

Link, Sebastian

Working Paper

The price and employment response of firms to the introduction of minimum wages

CESifo Working Paper, No. 7575

Provided in Cooperation with:

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Link, Sebastian (2019) : The price and employment response of firms to the introduction of minimum wages, CESifo Working Paper, No. 7575, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:

<https://hdl.handle.net/10419/198935>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

The price and employment response of firms to the introduction of minimum wages

Sebastian Link

Impressum:

CESifo Working Papers

ISSN 2364-1428 (electronic version)

Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH

The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute

Poschingerstr. 5, 81679 Munich, Germany

Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de

Editor: Clemens Fuest

www.cesifo-group.org/wp

An electronic version of the paper may be downloaded

- from the SSRN website: www.SSRN.com
- from the RePEc website: www.RePEc.org
- from the CESifo website: www.CESifo-group.org/wp

The price and employment response of firms to the introduction of minimum wages

Abstract

This paper studies the price and employment response of firms to the introduction of a nation-wide minimum wage in Germany. In line with previous studies, the estimated employment effect is only modestly negative and statistically insignificant. In contrast, affected firms increased prices much more frequently. The price effect is prevalent across different sectors of the economy including manufacturing and is thus not limited to low wage industries. I document that speed and degree of price pass-through were high and firms rolled over the lion's share of the costs generated by the minimum wage to their customers. Consistent with the role of price pass-through, I find considerable heterogeneity in firms' responses to the minimum wage depending on their own business expectations, product market competition, and local labor market conditions.

JEL-Codes: J380, J080, E310, J310.

Keywords: price pass-through, heterogeneity in minimum wage effects, firm data, Germany.

*Sebastian Link
Ifo Institute – Leibniz Institute for
Economic Research
at the University of Munich
Poschingerstrasse 5
Germany – 81679 Munich
link@ifo.de*

March 18, 2019

For helpful comments and fruitful discussions I thank Lukas Buchheim, Marco Caliendo, Georg Dürnecker, David Neumark, Andreas Peichl, and Uwe Sunde as well as seminar participants at LMU Munich and the ifo Institute, the annual meeting of the European Economic Association in Lisbon, the annual congress of the Verein für Socialpolitik in Vienna, the annual meeting of the European Society for Population Economics in Antwerp, the EVA-MIN conference at DIW Berlin, and the 9th ifo Macro Survey Data Conference in Munich. I also thank the staff of the ifo-LMU Economics and Business Data Center for help with the data.

1. Introduction

Whether minimum wages lead to job losses or not has been an issue of intensive discussion among economists for decades (see e.g., Stigler, 1946; Card and Krueger, 1994; and Neumark and Wascher, 2000). While the debate on employment effects has not reached consensus yet, there is increasing evidence that a substantial share of minimum wage costs is passed through to prices (see Lemos, 2008 and MaCurdy, 2015 for reviews). However, the importance of the price pass-through channel has usually been documented in industries that employ a large share of low-wage workers, such as restaurants (e.g., Card and Krueger, 1994; Aaronson, 2001; Aaronson et al., 2008; and Fougère et al., 2010) and retailing (Renkin et al., 2017 and Leung, 2018). In contrast, there is only scant evidence that the pricing margin is of comparable importance for firms in other sectors that typically differ strongly in their competitive environment.

This paper provides a comprehensive analysis of the price effect of minimum wages that documents that price-pass through is a common pattern in large parts of the economy, presents novel evidence on heterogeneity in firms' responses to minimum wages, and performs an analysis of price adjustment dynamics at monthly frequency. Thereby, this paper is the first to jointly examine the price and employment response of firms to the introduction of a statutory nation-wide minimum wage in Germany in 2015 (henceforth, NMW). The German NMW offers a unique opportunity to evaluate the reaction of firms to minimum wages because it directly affected more than 10% of all employment relations (Destatis, 2016).¹ While existing studies on the effects of minimum wages usually draw on a selected sample of low-wage sectors with sufficient variation in its bite, the NMW can hence be exploited to generalize these findings to firms in different sectors of the economy. In addition, the German NMW allows for the analysis of heterogeneity in responses to the NMW depending on their business expectations, product market competition, and local labor market conditions that have widely been neglected by the literature, so far.

The price effect of the German NMW has not been studied so far as micro data on producer prices are not available. I circumvent this constraint by making use of the ifo Business Survey (IBS). This representative survey is unique in asking a panel of approximately 5000 German manufacturing firms and service companies about their planned changes in prices and employment at monthly frequency. Despite of the qualitative nature of the questions, the IBS data closely track actual changes at the industry level. The IBS is thus ideally suited for a joint assessment of the minimum wage-induced price and employment response of firms in all relevant industries of the economy.

The reaction of firms to the NMW is estimated in a difference-in-differences design with continuous treatment. Using administrative wage data, the firm-specific treatment intensity is proxied by the fraction of full-time employees in each firm's industry and location that was affected by the NMW. This bite measure is not only strongly correlated with alternative indicators using other sources of wage data, but also captures whether or not firms perceive themselves as being affected by the NMW.

¹In contrast, at most 7% of covered workers were directly affected by each change in federal or state level minimum wages in the U.S. between the mid-1980s and 2014 (see Autor et al., 2016).

The estimation reveals a strong minimum wage effect on prices across firms in different sectors of the economy. While the frequency of planned price increases is not correlated with the bite of the NMW prior to the reform, this relationship is strong and significantly positive during the period around the introduction in January 2015. Using additional information on realized price changes provided by a subset of firms shows that firms not only planned to increase their prices in response to the NMW, but also implemented these changes. Given the same bite, the price reaction of firms is equally strong in manufacturing and services as well as in West and East Germany. Hence, the price pass-through channel constitutes an important margin of adjustment for firms in sectors that have not been covered by a large part of the minimum wage literature, so far.

Moreover, the data show that speed and degree of price pass-through were remarkably high. The monthly frequency of the IBS data allows for a detailed inspection of the adjustment dynamics. According to this, 70% of the NMW-induced price adjustment took place during the 12 months around its introduction. In addition, the strong correlation between aggregated IBS data and quantitative changes in industry-level producer price indices is exploited to approximate the effect of the NMW on the overall level of producer prices. A back-of-the-envelope calculation yields that prices in manufacturing and services were raised by approximately 0.24% in consequence of the NMW. In comparison, if firms had fully complied to the NMW and held their employment structure constant, this would have implied an overall cost increase of 0.29%. Hence, firms reacted to a 1%-increase in implicit costs induced by the NMW by raising prices by 0.82%. Thus, firms have rolled over the lion's share of the costs generated by the NMW to their customers.

In contrast to the strong and sizable effect on prices, the estimated NMW effect on planned employment changes is only moderately negative and insignificant throughout all empirical specifications. In light of potential measurement error in the firm-specific bite measure, however, a negative employment reaction cannot be ruled out completely. As the same argument applies to the estimated price effect, the results show that affected firms were much more likely to increase prices in response to the NMW instead of cutting employment.

Lastly, the paper presents new evidence on heterogeneity in firms' responses to the NMW depending on the competition they face in the product market and local labor market as well as their business expectations. First, the price effect is stronger—and the employment response slightly muted—if firms' export share is smaller, their goods and services are traded more locally, and competition through imports is lower. These firms have a larger scope to pass-through the costs of the NMW to their customers because they are less likely to face foreign or domestic competitors that are either unaffected or hit less strongly by the German NMW. Second, the employment response is significantly more negative for a given bite of the NMW if firms did not report labor shortages or if they were located in counties with higher unemployment rates or less tight labor markets, respectively. Third, the disemployment effect associated with the NMW is significantly negative for firms that have worse business expectations. In turn, these firms raised prices less frequently given the same bite.

The main contribution of the paper is to provide the most comprehensive assessment of pass-

through of minimum wages to prices comprising of (1) the generalization of existing evidence from highly affected industries to other sectors of the economy, (2) the presentation of novel evidence regarding heterogeneity along several dimensions, and (3) the evaluation of adjustment dynamics at monthly frequency. In this regard, the paper is closest to Harasztosi and Lindner (2019) who provide a detailed assessment of a large minimum wage increase in Hungary in 2001 along several margins of adjustment and show that 75% of its costs were paid by consumers via higher revenues. They restrict their main analysis to responses in revenues due to a lack of price data for services firms and only document a direct effect on prices for the subset of manufacturing firms. In contrast, I observe price responses of firms in all industries at monthly frequency. This allows for a direct comparison of the price response of manufacturers and services firms as well as for a more detailed inspection of the adjustment dynamics.² Moreover, Harasztosi and Lindner (2019) is the only other paper that (indirectly) examines heterogeneity in the price effect of minimum wages. They document a smaller revenue effect for firms in tradable, exporting, and manufacturing sectors. While my findings coincide with their first and second result, I do not find that manufacturing firms *per se* increased prices less frequently compared to services firms that were affected by the NMW to a similar degree. In addition, my results indicate that heterogeneity in industry-specific import pressure, local labor market conditions, and firms' business expectations are important in understanding their responses to minimum wages.

Specifically, my findings generalize the existing evidence on price effects of minimum wages by documenting that price pass-through is a commonly observed pattern across large parts of the economy and that firms in both manufacturing and services sectors roll over the lion's share of the NMW costs onto their customers. Although the view that higher minimum wages come along with higher prices is widely accepted (MaCurdy, 2015), earlier studies in favor of price pass-through usually draw on a selected sample of low-wage industries such as restaurants (e.g., Card and Krueger, 1994; Aaronson, 2001; Dube et al., 2007; Aaronson et al., 2008; Fougère et al., 2010; and Allegretto and Reich, 2018) and retailing (Renkin et al., 2017 and Leung, 2018). While many of these papers document (close to) full pass-through of costs to prices, the evidence on price effects in other sectors is sparse and less clear.³

In addition, the paper contributes to the literature investigating the speed of price adjustments to changes in minimum wages and comparable shocks. Detecting a prolonged positive effect on prices that is strongest during the months around the NMW introduction, my results range between those of Aaronson (2001) and Aaronson et al. (2008), who both find evidence in favor of immediate pass-through for restaurants in the U.S., and those of Fougère et al. (2010), who document that minimum

²Harasztosi and Lindner (2019) use annual data and find that the price effect in the manufacturing sector took more than two years to turn significantly positive in accumulated terms. As summarized below, my results for German firms suggest a faster price adjustment compared to their case that is more in line with existing evidence from low-wage sectors as well as cost shocks of comparable nature.

³Machin et al. (2003) and Draca et al. (2011) show that price affects have been absent in the heavily affected, but price-regulated British residential care industry. Moreover, Wadsworth (2010) does not find significant price effects in several low-wage industries in response to increases in the British national minimum wage based on industry-level price data. See Lemos (2008) for a survey.

wages take more than twelve months to fully pass through to French restaurant prices. Taking a broader perspective, my findings add to evidence in favor of relatively fast price pass-through in response to shocks of comparable nature, such as sales tax increases (Besley and Rosen, 1999), changes in exchange rates (Yang, 1997; Campa and Goldberg, 2005; and Gopinath et al., 2010), and emission costs in electricity markets (Fabra and Reguant, 2014).

Furthermore, the results of this paper are in line with other studies on the labor market consequences of the German NMW that add to the extensive literature on employment effects of minimum wages (see, e.g., Neumark et al., 2014 and Card and Krueger, 2015 for recent surveys). Despite of the large size of the minimum wage shock and consistent with my results, the effect of the NMW on overall employment is either found to be zero (e.g., Garloff, 2016 and Ahlfeldt et al., 2018) or negative, but small (e.g., Caliendo et al., 2018 and Bossler and Gerner, 2019).⁴ Thus, the evidence from Germany is comparable to Jardim et al. (2017) and Harasztosi and Lindner (2019) who also find small disemployment effects following very large changes in minimum wages in Seattle and Hungary, respectively. Taken together, this alleviates the concern that the small short-run employment effects documented in a prominent strand of the literature merely reflect adjustment costs à la Chetty et al. (2011) as these studies usually feature only small variations in minimum wages.

By highlighting the important role of price pass-through relative to employment adjustments, the paper also adds to an emerging literature that examines the effect of minimum wages on other margins of adjustment than employment. For example, some studies have emphasized that labor market flows and employment growth rates reacted more strongly to minimum wages than employment stocks (Portugal and Cardoso, 2006; Brochu and Green, 2013; Dube et al., 2016; Meer and West, 2016) and that the profitability and stock market value of firms suffer from minimum wages (Draca et al., 2011; Bell and Machin, 2018). Moreover, the literature has provided evidence that affected firms reacted to minimum wages via non-compliance (Metcalf, 2008), tax evasion (Tonin, 2011), or substitution of jobs by machines (Lordan and Neumark, 2018). Taken together, this suggests that an assessment that is not limited to the employment margin but that also accounts for different potential adjustment channels is important to gain a comprehensive understanding of firms' response to minimum wages.

The remainder of the paper is structured as follows. Section 2 provides information about the institutional background of the German NMW introduction in 2015. Section 3 describes the data and Section 4 specifies the empirical strategy. Section 5 presents the main results regarding minimum wage effects on firms' pricing and employment including a back-of-the-envelope approximation of the quantitative size of the price effect. Then, Section 6 examines the heterogeneity in responses to the NMW. Finally, Section 7 performs diverse robustness checks and Section 8 concludes.

⁴See Caliendo et al. (2019) for a survey on the German NMW. In general, job loss has been more severe for marginally employed workers compared to regular employment. Among all studies, Caliendo et al. (2018) estimate the strongest disemployment effects: a reduction in the number of full- and part-time jobs by 78,000 ($\sim 0.3\%$ of all regular jobs) and a loss of roughly 180,000 marginal employment relations ($\sim 2.4\%$ of all "mini-jobs"). Still, these effects are much smaller than anticipated ex ante by Müller and Steiner (2013) and Knabe et al. (2014) who predicted a long run employment loss between 500,000 and more than one million.

2. The German Reform as Unique Framework for Minimum Wage Evaluation

Institutional Background The German NMW was implemented at a gross wage of €8.50 per hour on January 1, 2015. The introduction of a wage floor that is binding for the vast majority of employment relations constituted a paradigm shift in the history of German labor market policy. Previously, wages had been determined almost exclusively through collective bargaining agreements between unions and employer associations. Consequently, minimum wages were only in force in a small number of industries provided that a wage floor, which was part of a collective bargaining agreement, was declared as binding for the rest of the industry.⁵

In general, the NMW applies to firms in all industries. As an exemption, firms in sectors with industry-specific minimum wages below €8.50 were conceded to delay their compliance to the NMW until the end of 2016.⁶ In order to prevent malpractice, the NMW law was accompanied by strict obligatory requirements for firms to document daily working hours of each employee with a gross monthly wage below €2,958.

The NMW was implemented in the following way: after the federal election of September 22, 2013, the chairmen of the conservative parties (*CDU* and *CSU*) and the social democrats (*SPD*) signed a coalition agreement on November 27, 2013 that contained the intention to introduce a statutory minimum wage of €8.50 on January 1, 2015. The Federal Cabinet proposed the respective minimum wage law ("*Mindestlohngesetz*" *MiLoG*) on April 2, 2014, including all relevant regulations regarding its introduction and details on the exemptions. Based on the comfortable majority of the "Grand Coalition" in both chambers of parliament, *Bundestag* and *Bundesrat* approved the law on July 3 and July 11, 2014 without major changes. After its introduction, the NMW remained constant until January 2017 when it was increased to an hourly rate of €8.84.

Unique Framework for Evaluation of Minimum Wage Effects From an international perspective, the case of Germany offers a unique setting for the evaluation of the response of firms to minimum wages because it strongly increased labor costs for firms in many different sectors of the economy. This is due to the fact that the German NMW was directly set to a relatively high level that corresponds to a minimum-to-median wage ratio of 0.48—a level that is lower than in France (0.62), close to the U.K. and the average across OECD countries (0.49), and much higher than in the U.S. (0.36), see OECD (2015). While the Kaitz indices of the national minimum wage have been historically quite stable at low levels in the U.S. and high levels in France, the British statutory minimum wage has been introduced at a lower level (0.42) in 1999 and was steadily increased

⁵Prior to 2015, industry-specific minimum wages had been in place for instance in the construction and roofing sector, in commercial cleaning, security, and laundry services, as well as in some handicraft sectors. In contrast to the NMW, they were allowed to differ between regions. See Fitzenberger and Doerr (2016) for a survey on the evidence regarding industry-specific minimum wages in Germany.

⁶These sectors include agriculture, forestry, gardening, the meat industry, manufacturing of textiles and clothing, temporary work agencies, hair dressers, and laundries. There are additional exemptions from the NMW for long-term unemployed during the first six months of re-employment, teenagers without training qualification, employees in vocational training, and internships compulsory for school programs, apprenticeship, or academic studies.

thereafter. Hence, none of these most extensively studied countries observed variation in minimum wages during the last decades that was comparable to the case of the introduction of the NMW in Germany.

Consequently, the average “bite” of the German NMW was comparably very large. Prior to the introduction, 4.0 million employees (10.7% of all jobs) that were eligible to the NMW earned less than €8.50 per hour (Destatis, 2016). On average, the group of affected employees earned approximately €7.20 per hour in 2014. In order to fully comply to the NMW, firms therefore needed to increase the wages of affected employees by 18%, *ceteris paribus*, which corresponds to an increase in the overall wage bill of the economy by 0.43% (Destatis, 2016; Mindestlohnkommission, 2018). As documented in Section 4.1, the German NMW hence strongly affected firms in many different sectors of the economy.

Compared to existing literature based on changes in minimum wages in other countries, the German minimum wage reform thus allows to study the price and employment response of firms in a much broader setting without restricting the analysis to highly affected industries such as restaurants or highly affected groups such as young workers or teens, only.

3. Data

To evaluate the price and employment response of firms to the NMW requires micro data along both margins for firms in all relevant sectors of the economy. This is particularly restrictive for prices as the micro data of the German producer price index are not available for research purposes.⁷ I circumvent this constraint by making use of the micro data of the ifo Business Survey (IBS). This survey is unique in repeatedly asking a large panel of approximately 5000 German manufacturing firms and service companies, *inter alia*, about their planned and realized changes in prices and employment at monthly frequency. As documented in Bachmann et al. (2019) and in the analysis below, the survey data on prices closely track *quantitative* changes in industry-specific producer price indices despite of their qualitative nature. The IBS thus provides the best firm-specific price data available to study the price pass-through of German firms.⁸

In order to assess the firm-level effects of the NMW in the relevant sectors of the economy, I use the IBS data for the subset of manufacturing firms (IBS-IND, 2017) and service companies (IBS-SERV, 2017).⁹ Firms that operate in industries that were allowed to pay wages below the NMW

⁷In contrast, the CPI micro data are available at the “Research Data Centers” of the Federal Statistical Office. However, these prices cannot be linked to the location of the firm, which is essential to identify the NMW bite.

⁸In contrast to the unique nature of the IBS price data, the quality of the employment data is inferior to other sources. For example, the “IAB Establishment Panel” used by Bossler and Gerner (2019) contains quantitative data on firm-level employment. However, this data neither contains prices nor can be matched to the IBS. Still, the IBS employment data are useful to replicate the finding of Caliendo et al. (2018) and Bossler and Gerner (2019) that the NMW only had a modestly negative effect on the employment level.

⁹The IBS has been conducted since 1949 in order to construct the ifo Business Climate Index which is the most recognized lead indicator for economic activity in Germany. According to Sauer and Wohlrabe (2019), the survey is usually filled by informed personnel such as managing directors and department heads. The IBS is divided into four industry surveys that cover the main sectors of the economy (manufacturing, services, retail/wholesale, construction). I do not use data from the construction survey because these sectors were already covered by an

during a transition phase until the end of 2016 are omitted from the sample.¹⁰ Restricting the data to January 2011 until December 2017 as well as to firms that responded at least twelve months to the survey, the data set comprises of on average 4500 firms per month (2300 manufacturers and 2200 service companies).¹¹ Attrition is very low in the restricted data set (on average, firms are observed for 5.5 years within these 7 years) and the ifo Institute puts effort to maintain a sample of firms that is representative of the German economy by finding suitable new respondents to replace exiting firms. Response rates to the survey are relatively high despite of the fact that participation is voluntary (firms answer the questionnaire in 84% of months on average).

The anonymized micro data of the IBS allow to track firms over the entire time span in the sample. The data contain information on firms' main sector of business following the standard German industry classification system of 2008 (WZ 08) which largely corresponds to the European NACE Rev. 2 classification. In addition, I gained access to confidential information about the firms' location at the level of counties. Hence, the firms in the IBS can be merged to disaggregate wage data at the level of industries and counties as described in Section 4.1 which is crucial for the identification of the bite of the NMW.

The analysis of NMW effects mainly focuses on the following questions regarding expected changes in prices and employment:¹²

Q1 *“Expectations for the next 3 months: The prices of our goods/services will [1] increase, [0] stay the same, or [-1] decrease.”*

Q2 *“Expectations for the next 3 months: The number of employees will [1] increase, [0] stay the same, or [-1] decrease.”*

In addition, the subset of manufacturing firms reports realized price changes and services companies provide information on realized employment changes:

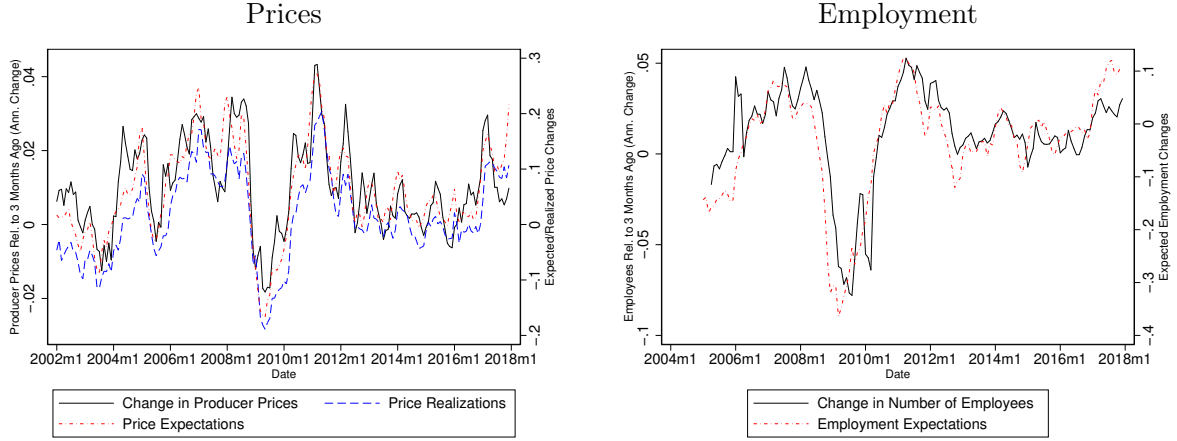
industry-specific minimum wage above the NMW. Moreover, retailers and wholesalers are excluded because the direct effect of the NMW through higher labor costs cannot be disentangled from price increases of the products they sell, which have potentially been produced by firms affected by the NMW.

¹⁰Specifically, I exclude firms in the two-digit industries WZ08-13 “Manufacture of textiles,” WZ08-14 “Manufacture of wearing apparel,” WZ08-78 “Temporary employment agencies and other employment activities,” WZ08-96 “Other personal service activities” (85% of all employees belong to WZ08-9602 “Hairdressing”) as well as the three-digit industry WZ08-101 “Processing and preserving of meat and production of meat products.” These firms cannot be used as a control group as their industry-specific minimum wages have been increased in steps during the treatment period to approach the level of the NMW by the end of 2016.

¹¹The micro data do not allow to discriminate between subsidiaries of the same company in different locations and other firms. The term “firm” used in this paper hence refers to both types of entities. Moreover, the manufacturing survey is at the product level. However, only 0.3% of all observations between 2011 and 2017 refer to multiple products of the same firm at a given point in time. Following the procedure described in Link (2018), these observations are aggregated to the firm level by taking means across products and rounding to the next integer. Moreover, firms in the services survey have been coded with respect to the older “WZ 03” classification scheme until March 2011. The assignment of these firms to the “WZ 08” system is described in Link (2018).

¹²The wording of the questions slightly differs between both surveys but is largely comparable. See Appendix A.1.1 for the translated questions. Moreover, firms' current backlog of orders is used to control for demand measured as “[1] comparatively large, [0] sufficient (typical for the season), or [-1] too small.” Further, the NMW effect on firms' current business conditions being either “[1] good, [0] satisfactory, or [-1] bad” as well as their expected business conditions in the next six months or production and demand expectations in the next three months is examined in Section 5.

Figure 1: Fit Between Aggregated Survey Data and Quantitative Changes in Price and Employment



Notes: The left (right) figure plots time series of the realized change in producer prices $\Delta \overline{PPI}_t$ (in the number of employees $\Delta \overline{Empl}_t$) in the manufacturing sector relative to three months before (solid line; left axis) against mean reported price expectations/realizations (employment expectations) of firms in the manufacturing survey of the IBS (dashed lines; right axis). The German Federal Statistical Office provides producer price indices and employment data for two-digit industries. For aggregation, the time series are weighted by the average share of firms per sector in the IBS. $\Delta \overline{Empl}_t$ is seasonally adjusted using month fixed effects. As documented in Appendix Table A.3, the correlation between $\Delta \overline{PPI}_t$ and mean price expectations is highest at the first lag of expectations ($\rho = 0.85$), while the correlation with price realizations is highest at contemporaneity ($\rho = 0.82$). Comparably, the correlation between $\Delta \overline{Empl}_t$ and employment expectations is highest if employment expectations are lagged by 2 months ($\rho = 0.80$).

Q1a “During the past month, the domestic (net) sales price [1] increased, [0] stayed the same, or [-1] decreased.” [only asked in manufacturing survey]

Q2a “During the past (2-3) months, the number of employees [1] increased, [0] stayed the same, or [-1] decreased.” [only asked in services survey]

In general, firms stick to their pricing and employment plans. Pesaran and Timmermann (2009) show that the price expectations of manufacturing firms are highly predictable for the realized price changes reported to the IBS in the subsequent months. In line with this, Appendix Tables A.1 and A.2 document that approximately 80% of manufacturing firms (67% of services companies) report realized price (employment) changes between months $t + 1$ and $t + 3$ that are in line with their expectations in month t . As shown in Section 5.2, the estimated NMW effects are comparable irrespective of using expected or realized changes in the respective sub-sample of firms. Therefore, the baseline estimation of the NMW effects uses price and employment expectations, which are available for all firms in the sample.

Importantly, the qualitative price and employment changes reported to the IBS on average closely track *quantitative* price and employment changes observed in administrative data. For the subset of manufacturing firms, Figure 1 plots the average answers to Q1 ($\overline{\text{Price Exp.}}_t^{+3m}$), Q1a ($\overline{\text{Price Realiz.}}_t^{-1m}$), and Q2 ($\overline{\text{Empl. Exp.}}_t^{+3m}$) against the change in producer prices ($\Delta \overline{PPI}_t$) and the number of employees ($\Delta \overline{Empl}_t$) relative to the level three months before, respectively.¹³

¹³The German Federal Statistical Office provides time series of producer price indices ($PPI_{s,t}$) and the number of

As documented in Appendix Table A.3 , the time series correlation between $\Delta \overline{PPI}_t$ and average price expectations in the IBS is highest if price expectations are lagged by one month ($\rho(\overline{\text{Price Exp.}}_{t-1}^{+3m}, \Delta \overline{PPI}_t) = 0.85$), while the correlation with average price realizations is highest at contemporaneity ($\rho(\overline{\text{Price Realiz.}}_t^{-1m}, \Delta \overline{PPI}_t) = 0.82$).¹⁴ Comparably, the correlation between $\Delta \overline{Empl}_t$ and average employment expectations is highest if employment expectations are lagged by 2 months ($\rho(\overline{\text{Empl. Exp.}}_{t-2}^{+3m}, \Delta \overline{Empl}_t) = 0.80$). In light of the strong correlation with administrative data, the survey questions appear to be useful indicators of firms' pricing and employment policies.

Restricting the time series underlying Figure 1 to the time frame covered by the empirical analysis, I estimate semi-elasticities that map qualitative survey responses to quantitative changes in producer price indices.¹⁵ They are defined as follows

$$\hat{\psi}^{Exp} := \frac{d\Delta \overline{PPI}_t}{d\overline{\text{Price Exp.}}_{t-1}^{+3m}} = 0.130 \quad \text{and} \quad \hat{\psi}^{Realiz} := \frac{d\Delta \overline{PPI}_t}{d\overline{\text{Price Realiz.}}_t^{-1m}} = 0.144. \quad (1)$$

Hence, an appreciation of average price expectations (realizations) in the IBS by 0.1 that lasts twelve months corresponds to an increase in producer prices by roughly 1.6 (1.7) percentage points.

4. Empirical Strategy

4.1. Identification of Firms' Affectedness by the Minimum Wage

In order to evaluate the reaction of firms to the NMW, the degree to which each firm is affected needs to be identified. Unfortunately, the IBS does not include any information about wages or labor costs at the firm level. I circumvent this constraint by following the minimum wage “bite” approach in the tradition of Card (1992), which is a standard method for the identification of heterogeneity in treatment intensity based on the variation in the fraction of affected workers across different groups, regions, or industries. Accordingly, the firms in the IBS are matched to administrative wage data of full-time employees in their sector and location. The treatment intensity specific to each firm i

employees ($Empl_{s,t}$) at the level of two-digit industries s in the manufacturing sector. The indices are weighted by the average share of firms in the respective sector of the IBS (ω_s) in order to get an aggregate time series that is representative for the manufacturing firms in the sample, i.e., $\overline{PPI}_t = \sum_s \omega_s PPI_{s,t}$. The employment time series is purged by month fixed effects for seasonal adjustment. For services, producer prices are only available at quarterly frequency and at heterogeneous aggregation levels for a small number services that are mostly industry-related. In turn, CPI data for services are not useful for my analysis because they are not limited to domestic service providers and cannot be linked to the the “WZ 08” classification system.

¹⁴Note that the aggregate price change relative to three months in the past ($\Delta \overline{PPI}_t$) fits the average survey data on price realizations better than monthly changes in \overline{PPI}_t , see Appendix Table A.3. Moreover, it is unreasonable to map qualitative survey responses to changes in producer price indices separately for each industry because the number of firms per sector is usually too low in the IBS. As can be inferred from Appendix Table A.4, however, the cross-correlations and semi-elasticities in the three two-digit industries that cover the highest number of firms are qualitatively comparable and of roughly equal size as for all manufacturing firms. In sectors with fewer firms, the correlations between $\overline{\text{Price Exp.}}_{s,t}^{+3m}$ and $\Delta \overline{PPI}_{s,t}$ are weaker due to the trichotomy of the survey data.

¹⁵The close relationship between the IBS data and quantitative changes in producer prices is exploited in a back-of-the-envelope calculation in Section 5.3 in order to approximate the quantitative size of the minimum wage-induced price effect.

(TI_i) is then proxied by the fraction of affected employees in the respective region-industry cell.

Construction of Bite Measure The bite measure is based upon data on the wage distribution of full-time employees in each two-digit industry at the level of counties (NUTS-3 regions) as well as labor market regions (LMRs) from the administrative remuneration statistic (“*Entgeltstatistik*,” henceforth “RS”).¹⁶ The data is collected by the Federal Employment Agency (FEA) via the reporting procedure of the social security system (“*Meldeverfahren zur Sozialversicherung*”) and thus covers all employees prone to social security in Germany. Based on this, the FEA provided me with the deciles of the distribution of gross monthly wages of full-time employees in each industry-region cell that contained at least 1000 full-time employees (Federal Employment Agency, 2016).¹⁷ Despite of this data protection restriction, the wage data at the level of two-digit industry*county-cells cover 68.8% of all full-time employees in Germany. At the level of LMRs, 92.3% of full-time employees can be assigned to the wage distribution in their industry. The baseline specification therefore uses the industry-specific wage distribution at the county level and replaces missing values by wage data at the level of LMRs. The robustness checks presented in Section 7, which solely use wage data either at the level of counties or at the level of LMRs, show that the results do not hinge on this choice.

TI_i is calculated as the fraction of full-time employees that earned a gross wage below the NMW of €8.50 per hour in each firm’s industry and location in the year prior to its introduction. The choice of the 2014 wage distribution is justified by the findings of Caliendo et al. (2018) who show that anticipation effects in wages were absent and wages followed a common trend before the NMW reform using wage data from the German Socio-Economic Panel (SOEP). As demonstrated in Section 7, the results do not change once TI_i is instead based on 2013 wages. Appendix A.2.1 describes the calculation of TI_i in detail and discusses the assumptions regarding the shape of the wage distribution in the area below the first decile, which do not drive the results as demonstrated in the robustness checks of Section 7. Following this procedure, 84.2% of firms in the data set can be assigned to a firm-specific bite measure.

Validity of Bite Measure In order to be a valid proxy for the firm-specific NMW bite, TI_i should meet the following three requirements: First, TI_i should capture the degree to which full-time employees are affected by the NMW sufficiently well despite of the assumptions underlying its construction and despite of the fact that the wages of 6.7% of full-time employees are not covered by the RS data. Second, TI_i should not only reflect the variation in the bite with respect to full-time

¹⁶There are 96 labor market regions (“*Raumordnungsregionen*”) in Germany that typically describe commuting zones consisting of on average 4 out of a total number of 402 counties (295 “*Landkreise*” and 107 “*kreisfreie Städte*”). Close to my specification, Garloff (2016) uses the RS data to construct bite measures of full-time employees at the level of LMRs, age-cohorts, and gender in order to analyze the relationship between (un-)employment growth and the regional bite of the NMW.

¹⁷Every firm is required by law to report the gross wage that each employee earned in a given year as well as information on the duration of the employment relation and whether the employee worked full-time or part-time. As the reports do not contain detailed information on hours worked, the FEA only provides data on gross monthly wages of full-time workers.

Table 1: Bites Calculated from Remuneration Statistic vs. Structure of Earnings Survey

Wage Data	Remuneration Statistic	Structure of Earnings Survey	
Source	Federal Empl. Agency	Federal Statistical Office	
Employees Covered	Full-Time only	All Types	
Representativeness at Region*Sector Level	yes	no	
<i>Panel A: Fraction of Workers Affected By MW in Manufacturing and Services Sectors Prone to MW</i>			
Fraction of Eligible Workers w/ $w < \text{€}8.50$			
All Employees		0.107	
Full-Time Employees	0.039	0.039	
<i>Panel B: Correlation b/w Bite Measures at Region*Sector Level</i>			
Correlation	TI	$TI^{SES,FT}$	$TI^{SES,all}$
TI	1	.	.
$TI^{SES,FT}$	0.871	1	.
$TI^{SES,all}$	0.886	0.894	1

Notes: This table compares the baseline bite measure TI based on wage data for full-time employees from the Remuneration Statistic (RS) to alternative measures using wage data from the Structure of Earnings Survey (SES) for full-time employees ($TI^{SES,FT}$) and all employees ($TI^{SES,all}$). Panel A summarizes the nationwide fraction of workers affected by the NMW in manufacturing and services sectors prone to the NMW in the group of all workers as well as restricted to full-time employees. Panel B provides the correlations between these bite measures calculated for each two-digit industry*LMR cell for which RS data are available and the SES contains at least 100 employees.

employees, but should also capture the increased wage costs for all types of employment relations. Third, the degree to which firms were affected by the NMW should be reflected by the bite in its industry and location.

To tackle the first concern, the overall NMW bite calculated from RS data is compared to results based on individual wage data of the 2014 wave of the Structure of Earnings Survey (SES). The micro data of the SES contain detailed individual-level information on income and working hours for a set of one million workers employed in 60 000 firms that is representative at the level of federal states and two-digit industries. In contrast to the RS data, the SES allows to determine the overall bite of the NMW for different groups of workers by directly examining hourly wages of individuals and without imposing assumptions on the shape of the wage distribution. Strikingly, both the SES and RS data deliver the same bite of 3.9% affected workers in the subset of full-time employees in the manufacturing and services sectors prone to the NMW, see Panel A of Table 1.

In addition, the SES allows for the construction of alternative bite measure along the same lines as TI_i , i.e., the fraction of affected full-time employees that earned less than €8.50 in 2014 in each firms sector and location ($TI_i^{SES,FT}$). In this respect, however, the SES data have at least two disadvantages relative to the RS data: first, the SES data are not representative at the level of LMR*industry cells (and below) while the RS by construction covers all full-time employees. Second, $TI_i^{SES,FT}$ can only be constructed for less than half of the manufacturing and services firms in the IBS sample even if the SES data are required to cover a minimum of 100 employees in each LMR*industry

Table 2: Plausibility Check of the Treatment Intensity Measure

	Treatment Intensity $TI \in$		
	[0%]	(0%,20%]	(20%,100%)
$prob(\text{"Affected"} = 1)$	0.172	0.379	0.753
$prob(\text{"Plan to Adjust Business"} = 1 \text{"Affected"} = 1)$	0.472	0.551	0.822
$prob(\text{"Do Not Plan to React"} = 1 \text{"Affected"} = 1)$	0.528	0.449	0.178

Notes. “ TI ” refers to the fraction of full-time employees that earned an hourly gross wage of less than €8.50 in 2014 in each firm’s two-digit industry and region. $prob(\text{"Affected"} = 1)$ displays the probability that a firm responded to be “affected” by the minimum wage in the special questions of the IBS in November 2014 depending on its proxied treatment intensity as indicated at the top of each column. $prob(\text{"Plan to Adjust Business"} = 1 | \text{"Affected"} = 1)$ captures the frequency that “affected” firms stated to plan to react in at least one of the following ways: reduction in staff, reduction in working hours, price increases, decreased investment volume, cuts in bonus payments, or other action. $prob(\text{"Do Not Plan to React"} = 1 | \text{"Affected"} = 1)$ is defined accordingly.

cell, only. Despite of these disadvantages, the correlation of TI_i and $TI_i^{SES,FT}$ —calculated for each LMR*industry combination for which RS data are available and the SES contains at least 100 employees per cell—is very high ($\rho(TI_i, TI_i^{SES,FT}) = 0.87$). Taken together, the RS data thus appear to plausibly capture the NMW bite for full-time employees despite of missing data for 7% of workers and despite of the assumptions made when constructing the measure.

The second concern is eased by showing that TI_i does not only reflect the bite for full-time employees, but also captures the degree to which firms in specific industry-region cells were affected by increased wage costs for all types of employment relations. This is crucial because part-time employees and marginally employed workers were on average more strongly affected by the NMW than full-time employees.¹⁸ To cope with this, the SES data are used to construct the additional bite measure “ $TI_i^{SES,all}$ ” that equals to the fraction of all employees—including part-time and marginally employed workers—that earned less than €8.50 in 2014. Again, $TI_i^{SES,all}$ is only calculated for LMR*industry cells with at least 100 employees in the SES data. As summarized in Panel B of Table 1, the correlation between TI_i and $TI_i^{SES,all}$ is strikingly high ($\rho(TI_i, TI_i^{SES,all}) = 0.89$).¹⁹

Lastly, I provide evidence that TI_i is strongly correlated with firms’ self-assessment of being affected by the NMW. For this purpose, I analyze a special survey regarding the upcoming NMW introduction that supplemented the IBS in November 2014. Specifically, firms were asked whether they were affected by the new regulation and how they planned to react in case of being affected, e.g., whether they planned to reduce their workforce or working hours, to cut bonus payments or

¹⁸In the SES data, the number of workers in manufacturing and services sectors that earned less than €8.50 in 2014 was higher among all employees eligible to the NMW (10.7%) compared to the group of full-time employees (3.9%). In these sectors, 61% of jobs were full-time, 25% part-time, and 14% marginally employed. Assuming full compliance to the NMW and holding the employment structure constant, the overall wage bill of firms in these sectors would have had to be increased by 0.44% due to the NMW. In this scenario, full-time employees would have been responsible for 40% of this implicit wage bill increase.

¹⁹As shown in Section 7, the main results of the paper are robust to using $TI_i^{SES,all}$ or TI_i calculated based on thresholds above €8.50 in order to capture firms in industry-region cells that paid full-time employees more than €8.50 per hour but arguably needed to increase wages of part-time employees and marginally employed workers.

Table 3: Variation in Treatment Intensity Across Firms

	Total		Manufacturing		Services		West Germany		East Germany	
	# Firms	%	# Firms	%	# Firms	%	# Firms	%	# Firms	%
Firms	3838	.	2043	.	1795	.	3303	.	535	.
$TI = 0$	2809	73.2	1700	83.2	1109	61.8	2634	79.7	175	32.7
$TI \in (0, 0.1)$	544	14.2	228	11.2	316	17.6	361	10.9	183	34.2
$TI \in (0.1, 0.2)$	295	7.7	82	4.0	213	11.9	208	6.3	87	16.3
$TI \in (0.2, 0.3)$	96	2.5	15	0.7	81	4.5	55	1.7	41	7.7
$TI \in (0.3, 0.5)$	77	2.0	13	0.6	64	3.6	44	1.3	33	6.2
$TI \in (0.5, 1)$	17	0.4	5	0.2	12	0.7	1	0	16	3.0
Mean TI	0.034		0.016		0.053		0.024		0.097	
Mean TI if $TI > 0$	0.125		0.097		0.139		0.115		0.145	

Notes: Distribution of firms (in January 2015) across different groups of treatment intensity as captured by the fraction of full-time employees in their two-digit industry and region that earned less than €8.50 per hour in 2014.

investment volumes, or to increase prices.²⁰ As sketched in Table 2 and documented in further detail in Appendix A.2.2, the frequency that firms stated to be affected by the NMW increases substantially in TI_i . Only 17% of firms perceived themselves as “affected” if they operated in sector-region combinations in which no full-time employee earned less than €8.50 in 2014. This fraction increases to 75% for firms in sector-region cells with more than 20% of full-time employees being treated. Moreover, the planned reaction of firms that perceive themselves as “affected” despite of $TI_i = 0$ differed strongly from their counterparts with $TI_i = 0$. While more than 80% of firms with $TI_i > 0.2$ planned to react to the NMW anyhow, the majority of firms that reported to be affected by the NMW despite of $TI_i = 0$ did not plan to react. Arguably, the later group was only affected indirectly by the NMW or perceived themselves as being affected because of the obligatory and time-consuming documentation requirements.²¹

Overall, the evidence presented confirms that TI_i plausibly captures the degree to which firms are affected by the NMW through its effect on labor costs.

Variation of Treatment Intensity Across Firms The treatment intensity measure captures a substantial degree of variation in the bite of the NMW across firms, see Table 3. According to TI_i , 27% of firms in the sample were affected at least to some degree. Among firms with $TI_i > 0$, roughly one in two (one in five) of the affected firms had to increase wages of more than 10% (20%) of their full-time employees due to the NMW, *ceteris paribus*. Moreover, there is a sufficient degree of variation in TI_i that allows for separate analyses of firms in different sectors or regions. In general,

²⁰As discussed in Appendix A.2.2, the special survey neither asks for treatment intensity, nor contains information about the channels through which firms are affected. Moreover, the questions regarding firms’ planned reaction are restricted to affected firms and one direction. Hence, the special survey itself neither permits an identification of firms’ kind and degree of affectedness, nor allows for causal inference on firms’ response to the NMW.

²¹According to the National Regulatory Control Council (“*Nationaler Normenkontrollrat*”), the NMW introduction and its first adjustment in 2017 imposed annual compliance costs of €6.3 billion on firms (National Regulatory Control Council, 2017, p.19).

service providers—of which approximately 40% are assigned to positive values of TI_i —have been affected more often by the NMW than manufacturing firms (17%).²² In addition, one out of five firms in West Germany was affected according to TI_i , while more than two out of three East German firms were affected to at least some degree.²³ Conditional on being affected ($TI_i > 0$), however, the variation in TI_i is roughly comparable between firms in the different subsets: the mean treatment intensity among affected firms is 0.10 and 0.14 for manufacturing firms and service companies as well as 0.12 and 0.15 for firms in East and West Germany, respectively.

4.2. Empirical Model

The empirical strategy aims at evaluating whether firms that were more strongly affected by the NMW were more likely to increase prices or to change the number of employees. For this purpose, I use a generalized difference-in-differences (DiD) framework with continuous treatment to estimate how strongly the firm-specific bite of the NMW (TI_i) is associated with their pricing and employment plans. In order to infer the timing of the effects, I start with a very flexible estimation of the dynamic treatment effect before turning to a more condensed examination of average minimum wage effects during the entire treatment period.

Specifically, the dynamic effects of the NMW on price and employment, denoted β_t , are estimated for each month relative to January 2013. By then, the NMW introduction in January 2015 could not have been anticipated as described in Section 2. The sequence of treatment effects is estimated based on the following empirical model²⁴

$$Y_{i,t}^{+3m} = \sum_{t:t \neq 2013m1} \beta_t \times TI_i \times \mathbf{1}(\text{Date}_t) + \gamma \times \text{Demand}_{i,t} + \alpha_i + \delta_t \times \mathbf{1}(\text{Sector}_i) + \varepsilon_{i,t}, \quad (2)$$

where the dependent variable $Y_{i,t}^{+3m}$ corresponds to either firm i 's expected price change in the next three months (Price Exp. $_{i,t}^{+3m}$) or firm i 's expected change in employment (Empl. Exp. $_{i,t}^{+3m}$) as reported to Q1 or Q2 in month t . The bite measure TI_i is interacted with date dummies $\mathbf{1}(\text{Date}_t)$ for each $t \in [2011m1, 2017m12] \wedge t \neq 2013m1$. This is a standard method for the identification of a dynamic treatment effect of an intervention in a DiD design and delivers an estimate of each element of β_t relative to the effect of TI_i on $Y_{i,t}^{+3m}$ in the baseline period and after controlling for all other covariates (c.f., Angrist and Pischke, 2008). Hence, the sequence of estimates around January 2015 should capture the NMW effects on price and employment plans of firms. In contrast, estimates for the dates prior to the treatment period should be equal to zero because the NMW should not have influenced firms' plans at that time. This parallel trends assumption is verified in Section 5.1.²⁵

²²Furthermore, there is also substantial variation in TI_i within two-digit industries, see Appendix Table A.6.

²³Throughout the paper, "East Germany" refers to the federal states of Mecklenburg-West Pomerania, Brandenburg, Saxony-Anhalt, Saxony, and Thuringia, while "West Germany" covers the remaining federal states.

²⁴Ideally, I would estimate a two-stage model comparable to Machin et al. (2003) who regress the outcome variable of interest on the NMW induced wage increase that has been estimated in the first stage. However, the empirical model can only be estimated in reduced form as firm-specific wage data are not available.

²⁵Another concern of the DiD approach is that the Stable Unit Treatment Value Assumption (SUTVA) is violated due to spillover effects. Section 7 provides evidence that my key results are unlikely to be affected by spillovers

The set of control variables in the baseline specification of model (2) includes current demand of each firm ($\text{Demand}_{i,t}$) as reported to the IBS, firm fixed effects α_i , and date fixed effects δ_t at the level of two-digit industries. Firm-specific demand controls for the fact that price or employment changes are potentially demand-driven. As documented in Section 5, $\text{Demand}_{i,t}$ itself is unaffected by the NMW. In addition, firm fixed effects capture time-invariant firm-specificities such as persistent optimism or pessimism that have been found to be important for the understanding of expectations in the IBS by Bachmann and Elstner (2015). Furthermore, date fixed effects at the level of two-digit industries flexibly control for industry-specific fluctuations that similarly influence the pricing and employment policies of all firms in each industry irrespective of TI_i . Notably, the date fixed effects also eliminate the entire variation in firms' price and employment plans due to aggregate fluctuations or other policies at the national level. Thus, the identification of the treatment effects relies on variation in TI_i between firms in the same two-digit industry.

While model (2) delivers a very detailed documentation of the timing of the effects, the multitude of coefficients complicates the interpretation of the overall effect of the NMW. To facilitate the latter, model (2) is adjusted as follows

$$Y_{i,t} = \beta \times TI_i \times \mathbf{1}(t \in (\underline{t}, \bar{t})) + \gamma \times \text{Demand}_{i,t} + \alpha_i + \delta_t \times \mathbf{1}(\text{Sector}_i) + \varepsilon_{i,t}. \quad (3)$$

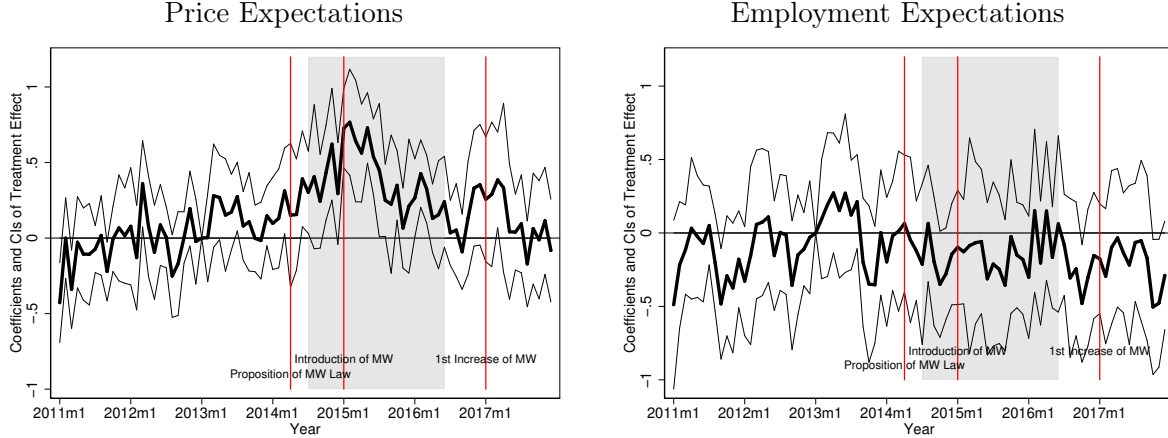
Here, β captures the average NMW effect on firms' changes in price or employment during the treatment period defined as dates between \underline{t} and \bar{t} relative to all other dates outside this window and after controlling for the same set of covariates. As shown in Section 5.1, it is reasonable to define the treatment period of the NMW to expectations formed between July 2014 and June 2016. When estimating the NMW effect on realized changes in prices and employment for the subsets of firms that report these variables, the treatment period is shifted by three months in order to cope with different time periods covered by Q1a and Q2a. Lastly, the months following the treatment period are from the estimation to prevent that the control period is corrupted by potential effects of the 2017 NMW increase.

The estimated NMW effect $\hat{\beta}$ can be interpreted as follows: Relative to the pre-treatment period, a firm with TI_i reported planned price or employment changes—scaled as “[1] increase,” “[0] stay the same,” “[−1] decrease”—that were *ceteris paribus* increased by $\hat{\beta} \times TI_i$ on average. Within the two-year treatment window, affected firms thus reported planned price or employment changes of a one-step higher category—i.e., increased instead of constant or constant instead of decreased prices—in $\hat{\beta} \times TI_i \times 24$ additional months compared to the counterfactual scenario in absence of the NMW.

Despite of the discrete and ordinal nature of the data, models (2) and (3) are estimated using ordinary least squares. This choice is due to the fact that standard methods for the estimation of generalized DiD models with fixed effects and non-binary ordinal data are not established in the literature, yet. However, Riedl and Geishecker (2014) find that linear panel data models generally

of the NMW to firms with $TI_i = 0$.

Figure 2: Dynamic Response of Firms to the NMW



Notes: The figure plots the coefficients of the dynamic treatment effect of the NMW introduction in January 2015 estimated in model (2). The dependent variables are firms' planned price or employment changes during the next three months. The effects are estimated relative to January 2013. The vertical lines in April 2014, January 2015, and January 2017 indicate the dates of the decision of the federal cabinet containing the relevant details of the minimum wage law, its introduction, and its first increase, respectively. The shaded area indicates the treatment period used in model (3). The thin lines display the 95%-confidence intervals based on standard errors clustered at the levels of industries, counties, and dates.

perform quite well in comparable settings with large cross-sections and long time series. In addition, standard errors are multi-way clustered at the levels of counties, two-digit industries, and dates.²⁶

5. Main Results

5.1. Dynamic Price and Employment Response of Firms to the NMW Introduction

The estimation of model (2) provides a first indication that affected firms were more likely to react to the NMW introduction in January 2015 by increasing their prices instead of adjusting their employment plans. The estimated sequences of treatment effects β_t are plotted in Figure 2 along with the 95%-confidence intervals. The positive effect on planned price changes is clearly concentrated in the time period around the NMW introduction. Obviously, the results do not hinge on the choice of the baseline period in January 2013. Overall, price expectations of firms are not correlated with TI_i prior to 2014. Hence, affected firms did not follow a different pre-trend in their pricing plans relative to their unaffected counterparts and after controlling for firm-specific demand as well as firm fixed effects and industry-specific trends.

The NMW induced an appreciation of pricing plans of affected firms between mid-2014 and

²⁶As highlighted by Bertrand et al. (2004), serially correlated error terms might cause severe inconsistencies in the estimated coefficients even after controlling for fixed effects. In my setting, the OLS standard errors are subject to different sources of potential bias which are taken into account via multi-way clustering as proposed by Dube et al. (2010) and Cameron et al. (2011). First, TI_i varies between two-digit industries and counties only. Hence, error terms are clustered at the level of two-digit industries and counties. Moreover, there might be a concern that common shocks lead to a downward bias in standard errors which is controlled for by additionally clustering along the time dimension.

mid-2016. Apparently, the coalition agreement on the NMW of November 2013 did not have an immediate effect. Instead, the treatment effect on firms' pricing plans has been appreciating over the course of 2014 as more details about the NMW became available and the introduction date approached. Strikingly, the treatment effect has been strongest between the last quarter of 2014 and the second quarter of 2015. This indicates that the bulk of the price adjustment took place immediately in the period around the NMW introduction. While the pass-through on prices slowed down during the second half of 2015, NMW-induced increases in pricing plans appear to have continued until mid-2016 at lower speed. In light of the first increase of the NMW in January 2017 to a level of €8.84 per hour, the association between TI_i and firms' pricing plans seems to have appreciated again. However, TI_i only imperfectly captures the degree to which firms are affected by the 2017 increase by definition. Based on these insights, the treatment period is defined such that expectations formed between July 2014 and June 2016 are covered when average NMW effects are estimated in model by means of model (3). Moreover, observations thereafter are excluded from the sample in order to prevent the control period to be corrupted by effects of the 2017 increase.

In contrast, the dynamic response of firms' employment plans to the NMW does not deliver a clear pattern. As displayed in the right-hand graph of Figure 2, the results of model (2) are ambiguous with respect to whether or not more strongly affected firms reported significantly deteriorated employment plans in response to the NMW. This is due to the fact that the coefficients largely depend on the choice of the baseline period and the association between TI_i and employment expectations is not constant throughout the pre-reform period. This problem is alleviated by model (3) that estimates the average NMW effect relative to a control period comprising of 42 months instead of a single baseline date.

5.2. Firms' Adjustment to NMW Introduction: Baseline Results

Next, I estimate average NMW effects by means of model (3). Table 4 summarizes the baseline results with respect to price and employment expectations (Columns 1 and 2). Columns (3) and (5) display the NMW effect on expected and realized general business conditions and Columns (4) and (6) examine the effect on firms' expected production or demand expectations as well as on current demand. As realized conditions and demand refer to the date of completing the survey, the treatment period is shifted by one quarter in the respective specifications.

Baseline Results for Price Expectations The NMW had a strongly positive effect on the probability that affected firms increased their prices as displayed in Column (1) of Table 4. The average treatment effect on planned price changes reported between July 2014 and June 2016 is estimated to $\hat{\beta} = 0.34$ and statistically significant at the 1% level. Hence, a firm that is affected with degree TI_i reported additional planned price changes of a one-step higher category—i.e., increased instead of constant or constant instead of decreased prices—compared to the counterfactual scenario in $8.2 \times TI_i$ months. Accordingly, a firm with $TI_i = 0.25$ reported on average more than two additional price increases due to the NMW.

Table 4: Minimum Wage Effects at the Firm-Level: Baseline Results

	Price Exp. _t ^{+3m} (1)	Empl. Exp. _t ^{+3m} (2)	Cond. Exp. _t ^{+6m} (3)	Prod./Dem. Exp. _t ^{+3m} (4)	Cond. _t (5)	Demand _t (6)
TI × 1(<i>t</i> ∈ {2014m7, 2016m6})	0.34*** (0.07)	-0.08 (0.06)	-0.04 (0.08)	0.07 (0.07)		
TI × 1(<i>t</i> ∈ {2014m10, 2016m9})					0.01 (0.06)	0.08 (0.08)
Control for Demand _{i,t}	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes
R ²	0.337	0.357	0.368	0.390	0.628	0.455
Observations	253350	253440	253394	254105	265227	265582

Notes: The dependent variables are planned price or employment changes during the next three months (Price Exp._t^{+3m} and Empl. Exp._t^{+3m}), expected business conditions for the next six months (Cond. Exp._t^{+6m}), expected production (manufacturing firms) or demand (services firms) for the next three months (Prod./Dem. Exp._t^{+3m}), as well as current business conditions and current backlog of orders of firms in the IBS (Cond._t and Demand_t). “TI” is the firm-specific bite of the NMW and “1(*t* ∈ {2014m7, 2016m6})” and “1(*t* ∈ {2014m10, 2016m9})” indicate the respective treatment period. “Time*Sector FE” are time fixed effects at the level of two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Levels of significance: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

The price pass-through mainly took place immediately in the period around the NMW introduction. Panel A of Appendix Table A.7 reports the treatment effects separately for the first and second half of the treatment period, denoted β_1 and β_2 . In line with the dynamic effects displayed in Figure 2, the results indicate that 70% ($\hat{\beta}_1/(\hat{\beta}_1 + \hat{\beta}_2) = 0.7$) of the NMW-induced effect on pricing plans took place during the 12 months around its introduction. During the second half of the treatment period, the effect is smaller in size ($\hat{\beta}_2 = 0.20$) but still significantly positive at the 1% level. Hence, more strongly affected firms continued reporting significantly appreciated pricing plans even with some delay after the NMW introduction.²⁷

The NMW effect on pricing plans mostly stems from additional price increases. Table 5 summarizes the results of estimating model (3) separately for binarized dependent variables that either capture planned increases in prices, i.e., using a dummy $1(\text{Price Exp.}_t^{+3m} = 1)$, or refer to planned changes that are non-negative, i.e., $1(\text{Price Exp.}_t^{+3m} \neq -1)$. As displayed in Columns (2) and (3), more than 85% of price effect can be attributed to additionally reported planned price increases. In contrast, only a small part of the effect is due to firms planning to decrease their prices less frequently.

The estimated NMW effect on firms’ pricing plans is constant for different specifications of the control vector and does not hinge on the functional form of model (3). As documented in Appendix Table A.8, the coefficients are virtually unaffected once time fixed effects specific for each county type or time fixed effects at the level of federal states are included to the regression in Columns (2) and (3). These specifications flexibly control for heterogeneous trends in more rural or more urban counties

²⁷Moreover, Panel B of Appendix Table A.7 displays the estimated NMW effects on a quarterly basis. They are strongest for reported pricing plans in the first and second quarter of 2015. In the second half of the treatment period, the coefficients are always positive, albeit statistically different from zero in only two out of four quarters.

Table 5: Minimum Wage Effects at the Firm-Level: Increases vs. Decreases

	Price Exp. _t ^{+3m}			Employment Exp. _t ^{+3m}		
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	= 1	≠ -1	Baseline	= 1	≠ -1
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$	0.34*** (0.07)	0.30*** (0.06)	0.05** (0.02)	-0.08 (0.06)	-0.01 (0.03)	-0.07 (0.04)
Control for Demand _{i,t}	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes
R ²	0.337	0.307	0.345	0.357	0.343	0.289
Observations	253350	253350	253350	253440	253440	253440

Notes: The dependent variables are planned price or employment changes during the next three months as reported to the IBS. In Columns (2) and (5), the dependent variables are binarized to capture increases in expectations only ($\mathbb{1}(Y_t^{+3m} = 1)$). In Columns (3) and (6), the dependent variables are restricted to planned changes that are non-negative ($\mathbb{1}(Y_t^{+3m} \neq -1)$). “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand_{i,t}” is firms’ current backlog of orders as reported in the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. Standard errors are multiway clustered at the level of sectors, counties, and dates. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

and shocks that heterogeneously affect firms in different federal states, respectively. Moreover, neither dropping the control for firm-specific demand in Column (4), nor controlling for expected demand (for service companies) or expected production volume (for manufacturing firms) instead of current demand in Column (5) affects the results. Finally, the results are robust to the inclusion of a squared term of TI_i to model (3), which enters insignificantly and does not affect the coefficient of the linear term of TI_i substantially, see Appendix Table A.9.

Moreover, the price response of firms only differed to a minor degree between firms in manufacturing and service sectors as well as between firms located in West or East Germany. As documented in Section 4.1, there is sufficient variation in TI_i across firms in the manufacturing sector and the services sector as well as in West and East Germany that offers scope for a separate analysis of firm-level NMW effects along these lines. The results in Column (1) of Table 6 show that in both sectors, affected firms planned to increase prices significantly more often than they would have done if they were not affected. If anything, manufacturing firms appear to have planned to increase their prices slightly more often due to the NMW compared to their counterparts in the services sector given the same degree of affectedness ($\hat{\beta}_M^{\text{Price Exp.}} = 0.39 > \hat{\beta}_S^{\text{Price Exp.}} = 0.30$). However, the difference between both coefficients is insignificant ($p = 0.47$). For a given bite of the NMW, the price response of firms in West Germany is also comparable to the reaction of their counterparts in the East, see Column (2).

Baseline Results for Employment Expectations and Other Firm-Specific Variables In contrast to the price effect, the relationship between planned employment changes and the intensity to which firms were affected by the NMW is much weaker. As documented in Column (2) of Table 4, the average treatment effect on planned employment changes reported between July 2014 and June 2016

Table 6: Minimum Wage Effects in Different Sectors and Regions

	Price Exp. $_t^{+3m}$		Price Change $_t^{-1m}$		Empl. Exp. $_t^{+3m}$		Empl. Change $_t^{-3m}$	
	(1)	(2)	(3)		(4)	(5)	(6)	
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$								
$\times \mathbb{1}(\text{Manufacturing})$	0.39***				-0.02			
	(0.06)				(0.04)			
$\times \mathbb{1}(\text{Services})$	0.30**				-0.13			
	(0.12)				(0.13)			
$\times \mathbb{1}(\text{West Germany})$		0.32**				-0.04		
		(0.16)				(0.14)		
$\times \mathbb{1}(\text{East Germany})$		0.34***				-0.08		
		(0.08)				(0.06)		
$TI \times \mathbb{1}(t \in \{2014m10, 2016m9\})$								
$\times \mathbb{1}(\text{Manufacturing})$			0.27***					
			(0.06)					
$\times \mathbb{1}(\text{Services})$							-0.10	
							(0.09)	
H0: Coefficients Equal: p-value	0.471	0.852			0.457	0.815		
Control for Demand $_{i,t}$	yes	yes	yes		yes	yes	yes	
Firm FE	yes	yes	yes		yes	yes	yes	
Time*Sector FE	yes	yes	yes		yes	yes	yes	
R ²	0.337	0.337	0.285		0.357	0.357	0.316	
Observations	253350	253350	141589		253440	253440	122685	

Notes: The dependent variables are planned price changes during the next three months, realized price changes during the previous month, expected price changes during the next three months, and realized employment changes during the last three months. “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” and “ $\mathbb{1}(t \in \{2014m10, 2016m9\})$ ” indicate the respective treatment periods. “ $\mathbb{1}(t \in \text{Manufacturing})$,” “ $\mathbb{1}(t \in \text{Services})$,” “ $\mathbb{1}(t \in \text{West Germany})$,” and “ $\mathbb{1}(t \in \text{East Germany})$ ” are dummies for firms in manufacturing, services, West Germany, and East Germany, respectively. “Demand $_{i,t}$ ” is firms’ current backlog of orders as reported in the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

is only slightly negative ($\hat{\beta} = -0.08$). This is almost exclusively stemming from planned reductions in the number of employees instead of fewer hires, see Table 5. Taking the coefficients at face value, affected firms were hence more than four times more likely to increase prices instead of reducing employment in response to the NMW.

The estimated employment effect is statistically indistinguishable from zero although it is close to approaching significance (p-value = 0.24). Accordingly, different specifications of model (3) always deliver slightly negative, but insignificant employment effects as shown in Appendix Table A.8. Estimating the effect separately for the first and second half of the treatment period in Panel A of Appendix Table A.7 provides a similar picture: both coefficients are negative ($\hat{\beta}_1 = -0.09$ and $\hat{\beta}_2 = -0.07$), but statistically insignificant. As shown in Panel B, the association between TI_i and planned employment changes is negative in face value in seven out of eight quarters of the treatment period, but is significantly different from zero only during the fourth quarter of 2014 and the third quarter of 2015.

Services companies, which have increased their prices slightly less strongly for a given TI_i compared to manufacturing firms, appear to have in turn reacted slightly more strongly along the employment margin ($|\hat{\beta}_S^{\text{Empl. Exp.}}| = |-0.13| > |\hat{\beta}_M^{\text{Empl. Exp.}}| = |-0.02|$), see Column (4) of Table 6.

However, the employment effects are not significant at the 10% level for each group and the difference between both coefficients is insignificant ($p = 0.46$). Moreover, a significantly negative effect on firms' employment plans can neither be detected for firms located in West Germany nor for their counterparts in the East, see Column (5).

Furthermore, the NMW does not appear to have had a strong effect on firms' expectations and realizations of revenues and demand.²⁸ First, neither firms' expected business conditions for the next six months ($\text{Exp. Cond.}_{i,t}^{+6m}$) nor their currently realized conditions ($\text{Cond.}_{i,t}$) appear to have significantly deteriorated due to the NMW, see Columns (3) and (5) of Table 4. Second, neither firms' expected production or demand changes ($\text{Prod./Dem. Exp.}_t^{+3m}$) for the next three months, nor their current demand ($\text{Demand}_{i,t}$) captured by the backlog of orders were affected negatively by the NMW, see Columns (4) and (6).

Minimum Wage Effect on Realized Price and Employment Changes Next, the effect of the NMW on realized price changes of manufacturing firms and realized employment changes of services companies are estimated along the lines of the baseline empirical model (3). Besides using the respective reports to the IBS as dependent variable, the window of the treatment period is forwarded by three months in order to accommodate for the different time period covered by the survey questions. The results are presented in Columns (3) and (6) of Table 6.

Manufacturing firms reported to have indeed increased their prices in response to the NMW. The estimated treatment effect of $\hat{\beta}_M^{\text{Price Realiz.}} = 0.27$ is significant at the 1%-level. Relative to all other periods when the NMW was not affecting them, a firm that is affected with degree TI_i reported additional price changes of a one-step higher category in $6.5 \times TI_i$ months between October 2014 and September 2016 due to the NMW. Moreover, the NMW effect on realized employment changes of services firms is insignificant. If anything, affected services companies decreased their stock of employees only slightly in response to the NMW ($\hat{\beta}_S^{\text{Empl. Realiz.}} = -0.10$).

The estimates of the NMW effect on realized price and employment changes are remarkably close to the estimated effects on expected changes during the next three months. In light of less variation in one-month realized price changes compared to three-month price expectations, it is not surprising that the coefficient with respect to realized price changes is slightly smaller than the effect on price expectations. As shown in Section 5.3, the quantitative size of the NMW effect on the overall level of producer prices in the manufacturing sector is in the same order of magnitude irrespective of the price data used in the estimation.

In general, firms hence appear to have reacted to the NMW in accordance with their previous plans. As survey data on realized price and employment changes are not available for all firms in the IBS, this finding can only be verified for the respective subset of firms. However, it is very unreasonable to assume that service companies differed from their counterparts in the manufacturing sector with respect to the degree to which their NMW-induced adjustment of pricing plans resulted

²⁸Link (2018) demonstrates that $\text{Exp. Cond.}_{i,t}^{+6m}$ and $\text{Conditions}_{i,t}$ are very closely related to the level of revenues. Moreover, the expected change in production during the next 3 months is only asked in the manufacturing survey of the IBS, while services firms are asked for their demand expectations.

in actual price increases.

5.3. Quantification of the Minimum Wage Effect on Producer Prices

In order to gain insights about the economic dimension of the price effect, this section provides a back-of-the-envelope calculation of its quantitative size. As documented in Section 3, aggregated survey responses regarding price changes closely track *quantitative* changes in price indices from administrative sources in a way that is captured by the semi-elasticities $\hat{\psi}^{Exp}$ and $\hat{\psi}^{Realiz}$. These measures can be used to approximate the quantitative size of firms' price increases in response to the NMW. Assuming (a) that the average size of NMW-induced price changes did not differ from the size of "normal" price changes and (b) that $\hat{\psi}^{Exp}$ and $\hat{\psi}^{Realiz}$ are homogeneous across different subsets of firms of the IBS, the NMW-induced price reaction of each firm (ΔP_i) can be quantified using the following relationship

$$\Delta P_i = \hat{\beta} \times TI_i \times \hat{\psi} \times \frac{\bar{t} - \underline{t}}{12 \text{ months}}, \quad (4)$$

where $\hat{\psi}$ refers to either $\hat{\psi}^{Exp}$ or $\hat{\psi}^{Realiz}$ and $\hat{\beta}$ is the treatment effect on firms' planned or realized price changes estimated in Section 5 based on model (3).²⁹ Moreover, the length of the treatment period in years ($\frac{\bar{t} - \underline{t}}{12 \text{ months}}$) controls for the fact that $\hat{\psi}^{Exp}$ and $\hat{\psi}^{Realiz}$ map the survey responses to *annualized* changes in producer prices.

The price effect is considerable and firms increased their prices in response to the NMW by $\Delta P_i = 0.09 \times TI_i$ according to this approximation. Given the average bite of $\overline{TI}_{TI_i > 0} = 0.125$, affected firms hence increased their prices on average by 1.1 percentage points due to the NMW. In line with the results in Section 5.2, the price effect of manufacturing firms does not differ substantially once it is approximated using survey data on price expectations or realized price changes.³⁰

NMW Effect on Aggregate Level of Producer Prices In order to examine the effect of the NMW on the overall level of producer prices in Germany, I substitute TI_i using a measure of average bite across all industry-region combinations (\widetilde{TI}) in equation (4). To capture the level of overall producer prices as closely as possible, the treatment intensity of each industry-region cell is weighted by revenues.³¹ Given that revenues are higher in industry-region combinations which

²⁹The first assumption cannot be tested as data on the intensive margin of price adjustments are not available. The second assumption can be rationalized at least for firms in different manufacturing sectors. As can be inferred from Table A.4 in Appendix A.1.2, semi-elasticities in the three two-digit industries that cover the highest number of firms are of roughly equal size compared to the results for all manufacturing firms. In sectors with fewer firms, the correlation between Price Exp._{s,t}^{+3m} and $\Delta PPI_{s,t}$ is weaker due to the trichotomy of the survey data preventing the calculation of reasonable industry-specific semi-elasticities.

³⁰Inserting the estimated coefficients of the price effect for manufacturing firms from Table 6 to equation (4) gives $\Delta P_i^{Exp} = 0.394 \times 0.130 \times 2 \times TI_i = 0.10 \times TI_i$ and $\Delta P_i^{Realiz} = 0.274 \times 0.144 \times 2 \times TI_i = 0.08 \times TI_i$.

³¹Revenue data are obtained from the Federal Statistical Office at the level of two-digit industries and federal states. From this, revenue weights are calculated for each county-sector combination using the county's employment share in the respective industry of the federal state. Moreover, I adjust the revenue weights for the fact that wage data are missing more often in East Germany compared to West Germany. For details, see Appendix A.3.

Table 7: Quantitative Effect of NMW on Overall Level of Producer Prices

	Quantification of Price Effect Based on					
	Price Expectations					Price Realizations
	Total	Manuf.	Services	West	East	Manuf.
PPI-Semi-Elasticity ($\hat{\psi}$)	0.130	0.130	0.130	0.130	0.130	0.144
Treatment Effect ($\hat{\beta}$)	0.345	0.394	0.296	0.323	0.343	0.274
Revenue-Weighted Treatment Intensity (\widetilde{TI})	0.027	0.013	0.048	0.022	0.090	0.013
Overall Price Effect ($\Delta\tilde{P}$ in %)	0.241	0.128	0.367	0.188	0.802	0.099
Wage Bill Increase c.p. ($\Delta\tilde{W}$ in %)	0.436	0.262	0.637			
Wage Bill Increase \times Labor Share ($\Delta\tilde{C}$ in %)	0.294	0.192	0.412			
Degree of Pass-Through ($\frac{\Delta\tilde{P}}{\Delta\tilde{C}}$)	0.82	0.67	0.89			

Notes: This table summarizes the approximated effect of the NMW on the overall level of producer prices “ $\Delta\tilde{P}$ ” and the degree of price pass-through “ $\frac{\Delta\tilde{P}}{\Delta\tilde{C}}$.” The “PPI-Semi-Elasticity ($\hat{\psi}$)” refers to the degree to which changes in average price expectations in the IBS translate to changes in producer price indices. $\hat{\psi}$ can only be estimated for manufacturing firms and is assumed to be constant across all sectors and regions. “Treatment effect ($\hat{\beta}$)” corresponds to the estimated coefficients of Tables 4 and 6. “ \widetilde{TI} ” is the revenue-weighted treatment intensity of all industry-region combinations as calculated in Appendix A.3. “ $\Delta\tilde{W}$ ” and “ $\Delta\tilde{C}$ ” indicate the average implicit increase in the wage bill and overall costs induced by the NMW.

were less strongly affected by the NMW, the revenue-weighted treatment intensity of $\widetilde{TI} = 0.027$ is slightly smaller than the average treatment intensity of all firms in the sample ($\overline{TI} = 0.034$).

According to this back-of-the-envelope calculation, aggregate producer prices in the manufacturing and services sectors prone to the NMW increased by approximately 0.24 percent in response to the NMW, see Table 7. As the average NMW bite largely differed between West and East Germany as well as between manufacturing firms and service providers, the aggregate price effect is heterogeneous among these groups. Producer prices were more strongly increased in East Germany (+0.80%) compared to West Germany (+0.19%) as well as in the services sector (+0.37%) in relation to the manufacturing sector (+0.13%). Again, estimating the overall price effect for manufacturing firms based on realized price changes (+0.10%) rather than expectations delivers comparable results.

The estimated size of the NMW-induced increase in producer prices is remarkably close to the prediction of the “German Council of Economic Experts.” In their annual report to the federal government published two months prior to January 2015, they predicted an additional increase in CPI inflation by 0.2 percentage points due to the minimum wage (c.f. Sachverständigenrat, 2014). Hence, the back-of-the-envelope calculation does not seem to deliver unreasonable results despite of the strong assumptions needed to interpret the qualitative effects found in the IBS data in a quantitative way.

Approximate Degree of Price Pass-Through Lastly, the aggregate price effect, $\Delta\tilde{P}$, is related to the average implicit increase in costs induced by the NMW, $\Delta\tilde{C}$, in order to evaluate whether firms passed through a substantial share of the increased costs to their customers. The aggregate cost increase in the manufacturing and services prone to the NMW, $\Delta\tilde{C}$, is calculated in three steps:

first, I approximate the implicit wage bill increase in each industry s induced by the NMW, ΔW_s , based on the micro data of the Structure of Earnings Survey, i.e., the increase in wage costs firms would have had to bear if they fully complied to the NMW and held their employment structure constant. Then, the industry-specific wage bill increase is multiplied with each sector’s labor share, LS_s , to obtain a measure for the cost increase in each industry, ΔC_s .³² Finally, the aggregate cost increase is calculated as $\Delta \tilde{C} = \sum_s (\omega_s \times \Delta C_s)$, where ω_s is the industry revenue weight as of 2014.

The estimated degree of price pass-through is very high. According to this back-of-the-envelope calculation, the overall costs in the sectors under consideration increased by 0.29% due to the NMW and the resulting elasticity of prices with respect to NMW costs is 0.82. Looking at the manufacturing and services sectors separately, the pass-through elasticity is slightly larger in the services sector ($\frac{\Delta \tilde{P}}{\Delta C} = 0.89$) compared to the manufacturing sector (0.67). The order of magnitude of the price effect is comparable to Harasztosi and Lindner (2019) who find that about 75% of the minimum wage increase in Hungary in 2002 was paid by consumers via higher revenues. Obviously, the results of my back-of-the-envelope calculation rely on strong assumptions and should be taken with a grain of salt. Nevertheless, it appears reasonable that the size of the price effect is non-negligible and firms have rolled over a substantial share of the costs generated by the NMW to their customers.

6. Heterogeneity

6.1. Heterogeneous Responses to NMW: Product Market Differences

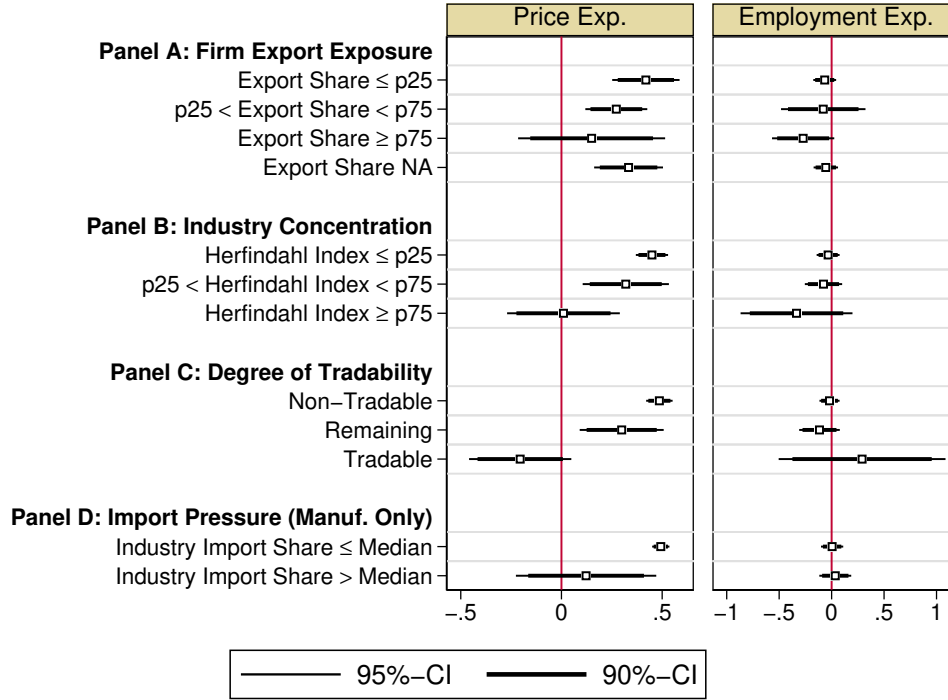
This section documents substantial heterogeneity in responses to the NMW across firms depending on product market competition. I show that price effects are stronger (and the employment response muted to some degree) if firms’ export share is smaller, their goods and services are traded more locally, and competition through imports is lower. This is consistent with the role of price pass-through as these firms are less likely to face foreign or domestic competitors that are either unaffected or hit less strongly by the German NMW. Hence, these firms have a larger scope to increase prices without experiencing a strong decline in demand.

For this purpose, model (3) is augmented with an additional interaction term of the firm-specific bite and factors that potentially influence the degree to which firms are able (or willing) to roll over increased costs to the prices of their products. These measures include firms’ export share, the degree of tradability of their good or service, as well as the import pressure in each industry. The firm-specific export share is proxied by the fraction of revenues generated abroad that has been reported by the firms to a special question of the IBS in September 2018.³³ Following Mian and

³²The industry-specific labor share, LS_s , is calculated based on national accounting data provided by the Federal Statistical Office at the two-digit industry level and defined as the ratio between the total compensation, TC_s , and gross value added, GVA_s . As the data only include the total compensation of employees, $TC_{empl.,s}$, rather than the wage bill of all workers in the industry (incl. self-employed), I approximate the total compensation as $TC_s \approx TC_{empl.,s} \times \frac{\text{All Workers}_s}{\text{Employees}_s}$.

³³The IBS does not contain information on the volume of exports before this date. However, 52% of the firms in the treatment period can be assigned to their export share in September 2018. The remaining firms are captured by

Figure 3: Heterogeneous Responses to NMW: Product Market Differences



Notes: The figure plots the coefficients of the treatment effect of the NMW on planned price or employment changes in different groups of treated firms as indicated in each row. Each panel reports the results of a separate regression in which “ $TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$ ” is interacted with dummies that group treated firms into bins of firms’ export share, the industry-specific Herfindahl index, the degree of tradability, or the industry-specific import share, respectively. Moreover, I control for “ $Demand_{i,t}$,” time fixed effects at the level of two-digit industries and firm fixed effects. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Confidence intervals are displayed at the 90% and 95% level. The complete regression output is displayed in Appendix Table A.10.

Sufi (2014), the degree of tradability is proxied by the geographical concentration captured by the Herfindahl index at the two-digit industry level based on county-level employment in 2014. They argue that industries that meet mostly local demand are more uniformly distributed, while those relying on national or international customers tend to be geographically concentrated. Appendix Table A.6 lists the Herfindahl index for all 62 two-digit industries in the services and manufacturing sector that were prone to the NMW. Moreover, the import pressure is defined as the ratio of imports over revenues in each two-digit industry in 2014 based on trade statistics provided by the Federal Statistical Office. As this data is not available for the services sectors, the last measure can only be constructed for manufacturing firms.

The more firms export, the less likely they increased prices in response to the NMW for a given degree of affectedness. Grouping treated firms into quartiles with respect to their export share, Panel A of Figure 3 shows that the price response is strongest in the group of firms with the lowest

the dummy variable $\mathbb{1}(\text{Firm Export Share} = NA)$ to ensure that industry-specific time fixed effects are identified based on the same set of observations as in the baseline regression.

export share while the treatment effect is only insignificantly positive in the group that exported most. As documented in Columns (1) and (2) of Appendix Table A.12, the difference between the coefficients of these groups is significant at the 10%-level and the direct interaction term between the treatment effect and firms' export share is significantly negative at the 5% level. In turn, treated firms in the group with the highest export share reacted significantly more strongly along the employment margin, see Column (9).

Moreover, firms reacted more strongly along the pricing margin if they operated in industries that were less concentrated. The interaction term between TI_i , the treatment period, and the industry Herfindahl is strongly negatively associated with firms' pricing plans, see Column (3) of Appendix Table A.12. Grouping treated firms into quartiles with respect to the Herfindahl index, Panel B of Figure 3 shows that the price effect is strongest for firms in the least concentrated industries and insignificant for firms in the most concentrated industries. Categorizing the top and bottom quartile of industries by geographical concentration as "tradable" and "non-tradable" according to Mian and Sufi (2014) provides a similar result: Firms in local markets increased prices strongly in response to the NMW, while higher TI_i is not associated with appreciated pricing plans for firms selling tradable goods or services, see Panel C. In both specifications, the differences between the treatment effects of firms in the most and least concentrated markets are significant at the 1% level. As displayed in Columns (10) through (12), the relationship between firms' employment response and market concentration is slightly negative, but insignificant in all specifications. Overall, my results are less ambiguous compared to Harasztosi and Lindner (2019) who only find a small negative, but insignificant effect of geographical concentration on the revenue elasticity of a NMW increase in Hungary, which is their proxy for price changes.

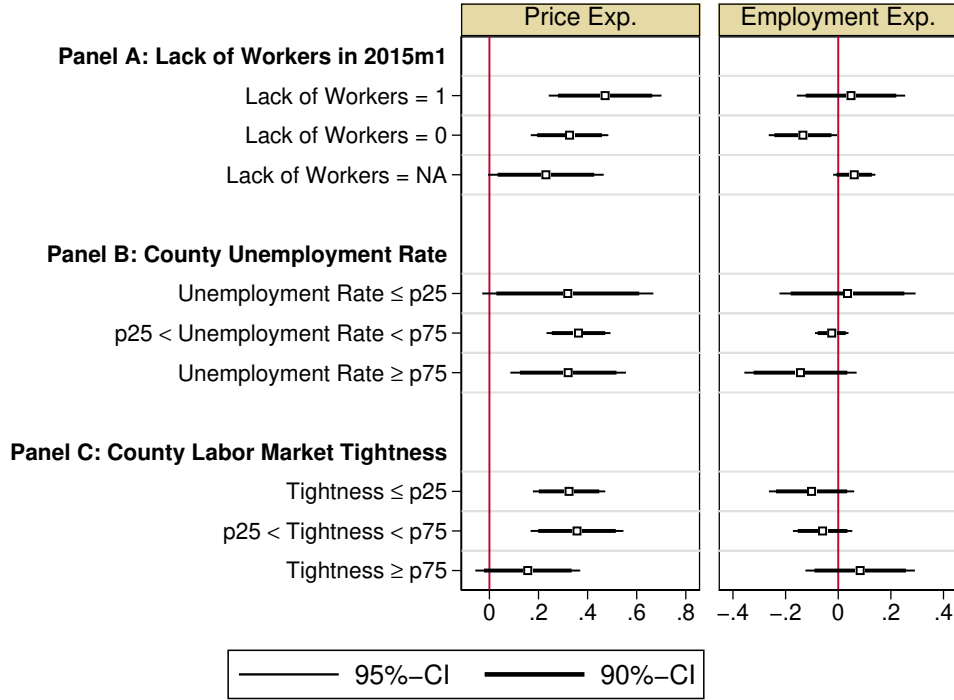
Lastly, industry-specific import pressure dampens the price response in the subset of manufacturing firms. Panel C reveals that the price effect is only significantly positive for treated manufacturers that face below-median import pressure.³⁴ In contrast, firms in industries with high import pressure did not show significantly appreciated pricing plans in response to the NMW. The interaction term with respect to the industry import share also enters significantly negative at the 5% level, see Column (6) of Appendix Table A.12. While import pressure appears to be important for the size of the price effect, I cannot detect a relationship between firms' employment response and import pressure.

6.2. Heterogeneous Responses to NMW: Labor Market Differences

This section investigates the heterogeneity in responses to the NMW across firms depending on the labor market conditions they face. The results presented in Figure 4 and Appendix Table A.11 are consistent with the notion that firms are more reluctant to lay off workers if vacancies can be filled less easily. For this purpose, model (3) is augmented with an additional interaction term of the firm-specific bite and dummies that indicate whether firms reported a lack of skilled workers to the IBS in January 2015 or indicators of county-level unemployment and labor market tightness at the

³⁴The analysis is restricted to median splits as there are less than 350 manufacturing firms in the IBS with $TI_i > 0$.

Figure 4: Heterogeneous Responses to NMW: Labor Market Differences



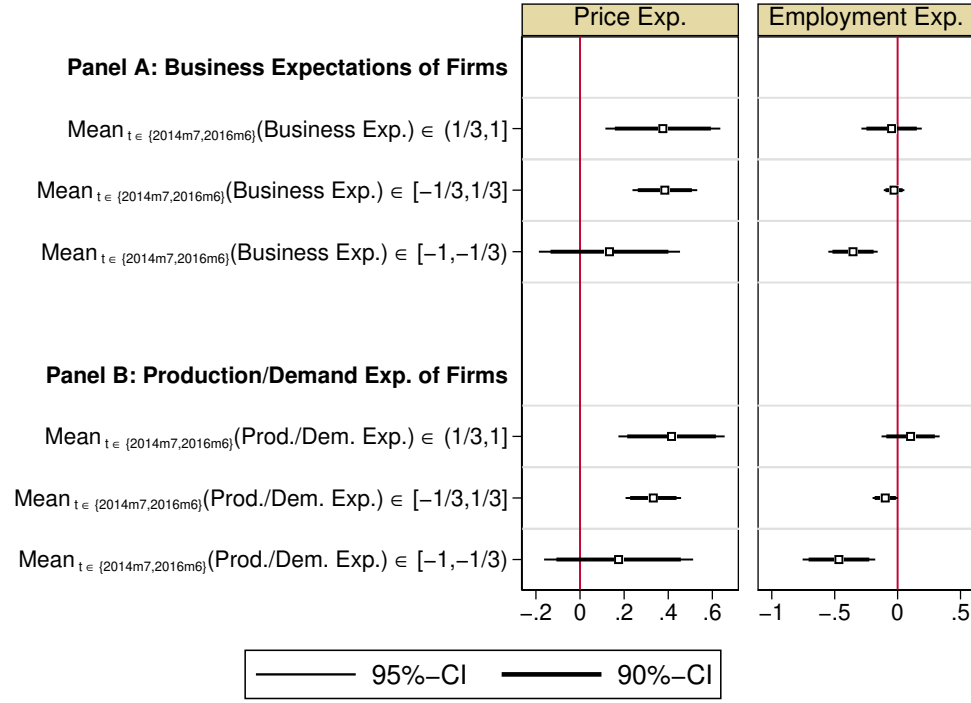
Notes: The figure plots the coefficients of the treatment effect of the NMW on planned price or employment changes in different groups of treated firms. Each panel reports the results of a separate regression in which “ $TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$ ” is interacted with dummies that group treated firms into bins of firms’ self-reported lack of workers in January 2015 and the unemployment rate/labor market tightness in the county they are located in. Moreover, I control for “Demand_{*i,t*},” time fixed effects at the level of two-digit industries and firm fixed effects. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Confidence intervals are displayed at the 90% and 95% level. The complete regression output is displayed in Appendix Table A.11.

date of the NMW introduction.³⁵

The employment response is found to be heterogeneous with respect to firms’ self-reported lack of workers during the period of the NMW introduction. The results in Panel A show a significantly negative employment response for the group of firms that was not constrained by labor shortages. Given the same degree of affectedness, these firms were significantly more likely to report depreciated employment plans compared to their counterparts that faced difficulties in satisfying their demand of workers, see Column (4) Appendix Table A.11. Instead of laying off workers, the later firms appear to have increased prices more frequently in response to the NMW. However, the estimated price effects are only significantly different from each other at the 20% level.

³⁵The IBS asks for constraints to business activity on a quarterly basis. Once affirming firms are asked for the reason including whether they were constrained by a lack of skilled workers. Clearly, lack of skilled workers is only an imperfect proxy for the unsatisfied demand for low-wage workers prone to the NMW as these workers are less skilled on average. However, shortages with respect to both types of workers are likely to be correlated. The dummy $\mathbb{1}(\text{Lack of Workers} = 1)$ subsumes firms that reported to be constrained by a lack of skilled workers in January 2015. Firms not replying to this question are grouped to $\mathbb{1}(\text{Lack of Workers} = NA)$ in order to insure that the industry-specific time fixed effects nest on the same set of observations as in the baseline regression.

Figure 5: Heterogeneous Responses to NMW: Business Condition of Firms



Notes: The figure plots the coefficients of the treatment effect of the NMW on planned price or employment changes in different groups of treated firms as indicated in each row. Each panel reports the results of a separate regression in which “ $TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$ ” is interacted with dummies that group treated firms according to their average reports (coded -1,0,1) during the treatment period with respect to reported business expectations for the next six months, expected production (manufacturing firms) or demand (services firms) for the next three months. Moreover, I directly control for each of these measures along with “Demand $_{i,t}$,” time fixed effects at the level of two-digit industries, and firm fixed effects. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Confidence intervals are displayed at the 90% and 95% level. The complete regression output is displayed in Appendix Table A.12.

Moreover, the degree of firms’ employment response is correlated with local labor market conditions at the time of the NMW introduction, see Panels B and C. Given the same degree of affectedness, the employment effect is strongest for firms in counties with the highest unemployment rates and most slackness according to the ratio of total vacancies over the number of unemployed. While the respective coefficients themselves are not statistically different from zero, the employment responses are significantly more negative at the 5% level compared to the group of treated firms located in the tightest local labor markets, see Columns (5) and (6) in Appendix Table A.11.

6.3. Heterogeneous Responses to NMW Depending on Business Conditions of Firms

Lastly, this section provides evidence that the reaction of firms to the NMW strongly depended on their expectations regarding the development of their businesses. For this purpose, model (3) is augmented with an additional interaction term of the firm-specific bite and dummies that indicate whether firms during the treatment period on average reported to be optimistic, neutral,

or pessimistic regarding the development of their business conditions during the next six months (“Business Exp. $_t^{+6m}$ ”) or regarding expected changes in production or demand during the next three months (“Prod./Dem. Exp. $_t^{+3m}$ ”) as reported to the IBS.³⁶ Importantly, neither measure was directly affected by the NMW as shown in Table 4. Furthermore, I control for Business Exp. $_t^{+6m}$ and Prod./Dem. Exp. $_t^{+6m}$ in the respective regression in order to capture the direct effect of each measure on pricing and employment plans.

The results presented in Figure 5 and Appendix Table A.12 show that treated firms with solid expectations regarding the future development of their businesses reacted more strongly along the pricing margin. In contrast, their counterparts with grim expectations anticipated significantly more layoffs. These results are even stronger when grouping firms according to their production and demand expectations. In both specifications, the price effect of the most pessimistic firms is positive, but not significantly different from zero, while the employment response is significantly negative at the 1% level. Hence, the relative importance of the different margins of adjustment appears to depend on the general assessment of firms regarding the future development of their businesses.

7. Robustness and Additional Analyses

Robustness. The previous results documented that affected firms increased their prices in response to the NMW, while their employment reaction appeared to be—if anything—only very modestly negative on average. Besides providing additional insights about the firms’ reaction, this section conducts several robustness checks that confirm the main findings with respect to firms’ adjustment of pricing and employment plans. In addition, Appendix Table A.13 summarizes the results of all robustness checks with respect to realized price changes in the subset of manufacturing firms which are comparable to the findings presented in the following.

First, the results do not change once controlling for attrition. If dropout of firms from the sample was correlated with the NMW bite, the baseline could be biased. To accommodate this concern, the sample is restricted to firms that stay in the data set until the end of the treatment period. The estimated NMW effect on firms’ price and employment expectations are very close to the results of the baseline regression as shown in Column (2) of Tables 8 and 9.

Second, the results are robust to the choice of the aggregation level in the RS wage data used for the construction of the bite measure. As described in Section 4.1, 52% (84%) of firms in the sample can be matched to administrative, industry-specific wage data at the level of the county (labor market region) they are located in. Trading off the higher coverage of wage data at the level of labor market regions and the fact that firm-level wages are better reflected by county level data,

³⁶The IBS asks firms whether their expected business conditions during the next six months are [1] “more favorable,” [0] “about the same,” or [-1] “more unfavorable”. Moreover, the expected change in production during the next 3 months is only asked in the manufacturing survey of the IBS, while services firms are asked for their demand expectations. Firms are grouped as “optimistic” or “pessimistic” if their average reports during the treatment period were above 1/3 and below 1/3, respectively. In both cases, roughly 20% of treated firms are labeled “optimistic”, while less than 10% of firms are “pessimistic”.

Table 8: Price Response to the Minimum Wage Introduction: Robustness

Specification	Planned Price Change in Next 3 Months								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline	No Attrition	RS Wage Data			SES Wage Data		$w(p0)$	
			Region Only	County Only	2013 Wages	Fulltime Workers	All Workers	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$	0.34*** (0.072)	0.35*** (0.068)	0.32*** (0.079)	0.50*** (0.087)	0.29*** (0.067)	0.35*** (0.051)	0.19** (0.074)	0.34*** (0.079)	0.34*** (0.073)
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.337	0.331	0.337	0.337	0.337	0.334	0.333	0.337	0.337
Observations	253350	220710	253350	154882	253536	146333	146333	253350	253350
PPI-Semi-Elasticity ($\hat{\psi}$)	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
Revenue-Weighted TI (\widetilde{TI})	0.027	0.027	0.028	0.023	0.029	0.023	0.071	0.046	0.024
Overall Price Effect ($\Delta\widetilde{P}$ in %)	0.241	0.248	0.234	0.297	0.212	0.212	0.345	0.408	0.216

Notes: The dependent variable is expected price changes during the next three months reported to the IBS. “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects specific to two-digit industries. “ $\hat{\psi}$ ” denotes the semi-elasticity mapping changes in price expectations to quantitative producer prices. “ \widetilde{TI} ” and “ $\Delta\widetilde{P}$ ” reflect the overall treatment intensity in the economy and the overall effect of producer prices based on revenue weights for each county-industry cell as described in Section 5.3. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the baseline specification uses county-level wage data once available and replaces missing values by data at the more aggregated level of labor market regions. If wage data at the level of labor market regions are used to determine TI_i for all firms instead, the results do not change substantially, see Column (3) of Tables 8 and 9.

As expected, the estimated NMW effects are stronger if the construction of TI_i is restricted to industry-specific wage data at the county level. Capturing the actual treatment intensity of firms with less measurement error reduces the attenuation bias in the estimated coefficient. Regarding the price reaction of firms, the treatment effect is estimated to $\hat{\beta}^{\text{Price Exp.}} = 0.50$, see Column (4) of Table 8. Consequently, the approximated effect on the level of overall producer prices is stronger (+0.30%) compared to the baseline specification (+0.24%). For the case of employment expectations, the estimated treatment effect increases in absolute value to $\hat{\beta}^{\text{Empl. Exp.}} = -0.13$, see Column (4) of Table 9. Although the estimate is still insignificant, I cannot rule out that firms’ employment reaction would be estimated to be significantly negative if firms’ treatment intensity was observed without measurement error. Hence, the results of the baseline specification are likely to reflect a lower bound of firms’ price and employment reaction to the NMW.

Third, using the share of full-time employees that earned less than €8.50 per hour in 2013 instead of 2014 as bite measure does not alter the results substantially. As can be inferred from Column (5) of Tables 8 and 9, the coefficients of the treatment effects are slightly smaller in absolute value but in the same order of magnitude compared to the baseline scenario. This can be attributed

Table 9: Employment Response to the Minimum Wage Introduction: Robustness

Specification	Planned Employment Change in Next 3 Months								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline No Attrition		RS Wage Data			SES Wage Data		$w(p0)$	
			Region Only	County Only	2013 Wages	Fulltime Workers	All Workers	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$	-0.079 (0.065)	-0.070 (0.059)	-0.065 (0.072)	-0.13 (0.12)	-0.062 (0.058)	-0.049 (0.095)	-0.089 (0.077)	-0.091 (0.076)	-0.086 (0.064)
Control for Demand _{<i>i,t</i>}	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.357	0.349	0.357	0.373	0.357	0.367	0.367	0.357	0.357
Observations	253440	220803	253440	155005	253633	146459	146459	253440	253440

Notes: The dependent variable is the expected employment change during the next three months reported to the IBS. “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand_{*i,t*}” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects specific to two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

to the fact that wages have increased irrespective of the NMW in 2014. Hence, there is larger measurement error and more variation in TI_i when using 2013 wages for the identification of the bite both resulting in coefficients that are slightly smaller in absolute value.

Fourth, the documented responses are robust to the utilization of alternative bite measures based on the Structure of Earnings Survey. On the one hand, the SES allows to construct a bite measure along the same lines as TI_i capturing the fraction of affected full-time employees ($TI_i^{SES,FT}$). On the other hand, the treatment intensity in each firm’s sector and location can be calculated based on the fraction of all affected employees, including part-time employees and marginally employed workers ($TI_i^{SES,all}$). However, the SES data have at least two disadvantages: first, they are not representative at the level of LMR*industry cells (or below) while the RS by construction covers all full-time employees. Second, $TI_i^{SES,FT}$ and $TI_i^{SES,all}$ can only be constructed for less than half of the manufacturing and services firms in the IBS sample even if the SES data are required to cover only a minimum of 100 employees per LMR*industry cell. As documented in Column (6) of Tables 8 and 9, the coefficients of the NMW effect on price and employment expectations are virtually unchanged when using $TI_i^{SES,FT}$ as bite measure.

Moreover, abstracting from affected part-time employees or marginally employed workers in the baseline scenario does not drive the results. Using the fraction of all workers—including part-time and marginally employed workers—that earned below the NMW in 2014 as captured by $TI_i^{SES,all}$ in the regression, again uncovers a strongly positive price effect, see Column (7) of Table 8. Naturally, the coefficient on the price effect is smaller compared to the baseline scenario because of the difference in the variation covered by the bite measures. However, the approximated effect on the overall level of producer prices is slightly larger, but in the same order of magnitude once using $TI_i^{SES,all}$ (+0.34%). In turn, the coefficient on employment expectations is slightly more negative, but again

Table 10: Firms' Responses to the NMW Introduction: Different "Virtual" NMW Levels

Specification	Planned Price Change in Next 3 Months					Planned Empl. Change in Next 3 Months				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline	Threshold \bar{w}				Baseline	Threshold \bar{w}			
		6.50€	7.50€	9.50€	10.50€		6.50€	7.50€	9.50€	10.50€
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$	0.34*** (0.072)	0.85*** (0.26)	0.55*** (0.13)	0.21*** (0.050)	0.13*** (0.038)	-0.079 (0.065)	-0.19 (0.21)	-0.13 (0.11)	-0.061 (0.043)	-0.047 (0.033)
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.337	0.337	0.337	0.337	0.337	0.357	0.357	0.357	0.357	0.357
Observations	253350	253350	253350	253350	253350	253440	253440	253440	253440	253440
PPI-Semi-Elasticity ($\hat{\psi}$)	0.130	0.130	0.130	0.130	0.130					
Revenue-Weighted TI (\widetilde{TI})	0.027	0.005	0.012	0.047	0.073					
Overall Price Effect ($\Delta \tilde{P}$ in %)	0.241	0.111	0.180	0.253	0.243					

Notes: The dependent variable is expected price changes and expected employment changes during the next three months reported to the IBS, respectively. "TI" is the firm-specific bite of the NMW and " $\mathbb{1}(t \in \{2014m7, 2016m6\})$ " indicates the treatment period. "Demand $_{i,t}$ " is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" are time fixed effects specific to two-digit industries. " $\hat{\psi}$ " denotes the semi-elasticity mapping changes in price expectations to quantitative producer prices. " \widetilde{TI} " and " $\Delta \tilde{P}$ " reflect the overall treatment intensity in the economy and the overall effect of producer prices based on revenue weights for each county-industry cell as described in Section 5.3. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

not approaching significance.

Fifth, the results are robust to different assumptions about the minimum of the wage distribution $w(0)$ which is not given in the RS wage data. The baseline specification is based on the assumption that $w(0)$ is related to the wage at the 10th percentile ($w(10)$) in the same way as $w(10)$ is related to wages at the 20th percentile. In this specification, the minima of the wage distribution on average correspond to approximately 85% of the wage rates at the 10th percentile. As documented in Columns (8) and (9) of Tables 8 and 9, the estimated treatment effects are unchanged once the wage curve below the 10th percentile is assumed to be either steeper (with $w(0) = 0.7 \times w(10)$) or flatter (with $w(0) = 0.9 \times w(10)$).

Different "Virtual" Levels of NMW. In addition, the results are robust to the choice of different "virtual" minimum wage levels \bar{w}_{min} for the construction of TI_i , see Table 10. If TI_i measures the fraction of all full-time employees that earned less than €6.50 or €7.50 in 2014, the bite measure only captures firms that are affected very strongly by the introduction of a NMW of €8.50 per hour. Unsurprisingly, the estimated effect on the overall price level is smaller (+0.11% for $\bar{w}_{min} = €6.50$ and +0.18% for $\bar{w}_{min} = €7.50$) because fewer firms are considered as being affected, see Columns (2) and (3). Further, the estimated employment reaction among these highly treated firms is more negative than in the baseline specification ($\hat{\beta}^{Empl. Exp.} = -0.19$ and $\hat{\beta}^{Empl. Exp.} = -0.13$) but still insignificant, see Columns (7) and (8). Despite of being insignificant, this points into the

Table 11: Minimum Wage Effects at the Firm-Level: Test for SUTVA

	Price Exp. $_t^{+3m}$				Employment Exp. $_t^{+3m}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Omit if $TI = 0$ if $TI(\bar{w}^{alt}) > 0$	Baseline	$\bar{w}^{alt} = 10\text{€}$	$\bar{w}^{alt} = 12\text{€}$	$\bar{w}^{alt} = 15\text{€}$	Baseline	$\bar{w}^{alt} = 10\text{€}$	$\bar{w}^{alt} = 12\text{€}$	$\bar{w}^{alt} = 15\text{€}$
$TI \times \mathbb{1}(t \in \{2014m7, 2016m6\})$	0.34*** (0.07)	0.36*** (0.08)	0.38*** (0.09)	0.36*** (0.09)	-0.08 (0.06)	-0.04 (0.07)	-0.04 (0.07)	-0.07 (0.07)
N	253350	205322	144047	91262	253440	205385	144048	91295
R^2	0.337	0.330	0.324	0.336	0.357	0.363	0.364	0.336
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variables are planned price or employment changes during the next three months reported to the IBS. “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. In Columns (2) through (4) and (6) through (8) firms are dropped from the sample if they are unaffected according to the baseline bite measure, but would be affected by a hypothetical minimum wage of \bar{w}^{alt} , i.e., if $TI^{Baseline} = 0$ and $TI(\bar{w}^{alt}) > 0$. “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

direction that deteriorated employment plans were—if anything—more likely to occur among very strongly affected firms.

If the NMW bite measure is calculated based on thresholds above €8.50, TI_i assigns a positive treatment intensity to firms that operate in industries and regions where all full-time employees earned wages slightly above the NMW prior to its introduction. However, it could be argued that these firms employed at least some part-time employees or marginally employed workers that previously earned less than €8.50. The results in Columns (4) and (5) of Table 10 indicate that price expectations in the period around the NMW introduction reacted less sensitive to a given variation in TI_i based on the thresholds of $\bar{w}_{min} = \text{€}9.50$ and $\text{€}10.50$ compared to the baseline specification. Naturally, the revenue-weighted mean of overall treatment intensity $\widetilde{TI}(\bar{w}_{min})$ is larger in these specifications, i.e., $\widetilde{TI}(9.50) = 0.047$ and $\widetilde{TI}(10.50) = 0.073$. Strikingly, the overall effect on producer prices (+0.25% and +0.24%) is comparable to the baseline scenario (+0.24%). This indicates that the price effect is generated by firms that were already captured by the baseline specification of the treatment intensity measure. Abstracting from firms that were affected by the NMW only through higher wage costs for part-time employees or marginally employed workers does hence not appear to be worrisome.

SUTVA. A major concern of the DiD approach is that the Stable Unit Treatment Value Assumption (SUTVA) is violated. If firms that were not directly subject to the NMW ($TI_i = 0$) were affected via spillover effects, the empirical results would be biased. The SUTVA is very likely to hold in the case of the German NMW due to several reasons. First, existing evidence does not speak

in favor of wage spillovers to workers that previously earned above the German NMW.³⁷ Second, general equilibrium effects on firms that are perceived as unaffected by the baseline bite measure are arguably limited. Despite of the fact that more than 10% of all employment relations were directly affected by the NMW, their share in the overall wage bill of the economy corresponded to 0.43% (Destatis, 2016). Although affected firms rolled over a substantial share of this wage bill increase to their customers, the second order effects on untreated firms are hence small. Third, restricting the set of firms in the control group by omitting those firms that were above, but close to the minimum wage threshold prior to the reform does not alter the main results of the paper. Table 11 shows the results of the main regressions when omitting firms with $TI_i = 0$ that would have been affected positively by alternative wage floors at levels as high as $\bar{w}^{alt} \in \{\text{€}10, \text{€}12, \text{€}15\}$. Apparently, the estimated price and employment responses of affected firms to the NMW are not different in any of these specifications.

8. Conclusion

This paper studies the price and employment reactions of firms in manufacturing and services in response to the introduction of nationwide wage floor in Germany in 2015. Instead of reducing employment, affected firms were more likely to increase prices in order to absorb the increase in the wage bill. The results suggest that the speed of price adjustment was relatively fast and that the firms rolled over the lion’s share of the minimum wage induced costs to their customers.

My results generalize the findings of other studies on price effects of minimum wages that are usually based on data from highly affected industries such as restaurants and retailers, only. Documenting strong price responses of firms in different sectors of the economy, including manufacturing, I show that the importance of price pass-through is not limited to firms in specific low-wage sectors but a widespread phenomenon. However, my findings indicate that the size of the price response to minimum wages is heterogeneous and depends on firms’ expectations regarding the development of their businesses as well as the competition firms face in the product market and local labor market.

The results presented in this paper have implications for the general understanding of the employment response to minimum wages. The small effect of minimum wages has often been associated with the importance of monopsony behavior (see Bhaskar et al., 2002 for a survey) or the role of informational frictions or search frictions in the labor market (e.g., van den Berg, 2003 and Dube et al., 2016). In light of the relatively restrictive labor market institutions and employment protection in Germany, my results cannot rule out that labor market frictions explain the weak effect of the German minimum wage on employment as proposed by Blömer et al. (2018). However, Aaronson and French (2007) and Aaronson et al. (2008) show that the monopsony model cannot explain strong price rises after minimum wage increases. Hence, my results suggest that monopsony

³⁷For example, Caliendo et al. (2017) do not find positive wage spillovers using wage data from the “Socio-Economic Panel” (SOEP). Moreover, Ahlfeldt et al. (2018) find stronger wage growth in low-wage regions relative to high-wage regions using administrative wage data in the “Integrated Employment Biographies” provided by the Institute for Employment Research (IAB). See Caliendo et al. (2019) for a comprehensive survey on this issue.

power did not play a major role in explaining the small employment effect of the introduction of a nation-wide minimum wage in Germany.

Taken together, the findings of this paper suggests that a joint assessment of different potential adjustment channels, which is not limited to the employment margin, is important to gain a comprehensive understanding of firms' response to minimum wages.

References

- Aaronson, D. (2001). Price Pass-through and the Minimum Wage. *Review of Economics and Statistics*, 83(1):158–169.
- Aaronson, D. and French, E. (2007). Product Market Evidence on the Employment Effects of the Minimum Wage. *Journal of Labor Economics*, 25(1):167–200.
- Aaronson, D., French, E., and MacDonald, J. (2008). The Minimum Wage, Restaurant Prices, and Labor Market Structure. *Journal of Human Resources*, 43(3):688–720.
- Ahlfeldt, G., Roth, D., and Seidel, T. (2018). The Regional Effects of Germany's National Minimum Wage. *Economics Letters*, 172:127–130.
- Allegretto, S. and Reich, M. (2018). Are Local Minimum Wages Absorbed by Price Increases? Estimates from Internet-Based Restaurant Menus. *ILR Review*, 71(1):35–63.
- Angrist, J. D. and Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Autor, D. H., Manning, A., and Smith, C. L. (2016). The Contribution of the Minimum Wage to US Wage Inequality over Three Decades: a Reassessment. *American Economic Journal: Applied Economics*, 8(1):58–99.
- Bachmann, R., Born, B., Elstner, S., and Grimme, C. (2019). Time-Varying Business Volatility and the Price Setting of Firms. *Journal of Monetary Economics*, 101:82–99.
- Bachmann, R. and Elstner, S. (2015). Firm Optimism and Pessimism. *European Economic Review*, 79:297–325.
- Bell, B. and Machin, S. (2018). Minimum Wages and Firm Value. *Journal of Labor Economics*, 36(1):159–195.
- Bertrand, M., Duflo, E., and Mullainathan, S. (2004). How Much Should We Trust Differences-in-Differences Estimates? *The Quarterly Journal of Economics*, 119(1):249–275.
- Besley, T. J. and Rosen, H. S. (1999). Sales Taxes and Prices: An Empirical Analysis. *National Tax Journal*, 52:157–178.

- Bhaskar, V., Manning, A., and To, T. (2002). Oligopsony and Monopsonistic Competition in Labor Markets. *Journal of Economic Perspectives*, 16(2):155–174.
- Blömer, M., Guertzgen, N., Pohlman, L., Stichnoth, H., and Van den Berg, G. J. (2018). Unemployment Effects of the German Minimum Wage in an Equilibrium Job Search Model. *CESifo Working Paper No. 7160*.
- Bossler, M. and Gerner, H.-D. (2019). Employment Effects of the New German Minimum Wage: Evidence from Establishment-Level Micro Data. *ILR Review*, forthcoming.
- Brochu, P. and Green, D. A. (2013). The Impact of Minimum Wages on Labour Market Transitions. *The Economic Journal*, 123(573):1203–1235.
- Caliendo, M., Fedorets, A., Preuss, M., Schröder, C., and Wittbrodt, L. (2017). The Short-Term Distributional Effects of the German Minimum Wage Reform. *IZA Discussion Paper No. 11246*.
- Caliendo, M., Fedorets, A., Preuss, M., Schröder, C., and Wittbrodt, L. (2018). The Short-run Employment Effects of the German Minimum Wage Reform. *Labour Economics*, 53:46–62.
- Caliendo, M., Schröder, C., and Wittbrodt, L. (2019). The Causal Effects of the Minimum Wage Introduction in Germany: An Overview. *German Economic Review*, forthcoming.
- Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2011). Robust Inference with Multiway Clustering. *Journal of Business & Economic Statistics*, 29(2):238–249.
- Campa, J. M. and Goldberg, L. S. (2005). Exchange Rate Pass-Through into Import Prices. *Review of Economics and Statistics*, 87(4):679–690.
- Card, D. (1992). Using Regional Variation in Wages to Measure the Effects of the Federal Minimum Wage. *ILR Review*, 46(1):22–37.
- Card, D. and Krueger, A. B. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review*, 84:772–793.
- Card, D. and Krueger, A. B. (2015). *Myth and Measurement: the New Economics of the Minimum Wage*. Princeton University Press.
- Chetty, R., Friedman, J. N., Olsen, T., and Pistaferri, L. (2011). Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records. *The Quarterly Journal of Economics*, 126(2):749–804.
- Destatis (2016). 4 Millionen Jobs vom Mindestlohn betroffen. *German Federal Statistical Office Press Release 121/2016-04-06*.
- Draca, M., Machin, S., and Van Reenen, J. (2011). Minimum Wages and Firm Profitability. *American Economic Journal: Applied Economics*, 3(1):129–151.

- Dube, A., Lester, T. W., and Reich, M. (2010). Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties. *The Review of Economics and Statistics*, 92(4):945–964.
- Dube, A., Lester, T. W., and Reich, M. (2016). Minimum Wage Shocks, Employment Flows, and Labor Market Frictions. *Journal of Labor Economics*, 34(3):663–704.
- Dube, A., Naidu, S., and Reich, M. (2007). The Economic Effects of a Citywide Minimum Wage. *ILR Review*, 60(4):522–543.
- Fabra, N. and Reguant, M. (2014). Pass-Through of Emissions Costs in Electricity Markets. *American Economic Review*, 104(9):2872–99.
- Federal Employment Agency (2016). Arbeitsmarkt in Zahlen, Verteilungsparameter der monatlichen Bruttoarbeitsentgelte von sozialversicherungspflichtig Vollzeitbeschäftigten der Kerngruppe nach Wirtschaftszweigen (WZ 2008), Nürnberg, Dezember 2016. *Special Evaluation of the Statistical Service of the Federal Employment Agency*.
- Fitzenberger, B. and Doerr, A. (2016). Konzeptionelle Lehren aus der ersten Evaluationsrunde der Branchenmindestlöhne in Deutschland. *Journal for Labour Market Research*, 49(4):329–347.
- Fougère, D., Gautier, E., and Le Bihan, H. (2010). Restaurant Prices and the Minimum Wage. *Journal of Money, Credit and Banking*, 42(7):1199–1234.
- Garloff, A. (2016). Side Effects of the New German Minimum Wage on (Un-)Employment: First Evidence from Regional Data. *IAB-Discussion Paper No. 31/2016*.
- Gopinath, G., Itskhoki, O., and Rigobon, R. (2010). Currency Choice and Exchange Rate Pass-Through. *American Economic Review*, 100(1):304–36.
- Harasztosi, P. and Lindner, A. (2019). Who Pays for the Minimum Wage? *American Economic Review*, forthcoming.
- IBS-IND (2017). *Ifo Business Survey Industry 1/1980 - 12/2017*. LMU-ifo Economics & Business Data Center, Munich, doi: 10.7805/ebdc-ibs-ind-2017b.
- IBS-SERV (2017). *Ifo Business Survey Service Sector 10/2004 - 12/2017*. LMU-ifo Economics & Business Data Center, Munich, doi: 10.7805/ebdc-ibs-serv-2017b.
- Jardim, E., Long, M. C., Plotnick, R., van Inwegen, E., Vigdor, J., and Wething, H. (2017). Minimum Wage Increases, Wages, and Low-Wage Employment: Evidence from Seattle. *NBER Working Paper No. 23532*.
- Knabe, A., Schöb, R., and Thum, M. (2014). Der flächendeckende Mindestlohn. *Perspektiven der Wirtschaftspolitik*, 15(2):133–157.
- Lemos, S. (2008). A Survey of the Effects of the Minimum Wage on Prices. *Journal of Economic Surveys*, 22(1):187–212.

- Leung, J. (2018). Minimum Wage and Real Wage Inequality: Evidence from Pass-Through to Retail Prices. *Working Paper*.
- Link, S. (2018). Harmonization and Interpretation of the ifo Business Survey’s Micro Data. *CESifo Working Paper No. 7427*.
- Lordan, G. and Neumark, D. (2018). People Versus Machines: The Impact of Minimum Wages on Automatable Jobs. *Labour Economics*, 52:40–53.
- Machin, S., Manning, A., and Rahman, L. (2003). Where the Minimum Wage Bites Hard: Introduction of Minimum Wages to a Low Wage Sector. *Journal of the European Economic Association*, 1(1):154–180.
- MaCurdy, T. (2015). How Effective is the Minimum Wage at Supporting the Poor? *Journal of Political Economy*, 123(2):497–545.
- Manning, A. (2003). *Monopsony in Motion: Imperfect Competition in Labor Markets*. Princeton University Press.
- Meer, J. and West, J. (2016). Effects of the Minimum Wage on Employment Dynamics. *Journal of Human Resources*, 51(2):500–522.
- Metcalf, D. (2008). Why Has the British National Minimum Wage Had Little or No Impact on Employment? *Journal of Industrial Relations*, 50(3):489–512.
- Mian, A. and Sufi, A. (2014). What Explains the 2007–2009 Drop in Employment? *Econometrica*, 82(6):2197–2223.
- Mindestlohnkommission (2018). Zweiter Bericht zu den Auswirkungen des gesetzlichen Mindestlohn. *Report of the Minimum Wage Commission to the Federal Government according to §9 para. 4 of the Minimum Wage Law*.
- Müller, K.-U. and Steiner, V. (2013). Distributional Effects of a Minimum Wage in a Welfare State—The Case of Germany. *Working Paper*.
- National Regulatory Control Council (2017). *Bureaucracy Reduction. Better Regulation. Digital Transformation. Leverage Successes - Address Shortcomings*. Annual Report.
- Neumark, D., Salas, J. I., and Wascher, W. (2014). Revisiting the Minimum Wage-Employment Debate: Throwing Out the Baby with the Bathwater? *ILR Review*, 67(3):608–648.
- Neumark, D. and Wascher, W. (2000). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Comment. *American Economic Review*, 90(5):1362–1396.
- OECD (2015). OECD Employment Outlook 2015. *OECD Publishing, Paris*.

- Pesaran, M. H. and Timmermann, A. (2009). Testing Dependence Among Serially Correlated Multicategory Variables. *Journal of the American Statistical Association*, 104(485):325–337.
- Portugal, P. and Cardoso, A. R. (2006). Disentangling the Minimum Wage Puzzle: An Analysis of Worker Accessions and Separations. *Journal of the European Economic Association*, 4(5):988–1013.
- Renkin, T., Montialoux, C., and Siegenthaler, M. (2017). The Pass-Through of Minimum Wages into US Retail Prices: Evidence from Supermarket Scanner Data. *Working Paper*.
- Riedl, M. and Geishecker, I. (2014). Keep It Simple: Estimation Strategies for Ordered Response Models with Fixed Effects. *Journal of Applied Statistics*, 41(11):2358–2374.
- Sachverständigenrat (2014). *Mehr Vertrauen in Marktprozesse*. Jahresgutachten 2014/15, Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung.
- Sauer, S. and Wohlrabe, K. (2019). Chef oder Praktikant—Wer beantwortet eigentlich die Fragebögen in den ifo Konjunkturumfragen? *ifo Schnelldienst*, 72(03):30–32.
- Stigler, G. J. (1946). The Economics of Minimum Wage Legislation. *American Economic Review*, 36(3):358–365.
- Tonin, M. (2011). Minimum Wage and Tax Evasion: Theory and Evidence. *Journal of Public Economics*, 95(11):1635–1651.
- van den Berg, G. J. (2003). Multiple Equilibria and Minimum Wages in Labor Markets with Informational Frictions and Heterogeneous Production Technologies. *International Economic Review*, 44(4):1337–1357.
- Wadsworth, J. (2010). Did the National Minimum Wage Affect UK Prices? *Fiscal Studies*, 31(1):81–120.
- Yang, J. (1997). Exchange Rate Pass-Through in US Manufacturing Industries. *Review of Economics and Statistics*, 79(1):95–104.

A. Appendix

A.1. Additional Material Regarding IBS Data

A.1.1. Wording of Survey Questions

The following set of questions, which are asked regularly on a monthly basis in the IBS, are used in this paper (English translation of German original):

Services Survey (S):

S:Q1 Price Expectations:

“During the next 3 months, the prices of our services will [1] increase, [0] stay the same, or [-1] decrease.”

S:Q2 Employment Expectations:

“During the next (2-3) months, the number of employees will [1] increase, [0] stay the same, or [-1] decrease.”

S:Q2a Realized Employment Changes:

“During the past (2-3) months, the number of employees [1] increased, [0] stayed the same, or [-1] decreased.”

S:Q3 Current Backlog of Orders:

“We evaluate our backlog of orders as [1] comparatively large, [0] sufficient (typical for the season), or [-1] too small.”

S:Q4 Current Business Situation:

“We evaluate our current business situation as [1] good, [0] satisfactory (typical for the season), or [-1] bad.”

S:Q5 Expected Business Situation:

“During the next six months, our business situation will be [1] more favorable, [0] stay the same, or [-1] more unfavorable.”

S:Q6 Demand Expectations:

“During the next (2-3) months, the demand for our services and/or our revenues will [1] increase, [0] stay approximately the same, or [-1] decrease.”

Manufacturing Survey (M):

In the manufacturing survey, firms are asked for assessments regarding specific products. However, only 0.43% of all observations between 2011 and 2017 refer to multiple products for the same firm at a given point in time. Following the procedure described in Link (2018), these observations are aggregated to the firm level by taking means across products and rounding to the next integer.

M:Q1 Price Expectations:

“During the next 3 months, the domestic (net) sales prices for product X will—in consideration of changes in conditions—probably [1] increase, [0] roughly stay the same, or [-1] decrease.”

M:Q1a Realized Price Changes:

“During the past month, the domestic (net) sales price for product X—in consideration of changes in conditions— [1] increased, [0] stayed the same, or [-1] decreased.”

M:Q2 Employment Expectations:

“During the next 3 months, the number of employees for the production of product X will [1] increase, [0] roughly stay the same, or [-1] decrease.”

M:Q3 Current Backlog of Orders:

“We evaluate our backlog of orders for product X as [1] comparatively large, [0] sufficient (typical for the season), or [-1] too small.”

M:Q4 Current Business Situation:

“We evaluate the current business situation for product X as [1] good, [0] satisfactory, or [-1] bad.”

M:Q5 Expected Business Situation:

“Expectations for the next six months: the business situation for product X will be [1] more favorable, [0] stay the approximately same, or [-1] more unfavorable.”

M:Q6 Production Expectations:

“Expectations for the next three months: the domestic production of product X will [1] increase, [0] stay the approximately same, or [-1] decrease.”

A.1.2. Descriptive Statistics of IBS Data

Table A.1: Price Expectations and Realized Price Changes in the Subsequent Three Months

	Obs.	Fractions of Mean Realized Price Changes b/w $t + 1$ & $t + 3$			Sum
		> 0	$= 0$	< 0	
Price Exp. $_{t-t+3m}^{+3m} = 1$	14003	0.62	0.35	0.03	1
Price Exp. $_{t-t+3m}^{+3m} = 0$	88288	0.09	0.83	0.08	1
Price Exp. $_{t-t+3m}^{+3m} = -1$	7073	0.03	0.27	0.69	1

Notes: This table contrasts the micro data of expected price changes during the next three months stated in t with the mean reported (monthly) price changes during the following three months, i.e., between $t + 1$ and $t + 3$. The sample is restricted to manufacturing firms that reported price expectations in t as well as price realizations in the subsequent three months.

Table A.2: Employment Expectations and Realized Changes in the Subsequent Three Months

	Obs.	Fractions of Realized Empl. Changes b/w $t + 1$ & $t + 3$			Sum
		> 0	$= 0$	< 0	
Empl. Exp. $_{t-t+3m}^{+3m} = 1$	17173	0.74	0.20	0.06	1
Empl. Exp. $_{t-t+3m}^{+3m} = 0$	69549	0.22	0.66	0.12	1
Empl. Exp. $_{t-t+3m}^{+3m} = -1$	6295	0.08	0.25	0.67	1

Notes: This table contrasts the micro data of expected employment changes during the next three months stated in t with the reported employment change three months later. The sample is restricted to services companies that reported employment expectations in t as well as employment realizations in $t + 3$.

Table A.3: Cross-Correlation b/w Average Reports to IBS and Changes in Quantitative Price Data

<i>Panel A: Changes in PPI Relative to 3 Months Before</i>							
Lag i	-3	-2	-1	0	1	2	3
$\rho(\text{Price Exp.}_{t-t+3m}^{+3m}, \Delta \overline{PPI}_t)$	0.334	0.54	0.696	0.812	0.845	0.799	0.653
$\rho(\text{Price Realiz.}_{t-t+1m}^{-1m}, \Delta \overline{PPI}_t)$	0.609	0.714	0.797	0.821	0.777	0.648	0.483
<i>Panel B: Changes in PPI Relative to Previous Month</i>							
Lag i	-3	-2	-1	0	1	2	3
$\rho(\text{Price Realiz.}_{t-t+1m}^{-1m}, \Delta \overline{PPI}_t)$	0.599	0.578	0.674	0.633	0.468	0.339	0.225

Notes: Cross-correlogram of time series of changes in weighted producer prices ($\Delta \overline{PPI}_t$) relative to three months ago (Panel A) or one month ago (Panel B) and average expected price changes for the next three months ($\text{Price Exp.}_{t-t+3m}^{+3m}$) or average realized price changes during the previous month ($\text{Price Realiz.}_{t-t+1m}^{-1m}$) as reported to the IBS. The sample is restricted to manufacturing firms between January 2011 and June 2016 or September 2016 for the specifications using price expectations and price realizations, respectively.

Table A.4: Industry-Level Cross-Correlation and Semi-Elasticity in Biggest Manufacturing Sectors

Two-Digit Industry (WZ 2008) s	Lag i							Semi-Elasticity
	-3	-2	-1	0	1	2	3	$\hat{\psi}^{Exp}/\hat{\psi}^{Realiz}$
28 Machinery and equipment n.e.c. (451 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	0.004	0.213	0.431	0.629	0.792	0.835	0.640	0.117
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	0.33	0.472	0.695	0.805	0.749	0.486	0.251	0.147
25 Fabricated metal products, except machinery & equipment (304 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	0.414	0.617	0.707	0.803	0.787	0.774	0.688	0.151
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	0.738	0.777	0.794	0.759	0.734	0.680	0.578	0.161
22 Rubber and plastic products (182 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	0.003	0.116	0.389	0.705	0.857	0.769	0.530	0.193
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	0.197	0.421	0.694	0.865	0.835	0.618	0.352	0.213
27 Electrical equipment (181 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	-0.259	-0.253	-0.140	0.042	0.214	0.223	0.143	0.028
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	-0.022	0.054	0.151	0.165	0.154	0.073	-0.050	0.028
23 Other non-metallic mineral products (116 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	-0.17	-0.069	0.080	0.271	0.484	0.563	0.565	0.088
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	-0.064	0.131	0.352	0.495	0.581	0.527	0.385	0.127
20 Chemicals and chemical products (115 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	0.267	0.399	0.534	0.628	0.655	0.614	0.531	0.316
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	0.420	0.454	0.522	0.579	0.598	0.526	0.418	0.260
18 Printing and reproduction of recorded media (96 firms)								
$\rho(\overline{\text{Price Exp.}}_{s,t-i}^{+3m}, \Delta \overline{PPI}_{s,t})$	0.013	0.043	0.085	0.149	0.211	0.170	0.159	0.054
$\rho(\overline{\text{Price Realiz.}}_{s,t-i}^{-1m}, \Delta \overline{PPI}_{s,t})$	0.006	0.098	0.069	0.152	0.007	-0.038	-0.073	0.033

Notes: This table presents industry-specific cross-correlations for the largest sectors in manufacturing between changes in producer prices ($\Delta \overline{PPI}_{s,t}$) relative to three months ago and average expected price changes for the next three months ($\overline{\text{Price Exp.}}_{s,t}^{+3m}$) or average realized price changes during the previous month ($\overline{\text{Price Realiz.}}_{s,t}^{-1m}$) as reported to the IBS. “ $\hat{\psi}$ ” denotes the semi-elasticity that maps changes in average price expectations/realizations to quantitative producer prices as described in Section 3. The sample is restricted to firms between January 2011 and June 2016 or September 2016 for the specifications using price expectations and price realizations, respectively.

A.2. Supplementary Material Regarding Treatment Intensity Measure

A.2.1. Details on Construction of the Bite Measure

This appendix complements Section 4.1 by providing detailed information on the construction of the bite measure TI_i . I obtained data of gross monthly wages paid to full-time employees in each two-digit industry at the level of counties (NUTS-3-regions) as well as labor market regions (LMRs) in 2014 at the following percentiles: $p \in \{10, 20, 30, 40, 50, 60, 80\}$ from the Federal Employment Agency (2016). As described in the main text, the baseline specification of TI_i is based on the industry-specific wage distribution at the county-level and missing values are replaced by wage data at the LMR-level.

Monthly wages are converted to hourly wages by means of the number of paid working hours per month collected by the Quarterly Earnings Survey (“*Vierteljährliche Verdiensterhebung*”). This survey, which is conducted by the statistical offices of the federal states, covers 40,500 German firms (7.4% of all firms) and is representative at the level of two-digit industries in both East and West Germany.³⁸ After calculating the average amount of monthly working hours in 2014 for each industry in West and East Germany, the monthly wages at each percentile are transformed to an hourly basis for each sector-region cell, i.e., to $w_{s,r}(p)$ which denotes the p^{th} percentile of hourly wages in sector s and region r (counties or LMRs).

Then, the fraction of full-time employees that earned a gross hourly wage of less than €8.50 is calculated for each sector-region combination. Figure A.1 provides an illustration of the procedure that is based on two assumptions about the shape of the wage distribution: first, the wage level of employees between any two percentiles for which wage data are available is approximated by linear interpolation. Second, the wage level at the minimum of the wage distribution $w_{s,r}(0)$ is assumed to be related to the wage at the 10th percentile similarly as $w_{s,r}(10)$ is related to $w_{s,r}(20)$, i.e., $w_{s,r}(0)/w_{s,r}(10) = w_{s,r}(10)/w_{s,r}(20)$. Accordingly, the wage level at the maximum of the wage distribution is assumed to be $w_{s,r}(100)/w_{s,r}(80) = w_{s,r}(80)/w_{s,r}(60)$. Given these assumptions, the fraction of full-time employees that earned less than €8.50 per hour in 2014 in each sector-region cell—henceforth denoted as $TI_{s,r}$ —can be derived from the intercept theorem:

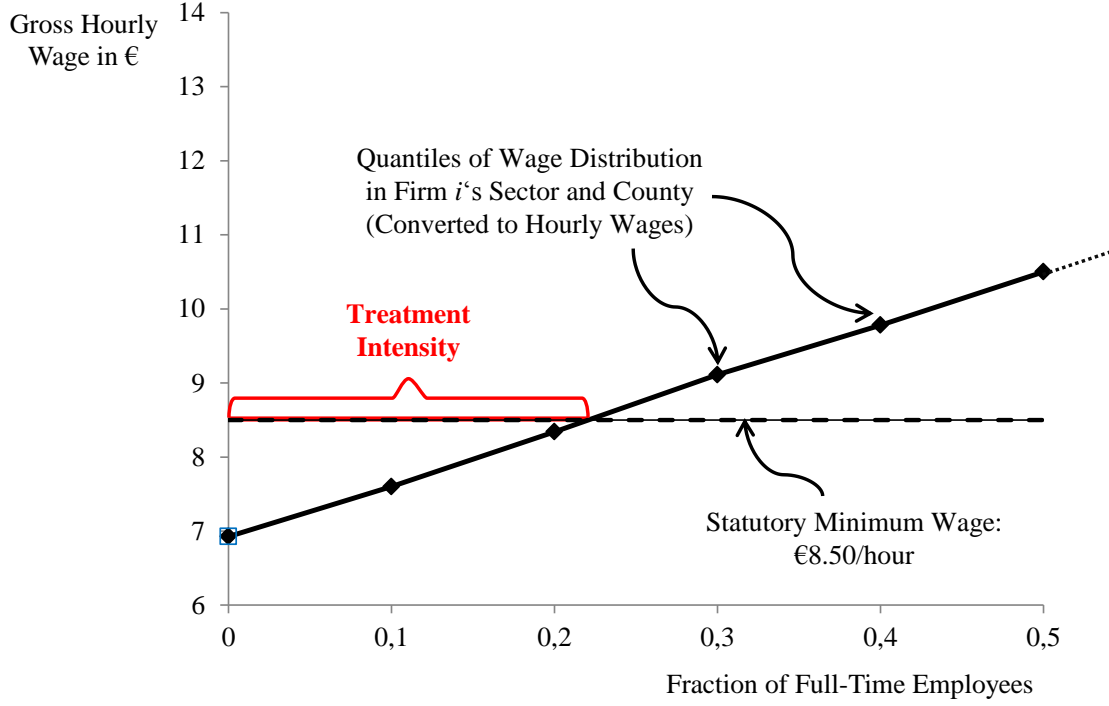
$$TI_{s,r} = \begin{cases} 0 & \text{if } \bar{w}_{min} \leq w_{s,r}(0) \\ p + 0.1 * \frac{\bar{w}_{min} - w_{s,r}(p)}{w_{s,r}(p+10) - w_{s,r}(p)} & \text{if } w_{s,r}(p) < \bar{w}_{min} \leq w_{s,r}(p+10) \wedge p \in \{10, 20, 30, 40, 50\} \\ p + 0.2 * \frac{\bar{w}_{min} - w_{s,r}(p)}{w_{s,r}(p+20) - w_{s,r}(p)} & \text{if } w_{s,r}(p) < \bar{w}_{min} \leq w_{s,r}(p+20) \wedge p \in \{60, 80\} \\ 1 & \text{if } w_{s,r}(100) \leq \bar{w}_{min} \end{cases} \quad (5)$$

where \bar{w}_{min} denotes the level of the new statutory minimum wage of €8.50 per hour.

It is important to note that the relative ordering of sector-region combinations with respect to their fraction of full-time employed that earned less than €8.50 does not hinge on the choice of $w_{s,r}(0)$ and $w_{s,r}(100)$. I also computed TI_i assuming that $w_{s,r}(0) = 0.9 * w_{s,r}(10)$ or $w_{s,r}(0) = 0.7 * w_{s,r}(10)$.

³⁸The quality of the data on working hours is perceived to be very high as response to the survey is compulsory. The data is publicly available from the Federal Statistical Office and described in more detail here: <https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/EarningsLabourCosts/Methods/QuarterlyEarningsSurvey.html>.

Figure A.1: Illustration of the Identification of Firms' Affectedness by the Minimum Wage



Notes: This diagram illustrates the identification of firms' affectedness by the NMW indicated by the red line ("Treatment Intensity") for the example of firms in industry "55 Accommodation/Lodging" in county "09180 Garmisch-Partenkirchen." The black rhombi refer to the deciles of the wage distribution of full-time employees in 2014 after conversion to hourly wages. The wage levels between the deciles given in the data are linearly interpolated, while the values for the minimum and maximum of the wage distribution are calculated as described in the main text.

The relative ordering of sector-region cells did not change substantially. Moreover, robustness checks presented in Section 7 show that the documented NMW effects do not hinge on the assumptions about $w_{s,r}(0)$.

A.2.2. Plausibility Test Exploiting Supplementary Questions in IBS

This appendix complements the evidence presented in Section 4.1 regarding the plausibility of the treatment intensity measure TI_i by making use of firms' responses to a series of supplementary questions in the IBS. Specifically, the IBS version of November 2014 has been complemented by the following set of questions referring to firms' assessments about the upcoming NMW introduction in January 2015 (English translation of German original):

SQ1: *"The statutory minimum wage will be introduced on January 1st, 2015. Is your company affected by this regulation? [1] yes, [0] no."*

"If yes, which actions are you going to undertake in reaction to the introduction of the minimum wage (multiple answers possible)?"

SQ2: *No action planned: [1] yes.*

SQ3: *Reduction in staff: [1] yes.*

SQ4: *Reduction in working hours: [1] yes.*

SQ5: *Price increases: [1] yes.*

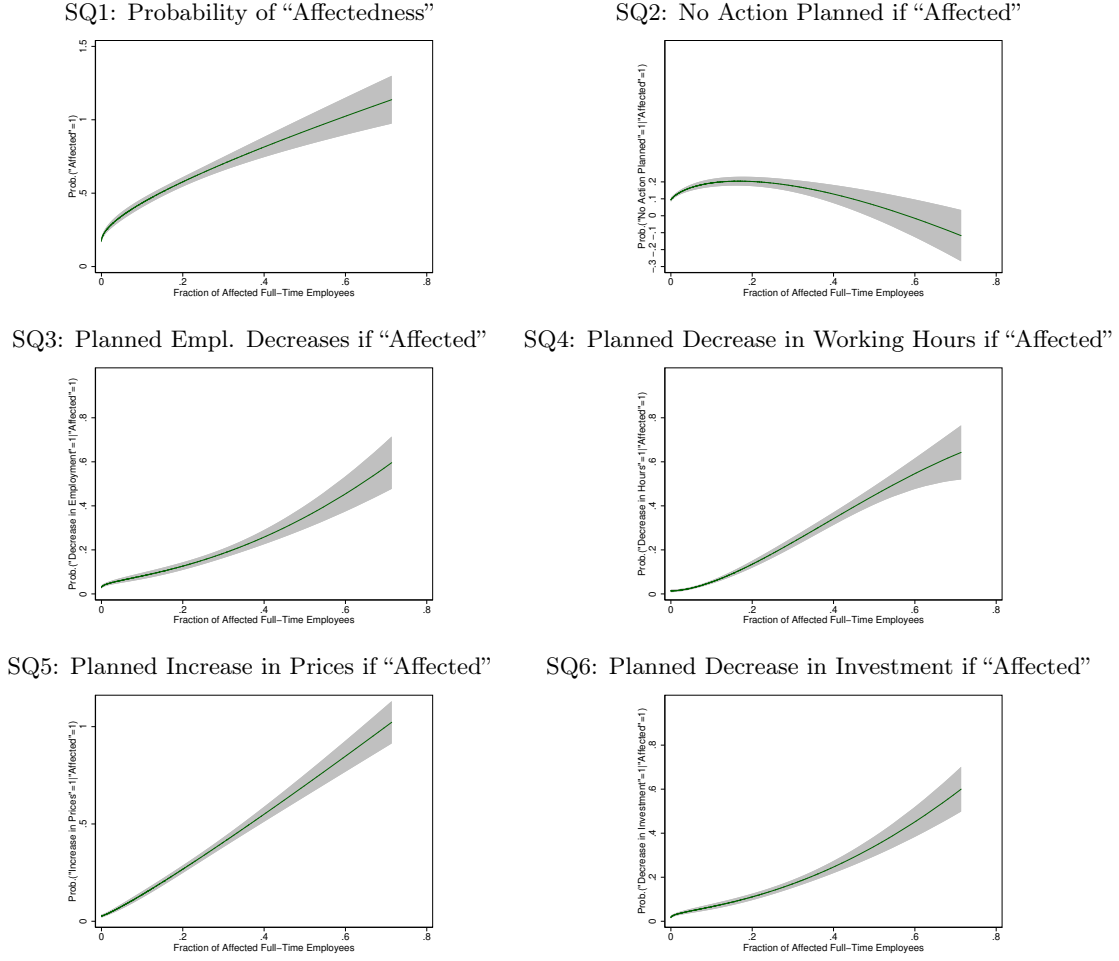
SQ6: *Decreased investment volume: [1] yes.*

SQ7: *Cuts in bonus payments: [1] yes.*

SQ8: *Other action: [1] yes."*

As the functional form of the relationship between TI_i and the frequency to which firms answered the supplementary questions in the affirmative is not clear *a priori*, I estimate a fractional polynomial of degree two of TI_i without adding any further covariates. Figure A.2 plots the resulting curves of the mean probability to affirm to the respective question at different levels of TI_i along with the 95%-confidence intervals. In addition, Table A.5 summarizes the average frequencies of responses at different levels of TI_i . The question about firms' affectedness (SQ1) neither provides any information about the intensity to which firms are affected nor contains any information about the channels through which firms are affected. As can be inferred from Figure A.2 and Table A.5, the frequency that firms stated to be affected by the NMW increases substantially in TI_i . The majority among the 17% of firms that reported to be affected by the minimum wage despite of $TI_i = 0$ did not plan to react to the NMW. Arguably, these firms were only affected indirectly by the NMW or perceived themselves as being affected because of the obligatory and time-consuming documentation

Figure A.2: Relationship Between TI_i and NMW-Related Supplementary Questions in the IBS



Notes: Each figure plots the predicted probability (green line) to affirm to the respective supplementary question by estimating a fractional polynomial of degree two of TI_i without adding any further covariates. The shaded area covers the 95%-confidence interval of the predicted probabilities.

Table A.5: Plausibility Check of the Treatment Intensity Measure: Extended Results

	Treatment Intensity $TI \in$		
	[0%]	(0%,20%]	(20%,100%)
$prob(\text{"Affected"} = 1)$	0.172	0.379	0.753
$prob(\text{"Do Not Plan to React"} = 1 \text{"Affected"} = 1)$	0.528	0.449	0.178
$prob(\text{"Staff Reduction"} = 1 \text{"Affected"} = 1)$	0.175	0.179	0.310
$prob(\text{"Hours Reduction"} = 1 \text{"Affected"} = 1)$	0.074	0.132	0.364
$prob(\text{"Price Increase"} = 1 \text{"Affected"} = 1)$	0.147	0.287	0.612
$prob(\text{"Reduction in Investment"} = 1 \text{"Affected"} = 1)$	0.101	0.132	0.302
$prob(\text{"Reduction in Special Payments"} = 1 \text{"Affected"} = 1)$	0.147	0.236	0.380

Notes. "TI" refers to the fraction of full-time employees that earned an hourly gross wage of less than €8.50 in 2014 in each firm's two-digit industry and county. $prob(\text{"Affected"} = 1)$ displays the frequency that firms responded to be "affected" by the NMW in the supplementary questions of the IBS in November 2014 depending on TI_i as indicated at the top of each column. $prob(\text{"Do Not Plan to React"} = 1 | \text{"Affected"} = 1)$, etc. are defined accordingly.

requirements.

Moreover, the probability that “affected” firms according to SQ1 stated to react to the NMW increases along all margins covered by the supplementary questions SQ3 through SQ7. Interestingly, the probability of stating to increase prices (SQ5) increases most strongly in TI_i . Albeit reacting less strongly compared SQ5, the probabilities of affected firms to confirm to plan reductions in employment (SQ3), cuts in working hours (SQ4), decrease investment (SQ6), or reduce special payments (SQ7) also increases in TI_i .

However, interpreting the correlations in a causal way is potentially misleading because the questions regarding firms’ planned reactions to the NMW (SQ3-SQ7) are restricted to affected firms and one direction. For example, affected firms could only state whether they planned to reduce the number of employees or not. If firms were operating in monopsonistic labor markets, for example, they should be expected to *increase* their labor demand in response to a minimum wage that is binding at sufficiently low levels (Manning, 2003). If a non-negligible fraction of affected firms did so, the fraction of firms that planned to decrease their labor demand could hence be accompanied by a fraction of firms that planned to increase labor demand resulting in a total employment effect that potentially cancels out. Hence, the supplementary questions themselves do not allow for causal inference on the firm-level response of the NMW due to missing counterfactuals as well as one-sided questions.

A.2.3. Variation in Firms' Treatment Intensity In Different Industries

Table A.6: Variation of Minimum Wage Bite in Different Industries

	Geogr.		# Firms	Mean <i>TI</i>	% Firms with Fraction of Affected Full-Time Employees				
Two-Digit Industry (WZ 2008)	Herfindahl	Class.			=0%	>0%	>10%	>20%	>30%
Panel A: Firms in Manufacturing Survey of IBS									
10 Food products	0.0050	Non-Trad.	66	0.1820	6.1	93.9	63.6	33.3	19.7
11 Beverages	0.0077	Non-Trad.	12	0.0046	91.7	8.3	0	0	0
15 Leather products (& related)	0.0207	Remaining	1	0.0136	0	100	0	0	0
16 Wood & products of wood (excl. furniture)	0.0074	Non-Trad.	61	0.0135	86.9	13.1	3.3	1.6	1.6
17 Paper & paper products	0.0090	Non-Trad.	75	0.0131	86.7	13.3	8	0	0
18 Printing and reproduction of recorded media	0.0085	Non-Trad.	96	0.0153	79.2	20.8	2.1	0	0
19 Coke and refined petroleum products	0.0612	Tradable	1	0	100	0	0	0	0
20 Chemicals and chemical products	0.0108	Remaining	115	0.0068	88.7	11.3	4.3	0	0
21 Basic pharmaceutical products & preparations	0.0251	Remaining	14	0.0056	78.6	21.4	0	0	0
22 Rubber and plastic products	0.0064	Non-Trad.	182	0.0189	78	22	9.3	0.5	0
23 Other non-metallic mineral products	0.0054	Non-Trad.	116	0.0046	86.2	13.8	0	0	0
24 Basic metals	0.0163	Remaining	88	0.0007	90.9	9.1	0	0	0
25 Fabricated metal products, except machinery & equipment	0.0063	Non-Trad.	304	0.0192	73.7	26.3	5.6	0	0
26 Computer, electronic and optical products	0.0093	Remaining	96	0.0087	84.4	15.6	4.2	0	0
27 Electrical equipment	0.0123	Remaining	181	0.0078	92.8	7.2	4.4	1.1	0
28 Machinery and equipment n.e.c.	0.0059	Non-Trad.	451	0.0007	98.2	1.8	0	0	0
29 Motor vehicles, trailers and semi-trailers	0.0287	Tradable	80	0.0030	90	10	1.3	0	0
30 Other transport equipment	0.0851	Tradable	9	0	100	0	0	0	0
31 Furniture	0.0132	Remaining	44	0.0270	75	25	6.8	6.8	2.3
32 Other Manufacturing	0.0100	Remaining	44	0.0652	45.5	54.5	18.2	9.1	6.8
33 Repair and installation of machinery and equipment	0.0067	Non-Trad.	7	0.0154	71.4	28.6	0	0	0
Panel B: Firms in Services Survey of IBS									
35 Electricity, gas, steam, and air conditioning supply	0.0095	Remaining	7	0	100	0	0	0	0
38 Waste collection, treatment and disposal activities; materials recovery	0.0082	Non-Trad.	64	0.0073	78.1	21.9	1.6	0	0
41 Construction of buildings	0.0046	Non-Trad.	4	0.0301	75	25	25	0	0
43 Specialised construction activities	0.0048	Non-Trad.	16	0.0135	75	25	0	0	0
49 Land transport and transport via pipelines	0.0095	Remaining	130	0.1423	0.8	99.2	73.1	22.3	2.3
50 Water transport	0.1701	Tradable	3	0	100	0	0	0	0
51 Air transport	0.2882	Tradable	3	0	100	0	0	0	0
52 Warehousing and support activities for transportation	0.0106	Remaining	120	0.0156	76.7	23.3	8.3	0	0
53 Postal and courier activities	0.0070	Non-Trad.	8	0.0837	0	100	37.5	0	0
55 Accommodation	0.0128	Remaining	89	0.1852	1.1	98.9	70.8	37.1	13.5
56 Food and beverage service activities	0.0126	Remaining	58	0.3810	0	100	100	98.3	81
58 Publishing activities	0.0287	Tradable	14	0.0073	92.9	7.1	7.1	0	0
59 Motion picture, video & TV programme production, sound recording & music publishing	0.0905	Tradable	10	0.0305	0	100	0	0	0
60 Radio and Television	0.0982	Tradable	5	0	100	0	0	0	0
61 Telecommunications	0.0249	Remaining	6	0	100	0	0	0	0
62 Computer programming, consultancy and related activities	0.0220	Remaining	245	0.0022	94.7	5.3	0.8	0	0
63 Information service activities	0.0559	Tradable	13	0.0027	84.6	15.4	0	0	0
64 Financial service activities, except insurance and pension funding	0.0209	Remaining	49	0	100	0	0	0	0
65 Insurance, reinsurance and pension funding, except compulsory social security	0.0514	Tradable	1	0	100	0	0	0	0
66 Activities auxiliary to financial services and insurance activities	0.0338	Tradable	11	0.0021	90.9	9.1	0	0	0
68 Real estate activities	0.0279	Tradable	63	0.0493	23.8	76.2	20.6	0	0
69 Legal and accounting activities	0.0195	Remaining	74	0.0498	32.4	67.6	18.9	6.8	0
70 Activities of head offices; management consultancy activities	0.0255	Remaining	90	0.0062	88.9	11.1	2.2	0	0
71 Architectural and engineering activities; technical testing and analysis	0.0134	Remaining	368	0.0033	91.3	8.7	0	0	0
72 Scientific research and development	0.0245	Remaining	39	0	100	0	0	0	0
73 Advertising and market research	0.0421	Tradable	62	0.0194	74.2	25.8	0	0	0
74 Other professional, scientific and technical activities	0.0214	Remaining	22	0.0299	13.6	86.4	0	0	0
77 Rental and leasing activities	0.0137	Remaining	25	0.0269	72	28	16	0	0
79 Travel agency, tour operator and other reservation service and related activities	0.0256	Remaining	37	0.0217	51.4	48.6	16.2	0	0
80 Security and investigation activities	0.0241	Remaining	12	0.2192	0	100	83.3	41.7	33.3
81 Services to buildings and landscape activities	0.0132	Remaining	57	0.1954	0	100	96.5	33.3	14
82 Office administrative, office support and other business support activities	0.0168	Remaining	46	0.1206	6.5	93.5	54.3	15.2	2.2
84 Public administration and defence; compulsory social security	0.0085	Non-Trad.	3	0	100	0	0	0	0
85 Education	0.0134	Remaining	14	0	100	0	0	0	0
86 Human health activities	0.0076	Non-Trad.	6	0.1021	16.7	83.3	33.3	16.7	0
87 Residential care activities	0.0058	Non-Trad.	3	0.0181	33.3	66.7	0	0	0
88 Social work activities without accommodation	0.0138	Remaining	2	0.0819	0	100	50	0	0
90 Creative, arts and entertainment activities	0.0265	Remaining	9	0.0260	55.6	44.4	0	0	0
92 Gambling and betting activities	0.0088	Non-Trad.	1	0.3801	0	100	100	100	100
93 Sports activities and amusement and recreation activities	0.0108	Remaining	3	0.1338	0	100	100	0	0
94 Activities of membership organisations	0.0238	Remaining	3	0	100	0	0	0	0

Notes. Distribution of firms in the IBS surveys covering the manufacturing and services sectors within different two-digit industries with respect to TI_i . As the composition of firms is varying over time, this table displays the distribution of firms that reported to the IBS in January 2015. The industry-specific Herfindahl index is calculated based on county-level employment in 2014. The classification into “tradable”, “non-tradable,” and “remaining” sectors follows Mian and Sufi (2014).

A.3. Revenue-Weighted Average Treatment Intensity of the German Economy

This appendix presents the calculation of the revenue-weighted average treatment intensity of all industry-region combinations (\widetilde{TI}) that is used for the quantification of the NMW effect on the overall level of producer prices in Section 5.3. To capture overall producer prices as closely as possible, the treatment intensity of each industry-county combination, $TI_{s,c}$, is weighted by the revenues generated in each cell, $\widetilde{revenues}_{s,c}$.³⁹ As data on industry-specific revenues are not available at the level of counties and the bite measure cannot be constructed for all cells due to data protection issues, the revenue weights are approximated as described in the following.

Revenue data are available at the Federal Statistical Office for two-digit industries s and federal states f ($revenues_{s,f}$) in 2014. In order to put an appropriate weight on each $TI_{s,c}$, the state-level revenue weights $revenues_{s,f}$ are assigned to each county in proportion to its relative size in the respective federal state. This relative size is approximated by the county-specific number of full-time employees that work in industry s , denoted $employees_{s,c}$. The employment data are included in the RS wage data received from the Federal Employment Agency (2016). From this, the total number of full-time employees represented by industry-specific wage data can be calculated for each federal state, i.e., $employees_{s,f} = \sum_{c \in f} (employees_{s,c} | w_{s,c} \notin \{\emptyset\})$.

The revenue weight for treatment intensities in counties for which wage data are available ($w_{s,c} \notin \{\emptyset\}$) is given by

$$revenues_{s,c} = revenues_{s,f} \times \frac{employees_{c,s}}{employees_{s,f}}. \quad (6)$$

Consequently, industry-county cells that are not covered by the RS wage data receive zero weight. This implicitly assumes that the industry-specific bite in these counties is similar to the average treatment intensity in all other counties of the same federal state.

However, state-level revenues cannot be matched to RS wage data in at least one of the respective federal state's counties in 10.9% (6.0%) of all East (West) German industry-federal state cells. Given that higher average bites in East Germany, \widetilde{TI} based on the weights of equation (6) would be downward biased if the asymmetry in the availability of wage data was not controlled for. For this purpose, the revenue weights ($revenues_{s,c}$) are inflated by the inverse fraction of industry-specific revenues in East Germany that can be assigned to wage data in any East German federal state, i.e.,

$$\xi_{s,East} = \frac{\sum_{f \in \{East\}} revenues_{s,f}}{\sum_{f \in \{East\}} (revenues_{s,f} | w_{s,f} \notin \{\emptyset\})},$$

where $w_{s,f} \notin \{\emptyset\}$ denotes that industry-specific wage data are available in at least one county of state f . $\xi_{s,West}$ is defined accordingly for West Germany.

The resulting revenue weight for $TI_{s,c}$ is hence given by

$$\widetilde{revenues}_{s,c} = revenues_{s,f} \times \frac{employees_{c,s}}{employees_{s,f}} \times \xi_{s,EW \in \{East, West\}}.$$

³⁹As in the baseline specification, empty county-level cells are replaced by wage data at the LMR-level.

A.4. Supplementary Tables Regarding NMW Effects

Table A.7: NMW Effects at the Firm-Level: Yearly and Quarterly Treatment Coefficients

	Price Exp. _t ^{+3m}	Empl. Exp. _t ^{+3m}
<i>Panel A: Yearly Treatment Effects</i>		
$TI \times 1(t \in \{2014m7, 2015m6\})$	0.47*** (0.09)	-0.09 (0.07)
$TI \times 1(t \in \{2015m7, 2016m6\})$	0.20*** (0.06)	-0.07 (0.06)
<i>Panel B: Quarterly Treatment Effects</i>		
$TI \times 1(t \in \{2014m7, 2014m9\})$	0.27** (0.13)	-0.04 (0.11)
$TI \times 1(t \in \{2014m10, 2014m12\})$	0.41*** (0.14)	-0.19* (0.10)
$TI \times 1(t \in \{2015m1, 2015m3\})$	0.67*** (0.11)	-0.04 (0.09)
$TI \times 1(t \in \{2015m4, 2015m6\})$	0.56*** (0.09)	-0.09 (0.13)
$TI \times 1(t \in \{2015m7, 2015m9\})$	0.25* (0.13)	-0.21** (0.09)
$TI \times 1(t \in \{2015m10, 2015m12\})$	0.16 (0.13)	-0.05 (0.08)
$TI \times 1(t \in \{2016m1, 2016m3\})$	0.29*** (0.07)	-0.05 (0.15)
$TI \times 1(t \in \{2016m4, 2016m6\})$	0.12 (0.08)	0.04 (0.12)
Control for Demand _{i,t}	yes	yes
Firm FE	yes	yes
Time*Sector FE	yes	yes
R ²	0.337	0.357
Observations	253350	253440

Notes: The dependent variables are planned price or employment changes during the next three months (Price Exp._t^{+3m} and Employment Exp._t^{+3m}). “TI” is the bite of the NMW which is interacted with dummies for the respective periods indicated in each row. “Demand_{i,t}” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Levels of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Minimum Wage Effects at the Firm-Level: Different Control Vector

$TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$	Price Exp._t^{+3m}					Employment Exp._t^{+3m}				
	0.34*** (0.07)	0.37*** (0.07)	0.34*** (0.10)	0.35*** (0.07)	0.34*** (0.07)	-0.08 (0.06)	-0.08 (0.06)	-0.01 (0.08)	-0.06 (0.06)	-0.07 (0.06)
Control for Demand $_{i,t}$	yes	yes	yes			yes	yes	yes		
Control for Dem./Prod. Exp._t^{+3m}					yes					yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*County Type FE		yes					yes			
Time*State FE			yes					yes		
R^2	0.337	0.338	0.340	0.329	0.346	0.357	0.357	0.359	0.318	0.380
Observations	253350	253350	253350	259214	258467	253440	253440	253440	259374	258626

Notes: The dependent variables are planned price or employment changes during the next three months reported to the IBS. “ TI ” is the firm-specific bite of the NMW and “ $\mathbf{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand $_{i,t}$,” “Dem. Exp._t^{+3m} ,” and “Prod. Exp._t^{+3m} ” are firms’ current backlog of orders and expected demand/production during the next three months, respectively. “Time*Sector FE,” “Time*State FE,” and “Time*County Type FE” are time fixed effects at the levels of two-digit industries, federal states, and county types, respectively. The Federal Office for Building and Regional Planning classifies counties into four categories: major cities, urban counties, rural counties, and sparsely populated rural counties. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.9: Minimum Wage Effects at the Firm-Level: Test for Non-Linearity in Treatment Effect

$TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$	Price Exp._t^{+3m}		Employment Exp._t^{+3m}	
	0.34*** (0.07)	0.26** (0.11)	-0.08 (0.06)	0.03 (0.10)
$TI^2 \times \mathbf{1}(t \in \{2014m7, 2016m6\})$		0.20 (0.20)		-0.25 (0.23)
Control for Demand $_{i,t}$	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes
R^2	0.337	0.337	0.357	0.357
Observations	253350	253350	253440	253440

Notes: The dependent variables are planned price or employment changes during the next three months reported to the IBS. “ TI ” is the firm-specific bite of the NMW and “ $\mathbf{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the levels of two-digit industries. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Minimum Wage Effects: Heterogeneity in Product Markets

	Price Exp. $_{i,t}^{+3m}$							Employment Exp. $_{i,t}^{+3m}$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
$TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$			0.66*** (0.07)			0.78*** (0.14)				-0.01 (0.12)			-0.01 (0.08)	
$\times \mathbf{1}(\text{Firm Export Share} \neq NA)$	0.40*** (0.06)							-0.08 (0.07)						
$\times \text{Firm Export Share}$	-0.91** (0.41)							-0.34 (0.25)						
$\times \mathbf{1}(\text{Firm Export Share} \leq p25)$		0.42*** (0.08)							-0.07 (0.05)					
$\times \mathbf{1}(p25 < \text{Firm Export Share} < p75)$		0.27*** (0.08)							-0.08 (0.20)					
$\times \mathbf{1}(p75 \leq \text{Firm Export Share})$		0.15 (0.18)							-0.27* (0.15)					
$\times \mathbf{1}(\text{Firm Export Share} = NA)$	0.32*** (0.09)	0.33*** (0.09)						-0.06 (0.06)	-0.06 (0.06)					
$\times \text{Herfindahl}$			-28.16*** (5.48)							-6.66 (13.23)				
$\times \mathbf{1}(\text{Herfindahl} \leq p25)$				0.45*** (0.04)							-0.03 (0.05)			
$\times \mathbf{1}(p25 < \text{Herfindahl} < p75)$				0.32*** (0.11)							-0.08 (0.09)			
$\times \mathbf{1}(p75 \leq \text{Herfindahl})$				0.01 (0.14)							-0.33 (0.27)			
$\times \mathbf{1}(\text{Non-tradable})$					0.49*** (0.03)							-0.02 (0.05)		
$\times \mathbf{1}(\text{Remaining})$					0.30*** (0.10)							-0.12 (0.10)		
$\times \mathbf{1}(\text{Tradable})$					-0.20 (0.13)							0.29 (0.40)		
$\times \text{Industry Import Share}$						-1.01** (0.38)							0.06 (0.19)	
$\times \mathbf{1}(\text{Industry Import Share} \leq p50)$							0.49*** (0.02)							0.00 (0.05)
$\times \mathbf{1}(\text{Industry Import Share} > p50)$							0.12 (0.17)							0.03 (0.07)
H0: Coefficients Equal: p-value		0.082		0.004	0		0.052		0.083		0.261	0.442		0.754
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R ²	0.337	0.337	0.337	0.337	0.338	0.294	0.293	0.357	0.357	0.357	0.357	0.359	0.351	0.351
Observations	253350	253350	253350	253350	247422	126010	126010	253440	253440	253440	253440	247498	125669	125669

Notes: The dependent variables are planned price or employment changes during the next three months. “ TI ” is the firm-specific bite of the NMW and “ $\mathbf{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. The product “ $TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$ ” is either directly interacted with firms’ export share, the industry-specific Herfindahl index, or the industry-specific import share or interacted with dummies that group treated firms into bins of each measure. “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. The p-values at the bottom indicate whether the treatment effects in the highest group are statistically different from the lowest one. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Minimum Wage Effects: Heterogeneity in Labor Market Conditions

	Price Exp. _t ^{+3m}			Employment Exp. _t ^{+3m}		
	(1)	(2)	(3)	(4)	(5)	(6)
$TI \times \mathbf{1}(t \in \{2014m7, 2016m6\}) \times \mathbf{1}(\text{Lack of Workers} = 1)$	0.47*** (0.11)			0.05 (0.10)		
$\times \mathbf{1}(\text{Lack of Workers} = 0)$	0.33*** (0.08)			-0.13** (0.06)		
$\times \mathbf{1}(\text{Lack of Workers} = NA)$	0.23* (0.12)			0.06 (0.04)		
$\times \mathbf{1}(\text{County Unempl. Rate} \leq p25)$		0.32* (0.17)			0.04 (0.13)	
$\times \mathbf{1}(p25 < \text{County Unempl. Rate} < p75)$		0.36*** (0.07)			-0.02 (0.03)	
$\times \mathbf{1}(p75 \leq \text{County Unempl. Rate})$		0.32*** (0.12)			-0.14 (0.11)	
$\times \mathbf{1}(\text{Labor Market Tightness} \leq p25)$			0.32*** (0.07)			-0.10 (0.08)
$\times \mathbf{1}(p25 < \text{Labor Market Tightness} < p75)$			0.36*** (0.09)			-0.06 (0.06)
$\times \mathbf{1}(p75 \leq \text{Labor Market Tightness})$			0.16 (0.11)			0.08 (0.10)
H0: Coefficients Equal: p-value	0.197	0.994	0.175	0.021	0.031	0.030
Control for Demand _{i,t}	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes
Observations	253350	253350	253350	253440	253440	253440
R ²	0.337	0.337	0.337	0.357	0.357	0.357

Notes: The dependent variables are planned price or employment changes during the next three months. “ TI ” is the firm-specific bite of the NMW and “ $\mathbf{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. As indicated in each row, the product “ $TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$ ” is interacted with dummies that group treated firms into bins of the following measures: firms’ self-reported lack of workers in January 2015 and the unemployment rate/labor market tightness in the county they are located in. “Demand_{i,t}” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. The p-values at the bottom indicate whether the treatment effects in the highest group are statistically different from the lowest one. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.12: Minimum Wage Effects: Heterogeneity in Business Expectations of Firms

	Price Exp. $_{i,t}^{+3m}$				Employment Exp. $_{i,t}^{+3m}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$	0.35*** (0.07)		0.32*** (0.07)		-0.07 (0.05)		-0.12** (0.05)	
$\times \overline{\text{Business Exp.}}$	0.14 (0.11)				0.26*** (0.09)			
$\times \mathbf{1}(\overline{\text{Business Exp.}} \in (1/3, 1])$		0.38*** (0.13)				-0.05 (0.12)		
$\times \mathbf{1}(\overline{\text{Business Exp.}} \in [-1/3, 1/3])$		0.38*** (0.07)				-0.03 (0.04)		
$\times \mathbf{1}(\overline{\text{Business Exp.}} \in [-1, -1/3])$		0.13 (0.16)				-0.35*** (0.10)		
$\times \overline{\text{Prod./Dem. Exp.}}$			0.26*** (0.09)				0.39*** (0.09)	
$\times \mathbf{1}(\overline{\text{Prod./Dem. Exp.}} \in (1/3, 1])$				0.41*** (0.12)				0.10 (0.12)
$\times \mathbf{1}(\overline{\text{Prod./Dem. Exp.}} \in [-1/3, 1/3])$				0.33*** (0.06)				-0.10* (0.05)
$\times \mathbf{1}(\overline{\text{Prod./Dem. Exp.}} \in [-1, -1/3])$				0.17 (0.17)				-0.47*** (0.14)
H0: Coefficients Equal: p-value		0.196		0.065		0.002		0
Control for Business Exp. $_{i,t}^{+6m}$	yes	yes			yes	yes		
Control for Prod./Dem. Exp. $_{i,t}^{+3m}$			yes	yes			yes	yes
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.346	0.351	0.346	0.352	0.390	0.395	0.403	0.408
Observations	236410	251935	237149	252633	236520	252018	237269	252729

Notes: The dependent variables are planned price or employment changes during the next three months. “ TI ” is the firm-specific bite of the NMW and “ $\mathbf{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. The product “ $TI \times \mathbf{1}(t \in \{2014m7, 2016m6\})$ ” is either directly interacted with firms’ average reports (coded -1,0,1) during the treatment period with respect to business expectations for the next six months or expected production (manufacturing firms) or demand (services firms) for the next three months or interacted with dummies that group treated firms into bins of each measure. “Business Exp. $_{i,t}^{+6m}$ ” are firms’ expected business conditions during the next six months, “Prod./Dem. Exp. $_{i,t}^{+3m}$ ” are firms’ expected production changes (reported by manufacturing firms) or expected changes in demand (services firms) during the next three months, and “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. The p-values at the bottom indicate whether the treatment effects in the highest group are statistically different from the lowest one. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.13: Price Response to the Minimum Wage Introduction: Robustness

Specification	Realized Price Change During Previous Month (Manufacturing Only)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline	No Attrition	RS Wage Data			SES Wage Data		$w(p0)$	
			Region Only	County Only	2013 Wages	Fulltime Workers	All Workers	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m10, 2016m9\})$	0.27*** (0.061)	0.27*** (0.062)	0.22** (0.089)	0.45*** (0.12)	0.22*** (0.068)	0.34** (0.15)	0.28* (0.15)	0.27*** (0.079)	0.27*** (0.059)
Control for Demand $_{i,t}$	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.285	0.274	0.285	0.273	0.286	0.269	0.269	0.285	0.285
Observations	141589	119085	141589	84750	141955	75503	75503	141589	141589
PPI-Semi-Elasticity ($\hat{\psi}$)	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144
Revenue-Weighted TI (\widetilde{TI})	0.013	0.013	0.013	0.012	0.014	0.013	0.036	0.028	0.011
Manuf.: Overall Price Effect ($\Delta\tilde{P}$ in %)	0.099	0.098	0.083	0.153	0.088	0.129	0.297	0.218	0.085

Notes: The dependent variable is the change in prices in the previous month as reported by manufacturing firms. “ TI ” is the firm-specific bite of the NMW and “ $\mathbb{1}(t \in \{2014m7, 2016m6\})$ ” indicates the treatment period. “Demand $_{i,t}$ ” is firms’ current backlog of orders reported to the IBS. “Time*Sector FE” are time fixed effects at the level of two-digit industries. “ $\hat{\psi}$ ” denotes the semi-elasticity mapping changes in price expectations to quantitative producer prices. “ \widetilde{TI} ” and “ $\Delta\tilde{P}$ ” reflect the overall treatment intensity in the economy and the overall effect of producer prices based on revenue weights for each county-industry cell as described in Section 5.3. Standard errors are multiway clustered at the levels of sectors, counties, and dates. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.