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The Minimum Wage in Germany: Institutional Setting and a Systematic Review of Key Findings

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Abstract: The introduction of a statutory minimum wage in Germany in 2015 aimed at improving the welfare of low-wage workers but was also accompanied by concerns about distortions in Europe's largest economy. This paper provides a comprehensive survey of results from the evaluation of the German minimum wage by compiling recent descriptive evidence and a systematic literature review on causal effects through 2022. On 1 October 2022, the minimum wage was raised legislatively by 15 percent to 12 euros per hour, which affected approximately 5.8 million employees and 23 percent of companies. The war in Ukraine and the coronavirus pandemic hit minimum wage workers and minimum wage firms harder than the rest of the economy. The minimum wage thus far had the strongest causal effects directly after its introduction. Hourly wages increased, while working hours decreased, resulting in mixed effects on monthly wages. Overall employment fell slightly, with a decline in marginal employment in particular. Companies' wage costs increased, and as productivity did not change, profits declined.

Keywords: minimum wage; systematic review; evaluation; Germany

JEL Classification: J08; J30; J31; J50

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1 Introduction

For many years, Germany was one of the few OECD countries lacking a statutory minimum wage. In response to a steady decline in collective bargaining coverage and a growing low-wage sector, a statutory minimum wage was introduced in 2015. At the time, the introduction of the minimum wage was subject to intense controversy. There were concerns that negative effects on employment could occur in Europe's largest economy (Arni et al. 2014; Knabe, Schöb, and Thum 2014). In fact, the introduction of the German minimum wage was a major intervention in the German labour market, which benefitted approximately four million or 11 percent of all employees. It therefore represented the most important labour market reform since the Agenda 2010 programme of the Schröder government in the early 2000s. Subsequently, the minimum wage was raised four times by an independent Minimum Wage Commission, most recently to 12.41 euros per hour in January 2024. In October 2022, the minimum wage was increased from 10.45 euros to 12 euros through a one-time government intervention with the aim of reaching a higher level of workers' protection against low wages.

From a conceptual point of view, a minimum wage is a policy measure that aims to increase the pay of low-wage earners and reduce in-work poverty. According to international studies, minimum wages have led to an increase in low incomes and reduced inequality (Autor, Manning, and Smith 2016; Lee 1999; Teulings 2003; DiNardo, Fortin, and Lemieux 1996). In Germany, there was also an expectation that the minimum wage would reduce the dependence of low-wage earners on supplementary benefit payments to top up their income to the subsistence level. Regarding employment, standard neoclassical theory predicts employment losses in a perfectly competitive labour market if the minimum wage is set above the market-clearing wage. Assuming that prevailing wage levels are market clearing rates, a minimum wage will cause unemployment. In contrast, monopsony theory claims that labour markets are imperfect. Transaction costs such as search, information or mobility costs may allow employers to exploit their bargaining power and set wages below market-clearing rates. In such a case, labour market outcomes might be inefficient, resulting in lower wages and lower employment levels than their counterfactual levels in a competitive framework. A minimum wage would thus increase wages and employment levels and promote the efficiency of the labour market (Borjas 2015; Manning 2003). From a different vantage point, wage cost increases under a minimum wage can affect the competitive conditions faced by companies. Labour productivity could increase due to a substitution of labour with capital (Aaronson and Phelan 2019). From a more behaviourally focused point of view, such as the wage–effort theory (Akerlof and Yellen 1990), minimum wages can influence workers' efforts and lead to an increase in their productivity. The average productivity of an entire industry can improve if less productive companies exit the market as a result of the minimum wage. However, firms' profits could decrease

due to higher wage costs if these cannot be compensated, e.g. by higher prices (Draca, Machin, and Van Reenen 2011; Harasztosi and Lindner 2019).

Due to political controversy, mixed international empirical evidence on minimum wage effects (Card and Krueger 1994, 1995; Neumark and Wascher 1992, 2008) and contradictory theory-based predictions, our paper aims to provide a comprehensive compilation of results from the evaluation of the German minimum wage. First, as countries with a statutory minimum wage differ in terms of institutional design, such as the setting of the minimum wage at the hourly or monthly level and adjustment mechanisms and exemptions (Arpaia et al. 2017; Eurofound 2022; OECD and AIAS 2021), we will provide insight into the institutional setting of the minimum wage in Germany. Second, since the introduction of the minimum wage, the economic environment will be examined, and adjustments to the minimum wage will be described. Third, and at the core of the paper, is a compilation of the results of 38 extensive studies commissioned by the Minimum Wage Commission thus far, as well as numerous academic papers from universities and research institutes. This study thus goes beyond the four literature reviews by Börschlein and Bossler (2019), Bruttel (2019), Bruttel, Baumann, and Dütsch (2018) and Caliendo, Schröder, and Wittbrodt (2019) and provides a more comprehensive assessment of the impact of the minimum wage in Germany. For each of the central evaluation criteria specified in the Minimum Wage Act, "appropriately protecting workers", "avoiding employment losses" and "enabling fair and functioning conditions of competition", we present descriptive findings on the most recent impact of the minimum wage in the years 2021 and 2022, for which no causal studies are yet available. In these descriptive analyses, we take a close look at the consequences of the coronavirus pandemic, Russia's war against Ukraine and the significant increase in the minimum wage to 12 euros. This is particularly relevant because separating minimum wage effects from the effects of other events, such as the pandemic or the war in Ukraine, will remain an important methodological task in future minimum wage research. We then carry out a systematic literature review of the causal effects of the minimum wage in the years 2015–2020. For each criterion, we try to answer our research question: What effects did the minimum wage have? In light of the comprehensive research literature, we note where the evidence converges to solid insights and where the results consistently differ or are ambiguous. Fourth, we summarize the main findings and offer an outlook on topics for future research on the minimum wage in Germany.

2 Institutional Setting

After many years of controversial discussions in Germany (Bosch 2015), a statutory minimum wage was passed by the German parliament in July 2014 and came into

force on 1 January 2015 at a gross rate of 8.50 euros per hour. It applies to all workers, except employees younger than 18 years, apprentices, trainees and/or interns, long-term unemployed workers in the first 6 months after taking up a new job, and nonprofit and/or voluntary workers. In addition, for a transitional period until the end of 2017, wages below the statutory minimum wage were permitted in sectors with collectively agreed minimum wages that were declared generally binding by government decrees. This approach was applied in the meat processing, hairdressing, agricultural, temporary work, textile and clothing, and industrial laundry industries. The minimum wage for newspaper delivery workers was also set below the statutory level until the end of 2017. Since January 2018, such sectoral exceptions no longer exist.

As measured by the Kaitz index for full-time employees, which is the ratio of the minimum to the median wage, the German statutory minimum wage in 2015 amounted to 48 percent, approximately equal to the minimum wages in the UK (49 percent) and the Netherlands (46 percent). France was at the top with an index of 62 percent, while Spain was at the bottom with 37 percent (OECD 2016). The proportion of workers affected by the new minimum wage was also high, corresponding to approximately 4 million jobs previously paying less than 8.50 euros (gross) per hour, or 11.3 percent of all jobs (Minimum Wage Commission 2016). In the United Kingdom, the coverage rate when the minimum wage was introduced was 5.3 percent (Low Pay Commission 2001).

The makeup of the German Minimum Wage Commission was inspired by the model of the British Low Pay Commission, albeit with important differences. When the German Minimum Wage Commission was established, emphasis was placed on reflecting the social partnership in collective bargaining and on noninterference by the state in wage negotiations, both of which are constitutionally enshrined in Germany. To this end, the independent Minimum Wage Commission was established with the responsibility of deciding on the adjustment of the minimum wage every 2 years. Six of its members (three each) are nominated by the BDA (Confederation of German Employers' Associations) and the DGB (Confederation of German Trade Unions). The independent chairperson is appointed on a joint proposal by the social partners. In addition, there are two scientific members who have an advisory role and no voting rights. For the adjustment of the minimum wage, the Minimum Wage Act requires the commission to make an overall assessment of the minimum wage level that is appropriate "to contribute to the adequate protection of workers, to enable fair and functioning competitive conditions and to avoid jeopardizing employment" (§ 9 MiLoG). The Minimum Wage Act also stipulates that the commission has to follow the past development of collectively negotiated wage rates in its decision.

3 Economic Context and Minimum Wage Adjustments

The economic situation in Germany after the introduction of the statutory minimum wage in 2015 was characterized by robust economic growth, a high level of employment, relatively low unemployment and low inflation. The introduction and first increase of the minimum wage thus occured in a favourable economic context (Figure 1). From the second half of 2018 until the end of 2019, the economy slowed. From 2020 to 2022, the coronavirus pandemic and associated restrictions on social and economic life affected economic growth and employment levels. From the beginning of the pandemic, economic development was strongly influenced by the changing incidence of infection and the containment measures taken by the government. The sharp economic downturn in the first coronavirus wave in spring 2020, with a 10.5 percent quarter-on-quarter decline in gross domestic product (GDP) in the second quarter of 2020, was followed by slight economic recovery in the second half of the year as the pandemic situation eased. The sharp increase in infection rates in the second coronavirus wave at the beginning of 2021 resulted in a renewed GDP decline of 2.3 percent in the first quarter of 2021, which was in turn followed by a recovery in spring and summer. The year 2022 showed a similarly undulating course but with less pronounced fluctuations in economic performance

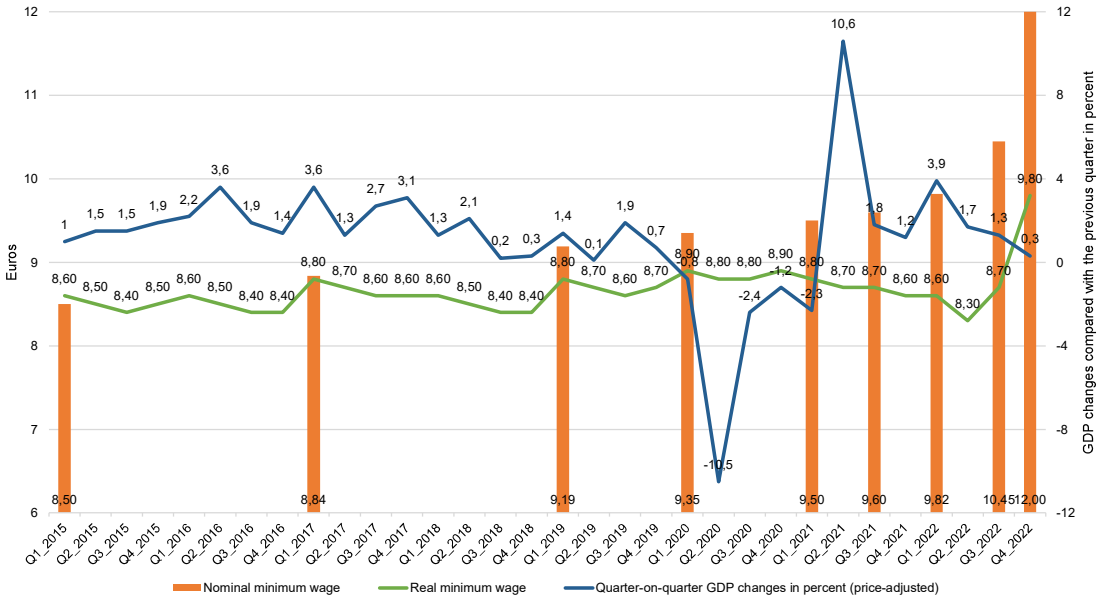

Figure 1: German minimum wage increases and economic conditions. Note: The values for the real minimum wage are rounded to 10-cent amounts. Source: Federal Statistical Office; own calculations.

overall. The negative economic consequences of the Russian war against Ukraine replaced the pandemic as the greatest challenge for the German economy during 2022. This has led to further increases in inflation and the reception of many refugees from Ukraine, who entered the German social benefit system and the labour market.

The Minimum Wage Commission made its first decision in June 2016 and increased the statutory minimum wage to 8.84 euros (gross) per hour beginning in January 2017 (Figure 1). The second decision of the commission in June 2018 led to a two-part minimum wage increase in January 2019 to 9.19 euros and in January 2020 to 9.35 euros. In view of the uncertainty about the duration and economic consequences of the coronavirus pandemic, the commission decided in June 2020 to set a four-step adjustment to 9.50 euros in January 2021, 9.60 euros in July 2021, 9.82 euros in January 2022 and 10.45 euros in July 2022. With the Act to Increase the Protection by the Statutory Minimum Wage and on Changes in Marginal Employment (MiLoEG), which came into effect on 1 July 2022, the German parliament increased the statutory minimum wage from 10.45 to 12 euros gross per hour as of 1 October 2022 by amending the Minimum Wage Act (MiLoG). The amendment suspended the regular adjustment procedure, according to which the Minimum Wage Commission would have made a decision on the minimum wage adoption in June 2022, which would have come into effect on 1 January 2023. Due to the change in the law, the date of the next adjustment decision of the Minimum Wage Commission was postponed by 1 year to 30 June 2023, when the Minimum Wage Commission decided by majority to increase the minimum wage to 12.41 euros per hour in 2024 and to 12.82 euros per hour in 2025.

According to calculations by the Organisation for Economic Co-operation and Development (OECD), the Kaitz index for full-time employees ranged from 42 percent in Latvia to 66 percent in Portugal in 2021. Germany was in the midrange of these countries in 2021, with a value of 51 percent. With the minimum wage increase to 12 euros per hour in October 2022 by the German Bundestag, the Kaitz index increased significantly. According to data from the October 2022 Earnings survey (ES), the Kaitz index based on the median hourly wage of full-time employees was approximately 56 percent in October 2022. The Kaitz index for all employees, including those in part-time and marginal employment, was 63 percent in October 2022. Thus, the increase in the minimum wage to 12 euros led to Germany moving from a middling position in international comparisons into the top range of the rankings. Against this background, we describe in the following section what effects the minimum wage has had since its introduction in Germany and provide early insights into the increase to 12 euros.

4 Findings on the German Minimum Wage

4.1 Coverage of the Minimum Wage

As already mentioned, there were approximately 4.0 million employees[1] with hourly wages less than 8.50 euros in Germany prior to the introduction of the statutory minimum wage, according to data from the Structure of Earnings Survey (SES) from April 2014.[2] This figure corresponds to 11.3 percent of all employees who were affected by the newly introduced minimum wage (Mindestlohnkommission 2016: 39). The incidence of affected workers declined thereafter. In 2018, before the second increase in the minimum wage, there were approximately 2.5 million employment relationships in Germany with hourly wages below the statutory minimum wage of 9.19 euros (Mindestlohnkommission 2020: 56). This was equivalent to a share of approximately 6.6 percent of total employment. At the beginning of 2020, approximately 2.2 million employees were affected by the minimum wage increase to 9.35 since they had previously earned hourly wages below that value. This corresponded to a share of approximately 5.6 percent (Mindestlohnkommission 2023: 71). Coverage of the minimum wage increased again with the adjustment of the minimum wage by the Minimum Wage Commission to 10.45 euros in July 2022 (3.1 million jobs or 8 percent). With the legislative minimum wage increase to 12 euros in October 2022, the number and share of affected jobs increased further to 5.8 million or 14.9 percent of total employment (Mindestlohnkommission 2023: 71).

The proportion of jobs covered by the minimum wage varies across regions and groups of employees. Data from the most recent Earnings Survey (ES) from April 2022 indicate a greater proportion of employees with an hourly wage at or below the binding minimum wage of 9.82 euros in eastern Germany (4.4 percent) than in

1 The SES/ES contains main jobs and side jobs. Therefore, strictly speaking, it represents employment relationships and not employees.

2 The 2014 and 2018 Structure of Earnings Surveys were mandatory and representative cross-sectional establishment surveys. They each covered approximately 60 thousand establishments with at least one employee subject to social insurance contributions and provided detailed information on earnings and working hours for approximately 1 million employment relationships (Statistisches Bundesamt 2016). The earnings surveys (ES) of the years 2015, 2016, 2017 and 2019 were voluntary establishments surveys conducted without an obligation to provide information on earnings and working hours. The ESs were based on data from approximately 6 to 8 thousand establishments each. The New Earnings Survey, beginning in 2021, replaced the two previously mentioned (Structure of) Earnings Surveys of the Federal Statistical Office. Participation in the new ES is mandatory. Since January 2022, the survey has been conducted monthly via an online reporting procedure. It comprises a nominal sample of 58 thousand establishments with at least one employee subject to social security contributions (Statistisches Bundesamt 2022).

western Germany (3.8 percent) (Mindestlohnkommission 2023: 57). The proportion of affected women was also greater than that of men (4.3 percent; 3.4 percent). The same applies to employees with non-German nationality (5.6 percent) compared to German employees (4.1 percent). Coverage of the minimum wage was also more frequent than on average in companies with fewer than 5 employees (9.1 percent), among unskilled or semiskilled workers (9.4 percent), among fixed-term workers (6 percent) and among workers not covered by collective agreements (6.1 percent). Marginal part-time workers were particularly frequently affected by the minimum wage (14.7 percent). The differences between the employee groups were very similar at the introduction of the minimum wage and at its later adjustments (Mindestlohnkommission 2018: 64; 2016: 41).

4.2 Wages

Regarding the evaluation criterion of worker protection, the focus is on the effects of the minimum wage on the wages and incomes of employees. Assessments of the effects of the minimum wage on hourly wages have thus far been carried out mainly with micro data from the German Socio-Economic Panel (GSOEP).[3] This survey contains information on monthly earnings and on contractually agreed and actual weekly working hours, which allows the calculation of hourly wages (Dütsch, Himmelreicher, and Ohlert 2019). The SES, an establishment survey, provides cross-sectional data and has been used for quasipanel analyses at the regional and establishment levels (Biewen, Fitzenberger, and Rümmele 2022; Ohlert 2022) and for descriptive analyses.[4] The administrative data of the Integrated Employment Biographies (IEB) have been used less frequently, as they do not contain information on working hours on a regular basis. Studies using the IEB therefore supplemented or imputed working hours from other datasets. The IAB Establishment Panel (IAB EP), which is a representative panel of establishments in Germany, is also regularly used to study the effects of the minimum wage on company-level variables such as wage costs.

For the most recent period between 2020 and 2023, only descriptive results are available. In this period, the German labour market was influenced by the coronavirus pandemic, Russia's war against Ukraine and the increase in the minimum wage by 15 percent to 12 euros per hour. To provide full insight into the effects that the

3 The GSOEP is a survey conducted annually since 1984 among approximately 16 thousand households with approximately 28 thousand persons, including approximately 13 thousand employees, with detailed information on main jobs (Goebel et al. 2019).

4 Since 2022, the Earnings Survey has gathered monthly panel data, which are, however, not yet available.

minimum wage had on wages to date, first, the descriptive results for the recent period and then causal evidence for the years 2015–2019 are presented. Due to data collection problems during the coronavirus pandemic, there is no causal evidence on the effects of the minimum wage on wages for 2020 and 2021. In both the GSOEP and ES, working hours and wages were not correctly recorded during these years. As a result, there are only a few descriptive findings on hourly wages during the pandemic based on specific coronavirus surveys. The results indicate that employees affected by the minimum wage experienced above-average declines in earnings during the pandemic. This is mainly because workers affected by the minimum wage were often employed in economic sectors that were particularly heavily impacted by the pandemic and by the corresponding containment measures. Furthermore, workers with low wages were less likely to be able to work from home than workers with higher wages because their jobs often require physical presence (Jaenichen 2021; Kirchmann et al. 2022). Employees with hourly wages up to the minimum wage were in short-time work as often as employees with higher wages were, but they reduced their hours to a greater extent (Jaenichen 2021). They also reduced their working hours more frequently without being involved in short-time work. Overall, employees with low wages experienced greater relative declines in earnings during the pandemic than employees with higher wages did (Blom and Möhring 2021; Jaenichen 2021; Schröder et al. 2020). For regular employees (i.e. those subject to social security contributions), the earnings declines were partly compensated by short-time work benefits paid out by unemployment insurance. However, low-wage employees were less likely to receive company or collectively agreed-upon supplements of short-time benefits than employees with higher wages were (Jaenichen 2021). Marginal part-time employees (i.e. employees largely exempt from social security contributions) are not entitled to short-time work benefits at all.

In 2022, the minimum wage increased sharply in Germany on two occasions. In July, the minimum wage increased from 9.82 euros to 10.45 euros, going back to the decision of the Minimum Wage Commission in June 2020. As of 1 October 2022, the statutory minimum wage was raised by the parliament from 10.45 euros to 12 euros per hour. Figure 2 presents descriptive evidence on wage growth in 2022 in the minimum wage range based on data from the Earnings Survey in July and October. Employees in the minimum wage range received an increase in hourly wages of approximately 15 percent between July and October 2022; this applied to full-time workers, part-time workers and marginally employed workers. The development of monthly wages in the minimum wage range was approximately 16 percent between July and October 2022; it was significantly more pronounced for full-time and part-time employees than for marginal employees. The earnings threshold for marginal employment was increased from 450 euros to 520 euros at the same time as the minimum wage was increased to 12 euros, basically allowing an increase in monthly

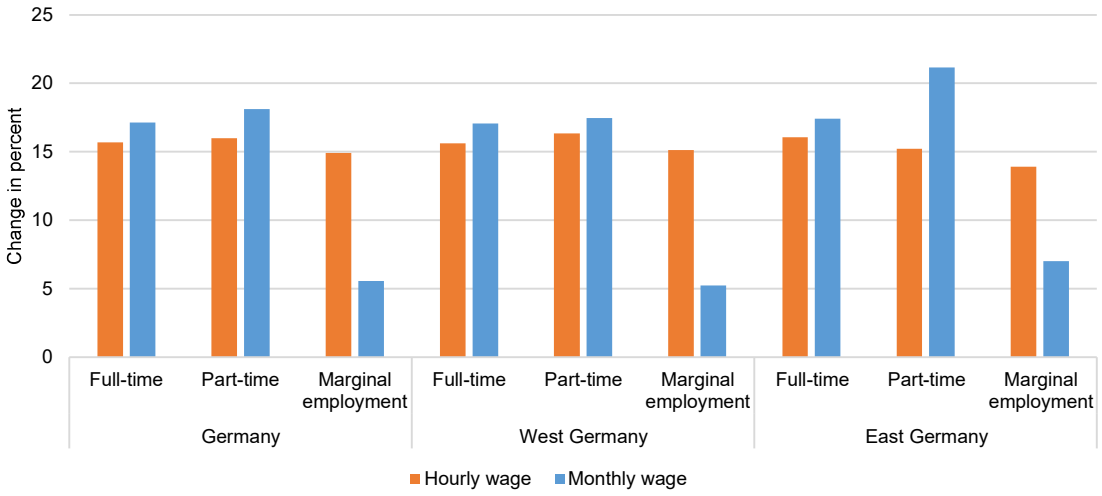

Figure 2: Growth of hourly and monthly wages in the minimum wage range between July and October 2022. Note: Employment relationships in the minimum wage range are those with hourly wages less than 10.50 euros in July 2022 and less than 12.05 euros in October 2022. Source: July and October Earnings Survey (ES) 2022, own calculations.

earnings from this form of employment of the same percentage as the minimum wage increase. Between July and October 2022, however, the monthly earnings of marginal part-time workers in the minimum wage range grew by only approximately 7 percent. The explanation for this unexpectedly low monthly wage growth is that at the same time, the average paid working time decreased by approximately 8 percent. For full-time employees, especially for part-time employees in eastern Germany, working hours in the minimum wage range rose slightly, which led to a somewhat greater increase in monthly wages than in hourly wages.

For the period from 2015 to 2019, in contrast to the more recent period, causal difference-in-differences studies on hourly and monthly wages are available. In the table 1, the superscript letters and numbers indicate the empirical approaches of the studies. They denote if the bite measure is continuous or binary, if the data are employee or firm data, if the analysis is performed at the regional, firm or employee level, and if the dependent variable measures wage growth, change in wage growth or wage growth by quintiles.

Regarding the effects of the introduction of the minimum wage, studies based on the GSOEP found significant increases in hourly wages almost across the board, which were calculated with contractual working time (Bachmann et al. 2020, 2022; Burauel et al. 2018). These effects continued into 2019 and ranged between 3.9 percent and 6.7 percent for employees who had hourly wages below 8.50 euros before the introduction of the minimum wage. This finding was confirmed in the short run by Dustmann et al. (2022), who used the same approach but approximated hourly wages in the IEB. They measured a minimum wage effect on hourly wages of 6 percent in

Table 1: Causal effect of the minimum wage on wages.

Minimum wage	Year	Hourly wages				Monthly wages			
		GSOEP (using contractual hours)	GSOEP (using actual hours)	IEB (using imputed working hours)	SES/ES (using paid working hours)	GSOEP	IAB EP	IEB	SES/ES
Introduction (2015)	2015	**n.s.**[2aZf] Bachmann et al. (2020: 95f.) **3.9 %**[2aZf] Burauel et al. (2018: 63) **9 %**[1aXg] Caliendo et al. (2023b: 1163f.)	**n.s.**[2aZf] Bachmann et al. (2020: 98)	**6 %**[2aZf] Dustmann et al. (2022: 291)	**13.2 %**[2aZe] Ohlert (2022: 10)	**n.s.**[2aZf] Burauel et al. (2018: 70) **n.s.**[1aXg] Caliendo et al. (2023b: 1165)	**3.8 %**[2bZe] **6.3 %**[1bZe] Bossler and Gerner (2020: 1080, 1085) **4.3 %**[2bZe] Bossler et al. (2022: 41)	**4.4 %**[1aXe] Bossler and Schank (2023: 835)	**7.8 %**[2aZe] Ohlert (2022: 10)
	2016	**6.5 %**[2aZf] Burauel et al. (2018: 63) **5.3 %**[2aZf] Bachmann et al. (2020: 95f.)	**n.s.**[2aZf] Bachmann et al. (2020: 98)	**4 %**[1aXe] Ahlfeldt, Duncan, and Seidel (2018: 128f.)	–	**6.6 %**[2aZf] Burauel et al. (2018: 70) **n.s.**[2aZf] Bachmann et al. (2020: 107)	**3.1 %**[2bZe] Bossler et al. (2022: 41)	**4.4 %**[1aXe] Bossler and Schank (2023: 835)	–
	2017	**5.9 %**[2aZf] Bachmann et al. (2020: 95f.)	**4.1 %**[2aZf] Bachmann et al. (2020: 98)	–	–	**n.s.**[2aZf] Bachmann et al. (2020: 107)	**6.6 %**[2bZe] Bossler et al. (2022: 41)	**5.4 %**[1aXe] Bossler and Schank (2023: 835)	–
	2018	**n.s.** [2aZf] Bachmann et al. (2022: 63f.)	**n.s.**[2aZf] Bachmann	–	–	**n.s.**[2aZf] Bachmann et al. (2022: 88f.) **n.s.**	**5 %**[2bZe] Bossler et al. (2022: 41)		–

Table 1: (continued)

Minimum wage	Year	Hourly wages				Monthly wages			
		GSOEP (using contractual hours)	GSOEP (using actual hours)	IEB (using imputed working hours)	SES/ES (using paid working hours)	GSOEP	IAB EP	IEB	SES/ES
		21 %[1aXg] Caliendo et al. (2023b: 1163f.)	et al. (2022: 66f.)			Caliendo et al. (2023b: 1165)			
	2019	**6.7 %**[2aZf] Bachmann et al. (2022: 63f.)	**6.4 %**[2aZf] Bachmann et al. (2022: 66f.)	–	–	**n.s.**[2aZf] Bachmann et al. (2022: 88f.)	**6.6 %**[2bZe] Bossler et al. (2022: 41)		–
	2020	–	–	–	–	–	**6.4 %**[2bZe] Bossler et al. (2022: 41)		–
First increase 2017	2017	**n.s.**[2aZf] Bachmann et al. (2020: 95f.)	**n.s.**[2aZf] Bachmann et al. (2020: 98)	–	–	**n.s.**[2aZf] Bachmann et al. (2020: 107)	**n.s.**[2bZe] Bossler et al. (2022: 41)		–
	2018	**n.s.**[3aZf] Bachmann et al. (2022: 63f.)	**n.s.**[2aZf] Bachmann et al. (2022: 66f.)	–	–	**–8.3 %**[2aZf] Bachmann et al. (2022: 88f.)	**1.8 %**[2bZe] Bossler et al. (2022: 41)		–
	2019	**n.s.**[2aZf] Bachmann et al. (2022: 63f.)	**n.s.**[2aZf] Bachmann et al. (2022: 66f.)	–	–	**n.s.**[2aZf] Bachmann et al. (2022: 88f.)	–		–
Second increase 2019	2019		**6.8 %**[2aZf] Bachmann	–	–				–

Table 1: (continued)

Minimum wage	Year	Hourly wages				Monthly wages			
		GSOEP (using contractual hours)	GSOEP (using actual hours)	IEB (using imputed working hours)	SES/ES (using paid working hours)	GSOEP	IAB EP	IEB	SES/ES
		n.s.[2aZf] Bachmann et al. (2022: 63f.)	et al. (2022: 66f.)			**n.s.**[2aZf] Bachmann et al. (2022: 88f.)	**–2 %**[2bZe] Bossler et al. (2022: 41)		
Third increase 2020	2020	–	–	–	–	–	**–3.8 %**[2bZe] Bossler et al. (2022: 41)		–

Notes: Bite-measure: [1]continuous versus [2]binary; Data: [a]employee versus [b]firm data; Level of analysis: [X]regional versus [Y]firm versus [Z]employees; Dependent variable: [e]wage growth versus [f]change in wage growth versus [g]wage growth by quintiles. n.s., nonsignificant results; p.t.v., violation of parallel trends assumption. Source: Own compilation.

2015. This finding was also corroborated by Ahlfeldt, Duncan, and Seidel (2018), who used IEB data and imputed hours worked. Even stronger effects were observed in two studies that differed more strongly in their approach from those previously mentioned. Caliendo et al. (2023b) analysed the GSOEP but ran difference-in-differences regressions by quintiles of the regional wage distribution. For the first quintile, they revealed a treatment effect of approximately 9 percent in 2015 and 21 percent between 2016 and 2018. Using the SES/ES of the years 2014 and 2015, Ohlert (2022) divided establishments into those affected by the minimum wage and those not affected; he reported an effect of 5.3 percent on average and of 13.2 percent on employees with hourly wages below 10 euros in establishments affected by the minimum wage. The lagged effects on contractual hourly wages suggest that there may have been short-term adjustments in contractual working hours. For employees affected by the first or second increase but not by the introduction of the minimum wage, no statistically significant effect on hourly wages could be detected. There is less evidence on the minimum wage effects on hourly wages that are calculated with actual working time (including unpaid working time), which is possible only with the GSOEP. Significant effects occurred only in 2017 and 2019 (Bachmann et al. 2020, 2022).

Analyses of heterogeneous effects revealed stronger increases in hourly wages in eastern Germany than in western Germany in the short term (Bachmann et al. 2020; Ohlert 2022) and among full-time employees (ibid.; Burauel et al. 2018). In the medium term until 2019, however, the minimum wage effects on hourly wages no longer varied between western and eastern Germany or by type of employment (Bachmann et al. 2022). Further studies evaluated differences in the minimum wage effects by gender. According to the SES/ES, the minimum wage effects on the average hourly wages of women and men in minimum wage establishments differed by 3.6 % points in 2015, which led to a reduction in the gender pay gap in these workplaces (Ohlert 2023). A comparison of regions that were more or less affected by the minimum wage using the 2014 and 2018 SESs showed a decrease in the mean gender pay gap of 2.3 % points in regions more affected by the minimum wage (Caliendo and Wittbrodt 2022). At the lower end of the wage distribution, the gender pay gap declined more strongly than at the mean, namely, by 3.4 (25th percentile) and by 4.6 (10th percentile) percentage points (Caliendo and Wittbrodt 2022). A differentiation of short-term minimum wage effects by gender based on the GSOEP revealed significant wage increases for women but not for men in 2015 and 2016 and significant wage increases for men but not for women in 2017 (Bachmann et al. 2020). In a later study based on the GSOEP, Bachmann et al. (2022: 75ff.), did not find significant minimum wage effects on hourly wages in the subgroups of women and men in the period from 2015 to 2019.

In terms of living conditions and social security, monthly wages are more relevant for employees than hourly wages are. When the minimum wage increases, monthly wages may increase, remain constant, or decrease depending on changes in hours worked. Empirical findings on monthly wages based on the GSOEP, the IEB, the SES/ES and the IAB Establishment Panel are presented in the right four columns of Table 1. Causal studies based on the GSOEP provide mixed results: While Burauel et al. (2018) could determine an effect of 6.6 percent on monthly wages in the short run up to 2016, Bachmann et al. (2020, 2022); Caliendo et al. (2023b) did not find any statistically significant effects of the introduction of the minimum wage in 2015 or of the minimum wage increases up until 2019. The latter result also applied to employee subgroups. Against the background of the positive minimum wage effects on actual hourly wages, the zero effect on monthly wages indicates that the weekly working hours of minimum wage employees may have been reduced. However, on the basis of the IEB, distinctly positive minimum wage effects on monthly wages were detected (Bossler and Schank 2023). Thus, a 10-percentage-point increase in the applicability of the minimum wage caused an increase in monthly wages of approximately 4.4 percent in 2015 and 2016 and approximately 5.4 percent in 2017. Based on the IAB EP, the average gross wage sum per employee in companies affected by the introduction of the minimum wage grew by 3.8–6.3 percent more in 2015 than in unaffected companies (Bossler and Gerner 2020). Using the same data, Bossler et al. (2022: 41) found significant minimum wage effects of between 4.3 and 6.6 percent in all years 2015–2020. In the short term until 2015, Ohlert (2022) revealed an increase in monthly wages of approximately 3.0 percent on average and of 7.9 percent for low-wage workers in minimum wage establishments using the SES/ES. The effects on monthly wages are therefore stronger in studies that are based on firm data and that measure wage growth as a dependent variable. Regarding the adjustments of the minimum wage, Bachmann et al. (2022) determined a significant decline in monthly earnings of 8.3 percent in 2018 based on the GSOEP. Bossler et al. (2022), in contrast, found a growth of 1.8 percent based on the IAB EP. However, they revealed later declines of 2 and 3.8 percent as a result of the second and third increases in the minimum wage, respectively. Both Bachmann et al. (2022) and Bossler et al. (2022) explained the respective declines in monthly wages with a lower increase in the minimum wage compared to average wages during this period.

There is evidence on the relationship between the minimum wage and collective bargaining negotiations in low-wage industries from a qualitative study (Bispinck et al. 2023). By examining the period from 2020 to 2022, the study found that the minimum wage increase to 12 euros per hour posed a particular challenge for collective bargaining. Thus, collectively agreed wages were threatened to be overtaken in many low-wage sectors. According to an analysis of 564 collective agreements

available to the Federal Statistical Office as of 21 November 2022, there were still a total of 180 sectoral and company collective agreements containing at least one pay group with gross hourly wages of less than 12 euros per hour. To avoid being overtaken by the minimum wage, the collective bargaining parties in almost all of the sectors examined in the study adjusted the collectively agreed wages accordingly. In some cases, the schedule of collective bargaining was even brought forward. The minimum wage-induced adjustments to collective pay scales led to above-average wage increases at the lowest pay scales. To a lesser extent, higher pay scales were also raised. Thus, the adjustment to the minimum wage has led to a significant increase in the level of collectively agreed wages in low-wage sectors.

4.3 Working Time

Reducing working hours can be a measure taken by companies to lower wage costs that have increased as a result of the minimum wage. Adjustments in working hours can thus also be seen as a way for firms to adjust employment. On the other hand, employees may also react to a minimum wage-induced increase in hourly wages by reducing or expanding their working hours (Bachmann et al. 2022: 115). Due to mixed evaluation results regarding the scope and persistence of these effects, there has been a lively debate about the relevance of minimum wage effects on working hours in Germany. Our literature survey shows that existing studies largely find reductions in working time, particularly directly after the introduction and the first increase in the minimum wage.

For the most recent years, only descriptive evidence on the working time of minimum wage workers is available. Due to data collection problems during the pandemic (see Section 3.1), the results for 2020 are particularly scarce. The results from the "coronavirus high-frequency online personal panel" (HOPP) survey showed that the percentage reduction in hours worked per week in May 2020, compared to the time before the pandemic, was significantly greater for minimum wage employees than for higher-paid employees (Jaenichen 2021). This result reflects the relatively strong impact of the pandemic on low-wage workers. According to the Earnings Survey from April 2022, the number of paid working hours for minimum wage workers was still lower than that in 2019, with 37.5 h for full-time employees, 20.4 h for part-time employees and 7.7 h for those in marginal employment (Mindestlohnkommission 2023: 136).

Causal studies on minimum wage effects for the years 2015–2019 consistently identified a reduction in contractual working hours directly after the introduction of the minimum wage in 2015 (see Table 2 and Bachmann et al. 2020: 118f.; Bonin et al. 2018: 92ff.; Bossler and Gerner 2020; Ohlert 2022; Pusch, Seifert, and Santoro 2020).

Table 2: Causal effect of the minimum wage on working time.

Minimum wage	Year	Contractual hours (GSOEP)	Actual hours (GSOEP)	Paid working time (SES/ES)
Introduction (2015)	2015	**–5 %**[2aZe] Bonin et al. (2018: 97) **–5 %**[2aZe] Burauel et al. (2020: 250)	**n.s.**[2aZe] Bonin et al. (2018: 97) **–6 %**[1aXg] Caliendo et al. (2023b: 1165f.)	**–6 %**[2aYe] Ohlert (2022: 10)
	2016	**n.s.**[2aZe] **–5 %**[1aXe] (Bachmann et al. 2020: 114ff.)	**–6 %**[1aXe] (Bachmann et al. 2020: 116)	
	2017	**n.s.**[2aZe] –7 %[1aXe] (Bachmann et al. 2020: 114ff.)	**–9 %**[1aXe] (Bachmann et al. 2020: 116)	
	2018	**n.s.**[2aZe] **–11 %**[1aXe] (Bachmann et al. 2022: 129, 134)	**–14 %**[1aXe] (Bachmann et al. 2022: 131f.) **–10 %**[1aXg] Caliendo et al. (2023b: 1165f.)	**n.s.**[1aXg] (Biewen, Fitzenberger, and Rümmele 2022: 18f.)
	2019	**n.s.**[2aZe] **–11 %**[1aXe] (Bachmann et al. 2022: 129, 134)	**–13 %**[1aXe] (Bachmann et al. 2022: 131f.)	
First increase 2017	2017	**–14.4 %**[2aZe] (Bachmann et al. 2022: 134)	–	
	2018	**–17.8 %**[2aZe] (Bachmann et al. 2022: 134)	–	
Second increase 2019	2019	**n.s.**[2aZe] (Bachmann et al. 2022: 134)	–	

Notes: Bite-measure: [1]continuous versus [2]binary; Data: [a]employee versus [b]firm data; Level of analysis: [X]regional versus [Y]firm versus [Z]employees; Dependent variable: [e]change in working time versus [f]change in working time growth versus [g]distribution of working hours n.s., non-significant results; p.t.v., violation of parallel trends assumption. Source: Own compilation.

Note that the scope of absolute changes in working hours differs strongly between studies and by research design. For example, Bachmann et al. (2020) reported for the year 2015 that contractual working time was on average reduced by 9 min per week

in regions with a higher minimum wage bite (by one standard deviation). For the same year, Bossler and Gerner (2020) noted a decrease in average contracted weekly working hours in minimum wage establishments of 0.22 h (13 min) compared to establishments without minimum wage employees. Burauel et al. (2020) revealed an average reduction in weekly working hours of 1.7 h in 2015 for employees with hourly wages less than 8.50 euros compared to employees with higher wages. Bachmann et al. (2022) and Ohlert (2022) showed that the measured working time effects were greater for low-wage workers than for average workers in regions or firms.

For later years, the findings differ between studies that measure the bite of the minimum wage at the individual level and those that measure the bite at the regional or the firm level. Focussing on employees who earned less than the minimum wage before its introduction, Bachmann et al. (2020, 2022) did not find effects of the introduction of the minimum wage on working time in 2016 or in later years until 2019. For employees affected by subsequent increases in the minimum wage, Bachmann et al. (2022: 132ff.) did reveal significant reductions in working hours in 2017 and 2018 of approximately 14.4 percent and 17.8 percent, respectively, but not in 2019.

By comparing regions with a higher minimum wage bite and regions with a lower minimum wage bite, Bachmann et al. (2020, 2022); Caliendo et al. (2023b) detected negative effects on contractual working time each year since 2015 using the GSOEP. Differentiation of working time effects with this approach pointed to stronger reductions in working time for part-time employees and marginal employees among women (in 2018 and 2019) and in the lower 40 percent of the distribution of monthly earnings (Bachmann et al. 2022: 137f.). Biewen, Fitzenberger, and Rümmele (2022) also measured the minimum wage bite at the regional level using the Structure of Earnings Survey in 2014 and 2018 and found no minimum wage effects on paid working time. Bossler and Gerner (2020) examined average working time in establishments affected by the minimum wage compared to that in other establishments. They revealed a working time effect of –0.4 percent in 2015 and no significant effect in 2016. Ohlert (2022) compared the change in paid working time of employees in minimum wage establishments to employees in other establishments. Thus, working time significantly decreased by approximately 3 percent on average and by 6 percent for low-wage employees in 2015. The average working time reduction was smaller among women than among men.

Regarding actual working time, no statistically significant minimum wage effect was found for 2015 using a treatment definition based on individual wages (Bonin et al. 2018: 92ff.). The authors concluded that the introduction of the minimum wage could have led to a substitution of agreed working time with overtime. However, Bachmann et al. (2020); Caliendo et al. (2023b): 116ff.) and Bachmann et al. (2022: 131), identified even somewhat stronger declines in actual working time than in

contractual working time based on a regional approach. This suggests a decrease over time among minimum wage employees.

4.4 Noncompliance with the Minimum Wage

The minimum wage is effective only if the provisions of the Minimum Wage Act are complied with and if the minimum wage is actually paid. However, deficits in compliance with the statutory minimum wage have been observed. Violations of the statutory minimum wage are in most cases associated with the failure to record or with misrecording of actual working hours. Information on hourly wages below the minimum wage obtained from the SES/ES, which is a survey of employers, differs significantly from that obtained from the household survey conducted by the GSOEP. However, importantly, neither survey is designed to determine the degree of noncompliance with the Minimum Wage Act in terms of their objectives nor the specific information requested. Previous studies on measurement errors have concluded that there are systematic differences between the two surveys. These can be attributed to the respective survey designs, to typical measurement errors, such as the rounding behaviour of respondents, and to the so-called mean reversion (Bachmann et al. 2020: 76ff.; Dütsch, Himmelreicher, and Ohlert 2019). There are also findings on the problem of incentives with respect to employer-reported noncompliance. Since paying wages below the minimum wage is an offence, employers may not want to report such low wages and adjust their data before reporting (Garnero, Kampelmann, and Rycx 2015). This leads to differences in monthly wages, weekly working hours and gross hourly wages, especially at the lower end of the respective distribution between the SES/ES and the GSOEP.

Accordingly, the ES reported approximately 1.0 million employment relationships below the minimum wage in 2015 and approximately 750 thousand in 2016 (Figure 3). In terms of all employment relationships, this resulted in shares of 2.8 percent and 2.1 percent. According to the GSOEP, a significantly larger group of employees earned less than 8.50 euros per hour after the introduction of the minimum wage. In 2015 and 2016, the GSOEP reported 2 million and 1.8 million employees, respectively, who earned less than the minimum wage when contractual working hours were examined (Burauel et al. 2017). In 2015, this corresponded to a share of 8.2 percent, and in 2016, it corresponded to a share of 7.0 percent of the population of approximately 26.2 million employees. In the following years, the figures for noncompliance fell somewhat, but in the GSOEP, they were still considerably greater than those in the SES/ES. In April 2022, on the basis of the ES, there were approximately 798 thousand employment relationships and thus a share of 2.1 percent with

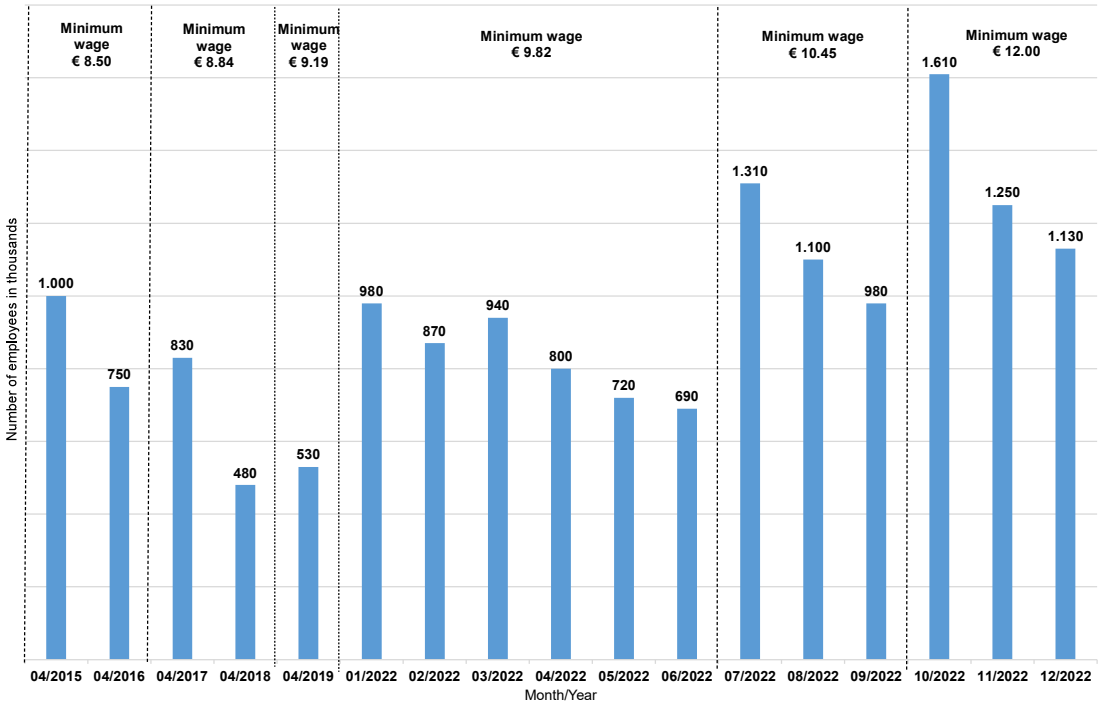

Figure 3: Development of minimum wage noncompliance over time. Source: Structure of Earnings Survey (SES) 2018, Earnings Surveys (ES) 2015, 2016, 2017, 2019, 2022.

hourly wages below the statutory minimum wage of 9.82 euros. For 2022, no figures are yet available from the GSOEP.

For 2022, the monthly development of employment with hourly wages below the statutory minimum wage is available based on data from the ES (Figure 3). The number of jobs below the minimum wage was relatively high in the months of January, July and October, during which the minimum wage increased, and decreased quickly in the following months. The pattern indicates that the implementation of the minimum wage in companies is still incomplete immediately after an adjustment and increases over time. The measures in 2018 and 2019 were taken at a time when the respective new minimum wage levels had already been in effect for 16 and 4 months, respectively, and the companies had accordingly had time to implement them. Thus, part of the noncompliance with the minimum wage is a transitional phenomenon and can be traced to delays in its implementation.

4.5 Employment and Unemployment

The second evaluation criterion mentioned in the Minimum Wage Act is that jeopardizing employment should be avoided. Descriptive evidence on selective

employment indicators will be presented first. Causal analyses on the effects of the minimum wage on employment will be subsequently discussed.

In 2015 and 2016, after the introduction of the minimum wage, employment grew more strongly in minimum wage sectors than in the rest of the economy. This was also true for western and eastern Germany (Figure 4). This development reversed in 2017 and 2018, when employment in the rest of the economy increased more strongly than did employment in minimum wage sectors. As a result of the measures taken to control the coronavirus pandemic, total employment decreased significantly beginning in the second quarter of 2020 in both parts of the country. There was an employment decline, particularly in the minimum wage sectors. This is because the minimum wage sectors were also those most affected by lockdown measures, for example, through the closure of restaurants, bars and retail shops. Accordingly, the number of employees in short-time work, which was the most important labour market policy measure during the coronavirus pandemic, increased sharply.[5] The proportion of employees receiving short-time benefits was greater in minimum wage sectors than in non–minimum wage sectors. Employment in the minimum wage sectors grew again and developed more dynamically than did employment in the non–minimum wage sectors from the fourth quarter of 2021 until the second quarter of 2022 (Figure 4). The reduction in employment in the minimum wage sectors during the pandemic was driven mainly by a decline in marginal employment (i.e. employment largely exempted from social security contributions), as only regular employees can receive short-time benefits. The subsequent strong employment growth after the pandemic, on the other hand, was due mainly to an increase in regular employment (i.e. employment subject to social security contributions). Empirically, it is non-trivial to distinguish whether differences between sectors during the COVID-19 pandemic were caused partly by the minimum wage or solely by the pandemic. The positive development of employment after the pandemic in

5 Short-time work provides a wage replacement benefit through the German unemployment insurance system, with the aim of preventing unemployment in the event of a temporary loss of working hours. Entitlement to short-time work kicks in if the regular weekly working hours in a company are temporarily reduced for economic reasons or because of an unavoidable event. To mitigate the economic consequences of the coronavirus pandemic, the federal government decided in 2020 on temporary enhancements that were repeatedly extended. Access to short-time work was made easier for a limited period, most recently until the end of June 2023, and its duration was extended for a limited period, most recently until June 2022, from 12 to 28 months. The amount of the benefit was increased for a limited period and most recently until June 2022 from 60 percent (67 percent for workers with at least one child) of the lost net pay to 70 percent (77 percent) from the 4th month of receipt and 80 percent (87 percent) from the 7th month of receipt. Of the social security payments made by employers for their short-time workers, 100 percent were reimbursed by the unemployment insurance system until December 2021, and 50 percent were reimbursed until March 2022.

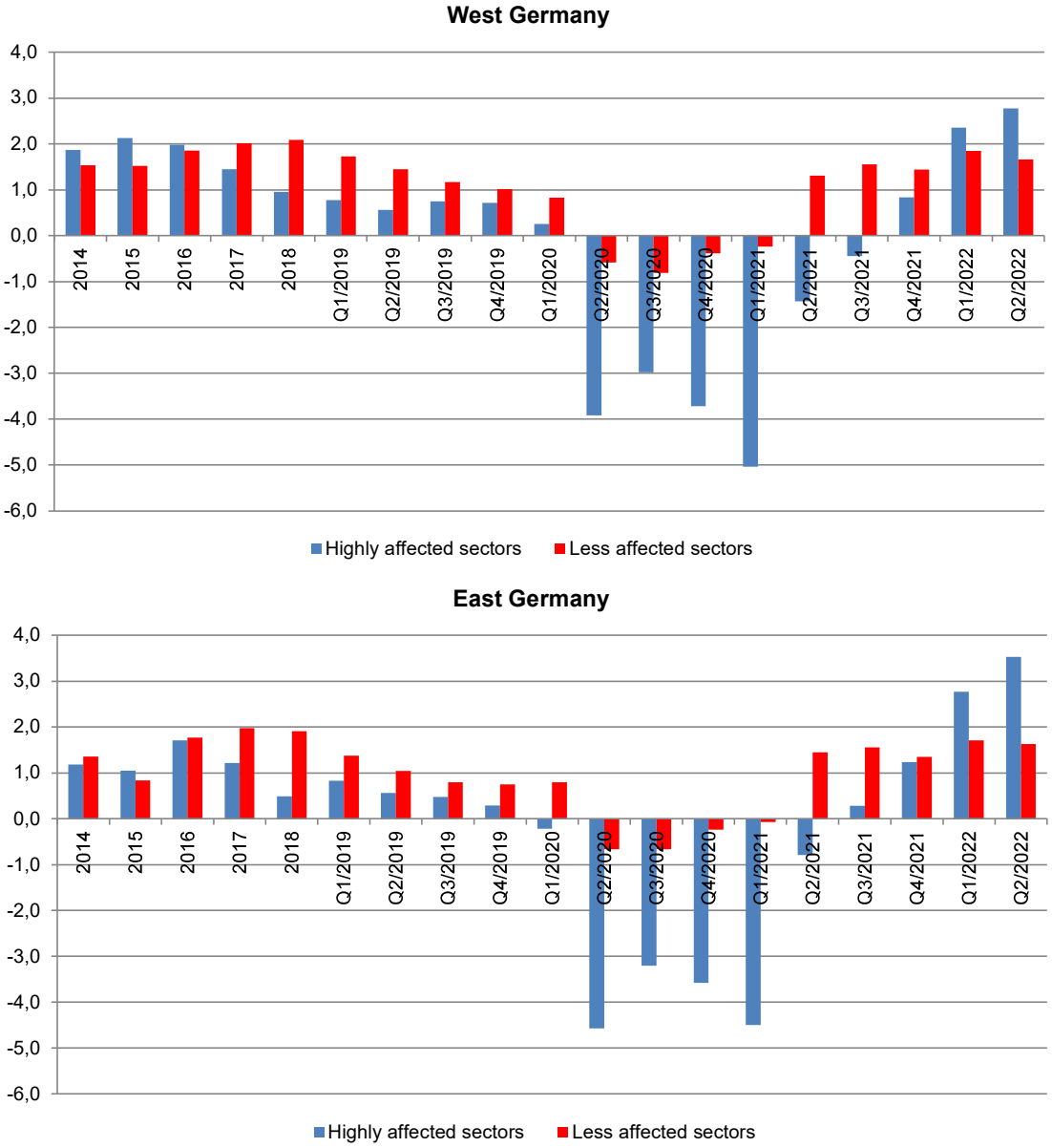

Figure 4: Development of total employment. Source: Statistics of the federal employment agency, own calculations.

sectors highly affected by the minimum wage suggests the latter. In the causal studies listed below, indicators of the pandemic were used to separate the effects of the pandemic and the minimum wage.

Numerous causal analyses are available on the effects of the statutory minimum wage on employment. These studies investigate different time horizons from their introduction in 2015 and 2016 to subsequent increases and up to January 2022 (Table 3). To a certain extent, the analyses apply different identification methods, use different databases and examine different outcome variables. This is again indicated by the superscript letters and numbers.

Table 3: Causal effect on employment.

Minimum wage	Year	Regular employment	Marginal employment	Total employment (regular and marginal employment)
Introduction (2015)	2015	**−0.012 %**[1aXe] Caliendo et al. (2018: 55f.) **0.2 %**[1aXe] Stechert (2018: 48) **0.05 %**[1aXe] Garloff (2019: 370) **0.03 %**[1aXe] Holtemöller and Pohle (2020: 114) **n.s.**%[1aXe] Schmitz (2019: 346) **0.5 %**[1aYe] Friedrich (2020: 285)	**−0.18 %**[1aXe] Caliendo et al. (2018: 55f.) **−0.3 %**[1aXe] Stechert (2018: 48) **−0.11 %**[1aXe] Garloff (2019: 370) **−0.05 %**[1aXe] Holtemöller and Pohle (2020: 114) **−1.1 %**[1aXe] Schmitz (2019: 346) **n.s.**[1aYe] −1.4 % in East Germany[1aYe] Friedrich (2020: 285f.)	**−0.025 %**[1aXe] Caliendo et al. (2018: 55f.) **−1.5 %**[2bYe] Bossler et al. (2018: 39) **−1.7 %**[2bYe] Bossler and Gerner (2020: 10) **n.s.**[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25) **n.s.**[2bYe] Bossler et al. (2022: 42) **n.s.**[12aXYe] Bossler and Schank (2023: 840) **0.04 %**[1aXe] Stechert (2018: 48) 0.8 pp[2aYf] Dustmann et al. (2022: 289) **n.s.**[1aXe] Dustmann et al. (2022: 315) **n.s.**[1bXe] Link (2019: 20) **0.03 %**[1aXe] Ahlfeldt, Duncan, and Seidel (2018, appendix table A3)
	2016	**n.s.**[2aXe] Bonin et al. (2018: 35)	**−1.8 %**[2aXe] Bonin et al. (2018: 35)	**−0.6 %**[2aXe] Bonin et al. (2018: 35) **−1.9 %**[2bYe] Bossler et al. (2018: 39) **n.s.**[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25) **n.s.**[2bYe] Bossler et al. (2022: 42) **n.s.**[12aXYe] Bossler and Schank (2023: 840)

Table 3: (continued)

Minimum wage	Year	Regular employment	Marginal employment	Total employment (regular and marginal employment)
				0.06 %[1aXe] Ahlfeldt, Duncan, and Seidel (2018: 130)
	2017			**–3.0 %**[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25)
				–3.0 %[2bYe] (Bossler et al. 2022: 42)
				n.s.[12aXYe] Bossler and Schank (2023: 840)
	2018			**–2.8 %**[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25)
				–2.9 %[2bYe] Bossler et al. (2022: 42)
	2019	**n.s.**[2aXe] Pestel et al. (2020: 30)	**–1.8 %**[2aXe] Pestel et al. (2020: 30)	**–4.8 %**[2bYe] Bossler et al. (2022: 42)
				–0.9 %[2aXe] Pestel et al. (2020: 30)
	2020			**–6.7 %**[2bYe] Bossler et al. (2022: 42)
	2021	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2022: 41)	**–2.1 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 41)	**–0.6 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 41)
		n.s.[1bYe] Isphording et al. (2022: 40)	**–7.8 %**[1bYe] Isphording et al. (2022: 40)	**–2.6 %**[1bYe] Isphording et al. (2022: 40)
	2022	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 48)	**–2.3 %**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 48)	**–0.7 %**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 48)
First increase 2017	2017	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)	**–1.7 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)
		n.s.[1aYe] Friedrich (2020: 285)	**n.s.**[1aYe] –3.6 % in East Germany[1aYe] Friedrich (2020: 285, 287)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)
				–2.3 %[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25)

Table 3: (continued)

Minimum wage	Year	Regular employment	Marginal employment	Total employment (regular and marginal employment)
				−2.3 %[2bYe] Bossler et al. (2022: 42)
	2018			**n.s.**[2bYe] Bossler, Gürtzgen, and Börschlein (2020: 25)
				n.s.[2bYe] Bossler et al. (2022: 42)
Second increase 2019	2019	**−0.6 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)	**−2.3 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)	**−0.8 %**[2aXe] Caliendo, Olthaus, and Pestel (2022: 61)
		p.t.v.[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**−2.4 %**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**−0.9 %**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)
		n.s.[1bYe] Isphording et al. (2022: 58)	**−8.7 %**[1bYe] Isphording et al. (2022: 58)	**−3.1 %**[1bYe] Isphording et al. (2022: 58)
				n.s. [2bYe] Bossler et al. (2022: 42)
Third increase in 2020	2020	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**−0.6 %**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)
				n.s.[2bYe] Bossler et al. 2022: 42)
Fourth and fifth increase in 2021	2021	p.t.v.[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)
Sixth increase in 2022	Q1 2022	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)	**n.s.**[2aXe] Caliendo, Olthaus, and Pestel (2023a: 67)

Notes: Bite-measure: [1]continuous versus [2]binary difference in difference estimation; Data: [a]employee versus [b]firm data; Level of analysis: [X]regional versus [Y]groups; Dependent variable: [e]change in employment level versus [f]change in probability of staying employed. n.s., nonsignificant results; p.t.v., violation of parallel trends assumption. Source: Own compilation.

For overall employment, which is made up of regular employment (i.e. employment subject to social security contributions) and marginal employment (i.e. employment largely exempt from social security contributions), the coefficients from the studies, by and large, show a small negative effect of the introduction of the minimum wage. According to calculations by Börschlein and Bossler (2019), the absolute employment effects of the minimum wage on total employment across various studies ranged from a gain of approximately 11,000 jobs to a loss of approximately 200,000 jobs. Caliendo et al. (2018) found a decline of 0.025 percent in employment for every additional percentage point in the share of minimum wage workers in a given travel to work area in 2015, the year of the minimum wage introduction. Bossler and Schank (2023) followed a similar identification strategy to that of Caliendo et al. (2018) and identified no effect on overall employment in the following year 2016. According to Bonin et al. (2018) and Pestel et al. (2020), the introduction of the minimum wage reduced overall employment by 0.6 percent in 2016 and by 0.9 percent in 2019 in regions with an above median wage gap (i.e. the difference between the actual wage in 2014 and the minimum wage) compared to regions with a below average wage gap. Caliendo, Olthaus, and Pestel (2022, 2023a) used the same identification strategy as Bonin et al. (2018) and Pestel et al. (2020) and revealed a 0.7 percent reduction in employment in the long run up until 2022 as a result of the minimum wage introduction. These negative employment effects were particularly driven by regions with relatively low GDP growth before the introduction of the minimum wage. The coefficients were somewhat larger if the unit of analysis was the firm rather than the region. This reflects the fact that transitions of employees to other firms in the same region are not necessarily accounted for if minimum wage effects are measured at the firm level. This is the case if employees change from minimum wage firms to non-minimum wage firms within the same region as a result of the minimum wage. Firm-level analyses measure this as a minimum wage-driven employment loss, whereas in regional analyses, the overall net sum of employment changes within the region constitutes the minimum wage effect. Bossler et al. (2018, 2020, 2022) compared firms with at least one minimum wage worker with firms without minimum wage workers and examined a lower employment level of approximately 1.5 percent in the former compared to the latter in 2015 as a result of the introduction of the minimum wage. This effect increased gradually until the year 2022 to 6.7 percent lower employment in firms with at least one minimum wage worker. Dustmann et al. (2022) looked at workers paid below the minimum wage before its introduction and, by using a different outcome variable than the other studies, identified a slightly greater probability of them being employed after the minimum wage had come into force. The authors also observed a reallocation of these workers to larger, higher paying firms due to the minimum wage.

This difference in effect sizes depending on the unit of analysis is also visible with respect to subsequent increases to the minimum wage. According to the studies of Caliendo, Olthaus, and Pestel (2022, 2023a), an increase in 2019 had a negative effect on overall employment of 0.8–0.9 percent in regions with an above-median wage gap. For increases in other years, the authors did not identify any effect on employment. According to Bossler, Gürtzgen, and Börschlein (2020, 2022), the increase in 2017 reduced employment in affected firms by 2.3 percent. The increases in 2019 and 2020 did not affect employment in firms with minimum wage workers.

The impact on overall employment was primarily driven by the minimum wage's effect on marginal employment. Regular employment was not affected. Several studies have identified small positive or negative effects on regular employment immediately after the minimum wage was introduced, but these effects vanished over the longer run. For marginal employment, all studies showed a reduction as a result of the minimum wage introduction and as a result of most subsequent increases. Effect sizes varied with the unit of analysis. Isphording et al. (2022) looked at the decline in marginal employment in more detail. According to the authors, the decline was primarily driven by a significant decline in the hiring rate for this type of employment; it was not due to an increased exit rate, i.e. dismissals or layoffs. Numerous marginal jobs were upgraded to regular employment as a result of the minimum wage introduction (vom Berge et al. 2016; Bossler and Schank 2023).

Regarding unemployment, no study has identified any minimum wage effects thus far (Bonin et al. 2018; Caliendo, Olthaus, and Pestel 2022, 2023a; Pestel et al. 2020). For the development of unemployment during the coronavirus pandemic from the second quarter of 2020 onwards, there were also no indications of a stronger increase in unemployment in regions with a high minimum wage and a high incidence of coronavirus than in regions with a lower incidence (Caliendo, Olthaus, and Pestel 2023a).

4.6 Companies Affected by the Minimum Wage

The third evaluation criterion mentioned in the Minimum Wage Act concerns the impact of the minimum wage on competition conditions. Accordingly, the minimum wage should contribute to fair and functioning market conditions by counteracting cutthroat competition through wage costs and maintaining firms' competitiveness. Competition between companies should take place on the grounds of service and product quality rather than through a race to the bottom on wages.

In the period from 2015 to 2020, the proportion of firms affected by the minimum wage decreased continuously, according to the IAB Establishment Panel. Before the

introduction of the minimum wage, in 2014, approximately 12 percent of companies had at least one employee with an hourly wage less than 8.50 euros (Bossler et al. 2022: 16 ff.). For the increases in the statutory minimum wage in 2017, 2019 and 2020, the proportions were approximately 8.5 percent, 6.9 percent and approximately 6 percent, respectively (Hohendanner 2022: 12). In January 2021, this still applied to approximately 6 percent of companies (ibid.). For the firms for which the minimum wage uprating at the beginning of 2020 was relevant, approximately 28 percent of employees previously earned hourly wages below the minimum wage level of 9.35 euros (Hohendanner 2022: 13). As a result of the increase in the minimum wage by the Minimum Wage Commission to 10.45 euros as of July 2022, 6 percent of companies were affected. The proportion of affected companies after the intervention of the government to raise the minimum wage to 12 euros increased to 23 percent.

4.7 Firm Competitiveness

In macroeconomic terms, the influence of the minimum wage on the total wage bill was relatively small. The introduction of the minimum wage caused an increase in the gross monthly wage bill of 431 million euros and in the annual gross wage bill of 5.2 billion euros in 2015 under the assumption of full implementation of the statutory minimum wage and unchanged working hours (Statistisches Bundesamt 2016). In relation to all gross wages, this corresponded to an increase of 0.43 percent. The effects of the minimum wage adjustments on the wage bill from 2017 to 2019 were comparatively small, at 0.07 percent and 0.06 percent (Kann 2018: 54; Statistisches Bundesamt 2017: 24). This also applied to the adjustment of the minimum wage to 9.35 euros on 1 January 2020, with a roughly estimated increase in the wage bill of approximately 360 million euros or 0.02 percent. However, the increase in the minimum wage to 12 euros by parliament had a similarly high impact on the wage bill as the introduction of the minimum wage in 2015. It amounted to approximately 480 million euros or 0.35 percent per month (Mindestlohnkommission 2023).[6]

Most recently, Russia's war against Ukraine, which began in February 2022, placed considerable strain on the entire German economy and on the competitive situation of minimum wage firms in particular. Almost half of the minimum wage firms, i.e. those that had employees with an hourly wage of less than 12 euros, stated that the war had a predominantly negative impact on them (Brunner, Gloger, and Hohendanner 2023). A smaller proportion of firms not affected by the minimum wage mentioned this (43 percent). However, firms not affected by the minimum wage

6 This estimation was calculated under the assumptions of full compliance with the minimum wage, unchanged working time and no spillover effects to higher wage groups.

were more likely to say that the war had no impact on them (39 percent versus 29 percent). Among the firms that reported a negative impact of the war in Ukraine, the specific consequences were similar for those affected and not affected by the minimum wage (Mindestlohnkommission 2023: 165). Approximately 94 percent of the minimum wage companies and 92 percent of the other companies were moderately to strongly affected by higher energy and fuel costs. At approximately 82 percent, a slightly greater proportion of minimum wage companies than of other companies (75 percent) reported facing higher costs for inputs or raw materials. Difficulties with suppliers or logistics, as well as liquidity bottlenecks, were also mentioned more frequently by minimum wage–affected companies than by other companies as effects of the war in Ukraine. Slightly more than 60 percent of the minimum wage companies and the other companies had difficulties obtaining inputs or raw materials. Other effects of the war were less significant.

In 2020 and 2021, the coronavirus pandemic and the associated restrictions to contain the pandemic, such as temporary closures of shops and restaurants, had strong economic effects and consequences for companies. Firms employing minimum wage workers were more affected by the coronavirus pandemic and suffered more negative effects from it than other companies (Börschlein and Bossler 2021; Hohendanner 2022; Kagerl and Ohlert 2021). This was largely because companies affected by the minimum wage are overrepresented in those sectors of the economy that were severely restricted by the pandemic or by the measures to contain it. This applies in particular to hotels and restaurants, personal services such as hairdressing and the retail trade. The most frequently reported negative consequences of the pandemic were a decrease in demand or a decrease in turnover and increased costs due to hygiene measures and difficulties obtaining inputs (Kagerl and Ohlert 2021). Therefore, compared with other companies, firms affected by the minimum wage more frequently took personnel policy measures to respond to the pandemic, such as short-time work, reductions in working hours, not filling vacancies and reducing fixed-term employment (Mindestlohnkommission 2023: 163). Wage increases and special payments were also postponed more frequently in minimum wage firms than in other firms (Kagerl and Ohlert 2021). Support measures provided by the government were used more frequently by firms affected by the minimum wage than by others. However, there was no statistically significant increase in the number of closures of firms affected by the minimum wage (Hohendanner 2022).

Causal analyses at the establishment level showed a minimum wage-induced increase in labour costs in companies affected by the minimum wage and thus confirmed the results on wage increases for employees affected by the minimum wage. On the basis of the IAB EP, the average wage costs (gross wage total) per employee in companies affected by the introduction of the minimum wage rose by 3 and 4 percent more in 2015 and 2016, respectively, than in companies not affected. In

2017 and 2018, the increase in wage costs for these companies was approximately 5 and 6 percent greater, respectively; in 2019 and 2020, it was approximately 6–7 percent greater (Bossler, Gürtzgen, and Börschlein 2020: 24ff.; Bossler et al. 2022: 41ff.). The effects on wage costs were stronger for companies in eastern Germany than for those in western Germany (Bossler et al. 2018: 94). For the minimum wage increase in 2017, there was a lagged effect of 1.8 percent on wage costs in 2018 (Bossler, Gürtzgen, and Börschlein 2020: 25). In contrast, the increases in 2019 and 2020 induced negative effects of 2 percent and 4 percent, respectively (Bossler et al. 2022). This finding indicates that the minimum wage adjustments in 2019 and 2020 did not lead to a significant wage increase and that the development of the affected companies even lagged behind general wage development.

Thus far, there have been no effects on business or macroeconomic labour productivity. At the company and individual levels, there are numerous reasons why the minimum wage could trigger changes in productivity. It is to be expected that companies affected by the minimum wage try to compensate at least partially for increased wage costs due to the minimum wage by increasing productivity (Bossler, Gürtzgen, and Börschlein 2020: 81 ff.; Bossler et al. 2022: 63ff.; Koch et al. 2020: 92 ff.; Riley and Bondibene 2017). To this end, companies could replace labour with capital, invest more in training, hire more productive workers, improve their organization or adjust their range of services. In addition, higher pay could lead to greater motivation among employees.

All the existing studies did not find evidence for minimum wage-induced effects on labour productivity in Germany, which is usually measured as revenue per employee (Bossler et al. 2018: 81ff., 2020: 45ff. 2022: 63ff.; De Monte et al. 2022: 104ff.). Only in the case of companies in western Germany has a small negative productivity effect of the minimum wage increases been revealed (Bossler et al. 2018: 81ff., 2020: 45ff., 2022: 63ff.). An extended estimate of the production function for the input factors labour and capital as well as total factor productivity also did not indicate any effects of the introduction of the minimum wage or the first minimum wage increase. Only the second minimum wage increase caused a slight rise in total factor productivity, while the contribution of the production factors labour and capital to the output of establishments fell slightly (ibid.). Dustmann et al. (2022) further noted that employees affected by the minimum wage move to more productive companies as a result of the introduction of the minimum wage. Companies' adjustments to the minimum wage in terms of wages and operational processes can have effects on employees' individual productivity. In this respect, positive effects of the minimum wage on satisfaction with pay were found (Bossler et al. 2022; Gülal and Ayaita 2020). Bachmann et al. (2020), on the other hand, did not identify any statistically significant minimum wage effects on the job satisfaction of employees in the bottom 40 percent

of the wage distribution. However, they detected a negative effect for employees with earnings just above the minimum wage.

Another aspect of competition is investment. Research shows that the introduction of the minimum wage had a short-term negative impact on investments but no longer-lasting negative effects (Bossler, Gürtzgen, and Börschlein 2020: 63ff.; Bossler et al. 2022: 88ff.). Total investment in companies affected by the minimum wage decreased by approximately 40 percent in 2015 in comparison to that in unaffected companies but did not further decrease after the minimum wage increases in the period from 2017 to 2019. Obviously, companies affected by the minimum wage withheld investments as an immediate reaction to the introduction of the minimum wage, while investment behaviour in later years was no longer influenced by the minimum wage.

Furthermore, according to the studies by Bossler et al. (2020, 2022), profits fell due to the introduction of the minimum wage. In the period from 2015 to 2019, the introduction of the minimum wage led to a reduction in profitability of approximately 6.6 percent and just under 9 percent in affected companies (Bossler et al. 2018: 97f.; Bossler, Gürtzgen, and Börschlein 2020: 59; Bossler et al. 2022: 76ff.). This finding can be explained by the fact that personnel costs increased due to the minimum wage, while productivity did not change. The decline in profits due to the introduction of the minimum wage was greater in 2016 than in 2015. In a differentiated estimation, the effect was confirmed only for eastern Germany, not for western Germany, and only for companies with high competitive pressure, not for companies without it. In contrast, the increases in the minimum wage in 2017 and 2019 had no statistically significant effects on business profitability.

The introduction and increases of the minimum wage may have influenced company start-ups and closures and hence the intensity of competition between businesses. Overall, company deregistrations and insolvency proceedings have declined continuously since 2015 (Mindestlohnkommission 2023: 195). The trends in company deregistrations and insolvencies in minimum wage sectors were similar to those in the economy overall. Findings from causal studies suggest at most moderate effects of the minimum wage on company density and the market entry rates of companies. However, various causal studies point to microbusiness closures due to the minimum wage. According to the Mannheim Business Panel, a slight reduction in the number of companies resulted from the introduction of the minimum wage, but no impact on company density was found (De Monte et al. 2022). An increase in the minimum wage in 2017 did not have an independent effect on the number of companies or company density. A separate analysis of overall market entry and exit rates at the regional level did not suggest any minimum wage effects. However, a subdivision by size class revealed a minimum wage-induced increase in market exits among microbusinesses with up to four dependent employees. These findings are

consistent with the results of Dustmann et al. (2022) and Bossler et al. (2022: 148ff.), who also identified an increase in market exits by microbusinesses due to the introduction of the minimum wage. In addition, the average size of companies in regions more affected by the minimum wage increased as employees earning less than 8.50 euros per hour moved from microbusinesses to larger companies. Thus, there were changes in the size structure of companies because of the introduction of the minimum wage. On the basis of analyses of data based on the IEB, Isphording et al. (2022: 74ff.) were unable to determine any minimum wage effects on the closure of companies – either overall or for small companies.

5 Conclusion and Outlook

The minimum wage in Germany was introduced in 2015. It binds universally with only a few exceptions, some of which were limited in time. The Minimum Wage Law established adjustments in a 2-year cycle to be set by the Minimum Wage Commission. This was intended to make forward planning easier for companies and for social partners in collective bargaining. The structure and composition of the Minimum Wage Commission follow the social partnership logic that has characterized industrial relations in Germany since the end of the Second World War. Consequently, employer representatives and trade unions decide jointly and independently of the state on minimum wage adjustments. One consequence of this was that the adjustments to the minimum wage in 2016, 2018 and 2020 strictly followed past developments of collectively negotiated wages. Due to a growing political perception that the minimum wage was too low on the one hand and tailwinds from the debate about the initiative on adequate minimum wages in the European Union on the other hand, the statutory minimum wage was increased by parliament to 12 euros on 1 October 2022. After this one-time intervention, the government handed back the authority for future adjustments to the Minimum Wage Commission. Accordingly, the commission decided in June 2023 to further increase the minimum wage level up to 12.41 euros from the beginning of 2024 and to 12.82 euros in 2025.

Ten years after the introduction of the statutory minimum wage, comprehensive evidence on the causal effects of the minimum wage allows us to point out several solid insights. The strongest effects of the minimum wage were thus far observed after its introduction. In accordance with the depth of intervention of the minimum wage in the wage structure, approximately 4 million employees benefited, and approximately 12 percent of the companies were required to make adjustments. Hourly wages calculated on the basis of contractual working hours increased due to the introduction of the minimum wage. This was accompanied by a decrease in contractual working hours. Accordingly, the findings on the effects on monthly

wages remain ambiguous. The introduction of the minimum wage had delayed negative effects on both contractual and actual working hours, but there is no conclusive evidence on the minimum wage effects on hourly wages measured on the basis of actual working hours. However, the increases in contractual hourly wages were mirrored by an increase in wage costs and a reduction in profits for companies. By lifting the bottom of the wage scale, the minimum wage reduced the wage dispersion in Germany. Microbusinesses and those under competitive pressure experienced the most stress from the introduction of the minimum wage. This led to the closure of microbusinesses due to the minimum wage. Due to strong economic growth in the years after its introduction, the minimum wage had no adverse effects on overall employment or unemployment levels. Compared to the impact upon introduction, the effect of the subsequent adjustments by the Minimum Wage Commission on all of these variables was much smaller and therefore also more inconsistent.

In view of the causal findings thus far, numerous open questions remain. This concerns wage and working time effects for marginal groups in the labour market, which cannot be thoroughly examined causally due to the small number of cases in the GSOEP. Such causal studies can be carried out in future evaluations with data from the new Earnings Survey (ES), which was introduced in 2021. Another major problem is the valid measurement of working hours or, alternatively, the total lack of information on working hours in certain datasets. This limitation cannot be remedied retrospectively and will remain a major challenge for future minimum wage research. There is also hardly any evidence on the effects of the minimum wage on vocational training participation among young adults. At the company level, minimum wage-related changes in vocational training and further training are largely unexplored. Finally, there is hardly any evidence on the effects of the German minimum wage on consumer prices.

Research on the German minimum wage will now increasingly focus on current developments. These include the economic distortions caused by the coronavirus pandemic and the war in Ukraine as well as the (simultaneous) sharp increase in the minimum wage to 12 euros. A legislative increase in the minimum wage to 12 euros affected approximately 5.8 million employees and approximately 23 percent of the companies in Germany. It thus had a greater impact than the introduction of the minimum wage. Based on the previous minimum wage of 10.45 euros in July 2022, this represents an increase of approximately 15 percent. In real terms, this figure constituted an increase of approximately 13 percent. Depending on which data are used, the German minimum wage is now just below or just above the internationally used benchmark for adequate minimum wages of 60 percent of the median wage, which is also mentioned in the EU directive on adequate minimum wages in the European Union. Based on data for full-time employees from the ES, the minimum

wage amounted to approximately 56 percent of the median wage in October 2022. Using data for all employees from the same data source, the minimum wage reached approximately 63 percent of the median wage.

The economic environment and labour supply and demand have changed significantly since the introduction of the minimum wage. The German economy may not return to the growth rates observed from 2015 to 2018 in the foreseeable future. Moreover, countering the effects of sluggish economic growth, there is a shortage of labour throughout the entire economy due to demographic changes. Future research will thus have to answer the questions of how the increase in the minimum wage to 12 euros interacts with these changed conditions at the macro level and whether this increase has led to a continuation of previous minimum wage effects or whether its effects differ in nature and scope.

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