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Striking a Bargain: Narrative Identification of Wage Bargaining Shocks

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ABSTRACT

Wage markup shocks, an important driver of business cycles, are hard to pin down. We quantify the importance of exogenous variation in wage bargaining power, one source of those shocks, from German minimum wage introduction episodes and strikes. This disciplines the impulse responses of unemployment and output, and sharpens inference for other variables, which behave consistently with predictions from search-and-matching models. We find that wage bargaining shocks meaningfully contribute to aggregate fluctuations in unemployment and inflation, exhibit substantial pass-through to prices, and imply plausible dynamics for the vacancy rate, firms' profits, and the labor share.

JEL Classification: J2, J3, E32, C32

1 | Introduction

Fluctuations in the labor wedge account for a sizable share of business cycle variation (Chari et al. 2007), but wage markup shocks—the usual way those fluctuations are identified in workhorse policy models (Smets and Wouters 2007; Del Negro et al. 2015; Coenen et al. 2018)—are arguably too broadly defined to provide robust policy prescriptions. Wage bargaining shocks have thus emerged as one theoretically founded and empirically relevant specialization of those ideas (Hagedorn and Manovskii 2008; Christoffel et al. 2009; Gali et al. 2012; Gertler et al. 2008; Drautzburg et al. 2021). Intuitively, workers and employers negotiate over the surplus generated by their relationship, and bargaining power (which can be subject to exogenous variation) determines how that surplus is split. However, bargaining power is still a fairly abstract concept—unobserved and potentially driven by many factors—in models capturing the essential features of wage negotiations (e.g., Pissarides 2000).

Previous contributions tended to rely on the implications of such structural models to guide their identification strategy.

For example, Gali and Gambetti (2019) identify a wage markup shock as the only shock that generates a positive co-movement between real wages and unemployment on impact, and Foroni et al. (2018) rely on sign restrictions implied by a New Keynesian model to disentangle labor supply from wage bargaining shocks.¹ Instead, we shift the emphasis on narrative information about bargaining power,² which allows us to relax some of the more contentious³ identification restrictions imposed on the data in previous studies, while at the same time sharpening inference (Antolin-Diaz and Rubio-Ramirez 2018). We propose exploiting information about minimum wage policy and wage strikes for that purpose. The aim of a minimum wage policy is to improve conditions for workers by forcing employers to increase wages. The policy thus acts as a direct shift of bargaining power in favor of workers (Flinn 2006). Collective bargaining rounds that involve the threat of, or actual, industrial strikes are also a device to boost workers' bargaining power (Hicks 1963).

Germany arguably provides a number of suitable historical events: a statutory minimum wage introduction in 2015, as well as a small number of labor strikes led by the promi-

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ment union IG Metall. Our first contribution is to show their quantitative relevance for pinning down wage bargaining shocks and exogeneity to cyclical developments. Both sets of events meaningfully affected wages for a large share of the workforce (Cahuc et al. 2014; Destatis 2016). Moreover, the wage floor was introduced mainly for political reasons ahead of a Federal election, thus fitting established criteria for exogeneity to economic conditions in narrative identification approaches (Romer and Romer 2010). On the other hand, we conduct an event-study analysis to show that our selected strikes were not fully anticipated by market participants, either.

Our second contribution is to revisit the effects of wage bargaining shocks on aggregate fluctuations. We find that narrative identification disciplines the impulse responses to a wage bargaining shock of unemployment and output, which we otherwise leave unrestricted: unemployment increases and output falls, in line with the predictions of structural models with search frictions in labor markets or monopolistically competitive unions (e.g., Smets and Wouters 2003; Christoffel and Linzert 2005). We also find that bargaining shocks explain around a quarter of GDP deflator inflation and unemployment variability at longer horizons. The so-called pass-through of higher wages to prices following a wage bargaining shock is substantial and provides a rationale for monetary policy-makers to monitor factors influencing wage bargaining outcomes. Focusing on the minimum wage introduction episode, we also show that estimated contributions of wage bargaining shocks to developments in unemployment, prices and nominal wages are in line with existing estimates from microeconomic studies (Link 2019; Mindestlohnkommission 2018; Bundesbank 2015a).⁴

1.1 | Paper Structure

The rest of the paper is organized as follows. In Section 2 we detail our identification strategy using sign and narrative restrictions. In Section 3 we present the data and estimation approach. In Section 4 we discuss our baseline results, and in Section 5 various extensions and robustness checks. In Section 6, we conclude. Additional results are reported in the [Supporting Information Appendix](#).

2 | Identification of Wage Bargaining Shocks

Previous studies of wage bargaining shocks in a VAR setting (e.g., Foroni et al. 2018; Conti and Nobili 2019; Gali and Gambetti 2019) typically relied upon sign restrictions on impulse responses, informed by a specific structural model, to achieve identification. However, when it comes to wage bargaining shocks, labor market models vary considerably in their structural assumptions, underlying mechanisms, and implications for some observable variables. For that reason, we retain only a handful of sign restrictions and dispense with the more contentious ones—those on unemployment and output—instead exploiting narrative information to pin down their dynamic responses.⁵

In addition, sign restrictions are typically imposed on impact. But for wage bargaining shocks, especially those associated with more lasting changes to the labor market, such as the setting of a minimum wage, legislative and implementation lags, as well as anticipation effects, can be substantial. Narrative restrictions,

especially as implemented with the approach of Antolin-Diaz and Rubio-Ramirez (2018), help address those issues, because the exact timing of *shocks* does not need to be imposed a priori. Instead, shocks are only required to show their *effects* on observables within a specified timeframe and with bounds on their economic significance. Another appealing feature of the method is that a selected event need not be completely exogenous and unpredictable to be useful for identification.

There are of course limits to what narrative identification can plausibly achieve: one reason for not including the more far-reaching Hartz reforms—a series of extensive labor market reforms that represented a major shift in bargaining relations—as events in our analysis is that the reforms were extensively discussed in negotiation rounds, announced very much in advance, and implemented over several years, making it difficult to even approximately pinpoint the timing of a shock or series of shocks. In addition, the primary focus of the reforms was on reorganizing unemployment benefits, which arguably reflects a change in workers' external options rather than a shift in bargaining power. Overall, the policies represented a lasting structural change with long-term effects on labor markets and the broader economy (for a parallel with the US, see Stansbury and Summers 2020). Our interpretation is that they are likely to be better captured by the evolution of the deterministic components in our model, as opposed to the more transitory wage bargaining shocks that we seek to identify. In sum, our focus on the short-run aggregate effects of shifts in bargaining power is best viewed as a complement to the dynamic reform literature emphasizing reallocation and associated short-run adjustment costs.⁶

2.1 | Sign Restrictions

Foroni et al. (2018), who rely on a New-Keynesian model with search and matching frictions in the labor market to derive a set of sign restrictions on aggregate variables, require that an increase in workers' bargaining power raise real wages, which, due to increased labor costs, then leads to an increase in prices and a reduction in employment, with output also dropping on impact.⁷ The empirical literature on collective bargaining tends to agree that wages typically increase due to unions' actions (Cahuc and Zylberberg 2004), so we retain the positive restrictions on wages and prices—the latter one being largely nonbinding, as shown in [Supporting Information Appendix I.3](#).

However, we opt not to impose any restrictions on either unemployment or output, because their impact responses can depend on the specifics of the underlying structural model, so we prefer to remain as agnostic as possible. For example, labor market models predict different effects on employment depending on what aspects of the employment contract social partners are bargaining over, the competitive structure as well as unions' and workers' preferences (Cahuc and Zylberberg 2004). One example is minimum wage policy (Dolado et al. 1996; Card and Krueger 1993; Caliendo et al. 2019): in that case, depending on whether the labor market is assumed to be competitive or monopsonistic, the introduction of a minimum wage can either decrease or increase the overall employment level in the economy.

Instead, we extend the baseline VAR specification of Foroni et al. (2018) with average hours per employee, because

distinguishing between employment adjustment along the intensive and extensive margins can help to pin down wage bargaining shocks. In the euro area in general, the intensive margin tends to be more important for labor market adjustment than in the United States (Ohanian and Raffo 2012; Bulligan et al. 2019). But especially in Germany, job-protection policies are quite stringent, making the hiring and firing of workers costly and time-consuming. Instead, firms have an incentive to adjust working hours: short-term working arrangements, open clauses in collective agreements, and various subsidies ensure that the adjustment cost in terms of working hours is relatively lower.⁸ Historical evidence corroborates this picture: on the back of the Great Financial Crisis, unemployment in Germany only increased marginally, while firms reduced the hours worked for most employees (Burda and Hunt 2011; Krugman 2009). Following Hansen (1985), we also estimate a variance decomposition of total hours worked into intensive and extensive margin contributions and find that average hours per employee can explain as much of the cyclical variation in total hours worked as fluctuations in the number of employees (see [Supporting Information Appendix E](#)).

Still, the impact of wage bargaining shocks specifically on average hours is not clear a priori. In a structural framework incorporating labor adjustment along both margins, the assumed bargaining structure determines whether average hours increase or decrease (Cahuc and Zylberberg 2004): in the efficient bargaining case, the marginal rate of substitution is equal to the marginal product of an additional hour, and following an increase in workers' bargaining power, labor market tightness decreases, employment and consumption fall, but average hours worked increase (Fang and Rogerson 2007). Instead, in the right-to-manage model, the first-order condition equates the wage rate to the marginal product of an additional hour, and as a result, average hours worked fall following an increase in workers' bargaining power.

Empirically, Caliendo et al. (2019) and Mindestlohnkommission (2018) review a number of studies that find significant decreases in working hours following the introduction of a minimum wage rate. Moreover, since, as noted above, German employers generally tend to react to higher labor costs by first adjusting the intensive margin, we would also argue that the right-to-manage framework better fits certain features of the German labor market. Most notably, working hours are rarely negotiated alongside wage increases within collective bargaining processes,⁹ and employers can also rely on open clauses to deviate from any agreed level at the company level. Thus, we argue that following a surprise increase in workers' bargaining power, it is reasonable to expect a negative impact on average hours.^{10,11}

Restriction 1. A positive wage bargaining shock increases real wages and prices, but reduces hours worked per employee on impact.

2.2 | Narrative Restrictions

2.2.1 | The Introduction of a Minimum Wage Floor

At the beginning of 2013, German political parties declared a shared intention to introduce a binding wage minimum.

However, only after the general election of September 2013, the issue of a statutory minimum wage was revived. During coalition talks, political parties reached an agreement that included an aspiration for a minimum wage of 8.50 euros from 1 January 2015. Most details, such as the date of introduction, the minimum wage rate, provision period, and terms for collectively agreed wages, were pinned down by the coalition agreement and barely changed in the final legislation (WSI 2013).¹² In April 2014, there was an agreement on the draft legislation, which was passed in July and came into force on 16 August 2014.

2.2.1.1 | Relevance and Timing. The initial minimum wage rate of 8.50 euros was sizeable. Compared to wage floors in other European countries adjusted for purchasing power, it was the third largest, with a ratio of minimum-to-median wage of 52% (Caliendo et al. 2019, 2018; Link 2019). Around 10.7% of the workforce (4 million employees) had wage rates below the new threshold and were eligible for the minimum wage rate, suggesting that the average wage increase was also sizeable, even without accounting for spillover effects on the rest of the wage distribution (Destatis 2016). A number of micro studies subsequently found that there were significant hourly wage increases at the lower end of the wage distribution.¹³ Despite warnings of heavy employment losses, there were only small aggregate employment effects, mostly concentrated in mini-jobs and part-time work arrangements.¹⁴ Instead, the adjustment of employment was more noticeable on the intensive margin, as contractual working hours fell (Caliendo et al. 2019, 2018), consistent with our assumptions (see Restriction 1 in the previous subsection).

The exact date of the policy shock is difficult to determine, as announcement, legislation, and implementation are each two quarters apart, leaving the possibility of nonnegligible anticipation effects (WSI 2015; Kubis et al. 2015; Bellmann et al. 2015; Bossler 2017; Bundesbank 2018; Link 2019)—with only Caliendo et al. (2018) arguing the opposite. We therefore opt not to take a stance on the exact timing of the shock, and instead view the introduction of a minimum wage as a (series of) wage bargaining shock(s) of uncertain timing, but that contributed positively to aggregate real wages over the 2014q1:2015q1 period.

2.2.1.2 | Exogeneity. The reasoning behind the policy was to reduce inequality, protect the less-skilled and lower-paid, especially those not covered by any collective agreement, as well as to improve workers' rights and bargaining power in response to the ongoing decline in unionization rates and a number of "wage-dumping" scandals (CDU, CSU und SPD 2013; Spiegel 2013; Haufe 2013; Reuters 2012; The New York Times 2013; The Local 2013). And although its introduction coincided with a period of favorable economic conditions in Germany, the policy only came into force one year after the announcement, supporting the view that it was not primarily cyclical in nature. Taken together, this suggests that the policy met the criteria—structural, long-run, and ideological—proposed by Romer and Romer (2010) to classify the motive as largely exogenous to economic conditions.

Restriction 2. The net contribution of wage bargaining shocks occurring between 2014q1 and 2015q1 to real wages over the same period is positive.

2.2.2 | Major Industrial Actions

We also treat major industrial disputes as events indicating the possible occurrence of wage bargaining shocks, an idea dating back to Hicks (1963). More recently, a number of bargaining models with strikes have been developed (see Cahuc and Zylberberg 2004; Kennan 1986; Kennan and Wilson 1989, for comprehensive reviews). In general, and *ceteris paribus*, a union's greater bargaining power manifests itself in an increase in the incidence of strikes and in higher negotiated wages. Therefore, observing an above-average wage increase after a strike can suggest that a wage bargaining shock occurred.

We apply stringent criteria to select strikes suitable for our identification purposes. We focus on strikes where (1) a union is viewed as the winner of a negotiation round, and (2) available evidence suggests that wage increases, among other aspects of the negotiation, would have been much less favorable to workers in the absence of a strike (threat). These first two conditions are motivated by the aforementioned predictions of theoretical models of the bargaining process. Moreover, we require that (3) the strike is an economic strike, reflecting the union's aim to obtain higher wage increases or better working conditions. This criterion rules out strikes due to a union's reaction to unfavorable firm policies, which could be construed as an admission of weakness. We also choose (4) significant and costly strikes. In Germany, the legislative framework on strikes encourages unions to call warning strikes that are typically short and induce only minor production losses for the firm. Instead, we mostly focus on full-day strikes (with one exception). Finally, we only consider (5) major labor market conflicts involving IG Metall, the union representative for the metal and electricity industry. IG Metall is generally viewed as a trend-setter for wage bargaining activity in Germany, due to its coverage and historical dominance: the union is the largest in Germany as well as in Europe, representing around 3.5-3.9 million employees (see Cahuc et al. 2014; Eurofound 1999; Bispinck 1995).¹⁵

2.2.2.1 | Relevance and Timing. We identify three events that fully match our criteria. These occurred in 1995q2, 2002q3 and 2018q2, respectively. We also include another event, in 1999q2, that, unlike the previous ones, did not result in a full-day strike, but ended with a compromise reached, however, two hours *after* the deadline to authorize a strike. A more detailed description of the events is provided in [Supporting Information Appendix B](#).

Prima facie, we observe nonnegligible wage increases after IG Metall industrial disputes. Figure 1 shows nominal wage dynamics around our selected events. The series of monthly Basic Pay Rates growth shows spikes coinciding with the timing of IG Metall-negotiated wage increases. We also note that the pictured increases were all above the 85th percentile of wage increases over the 1993:2020 period. The increase in May 1995, in particular, constitutes an extreme outlier. The effective dates of wage increases thus seem to be a reasonable guide to time our narrative restrictions.¹⁶ Disputes and agreements take place one to two months prior to a pay increase, so there is little scope for anticipation effects using quarterly data. However, time aggregation plays a role, as becomes evident comparing the monthly, BPR (MoM), and quarterly, BPR (QoQ), versions of the same series in [Supporting Information Figure C.1](#): at a quarterly frequency, a wage increase lags by a quarter if the effective date is the last month of the quarter, as in 2002q2.¹⁷ Our narrative restrictions are thus imposed for the same quarter if the effective date of a wage increase occurs in the first two months of that quarter, and otherwise, for the following one.¹⁸

2.2.2.2 | Exogeneity. Strikes do not represent completely exogenous events. In fact, calls for strikes and most negotiated wage increases typically reflect unions' endogenous reactions to improving economic conditions (Kennan 1986), and historical sources emphasise that IG Metall has tended to respond to past and expected developments in wages, low workers' purchasing power, a better economic situation and rising profitability

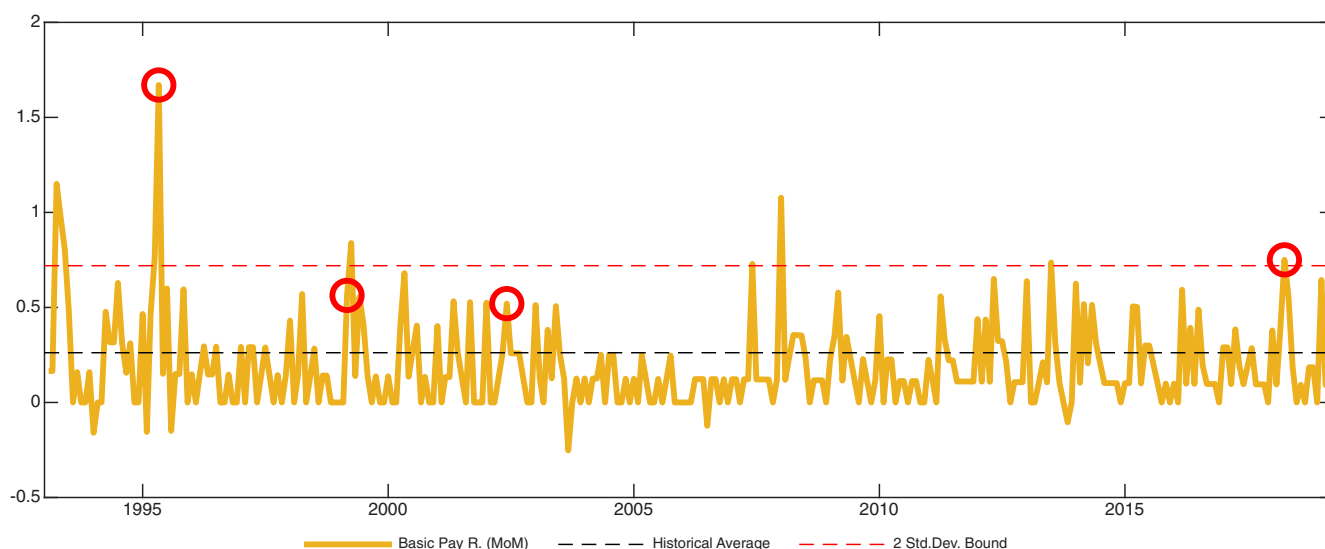


FIGURE 1 | Growth rate of Basic Pay Rates around selected IG Metall industrial strikes. The Basic Pay Rates (BPR) is a monthly leading wage statistic from the Bundesbank that summarizes developments in wages under collective agreements covering over half of the German workforce (Bundesbank 2020). It excludes one-off payments and additional benefits. Red circles indicate the months in which a wage increase was agreed between IG Metall and the association of employers.

(Gesamt Metall 2018). However, as already pointed out by Hicks (1963), strikes are not entirely predictable either. For one thing, while the incidence of strikes may coincide and correlate with favorable economic conditions, industrial actions are still pretty rare, subject to legal barriers and usually viewed as a last resort option in wage negotiations, due to the potential unemployment and reputational costs for all social partners involved.¹⁹

As a first step to probe the events shown in Figure 1, we estimate a set of wage Phillips curves to check whether wage dynamics can be adequately explained by macroeconomic developments alone for the quarters in which industrial disputes occurred.²⁰ In our baseline specification, we find that quarterly wage growth is on average around 0.6pp in excess of what macroeconomic factors would warrant for those quarters—nearly twice the root mean squared error of the regression—suggesting that our selected events do indeed coincide with positive surprise effects and are economically relevant for wage dynamics.

Furthermore, we assess the *predictability* of the full-day strikes discussed above by means of an event study of the stock market returns of firms whose employees are represented by IG Metall, revisiting Neumann (1980), Becker and Olson (1986), Kramer and Vasconcellos (1996) among others.²¹ Strikes are harmful and costly for firms. Future profitability may suffer for a number of reasons, such as lost or delayed production due to stoppages or the expectation of a higher wage bill due to increased wage demands. Thus, strikes may reduce the valuation of a company, and if capital markets are efficient, the lower valuation should be reflected in the firm's stock price.

An event study allows us to compare observed stock market returns, $R_{i,t}$, to counterfactual normal returns in the absence of a strike, $R_{i,t}^e$. The difference constitutes abnormal returns, $AR_{i,t}$, that should be zero on average but may be significantly different from zero around particular events related to the firm's profitability. In our case, we would expect to observe significantly negative abnormal returns around the periods of industrial strikes. For the firm's normal returns, we use a basic market model that relates a company's returns to fluctuations in the overall stock market, reflecting the risk associated with investing in the company:

$$R_{i,t}^e = \alpha_i + \beta_i X_{m,t} \quad (1)$$

To quantify abnormal returns due to strikes, we first compute the model's parameters over at most 200 trading days, with the last day in the sample being 50 trading days prior to the beginning of a strike to avoid potential bias due to anticipation effects.²² We then compute out-of-sample abnormal returns starting five trading days before the beginning of a strike, aggregating abnormal returns across different stocks to obtain average and cumulative abnormal returns for each strike and across strike incidences.²³ Finally, we evaluate the statistical significance of abnormal returns using the nonparametric test statistic of Kolari and Pynnonen (2011), adjusted for event clustering. We use stock market returns for a list of companies whose workers are represented on supervisory boards by IG Metall and are listed on German stock exchanges (either Xetra or the Frankfurt Stock Exchange). To control for market fluctuations, we use the German total market and industrial indices or just the latter, as constructed in Datastream.²⁴

The results are summarized in Table 1. For both specifications, we find that, on average, stock returns fall by around 0.7%–0.95% over the four days running up to and including the strike, which is within the range found in previous studies. On the day of a strike itself, the fall is around 0.5% but not significantly different from zero.²⁵ Cumulative abnormal returns are consistently negative across events and different horizons, although there is limited statistical significance for each incidence individually. But given that industrial disputes are not firm-specific and do not lead to economically significant devaluations, the power of the test for individual events is very limited and should be interpreted with a grain of salt. To isolate the surprise component from a possible anticipation effect, we also present cumulative abnormal returns since the official announcement (row 'Ann.').²⁶ We observe that this effect on stock returns is around 0.8%–0.9% and highly statistically significant. The results thus confirm that strikes are not fully anticipated and still constitute a surprising factor for stock market valuations, which also supports their use for narrative identification purposes.

Following the discussion of industrial disputes, we require that wage bargaining shocks in 1995q2, 1999q2, 2002q3 and 2018q2 be positive, that is, increasing workers' bargaining power, and that the absolute contribution of wage bargaining shocks to the historical decomposition of real wages be the largest in 1995q2, 1999q2 and 2002q3.²⁷

Restriction 3. The wage bargaining shocks in 1995q2, 1999q2, 2002q3, and 2018q2 are positive, that is, increasing workers' bargaining power. The absolute contribution of wage

TABLE 1 | Cumulative abnormal returns around the beginning of a strike.

Window	1995	2002	2018	All
<i>Using industrial and market index</i>				
−4: 0	−1.62***	−0.526	−0.602	−0.779*
−3: 0	−1.507**	−0.504	−0.702	−0.806**
−2: 0	−0.624	−0.68	−0.869*	−0.759**
−1: 0	−0.821*	−1.001	−0.557	−0.754*
0: 0	−0.43	−1.036	−0.252	−0.541
Since Ann.	−0.821*	−0.68	−0.869*	−0.799**
<i>Using industrial index</i>				
−4: 0	−1.697***	−0.639	−0.833	−0.942**
−3: 0	−1.581***	−0.581	−0.804	−0.894**
−2: 0	−0.659	−0.828	−1.024**	−0.887***
−1: 0	−0.819	−1.026	−0.672	−0.816**
0: 0	−0.445	−0.966	−0.265	−0.528
Since Ann.	−0.819	−0.828	−1.024**	−0.92***
<i>Obs</i>	19	29	44	92

Note: Statistical significance is based on the nonparametric generalised rank statistic of Kolari and Pynnonen (2011) adjusted for event clustering. Asterisks denote significance levels for a two-tailed test (***= 1%, **= 5%, *= 10%). Results are also robust to an alternative parametric test statistic, 'ADJ-BMP' in Kolari and Pynnonen (2010), that also adjusts for the cross-correlation across firms in the event window.

bargaining shocks to real wages is the largest compared to other shocks in 1995q2, 1999q2, and 2002q3.

3 | Model and Data

We consider the structural vector autoregression model (VAR) given by

$$A_0 y_t = C + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \epsilon_t \quad (2)$$

where y_t is a $n \times 1$ vector of endogenous variables, C is a $n \times 1$ vector of constants, A_i are $n \times n$ matrices of coefficients, p is the number of lags, ϵ_t is a $n \times 1$ vector of i.i.d. structural shocks with identity covariance matrix. Our baseline specification includes six variables ($n = 6$) and four lags ($p = 4$).²⁸ The variables are: the GDP deflator; real wages and salaries per hour, deflated using the GDP deflator; the unemployment rate; hours worked per employee; real GDP per capita; and the IFO Business Expectations index. All variables except the GDP deflator (which is log-differenced) are in log-levels, save for the unemployment rate and IFO index, which is in levels. All series are seasonally adjusted and enter the model at a quarterly frequency.²⁹ The sample is 1993q1 to 2019q2, providing 106 observations. For further details on the dataset, see Table 2.

Note that despite the addition of hours worked per employee, our model remains relatively parsimonious, and could therefore potentially raise concerns about invertibility, especially regarding anticipation effects for the minimum wage introduction episode that we rely on for narrative identification. To allay such concerns, in [Supporting Information Appendix I.10](#) we augment our baseline model with a number of forward-looking variables (stock market indices and consumer/business surveys). The results suggest that invertibility is not a significant concern, with the impulse responses from the augmented models largely consistent with our baseline results.

We estimate the reduced-form counterpart of Equation (2),

$$y_t = X_t \beta + \epsilon_t \quad (3)$$

with well-established Bayesian techniques. Here $X_t \equiv I_n \otimes [1, y'_{t-1}, \dots, y'_{t-p}]$, $\beta \equiv \text{vec}([A_0^{-1}C, A_0^{-1}A_1, \dots, A_0^{-1}A_p]')$ and ϵ_t is a $n \times 1$ vector of reduced-form residuals with full covariance matrix $\Sigma = A_0^{-1}A_0'^{-1}$. From the family of Normal-Inverse Wishart priors for Σ and β

$$\Sigma \sim IW(\Psi, d) \quad \beta \sim N(b, \Sigma \otimes \Omega) \quad (4)$$

we adopt a standard Minnesota prior—shrinking nonstationary variables towards independent unit roots, and stationary

TABLE 2 | Data sources and transformations.

Variable	Source	ID	Transformation
Wages and salaries	Eurostat	WAGE	
Basic pay rates	Bundesbank	BPR	Averaged over the quarter
Total hours worked by employees	Eurostat	HOURS	
Unemployment rate	Eurostat	URX	Averaged over the quarter
Nominal GDP	Eurostat	NYER	
Real GDP	Eurostat	YER	
Population	Eurostat	POP	
Total number of employees	Eurostat	SAL	
Active population	Destatis	ACT	
Reported vacancies	OECD	VAC	Averaged over the quarter
GDP deflator	Eurostat	YED	
Wages and salaries per hour worked in manufacturing	Destatis	WAGEHman	
Gross operating surplus per capita	Eurostat	GOSP	ln(GOSP/POP)
IFO business expectations	IFO	IFOBE	
IFO business climate	IFO	IFOBC	
Consensus inflation expectation 6Q ahead	Consensus	CHIC6	
Total German stock market log returns	Datastream	TOTMK	
DAX log returns	Datastream	DAX	
Real hourly wage		RWAGEH	ln(WAGE/(HOURS*YED))
Real GDP per capita		YERP	ln(YER/POP)
Average hours worked		HOUSE	ln(HOURS/SAL)
Vacancy Rate		VACA	VAC/ACT
Real hourly wage in manufacturing		RWAGEHman	ln(WAGEHman/YED)
Real basic pay rates		RBPR	ln(BPR/YED)

Note: The table summarizes all variables used in the analysis, their sources and transformations.

ones towards white noise processes (see Litterman 1986; Kadiyala and Karlsson 1997; Bańbura et al. 2010, among others)—supplemented with a long-run prior (Giannone et al. 2019), which can both be implemented through appropriate choices of Ψ , d , b and Ω . We opt to impose a long-run prior, preferring it to more traditional refinements to the Minnesota prior, to avoid over-fitting of the deterministic component. This is particularly important for Germany, where reunification and a number of structural reforms in the early 2000s induced some trending behavior for otherwise rather stationary variables, notably unemployment and average hours worked.

In terms of restrictions imposed through the long-run prior, we require that inflation (π_t), average hours worked (h_t), unemployment (u_t) and IFO index (i_t) follow their own independent deterministic trends, whereas real wages (w_t) and output per capita (z_t) share a common trend and cointegrating relationship.³⁰ Following the notation of Giannone et al. (2019):

$$\tilde{y}_t = \underbrace{\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}}_H \underbrace{\begin{pmatrix} \pi_t \\ w_t \\ u_t \\ z_t \\ h_t \\ i_t \end{pmatrix}}_{y_t} \quad (5)$$

We use an invariant version of the prior, where we impose more shrinkage on the common trend of real wages and output per capita and on unemployment, which is very persistent. Hyperparameters are selected following the hierarchical approach suggested in the same paper. The resulting deterministic components are shown in Supporting Information Figure I.18 in the Supporting Information Appendix.

To recover the structural form of the VAR, we follow the algorithm of Antolin-Diaz and Rubio-Ramirez (2018), which combines sign/zero restrictions with narrative ones. Unlike traditional sign restrictions imposed on the impulse response function or the structural parameters themselves, narrative sign restrictions are imposed on the realized structural shocks, or on elements of the historical decomposition computed on their basis, and therefore require modifications to the standard algorithm (Rubio-Ramirez et al. 2010). As shown by the authors, these can be imposed by truncating the likelihood function of the VAR, which can be approximated using importance sampling. We obtain around 10^7 draws that satisfy the required sign restrictions, and then approximate importance weights using $4 \cdot 10^6$ draws to obtain around $2.2 \cdot 10^4$ posterior draws that also satisfy our narrative restrictions.³¹

Note that our narrative restrictions are likely to be relatively agnostic compared to other approaches using historical events. For example, in the context of the Great Financial Crisis, Ludvigson et al. (2015) require that the structural shocks be close to four standard deviations in size at some specific dates, which may be appropriate for that particular episode but would be difficult to both achieve and convincingly defend in the case of strikes.

4 | Results

4.1 | Narrative Restrictions and Identifiability

Following Antolin-Diaz and Rubio-Ramirez (2018), Figure 2 shows the posterior distributions of wage bargaining shocks in the periods where our narrative restrictions (Restrictions 2 and 3 in Section 2) are imposed, comparing models with only sign restrictions imposed (Restriction 1 in Section 2) and including narrative restrictions, in grey and pink, respectively. The restriction for 2018q2 clearly appears as the most binding one, while the model only identified with sign restrictions tends to at least directionally agree with the narrative one in the other instances, though with a much wider identified set.

Figure 2 also provides some insights on the chronology of shocks around the minimum wage introduction episode based on our narrative restrictions. As previously mentioned, the exact timing for this shock is hard to pin down, as the policy was announced and legislated far ahead of its actual implementation. The estimated posterior distributions suggest that agents acted just after the announcement, with a clearly positive wage bargaining shock in 2014q1, thus hinting at the importance of anticipation effects, possibly with some second-round effects on the effective introduction date in 2015q1.³² However, on the latter date there was also a separate round of collective agreements in important sectors, and our framework is unable to distinguish between the two.³³

Inoue and Kilian (2026) suggest to also check identified sets and robust credible intervals in the sense of Giacomini and Kitagawa (2021), Giacomini et al. (2022a) to allay concerns that identification is unduly driven by the choice of prior on the rotation matrices underpinning identification strategies that rely on sign restrictions, including Antolin-Diaz and Rubio-Ramirez (2018)'s. In Supporting Information Appendix H we report selected statistics along those lines. We find, similar to their finding—and reinforcing the above results—that when narrative restrictions are added to the sign restrictions, identified sets of impulse responses shrink significantly (Supporting Information Table H.1), and that standard credible intervals are more in line with their robust counterpart (Supporting Information Table H.2).

4.2 | Macroeconomic Transmission of Wage Bargaining Shocks

Figure 3 shows the impulse responses to a positive wage bargaining shock that increases workers' bargaining power, scaled to deliver one standard deviation shock to real wages. Crucially, our narrative restrictions are also informative about the dynamic responses of variables with no sign restrictions imposed on them, that is, unemployment and output per capita. As discussed in Section 2, the theoretical responses of these variables depend on various modeling assumptions about labor market structure. Our results highlight that the effect of higher workers' bargaining power on unemployment is unambiguously increasing, which is in line with the implications of models with search and matching frictions or monopolistically competitive unions.

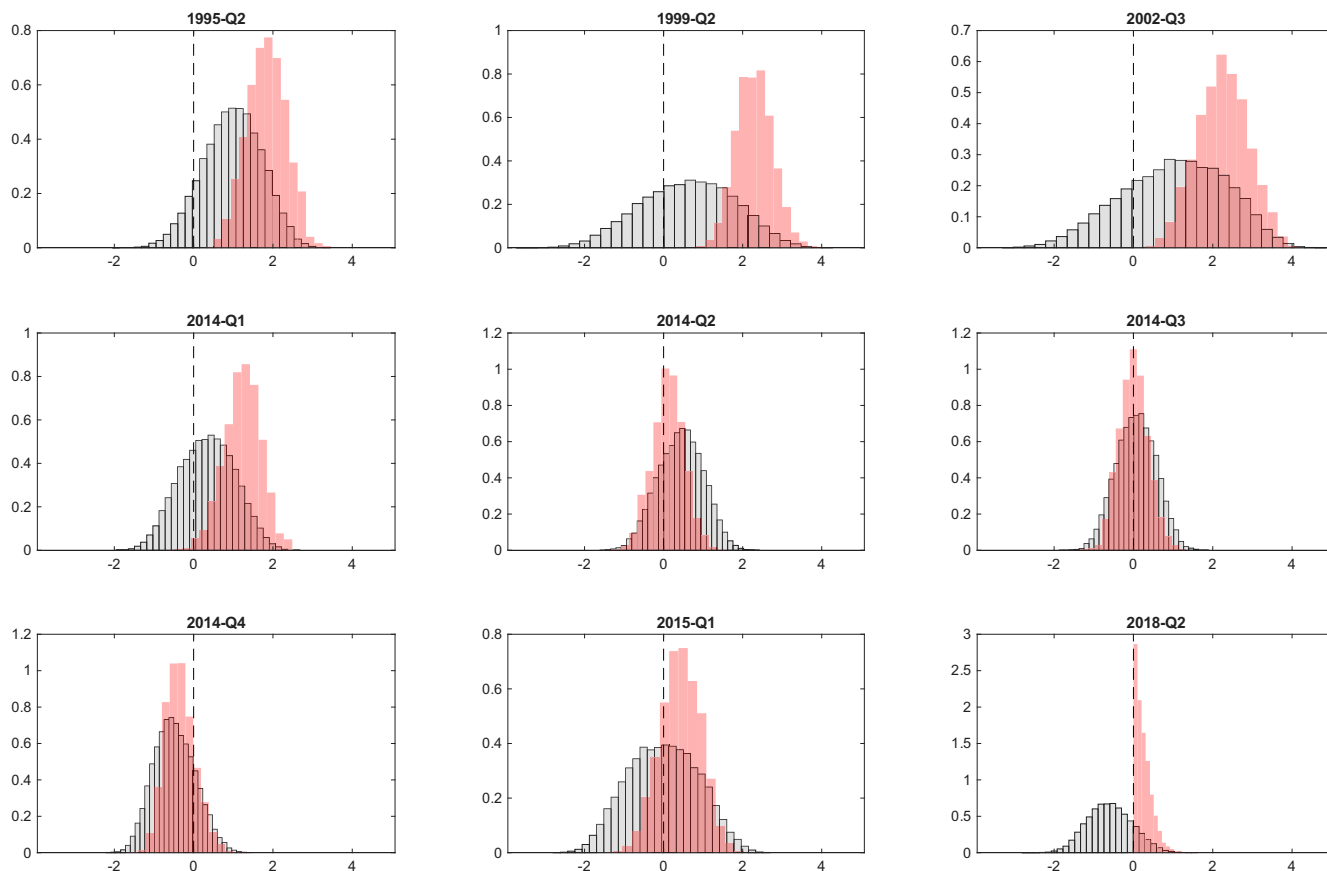


FIGURE 2 | Posterior distribution of wage bargaining shocks. The figure shows posterior distributions of wage bargaining shocks for the model with sign restrictions in grey and the specification including narrative restrictions in pink.

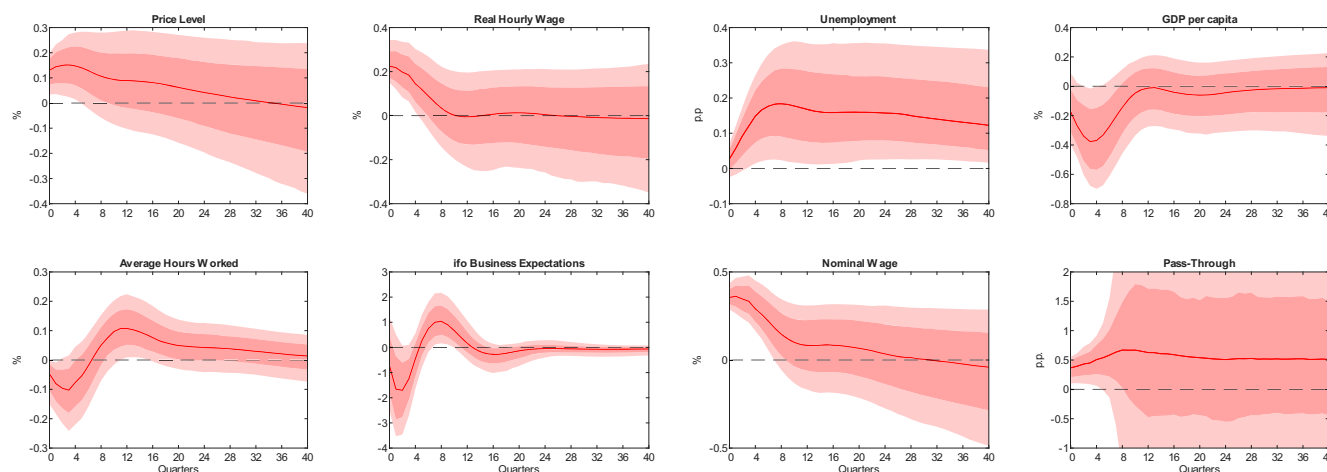


FIGURE 3 | Impulse responses to a positive wage bargaining shock. The figure shows impulse responses to a positive wage bargaining shock for the baseline model. Bands show posterior 68% and 90% credible sets.

The increase in real wages, of around 0.2 percentage points on impact, persists for about two years following the initial shock. The pattern mostly reflects the dynamics of nominal wages, scaled by a slower-moving response of the GDP deflator. Indeed, the unexpected increase in the wage bill raises the price level by 0.15 percentage points on impact, which then remains above its steady state level for five to six years.³⁴ Average hours worked fall by about 0.1 percentage points within two quarters after the

shock, but then experience a highly persistent reversal that peaks at 0.1 percentage points after around three years, while the unemployment rate gradually picks up following the shock, reaching its peak of 0.18 percentage points after around two years, and with an even more gradual reversal. Output per capita falls on impact and troughs at around -0.4 percentage points after three quarters, for the effects to then fade completely within three years. The dynamics of business expectations mirror the path of

hours worked and GDP per capita, dropping by around 1 point on impact and troughing somewhat below that, but largely rebounding within a year.

We also calculate the wage pass-through to prices implied by a wage bargaining shock, defined as the ratio of the impulse responses of the GDP deflator and of nominal wages (last panel of Figure 3).³⁵ Pass-through thus defined represents an elasticity, namely the percent change in prices given a concomitant one percent increase in nominal wages. On impact, prices adjust only partially to the shock, roughly by 40% of the initial nominal wage response. Pass-through peaks at around 70% after three years, and gradually converges to a value of around 50% in the long run.

The uncertainty around our estimates is large, but doesn't invalidate key elements of our narrative, as shown by the 90% credible sets in Figure 3: the real wage response remains statistically significant for more than a year after the shock; the unemployment rate response's credible set is more than 0.3 percentage point wide at the peak, but never crosses zero after the initial quarters; and the initial response of average hours worked, evidence of adjustment along the intensive margin, also remains significant at that level.³⁶

Overall, the pattern of impulse responses indicates that German firms first react to increased labor costs by adjusting prices and reducing average hours worked. With time, firms then also adjust their workforce and unemployment increases as a result, while those still in employment end up working longer hours. This is consistent with existing evidence about the relative importance of the intensive margin of adjustment in the euro area compared to the United States (see Ohanian and Raffo 2012; Buligan et al. 2019). Moreover, as already mentioned, the impact signs of our estimated impulse responses on unemployment and output, although left unrestricted by our identification assumptions, do match the predictions of structural models with search frictions in labor markets. They are therefore, *a fortiori*, also consistent with the identification strategy proposed by Forni et al. (2018), which entirely relies on sign restrictions inferred from such frameworks.

However, to highlight the advantages of our approach—besides the fact that it provides an independent empirical validation of their restrictions—it is instructive to compare our results to a model that relies on their identification strategy (see Supporting Information Figure I.1 in the Supporting Information Appendix). We find that while the broad pattern of responses is similar, our approach yields sharper inference, and also avoids some counter-intuitive, and theoretically difficult to explain, behavior of nominal variables (notably, the price level and nominal wage both turn negative within around two years after the initial response).

Finally, we also compute a forecast error variance decomposition to quantify the relative importance of wage bargaining shocks in explaining variation in our data. Table I.1 in the Supporting Information Appendix summarizes the results for selected horizons. Around 17% of the contemporaneous variation in real wages is

explained by the shock, decreasing to approximately 7% at the ten-year horizon. The shock is an important driver of GDP deflator inflation, explaining almost a fifth of its variation at all horizons. In the long run, the shock similarly accounts for a quarter of the variation in the unemployment rate, while on impact, its contribution is minimal. For output and hours, the contributions are also nonnegligible, but generally smaller at all horizons. As for the IFO survey, the contribution increases from 4% on impact to 14% in the long-run. Thus overall, wage bargaining shocks appear to be an important driver of the business cycle in Germany. As for the IRFs, the headline estimates are subject to a large degree of uncertainty, as reported in the same table. Still, even the lower-bound estimates point to sizable long-run contributions to both inflation (9%) and the unemployment rate (8%).

4.3 | Case Study: Introduction of a National Minimum Wage Floor

In this section, we use our framework to supplement the existing microeconomic evidence on the effects of the national minimum wage introduction in 2014. Figure 4 shows the contributions of wage bargaining shocks to aggregate variables from 2014q1 onwards, that is, from the time of announcement, one year before the actual introduction.³⁷ Wage bargaining shocks led to a persistent increase of around 0.25% in hourly real wages, or roughly 0.5% in nominal terms, lasting until early 2016. This corroborates existing estimates of the resulting increase in the nominal wage bill, which range between 0.4% and 0.55% (Bundesbank 2018; Mindestlohnkommission 2018; Caliendo et al. 2019).

The impact of minimum wage changes on employment is also debated in the literature. Existing studies suggest that there was at best a small dent to regular employment (Caliendo et al. 2019), but a sizeable impact on marginal employment—the so-called 'mini-jobs'—where studies found that 100k-200k jobs were affected, with about equal shares transitioning to regular employment or unemployment/inactivity (Mindestlohnkommission 2018). In the previous Section, we showed that wage bargaining shocks raise the unemployment rate. The historical decomposition shows that the increase in unemployment attributable to the shock reached around 20 basis points by 2015q1, and 34 basis points at the peak in 2016q2. A back-of-the-envelope calculation thus suggests that wage bargaining shocks around the minimum wage introduction period led to around 130,000 more unemployed people.³⁸ The effects on output per capita are also sizeable, with a (temporary) reduction in output that troughs at just below 0.5% in 2015q2, but is fully unwound by early 2017.

The counterfactual exercise also highlights a nonnegligible effect on the price level, which increases by 0.21% in 2015q1 and up to 0.3% in 2016q1, in line with existing estimates (Link 2019; Mindestlohnkommission 2018; Bundesbank 2015a). Link (2019) also finds that the pass-through from wages to prices during the same episode was large and quick, as firms reacted in anticipation of higher labor costs and the adjustment in prices happened even before the minimum wage came into force.

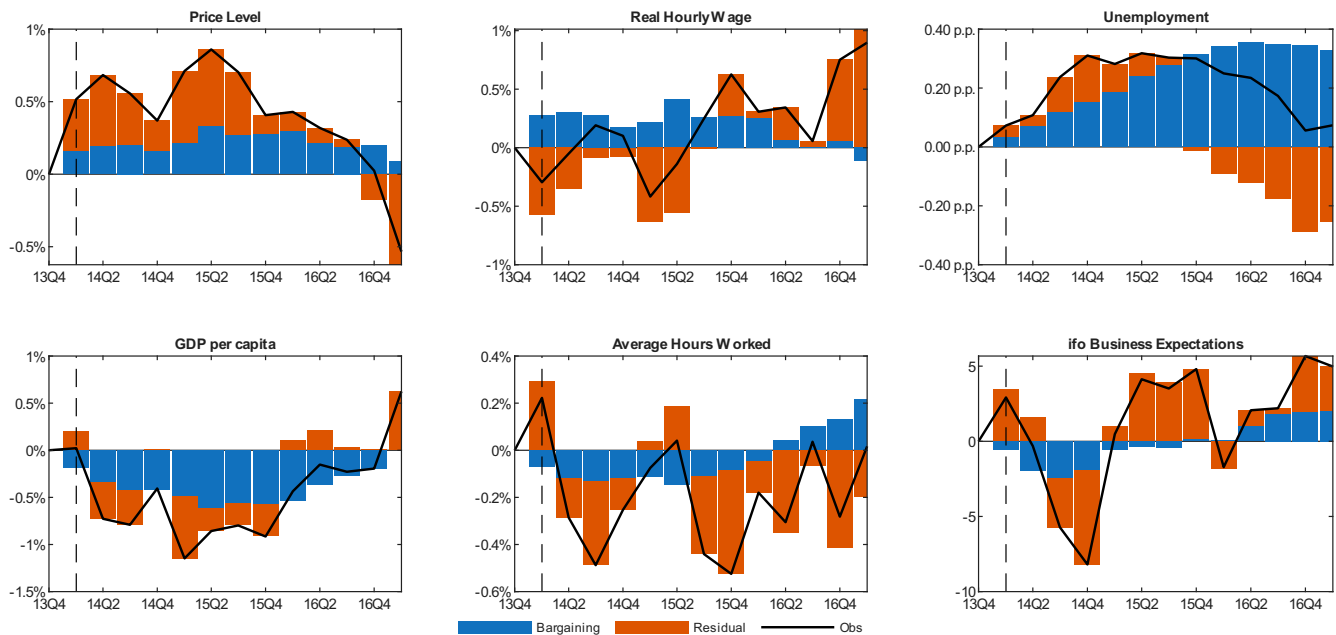


FIGURE 4 | Contributions of wage bargaining shocks from 2014q1. The figure shows the contributions of wage bargaining shocks from 2014q1 until 2017q1. We use the posterior mean of the historical decomposition as our point estimate. The blue bars show the contributions of wage bargaining shocks, while the orange bars show the residual contributions of all other shocks. The solid black lines show the evolution of the data relative to 2013q4. All variables are expressed in levels or log-levels, including the GDP deflator.

5 | Extensions and Robustness

5.1 | Vacancies

We estimate a specification that includes the vacancy rate as an additional variable (left unrestricted for identification purposes), instead of the IFO Business expectations index. The vacancy rate is the ratio between the number of reported vacancies and the labor force. Models with search frictions in labor markets predict that following a positive wage bargaining shock, firms should react to higher labor costs by creating fewer jobs, or in other words, by reducing the number of posted vacancies. The impulse response of the vacancy rate, shown in Figure 5, corroborates this prediction: the vacancy rate decreases with a trough of around -3 basis points (about 0.1 standard deviations), and remains persistently below steady state, mirroring the response of unemployment.³⁹

Moreover, the results suggest that our narrative restrictions allow us to distinguish between wage bargaining shocks and other labor market shocks typically studied in models with search frictions. Specifically, shocks to the separation rate as well as to matching efficiency tend to induce a positive co-movement between unemployment and vacancies, while the responses of other variables are similar to the ones we find for a wage bargaining shock (Forni et al. 2018; Furlanetto and Groshenny 2016).

5.2 | Profits and Labor Share

Wage bargaining shocks are often interpreted as leading to redistribution between firms and workers, with workers obtaining a larger share of surplus at the expense of reduced profits. To assess

the effect of wage bargaining shocks on profits, we add per capita real gross operating surplus to our baseline as a proxy for aggregate profits (again swapping it for the IFO index and leaving it unrestricted for identification purposes).⁴⁰ Reassuringly, we find that real gross operating surplus falls in response to a positive wage bargaining shock (Figure 5).

We also investigate whether our wage bargaining shocks meaningfully contribute to variation in the labor share. In the spirit of Bergholt et al. (2022), we compute impulse responses for two different measures of the labor share. First, using the same specification, we define the profit share as the (log) ratio of real gross operating surplus (RGOSP) to real GDP (YERP), which can also be viewed as the complement to the labor share:

$$IRF_{Profit\ Share} = IRF_{RGOSP} - IRF_{YERP}$$

Second, we compute a wage share as the ratio between wages and salaries per employee and output divided by total employment, following the approach in the European Commission's AMECO database.⁴¹ We substitute output per capita (YERP), used in the baseline model, with output over total employment (YERE). The impulse response of the wage share can then be obtained as a linear combination of variables in the system:

$$IRF_{Wage\ Share} = IRF_{RWAGEH} + IRF_{HOURSE} - IRF_{YERE}$$

Impulse responses for the profit and wage shares thus obtained are shown in the last two panels of Figure 5. We find that an exogenous shock to wage bargaining significantly increases the labor share on impulse using both measures, in line with similar results found by Bergholt et al. (2022) for the US. Results using both definitions provide similar implications also for the

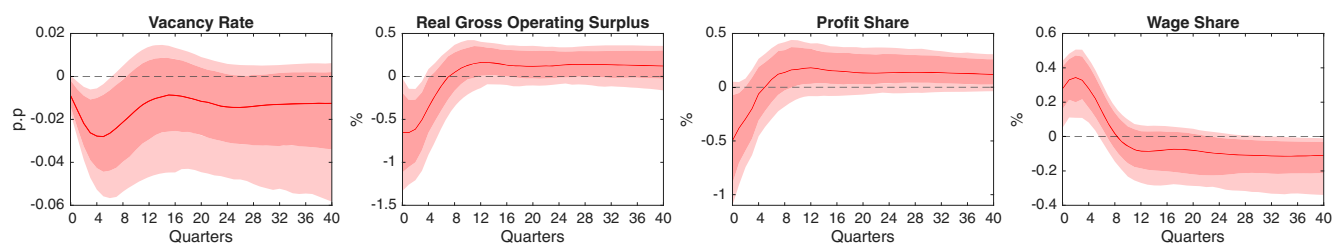


FIGURE 5 | Impulse responses to a positive wage bargaining shock for additional variables. The figure shows impulse responses to a positive wage bargaining shock for specifications with additional variables. Bands show posterior 68% and 90% credible sets.

medium term. The positive effect is rather short-lived: by the second year following a shock, the labor share experiences a reversal and persistently remains below a steady state. The result questions to what extent changes in bargaining power can secure a higher share of surplus over longer horizons. Our results suggest that following a wage bargaining shock, real wages improve only for a few years, at the cost of persistently higher unemployment. The latter effect dominates in the medium term, suggesting that the lower labor share arises as a result of lower employment, as also evidenced by the behavior of the vacancy rate (Figure 5). To be sure, other labor market policies, notably those of a more structural nature, such as the Hartz reforms, may lead to different conclusions.

5.3 | Measurement of Wages

In our baseline, we use aggregate wages and salaries from the national accounts. However, our narrative contribution restrictions could potentially be ignoring compositional effects arising in other sectors not represented by IG Metall. For that reason, we estimate two alternative specifications, *adding* hourly wages and salaries in the manufacturing sector and basic pay rates, respectively, both deflated with the GDP deflator (again swapping them for the IFO index). The first measure should be more sensitive to the actions of IG Metall, given that the manufacturing sector is where the union has the most clout and that industrial disputes were mostly concentrated in the car industry. Basic pay rates summarize collectively-negotiated wages in the production sector including construction, and thus capture wage developments for the unionized portion of the economy. In both cases, we impose narrative restrictions regarding industrial disputes on these alternative variables and leave the aggregate wages and salaries measure unrestricted.⁴² Figures I.10 and I.11 show that impulse responses using these alternative measures are very similar to our baseline, suggesting that our narrative restrictions provide sufficient information to capture the dynamic effects of wage bargaining shocks.

5.4 | Invertibility

To ensure that structural bargaining shocks can be recovered within our baseline framework, we also present a series of robustness specifications in the [Supporting Information Appendix Section I.10](#) that expand the information set with other forward-looking variables instead of the IFO Business Expectations index: stock market indices, inflation expecta-

tions or business sentiment. Overall, the impulse responses are consistent with our baseline results, providing further confidence that our results are not plagued by invertibility issues.

5.5 | Priors

In our baseline, we follow Giannone et al. (2019) and employ long-run priors, optimally selecting the hyperparameters regulating the deterministic components in our estimates. We also estimate a version with flat priors. [Supporting Information Figure I.17](#) shows that impulse responses remain broadly in line with our baseline results, the only noticeable difference being that real wages per hour exhibit a reversal following a wage bargaining shock, which we regard as a somewhat puzzling result. We also note that with flat priors, the implied deterministic components for real wages per hour and output per capita are projected to flatten, implying no growth, shortly after the end of our sample, unlike in our baseline ([Supporting Information Figure I.18](#)). This suggests that the specification with flat priors does not capture some relevant common trends between wages and output, which is at odds with both historical regularities and economic theory.⁴³

6 | Conclusion

We revisit the identification of wage bargaining shocks—a theoretically-founded and quantitatively important type of wage markup shocks—in a vector autoregression model using narrative information for Germany. We propose to use two sets of historical events, the introduction of a minimum wage as well as selected industrial disputes, which are both economically relevant for aggregate wage dynamics and plausibly attributable to exogenous variation in bargaining power. After establishing the suitability of these events for the purpose of narrative identification, we evaluate the effects of wage bargaining shocks on macroeconomic aggregates. Our restrictions discipline the impulse responses to a wage bargaining shock of unemployment and output, which are otherwise left unrestricted, in line with the implications of a broad class of structural models with labor market frictions. Our findings suggest that wage bargaining shocks are an important source of macroeconomic fluctuations, and our model's quantification of the impact of the minimum wage introduction in Germany is in line with and complements existing microeconomic evidence. Given the similarities in wage bargaining institutions shared by many economies, such as the

existence of some form of national minimum wage, our methods and findings are of broader applicability and relevance.

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Disclosure

The views expressed in this paper are those of the authors and do not necessarily reflect those of the European Central Bank, Bank of Lithuania, or Bloomberg LP.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are openly available in the Journal Data Archive at <https://doi.org/10.15456/jae.2026202.1151360079>.

Endnotes

¹See also Bergholt et al. (2022).

²To date, only a handful of papers with a focus on labor markets have exploited narrative information: Duval et al. (2017), who evaluate the effects of job protection deregulation policies on employment and whether there are any asymmetries across business cycle states; Ciminelli et al. (2018) investigate whether employment protection reforms can explain the fall in the labor share in western countries; Drautzburg et al. (2021)'s proxy SVAR exercise is also related to our efforts.

³Appendices A and F show both theoretically and quantitatively how even the sign of some responses, notably that of unemployment, depends on parametrization within a given bargaining framework.

⁴Our focus on the short-run effects of changes in wage-setting institutions also relates to the broader literature on product- and labor-market regulation and reform in Europe. Dynamic analyses in that tradition emphasize transition costs from reallocation even when reforms raise long-run efficiency (e.g., Blanchard and Giavazzi (2003); Cacciato and Fiori (2016); see also Cacciato et al. (2016) on the state-dependence of reform effects).

⁵In Section I.2 of the *Supporting Information* Appendix, we show that dispensing with sign restrictions altogether and solely relying on narrative information still yields plausible, if less sharply identified, dynamic responses.

⁶See Blanchard and Giavazzi (2003), Cacciato and Fiori (2016), Cacciato et al. (2016).

⁷We show results applying their identification scheme in *Supporting Information* Figure I.1 in the *Supporting Information* Appendix.

⁸For more information, see <http://www.oecd.org/employment/protection>.

⁹Destatis data on agreed weekly working hours from collective agreements suggest that, on average, only 3%–4% of all subsectors had their working hours renegotiated in each year between 2010 and 2020.

¹⁰That's also corroborated by the impulse responses to a wage bargaining shock in the DSGE model of Christoffel et al. (2009). Their model features both intensive and extensive margins of labor adjustment, as well as wage and price rigidities, and is calibrated on euro area data. See *Supporting Information* Appendix F for details.

¹¹Our results for wages, prices, the unemployment rate, and output per capita remain qualitatively similar without imposing this restriction. However, some statistical power is lost, and the impact response of average hours worked is, unsurprisingly, ambiguous—see *Supporting Information* Figure I.5 in *Supporting Information* Appendix I.

¹²The rate was set at 8.50 euros from 2015, with a further adjustment in two years' time. The pay rates agreed in collective agreements were allowed to stay below the national rate for a transition period ending in 2017. A minimum wage commission was established to determine future adjustments based on developments in the economy and changes negotiated in future collective agreements. Apprentices, volunteers, young people under 18, and trainees were among those exempted from the minimum wage.

¹³The overall wage bill is estimated to have increased by 0.43% in 2015 (Mindestlohnkommission 2018), with gross incomes rising more strongly than collectively-agreed pay for the first time in years (Bundesbank 2015b). For a more recent analysis, see Dustmann et al. (2021).

¹⁴In Germany, mini-jobs refer to part-time work arrangements or "marginal employment", for which workers earn less than 450 euros per month and are exempt from social security contributions.

¹⁵The coverage extends to the large part of employees in the metal and electricity industry, despite the fact that the union has over 2.2 million members and covers other sectors like textile and plastics. In Germany, bargaining agreements typically encompass all employees of the firms that have signed them, regardless of their union membership status (Jäger et al. 2022). Nonaffiliated companies either choose individual agreements with the union or imitate sectoral agreements (Ellguth and Kohaut 2020). The discretion to deviate seldom concerns wages but mostly concerns contractual benefits, such as leisure packages.

¹⁶Note that the effective date of a wage increase differs from the effective date of a collective agreement, which in the case of industrial action is back-dated to the end of the previous agreement.

¹⁷This happens mechanically as a result of the aggregation of cumulative variables such as BPR and wages and salaries from monthly growth rates into quarterly ones. Specifically, let the quarterly series be a cumulation of monthly series $y_t^q = y_t^m + y_{t-1}^m + y_{t-2}^m$. Then its quarterly differences will relate to its monthly differences as follows: $\Delta y_t^q = \Delta y_t^m + 2\Delta y_{t-1}^m + 3\Delta y_{t-2}^m + 2\Delta y_{t-3}^m + \Delta y_{t-4}^m$. A similar relationship holds for the transformation of quarterly averages. Of course, if (as here), the underlying series is in logs, this involves an approximation, which however is typically acceptable.

¹⁸The same timing assumption is used in other studies with narrative identification (e.g., Romer and Romer 2010; Cloyne 2013; Duval and Furceri 2018).

¹⁹The average number of days not worked due to industrial actions per 1000 employees is one of the lowest among European Union Member States.

²⁰We regress wage growth on lags of itself, price inflation, labor productivity growth, inflation expectations, and economic slack, also adding dummies for the dates of industrial strikes. See *Supporting Information* Appendix C for details.

²¹These papers conclude that financial markets can anticipate strikes to an extent, with the largest reaction one week in advance, but some surprise effects are still observed upon the announcement.

²²Due to data availability or reduced market liquidity for some stocks, the estimation sample may be shorter than 200 trading days. If the sample is below 100 trading days, the stock is not traded often or is subject to severe liquidity issues, the company is dropped from the sample.

- ²³We set the event day to the beginning of a strike, but since market participants may anticipate the strike, or it may have been announced earlier, the effect on stock prices on the day may be understated. We therefore compute cumulative returns for recursive event windows leading to the start of a strike.
- ²⁴Mnemonics: TOTMBKD and INDXFI, respectively.
- ²⁵For the alternative one-tail hypothesis that the effect is below zero, we find that the effect is significantly different at the 10% significance level for both specifications (see [Supporting Information Appendix D.1](#)).
- ²⁶We define the announcement as an official and public declaration of a full-day strike by the union. The official announcement usually precedes by two or three trading days the beginning of a strike. In 1995 and 2002, the announcement followed a vote by union members to begin the strike. In 2018, the union unilaterally declared a 24-hour warning strike after a failed negotiation. If the announcement coincides with a nontrading day, the next trading day is selected as an announcement day.
- ²⁷In the [Supporting Information Appendix](#), we also show the effect of omitting the restrictions on the largest contributions to the historical decomposition ([Supporting Information Figure I.5](#)).
- ²⁸Results remain very similar when increasing the number of lags.
- ²⁹The unemployment rate is observed at monthly frequency. To transform it into a quarterly series, we take an average over the quarter.
- ³⁰According to augmented Engle and Granger (1987) and Johansen (1988) tests for cointegration, real hourly wages and output per capita are cointegrated. The estimated cointegration vectors are $[1.26 \ -1]$ and $[-1.41 \ 1]$, respectively, close to our long-run prior specification.
- ³¹The relative effective sample size of the importance sampling procedure is 11%.
- ³²Bundesbank (2015b) also report that for some specific sectors, which are not covered by a collective agreement, wages were increased once the statutory wage came into force.
- ³³There were agreed wage settlements in the chemical, public and energy sectors starting around March 2014 (WSI 2014).
- ³⁴The impulse response of the price level is inferred from the cumulative response of inflation.
- ³⁵An analogous definition is used in VAR applications to compute fiscal multipliers (Ramey 2016), or to evaluate exchange rate effects on prices (Forbes et al. 2018), among many others.
- ³⁶In [Supporting Information Appendix H](#) we also report robustness checks on those credible intervals, comparing them to robust credible intervals in the sense of Giacomini and Kitagawa (2021), Giacomini et al. (2022a).
- ³⁷In the [Supporting Information Appendix](#), we also present counterfactual series stripped of the contributions due to wage bargaining shocks, see [Supporting Information Figure G.1](#).
- ³⁸After accounting for the effects of other concomitant shocks (orange bars in [Figure 4](#)), overall there were negligible effects on aggregate unemployment during the entire episode.
- ³⁹For the full set of impulse responses, see [Supporting Information Figure I.8](#) in the [Supporting Information Appendix](#).
- ⁴⁰Gross operating surplus is a balancing item in the national accounts. It is what's left of GDP after compensation of employees and taxes less subsidies on production and imports are subtracted.
- ⁴¹We slightly deviate from their definition, which uses a broader measure of workers' income that includes employers' social contributions in addition to wages and salaries, but the two measures are almost perfectly correlated.

- ⁴²We retain the narrative restriction concerning the minimum wage episode on the aggregate wage measure, since arguably the policy's aim was to improve conditions for all workers, including those not subject to any collective wage agreement.
- ⁴³We find that the problem also persists in a specification with a Minnesota prior complemented by a Single-Unit-Root prior (Sims 1993). We omit the results to conserve space.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Figure A.1:** Illustrative effects of a wage bargaining shock in a canonical Diamond-Mortensen-Pissarides model. **Figure C.1:** Nominal wages around selected IG Metall industrial strikes. **Table C.1:** Parameter estimates for selected wage Phillips curve specifications. **Table D.1:** Cumulative Abnormal Returns around the beginning of a strike (One-tail test). **Figure E.1:** Cyclical components of total hours, average hours, and employment. **Table E.1:** Contributions of the intensive and extensive margins to the variation in total hours worked. **Table E.2:** Contributions of the intensive margin, employment rate, and participation rate to the variation in total hours worked. **Table F.1:** Parameters and ranges for the Monte Carlo exercise. **Figure F.1:** Impact impulse responses to a wage bargaining shock in the Christoffel et al. (2009) model under different parameterisations. **Figure G.1:** Counterfactual macroeconomic variables simulated without wage bargaining shocks. **Table H.1:** Identified Sets and Posterior Means of Impulse Responses. **Table H.2:** Robust and Conventional 90% Credible Intervals of Impulse Responses. **Table I.1:** Share of forecast error variance attributed to wage bargaining shocks for the baseline and alternative specifications. **Figure I.1:** Impulse responses to a wage bargaining shock as in Foroni et al. (2018). **Figure I.2:** Impulse responses to a positive wage bargaining shock, only narrative restrictions. **Figure I.3:** Impulse responses to a positive wage bargaining shock, only narrative restrictions. **Figure I.4:** Impulse responses to a positive wage bargaining shock, without sign restriction on average hours worked. **Figure I.5:** Impulse responses to a wage bargaining shock without narrative contribution restrictions. **Figure I.6:** Posterior distribution of wage bargaining shocks, 2018q2 restriction only. **Figure I.7:** Impulse responses to a positive wage bargaining shock, 2018q2 restriction only. **Figure I.8:** Impulse responses to a positive wage bargaining shock, with vacancy rate. **Figure I.9:** Impulse responses to a positive wage bargaining shock, with real gross operating surplus per capita. **Figure I.10:** Impulse responses to a positive wage bargaining shock with narrative restrictions on aggregate wages in the manufacturing sector. **Figure I.11:** Impulse responses to a positive wage bargaining shock with narrative restrictions on basic pay rates. **Figure I.12:** Impulse responses to a positive wage bargaining shock, with DAX stock market index (DAX). **Figure I.13:** Impulse responses to a positive wage bargaining shock, with total stock market index (constructed by Datastream). **Figure I.14:** Impulse responses to a positive wage bargaining shock, with IG Metall stock market index. **Figure I.15:** Impulse responses to a positive wage bargaining shock, with Consensus inflation expectation 6Q ahead. **Figure I.16:** Impulse responses to a positive wage bargaining shock, with IFO Business Climate index. **Figure I.17:** Impulse responses to a positive wage bargaining shock, flat priors. **Figure I.18:** Deterministic components using long-run and flat priors.