The Price and Employment Response of Firms to the Introduction of Minimum Wages

Sebastian Link*

January 31, 2018

Preliminary version.

Abstract:

This paper studies the short-term price and employment reaction of manufacturing firms and service companies to the introduction of a statutory minimum wage in Germany in 2015. Exploiting variation in treatment intensity across different industries and regions, the minimum wage effects are analyzed by means of unique firm-level survey data on expected and realized changes in prices and employment. In line with previous studies, the estimated employment effect is only very modestly negative and insignificant. In contrast, firms that were affected more strongly by the minimum wage increased their prices significantly more frequently in the period around its introduction. Given the same treatment intensity, the price effect is equally strong within the subsets of manufacturing firms and service companies as well as firms located in West and East Germany. Making use of the high correlation between the survey data and administrative producer price indices reveals that the magnitude of the price effect is quantitatively large. This materialized in an increase in the overall level of German producer prices by roughly 0.2%. Altogether, the results suggest that price pass-through is an important margin of adjustment for firms in response to minimum wages.

Keywords: Minimum Wage, Price Pass-Through, Employment, Firm Response to Policy
JEL Classification: J38, J08, E31, J31

*Department of Economics, LMU Munich, Schackstraße 4, 80539 Munich, Germany; sebastian.link@econ.lmu.de.
For helpful comments and fruitful discussions I thank Lukas Buchheim, Georg Dürnecker, 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 and the annual congress of the Verein für Socialpolitik in Vienna. I also thank Heike Mittelmeier, Sebastian Wichert, and Shuyao Yang from the ifo Institute for help with the data. I gratefully acknowledge financial support from the Egon-Sohmen-Graduate-Center at the Munich Graduate School of Economics and funding by the German Research Foundation (DFG) through GRK 1928.

1. Introduction

In spite of the increasing popularity of minimum wages in many countries around the world, their economic consequences are still hotly debated. On the one hand, the literature has mainly focused on the question whether minimum wages reduce employment (e.g., Neumark and Wascher, 2000, 2008; Neumark et al., 2014) or not (e.g., Card and Krueger, 1994, 2000; Dube et al., 2010; Allegretto et al., 2011).[1] On the other hand, there is evidence that firms (at least in the short-term) absorb a substantial share of a minimum wage-induced wage bill increase by raising prices. However, the literature has only robustly documented price pass-through in highly affected industries, such as restaurants (e.g., Aaronson, 2001, Lemos, 2006, Aaronson et al., 2008, and Fougère et al., 2010) and retail trade (Leung, 2016 and Montialoux et al., 2017) without jointly assessing the price and employment response at the firm-level. In contrast, the evidence is less clear for firms in other sectors of the economy.[2]

This paper takes a step into this direction by examining the short-term price and employment reaction of manufacturing firms and service companies to the introduction of a nationwide statutory minimum wage in Germany in 2015. Importantly, the minimum wage was directly set to the average level of OECD countries (OECD, 2015). Affecting 4.0 million employment relationships (10.7% of all jobs, see Destatis, 2016), the German minimum wage thus offers a unique opportunity to study price and employment effects of firms in many different sectors of the economy. Hence, this paper helps to generalize existing evidence on employment effects and price pass-through which is usually based on the analysis of *changes* in long-standing minimum wages that per construction only affect a smaller share of firms in fewer industries.

Uncovering the short-term price and employment response of firms to the introduction of minimum wages requires firm-level data along both margins. This is particularly restrictive for prices as the micro data of the producer price index are currently not available for research purposes. Consequently, the price adjustment to the German statutory minimum wage has not been studied in the literature, yet. I circumvent this constraint by making use of the ifo Business Survey (IBS).[3] This survey is unique in repeatedly asking a large sample of approximately 5000 German manufacturing firms and service companies about both their planned changes in prices and employment at monthly frequency. Despite of their qualitative nature, the survey data closely track changes in the respective industry-specific time series on prices and employment. 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.

[1] See Neumark et al. (2014) and Card and Krueger (2015) for recent surveys on employment effects of minimum wages.

[2] The existing evidence regarding price effects of minimum wages in other sectors is discussed below.

[3] The IBS has already been used for the evaluation of industry-specific minimum wages in the construction sector by Werner and Sell (2015). However, their identification of "treated" firms only relies on the fact whether a minimum wage has been introduced in their industry or not. Hence, they neither observe whether the minimum wage is binding for the firm, nor the intensity to which it is affected.

The empirical strategy follows the "minimum wage bite" approach proposed by Card (1992) and exploits the variation in treatment intensity between firms in different industries and regions in a difference-in-difference design with continuous treatment. As initial wages strongly differed between industries and regions due to structural and environmental reasons, there is a substantial degree of heterogeneity in the intensity to which firms were affected by the nationwide statutory minimum wage. Using regionally and sectorally disaggregated wage data, I identify the firm-specific treatment intensity as the fraction of full-time employees that earned a gross wage below the new minimum prior to its introduction. It turns out that this measure not only captures the probability that these firms perceived themselves as being affected very well, but also identifies roughly 30% of firms in the sample as being affected by the minimum wage to at least some degree.

The estimation delivers strong evidence in favor of a minimum wage effect on prices. Specifically, the frequency that firms planned to increase their prices during the period around the introduction in January 2015 is strongly significantly associated with their degree of affectedness. Given the same treatment intensity, the price reaction of firms is equally strong in manufacturing and services as well as in West and East Germany. Moreover, the analysis of the subset of manufacturing firms, which provide additional information on *realized* price changes to the IBS, reveals that the minimum wage effect on the frequency of planned price changes is comparable to the effect on realized price changes.

The price effect of the minimum wage introduction is considerably large. Exploiting the strong correlation between average reported price changes in the IBS and quantitative changes in industry-level producer price indices, the minimum wage effect on the overall level of producer prices is approximated to roughly 0.2%. This effect is sizable in light of the fact that average wages of full-time employees increased by approximately 0.6%. Hence, price pass-through appears to have been an important margin of adjustment for firms in response to the new minimum wage.

In contrast to the strong and sizable effect on prices, the minimum wage effect on planned employment changes is estimated to be only very modestly negative and insignificant throughout all empirical specifications. In light of potential measurement error in the firm-specific treatment intensity measure, however, a negative employment reaction cannot be ruled out with certainty. As the same argument applies to the estimated price effect, the results hence suggest that the probability that affected firms increased prices due to the minimum wage is much larger compared to the probability that they planned to reduce the number of employees.

Documenting that German firms did not cut back their short-term employment plans in response to the minimum wage introduction, this paper adds to the prominent strand of the "New Minimum Wage Literature" that finds that minimum wages in general do not inevitably destroy jobs in the short-term (e.g., Card and Krueger, 1994, 2000; Dube et al., 2010; and Allegretto et al., 2011). In line with this, the paper confirms existing evidence on the short-term employment effects of the introduction of the German statutory minimum wage that—if anything—detected only moderately negative effects. Using data on employment relationships from the Federal Employment Agency in a descriptive analysis, vom Berge et al. (2016) document a loss of approximately 94,000 marginal

employment relationships without finding a negative short-term effect for employment relationships prone to social security. Comparably, Bossler and Gerner (2016) estimate that 60,000 jobs were lost (marginally employed plus regular jobs) based on the IAB Establishment Panel which equals to 0.18% of all German employees and is only statistically significant for East Germany. Identifying the minimum wage "bite" by means of the Structure of Earnings Survey, Caliendo et al. (2017) estimate a small significant reduction in the number of regular (full- and part-time) employment relationships by 78,000 (~0.3% of all regular jobs) and a loss of roughly 180,000 jobs of marginally employed workers (~2.4% of all "mini-jobs").

Providing the first credibly identified evidence in favor of a strong short-term price effect of the German minimum wage introduction, this paper provides a potential explanation for the fact that the documented short-term employment effect of the German minimum wage introduction is much weaker than previously predicted long-term effects. For example, Knabe et al. (2014) predicted a job loss of up to 910,000 employees of which 251,000 were regular jobs prone to social security, while Arni et al. (2014) expected a total job loss of 570,000. As demonstrated by Sorkin (2015) in a putty-clay model, the short-run elasticities of employment with respect to a permanent increase in minimum wages are much smaller compared to long-run elasticities because once capital is installed, a firm cannot adjust its labor demand in the short-run. Instead, Sorkin's model predicts that firms respond to a minimum wage-induced increase in labor costs by raising prices in the short-run. My results are in line with his prediction.[4]

Moreover, this paper contributes to the literature on the importance of price pass-through of minimum wages. During the last years, there has been accumulating evidence that prices are an important margin of adjustment for firms that face a minimum wage-induced increase in labor costs. So far, the price effect has almost exclusively been documented for (fast food) restaurants or retailers based on disaggregated city/region-level CPI data (Aaronson, 2001; Lemos, 2006) or store-level prices of different products (Dube et al., 2007; Aaronson et al., 2008; Fougère et al., 2010; Allegretto and Reich, 2016; Leung, 2016; Montialoux et al., 2017). For other sectors of the economy, existing evidence on pass-through on prices is less clear.[5] For example, Wadsworth (2010) does not find significant short-run effects on prices in several low-wage industries in response to increases in the British national minimum wage based on industry-level price data. In contrast, I use firm-level data and provide evidence that firms' price response does not differ substantially between the manufacturing and services sector given their degree of affectedness by the minimum

[4] Alternative explanations for the discrepancy between ex ante simulated losses and ex post estimated employment effects include that these models did not incorporate any other adjustment mechanism besides the layoff of workers (such as prices, investment in capital, etc.) that allowed firms to react to increased labor costs. Moreover, the assumption of competitive, neoclassical labor markets in the models' baseline specifications might not be appropriate in the context of minimum wages as, e.g., argued by Manning (2003).

[5] There is one notable exemption: Harasztosi and Lindner (2015) find evidence for minimum wage-induced increases in prices of Hungarian manufacturing firms, which are calculated based on an annual survey covering volumes and values of production for different products. Moreover, Lemos (2008) provides a survey of almost thirty studies on the price effect, which, however, usually rely on price data at rather aggregated industry levels and thus cannot exploit heterogeneity in firms' price reaction resulting from within-industry variation in the degree to which firms are affected by minimum wages.

wage.

Highlighting the importance of short-term price effects, this paper also adds to an increasing literature that more generally examines the relevance of additional channels of adjustment besides the extensive margin of employment, such as labor market flows/employment growth rates (Portugal and Cardoso, 2006; Brochu and Green, 2013; Dube et al., 2016; Meer and West, 2016), non-compliance (Metcalf, 2008), firm profitability/value (Draca et al., 2011; Bell and Machin, 2018), tax evasion (Tonin, 2011), hygiene in fast food restaurants (Chakrabarti et al., 2017), or substitutability of jobs by machines (Lordan and Neumark, 2017).[6] For the case of the German statutory minimum wage, there is evidence that affected firms also reacted along various dimensions. For example, vom Berge et al. (2016) and Garloff (2016) document that marginal employment relationships were substituted by regular jobs. Moreover, Bellmann et al. (2017) find that affected firms reduced employer-financed training programs, while Gürtzgen et al. (2016) notice that skill requirements for vacant and newly filled low-wage positions increased after the introduction of the German statutory minimum wage. Complementing these findings by highlighting the importance of firms' price reaction shows that an exclusive focus on employment outcomes steps short of telling the full story of minimum wage effects.

The remainder of the paper is structured as follows. Section 2 provides information about the institutional background of the introduction of statutory minimum wages in Germany in 2015. Section 3 describes the data as well as the identification of firms' degree of affectedness by the minimum wage. Section 4 specifies the empirical strategy and Section 5 documents the effect of the minimum wage introduction on the pricing and employment policies of firms. Section 6 provides an approximation of the quantitative size of the price effect. Finally, Section 7 performs diverse robustness checks and Section 8 concludes.

2. The New Statutory Minimum Wage in Germany: Institutional Background

Accompanied by a controversial public debate, a statutory minimum wage of €8.50 came into force in Germany on January 1, 2015. This introduction constituted a paradigm shift in the history of German labor market policy as wages had previously been determined almost exclusively through collective bargaining agreements between unions and employer associations. Until then, 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 based on the "Posted Workers Act" ("*Arbeitnehmer-Entsendegesetz*" AEntG).[7]

In contrast to the history of statutory minimum wages in other countries, which is most ex-

[6] See Metcalf (2008) and Schmitt (2015) for a more complete and more extensive overview of the literature on the importance of different margins for firms' reaction to minimum wages.

[7] Prior 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 a number of handicraft sectors. These industry-specific minimum wages were allowed to differ between regions, e.g., between West and East Germany. Moreover, an industry-specific minimum wage had been introduced in the care industry in 2010 that was not based on a collective bargaining arrangement, but implemented following a proposal of a commission installed by the Federal Ministry of Labor and Social Affairs in accordance with §12 AEntG.

tensively studied in the U.S., the U.K., and France, the German introduction of 2015 is unique with respect to the degree to which firms faced changes in labor costs. According to the "OECD Employment Outlook 2015," the German statutory minimum wage was directly set to a level that resulted in a minimum-to-median wage ratio of 0.48. This level 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 level of the national minimum wage has 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 lower levels (0.42) in 1999 and steadily increased to the current level. Hence, none of these countries observed variation in national minimum wages during the last decades that were comparable to the case of the introduction of statutory minimum wages in Germany.

The new statutory minimum wage is set at a uniform level in (almost) all industries and across all regions. The German system is hence different from the U.S., where the national minimum wage can be trumped by higher rates set at the levels of states or cities. Compared to other countries, the German system is most similar to the British, as the wage floor is set at a national level and a commission decides on changes of its rate. In Germany, this commission is composed of unions and employer associations and takes advice from independent experts.

While the statutory minimum wage in general applies to all industries, there are exemptions for sectors that previously agreed on industry-specific wage floors below the level of €8.50 per hour. These sectors, including agriculture, forestry, gardening, the meat industry, manufacturing of textiles and clothing, temporary work agencies, hair dressers, and laundries, were conceded to delay their compliance to the statutory minimum wage until the end of 2016.[8] In order to prevent malpractice, the minimum wage 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.[9]

The introduction of the minimum wage was implemented in the following way: after the federal election ("*Bundestagswahl*") 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 containing the intention to introduce a statutory minimum wage of €8.50 on January 1, 2015. The Federal Cabinet proposed the minimum wage law ("*Mindestlohngesetz*" MiLoG) on April 2, 2014, containing all relevant regulations regarding its introduction and details on the exemptions. In light of the overwhelming majority of the "Grand Coalition" in both chambers of parliament, *Bundestag* and *Bundesrat* finally approved the law on July 3 and July 11, 2014 without major changes.

[8] Moreover, there are additional exemptions from the minimum wage for long-term unemployed during the first six months of re-employment, employees below the age of 18 years without training qualification, employees in vocational training, and internships compulsory for school programs, apprenticeship, or academic studies.

[9] According to the National Regulatory Control Council ("*Nationaler Normenkontrollrat*"), the introduction of the statutory minimum wage in 2015 and its first adjustment in 2017 imposed annual compliance costs of €6.3 billion on firms (National Regulatory Control Council, 2017, p.19).

3. Data and Identification of Firms' Affectedness by the Minimum Wage

3.1. Micro Data of the ifo Business Survey

The ifo Business Survey (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 (see Becker and Wohlrabe (2008) for details of the survey). Each month, firms from all sectors of the economy are, *inter alia*, asked for an assessment of their expected changes in employment and prices of their products or services. The IBS is divided into four industry surveys that cover the main sectors of the economy (manufacturing, services, retail/wholesale, construction). In order to assess the firm-level effects of the minimum wage introduction in the relevant sectors of the economy, I use data of the two surveys covering (a) manufacturing firms (IBS-IND, 2015) and (b) service companies (IBS-SERV, 2015).[10] Furthermore, I exclude firms from the sample if they were operating in industries that were allowed to pay wages below the statutory minimum wage of €8.50 per hour during a transition phase until the end of 2016.[11]

Restricting the sample to the period between January 2010 and December 2015 as well as to firms that responded at least 12 months to the survey, the dataset comprises of approximately 5000 firms per month (on average 2550 manufacturers and 2400 service companies).[12] Attrition is very low in the restricted data set (firms are observed for almost 5 years on average) and response rates to the survey are relatively high despite of the fact that participation is voluntary (firms answer the questionnaire in more than four out of five 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 scheme.[13] In addition, I gained access to confidential information about the firms' location at the level of counties. These regional and sectoral identifiers permit to merge

[10] I do not use data from the construction survey because these firms already had to adhere to an industry-specific minimum wage of €11.15 (€10.75) per hour in West (East) Germany in January 2015. Moreover, retailers and wholesalers are excluded—despite of the fact that especially retail firms were strongly affected by the minimum wage—as the direct effect of minimum wages 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 minimum wage.

[11] Specifically, 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." Firms in these sectors do not constitute a valid control group as their industry-specific minimum wages have been increased in steps during the treatment period to approach the level of the statutory minimum wage by the end of 2016.

[12] The 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 of the IBS is at the product level and not at the firm level. However, only 0.4% of all observations between 2010 and 2015 refer to multiple products of the same firm at a given point in time. Following the procedure described in Link (2017), these observations are aggregated to the firm level by taking means across products and rounding to the next integer.

[13] Firms in the services survey have been coded with respect to the older "WZ2003" classification scheme until March 2011. The assignment of these firms to identifiers according to the "WZ2008" classification scheme is described in Link (2017).

firms to wage statistics at the level of industries and counties as described in Section 3.2.

The analysis of firms' responses to the minimum wage mainly focuses on the following questions regarding expected changes in prices and employment contained in the IBS:[14]

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."*

Clearly, realized changes in prices and employment would be preferable relative to the expected changes stated in Q1 and Q2. While realized changes in prices and employment are not covered in both industry surveys of interest, firms in the manufacturing survey are asked to additionally state whether the prices of their products [1] increased, [0] stayed the same, or [-1] decreased during the previous month. As the majority of affected firms operate in the services sector, the baseline analysis is restricted to minimum wage effects on the pricing plans of firms in both industry surveys. In turn, the price realizations are used in Section 5.3 to demonstrate that—within the subset of manufacturing firms—the effect of the minimum wage introduction on firms' pricing plans is accompanied by a comparably strong effect on realized price changes.

Moreover, the data is categorical and effects estimated based on these variables hence cannot be interpreted quantitatively without further assumptions. However, there is no dataset available that contains quantitative producer price data at the level of firms in different industries. For example, the micro data underlying the German producer price index hosted by the Federal Statistical Office are not available for research purposes. In contrast, the micro data of the consumer price index are available at the "Research Data Centers" of the Federal Statistical Office but the prices of goods and services cannot be linked to the location of the producing firm or service provider, which is essential for the identification of the degree to which firms are affected by the minimum wage. Hence, the micro data of the IBS appear to be the best source of price data in order to study the pass-through of minimum wages on prices at the firm-level in Germany.

In contrast to the outstanding nature of the price data, the IBS data on expected employment changes are inferior to employment data from other sources. For example, there are quantitative micro data on firm-level employment available in the "IAB Establishment Panel" hosted by the Institute for Employment Research in Nuremberg, which are used in other studies on the effect of the introduction of the minimum wage in Germany, e.g., Bossler (2017) and Bossler and Gerner

[14] The wording of the questions slightly differs between the manufacturing survey and the services survey but is largely comparable. The translated questions in the respective surveys are listed in Appendix A.1. Moreover, I use firms' assessment of their current backlog of orders to control for the demand they face which is also measured at a trichotomous scale ("[1] comparatively large, [0] sufficient (typical for the season), or [-1] too small"). I further examine the effect of the minimum wage introduction on firms' reported current business conditions being either "[1] good, [0] satisfactory, or [-1] bad" as well as their expectations regarding their business conditions in the next six months as part of the analysis in Section 5.

Figure 1: Average Employment and Price Expectations Compared to Quantitative Data

Notes: The left (right) figure plots time series of the realized change in producer prices (in the number of employees) in the manufacturing sector relative to three months before (solid line; left axis) against time series of mean reported price expectations (employment expectations) of firms in the manufacturing survey of the IBS (dashed line; right axis). The German Federal Statistical Office provides time series of producer price indices and the number of employees at the two-digit industry level. For aggregation, the time series are weighted by the average share of manufacturing firms in the respective sectors of the IBS. The employment time series is purged using month fixed effects for seasonal adjustment.

(2016). However, this dataset does not contain data on prices and cannot be matched to the micro data of the IBS. Still, the employment data in the IBS are useful enough to verify the finding of Bossler (2017) and Bossler and Gerner (2016) that the effect of the statutory minimum wage on the employment level was very weak and only slightly negative.[15]

Importantly, the qualitative expected price and employment changes as reported to the IBS on average closely track actually realized price and employment changes observed in administrative data. For the case of manufacturing firms, Figure 1 plots the time series of average answers to Q1 and Q2 against the annualized percentage change in producer prices and the number of employees relative to the level three months before, respectively.[16] As the time series are strongly correlated, the survey questions appear to be useful indicators of firms' pricing and employment policies. This close relationship is exploited in Section 6 to approximate the quantitative size of the price effect

[15] It is important to note that the survey question on expected employment changes (Q2) is asked in a rather vague way and only refers to the "number of employees." Hence, Q2 does not allow to discriminate between different types of employment relationships, which is potentially an important margin of adjustment for firms affected by the minimum wage as shown by other studies on the German minimum wage, such as vom Berge et al. (2016) and Garloff (2016).

[16] The German Federal Statistical Office provides time series of producer price indices ($PPI_{s,t}$) and the number of employees ($Empl_{s,t}$) at the level of two-digit industries s which are downloaded from Destatis' GENESIS database (prices: code "61241-0002;" employment: code "42111-0004"). Aggregated time series on producer prices of service companies are not available for most sub-industries of the services sector. As described in Section 6, the time series of industry-level indices are weighted by the average share of manufacturing firms in the respective sectors of the IBS in order to get an aggregate time series that is representative for the firms in the survey. The employment time series is purged by month fixed effects for seasonal adjustment. During the time period of the baseline sample (January 2010 until December 2015), the time-series correlation between realized price (employment) changes and average price (employment) expectations in the IBS is highest at the first (second) lag of price (employment) expectations with $\rho = 0.87$ ($\rho = 0.90$).

documented in Section 5.

3.2. Identification of Firms' Affectedness by the Minimum Wage

In order to evaluate the reaction of firms to the introduction of the statutory minimum wage, the degree to which each firm is affected by this policy intervention 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 of Card (1992), a standard method for the identification of heterogeneity in treatment intensity with respect to minimum wages. Utilizing data on the wage distribution at disaggregated levels of industries and regions, I construct a treatment intensity measure specific for each firm: the fraction of full-time employees that earned a gross wage below the newly introduced minimum wage of €8.50 per hour in the firms' industry and location prior to its introduction.[17]

The underlying idea of the treatment intensity measure is that firms in industry-region cells with a higher fraction of full-time employees that earned less than €8.50 in 2013 are plausibly more strongly affected by the minimum wage than their counterparts in cells with a smaller fraction of affected full-time employees, *ceteris paribus*. Due to data limitations described below, the treatment intensity measure is not based on wage data of part-time employees and marginally employed workers despite of the fact that these groups were more strongly affected by the minimum wage as for example documented by Brenke (2014) and Falck et al. (2013).[18] However, the relative wage levels of part-time and full-time employees are plausibly strongly correlated across firms in different sectors and regions. In turn, the treatment intensity measure should be strongly correlated with the relative increase in labor costs faced by affected firms that wanted to leave the composition and size of their workforce unchanged.[19] In order to identify the *ex ante* "bite" of the minimum wage introduction, I use data on wages in 2013 instead of 2014, as affected firms might have adjusted their wages towards the new minimum wage of €8.50 already in the period prior to its introduction in January 2015.

Importantly, the treatment intensity measure only captures the direct effect on firms' labor costs. In turn, it abstracts from other effects such as spillovers through potentially more expensive inputs or additional costs for firms to comply with the administrative requirements of the minimum wage law. Another indirect effect of the minimum wage introduction which is beyond the scope of this paper is its effect on labor supply.

The treatment intensity measure is calculated based on data of gross monthly wages paid in

[17] Closest to my specification, Garloff (2016) uses administrative wage data of full-time employees at the level of labor market regions, age-cohorts and gender in order to analyze the relationship between (un-)employment growth and the "bite" of the German statutory minimum wage at the regional level.

[18] Relatedly, Müller and Steiner (2013) show that the relative ordering in the "bite" of the minimum wage introduction between different skill groups, gender, and the employment types of full-time, part-time, and marginally employed workers is largely unaffected by the choice of hypothetical levels of the wage floor using SOEP data.

[19] 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 the wages of part-time employees and marginally employed workers, I also construct the treatment intensity measure based on thresholds above €8.50. The results are presented in Section 7.

each two-digit industry at the level of counties (NUTS-3-regions) as well as labor market regions in 2013.[20] The Federal Employment Agency provides this data along with information on wages at the following percentiles: $p \in \{10, 20, 30, 40, 50, 60, 80\}$ (Federal Employment Agency, 2016). The data is collected via the reporting procedure of the social security system ("*Meldeverfahren zur Sozialversicherung*") in order to determine unemployment benefits and social security contributions. Every firm is required by law to report the gross wage that each of its employees earned in a given year. In addition, firms need to provide information about the duration of the employment relationship and whether the employee worked full-time or part-time.[21] As the reports do not contain detailed information on hours worked, the analysis needs to be restricted to gross monthly wages for full-time workers. Moreover, distributional parameters of wages are only available for sector-region combinations with at least 1000 full-time employees due to data protection issues. Despite of this restriction, wage data at the levels of two-digit industries and counties cover 72.1% of all full-time employed workers in Germany. At the level of labor market regions, 93.0% of full-time employed workers can be assigned to the wage distribution in their two-digit industry. In the baseline specification, I therefore use the industry-specific wage distribution at the county-level and replace missing values by wage data at the level of labor market regions. In addition, robustness checks solely using wage data at the levels of labor market regions or counties are presented in Section 7.

Next, 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.[22] After calculating the average amount of monthly working hours in 2013 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 labor market regions).

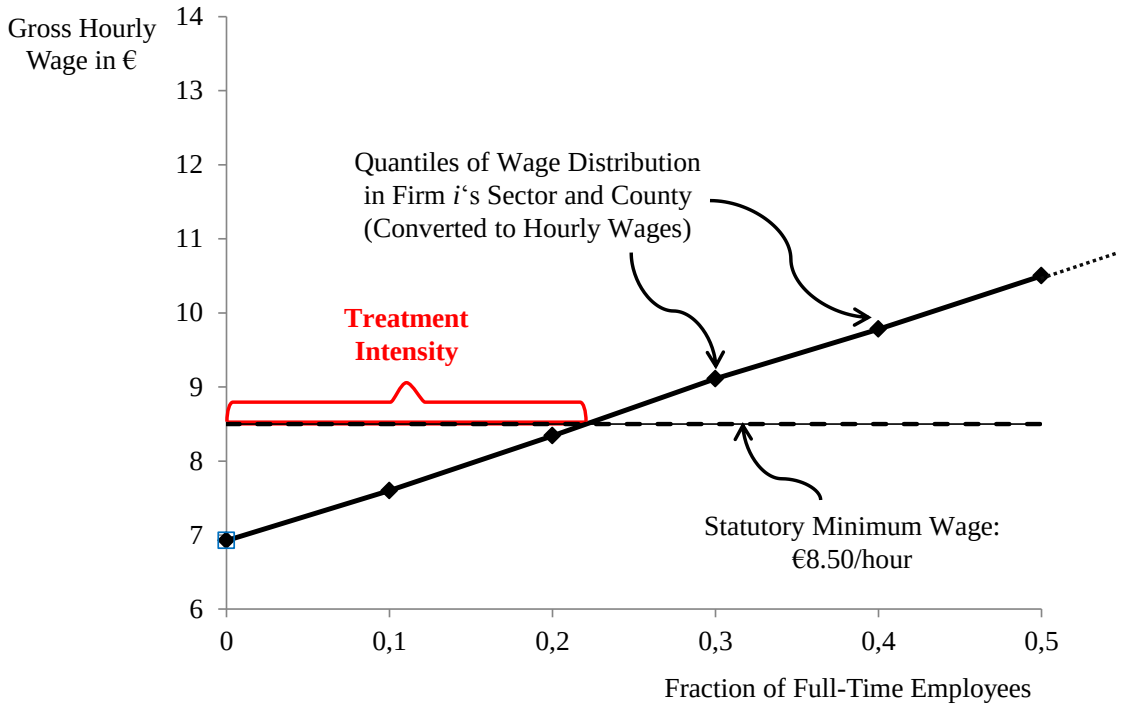
Then, the fraction of full-time employees that earned a gross hourly wage of less than €8.50 is calculated for each sector-region combination. Figure 2 provides an illustration of the procedure that is based on two assumptions about the shape of the wage distribution: first, the wage level of employees 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 10^{th} 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

[20] There are 96 labor market regions ("*Raumordnungsregionen*") in Germany that typically describe commuting zones. On average, they consist of approximately 4 out of a total number of 402 counties (295 "*Landkreise*" and 107 "*kreisfreie Städte*").

[21] The reporting procedure only refers to employees prone to social security and does hence not include wages of marginally employed workers ("*Mini-Jobs*") as well as self-employed. Unfortunately, data on wages in these groups are not available at disaggregated levels of industries and regions.

[22] The quality of the data on working hours is perceived to be very high as response to the survey is compulsory. The data is available online through the GENESIS database of the Federal Statistical Office (code 62321) and described in more detail here: https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/EarningsLabourCosts/Methods/QuarterlyEarningsSurvey.html.

Figure 2: Illustration of the Identification of Firms' Affectedness by the Minimum Wage



Notes: This diagram illustrates the identification of firms' affectedness by the minimum wage 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 2013 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.

distribution is assumed to be $w_{s,r}(100)/w_{s,r}(80) = w_{s,r}(80)/w_{s,r}(60)$.[23] Given these assumptions, the fraction of full-time employees that earned less than €8.50 per hour in 2013 in each sector-region cell—henceforth denoted as $TI_{s,r}$—can be derived from the intercept theorem:

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

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

Weighting the treatment intensity measure $TI_{s,r}$ by the number of full-time employees in each sector-region cell yields that 4.0% of all full-time employees in West Germany and 15.6% in East Germany earned less than €8.50 per hour prior to the introduction of the statutory minimum

[23] 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 $w_{s,r}(0) = 0.7 * w_{s,r}(10)$ and the relative ordering of sector-region cells did not change substantially. Moreover, robustness checks presented in Section 7 show that the main effects of this study do not hinge on the assumptions about $w_{s,r}(0)$.

Table 1: Variation in Treatment Intensity

	Total		Manufacturing		Services		West Germany		East Germany	
	# Firms	%	# Firms	%	# Firms	%	# Firms	%	# Firms	%
Firms	3825	.	2039	.	1786	.	3292	.	533	.
$TI = 0$	2733	71.5	1668	81.8	1065	59.6	2588	78.6	145	27.2
$TI \in (0, 0.1)$	545	14.2	212	10.4	333	18.6	382	11.6	163	30.6
$TI \in (0.1, 0.2)$	339	8.9	121	5.9	218	12.2	211	6.4	128	24.0
$TI \in (0.2, 0.3)$	85	2.2	11	0.5	74	4.1	53	1.6	32	6.0
$TI \in (0.3, 0.5)$	96	2.5	18	0.9	78	4.4	53	1.6	43	8.1
$TI \in (0.5, 1)$	27	0.7	9	0.4	18	1.0	5	0.2	22	4.1

Notes: Distribution of firms (in January 2015) across different groups of treatment intensity as captured by the percentage of full-time employees in their two-digit industry and region that earned less than €8.50 per hour in 2013.

wage.[24] These numbers are remarkably close to Falck et al. (2013), who find that 4.2% and 15.5% of all full-time employees earned less than €8.50 per hour in 2013 in West and East Germany, respectively, based on individual-level wage data from the German Socio-Economic Panel (SOEP).

Finally, each firm i in the IBS is matched to the respective level of treatment intensity of its sector-region cell $TI_{i \in SR}$ (henceforth denoted as TI_i). Overall, 84.5% of all manufacturing firms and service companies in the IBS can be matched to a measure that proxies the degree of affectedness by the minimum wage introduction. Moreover, the frequency of matches is relatively homogeneous across sectors (86.1% of manufacturing firms vs. 82.7% of service companies) as well as between West Germany (85.3%) and East Germany (80.0%).

The treatment intensity measure captures a substantial degree of variation in the degree to which firms were affected by the minimum wage. As summarized in Table 1, approximately three out of ten firms in the sample had to increase wages of full-time employees by at least some degree due to the minimum wage if they wanted to leave the number and composition of their workforce unchanged. In turn, approximately seven out of ten firms are perceived as unaffected in the baseline specification of TI_i. Among firms with $TI_i > 0$, roughly half of the affected firms had to increase wages of more than 10% of their full-time employees due to the minimum wage, *ceteris paribus*. Moreover, a group of approximately 210 (120) firms had been very strongly affected as they operated in sector-region cells in which more than 20% (30%) of full-time employees were affected by the minimum wage.

Moreover, there is a sufficient degree of variation in TI_i that allows for separate analyses of the response of manufacturing firms relative to service companies as well as firms in West Germany relative to their counterparts in the East. In general, service providers—of which approximately

[24] Within the manufacturing and services industries relevant for this study, i.e., industries that were not conceded to delay their compliance to the federal level of €8.50 per hour until the end of 2016, these numbers are still 2.4% and 12.1% of full-time employees in West and East Germany, respectively. Throughout the paper, the term "East Germany" refers to the federal states of Mecklenburg-West Pomerania, Brandenburg, Saxony-Anhalt, Saxony, and Thuringia, while "West Germany" covers the area of the Federal Republic of Germany prior to the reunification in 1990 plus Berlin, which is organized as a single county.

Table 2: Plausibility Check of the Treatment Intensity Measure

	Treatment Intensity (TI)			
Treatment Intensity $TI \in$	[0%]	(0%,20%]	(20%,30%]	(30%,100%)
prob("Affected" = 1)	0.171	0.374	0.597	0.811
prob("Plan to Adjust Business" = 1|"Affected" = 1)	0.455	0.525	0.739	0.833
prob("Do Not Plan to React" = 1|"Affected" = 1)	0.545	0.475	0.261	0.167

Notes. "Treatment Intensity" refers to the fraction of full-time employees that earned an hourly gross wage of less than €8.50 in 2013 in each firm's two-digit industry and region. *prob*("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*("Plan to Adjust Business" = 1|"Affected" = 1) captures the probability 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*("Do Not Plan to Adjust Business" = 1|"Affected" = 1) is defined accordingly.

40% are perceived as being affected—have been affected more strongly by the minimum wage than manufacturing firms (roughly 20%).[25] In addition, one out of five firms in West Germany was affected according to TI_i, while almost three out of four East German firms were affected to at least some degree. Conditional on being affected ($TI_i > 0$), however, the variation in TI_i is roughly comparable between firms in the different subsets as the mean treatment intensity among affected firms is 0.113 and 0.150 in the subset of manufacturing firms and service companies as well as 0.123 and 0.165 for firms East and West Germany, respectively.

The plausibility of the firm-specific treatment intensity measure is confirmed by making use of firms' responses to a series of special questions in the IBS regarding their assessment of the upcoming introduction of the statutory minimum wage that has been conducted in November 2014. In these supplementary questions, firms were asked whether their company is 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 investment volumes, or to increase prices.[26]

As sketched in Table 2 and documented in further detail in Appendix A.2, the probability that firms stated to be affected by the minimum wage increases substantially in TI_i. While only 17% of firms stated to be affected if they operated in sector-region combinations in which no full-time employee earned less than €8.50 in 2013, this probability increases to 81% for firms in sector-region cells with more than 30% of full-time employees being treated. At the same time, firms that were

[25] Furthermore, there is also substantial variation in firms' proxied treatment intensity within the different two-digit industries of the manufacturing and services sector, see Table A.2 in Appendix A.4.

[26] The question about firms' affectedness 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 the English translation of the supplementary questions in Appendix A.2. Moreover, the questions regarding firms' planned reaction to the introduction of the minimum wage are restricted to affected firms and one direction. For example, affected firms could only state whether they planned to reduce their number of employees or not. If firms were operating in monopsonistic labor markets, however, they should be expected to increase their labor demand in response to a binding minimum wage at sufficiently low levels as argued by Manning (2003). Hence, the supplementary questions on the minimum wage introduction themselves do neither permit an identification of firms' kind and degree of affectedness, nor allow for causal inference on the firm-level response of the minimum wage introduction due to missing counterfactuals as well as one-sided questions.

affected to a larger degree as captured by TI_i appear to be hit differently by the minimum wage: once stating to be affected, they are substantially more likely to take action through decreases in employment, increases in prices, reductions in investment, or cuts in special payments. In contrast, the majority of firms that reported to be affected by the minimum wage despite of $TI_i = 0$ did not plan to react to the minimum wage introduction. Arguably, these firms were only affected indirectly by the minimum wage or perceived themselves as being affected because of the obligatory and time-consuming documentation requirements. Overall, this evidence confirms that TI_i plausibly captures the degree to which firms are directly affected by the introduction of the minimum wage through the channel of increased labor costs.

4. Empirical Strategy

The goal of the empirical strategy is to evaluate whether firms that were more strongly affected by the introduction of the statutory minimum wage in Germany were more likely to increase prices or to change their number of employees. For this purpose, I use a generalized difference-in-differences (DiD) framework to estimate how strongly the intensity to which firms are affected by the minimum wage introduction (TI_i) is associated with firms' pricing and employment plans, denoted β. Before examining the dynamic response of firms, I start with the estimation of the average effect of the minimum wage on firms' price and employment expectations during the year around its introduction in January 2015, relative to "normal" times outside this window.

The estimation of β is based on the following empirical model

$$Y_{i,t}^{+3m} = \beta \times TI_i \times \mathbb{1}(t \in (2014m7, 2015m6)) + \gamma \times \text{Demand}_{i,t} + \alpha_i + \delta_t \times \mathbb{1}(\text{Sector}_i) + \delta_t \times \mathbb{1}(\text{State}_i) + \varepsilon_{i,t}, \quad (2)$$

where the dependent variable $Y_{i,t}^{+3m}$ denotes either firm i's expected change in the price of its products (or provision of its services) 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 the IBS questions Q1 and Q2 in month t. As described in Section 3.1, both variables take values on a trichotomous scale ([1] "increase", [0] "stay the same", [-1] "decrease").

To estimate the minimum wage effect, I interact the firm-specific treatment intensity measure TI_i with a dummy variable for the treatment period between six months before and after the introduction of the minimum wage in January 2015. This standard method for the identification of the treatment effect of an intervention in a DiD design delivers an estimate of β, relative to the dates outside the treatment period and after controlling for all other covariates (Angrist and Pischke, 2008).

The set of control variables in the baseline specification of model (2) includes current demand of each firm (Demand$_{i,t}$) as reported to the IBS, firm fixed effects α_i, and date fixed effects δ_t at the levels of two-digit industries as well as federal states. 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 not affected significantly by the introduction of statutory minimum wages. In addition, firm fixed effects capture time-invariant firm-specificities such as persistent optimism or pessimism of firms that has been found to be important for the understanding of expectations in the IBS by Bachmann and Elstner (2015). Furthermore, date fixed effects at the levels of two-digit industries as well as federal states flexibly control for industry-specific and state-specific fluctuations that similarly influence the pricing and employment policies of all firms in each industry or region 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.

After evaluating the average effect of the minimum wage on firms' price and employment policies by means of model (2), I estimate the dynamic response of firms along these margins over time. Specifically, the price and employment effects induced by the minimum wage, denoted β_t, are estimated for each month relative to September 2013, the month of the federal election. For this purpose, the DiD framework of model (2) is augmented in a standard way given by

$$Y_{i,t}^{+3m} = \sum_{t:t\neq 2013m9} \beta_t \times TI_i \times \mathbb{1}(\text{Date}_t) + \gamma \times \text{Demand}_{i,t} + \alpha_i + \delta_t \times \mathbb{1}(\text{Sector}_i) + \delta_t \times \mathbb{1}(\text{State}_i) + \varepsilon_{i,t}, \quad (3)$$

where the treatment intensity measure TI_i is interacted with date dummies ($\mathbb{1}(\text{Date}_t)$). The empirical model (3) delivers estimates of β_t both for the dates before and after September 2013. Consequently, the sequence of estimates after September 2013 should capture the effects of the statutory minimum wage on price and employment plans of firms. In contrast, estimates for the dates prior to the federal election in 2013 should be equal to zero because the introduction of the statutory minimum wage was not expected at that time.

Despite of the discrete and ordinal nature of the data, both empirical 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 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.[27]

[27] As 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 possible bias which are taken into account via multi-way clustering as proposed by Dube et al. (2010) and Cameron et al. (2011). First, the treatment intensity measure (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.

Table 3: Minimum Wage Effects at the Firm-Level: Baseline Results

	Planned Price Change Next 3 Months				Planned Empl. Change Next 3 Months			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\})$	0.40***	0.37***	0.39***	0.41***	-0.0100	-0.019	-0.062	0.00082
	(0.10)	(0.11)	(0.074)	(0.11)	(0.070)	(0.079)	(0.051)	(0.082)
R^2	0.331	0.321	0.328	0.347	0.350	0.311	0.348	0.365
Control for $\text{Demand}_{i,t}$	yes	no	yes	yes	yes	no	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes	yes	yes
Time*State FE	yes	yes	no	no	yes	yes	no	no
Time*Region FE	no	no	no	yes	no	no	no	yes
Observations	280541	287020	280541	280447	280500	287035	280500	280407

Notes: The dependent variables are planned price or employment changes during the next 3 months as reported to the IBS. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m7, 2015m6\})$" is a dummy that is one during the treatment period. "$\text{Demand}_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE," "Time*State FE," and "Time*Region FE" are time fixed effects at the levels of two-digit industries, federal states, and labor market regions, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Minimum Wage Effects at the Firm Level

This section presents the main findings of the study. The empirical analysis in Section 5.1 shows that the introduction of the statutory minimum wage went along with substantial increases in the probability that affected firms planned to increase their prices which is accompanied by at most very weak adjustments of their employment policies. Interestingly, the minimum wage effect on pricing and employment plans are homogeneous across firms in the manufacturing and services sectors as well as between firms in West and East Germany, as documented in Section 5.2. Importantly, estimating the price effect based on realized price changes of firms in the subsample of manufacturing firms delivers results that are comparable to the baseline specification that uses price expectations, as demonstrated in Section 5.3.

5.1. Firms' Adjustment of Price and Employment Plans

The estimation of the baseline model (2) reveals a strongly positive relationship between the degree to which firms were affected by the minimum wage introduction and their probability to plan price increases during the next three months. The results for the baseline specification are displayed in Column (1) of Table 3. The average treatment effect on planned price changes reported between July 2014 and June 2015 is estimated to $\hat{\beta} = 0.4$. This price effect is not only statistically significant at the 1%-level, but also economically substantial and quantitatively large, as will be shown in the quantification exercise conducted in Section 6.

The estimated minimum wage effect on firms' price expectations of $\hat{\beta} = 0.4$ can be interpreted as follows: Suppose a firm is located in a sector-region cell in which 25% of all full-time employees earned an hourly wage of less than €8.50 in 2013, i.e., $TI_i = 0.25$. Relative to the time period before and after the twelve-month window around January 2015, this firm reported planned price

Table 4: 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	$= 1$	$\neq -1$	Baseline	$= 1$	$\neq -1$
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\})$	0.40***	0.30***	0.096***	-0.0100	-0.051	0.041
	(0.10)	(0.085)	(0.036)	(0.070)	(0.032)	(0.048)
$\text{Demand}_{i,t}$	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
Time*Sector FE	yes	yes	yes	yes	yes	yes
Time*State FE	yes	yes	yes	yes	yes	yes
R^2	0.331	0.303	0.334	0.350	0.334	0.285
Observations	280541	280541	280541	280500	280500	280500

Notes: The dependent variables are planned price or employment changes during the next 3 months as reported to the IBS. In Columns (2), (3), (5), and (6) the respective dependent variable is binarized as indicated above each column. "TI" is the proxy of the firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m7, 2015m6\})$" is a dummy that is one during the treatment period. "$\text{Demand}_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE," "Time*State FE," and "Time*Region FE" are time fixed effects at the levels of two-digit industries, federal states, and labor market regions, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

changes—scaled as "[1] increase," "[0] stay the same," "[-1] decrease"—that were *ceteris paribus* increased by 0.1 on average ($\hat{\beta} \times TI_i = 0.4 \times 0.25 = 0.1$). Within the 1-year window around January 2015, the average number of months in which affected firms reported 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 absence of the minimum wage is given by $\hat{\beta} \times TI_i \times 12$ months. Hence, firms with $TI_i = 0.25$ reported planned price changes of a one-step higher category in on average 1.2 months compared to the planned price changes they would have reported if the minimum wage was not affecting them.

The estimated effects of the introduction of minimum wages on firms' pricing plans are constant for different specifications of the baseline empirical model (2): neither dropping the control for firm-specific demand in Column (2), nor controlling for time-specific fluctuations at the more aggregate federal level in Column (3) as well as at the more disaggregate level of labor market regions in Column (4) substantially affects the results.

In contrast, the relationship between the intensity to which firms were affected by the minimum wage introduction and their probability to report planned employment changes is not found to differ relative to other time periods. As documented in Column (5) of Table 3, the average treatment effect on planned employment changes reported between July 2014 and June 2015 is only slightly negative and statistically indistinguishable from zero. Again, the results are robust to the different specifications summarized in Columns (6) through (8). Notably, the estimated effect on planned employment changes is more negative in the specification that does not control for variation at regional levels, see Column (7). However, the estimated effect of $\hat{\beta} = -0.062$ is still insignificant (p-value=0.21).

Table 5: Minimum Wage Effects at the Firm-Level: Other Dependent Variables

	Conditions_t	$\text{Expectations}_t^{+6m}$	Demand_t
$TI \times \mathbb{1}(t \in \{\underline{t}, \bar{t}\})$	0.0043	-0.099	-0.059
	(0.10)	(0.12)	(0.068)
Begin Treatment Period ($\underline{t}$)	2014m10	2014m7	2014m10
End Treatment Period ($\bar{t}$)	2015m9	2015m6	2015m9
Control for $\text{Demand}_{i,t}$	yes	yes	no
Firm FE	yes	yes	yes
Time*Sector FE	yes	yes	yes
Time*State FE	yes	yes	yes
R^2	0.632	0.359	0.454
Observations	281823	280482	282178

Notes: The dependent variables are current business conditions, expected business conditions for the next six months, as well as current backlog of orders as reported to the IBS. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{\underline{t}, \bar{t}\})$" is a dummy that is one during the treatment period between $\underline{t}$ and $\bar{t}$. "Time*Sector FE", "Time*State FE", and "Time*Region FE" are time fixed effects at the levels of two-digit industries, federal states, and labor market regions, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The minimum wage-induced effect on pricing plans mostly stems from additional price increases. Table 4 summarizes the results of estimating model (2) separately for binarized dependent variables that either capture planned increases in prices, i.e., using a dummy $\mathbb{1}(\text{Price Exp.}_t^{+3m} = 1)$, or refer to planned changes that are non-negative, i.e., $\mathbb{1}(\text{Price Exp.}_t^{+3m} \neq -1)$. As displayed in Columns (2) and (3), three quarters of the price effect can be attributed to additional reports of planned price increases, while one quarter of the effect is due to the fact that firms planned to decrease their prices less frequently compared to the counterfactual scenario without the minimum wage. In turn, affected firms appear to have reported to plan to increase as well as decrease their number of employees less frequently in response to the minimum wage introduction. As documented in Columns (5) and (6), both effects are not statistically different from zero, however, and almost perfectly cancel each other out.

Furthermore, the minimum wage introduction does not appear to have had a strong effect on firms' realized and expected revenues as well as current demand. Table 5 summarizes the results of the estimation of model (2) using additional variables from the IBS as dependent variable. On the one hand, TI_i is not associated with differences in firms' current business conditions ($\text{Conditions}_{i,t}$) during the period around the introduction of the minimum wage, which are very closely related to the level of revenues as demonstrated in Link (2017). On the other hand, firms reported slightly more negative expected business conditions for the next six months ($\text{Expectations}_{i,t}^{+6m}$) as well as current backlog of orders ($\text{Demand}_{i,t}$) if they were more heavily affected by the minimum wage. However, these effects are not statistically significant irrespective of using the baseline specification presented in Table 5 or alternative specifications displayed in Table A.4 in Appendix A.4.

Figure 3: Dynamic Response of Minimum Wage Effects at the Firm-Level

Notes: The figure plots the coefficients of the dynamic treatment effect of the minimum wage introduction in January 2015 as estimated in model (3). The dependent variables are firms' planned price or employment changes during the next 3 months as reported to the IBS. The effects are estimated relative to September 2013, the month of the federal election. The vertical lines in April 2014 and January 2015 indicate the months of the decision of the federal cabinet containing the relevant details of the minimum wage law and the month of its introduction, respectively. The shaded areas indicate the treatment period used in model (2). The thin lines display the 95%-confidence intervals based on standard errors clustered at the sector, county, and date levels.

Dynamic Response of Price and Employment Plans

Next, I estimate the dynamic response of firms' price and employment plans over time by means of model (3). The estimated sequences of treatment effects β_t relative to the baseline period in September 2013 are plotted in Figure 3 along with the 95%-confidence intervals.

The positive effect on planned price changes is clearly concentrated in the time period around the introduction of the minimum wage in January 2015, as can be inferred from the left-hand graph of Figure 3. Overall, the price expectations of firms are not correlated with the treatment intensity measure prior to the federal election in September 2013.[28] 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 as well as state-specific trends. Moreover, the coalition agreement of November 2013 stating the introduction of the statutory minimum wage by January 2015 does not seem to have had an immediate effect on price expectations of affected firms. Instead, the treatment effect on firms' pricing plans has been appreciating over the course of 2014 as more details about the minimum wage law, which was proposed by the federal cabinet in April 2014 and finally approved in July 2014, became available and the introduction date approached. Unsurprisingly, the treatment effect on pricing plans has been strongest between the last quarter of 2014 and the second quarter of 2015. Finally, the pass-through on prices appears to have been completed during the second half of 2015 when the

[28] Comparably, placebo tests based on the empirical model (2) do not deliver any statistically significant relationship between TI_i and average pricing plans during the twelve months around January 2012, January 2013, and January 2014 relative to all other dates, see Table A.3 in Appendix A.4.

estimated effect of the minimum wage on firms' planned (additional) price changes for the next three months approached zero again.

In contrast, the dynamic response of firms' employment plans to the introduction of statutory minimum wages does not deliver a comparably strong pattern. As displayed in the right-hand graph of Figure 3, firms that were affected more strongly did not report employment plans that were significantly deteriorated relative to September 2013 after controlling for firm-specific demand, firm fixed effects as well as general trends in their industry and federal state. Interestingly, a significantly negative treatment effect can be detected in October 2014—exactly three months prior to the introduction of the minimum wage. In all remaining months around January 2015, however, the estimated treatment effects are insignificant. Moreover, employment expectations of affected firms generally tended to deteriorate during autumn in all previous years. The negative coefficient in October 2014 could thus just capture a degree of seasonality in employment plans that is not captured by the control variables of model (3).

In opposition to the case of estimated price responses, the choice of the baseline date is crucial for the estimation of the dynamic employment effects. The reason is that the estimated relationship between employment expectations and firms' treatment intensity had been very volatile in the period before the minimum wage was announced.[29] The results presented in Figure 3 show that the planned employment changes of firms were positively—and compared to all other periods unusually strongly—associated with TI_i during the months prior to the federal election in September 2013 although the minimum wage could not have been expected by then. In contrast, choosing November 2013—the month of the signing of the coalition treaty—as baseline period, the estimated treatment effect on employment responses would be positive at almost all dates during 2014 and 2015. Hence, a negative employment reaction of firms in response to the introduction of minimum wages cannot be ruled out with certainty, but can only be detected using baseline dates that are arguably less realistic than in the benchmark scenario.

Note on Measurement Error

It is important to note that the estimated coefficients regarding the treatment effect are likely to be biased towards zero due to measurement error in the treatment intensity measure. TI_i only imperfectly captures the degree to which firms are affected by the minimum wage for various reasons. First, measurement error originates from the fact that TI_i is constructed from wage data of full-time employees at the levels of two-digit industries as well as counties or labor market regions. Thus, labor costs for part-time employees and marginally employed workers as well as heterogeneity in payment schemes between firms within each sector-region cell is not reflected in TI_i. Second, TI_i only captures the direct effect of the minimum wage introduction on the wage bill of firms and thereby abstracts from additional effects such as spillovers through potentially more

[29] Importantly, firms' employment plans were *on average* not related to TI_i prior to the policy intervention. As shown in Table A.3 in Appendix A.4, placebo tests based on the empirical model (2) do not deliver any statistically significant relationship between the treatment intensity measure and average employment plans during the twelve months around January 2012, January 2013, and January 2014.

expensive inputs or compliance costs originating from the documentation requirements formulated in the minimum wage law.

In light of the resulting attenuation bias, the estimated coefficients should be viewed as a lower bound of the "true" size of the treatment effects on planned employment and price changes. Hence, the insignificant (but throughout most specifications negative) coefficient on employment expectations does not generally rule out that negative employment effects could be detected if firms' affectedness to the minimum wage introduction was observed without measurement error. Importantly, the relative magnitude of the price and employment effect should be largely unaffected by the fact that TI_i is measured with error.

5.2. Minimum Wage Effects in Different Sectors and Regions

The existing literature on the price effect of minimum wages is mainly drawing on evidence from highly affected industries such as fast food restaurants (e.g., Aaronson, 2001 and Aaronson et al., 2008 for the U.S., Lemos, 2006 for Brazil, and Fougère et al., 2010 for France) or retailers (Leung, 2016 and Montialoux et al., 2017). The main advantage of these studies is that they can exploit a large number of changes in (already existing) minimum wages in order to identify price effects. At the same time, the analysis is naturally restricted to industries with a high fraction of minimum wage workers because changes in minimum wages are usually small and thus do not strongly affect firms in other industries.

In contrast, the introduction of statutory minimum wages in Germany offers scope for a separate analysis of firm-level minimum wage effects in the services sector compared to the less strongly affected manufacturing sector. As documented in Section 3.2, there is a large degree of variation in the treatment intensity measure in both sectors which allows to investigate whether the reaction to the minimum wage introduction differed between manufacturing firms and service companies given their level of TI_i. In order to estimate the minimum wage-induced adjustment of pricing and employment plans separately for firms in manufacturing and services, denoted β^M and β^S, the baseline empirical model (2) is adjusted as follows

$$\begin{aligned} Y_{i,t}^{+3m} = \beta^M \times TI_i \times \mathbb{1}(t \in (2014m7, 2015m6)) \times \mathbb{1}(\text{Manuf.}_i) \\ + \beta^S \times TI_i \times \mathbb{1}(t \in (2014m7, 2015m6)) \times \mathbb{1}(\text{Services}_i) \\ + \gamma \times \text{Demand}_{i,t} + \alpha_i + \delta_t \times \mathbb{1}(\text{Sector}_i) + \delta_t \times \mathbb{1}(\text{State}_i) + \varepsilon_{i,t}, \quad (4) \end{aligned}$$

where the dummies $\mathbb{1}(\text{Manuf.}_i)$ and $\mathbb{1}(\text{Services}_i)$ equal one if firm i operates in the manufacturing or services sector, respectively. The results are summarized in Table 4, where Columns (1) and (4) replicate the results for the baseline estimation and Columns (2) and (5) provide the estimated treatment effects in the adjusted empirical model (4).

The results show that manufacturing firms and service providers responded to the introduction of the statutory minimum wage in a comparable way. In both sectors, affected firms planned to increase prices significantly more often than they would have done if they were not affected.

Table 6: Minimum Wage Effects at the Firm-Level in Different Sectors and Regions

	Price Expectations$_t^{+3m}$			Empl. Expectations$_t^{+3m}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\})$	0.40***			-0.0100		
	(0.10)			(0.070)		
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\}) \times \mathbb{1}$(Manuf.)		0.41***			0.079	
		(0.13)			(0.091)	
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\}) \times \mathbb{1}$(Services)		0.39**			-0.084	
		(0.15)			(0.096)	
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\}) \times \mathbb{1}$(West)			0.41***			0.080
			(0.14)			(0.17)
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\}) \times \mathbb{1}$(East)			0.40***			-0.0095
			(0.10)			(0.070)
R^2	0.331	0.331	0.331	0.350	0.351	0.351
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
Time*State FE	yes	yes	yes	yes	yes	yes
H0: Coefficients Equal: p-value		0.928	0.948		0.202	0.576
Observations	280541	280541	280541	280500	280500	280500

Notes: The dependent variables are planned price or employment changes during the next 3 months as reported to the IBS. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m7, 2015m6\})$" is a dummy that is one during the period between July 2014 and June 2015. "$\mathbb{1}(Manuf.)$," "$\mathbb{1}(Services)$," "$\mathbb{1}(West)$," and "$\mathbb{1}(East)$" 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" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The estimated adjustment of pricing plans of manufacturing firms induced by a given degree of treatment intensity is $\hat{\beta}^M = 0.41$. Despite of being treated less on average, the treatment effect is not statistically different from the price reaction of service companies ($\hat{\beta}^S = 0.39$). *Ceteris paribus*, manufacturing firms thus planned to increase prices with roughly the same probability as service firms that were affected to a comparable degree. Moreover, the minimum wage introduction did not result in significantly depreciated employment plans of firms in both samples as can be inferred from the insignificant coefficients in Column (5) of Table 1 which are not statistically different from each other at the 10% level.

Next, I evaluate whether the reaction to the minimum wage introduction differed between firms in West and East Germany given their level of TI_i. As documented in Table 1, firms in West Germany were on average less strongly affected by the introduction of statutory minimum wages than their counterparts in the East. However, there is sufficient variation in TI_i across firms in both regions that allows for the estimation of minimum wage effects separately for firms in West and East Germany. Along the lines of model (4), the treatment interaction term is multiplied with dummies indicating whether firms are located in West or East Germany.

The results show that the reaction of affected firms regarding their pricing and employment

plans did not differ between firms in East and West Germany given their degree of affectedness. As displayed in Columns (3) and (6) of Table 4, the respective coefficients of the treatment effects are of comparable size for firms in both regions. For the same degree of TI_i, the probability to plan to increase prices due to the minimum wage was hence comparably strong for firms in the East and the West. Moreover, a significantly negative effect on firms' employment plans cannot be detected for firms in any of the two regions.

5.3. Realized Price Changes of Manufacturing Firms

The previous analysis documented a strongly positive effect on the probability that affected firms *planned* to increase the prices of their goods or services in response to the introduction of minimum wages in Germany in January 2015. As described in Section 3.1, the focus on *expected* rather than *realized* price changes results from the design of the IBS: While firms in both surveys covering manufacturers and service companies are asked about their expected price changes in the next three months, realized price changes are only extracted from firms in the manufacturing survey. As the majority of firms that are affected by the minimum wage introduction operate in the services sector, it is reasonable to include them into the baseline sample and restrict the main analysis to firms' pricing plans. However, it is *a priori* not clear whether firms indeed realized the price changes they previously planned in response to the minimum wage. In order to accommodate this concern, I make use of the realized price changes reported by firms in the manufacturing survey of the IBS.

Before estimating the effect of the minimum wage introduction on realized prices of manufacturing firms, the general relationship between firms' realized and expected price changes is assessed. While firms are asked whether they plan to change their prices during the *next three months*, the question on price realizations refers to the change in *the previous month*. Unsurprisingly, firms report to expect price changes (20.4% of reports) during the next three month more often than they state to have changed prices during the previous month (16.9%). Consequently, the variation in price expectations is larger than in reported price realizations, which is important for the interpretation of the estimated treatment effects.

In general, firms are relatively good in predicting changes of their prices during the next three months. This can be inferred from Table 7 that contrasts the price expectations reported by manufacturing firms in month t and their average reported price changes in the subsequent three months.[30] In total, firms stick to their pricing plans in 79% of the cases. Specifically, if firms planned to increase (decrease) their prices, they reported price increases (decreases) thereafter in 64% (68%) of all periods, while they did not change their prices during 82% of the periods after reporting that they did not plan to change prices. These descriptive results are in line with Pesaran and Timmermann (2009) who find evidence for a high degree of predictability in the price data of

[30] This comparison assumes that positive and negative changes are of comparable size and can hence be weighted equally. This assumption is not too restrictive given the fact that less than 1% of all price expectations are followed by realizations in the subsequent three months that contained at least one positive and one negative realized price change.

Table 7: Price Expectations and Realized Price Changes in the Subsequent 3 Months

	Obs.	Fractions of Mean Realized Price Changes b/w $t+1$ & $t+3$			Sum
		> 0	$= 0$	< 0	
Price Exp.$_t^{+3m} = 1$	15975	0.64	0.33	0.03	1
Price Exp.$_t^{+3m} = 0$	93079	0.10	0.82	0.08	1
Price Exp.$_t^{+3m} = -1$	7447	0.04	0.28	0.68	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 8: Minimum Wage Effect on Realized Price Changes of Manufacturing Firms

	Change in Prices$_t^{-1m}$
$TI \times \mathbb{1}(t \in \{2014m10, 2015m9\})$	0.34**
	(0.15)
R^2	0.288
Control for Demand$_{i,t}$	yes
Firm FE	yes
Time*Sector FE	yes
Time*State FE	yes
Observations	150051

Notes: The dependent variable is the realized price change during the previous month as reported by firms in the manufacturing survey of the IBS. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m10, 2015m9\})$" is a dummy that is one during the period between October 2014 and September 2015. "Demand$_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the IBS using more involved statistical tests. Hence, it is very likely that affected firms stuck to their plans and increased prices in response of the introduction of minimum wages.[31]

Next, the effect of the minimum wage introduction on realized price changes of manufacturing firms is estimated along the lines of the baseline empirical model (2). 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 question.

The results presented in Table 8 demonstrate that manufacturing firms reported to have indeed increased their prices in response to the introduction of minimum wages in January 2015. The estimated coefficient of the treatment effect of $\hat{\beta} = 0.34$ is significant at the 5%-level. Relative to all

[31] Furthermore, the number of "unexpected" price increases (in total 10,224 observations consisting of 10% of the cases following a "neutral" price expectation and 4% of those following "negative" plans) strongly outweighs the 5751 cases in which firms previously planned to increase prices without sticking to their plans. Hence, it is likely that some firms increased their prices due to the minimum wage although they did not plan to do so.

other periods when the minimum wage was not affecting them, a hypothetical firm with $TI_i = 0.25$ reported realized price changes of a one-step higher category—i.e., increased instead of constant or constant instead of decreased prices—in one additional month on average ($\hat{\beta} \times TI_i \times 12m = 0.34 \times 0.25 \times 12m = 1.02m$) between October 2014 and September 2015.

This estimate of the minimum wage effect on realized price changes is remarkably close to the effect on expected price changes during the next three months ($\hat{\beta} = 0.41$) documented in Section 5.1. In light of less variation in one-month realized price changes compared to three-month price expectations, it is not surprising that the estimated minimum wage effect on realized price changes is slightly smaller than the effect on expectations. As shown in the next section, however, the quantitative size of the overall effect on producer prices in the manufacturing sector is the same irrespectively of being estimated based on price changes in the previous month or price expectations.

Hence, firms appear to have increased their prices in response to the introduction of minimum wages to the same degree as they had previously planned. As survey data on realized price changes are not available for service firms in the IBS, this finding can only be verified for the subset of manufacturing 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 minimum wage-induced adjustment of pricing plans resulted in actual price increases.

6. Quantification of the Minimum Wage Effect on Producer Prices

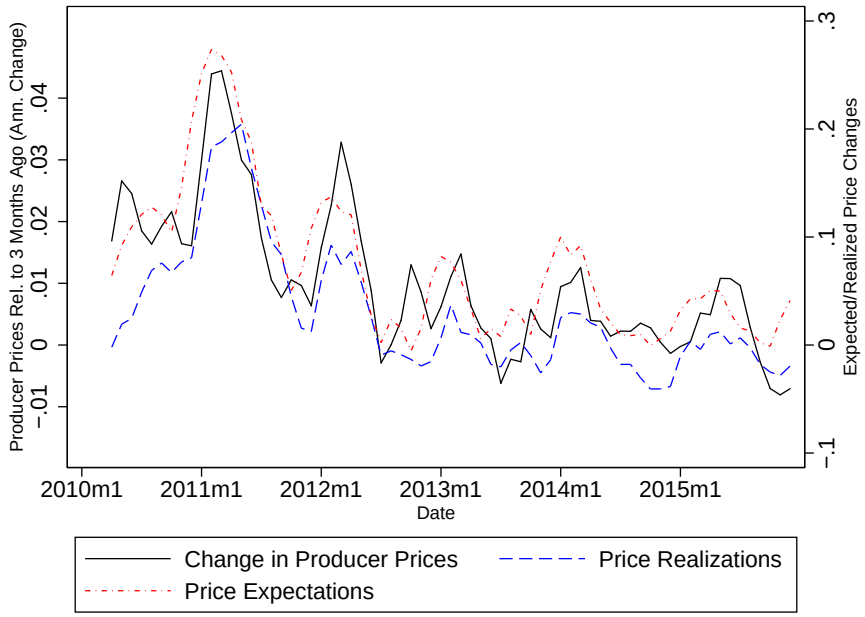
In order to gain insights about the economic dimension of the price effect documented previously, this section provides an approximation of the quantitative size of the increase in producer prices. As the micro data of the IBS do not contain information about the size of price changes, I exploit the fact that aggregated survey responses regarding price changes closely track *quantitative* changes in price indices from administrative sources.

As aggregated time series on producer prices in most sub-industries of the services sector are not available, a quantitative counterpart to the reported price changes in the IBS based on administrative producer price data can only be constructed for manufacturing firms. For this subset, I use monthly time series of producer price indices ($PPI_{s,t}$) at the level of two-digit industries s provided by the German Federal Statistical Office.[32] In order to track the average reported prices of firms as closely as possible, the industry-level time series are weighted by the share of manufacturing firms in the respective sectors of the IBS (ω_s), i.e., $\overline{PPI}_t = \sum_s \omega_s PPI_{s,t}$.

The time series of average expected and realized price changes of manufacturing firms reported to the IBS ($\overline{\text{Price Exp.}}_t^{+3m}$ and $\overline{\text{Price Realiz.}}_t^{-1m}$) are strongly correlated with annualized changes in

[32] For the manufacturing sector, price data are available at Destatis' GENESIS database (code "61241-0002"). If anything, time series on producer prices in the services sector are only available for very few, mostly industry-related services. In these cases, however, the data are only available at quarterly frequency and at inhomogeneous aggregation levels. Moreover, price data for services that enter the consumer price index are available. These time series are not useful for my analysis because they are not necessarily limited to domestic service providers and because they are coded according to a classification system that cannot directly be linked to two-digit industries of the WZ2008 classification.

Figure 4: Comparison between Expected/Realized Price Changes and Quantitative Data



Notes: The figure plots time series of the realized change in producer prices in the manufacturing sector relative to three months before (black solid line) against time series of average realized price changes (blue dashed line) and expected price changes (red dotted line) reported by firms in the manufacturing survey of the IBS. The German Federal Statistical Office provides time series of producer price indices at the two-digit industry level. For aggregation, the industry-specific price indices are weighted by the average share of manufacturing firms in the respective sectors of the IBS.

the time series of weighted producer prices ($\Delta\overline{PPI}_t$), see Figure 4. As documented in Table A.5 in the Appendix**,** 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 ($\rho(\overline{\text{Price Exp.}}_t^{+3m}, \Delta\overline{PPI}_t) = 0.87$), while the correlation with average price realizations is highest at contemporaneity ($\rho(\overline{\text{Price Realiz.}}_t^{-1m}, \Delta\overline{PPI}_t) = 0.86$).[33]

Based on these time series, I estimate semi-elasticities that map qualitative survey responses to quantitative changes in producer price indices, which are defined as follows

$$\hat{\psi}^{Exp} := \frac{\mathrm{d}\Delta\overline{PPI}_t}{\mathrm{d}\overline{\text{Price Exp.}}_t^{+3m}} = 0.147 \text{ and } \hat{\psi}^{Realiz} := \frac{\mathrm{d}\Delta\overline{PPI}_t}{\mathrm{d}\overline{\text{Price Realiz.}}_t^{-1m}} = 0.169. \tag{5}$$

Reflecting the lower volatility in average price realizations, the semi-elasticity that links reported price changes to changes in producer prices is higher ($\hat{\psi}^{Realiz} = 0.169$) than for the case of price

[33] Note that the aggregate price change used here ($\Delta\overline{PPI}_t$) is the annualized percentage change of the current price level relative to three months in the past, which fits the average survey data on price realizations better than monthly changes in producer price indices, see Table A.5 in Appendix A.4. It is important to note that it is not reasonable to estimate a semi-elasticity mapping qualitative survey responses to changes in producer price indices separately for each industry because the number of firms in the IBS is too low in most two-digit industries. Consequently, the changes in industry-level producer price indices do not fit with the mean reported price changes of firms in the respective sectors due to the trichotomy of the survey data.

expectations ($\hat{\psi}^{Exp} = 0.147$). Hence, an appreciation of average price expectations (realizations) in the IBS by 0.1 over the course of 12 months can be associated with an increase in producer prices by roughly 1.5 (1.7) percent.

The estimated semi-elasticities $\hat{\psi}^{Exp}$ and $\hat{\psi}^{Realiz}$ can be used to approximate the quantitative size of firms' price increases in response to the introduction of minimum wages. Assuming (a) that the average size of price changes due to the minimum wage introduction did not differ from "normal" price changes and (b) that price changes of manufacturing firms and service providers are on average of similar size, the minimum wage-induced price reaction of each firm (ΔP_i) can be quantified using the following relationship:

$$\Delta P_i = \hat{\psi} \times \hat{\beta} \times TI_i, \tag{6}$$

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 the previous section based on model (2).

The approximated price effect is considerably large. For example, firms that operate in sector-region combinations in which one out of four full-time employees was affected by the minimum wage ($TI_i = 0.25$) increased their prices by approximately 1.5% in response to the minimum wage. In line with the results in Section 5.3, the price effect of manufacturing firms does not differ substantially once it is approximated using survey data on expected or realized price changes.[34]

6.1. Approximation of the Average Price Effect Across All Firms in the Sample

Next, the average size of price increases of all firms in the sample is approximated. Plugging the average degree of treatment intensity of all firms ($\overline{TI} = 0.039$) into equation (6) delivers an average price increase of 0.23%. As the average degree to which firms were affected by the minimum wage largely differed between West and East Germany as well as between manufacturing firms and service providers, the average price effect is heterogeneous among these groups. As displayed in Panel A of Table 9, firms in West Germany are estimated to have increased their prices by only 0.15% in response to the minimum wage introduction, while the price reaction of East German firms was much stronger (+0.71%). Moreover, manufacturing firms (+0.12%) appear to have raised their prices less strongly than firms in services (+0.35%). Again, estimating the overall price effect for manufacturing firms based on realized price changes rather than expectations delivers comparable results.

Comparing these estimates to the approximate extent of the wage increase in response to the minimum wage introduction indicates that firms passed through a substantial share of their increased labor costs to the prices of their products and services. Assuming that the number and composition of workers did not change, the average increase in total wage costs of all firms in the

[34] Inserting the estimated coefficients of the price effect for manufacturing firms from Tables 6 and 8 to equation (6) gives $\Delta P_i^{Exp} = 0.147 \times 0.409 \times TI_i = 0.060 \times TI_i$ and $\Delta P_i^{Realiz} = 0.169 \times 0.338 \times TI_i = 0.057 \times TI_i$.

Table 9: Quantitative Effect of Minimum Wage 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 ($\hat{\psi}$)	0.147	0.147	0.147	0.147	0.147	0.169
Treatment Effect ($\hat{\beta}$)	0.400	0.409	0.392	0.407	0.400	0.338
Panel A: Average Price Effect of All Firms in Sample						
Mean Treatment Intensity ($\overline{TI}$)	0.039	0.02	0.06	0.024	0.121	0.02
Average Price Effect ($\Delta\overline{P}$ in %)	0.23	0.12	0.35	0.15	0.71	0.12
Panel B: Minimum Wage Effect on Revenue-Weighted Producer Price Index						
Revenue-Weighted Treatment Intensity ($\widetilde{TI}$)	0.029	0.014	0.051	0.023	0.100	0.014
Overall Price Effect ($\Delta\widetilde{P}$ in %)	0.17	0.08	0.31	0.14	0.59	0.08

Notes: This table summarizes the estimated minimum wage effect on the overall level of producer prices. 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. The "treatment effects ($\hat{\beta}$)" correspond to the estimated coefficients of Table 6 and 8. "$\overline{TI}$" is the average treatment intensity of all firms in the IBS and "$\widetilde{TI}$" refers to the revenue-weighted average treatment intensity of all industry-region combinations.

sample induced by the minimum wage can be approximated to 0.70%.[35] Admittedly, this calculation only delivers a very rough estimate of the true increase in labor costs firms faced on average. On the one hand, the estimate provides a lower bound of the true increase in the wage bill because the more strongly affected wages of part-time employees and marginally employed workers are not considered. On the other hand, the estimate is upward biased because of potential non-compliance of firms and because of the fact that wage increases that would have taken place in absence of the minimum wage are not taken into account. However, it is reasonable to argue that the order of magnitude of the true increase in wage costs is roughly captured by this estimate. In light of this, an average price increase of 0.23% appears to be relatively strong and non-negligible.[36]

6.2. Minimum Wage Effect on Overall Producer Prices

In a next step, I examine the effect of the minimum wage introduction on the overall level of producer prices in Germany. For this purpose, the average degree of treatment intensity of all industry-region combinations ($\widetilde{TI}$) is inserted to equation (6). To capture the level of overall producer prices as closely as possible, the treatment intensity of each industry-region combination

[35] Each firm's approximate increase in wage costs is calculated based on the wage data presented in Section 3.2, i.e., the wage distribution of full-time employees in each firm's two-digit industry and region in 2013. In Figure 2, the minimum wage-induced increase in the wage bill corresponds to the fraction of (a) the area between the wage distribution of 2013 in each firm's sector-region combination and the new minimum wage of €8.50/hour and (b) the integral below the entire support of the wage distribution.

[36] In order to calculate the exact share of firms' additional labor costs that is passed through to prices, additional information on other input costs besides labor as well as the development of firms' revenues or profits would be needed. Unfortunately, this additional information is not available at the corresponding level of analysis.

is weighted by revenues in each cell.[37] Similarly to Section 6.1, $\widetilde{TI}$ is also calculated separately for the manufacturing sector and the services sector as well as for West and East Germany.

The results of this quantification exercise presented in Panel B of Table 9 show that overall producer prices in Germany increased by approximately 0.17 percent in response to the introduction of statutory minimum wages in January 2015. Again, producer prices were more strongly increased in East Germany (+0.59%) compared to West Germany (+0.14%) as well as in the services sector (+0.31%) in relation to the manufacturing sector (+0.08%). The estimated effect on the overall level of producer prices is slightly lower than the average price effect across all firms in the IBS displayed in Panel A. This difference can be rationalized by the fact that revenues are higher in industry-region combinations which were less strongly affected by the minimum wage. However, the order of magnitude of both estimates is comparable.

The estimated size of the minimum wage-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 in response to the introduction of the statutory minimum wage (c.f. Sachverständigenrat, 2014, p. 107).[38] Hence, the back-of-the-envelope calculation of the price effect does not seem to deliver unreasonable results despite of the very strong assumptions needed to interpret the effects found in the qualitative survey data in a quantitative way.

7. Robustness

This study documents that affected firms increased their prices in response to the introduction of the statutory minimum wage in Germany, while their employment reaction appeared to be—if anything—only very modestly negative on average and insignificant. 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, Table A.6 in Appendix A.4 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 I control for attrition. If dropout of firms from the sample was correlated with the degree to which they were affected by the minimum wage introduction, the results of the baseline specification could be biased. To accommodate this concern, I restrict the sample to firms that stay in the dataset until December 2015. The estimated minimum wage effect on firms' price and employment expectations are very close to the results of the baseline regression

[37] Revenue data are received from Destatis' GENESIS database (code "73321") 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 share of the total number of employees in the respective industry of its 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.

[38] Unfortunately, the report only includes a prediction for consumer prices rather than producer prices and does not provide details on how the prediction of the minimum wage effect is performed.

Table 10: Firms' Price Response to the Minimum Wage Introduction: Robustness

	Planned Price Change in Next 3 Months									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	Baseline	No Attrition	Wage Data		Threshold $\bar{w}$				$w(p0)$	
			Region	County	6.50€	7.50€	9.50€	10.50€	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\})$	0.40***	0.42***	0.38***	0.56***	0.89***	0.58***	0.26***	0.17**	0.46***	0.39***
	(0.10)	(0.098)	(0.10)	(0.15)	(0.24)	(0.14)	(0.092)	(0.075)	(0.12)	(0.10)
$\text{Demand}_{i,t}$	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
Time*State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.331	0.325	0.331	0.332	0.331	0.331	0.331	0.331	0.331	0.331
Observations	280541	227216	280541	173051	280541	280541	280541	280541	280541	280541
PPI-Semi-Elasticity ($\hat{\psi}$)	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
Mean Treatment Intensity ($\overline{TI}$)	0.039	0.039	0.04	0.031	0.007	0.018	0.068	0.105	0.064	0.037
Average Price Effect ($\Delta\overline{P}$ in %)	0.231	0.238	0.222	0.256	0.095	0.157	0.264	0.262	0.438	0.211
Revenue-Weighted TI ($\widetilde{TI}$)	0.029	0.029	0.03	0.026	0.006	0.014	0.048	0.073	0.035	0.026
Overall Price Effect ($\Delta\widetilde{P}$ in %)	0.168	0.175	0.165	0.209	0.075	0.12	0.186	0.181	0.236	0.148

Notes: The dependent variable is expected price changes during the next 3 months as reported to the IBS. "TI" is the proxy of firms' degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m7, 2015m6\})$" is a dummy that is one during the treatment period. "$\text{Demand}_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states, respectively. "$\hat{\psi}$" denotes the semi-elasticity that maps changes in average price expectations to quantitative producer prices. "$\overline{TI}$" and "$\Delta\overline{P}$" refer to the average treatment intensity and approximated minimum wage-induced price increase of all firms in the sample. "$\widetilde{TI}$" 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 6.2. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

as shown in Columns (1) and (2) of Tables 10 and 11.

Second, the results are robust to the choice of the aggregation level in the wage data used for the construction of the treatment intensity measure. As described in Section 3.2, 53.9% (84.5%) of all firms in the manufacturing and services surveys of the IBS 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 the county level data, the baseline specification uses county-level wage data once they are available and replaces missing values by wage 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. As can be inferred from Column (3) of Tables 10 and 11, the estimated coefficient on the treatment effect on pricing and employment plans is slightly smaller in absolute value in both cases. This can be attributed to additional measurement error in TI_i.

As expected, the estimated minimum wage effects on firms' pricing and employment reaction are stronger if the construction of TI_i is restricted to industry-specific wage data at the county

Table 11: Employment Response to the Minimum Wage Introduction: Robustness

	Planned Employment Change in Next 3 Months									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	Baseline	No Attrition	Wage Data		Threshold $\bar{w}$				$w(p0)$	
			Region	County	6.50€	7.50€	9.50€	10.50€	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m7, 2015m6\})$	-0.0100	0.0035	-0.0040	-0.060	-0.15	-0.078	-0.0056	-0.00027	-0.026	-0.025
	(0.070)	(0.069)	(0.076)	(0.10)	(0.15)	(0.088)	(0.055)	(0.044)	(0.075)	(0.065)
$\text{Demand}_{i,t}$	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
Time*State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.350	0.340	0.350	0.364	0.351	0.351	0.350	0.350	0.350	0.350
Observations	280500	227248	280500	173019	280500	280500	280500	280500	280500	280500

Notes: The dependent variable is the expected employment change during the next 3 months as reported to the IBS. "TI" is the proxy of firms' degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m7, 2015m6\})$" is a dummy that is one during the treatment period. "$\text{Demand}_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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 $\hat{\beta} = 0.56$, see Column (4) of Table 10. Consequently, the approximated effect on the level of overall producer prices is stronger (+0.21%) compared to the baseline specification (+0.17%). For the case of employment expectations, the estimated treatment effect increases in absolute value to $\hat{\beta} = -0.06$, see Column (4) of Table 11. 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 the true extent of firms' price and employment reaction to the introduction of minimum wages.

Third, the results are robust to the choice of different "virtual" minimum wage levels $\bar{w}_{min}$ for the construction of TI_i. If TI_i measures the fraction of all full-time employees that earned less than €6.50 or €7.50 in 2013, the treatment intensity measure only captures firms that are affected very strongly by the introduction of a minimum wage of €8.50 per hour. Unsurprisingly, the estimated effect on the overall price level is smaller (+0.08% for $\bar{w}_{min} =$ €6.50 and +0.12% for $\bar{w}_{min} =$ €7.50) because fewer firms are considered as being affected. Further, the estimated employment reaction among these highly treated firms is more negative than in the baseline specification ($\hat{\beta} = -0.15$ and $\hat{\beta} = -0.08$) but still insignificant, see Columns (5) and (6) of Table 11. Despite of being insignificant, this points into the direction that deteriorated employment plans were—if anything—more likely to occur among very strongly affected firms.

If the treatment intensity measure is calculated based on minimum wage thresholds above €8.50, TI_i assigns a positive degree of affectedness to firms that operate in industries and regions where all full-time employees earned wages slightly above the minimum wage prior to its introduction.

However, it is reasonable to argue 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 (7) and (8) of Table 10 indicate that price expectations in the period around the minimum wage introduction reacted less sensitive to a given variation in TI_i based on the thresholds of $\bar{w}_{min} = €9.50$ and €10.50 compared to the baseline specification. Naturally, the average degree of treatment intensity across all firms $\overline{TI}(\bar{w}_{min})$ as well as the revenue-weighted mean of overall treatment intensity $\widetilde{TI}(\bar{w}_{min})$ is much larger in these specifications, i.e., $\overline{TI}(9.50) = 0.068$ and $\overline{TI}(10.50) = 0.105$ as well as $\widetilde{TI}(9.50) = 0.048$ and $\widetilde{TI}(10.50) = 0.073$. Unsurprisingly, the overall effect on producer prices is larger (+0.19% and +0.18%) compared to the baseline scenario (+0.17%). This small difference indicates that the lion's share of 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 minimum wage only through higher wage costs for part-time employees or marginally employed workers does hence not appear to be a major concern.

Fourth, the results are robust to different assumptions about the minimum of the wage distribution $w(0)$ which is not given in the wage data. The baseline specification is based on the assumption that $w(0)$ is related to the wage at the 10^{th} percentile ($w(10)$) in the same way as $w(10)$ is related to wages at the 20^{th} percentile. In this specification, the minima of the wage distribution on average corresponded to approximately 85% of the wage rates at the 10^{th} percentile. As documented in Columns (9) and (10) of Tables 10 and 11, the results are very close to those of the baseline specification once the wage curve below the 10^{th} percentile is assumed to be either steeper (with $w(0) = 0.7 \times w(10)$) or flatter (with $w(0) = 0.9 \times w(10)$).

8. Conclusion

This paper studies the short-term response of manufacturing firms and service companies to the introduction of statutory minimum wages in Germany in 2015. The analysis focuses on two potential margins of adjustment for firms in response to minimum wage-induced increases in labor costs: changes in the number of employees and pass-through on prices. For this purpose, the paper makes use of the micro data of the ifo Business Survey that is unique in containing information on price changes at the level of firms across a wide range of sectors and regions at high, monthly, frequency.

Identifying each firm's degree of affectedness by means of sectorally and regionally disaggregated wage data, I find strong evidence for price pass-through of affected firms. Based on a generalized difference-in-differences estimation strategy, I find that the probability that firms increased their prices is strongly associated with the intensity to which they were affected by the minimum wage introduction. Conditional on the same degree of affectedness, the price effect does not differ between manufacturing firms and service companies as well as between firms in West and East Germany. This provides evidence in favor of the external validity of other studies that document strong minimum wage effects on prices based on data from single sectors only, such as restaurants (e.g., Aaronson, 2001, Lemos, 2006, Aaronson et al., 2008, and Fougère et al., 2010) and retailers (Leung, 2016 and Montialoux et al., 2017). In addition, exploiting the strong correlation between qualitative

survey data and administrative producer price indices reveals that the minimum wage-induced price reaction of affected firms is quantitatively large and increased the overall level of producer prices in Germany by roughly 0.2%.

In contrast to the pronounced price reaction, I only find a very modestly negative and insignificant effect of the minimum wage introduction on firms' planned employment changes. While a negative employment effect cannot be ruled out with certainty in light of potential measurement error in the treatment intensity measure, this finding points into the direction of a prominent strand of papers including Card and Krueger (1994, 2000), Dube et al. (2010), and Allegretto et al. (2011) who find that minimum wages do not inevitably destroy jobs. Moreover, the paper adds to first evidence in favor of moderate employment effects in response to the introduction of minimum wages in Germany by Bossler and Gerner (2016) and vom Berge et al. (2016) that were much weaker than previously predicted by Knabe et al. (2014) and Arni et al. (2014).

Overall, the results suggest that price pass-through is an important margin of adjustment for firms in response to minimum wages because affected firms appear to have (at least partially and in the short-run) compensated their increased labor costs more often by raising prices than by reducing their number of employees. This highlights that the joint assessment of different potential adjustment channels is a fruitful avenue of research to gain a comprehensive understanding of firms' response to minimum wages. Ideally, this approach would include quantitative micro data on producer prices at very disaggregated levels, which hopefully become available in the future, along with firm-level data on employment stocks and flows as well as further important dimensions such as investment, quality of outputs, and different characteristics of jobs and workers. While data on many of these aspects are being collected, they are either not available or can only hardly be matched to other sources of micro data, yet. I leave this challenge to future work.

References

Aaronson, D. (2001). Price Pass-through and the Minimum Wage. *Review of Economics and Statistics*, 83(1):158–169.

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.

Allegretto, S. and Reich, M. (2016). Are Local Minimum Wages Absorbed by Price Increases? Estimates from Internet-Based Restaurant Menus. *ILRE Working Paper*.

Allegretto, S. A., Dube, A., and Reich, M. (2011). Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data. *Industrial Relations*, 50(2):205–240.

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Arni, P., Eichhorst, W., Pestel, N., Spermann, A., and Zimmermann, K. F. (2014). Kein Mindestlohn ohne unabhängige wissenschaftliche Evaluation. *IZA Standpunkte*.

Bachmann, R. and Elstner, S. (2015). Firm Optimism and Pessimism. *European Economic Review*, 79:297–325.

Becker, S. O. and Wohlrabe, K. (2008). Micro Data at the Ifo Institute for Economic Research - The "Ifo Business Survey" Usage and Access. *Schmollers Jahrbuch-Zeitschrift fur Wirtschafts und Sozialwissenschaften*, 128(2):307–319.

Bell, B. and Machin, S. (2018). Minimum Wages and Firm Value. *Journal of Labor Economics*, 36(1):159–195.

Bellmann, L., Bossler, M., Gerner, H.-D., and Hübler, O. (2017). Training and Minimum Wages: First Evidence from the Introduction of the Minimum Wage in Germany. *IZA Journal of Labor Economics*, 6(1):8.

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.

Bossler, M. (2017). Employment Expectations and Uncertainties Ahead of the New German Minimum Wage. *Scottish Journal of Political Economy*.

Bossler, M. and Gerner, H.-D. (2016). Employment Effects of the New German Minimum Wage: Evidence from Establishment-Level Micro Data. *IAB Discussion Paper 10/2016*.

Brenke, K. (2014). Mindestlohn: Zahl der anspruchsberechtigten Arbeitnehmer wird weit unter fünf Millionen liegen. *DIW-Wochenbericht*, 81(5):71–77.

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-Run Employment Effects of the German Minimum Wage Reform. *IZA Discussion Paper No. 11190*.

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.

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. (2000). Minimum Wages and Employment: a Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Reply. *American Economic Review*, 90(5):1397–1420.

Card, D. and Krueger, A. B. (2015). *Myth and Measurement: the New Economics of the Minimum Wage*. Princeton University Press.

Chakrabarti, S. K., Devaraj, S., and Patel, P. C. (2017). Minimum Wage and Restaurant Hygiene Violation: Evidence from Food Establishments in Seattle. *Working Paper*.

Destatis (2016). 4 Millionen Jobs vom Mindestlohn betroffen. *Statistisches Bundesamt 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.

Erthle, C., Wohlrabe, K., and Wojciechowski, P. (2014). Der flächendeckende Mindestlohn und die Reaktion der Unternehmen-Ergebnisse einer Sonderumfrage im ifo Konjunkturtest. *Ifo Schnelldienst*, 67(49/50):50–52.

Falck, O., Knabe, A., Mazat, A., and Wiederhold, S. (2013). Mindestlohn in Deutschland: Wie viele sind betroffen? *ifo Schnelldienst*, 66(24):68–73.

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*.

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*.

Gürtzgen, N., Kubis, A., Rebien, M., and Weber, E. (2016). Neueinstellungen auf Mindestlohnniveau: Anforderungen und Besetzungsschwierigkeiten gestiegen. *IAB-Kurzbericht no. 12/2016*.

Harasztosi, P. and Lindner, A. (2015). Who Pays for the Minimum Wage? *Working Paper*.

IBS-IND (2015). *Ifo Business Survey Industry 1/1980 - 12/2015*. LMU-ifo Economics & Business Data Center, Munich, doi: 10.7805/ebdc-ibs-ind-2015b.

IBS-SERV (2015). *Ifo Business Survey Service Sector 10/2004 - 12/2015*. LMU-ifo Economics & Business Data Center, Munich, doi: 10.7805/ebdc-ibs-serv-2015b.

Knabe, A., Schöb, R., and Thum, M. (2014). Der flächendeckende Mindestlohn. *Perspektiven der Wirtschaftspolitik*, 15(2):133–157.

Lemos, S. (2006). Anticipated Effects of the Minimum Wage on Prices. *Applied Economics*, 38(3):325–337.

Lemos, S. (2008). A Survey of the Effects of the Minimum Wage on Prices. *Journal of Economic Surveys*, 22(1):187–212.

Leung, J. (2016). Minimum Wage and Real Wage Inequality: Evidence from Pass-Through to Retail Prices. *Working Paper*.

Link, S. (2017). Harmonization and Interpretation of the Ifo Business Survey's Micro Data. *Working Paper*.

Lordan, G. and Neumark, D. (2017). People Versus Machines: The Impact of Minimum Wages on Automatable Jobs. *NBER Working Paper No. 23667*.

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.

Montialoux, C., Renkin, T., and Siegenthaler, M. (2017). The Pass-Through of Minimum Wages into US Retail Prices: Evidence from Supermarket Scanner Data. *Working Paper*.

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.

Neumark, D. and Wascher, W. L. (2008). *Minimum Wages*. MIT Press.

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.

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 Wojciechowski, P. (2016). Wie reagierten die deutschen Firmen auf die Einführung des Mindestlohns? Befragungsergebnisse aus dem ifo Konjunkturtest. *Ifo Schnelldienst*, 69(7):62.

Schmitt, J. (2015). Explaining the Small Employment Effects of the Minimum Wage in the United States. *Industrial Relations*, 54(4):547–581.

Sorkin, I. (2015). Are There Long-Run Effects of the Minimum Wage? *Review of Economic Dynamics*, 18(2):306–333.

Tonin, M. (2011). Minimum Wage and Tax Evasion: Theory and Evidence. *Journal of Public Economics*, 95(11):1635–1651.

vom Berge, P., Kaimer, S., Copestake, S., Croxton, D., Eberle, J., Klosterhuber, W., and Krüger, J. (2016). Arbeitsmarktspiegel: Entwicklungen nach Einführung des Mindestlohns (Ausgabe 2). *IAB-Forschungsbericht, 12/2016*.

Wadsworth, J. (2010). Did the National Minimum Wage Affect UK Prices? *Fiscal Studies*, 31(1):81–120.

Werner, T. and Sell, F. L. (2015). Price Effects of the Minimum Wage: A Survey Data Analysis for the German Construction Sector. *Labour*, 29(3):310–326.

A. Appendix

A.1. Survey Questions Used in the Paper

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: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."

Manufacturing Survey (M):

In the manufacturing survey, firms are asked for assessments regarding specific products. However, only 0.43% of all observations between 2010 and 2015 refer to multiple products for the same firm at a given point in time. Following the procedure described in Link (2017), 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 [only asked in manufacturing survey]:
"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."

A.2. Plausibility of the Treatment Intensity Measure: Supplementary Evidence

This appendix complements the evidence presented in Section 3.2 regarding the plausibility of the treatment intensity measure TI_i by making use of firms' responses to a series of special 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 introduction of the statutory minimum wage in January 2015 (English translation of German original):[39]

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.*

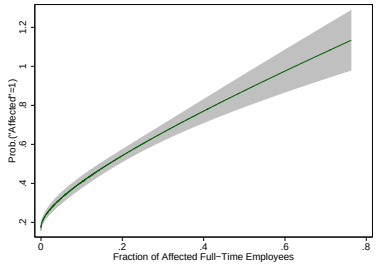
SQ8: *Other action: [1] yes."*

As the functional form of the relationship between TI_i and the frequency to which firms answered questions SQ1, SQ3, SQ4, and SQ5 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.1 plots the resulting curves of the mean probability to affirm to the respective special question at different levels of TI_i along with the 95%-confidence intervals. In addition, Table A.1 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.1 and Table A.1, the probability that firms stated to be affected by the minimum wage increases substantially in TI_i. The majority among the 17% of firms that reported to be affected

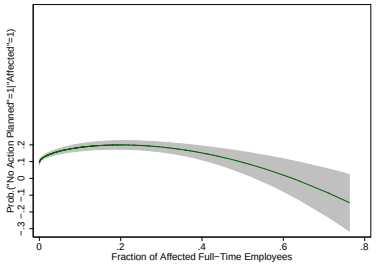
[39] See Erthle et al. (2014) for a description and summary statistics of the minimum wage-related special questions in the IBS of November 2014 as well as Sauer and Wojciechowski (2016) for a descriptive analysis based on these data.

Figure A.1: Relationship between TI_i and Firms' Responses to Minimum Wage Related Special Questions in the IBS

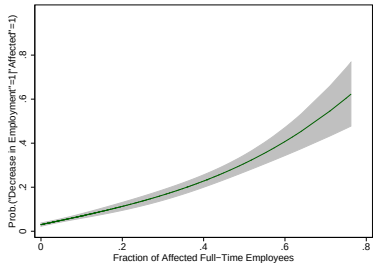
SQ1: Probability of "Affectedness"



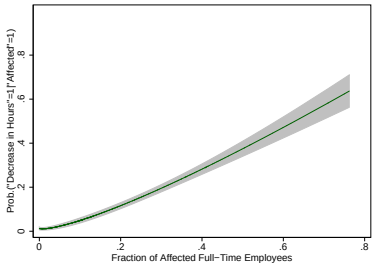
SQ2: No Action Planned if "Affected"



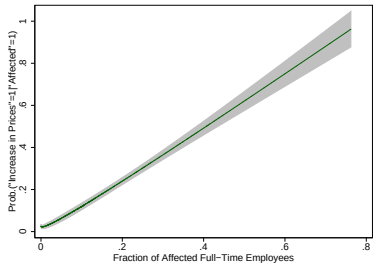
SQ3: Planned Empl. Decreases if "Affected"



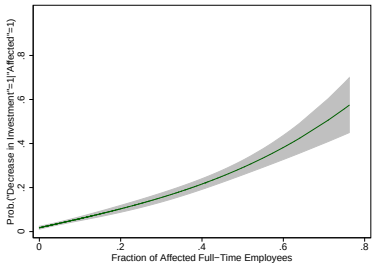
SQ4: Planned Decrease in Working Hours if "Affected"



SQ5: Planned Increase in Prices if "Affected"



SQ6: Planned Decrease in Investment if "Affected"



Notes: The figure plots the predicted probabilities (green line) to affirm to the respective special question indicated above each graph by estimating a fractional polynomial of degree two of TI_i, i.e., the fraction of full-time employees affected by the minimum wage, without adding any further covariates. The shaded area covers the 95%-confidence interval of the predicted probabilities.

Table A.1: Plausibility Check of the Treatment Intensity: Extended Results

	Treatment Intensity (TI)			
Treatment Intensity $TI \in$	[0%]	(0%,20%]	(20%,30%]	(30%,100%)
prob("Affected" = 1)	0.171	0.374	0.597	0.811
prob("No Action" = 1|"Affected" = 1)	0.545	0.475	0.261	0.167
prob("Staff Reduction" = 1|"Affected" = 1)	0.176	0.165	0.261	0.322
prob("Hours Reduction" = 1|"Affected" = 1)	0.07	0.123	0.239	0.389
prob("Price Increase" = 1|"Affected" = 1)	0.152	0.272	0.565	0.644
prob("Reduction in Investment" = 1|"Affected" = 1)	0.104	0.13	0.261	0.311
prob("Reduction in Special Payments" = 1|"Affected" = 1)	0.156	0.215	0.326	0.411

Notes. "Treatment Intensity" refers to the fraction of full-time employees that earned an hourly gross wage of less than €8.50 in 2013 in each firm's two-digit industry and county. *prob*("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*("No Action" = 1|"Affected" = 1), etc. are defined accordingly.

by the minimum wage despite of $TI_i = 0$ did not plan to react to the minimum wage introduction. Arguably, these firms were only affected indirectly by the minimum wage or perceived themselves as being affected because of the obligatory and time-consuming documentation requirements.

Moreover, the probability that "affected" firms according to SQ1 stated to react to the minimum wage introduction 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 these correlations in a causal way is potentially misleading because the questions regarding firms' planned reactions to the introduction of the minimum wage (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, however, 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 operated in such monopsonistic labor markets, 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 on the minimum wage introduction themselves do not allow for causal inference on the firm-level response of the minimum wage introduction due to missing counterfactuals as well as one-sided questions.

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 minimum wage effect on the overall level of producer prices in Section 6.2. To capture overall producer prices as closely as possible, the treatment intensity of each industry-county combination is weighted by the revenues generated in each cell, denoted $\widetilde{revenues}_{s,c}$. As data on industry-specific revenues are not available at the level of counties and the treatment intensity measure cannot be constructed for all industry-county combinations due to data protection issues, the revenue weights are approximated as described in the following.

Revenue data are received from Destatis' GENESIS database (code "73321") at the level of two-digit industries s and federal states f ($revenues_{s,f}$) for 2013, the year used for the construction of $TI_{s,c}$. 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 federal state.[40] This relative size is approximated by the share of full-time employees in each county working in the industry of interest, denoted $employees_{s,c}$. The employment data are included in the wage data set 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., $employees_{s,f} = \sum_{c \in f}(employees_{s,c} | w_{s,c} \notin \{\emptyset\})$.

Assuming that the industry-specific treatment intensity in counties not covered by wage data is similar to the average treatment intensity in all other counties of the federal state, the revenue weight for treatment intensities in counties for which wage data are available ($w_{s,c} \notin \{\emptyset\}$) is given by

$$revenues_{s,c} = revenues_{s,f} \times \frac{employees_{c,s}}{employees_{s,f}}.$$

However, there are industry-federal state cells for which wage data are not available in any county or labor market region. Specifically, federal state-level revenue data cannot be matched to treatment intensity measures in at least one of the respective federal state's counties in 12.0% (7.4%) of all East (West) German industry-federal state combinations. As workers were more strongly affected in East Germany, the calculated $\widetilde{TI}$ would hence be downward biased without adjustment of this asymmetry in the availability of wage data. In order to correct this bias, the revenue weights ($revenues_{s,c}$) of counties in East German federal states are inflated by the inverse of the proportion 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

[40] As in the baseline specification, empty county-level cells are replaced by wage data at the level of labor market regions.

state f. $\xi_{s,West}$ is defined accordingly for the case of industry-federal state combinations in West Germany.

The resulting revenue weight for $TI_{s,c}$ in each industry-county cell is hence given by

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

where $\xi_{s,EW}$ refers to $\xi_{s,East}$ or $\xi_{s,West}$ if county c is located in East or West Germany, respectively.

A.4. Supplementary Tables

Table A.2: Variation in Firms' Treatment Intensity In Different Industries

		% Firms with Fraction of Affected Full-Time Employees					
Two-Digit Industry (WZ 2008)	# Firms	=0%	>0%	>10%	>20%	>30%	>50%
Panel A: Firms in Manufacturing Survey of IBS							
10 Food products	66	1.5	98.5	71.2	34.8	30.3	9.1
11 Beverages	12	91.7	8.3	0	0	0	0
12 Tobacco products	2	100	0	0	0	0	0
15 Leather products (& related)	1	100	0	0	0	0	0
16 Wood & products of wood (excl. furniture)	57	87.7	12.3	3.5	1.8	1.8	0
17 Paper & paper products	76	81.6	18.4	15.8	0	0	0
18 Printing and reproduction of recorded media	97	79.4	20.6	7.2	0	0	0
19 Coke and refined petroleum products	1	100	0	0	0	0	0
20 Chemicals and chemical products	118	87.3	12.7	3.4	0	0	0
21 Basic pharmaceutical products & preparations	16	68.8	31.3	0	0	0	0
22 Rubber and plastic products	180	73.9	26.1	12.2	1.1	0	0
23 Other non-metallic mineral products	116	81	19	0	0	0	0
24 Basic metals	92	91.3	8.7	0	0	0	0
25 Fabricated metal products, except machinery & equipment	302	73.2	26.8	12.9	0	0	0
26 Computer, electronic and optical products	95	80	20	7.4	0	0	0
27 Electrical equipment	174	93.1	6.9	3.4	1.1	0	0
28 Machinery and equipment n.e.c.	448	98	2	0	0	0	0
29 Motor vehicles, trailers and semi-trailers	82	89	11	0	0	0	0
30 Other transport equipment	9	100	0	0	0	0	0
31 Furniture	44	75	25	9.1	6.8	6.8	0
32 Other Manufacturing	44	45.5	54.5	20.5	15.9	6.8	6.8
33 Repair and installation of machinery and equipment	7	71.4	28.6	0	0	0	0
Panel B: Firms in Services Survey of IBS							
35 Electricity, gas, steam, and air conditioning supply	7	100	0	0	0	0	0
38 Waste collection, treatment and disposal activities; materials recovery	61	72.1	27.9	6.6	0	0	0
41 Construction of buildings	13	84.6	15.4	7.7	0	0	0
43 Specialised construction activities	14	71.4	28.6	7.1	0	0	0
45 Wholesale and retail trade and repair of motor vehicles and motorcycles	1	0	100	100	100	0	0
49 Land transport and transport via pipelines	131	1.5	98.5	71.8	22.9	5.3	0
50 Water transport	2	100	0	0	0	0	0
51 Air transport	3	100	0	0	0	0	0
52 Warehousing and support activities for transportation	127	76.4	23.6	7.9	.8	0	0
53 Postal and courier activities	8	0	100	37.5	0	0	0
55 Accommodation	89	1.1	98.9	78.7	40.4	14.6	5.6
56 Food and beverage service activities	57	0	100	100	100	93	15.8
58 Publishing activities	14	92.9	7.1	7.1	0	0	0
59 Motion picture, video & TV programme production, sound recording & music publishing	10	0	100	10	0	0	0
60 Radio and Television	7	100	0	0	0	0	0
61 Telecommunications	6	100	0	0	0	0	0
62 Computer programming, consultancy and related activities	247	91.5	8.5	1.2	0	0	0
63 Information service activities	15	73.3	26.7	0	0	0	0
64 Financial service activities, except insurance and pension funding	49	100	0	0	0	0	0
65 Insurance, reinsurance and pension funding, except compulsory social security	1	100	0	0	0	0	0
66 Activities auxiliary to financial services and insurance activities	11	90.9	9.1	0	0	0	0
68 Real estate activities	61	26.2	73.8	24.6	0	0	0
69 Legal and accounting activities	72	25	75	22.2	8.3	0	0
70 Activities of head offices; management consultancy activities	90	87.8	12.2	1.1	0	0	0
71 Architectural and engineering activities; technical testing and analysis	350	88.3	11.7	0	0	0	0
72 Scientific research and development	39	97.4	2.6	0	0	0	0
73 Advertising and market research	61	70.5	29.5	6.6	0	0	0
74 Other professional, scientific and technical activities	22	13.6	86.4	13.6	0	0	0
77 Rental and leasing activities	25	64	36	16	0	0	0
79 Travel agency, tour operator and other reservation service and related activities	36	52.8	47.2	0	0	0	0
80 Security and investigation activities	12	0	100	83.3	41.7	41.7	25
81 Services to buildings and landscape activities	55	0	100	100	40	23.6	0
82 Office administrative, office support and other business support activities	47	0	100	55.3	17	6.4	0
84 Public administration and defence; compulsory social security	3	100	0	0	0	0	0
85 Education	14	92.9	7.1	0	0	0	0
86 Human health activities	5	0	100	40	40	0	0
87 Residential care activities	3	33.3	66.7	0	0	0	0
88 Social work activities without accommodation	2	0	100	50	0	0	0
90 Creative, arts and entertainment activities	9	55.6	44.4	0	0	0	0
92 Gambling and betting activities	2	0	100	100	100	100	50
93 Sports activities and amusement and recreation activities	4	0	100	100	25	0	0
94 Activities of membership organisations	3	100	0	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 their treatment intensity. As the composition of firms is varying over time, this table displays the distribution of firms that reported to the IBS in January 2015.

Table A.3: Minimum Wage Effects at the Firm-Level: Placebo Tests

	Price Exp.$_t^{+3m}$				Employment Exp.$_t^{+3m}$			
	Placebo			Treatment	Placebo			Treatment
Begin Period ($\underline{t}$)	2011m7	2012m7	2013m7	2014m7	2011m7	2012m7	2013m7	2014m7
End Period ($\bar{t}$)	2012m6	2013m6	2014m6	2015m6	2012m6	2013m6	2014m6	2015m6
$TI \times \mathbb{1}(t \in \{\underline{t}, \bar{t}\})$	-0.053	-0.063	0.013	0.40***	-0.15	0.052	0.042	-0.0100
	(0.059)	(0.081)	(0.060)	(0.10)	(0.093)	(0.053)	(0.051)	(0.070)
R^2	0.331	0.331	0.331	0.331	0.351	0.351	0.350	0.350
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
Time*State FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	280541	280541	280541	280541	280500	280500	280500	280500

Notes: This table summarizes the results of estimating the minimum wage effect in model (2) during different placebo periods. The dependent variables are planned price or employment changes during the next 3 months as reported to the IBS. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{\underline{t}, \bar{t}\})$" is a dummy that is one during the time period between $\underline{t}$ and $\bar{t}$ as indicated above each column. "Demand$_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4: Minimum Wage Effect on Other Variables - Robustness

	Conditions$_{i,t}$				Expectations$_t^{+6m}$				Demand$_t$		
$TI \times \mathbb{1}(t \in \{\underline{t}, \bar{t}\})$	0.0043	-0.028	-0.0058	-0.0049	-0.099	-0.11	-0.068	-0.091	-0.059	0.019	-0.12
	(0.10)	(0.12)	(0.070)	(0.10)	(0.12)	(0.11)	(0.099)	(0.12)	(0.068)	(0.056)	(0.086)
Begin Period ($\underline{t}$)	2014m10	2014m10	2014m10	2014m10	2014m7	2014m7	2014m7	2014m7	2014m10	2014m10	2014m10
End Period ($\bar{t}$)	2015m9	2015m9	2015m9	2015m9	2015m6	2015m6	2015m6	2015m6	2015m9	2015m9	2015m9
Control for Demand$_{i,t}$	yes		yes	yes	yes		yes	yes			
Firm FE	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
Time*State FE	yes	yes			yes	yes			yes		
Time*Region FE				yes				yes			yes
R^2	0.632	0.508	0.630	0.640	0.359	0.351	0.356	0.373	0.454	0.451	0.466
Observations	281823	291683	281823	281728	280482	290263	280482	280386	282178	282178	282083

Notes: The dependent variables are current business conditions, expected business conditions for the next six months, as well as current backlog of orders as reported to the IBS. "TI" is the proxy of the each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{\underline{t}, \bar{t}\})$" is a dummy that is one during the treatment period between $\underline{t}$ and $\bar{t}$. "Time*Sector FE," "Time*State FE," and "Time*Region FE" are time fixed effects at the levels of two-digit industries, federal states, and labor market regions, respectively. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.5: Cross-Correlation Between Time Series of Average Reports to IBS and Changes in Quantitative Price Data

Panel A: Changes in PPI Relative to 3 Months Before							
Lag i	-3	-2	-1	0	1	2	3
$\rho(\overline{\text{Price Exp.}}_{t-i}^{+3m}, \Delta\overline{PPI}_t)$	0.554	0.678	0.782	0.858	**0.870**	0.781	0.579
$\rho(\overline{\text{Price Realiz.}}_{t-i}^{-1m}, \Delta\overline{PPI}_t)$	0.731	0.805	0.854	**0.855**	0.745	0.536	0.333

Panel B: Changes in PPI Relative to Previous Month							
Lag i	-3	-2	-1	0	1	2	3
$\rho(\overline{\text{Price Realiz.}}_{t-i}^{-1m}, \Delta\overline{PPI}_t)$	0.621	0.635	0.699	0.610	0.396	0.238	0.158

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 ($\overline{\text{Price Exp.}}_t^{+3m}$) or average realized price changes during the previous month ($\overline{\text{Price Realiz.}}_t^{-1m}$) as reported to the IBS. The sample is restricted to manufacturing firms between January 2010 and December 2015.

Table A.6: Firms' Price Response to the Minimum Wage Introduction: Robustness

	Realized Price Change During Previous Month									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Specification	Baseline	No Attrition	Wage Data		Threshold $\bar{w}$				$w(p0)$	
			Region	County	6.50€	7.50€	9.50€	10.50€	$0.7w(p10)$	$0.9w(p10)$
$TI \times \mathbb{1}(t \in \{2014m10, 2015m9\})$	0.34**	0.35**	0.25	0.60***	0.92***	0.54***	0.21	0.16	0.49***	0.32**
	(0.15)	(0.15)	(0.15)	(0.14)	(0.00072)	(0.11)	(0.14)	(0.11)	(0.14)	(0.14)
$\text{Demand}_{i,t}$	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
Time*State FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.288	0.277	0.288	0.283	0.288	0.288	0.288	0.288	0.288	0.288
Observations	150051	122576	150051	92479	150051	150051	150051	150051	150051	150051
PPI-Semi-Elasticity ($\hat{\psi}$)	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
Mean Treatment Intensity ($\overline{TI}$)	0.02	0.021	0.02	0.018	0.002	0.007	0.041	0.07	0.045	0.019
Average Price Effect($\Delta\overline{P}$ in %)	0.116	0.122	0.085	0.182	0.028	0.061	0.144	0.192	0.374	0.104
Revenue-Weighted TI ($\widetilde{TI}$)	0.014	0.014	0.015	0.013	0.001	0.005	0.026	0.041	0.018	0.012
Overall Price Effect ($\Delta\widetilde{P}$ in %)	0.079	0.081	0.062	0.128	0.022	0.05	0.09	0.113	0.149	0.069

Notes: The dependent variable is the reported change in prices in the previous month as reported by manufacturing firms. "TI" is the proxy of each firm's degree of affectedness by the minimum wage introduction and "$\mathbb{1}(t \in \{2014m10, 2015m9\})$" is a dummy that is one during the treatment period. "$\text{Demand}_{i,t}$" is firms' current backlog of orders as reported in the IBS. "Time*Sector FE" and "Time*State FE" are time fixed effects at the levels of two-digit industries and federal states, respectively. "$\hat{\psi}$" denotes the semi-elasticity that maps changes in average price expectations to quantitative producer prices. "$\overline{TI}$" and "$\Delta\overline{P}$" refer to the average treatment intensity and approximated minimum wage-induced price increase of all firms in the sample. "$\widetilde{TI}$" 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 6.2. Standard errors are multiway clustered at the sector, county, and date levels. Level of significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.