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Minimum wage

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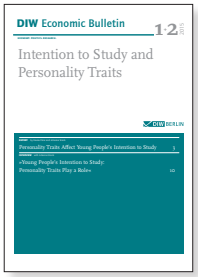

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Minimum wage not yet for everyone: on the compensation of eligible workers before and after the minimum wage reform from the perspective of employees

By Patrick Burauel, 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 data[2] 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.

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.

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 Auffrischungsstichproben am Beispiel des Sozio-oekonomischen Panels (SOEP)," in Nonresponse 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).

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 Office[4] (*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 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

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).)

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 for 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 StaBu[1]	**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 sector-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 distribution[8] 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

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

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.

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 month[1] 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.

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.

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).

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.

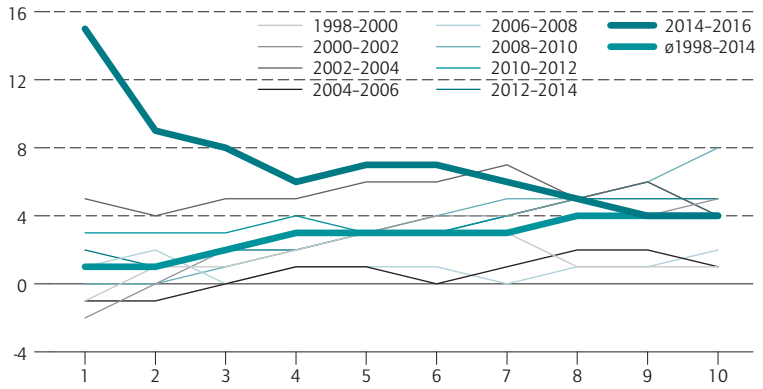
Wage growth in the lower 40 percentiles in the period from 2014 to 2016 was significantly higher than in the period from 2012 to 2014. In particular, employees up to the fifth percentile reported higher wage increases.

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.

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

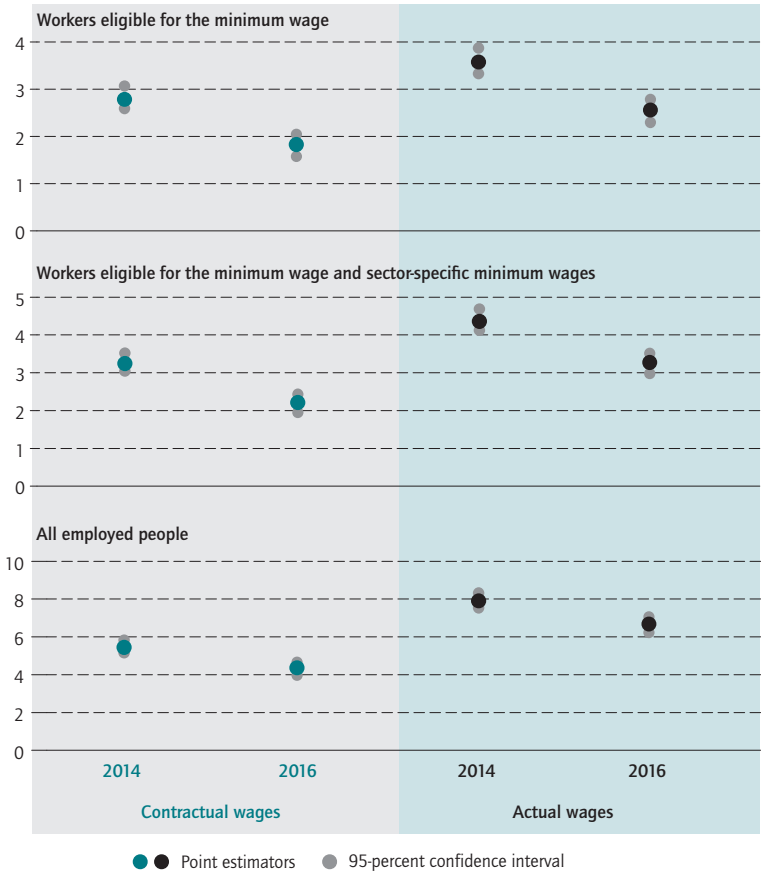
		2014			2015			2016			Change in percent	
		95-%-confidence interval lower bound	Point estimate	95-%-confidence interval upper bound	95-%-confidence interval lower bound	Point estimate	95-%-confidence interval upper bound	95-%-confidence interval lower bound	Point estimate	95-%-confidence interval upper 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.

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.

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]

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 (*Arbeitnehmerentsendegesetz*, 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 (*Verdiensterhebung*, VE). It cannot be ruled out that there was a selection process into participation, especially as only about 13 percent of the companies

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).

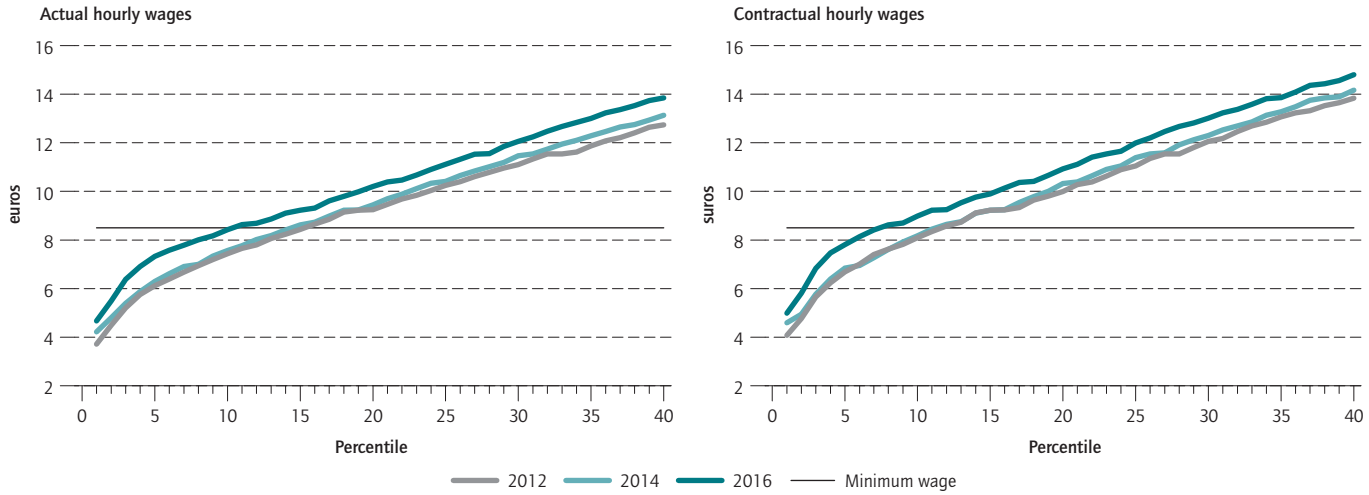
11 John Bound, Charles Brown, and Nancy Mathiowetz, "Measurement Error in Survey Data." In *Handbook of Econometrics*, Vol. 5. (Oxford: North-Holland, 2001), 3705–3843 and for the tendency to overestimate income in the lower part of wage distribution see Kim, C., & Tamborini, C. R. (2014). Response Error 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.

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 idiosyncracies of individual observations affect the results, we tested robustness for key results using a resampling method[1] (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).

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 *under*estimation of hourly wages, the calculated values would be higher.

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

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.

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)	SOEP		
	Percentage	Percentage 2014 (actual working hours)	Percentage 2016 (actual working hours)	Decline in percent
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
Part-time 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: Mindeslohnkommission (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.

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 difficulties[18] 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-self-employment.

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.

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 Höltmann, "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).

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.

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

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 reported[23] 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 problems regarding the supply of personnel[24] 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

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)).

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 set-up times, and pre- and post-processing or flat-rate 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.

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 indicate[29] 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 burden 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 Thrsten 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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Using public procurement as a decarbonisation policy: a look at Germany

By Olga Chiappinelli and Vera Zipperer

Public authorities spend large proportions of their GDP on goods and services and are therefore responsible for a significant share of embedded emissions. Given this large impact, governments have the responsibility of decarbonizing their purchases, as well as the potential to influence markets towards sustainability. So-called 'Green Public Procurement' (GPP) consists in the use of environmental criteria in the procurement process. In Germany, Europe's biggest economy, public purchases account for 15 percent of annual GDP. However, despite a rising trend, the use of GPP in public procurement contracts remains marginal. The main barriers to broader implementation is the perception that including environmental criteria leads to higher procurement costs. Further, administrative capacity faces constraints to acquire legal and technical expertise about GPP. A clear political mandate for financing the incremental costs incurred from the environmental impact of procured goods and services, as well as specific training programs for procurement officials can encourage an increased adoption of GPP in the future.

In Germany, public procurement amounts to over 500 billion euros per year. This equates 15 percent of GDP, making it both a paramount economic phenomenon and a central activity of the government.[1] Specifically, government purchases account for 18 percent of total consumption and 11 percent of total investment.[2] In some sectors, public purchasers command a significant share of the market, such as in health (74 percent[3]), education (91 percent[4]), transport infrastructure, telecommunications, and defense (100 percent each). Given this considerable impact, governments can use their purchasing decisions to pursue strategic policy objectives, among which sustainability is a major one.[5]

Green Public Procurement (GPP) describes procurement processes that specify environmental criteria in the call for tenders and thus take into account environmental considerations, such as energy efficiency and the use of low-carbon materials, in the award process.[6] Some examples of GPP purchases are energy-efficient computers and buildings, office furniture from sustainable

1 OECD (2017): Size of public procurement in Government at a glance 2017 (available online, retrieved on November 22nd, 2017. This applies to all other online sources in this report, unless specified otherwise). According to the OECD, public procurement is defined as the sum of (1) intermediate consumption by governments for their own use, (2) gross fixed capital formation, and (3) social transfers in kind via market producers. These figures exclude spending by utility companies and state-owned enterprises.

2 OECD (2017): OECD.stats – National Accounts – National Accounts at a Glance 2017 – General Government and OECD.stats – National Accounts – National Accounts at a Glance – Overview Table. The consumption share is the ratio between the sum of (1) and (3) in footnote 1, and total consumption expenditure in the economy; the investment share is the ratio between (2) in footnote 1, and total investment expenditure in the economy.

3 Calculation based on Statistisches Bundesamt (2015): Health Expenditure (available online).

4 See Eurostat: Total educational expenditure by education level, program orientation and type of source (educ_uoe_fine01) (available online).

5 Other strategic objectives that can be pursued through public procurement are for example innovation, competitiveness and growth, support for small and medium enterprises and gender equality.

6 European Commission (2008): Public Procurement for a better environment. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (available online).

timber, recycled paper, cleaning services using ecologically sound products, low-emission vehicles, and electricity from renewable energy sources.

GPP holds great large potential to decarbonize the economy, also relative to the other decarbonization policies that are currently being implemented or discussed. Current levels of carbon pricing in emission trading schemes are not yet high enough to trigger the changes that are needed for moving towards a low-carbon economy. On the other hand, GPP can have a fast, significant and comprehensive impact. First, GPP offers authorities the option to make purchase decisions based on implicit carbon prices that are higher than the general carbon price, as well as taking into account more environmental impacts than solely carbon emissions. This implies that when buying green products and services, authorities can substantially reduce their own environmental impact. Second, given authorities' large procurement volumes, GPP can create lead markets for climate-friendly options early on, which carbon pricing may struggle to create in the short term. Therefore GPP can provide the industry with credible incentives for adopting and developing green technologies and processes along the whole value chain.[7] Furthermore, like other 'demand-side' innovation policies (e. g. regulations and standards), procurement can provide incentives for industries to innovate without or with limited impact on public spending, which is a key advantage in times of fiscal consolidation.[8] Also, GPP seems politically easier to implement than other forms of carbon pricing, such as a carbon tax. GPP can be implemented at the national and local level without requiring broader political consensus.

Moreover, public authorities have the size and the role to push the public awareness and the political commitment for environmental protection, as well as sustainable consumption and production.[9]

The potential of public procurement as a decarbonization policy is widely acknowledged by key international policy institutions. For example, a target on GPP was included in the United Nations' 2030 Sustainable Development Goals (SDG 12, target 12.7).[10] Though the implementation of GPP is not mandatory (Box 1) and the targets are not binding, the European Commission made GPP one of six policy priorities in its newly published public procurement strategy.[11]

Given the political momentum in Europe, Germany's ambitious emission reduction targets[12] – at risk of being missed if no further action is taken – and in anticipation of the formation of a new government, it is a good time to assess where Germany currently stands in regard to goals and implementation of GPP. This report also examines the barriers to fully unleashing GPP's potential, and proposes policy options to overcome them.

Implementing GPP: going beyond the purchase price by accounting for environmental impacts

In many cases, public procurement contracts are awarded solely on the basis of the purchase price: Using the so-called "lowest price criterion", the cheapest bid is awarded the contract.[13] However, the purchase price only accounts for a portion of the total cost generated by a public purchase (see Figure 1). There are further direct and indirect cost, which should be considered in the procurement process in order to reflect the true costs of a procured good or service.

Regarding direct costs, the public authority will often face post-purchase expenses over the life-time of the object. For example, when procuring the construction of a building, the public authority will not only incur an expenditure for the construction, but will also have to cover the costs during the operational stage of the building (i. e. electricity bills, maintenance works) and the disposal costs at the end of life (i. e. demolition costs). The direct costs of an object over its entire lifetime are often referred to as Total Cost of Ownership (TCO).[14]

Alongside economic benefits, using TCO when awarding procurement contracts, even if not explicitly taking into account environmental criteria that would qualify as green procurement, can have environmental benefits. While sustainable products and services tend to have a higher purchase price than conventional options (e. g., LED lighting compared to incandescent bulbs), they are likely to be cheaper overall when accounting for the costs incurred over the entire life-time, since they have lower

7 UN Environment (2017): Global review of Sustainable Procurement (available online).

8 Veiko Lember, Rainer Kattel, and Tarmo Kalvet (2015): Quo vadis public procurement of innovation, The European Journal of Social Science Research, 28(3), 403–421.

9 Karsten Neuhoff et al. (2017): Innovation and use policies required to realize investment and emission reductions in the materials sector. Policy Design for a Climate-Friendly Materials Sector. Climate Strategies and DIW Berlin (available online).

10 UN Environment (2017), loc.cit.

11 European Commission (2017): Communication from the Commission to the Institutions: Making Public Procurement work in and for Europe (available online).

12 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2007): Das integrierte Energie- und Klimaprogramm der Bundesregierung (available online).

13 CEPS and College of Europe (2011): Uptake of Green Public Procurement in the EU 27. Study mandated by the European Commission, DG Environment (available online).

14 CEPS and College of Europe (2011), loc.cit.

Box 1

Regulatory framework for GPP in the EU

The EU sets common rules for the public procurement of contracts which have a reserve price (i. e., the auction's starting value as defined by the purchasing authority) exceeding given thresholds.[1] Regarding the use of environmental considerations in public procurement, two sets of EU Directives are especially important. First, the EU-2004 Directives[2] introduced the option of including environmental considerations in the award procedure, both as award criteria and as technical requirements (e. g., environmental labels). Second, the EU-2014 Directives[3] explicitly introduced the possibility of including the costs imputed to environmental externalities, as part of the concept of life-cycle cost, which allows to take into account all direct and environmental costs of a purchase over the entire life time of a product. Also, the EU-2014 Directives simplified the use of environmental labels and allowed the public authorities to require certain environmental labels without infringing the competition law. The current EU regulation thus provides a regulatory framework for including environmental criteria. However, it neither not mandates the use of GPP nor sets binding targets. Therefore, EU Member States are free to determine the extent to which they implement and use GPP.[4]

Germany implemented the EU-2004 Directives in 2006. The novel EU regulation of 2014 was implemented in 2016.[5] In addition, for contracts below the EU thresholds, national regulations apply. Here are some examples of sector-specific laws which foster sustainability aspects[6]:

- the law to promote the circular economy and environmentally friendly waste management,[7] where environmentally friendly options have to be considered in procurement contracts;
- the administrative directive of the Federal Ministry for Economic Affairs and Energy on the procurement of energy efficient products and services in 2017,[8] which requires the consideration of the highest energy efficiency standards as well as environmental labels in evaluating tender bids;
- a joint decree on the procurement of wood products[9] from 2011, which requires that all wood products are sourced from legal and sustainable wood production.

1 European Commission (2014): Thresholds according to type of procurement under the 2014 directives on concessions, general procurement, and utilities (available online, last retrieved November 13th, 2017)

2 European Commission (2004): Directive 2004/18/EC on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts (available online); and Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (available online).

3 European Commission (2014): Directive 2014/24/EU on public procurement and repealing Directive 2004/18/EC (available online); Directive 2014/25/EU on procurement by entities operating in the water, energy, transport, and postal services sectors, and repealing Directive 2004/17/EC (available online).

4 There are, however, some sector specific legislations e. g. requiring certain energy efficiency standards of office IT equipment (EU Regulation No 106/2008 on a Community energy-efficiency labelling programme for office equipment, available online) or road transport vehicles (EU Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, available online).

5 Bundesregierung (2016): Gesetz zur Modernisierung des Vergaberechts (VergRModG), in: Bundesgesetzblatt Jahrgang 2016, Teil I, Nr. 8; Verordnung zur Modernisierung des Vergaberechts (VergRModVO), in: Bundesgesetzblatt Jahrgang 2016, Teil I, Nr. 16.

6 For a detailed overview of the legal framework of environmentally friendly procurement see Umweltbundesamt (2017): Rechtsgutachten umweltfreundliche öffentliche Beschaffung (available online).

7 Bundesregierung (2012): Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz – KrWG), BGBl. I S. 212. Lastly changed in 2016 by Article 4 of BGBl. I, 569.

8 Bundesregierung (2017): Bundesanzeiger BAnz AT 24.01.2017 B1.

9 Bundesministerium für Ernährung und Landwirtschaft (2010): Gemeinsamer Erlass zur Beschaffung von Holzprodukten (available online).

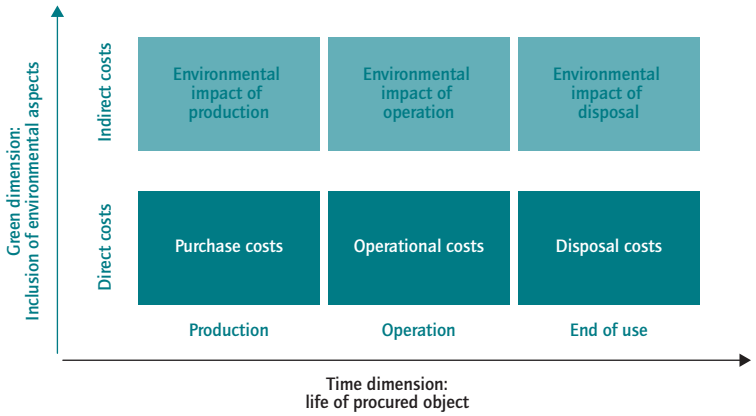
operating costs (for instance because of more efficient energy and fuel use), as well as lower maintenance, conversion, recycling and disposal costs than the business-as-usual option.[15] Looking at TCO instead of the simple purchase price therefore allows the purchaser to choose the offer with the overall lowest direct cost, exploiting potential economic savings over the life-time of a product or infrastructure.

Due to the environmental impact of products (environmental externalities), the purchase will not only generate costs for the purchasing organization but also for society as a whole. For example, the construction of a public building requires materials (e. g., steel and concrete) the

15 European Commission (2009): Collection of Statistical Information on Green Public Procurement in the EU. Report on data collection results by PricewaterhouseCoopers, Ecofys and Significant (available online).

Figure 1

Direct and indirect costs in public procurement



Source: Author's own depiction.

Purchase costs only account for a part of the procured product's total costs incurred over its lifespan.

production of which is energy-intensive, generates greenhouse gas emissions, and thus leads to environmental damage.[16] This environmental impact is not limited to the purchase stage, but often continues for the entire life of the procured object. In a building, for example, the use of energy and fuel during the operational stage will also contribute to emissions, as will the disposal process. Adding the costs of environmental externalities to TCO is commonly referred to as Life-cycle Cost (LCC).[17] Using LCC as basis for procurement decision, is a way to take into account the full social and environmental costs of the purchase. If environmental externalities are reflected, climate-friendly offers are ultimately favored, contributing to the decarbonization of public authorities' purchases.

GPP implementation options

The regulatory framework of the EU and Germany (see Box 1) allows for two GPP implementation options. First, environmental considerations can be specified in the *technical requirements* in the call for tenders. This implies that all bids are required to satisfy certain (minimum) standards or specifications (e. g., on energy efficiency, material use). Second, environmental criteria can be part of the *award criteria*. This approach is possible when the so-called "Most economically advantageous tender" (MEAT) award criterion is used, which allows to consider quality dimensions in the award alongside price. Using the MEAT criterion allows to take both total cost of ownership and environmental considerations into account in the competition. The current EU directives on public procurement actually sets MEAT as the default award criterion, in contrast to the lowest-price criterion. Using the MEAT rather than tender technical requirements allows for flexibility in evaluating different technologies that may be offered with respect to the environmental performance and costs rather than predefining specific technical requirements. A combination of technical requirements and environmental award criteria is also possible.

There are two GPP implementation options with MEAT. The approach used most frequently considers various dimensions of environmental quality as award criteria, such as material use and energy efficiency and allots specific weights to them. The contract is awarded to the bidder that achieves the highest overall "score," i. e. weighted average between the price and quality score (including environmental dimensions). By reducing the weight given to the simple purchase price and increasing the weight given to the environmental quality dimensions, climate-friendly options can be put at an advantage in the competition (see Box 2).

In the second implementation option, environmental quality attributes are fully monetized, discounting the bidders' submitted prices, and the contract is awarded to the bidder with the lowest (fictional) "corrected bidding price". The more environmentally friendly the products or services with respect to business-as-usual alternatives are, the larger the downward adjustment to reach the corrected bidding price. The discount can be significant enough to award contracts to bidders who do not present the lowest bidding price, but whose offer is cheaper once environmental impacts during the production phase and subsequent stages are included.

This second GPP implementation option through MEAT is used for example by the Dutch public infrastructure authority for their infrastructure procurement (see Box 2). This has led to an estimated reduction in the overall emissions produced over the entire life span of the infrastructure—construction, operation, and disposal—of 24 to 50 percent compared to standard tenders.[18]

16 Karsten Neuhoff et al. (2017), loc.cit.

17 European Commission (2014): Directive 2014/24/EU on public procurement and repealing Directive 2004/18/EC (available online); Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC (available online).

18 These figures refer to seven big infrastructure contracts awarded in 2015 and 2016 by the Dutch Public Infrastructure Authority in the context of the GPP2020 Initiative. See footnote 28 for more information on GPP2020.

Box 2

Examples of GPP implementation in practice: weighted criteria and corrected bidding prices

Example 1. Weighted criteria

The Norwegian Public Roads Administration ran a competition for an energy-efficient and low-emission car ferry to link two villages in the Sognefjord in 2010.[1] The successful bidder would be awarded a ten-year concession contract. All offers were required a minimum 15- to 20-percent improvement in energy efficiency over that of the existing diesel-powered ferry. Bids were evaluated on the basis of the following criteria and weights:

- price (60 percent weight),
- quality (40 percent weight), as the sum of: energy use per passenger car-kilometer (18 percent), total energy use per year (six percent), tons of carbon emitted per year (six percent), kilograms of nitrogen oxides emitted per year (four percent) and innovation (six percent).

The winning consortium offered the world's first electric car ferry.

Example 2. Corrected bidding prices

The Dutch Public Infrastructure Authority (Rijkswaterstaat) represents a best-practice example of triggering decarbonization and sustainable innovation through procurement processes. When awarding contracts for construction and maintenance works, Rijkswaterstaat selects the winner on the basis of both bidding price and quality.[2] Environmental quality is taken into account along two dimensions:

- Assessment of the environmental performance of the tender participant in terms of the overall efforts to reduce CO_2-emissions caused by the firm's activities and processes are considered. This is evaluated with the "CO_2 performance ladder", which rates firms on a scale from one to five, where five corresponds to the highest environmental performance level.
- Environmental performance of the infrastructure design on the basis of Life Cycle Costing (LCC) basis is taken into account. LCC is calculated using "Dubocalc", a tool to assess and monetize the environmental impacts of a design (mostly materials and energy use) over its entire life-time.[3]

The contract is awarded to the bidder with the lowest "corrected bidding price". This fictional bidding price is calculated by taking the official bidding prices minus i) a discount depending on the position of the bidder on the CO_2 performance ladder, where each step on the ladder corresponds to a one percent reduction of the bidding price, and ii) a discount based on the monetized environmental impact of the infrastructure design, where a smaller environmental impact results in a larger discount,[4] and iii) a discount based on other quality dimensions.[5] A cleaner option, with a higher official bidding price than a dirtier alternative, can thus win the tender after the environmental impact is taken into account in the corrected bidding price.

1 The tender is described in detail in: Richard Baron (2016): The Role of Public Procurement in Low-carbon Innovation, Background paper for the 33rd Round Table on Sustainable Development, 12–13 April 2016, OECD Headquarters, Paris (available online).

2 Richard Baron (2016), a. a. O.

3 See website of Dubocalc (available online) for more details.

4 A maximum and minimum value for the environmental impact are defined. The former, corresponding to as business-as-usual design, gets zero discount, while the latter gets maximum discount. For intermediate values of the impact, the lower the value, the higher the discount.

5 Compliance of the winning bidder with CO_2 PL is verified via ex-post certification and the environmental impact of the infrastructure is checked at delivery.

GPP potential is still largely unexploited in Germany

The majority of large-scale public procurement contracts in Germany are concentrated in a small number of sectors. Based on data from the European TED-Database (see Box 3), which only covers tenders that fall under EU directives, contracts for petroleum products and electricity, for construction works, and for transport services, account for almost 65 percent of the volume all public contracts in Germany between 2009 and 2015. Measured by the number of contracts, construction works alone account for 38 percent of the overall volume of public contracts (Figure 2).

Only half of these large public procurement contracts are awarded based on MEAT, the other half are based on the lowest price criterion (Figure 3). Thus, the options for GPP in current procurement procedures are not yet fully exhausted. In terms of monetary values, the share of MEAT awards varies significantly over time. Peak shares of nearly 60 percent in 2010 and more than 70 percent in 2013 indicate that some large-scale procurement contracts indeed involved MEAT criteria.

The usage of environmental criteria for procurement contracts is still very limited in Germany, amounting to 2.4 percent of all public contracts awarded in 2015, suggesting that authorities still underestimate the strategical potential of GPP. The trend has been positive, however, and the number of tenders with environmental criteria has tripled over the last decade. The main driver behind the increase is the growing use of GPP in tenders for services contracts. The number of green service contracts increased almost six-fold from 2009 to 2015 (Figure 4). On the other hand, the use of GPP is particularly low for works (i.e., construction) contracts. While tenders for works accounted for almost 30 percent of all tenders in 2015 (both in terms of number of contracts and in terms of value contracted), only 1.3 percent of the volume of work awards considered environmental criteria.

While GPP is used in almost every category of procured goods, works and services,[19] only four product categories account for more than two thirds of tenders that adopted green criteria: office and computing machinery; transport equipment; sewage, refuse and cleaning services and architectural, construction and engineering services (Figure 5). In terms of volume contracted, office and computing machinery come first, followed by construction work, and transport equipment. Box 4 describes two examples of GPP in Germany in more detail.

Remaining obstacles and policy recommendations

Despite GPP's large potential as a decarbonization policy, actual data shows that the uptake in Germany to date is low. This is due to a number of challenges and barriers. These are typically more pronounced at the local level, which is particularly relevant as it is where most of the procurement takes place (80 percent in Germany).[20]

The most important barrier to a widespread use of GPP is the perception that green products and services are more costly than standard ones.[21] In light of the expectation that public authorities use financial resources sparingly, this poses a big concern to procurement officers. This is especially true at the local level because of tighter budget constraints and a higher reluctance to stress the tax base. While the purchase price for environmentally friendly products and services is indeed often higher than for business-as-usual options—for instance, LED bulbs against standard ones—taking into account the costs over the entire life-time (TCO), however, the green alternatives can actually be cheaper.[22] Procurement procedures should thus to a greater degree include costs

Box 3

Data and methodology

The Tenders Electronic Daily (TED) database[1] contains public procurement data for the European Economic Area plus Switzerland for 2006 until 2016. Contracting authorities are required to publish the contract notices (i.e. calls for tenders) as well as the award notices of contracts above the EU relevant thresholds[2] on the TED website, which is the official online version of the Supplement to the Official Journal of the European Union (OJEU).[3] The dataset offers information on the contracting authority, the winning firm, the object of the contract, the award value, the award procedure and criteria, and more.

The analysis in this report only considers a subset of the TED database, namely data on public procurement awards in Germany from 2009 until 2015. In total, this subset amounts to 103,968 awards. Awards were coded as being 'GPP' awards if an environmental criterion was present among the award criteria.[4] As the data are based on award documents, this analysis explicitly only takes into account environmental criteria specified in the award criteria and not in the technical requirements of the call for tenders. This is one of the reasons why the GPP shares presented in this analysis are likely to be lower bounds of the actual GPP usage. The second reason is that the analysis only considers procurement contracts above the EU thresholds, which represent only a subset of all procurement in Germany.

1 European Union (2017): TED Database (available online, dataset retrieved April 4th, 2017)

2 EU thresholds for publishing calls for tenders vary over time and with respect to the type of contracting authorities (central vs. local government) and the type of contract. For example, for the central government, work contracts with a value of 5.225.000 Euros and upwards have to be published EU-wide (threshold applying in 2017). For more details see the Europa.eu website (available online).

3 European Union (2017): TED website (availbale online, last retrieved November 13th, 2017).

4 This information was extracted on the basis of a keywords search on the text-based information on award criteria present in the data.

19 In four out of 45 object categories, GPP was not used at all from 2009 to 2015.

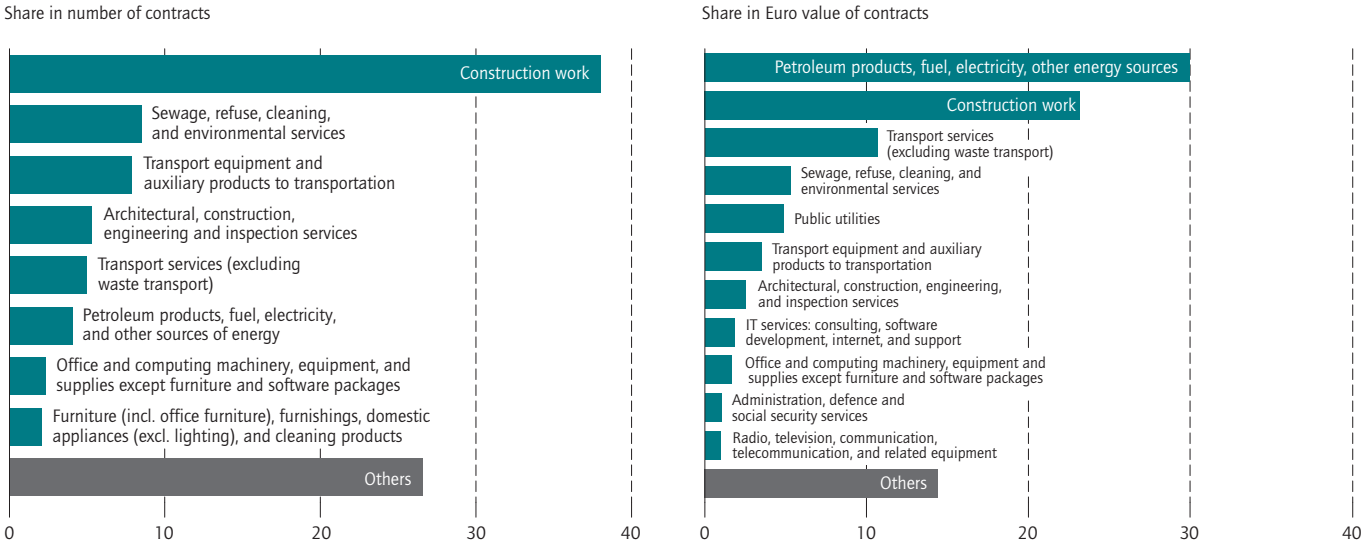
20 OECD (2011): Size of public procurement market—Government at a Glance 2011 (available online).

21 Marteen Bouwer et al. (2006): Green Public Procurement in Europe 2006—Conclusions and recommendations. Virage Milieu & Management (available online).

22 Gröger, Jens, Stratmann, Britta, Brommer, Eva (2015): Umwelt- und Kostenentlastung durch eine umweltverträgliche Beschaffung, im Auftrag der Senatsverwaltung für Stadtentwicklung und Umwelt Berlin, Öko-Institut e.V. Freiburg/Berlin.

Figure 2

Share of product categories in total public procurement, in Germany (2009–2015)
In percent



Note: Data shown uses the macro-level categorization of the Common Procurement Vocabulary (CPV). The Common Procurement Vocabulary (CPV) was developed by the EU in order to provide a classification system for procurement contracts and facilitate the description of the objects of procurement for public authorities. The first two digits of the eight-digit CPV code indicate a macro category of the objects. The rest of the code provides more details on the object (e.g., 45,000,000 indicates the macro category "Construction works", 45,100,000 "Site preparation work", 45,110,000 "Building demolition and wrecking work and earth-moving work" and so forth with increasing detail. For more details on the CPV coding, see EU Commission Regulation (EC) No 213/2008.

Source: Authors' own calculations based on data from EU TED-database (available online).

Only a few procurement object categories account for the vast majority of contracts.

that go beyond the mere purchase price and reflect ulterior costs as well.

Furthermore, local purchasing authorities typically have no incentive for considering the social costs of the purchase decisions they make. To push the willingness to implement GPP at the local level, specific funding arrangements should be designed, whereby the central government—the federal level, in the case of Germany—, covers the incremental costs of GPP. A more extensive use of GPP requires a clear commitment by the central government and a clear governance structure ensuring consistency among all government levels such that the national climate objectives have influence on individual procurement choices.

Another obstacle is that GPP is perceived to reduce the number of bidders in the competition, thereby leading to a further increase in the purchase price. A priori, such a negative effect on competition is not clear, however. Adopting green criteria may in fact encourage the participation of more innovative firms because they could have a competitive advantage in a competition that not only considers price.[23] GPP may therefore both attract participation and level the playing field for the competition.

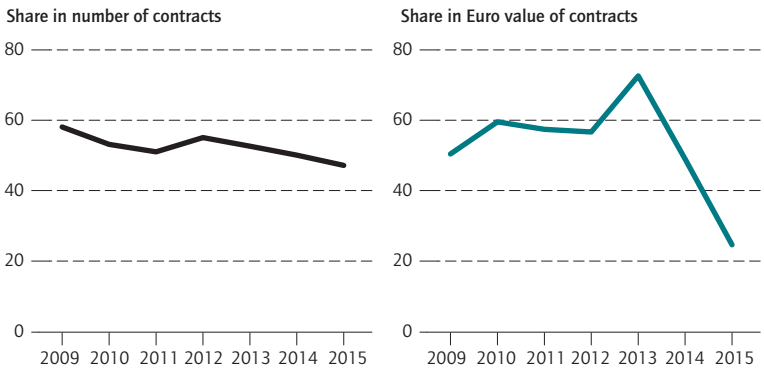
Administrative capacity constraints are also a relevant barrier. Especially at the local level, procurement teams are often small and officials lack both technical and legal expertise needed for the implementation of GPP, regarding technical details and environmental impact of a product or service, for instance. Moreover, GPP is perceived as time-consuming, a delay in acquiring of necessary goods and services that adds to the overall complexity of an activity that is already seen as complicated and overly bureaucratic. Due to structural and financial constraints, public authorities, especially at the local level, are often not in a position to hire extra trained staff. More specific training courses for procurement officials, such as those

23 Runar Brännlund, Sofia Lundberg, and Per-Olov Marklund (2009): Assessment of Green Public Procurement as a Policy Tool: Cost-efficiency and Competition Considerations. Umeå Economic Studies 775, Umeå University, Department of Economics, revised 25 Jan 2010.

Figure 3

Share of tenders using MEAT in total public procurement in Germany (2009–2015)

In percent



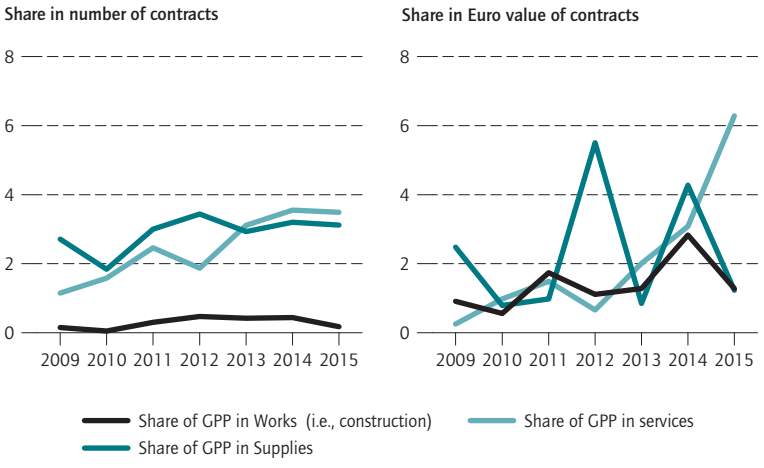
Source: Authors' own calculations based on data from EU TED-database (available online).

Only half of the contracts procured in Germany use additional criteria other than the price in the award procedure.

Figure 4

GPP share according to different types of contracts in Germany (2009–2015)

In percent



Source: Authors' own calculation based on data from EU TED-database (available online).

Green public procurement is heavily underused with take-up rates between almost zero and three percent depending on the type of contract.

provided by the Competence Centre for Sustainable Procurement (*Kompetenzstelle für nachhaltige Beschaffung beim Beschaffungsamt des Bundesministeriums des Innern (KNB)*), would improve both professionalization of and commitment to GPP, and would facilitate its systematic implementation.[24] The publication of relevant handbooks to evaluate environmental criteria, as the EU has started to produce on some products,[25] would further facilitate the implementation. At both national and European levels (for large tenders), a regulatory framework for these guidelines and product evaluation criteria could lead to higher confidence in using GPP as well.

Strengthening the communication and coordination between authorities is also proven to foster a broader implementation of GPP. The establishment of multi-stakeholder collaboration and knowledge-sharing platforms (also including the private sector) at local, national and international level seems promising. A good-practice example here is the European GPP2020 initiative, which aims to establish green procurement practices at the EU level.[26] Coordinating efforts is particularly valuable at the local level, for instance with the establishment of networks of municipalities that implement joint procurement, as practiced by the German Association of Cities (Box 4). This allows to aggregate demand (e. g., at the central/federal level), thereby allowing public authorities to reap benefits from suppliers' economies of scale, while reaching the size, information and professionalism needed to unlock the opportunities mentioned above.

Going beyond the actual procurement process, there is a lack of standards and practices for monitoring and evaluating compliance in the contract implementation, as well as practices and standards on measuring and reporting the outcomes of GPP. It is important that such standards are established at both the national and the EU level. Appointing an independent institution to conduct random checks on compliance could guarantee the transparency of the procurement process including the implementation stage.

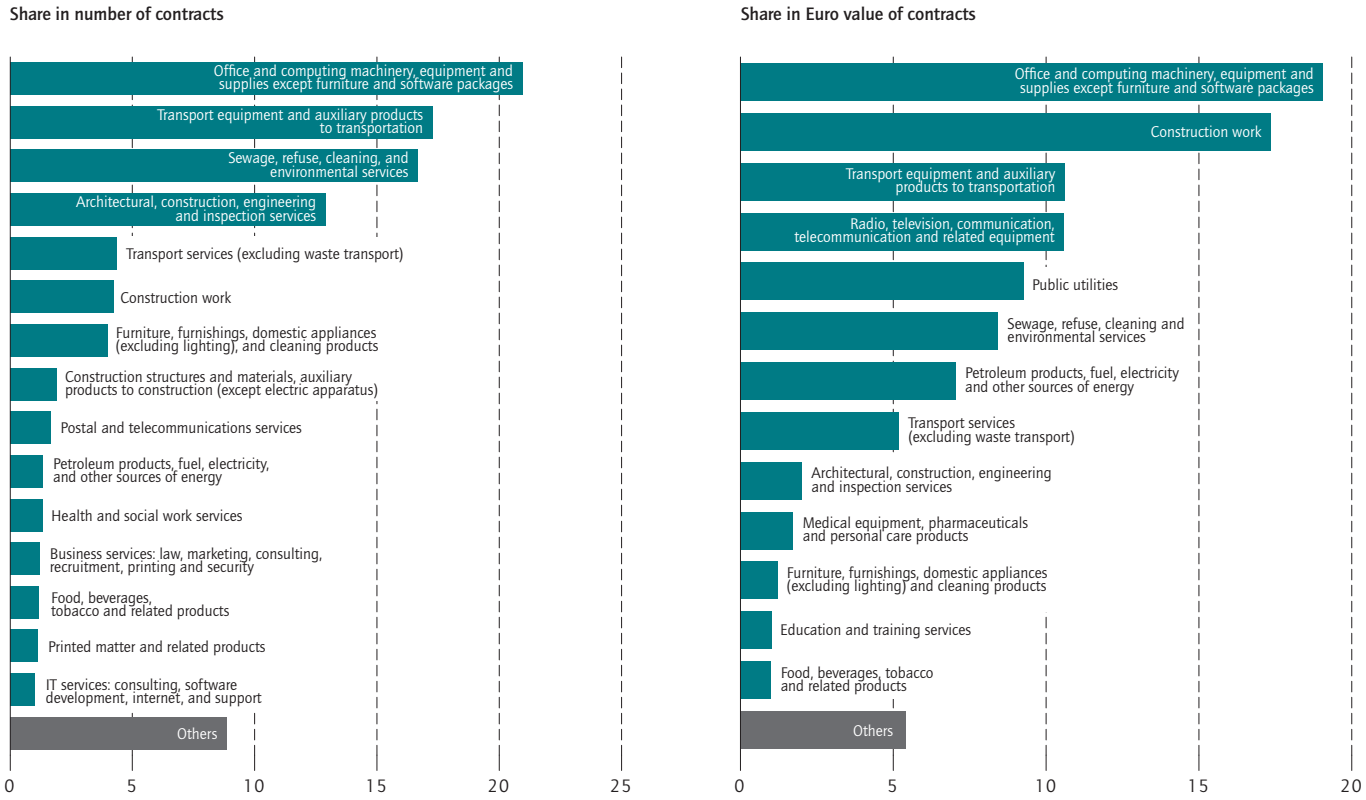
24 Additional information on the experience of KNB in the context of the GPP 2020 project (e. g., for the procurement of thin clients, industrial dishwashers and printers) can be found at the Nachhaltige-Beschaffung.info (available online).

25 For example: European Commission (2017): EU Green Public Procurement criteria. DG Environment (available online).

26 A consortium of eight European countries, among which the Netherlands and Germany, aim at pushing GPP activities by conducting more than 100 environmentally friendly public procurement tenders, directly reducing CO_2 emissions, conducting training- and networking sessions on the subject of GPP, and extending support structures such as helpdesks in the partner countries.

Figure 5

Share of product categories in green public procurement, in Germany (2009–2015)
In percent



Source: Authors' calculation based on data from EU TED-database (available online).

Green public procurement is used in almost all product categories.

Conclusion: a political commitment to green public procurement can help Germany achieve its emission reduction targets

Germany needs to act quickly if it wants to live up to its 2020 emission reduction targets. The decarbonization policies currently in place are not sufficient to drive the changes that are needed towards a low-carbon economy. Given the large volumes of government purchases, green public procurement offers a significant potential for steering public money into climate-friendly products and services and reducing emissions. By choosing environmentally friendly goods and services in the areas where public authorities are important buyers, public purchasers can have both a direct and indirect effect in helping driving markets towards sustainability. A broader use of GPP, which is currently being implemented only in homeopathic doses, is thus one option to reduce Germany's carbon footprint.

There is a discrepancy between the German government's climate goals and the incentives at the local level, where most of the procurement activity takes place but where the budget constraints are the tightest. More extensive use of GPP therefore requires a clear political mandate that makes climate goals relevant at all levels and providing it with adequate earmarked funding locally, for instance through dedicated transfers from the federal level.

A successful implementation of GPP further requires adequate capacity building. In particular, procurement officers have to be trained to implement GPP and further tools have to be developed to make the practice of GPP as easy and time-efficient as possible. Single initiatives and projects, put in place by various municipalities or organizations in Germany but also abroad, for instance in the Netherlands, can serve as best-practice examples.

Box 4

Two examples of GPP from Germany

Use of recycled concrete in new public construction projects in the State of Berlin[1]

In order to reduce the environmental impact of construction, the City-State of Berlin has required the use of recycled concrete in a number of public construction projects. This includes the recent construction of the Berlin Institute for Medical System's new laboratory building at the Max-Dellbrück-Centre for Molecular Medicine, which started in 2015. This project has proven that recycled concrete can be of high quality as well as meet all necessary standards (such as strength, class and consistency) and require no special or additional handling during installation. As a result, the State of Berlin will require the use of recycled concrete in all its future public high-rise construction projects. This will replace around 100,000 m^3 of standard concrete per year.

Joint procurement of 100 % recycled copying paper in the City of Erlangen[2].

Erlangen is part of a joint initiative for the procurement of recycled paper organized by the German Municipal Purchasers Group (Einkaufsgemeinschaft Kommunaler Verwaltungen eG), which is coordinated by the German Association of Cities (Deutscher Städtetag). This joint procurement allows (especially small) local authorities to coordinate their efforts and to reach the size and the expertise needed to implement GPP optimally. Since 2013 all municipal departments in the City of Erlangen are required to only use 100 percent recycled paper for their office needs. The annual environmental savings are estimated at 12.03 tonnes of CO_2, 2,191,093 litres of water and 451,234 kWh in energy.[3]

1 European Commission (2017): GPP in practice – "Using recycled concrete in the construction of new buildings State of Berlin", Case study, Issue no. 75.

2 European Commission (2017): GPP in practice – "Joint Procurement of 100 % recycled copying paper in the Municipality of Erlangen", Case study, Issue No. 71.

3 Calculations were made using the Pro Recycling Paper (IPR) Sustainability Calculation tool and based on the annual consumption (from 2013) of 13.85 million sheets of Blue Angel certified 100 percent A4-sized recycled paper.

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Early exit from ECB bond purchase program could reduce GDP growth and inflation

By Marius Clemens, Stefan Gebauer, and Malte Rieth

The European Central Bank is planning a gradual reduction of government bond purchases under the asset purchase program it initiated in 2015. The present study by the German Institute for Economic Research analyzes the potential macroeconomic implications of different exit strategies. The authors examined the potential effects of a reduction in net purchase volume, an early exit, and a faster exit from the program on output and inflation in the euro area. Model simulations showed that economic growth and inflation rates would decrease in all three scenarios. However, the effects of the scenario with reduced asset purchases are less severe than those of an exit from the program that is earlier or faster than expected. In particular, an early exit from the program should significantly affect inflation rates, an effect that the European Central Bank should factor into its decision-making process.

On October 26, 2017, the European Central Bank (ECB) announced it was planning to cut its current asset purchases of 60 billion euros per month to only 30 billion euros as of January 2018. Economic recovery in the euro area is set to continue, and given some positive signals from forward-looking economic indicators such as purchasing manager and consumer confidence indexes, the ECB is facing pressure to taper its "Asset Purchase Programme" (APP) as a means of countering the potential threat of overheating and risks to financial stability. However, it is opting to stay the course with its expansionary policy until inflation picks up. By mandate, the ECB is committed to guaranteeing price stability in both directions and considers its policy to be successful when the inflation rate is just below two percent. Given this strategy, the present study evaluates the macroeconomic consequences of different tapering scenarios, i.e., different strategies for gradually exiting the APP, particularly with respect to GDP growth and inflation rates in the euro area.

There is a wealth of literature on the effects of central bank asset purchases on financial markets and the macro economy.[1] However, these studies evaluate the overall impact of APPs instead of separately evaluating entry into and exit from such programs. More precisely, they evaluate the aggregated effects of net asset purchases, reinvestments due to expiration of bonds, and reductions in the volume held by the central bank. In most cases, purchase programs by the U.S. Federal Reserve, which has started to decrease its bond holdings, have been analyzed. The ECB, on the other hand, remains a net purchaser of bonds although it reduced its pur-

1 See Han Chen, Vasco Cúrdia, and Andrea Ferrero, "The macroeconomic effects of large-scale asset purchase programmes," *Economic Journal* 122 (2012); P. Andrade et al., "The ECB's asset purchase programme: an early assessment," *ECB working paper* no. 1956 (2016); Michael Hachula, Michele Piffer, and Malte Rieth, "Unconventional Monetary Policy, Fiscal Side Effects and Euro Area (Im)balances," *DIW Berlin Discussion Paper* 1596 (2016) (available online); and Stefan Hohberger, Romanos Proftis, and Lukas Vogel, "The macroeconomic effects of quantitative easing in the Euro Area: Evidence from an Estimated DSGE Model," *EUI Working Papers ECO* 2017/04 (2017).

Box 1

A DSGE model for the euro area

The present study relied on a dynamic stochastic general equilibrium (DSGE) model with price and real wage rigidity,[1] financial friction, and different types of households.[2]

Assumptions

When analyzing asset purchase programs, the assumption of segregated bond markets (short- and long-term bonds) is a crucial means of incorporating the monetary policy channel through which these purchases affect the macro economy. And households are assumed to differ with respect to their access to financial markets. Whereas unrestricted households are allowed to trade in both short- and long-term bond markets, restricted households only have access to long-term bonds. Although in reality it is not possible to separate households into these categories literally, the assumptions of market segmentation and separation of the two household types capture the observation that a fraction of the private sector saves through pension funds and other intermediaries that are specialized in the market of long-term securities. On the other hand, unrestricted agents can be thought of as standing in for agents that save through highly liquid assets such as commercial bank deposits. Central banks engage in both unconventional asset purchases and conventional interest rate policy to conduct monetary policy, and governments finance fiscal policy expenses by issuing short- and long-term bonds.

Effects

Market segmentation and household heterogeneity in the model imply that only a fraction of the agents in the economy can arbitrage away differences in risk-adjusted returns between long- and short-term bonds. This introduces friction that provides a rationale for asset purchase programs having an effect on macroeconomic developments: the yield curve matters for aggregate demand, such that monetary policy affects the real economy not only via the short-term policy rate but also via interventions in long-term bond markets that affect long-term interest rates.

The macroeconomic relevance of both short- and long-term rates evokes monetary policy interventions that can affect the economy even when the nominal short-term policy rate is at the zero lower bound (ZLB) and cannot be reduced further. In the model, we allow for a ZLB constraint on policy rates and assume it to be binding for an extended period of time (five quarters). In the long-term government bonds market, central bank tapering leads to an increasing bond price and a reduction of long-term yields.

In the case of a segmented bond market, restricted households react by changing their saving and consumption patterns. They tend to consume more today, which increases output growth. On the other hand, households adjust their portfolios upward to some transaction costs when markets are not segmented. They would sell long-term bonds and buy short-term bonds immediately, resulting in a decline in the yield to maturity of the long-term bonds. However, the expected returns for long- and short-term assets stay constant over time, which does not have real effects.

1 See Lawrence Christiano, Martin Eichenbaum, and Charles L. Evans, "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy* vol. 113(1) (2005):1–45; and Frank Smets and Rafael Wouters, "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review* vol. 97(3) (2007): 586–606.

2 See Han Chen, Vasco Cúrdia, and Andrea Ferrero, "The Macroeconomic Effects of Large-Scale Asset Purchase Programs," *Economic Journal* 122, no. 564 (2012): 289–315.

chases from 80 to 60 billion euros per month in 2017. Currently, its cumulative bond holdings amount to two trillion euros, or 15 percent of the euro area GDP. The ECB has announced that it is set to reduce asset purchases further to 30 billion euros per month. Under the circumstances, the macroeconomic effects of tapering asset purchases and a subsequent reduction in the volume held by the central bank are of particular interest.

Macroeconomic effects of asset purchase programs

To evaluate the macroeconomic effects of different tapering scenarios, a dynamic stochastic general equilibrium (DSGE) model is constructed and calibrated to match euro area conditions. The model features the expectation formation of agents and therefore permits quantitative evaluation of the impact of ECB monetary policy announcements. It is also set up to enable analysis of the fundamental mechanisms through which bond purchases affect the real economy (Box 1).

Given that the goal was to evaluate the effects of different tapering paths and not the overall APP, the following assumptions for the quantitative analysis of the model are made. Only the period since the latest announcement of reducing asset purchases from January 2018 onward is included in the analysis. Therefore, past announcements

regarding the size and duration of the programme were ignored. And it is abstracted from the trend in short-term interest rates from past announcements.

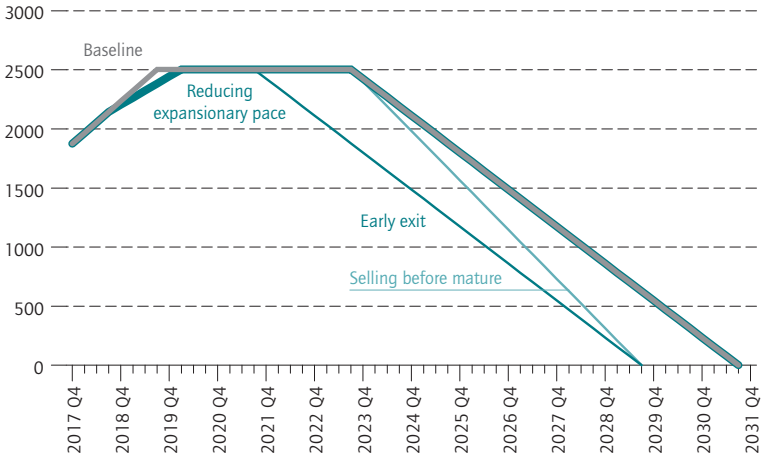
First, the effects of a baseline scenario consisting of three phases are calculated: accumulation of bond holdings by the ECB, constant asset holdings, and reduction of bond holdings (Figure 1). The baseline scenario trend until September 2018 therefore parallels the latest ECB announcement in October 2017. The ECB was subsequently expected to continue its asset purchases until it reached the legal limit of holding no more than one-third of the bonds traded in the market.[2] Thereafter, the ECB keeps its portfolio of bonds constant for four years by assumption before reducing its holdings, allowing bonds to expire without replacement (Box 2).

To quantify the effects of different tapering scenarios, three alternative scenarios were considered and the resulting deviations from the baseline scenario were evaluated. The focus was not on the effects derived from the baseline scenario in the analysis, since they include the overall effects of quantitative easing (QE)—and the effects from entering the APP in particular. The alter-

Figure 1

Market value of long-term bonds held by the ECB in the baseline and alternative scenarios

In Million Euro (stylized)



Source: Authors' own calculations.

Until the third quarter of 2018, the ECB will keep buying bonds, afterwards there are alternative ways to taper.

2 Given that the legal maximum is particularly relevant for country-specific government bonds and the ECB already holds more than 30 percent of the existing bonds of some countries, the reinvestment phase could potentially start earlier. In this case, a uniform increase in overall holdings would only be feasible assuming changes in country quotas and by allowing for consistent distribution effects.

Table

The scenarios

Scenario	1st expansionary stage, quarterly	2nd reinvestment stage	3rd exit stage, quarterly
"Baseline"	90 billion euros until 3rd quarter 2019	until 3rd quarter 2023	−80 billion euros until 3rd quarter 2031
"Reducing expansionary pace"	90 billion euros until 3rd quarter 2019 and 60 billion euros until 3rd quarter 2020	until 3rd quarter 2023	−80 billion euros until 3rd quarter 2031
"Early exit"	90 billion euros until 3rd quarter 2019	until 3rd quarter 2021	−80 billion euros until 3rd quarter 2029
"Selling before mature"	90 billion euros until 3rd quarter 2019	until 3rd quarter 2023	−104 billion euros until 3rd quarter

Source: Authors' own calculations.

natives vary with respect to the pace of asset purchase, the duration for which the quantity of bonds held was expected to be constant, and the pace at which the amount was ultimately reduced (Table). For all scenarios, the assumption has been that private households and firms expected the short-term policy rate to remain at zero for five quarters and the central bank would return to its standard interest rate policy afterwards.

In the first scenario, the ECB was expected to announce a sharper reduction in the pace of bond purchases compared to the baseline scenario in Q4 2017, with lower purchases from Q4 2018 onwards. In the second scenario, the ECB announced it would reduce bond holdings by not replacing expiring bonds in Q3 2019, two years earlier than in the baseline scenario. Finally, the third scenario featured an announcement by the ECB in Q3 2023 that it would also sell bonds during the phase of reducing bond holdings, such that holdings would be reduced at a faster pace than in the baseline scenario.

Reducing the expansionary pace of monetary policy has moderate effect on output growth and inflation

In the first scenario, the ECB reduced the expansionary pace by decreasing net purchases from 30 to 20 billion euros per month or 90 to 60 billion per quarter, respectively. Based on this behavior, the long-term bond portfolio held by the central bank reached its legal maximum of 33 percent of the total volume of government bonds issued six months later than in the baseline scenario. Afterward, it followed the baseline scenario trend.

The results of the model simulation indicated lower GDP growth and inflation rates for several quarters compared to the baseline scenario (Figure 2). In the first year, the cumulative differences in GDP growth and inflation rates would be 0.01 percentage points each.

Early exit has negative short-term macroeconomic implications

Assuming that the decrease in bond holdings starts not four, but two years after the end of net purchases, growth effects would phase out earlier (Figure 3). In the first year, this resulted in a cumulative reduction in GDP growth and the inflation rate of 0.1 and 0.3 percentage points, respectively. In view of the constant refinancing needs of governments and firms, lower ECB demand would result in lower bond prices and consequently, in rising long-term yields compared to the baseline scenario. This

Box 2

The implications of the zero lower bound in the baseline scenario

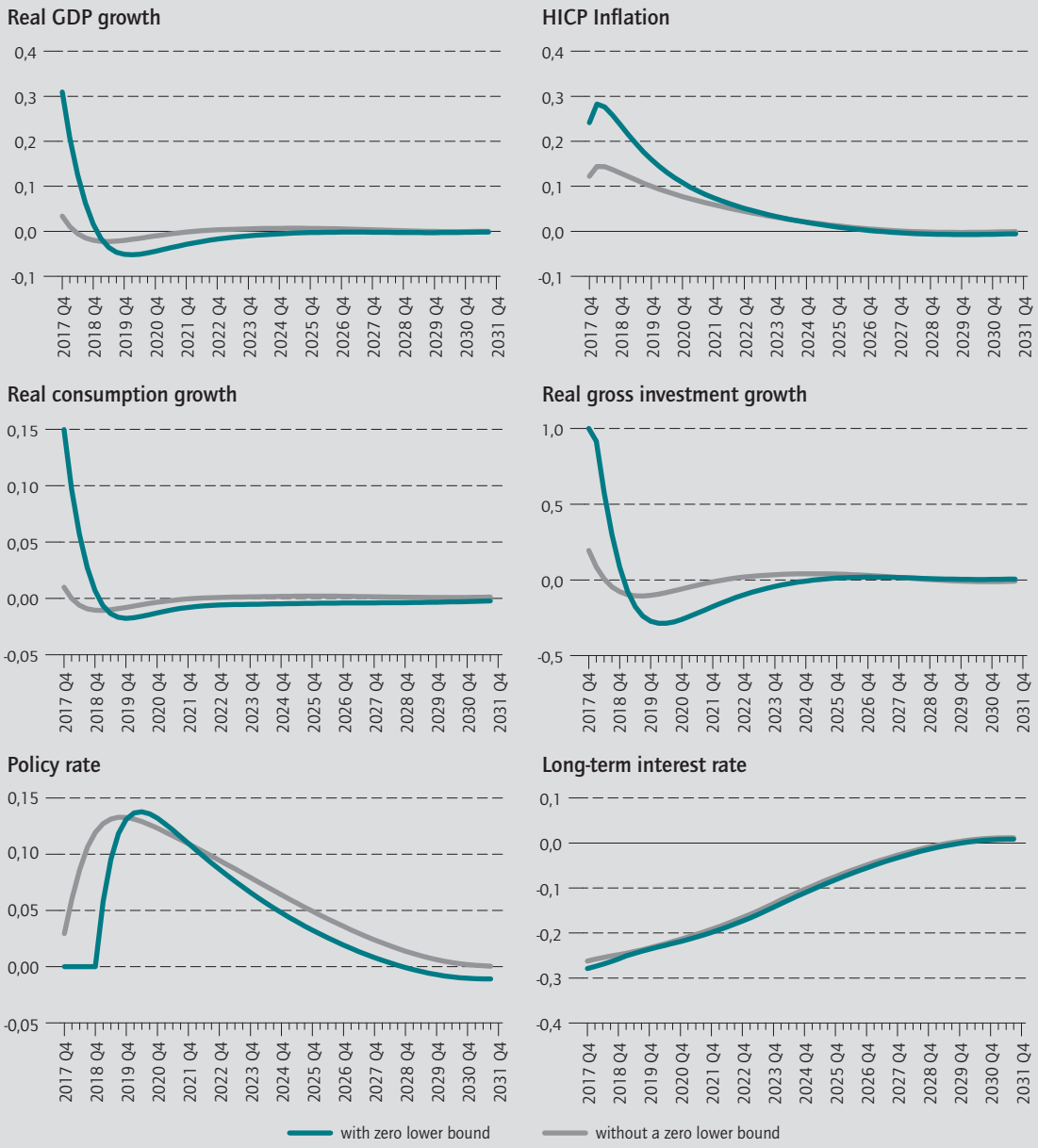
In line with the DSGE literature, the parameters are calibrated to match the economic structure of the euro area. The trend of the net purchase program is simulated over time in our baseline scenario to compare our model results with those in the literature. Initially, the level of long-term bonds in the hands of the public was reduced by 25 percent of its steady state value, while the central bank asset purchase balance increased by the same amount.

The effects of bond purchases are amplified if the central bank announces the short-term interest rate to be fixed at the lower bound for an extended period (forward guidance). The reason is that QE-induced higher output growth leads to higher inflation. Without a fixed interest rate, monetary policy would typically react to higher output growth and inflation by increasing the policy rate. This would have a contractive effect on output growth and inflation. However, a commitment to leaving the policy rate at the zero lower bound would eliminate the contractive impulse and amplify the effects of the APP. More precisely, the policy rate is not limited from below because of non-negativity. Instead, it is limited from above by the central bank announcement. By simulating the APP scenario with and without a ZLB, we can see that the effects on GDP growth and inflation are roughly doubled (Figure).

In the baseline scenario with a binding ZLB, the APP increases output growth by roughly 0.7 percentage points and inflation by around 1 percentage point annualized and in the first year.

Figure

Macroeconomic effects of quantiative easing with and without a zero lower bound announcement
Deviation from the baseline in percentage points, quarterly

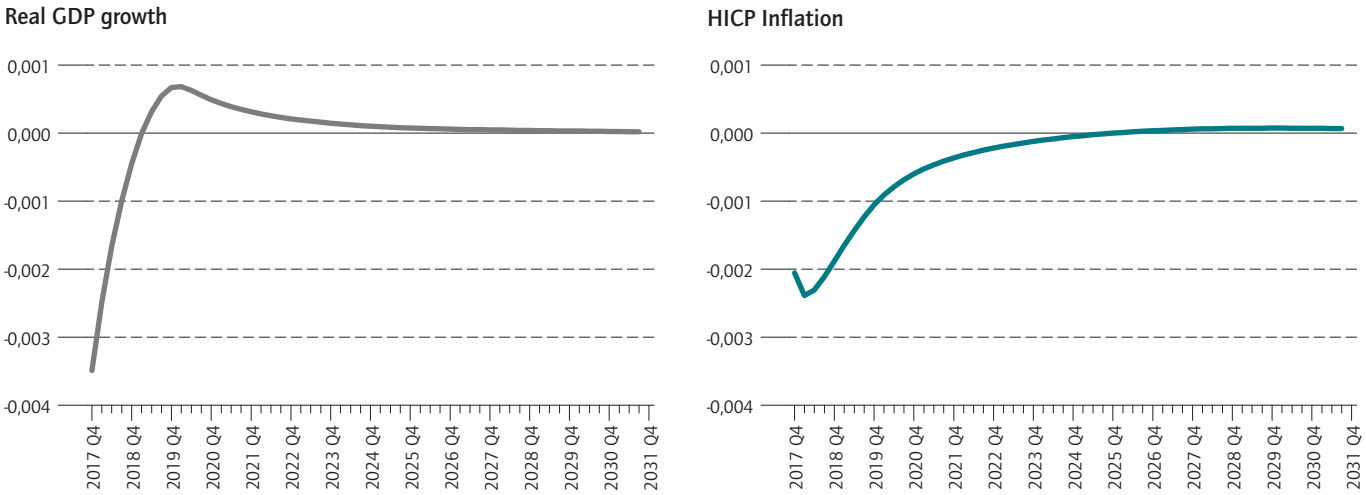


Source: Authors' own calculations.

The macroeconomic effects of quantitative easing are amplified by forward guidance and the ZLB.

Figure 2

Macroeconomic effects of reducing the expansionary pace
Deviation from the baseline in percentage points, quarterly

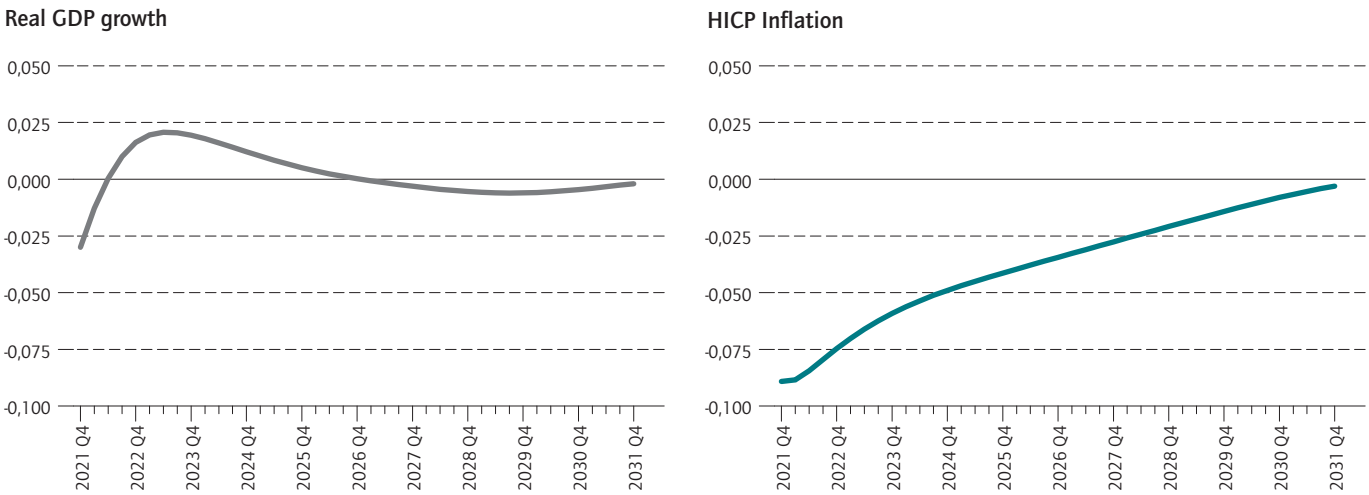


Source: Authors' own calculations.

Reducing the expansionary pace may have only moderate effects.

Figure 3

Macroeconomic effects of an early exit
Deviation from the baseline in percentage points, quarterly

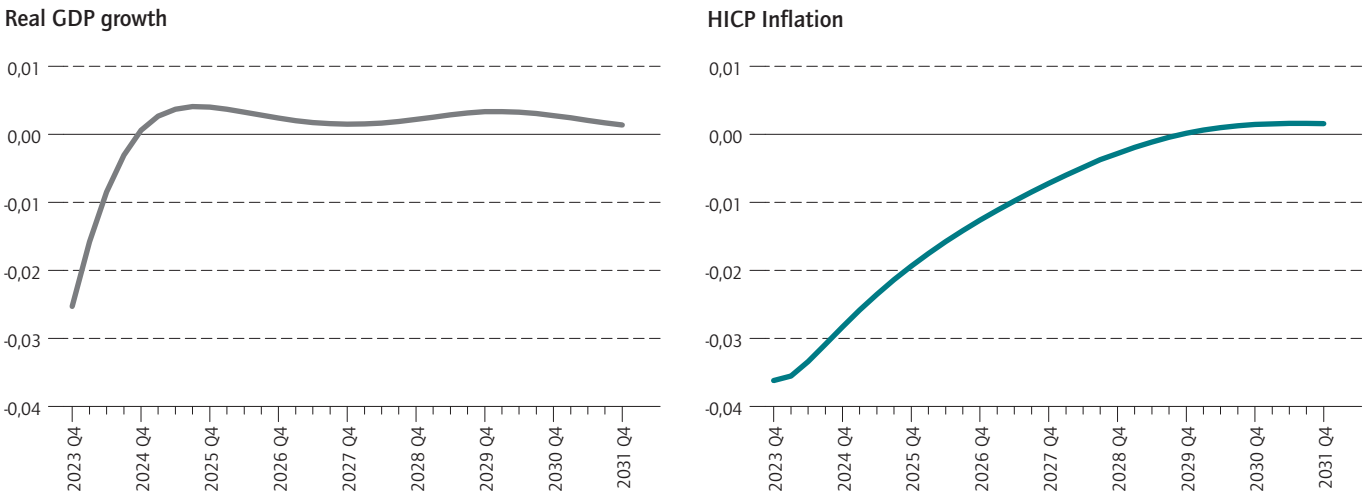


Source: Authors' own calculations.

An early exit may dampen especially inflation.

Figure 4

Macroeconomic effects of selling before mature
Deviation from the baseline in percentage points, quarterly



Source: Authors' own calculations.

Selling before mature may reduce growth and inflation to the same extent.

effect basically drives output growth.[3] While the effects of an early exit were consistently negative for inflation, such a policy could have slightly positive effects on GDP growth in later periods, particularly when the period of zero interest rates ends. Agents expected the central bank to raise the interest rate by less, since an early exit would dampen the inflation rate and GDP growth in the short term. The growth impulse would fade out earlier but the contractive effect in subsequent periods would also be less pronounced. Therefore, whether an early exit turns out to be generally beneficial depends on the gap between the inflation rate and the ECB's target in the particular period.

Additional selling in secondary markets has contractive effects

In the final scenario, a faster pace of bond holding reduction compared to the baseline scenario was simulated. The term structure of the portfolio and the average remaining maturity of bonds held were the sole determinants of the trend over time. The alternative scenario assumed that the ECB would increase the speed of tapering by selling additional bonds before maturity.[4] Thus, the pace of tapering would increase. More precisely, the assumption was that the ECB reduction rate would be 1.5 times higher than in the baseline scenario in order to arrive at exactly the same date as in the early exit scenario. This made it easier to compare the two scenarios independently of the baseline. The simulation showed that a steeper path is associated with dampened GDP growth and lower inflation rates compared to the baseline scenario (Figure 4). In the first year, cumulatively, both GDP growth and the inflation rate should be 0.1 percentage point lower than in the baseline scenario. Compared to the early exit scenario, the effects on inflation were therefore lower (Figure 5).

Summary

To evaluate the potential macroeconomic effects of different exit scenarios on the ECB's asset purchase program (APP) for the euro area in a general equilibrium model, a baseline scenario was constructed. The scenario con-

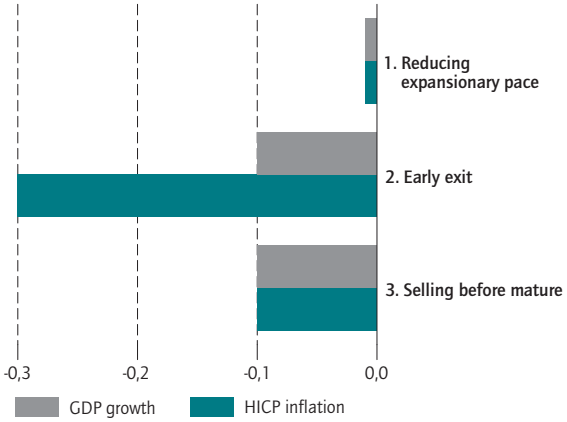
3 Due to market segmentation, not all agents can react to changes in yield spreads by shifting portfolios towards long-term assets. To compensate for this, they will increase savings and reduce consumption and investment.

4 Alternatively, one could imagine that the ECB reduced its purchases more slowly by continuing asset purchases, but at a lower level than that at which bonds expire.

Figure 5

The macroeconomic effects of different tapering strategies

Deviation from the baseline in percentage points, annual cumulated



Source: Authors' own calculations.

The early exit has a higher contractive effect than alternative tapering paths.

sisted of the previously observed increase in asset holdings by the central bank and a hypothetical future trend.

The analysis of three alternative scenarios shed light on the effects of announced changes in program setup. The simulated scenarios were characterized by 1) a reduction in net purchases, 2) an earlier-than-expected reduction in asset holdings, and 3) a faster exit pace, achieved by selling assets in addition to forgoing the replacement of expiring bonds. All three tapering strategies reduced the growth and inflation impulses of the baseline scenario. The comparison showed that reducing net purchases further only has moderate effects, whereas the earlier reduction of holdings and a higher exit pace have more pronounced effects. While the GDP growth rate was 0.1 percentage points lower compared to the baseline scenario in both cases, the impact on inflation was particularly pronounced in the case of an early exit. Cumulatively, the inflation rate was 0.3 percentage points lower than in the baseline scenario, whereas ultimately the difference was only 0.1 percentage points in the scenario with a higher exit pace. Policy decisions should therefore be based on the prevailing inflation rate.

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