. For the actual hourly wage, these numbers were 2.3 or 1.8 million in 2015 and 2.0 or 1.5 million in 2016, respectively. If there were a systematic *underestimation* of hourly wages, the calculated values would be higher.

characteristics of these groups. To do so, the proportion of eligible employees who earned less than 8.50 euros gross per hour in 2014 and 2016 is broken down by features such as gender, age, professional education, and employment characteristics (see Table 3). For the purpose of comparability with the data according to VSE 2014, we use the concept of the actual hourly wage.

While the proportions in the VSE are consistently slightly lower, the structural patterns between the groups are similar. For example, in both data sets, the proportion of men earning less than the minimum wage is significantly lower than that of women. The percentage is significantly lower among full-time workers than among the marginally employed, and lower for employees of larger companies than of smaller companies. The table also shows that the proportion of workers paid less than minimum wage has fallen in all subgroups. For example, according to SOEP, while only about nine percent of men earned an hourly wage less than the minimum wage in 2014, this was true for about 20 percent of women. The proportion of those earning less than 8.50 euros in 2016 decreased to around 7 percent and 13 percent for men and women, respectively; around twice as many women as men earn below the minimum wage. Around sixty-

two percent of people in marginal employment earned low wages in 2014. Although this percentage decreased significantly by 2016, it was still around 40 percent.¹⁷ Wages below 8.50 euros per hour were relatively common in eastern Germany. There, in 2014, the proportion of those earning less than minimum wage was at around 22 percent, while in western Germany it was only 12 percent. Yet the proportion also fell by 2016 in both regions, to around nine percent in western Germany and around 15 percent in eastern Germany.

Average wages are rising

In terms of contractual wages, male employees who worked in industries without industry-specific minimum wages earned on average almost 20 euros an hour in 2014, around 4.60 euros more than female employees (see Table 4). Wages increased in the 18-44 age group before stagnating and declining among workers 66 years

¹⁷ According to the Panel Study Labor Market and Social Security, the proportion of marginally employed workers with an hourly wage of less than 8.50 euros fell from 60.9 percent in 2014 to 48.5 percent in 2015. See Toralf Pusch and Hartmut Seifert, "Mindestlohngesetz. Für viele Minijobber weiterhin nur Minilöhne," *Policy Brief WSI*, no. 9 (2017) (in German).

Table Box 3

Robustness tests of estimated percentages with wages below 8.50 euros per hour

		2014			2015			2016		
		95%- confidence interval lower bound	Point estimate	95%- confidence interval upper bound	95%- confidence interval lower bound	Point estimate	95%- confidence interval upper bound	95%- confidence interval lower bound	Point estimate	95%- confidence interval upper bound
Workers eligible for the minimum wage										
Contractual hourly wages, 8.50 × 0.95	Million persons	2.040	2.248	2.520	1.458	1.649	1.879	1.152	1.351	1.520
	percent	8.0	8.7	9.7	5.7	6.5	7.3	4.4	5.2	5.8
Contractual hourly wages, 8.50 × 0.90	Million persons	1.751	1.928	2.187	1.163	1.339	1.547	0.829	0.999	1.148
	percent	6.7	7.5	8.4	4.6	5.3	6.0	3.2	3.8	4.4
Actual hourly wages, 8.50 × 0.95	Million persons	2.685	2.934	3.217	2.012	2.252	2.512	1.793	2.021	2.280
	percent	10.4	11.4	12.4	8.0	8.9	9.9	7.0	7.8	8.6
Actual hourly wages, 8.50 × 0.90	Million persons	2.265	2.487	2.741	1.577	1.786	2.029	1.277	1.462	1.640
	percent	8.8	9.7	10.6	6.23	7.1	7.8	4.9	5.6	6.3
Eligible workers + industry-specific minimum wages										
Contractual hourly wages, 8.50 × 0.95	Million persons	2.386	2.598	2.862	1.815	2.040	2.262	1.447	1.660	1.845
	percent	7.9	8.6	9.4	5.9	6.7	7.4	4.6	5.30	5.9
Contractual hourly wages, 8.50 × 0.90	Million persons	2.036	2.228	2.486	1.470	1.679	1.892	1.079	1.280	1.436
	percent	6.7	7.4	8.1	4.8	5.5	6.2	3.4	4.08	4.6
Actual hourly wages, 8.50 × 0.95	Million persons	3.329	3.560	3.872	2.703	2.954	3.229	2.331	2.604	2.868
	percent	11.0	11.7	12.5	8.8	9.6	10.4	7.5	8.29	9.1
Actual hourly wages, 8.50 × 0.90	Million persons	2.777	2.993	3.272	2.147	2.383	2.639	1.749	1.973	2.196
	percent	9.1	9.8	10.6	7.0	7.8	8.6	5.5	6.28	6.9
All employed people										
Contractual hourly wages, 8.50 × 0.95	Million persons	4.418	4.739	5.100	3.766	4.110	4.375	3.371	3.716	3.996
	percent	13.4	14.25	15.3	11.2	12.21	13.0	9.8	10.73	11.5
Contractual hourly wages, 8.50 × 0.90	Million persons	4.025	4.308	4.653	3.334	3.673	3.906	2.928	3.263	3.555
	percent	12.1	12.95	14.0	10.0	10.91	11.6	8.6	9.42	10.3
Actual hourly wages, 8.50 × 0.95	Million persons	6.550	6.967	7.352	5.861	6.269	6.580	5.384	5.807	6.167
	percent	17.3	18.24	19.2	15.3	16.33	17.2	13.9	14.81	15.7
Actual hourly wages, 8.50 × 0.90	Million persons	5.876	6.222	6.620	5.153	5.533	5.872	4.619	4.944	5.313
	percent	15.4	16.29	17.3	13.5	14.41	15.3	11.8	12.61	13.5

Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept, see Boxes 1 and 2. Bootstrap confidence intervals with 200 repetitions.

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In a conservative scenario, robustness tests show around 1 million employees who are eligible for the minimum wage but still paid below this level.

Table 3

Jobs with hourly wages below 8.50 euros, employees eligible for the minimum wage

	VSE (2014) Percentage	SOEP		Decline in percent
		Percentage 2014 (actual working hours)	Percentage 2016 (actual working hours)	
Total	11.3	13.9	9.8	29.5
Women	14.2	19.5	13.2	32.3
Men	8.4	8.5	6.5	23.5
Age in survey year				
18-24	26.9	34.0	28.9	15.0
25-34	10.5	14.9	9.0	39.6
35-44	8.7	11.7	7.2	38.5
45-54	8.7	11.0	8.6	21.8
55-65	11.6	12.2	8.9	27.0
66 or older	31.8	38.0	30.9	18.7
Employment type				
Full-time employment	4.2	9.0	6.2	31.1
Parttime employment	10.5	15.4	14.7	4.5
Marginal employment	38.7	61.5	43.3	29.6
Limitation on term of employment				
Unlimited	10.5	11.7	8.2	29.9
Limited	16.8	25.5	19.2	24.7
Occupational qualifications				
No vocational training	24.3	19.7	15.6	20.8
With vocational training	11.1	16.2	10.0	38.3
University degree	2.4	4.3	3.9	9.3
Company size (employees)				
Fewer than 5	24.4	42.6	33.3	21.8
5-9	19.6	29.7	23.6	20.5
10-19 (SOEP)		22.1	17.7	19.9
20-99		16.4	11.7	28.7
100-199		10.7	6.6	38.3
200-1999		7.6	4.7	38.2
2000+		7.4	4.1	44.6
10-49 (VSE)	16.3			
50-99	11.8			
100-249	9.8			
250-999	7.3			
1000+	3.8			
Region				
Western Germany		11.9	8.6	27.7
Eastern Germany		22.3	15.4	30.9
Nationality				
German		13.0	8.9	31.5
Foreign		23.1	17.7	23.4

Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept, see Boxes 1 and 2.

Source for VSE: Mindestlohnkommission (2016): Erster Bericht zu den Auswirkungen des gesetzlichen Mindestlohns, Figure 2. For VSE only employees above the age of 18 years, without vocational trainees, interns, employees in semi-retirement, people in youth homes, or working in workshops for sheltered workshops or one-euro jobs.

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Women, East Germans, people in marginal employment and workers in small firms are more often paid below 8.50 per hour.

and older. Furthermore, with a salary of approximately 8.70 euros in 2014 and 9.50 euros in 2015, marginally employed persons earned significantly less than part-time (approximately 16.80 or 17.20 euros) or full-time workers (approximately 19 or 20 euros). Average wages were higher among those with higher levels of educational attainment and in companies with higher numbers of employees, and lower among those with fixed-term contracts. Overall, employees working in western Germany earned more than those in eastern Germany, and German citizens earned more than foreign citizens.

Contractual hourly wages in all groups are increasing over time. The percentage increase is particularly high among marginally employed persons, employees at small companies, women, persons without vocational training, and foreign citizens.

The above-mentioned findings for the contractual hourly rate also apply structurally to the actual hourly wage. However, the average values are consistently lower with this measurement concept.

Challenges in implementing the minimum wage were to be expected

Even before the introduction of the minimum wage in Germany, critics predicted difficulties¹⁸ in implementing the reform.¹⁹ In particular, the lack of adequate time-keeping and documentation requirements for employers posed problems for the enforcement of minimum wages. This applied especially to workers in the mini-job sector, who often have no written employment contracts. The new documentation requirements introduced with the minimum wage reform have been the subject of numerous lawsuits, in particular by employers, since they are found to have significantly increased the administrative burden.

The calculations presented in this report confirm that the number of workers with hourly wages less than 8.50 euros varies depending on which measuring concept is used for the hourly wages. Looking at the specified contractual working hours, considerably more employees are paid according to the law. This makes it clear that while many employees have a contract according to which

¹⁸ This also includes employees pushed into pseudo-selfemployment.

¹⁹ Cf. Karl Brenke and Gert Wagner, "Mindestlohn" (2013) (available online). There were also criticisms due to the experiences of other countries in implementing a minimum wage law; cf. Thorsten Schulten, "Herausforderungen für die Umsetzung des allgemeinen gesetzlichen Mindestlohns in Deutschland." In *Umsetzung und Kontrolle von Mindestlöhnen: Europäische Erfahrungen und was Deutschland von ihnen lernen kann*. (working paper no. 49, study commissioned by the Society for Innovative Employment Promotion in NRW, GIB: Bottrup, 2014, 40-50) (in German).

Table 4

Average hourly wages among employees eligible for the minimum wage, by group

	SOEP					
	2014	2016		2014	2016	
	Average contractual hourly wage in euros	Average contractual hourly wage in euros	Change in percent	Average actual hourly wage in euros	Average actual hourly wage in euros	Change in percent
Total	17.88	18.74	4.8	16.28	17.16	5.4
Women	15.54	16.59	6.8	14.27	15.33	7.4
Men	20.13	20.83	3.5	18.22	18.93	3.9
Age in survey year						
18–24	11.12	11.60	4.3	10.52	10.80	2.7
25–34	16.25	17.03	4.8	14.76	15.63	5.9
35–44	19.15	20.06	4.8	17.4	18.23	4.8
45–54	18.9	19.61	3.8	17.16	17.90	4.3
55–65	19.09	20.18	5.7	17.43	18.60	6.7
66 or older	12.06	12.11	0.4	11.46	11.69	2.0
Employment type						
Full-time employment	18.98	19.78	4.2	17.35	18.15	4.6
Part-time employment	16.82	17.21	2.3	14.92	15.41	3.3
Marginal employment	8.69	9.49	9.2	8.18	9.15	11.9
Limitation on term of employment						
Unlimited	18.46	19.32	4.7	16.81	17.67	5.1
Limited	14.70	15.05	2.4	13.31	13.86	4.1
Occupational qualifications						
No vocational training	14.37	15.40	7.2	13.38	14.29	6.8
With vocational training	16.14	16.99	5.3	14.85	15.69	5.7
University degree	24.23	25.09	3.5	21.53	22.57	4.8
Company size (employees)						
Fewer than five	10.84	11.19	3.2	10.1	10.70	5.9
5–9	12.48	14.15	13.4	11.54	13.04	13.0
10–19 (SOEP)	13.86	14.5	4.6	12.78	13.47	5.4
20–99	16.22	16.52	1.8	14.53	15.13	4.1
100–199	17.22	17.82	3.5	15.88	16.44	3.5
200–1999	18.68	19.94	6.7	17.21	18.39	6.9
2000+	21.94	22.80	3.9	19.77	20.62	4.3
Region						
Western Germany	18.53	19.39	4.6	16.88	17.75	5.2
Eastern Germany	15.12	15.89	5.1	13.79	14.52	5.3
Nationality						
German	18.22	19.07	4.7	16.57	17.43	5.2
Foreign	14.56	15.92	9.3	13.57	14.79	9.0

Sources: SOEPv33; authors' own calculations using weighting factors. On the delimitation of the sample and the wage concept, see Boxes 1 and 2.

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Actual average hourly wages have risen over time, especially among workers in marginal employment, employees in small firms, women, people without vocational training, and foreign citizens.

they are employed at minimum wage, they are effectively working longer hours.²⁰ This was already reported by various news outlets shortly after the minimum wage

was introduced.²¹ Reports showed, for instance, that employees were being paid less or not at all for time spent in preparation, waiting, and on standby, and in

²⁰ See the possibilities of adapting working time in the introduction of the minimum wage. Jürgen Schupp, "Wer profitiert vom Mindestlohn? (Kommentar)," *DIW Wochenbericht*, no. 6, 112 (2014) (available online) (in German).

²¹ See "Umgehungsstrategien der Arbeitgeber: Popcorn statt Mindestlohn," *Spiegel Online*, September 15, 2015, (available online) and Inga Höltnann, "Wie Unternehmen den Mindestlohn umgehen," *Tagesspiegel*, April 4, 2015, (available online) (both in German).

Box 4

Multi-topic surveys on the minimum wage

In June/July 2015, a representative multi-topic survey on the perceptions of the minimum wage reform took place, commissioned by the SOEP. Approximately 2,000 respondents were asked about their views on the reform, individual labor market characteristics, and experiences of employers' efforts to avoid paying the minimum wage. Respondents were asked two questions about their degree of agreement or disagreement with the introduction of the minimum wage again in June/July 2016 and August/September 2017.

All in all, the survey shows a constant, very high level of approval of the reform of around 87 percent among adult Germans.¹ If one takes a closer look at the 10 to 12 percent of respondents who are not in favor of the minimum wage, it turns out that in the year of its introduction, about a third of this group was fundamentally against the minimum wage. This proportion sunk in 2016 and again in August/September 2017 and is now around 17 percent. Conversely, the proportion of people in the group rejecting the minimum wage who consider the current minimum wage too low, even after the January 1, 2017, adjustment, has increased. In the summer of 2015, around one-third of the respondents considered the minimum wage to be too low, compared with almost three quarters in late summer 2017 (see Table).

¹ Results of telephone surveys on behalf of the German Trade Union Confederation (*Deutscher Gewerkschaftsbund*, DGB) show similarly high approval levels (available online).

The multi-topic surveys also asked whether the participants themselves were affected by employers' efforts to avoid paying the minimum wage (such as unpaid overtime) or if they knew someone in their personal environment who was affected by such measures. In all three years, in response to these survey-methodically sensitive questions, around every fifth adult responded that they were either personally affected or knew someone in their immediate circle of acquaintances whose wages had been affected by employers' efforts to avoid paying the minimum wage.² Without attempting to extrapolate this group, the analysis nonetheless makes it clear that within the population, the view that employees are not being paid in accordance with the Minimum Wage Act is widespread. This should be considered a social issue both by those designing labor market policy and by those conducting research on minimum wages.

² Concrete examples of such circumvention strategies were also provided by a qualitative study carried out by the SOEP in the summer of 2015, involving six focus groups of employed and non-working persons in the low-income sector. See Axel Glemser, Astrid Kunert, and Simon Huber, "Einführung und Auswirkung des gesetzlichen Mindestlohns in Deutschland," *SOEP Survey Papers*, no. 474, series C (in German).

some cases were being paid by piece rates rather than hourly rates. Additionally, employers sometimes negotiated with employees over payments in kind or deducted the cost of work materials from wages.²² Furthermore, it was reported²³ that the planned provision of additional customs inspection posts to monitor compliance with the minimum wage law had not progressed sufficiently, making enforcement of the law more difficult. In August 2015, for example, the federal government confirmed

²² See question from the Alliance 90/The Greens parliamentary group (Bundestag document 18/7525 (2016): 14 (in German)).

²³ See the federal government's answer to the Left party's question regarding the effects of the statutory minimum wage (Bundestag document 18/5807 (2015) (in German)).

problems regarding the supply of personnel²⁴ and documentation on the part of employers.²⁵ Additionally, customs inspections are time-intensive, which is why they are applied in a risk-based manner,²⁶ that is, they are more likely to occur where major violations are expected.²⁷ The existing procedure thus does not guarantee a systematic

²⁴ In the question from the Alliance 90/The Greens parliamentary group from 02/15/2016 (Bundestag document 18/7525), the federal government confirmed that numerous members of the Tax Enforcement Unit for Undeclared Work were delegated to other areas.

²⁵ Practices observed to prevent the payment of minimum wages include: incorrect hourly records, setting up work time accounts incorrectly, identification of working hours as breaks, non-compensation of setup times, and pre- and post-processing or flatrate remuneration without taking into account the minimum wage and working hours; see Bundestag document 18/7525 (2016): 14 (in German).

²⁶ See Bundestag document 18/11475 (2016): 19 (in German).

²⁷ See German Bundestag document 18/7525, federal government's answer, (2016): 1 (in German).

Table Box 4

Agreement with and objections to the uniform statutory minimum wage

"In January 2015, with only a few exceptions, a uniform statutory minimum wage of 8.50 euros per hour [in 2017 with the addition: which was increased to 8.84 euros per hour in January 2017] went into effect in Germany. Do you think it was a good idea to introduce the minimum wage?"	June-July 2015	June-July 2016	August-September 2017
		in percent	
I think it was a good idea	87	89	87
I don't think it was a good idea	10	8	11
No answer	3	3	3
Percent of total (case number)	100 (2.013)	100 (2.000)	100 (2.000)
BASIS: Respondents who donot think the minimum wage was a good idea: "Why don't you think it was a good idea to introduce the minimum wage?"			
I am opposed to the minimum wage in general	32	23	17
I think that a minimum wage of 8.50 euros/hour is too high	(11)	(11)	(3)
I think that a minimum wage of 8.50 euros/hour is too low	34	55	73
Other reasons	22	(12)	(6)
Percent of total (case number)	100 (197)	100 (165)	100 (211)
"There has been discussion surrounding the introduction of the minimum wage about employers who use various methods to avoid paying the minimum wage (such as requiring employees to work unpaid overtime, giving them added work responsibilities, or increasing performance expectations). Have you been affected by such methods yourself or do you know someone who has?"			
Yes, I have been affected	5	6	4
Yes, someone I know has been affected	17	13	17
No, I have not been affected, and I do not know anyone who has	76	80	77
No answer	2	2	2
Percent of total (case number)	100 (2.013)	100 (2.000)	100 (2.000)

Sources: CAPI-BUS, Minimum Wage Module; SOEP/DIW Berlin.

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Popular support for the minimum wage is high.

and comprehensive assessment of whether or not the minimum wage law is actually being applied. According to the federal government, 1,600 additional posts are planned for the Tax Enforcement Unit for Undeclared Work (*Finanzkontrolle Schwarzarbeit, FKS*) by 2019.²⁸

Other data sources as well as the experiences of other countries in implementing the minimum wage also indicate²⁹ that some employers take advantage of the aforementioned (un)permissible “adaptation measures” (see Box 4). It is argued that more must be done in order to support people with a low hourly wage since the bur-

den to prove non-compliance by employers is on them alone. Proposed measures include, among other things, the obligation for employers to record the starting time, ending time, and number of hours worked.³⁰

Conclusions

The introduction of the minimum wage at the beginning of 2015 was a turning point for the German labor market that raised high expectations but also drew skepticism and sharp critique. The official employment figures available to date and causal analyses for the period

28 See Bundestag document 18/4719, federal government's answer, (2015): 1 (in German).

29 See Schulten, “Herausforderungen für die Umsetzung des allgemeinen gesetzlichen Mindestlohns in Deutschland,” 40–50 (in German).

30 Marc Amlinger and Throsten Schulten, “Praxis und Wirkung des Mindestlohns, Stellungnahme anlässlich der Anhörung des Bundestagsausschusses für Arbeit und Soziales,” Bundestag document 18(11)558 (2016).

from 2015 to 2017 indicate neither major job losses nor a sharp increase in the number of unemployed.³¹ Accordingly, in July 2016, the Minimum Wage Commission decided to raise the minimum wage to 8.84 euros beginning January 1, 2017.

Currently, it would certainly be premature to make a final assessment on the impact of the introduction of minimum wages on real job creation and wage distribution.³² Expert reports are currently being prepared by several research institutes on behalf of the Minimum Wage Commission based both on company information and on data from employee surveys, and will be used in the Commission's assessment. The descriptive results presented here from the employee perspective document, on the one hand, that especially lower wage groups have benefited disproportionately from an increase in their hourly wages since 2014. On the other hand, the results indicate that a substantial proportion of employees still earned less than the statutory minimum wage in 2016.

The results suggest that the minimum wage law is not implemented one-to-one in practice and indicate that there is a need to improve the inspection and sanctions mechanisms. At the same time, research is required to continue the comprehensive evaluation of the reform

with causal analytical methods in order to make a comprehensive statement on the short-, medium-, and long-term effects of the minimum wage.³³

In light of the fact that in July 2018, the Minimum Wage Commission will once again decide on whether to adjust the minimum wage level, in accordance with its mandate, calls for an easing of documentation obligations and employer inspections are increasing, as are demands for a significant increase in the minimum wage.

There remains a difficult-to-answer hypothetical question: Would the actual employment effects on the labor market have been different if, on January 1, 2015, all the workers entitled to the benefit had actually received the legal minimum wage they were due? It is still too early to answer this question with a "declaration of no employment policy objection" for the minimum wage at the present time.

The results presented here suggest that for many workers, raising the statutory minimum wage would do less to improve their pay situation than effectively enforcing the law. This is especially true when one considers that low wages can lead to long-term biographical risks (affecting, e. g., pensions and other retirement provisions).

31 See, for example, Mario Bossler, and Hans-Dieter Gerner, "Employment effects of the new German minimum wage," *IAB Discussion Paper* (2016); and Marco Caliendo et al., "The Short-Run Employment Effects of the German Minimum Wage Reform," *IZA Discussion Paper* (2017).

32 In its most recent annual report, the German Council of Economic Experts (*Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung*) also points to the favorable economic conditions since the introduction of the minimum wage and leaves the question open as to whether these conditions will continue in the event of a slowdown in the economy. SVR, "Für eine zukunftsorientierte Wirtschaftspolitik," *Jahresgutachten*, no. 8, (Stuttgart: Metzler-Poeschel, 2017): number 785 (in German).

33 The link between the informal economy and the minimum wage is socially relevant, largely unexplored, and could be an interesting contribution to future reports by the Minimum Wage Commission. For an up-to-date overview of estimated quantities and structures, see: Dominik H. Enste, "Schwarzarbeit und Schattenwirtschaft – Argumente und Fakten zur nicht angemeldeten Erwerbstätigkeit in Deutschland und Europa," *IW Report*, no. 9 (2017) (in German).

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