Rigid yet resilient:
Firms' margins of adjustment to demand shocks
in regulated labour markets.

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Abstract

In this paper we investigate how firms adjust to demand shocks when wages and employment determination are regulated. Using firm-level panel data for the Italian metal engineering industry for the 2009-2015 period, we estimate the elasticity of the overall wage bill and of wage and employment margins to changes in firm's real sales. We then disentangle the effect on different wage components (base wage and wage cushion) and labour inputs (permanent vs. temporary employment and working hours). The main results, based on an IV-FE empirical strategy, show that resilience of the wage bill to demand shocks mainly works through the working time adjustment margin (especially short-time work), while wages and employment are relatively rigid The industrial relations setting also proves to be an important feature in the firm's adjustment process: strong unions, within the firm, are more likely to oppose large employment changes, while firm-level agreements allow more flexibility through wage cushion components. Finally we discuss the implications of rent sharing for firm's profitability.

Key words: Labour costs, demand shock, employment, wage, hours, short-time work schemes
JEL codes: J30, J58, C81

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1. Introduction

The 2008-2009 economic crisis, and more recently the Covid-19 pandemic, exposed most firms to unprecedented large and persistent product demand shocks. Firms' reaction to these shocks has been quite heterogeneous both between and within countries, with large employment adjustment registered especially in firms located in Southern Europe. In order to explain firm's resilience to these shocks, and the differential impact across countries, the economic literature has renewed attention on the interactions between the shock and labour market institutions (Boeri and Jimeno, 2016).

In this paper, we investigate how firms adjust to demand shocks when wages and employment determination are regulated by either legislation or collective bargaining. We show that under different institutional constraints, firms have to rely on a wider menu of adjustment compared to the standard price-wage margins. Typically, when a firm is hit by a change in product demand, it reacts by either adjusting output price or revising production costs. This mix has been shown to vary along the business cycle, with price adjustment mainly used when demand is high and competition weak; while cost margins are more likely under negative demand shocks and intense competition (Druant et al., 2012). In particular, when adjusting prices is difficult due to international market exposure or extremely costly, other margins need to be adjusted.[2] For example, focusing on labour cost margins, firms can adjust the wage bill to a negative demand shock either cutting wages or reducing labour inputs. Both the wage and employment margins can also be adjusted along a number of other dimensions, such as hours worked, share of fixed-term contracts and incidence of variable pay. In other words, existing regulations and institutional rigidities *de facto* imply different trade-offs for firms when facing a demand shock. Firms with a larger share of employment on fixed-term contracts may simply not renew these, implicitly protecting "insiders" with open-ended contract. Alternatively, firms may extensively use short-time work schemes instead of redundancies to protect employment and reduce turnover costs (Babecky et al. 2012; Dias et al. 2013). Finally, firms with performance-related-pay schemes may rely on wage adjustment granted by the downward flexibility of the variable components of pay (Lemieux et al. 2012; Lucifora and Origo, 2015). The result is a highly heterogeneous picture whereby different firms may rely on a different mix of margins according to the institutional constraints they face and the relative costs of adjustment.

In this context, the presence of collective agreements, particularly at the national or industry level, may generate nominal wage rigidity forcing firms to react to a negative demand shock mainly by reducing employment (Magruder, 2012). However, employment adjustment may differ in presence

[2] Changes in nominal prices may be affected by frictions and "menu" costs which result in price stickiness (Bertola et al., 2012).

of costly turnover caused by strict employment protection legislation (Bertola et al., 1999; Kugler and Pica, 2005), or it may affect employment composition mainly through the lack of renewal of fixed-term contracts (Bertola et al., 2012). Centralized collective bargaining and strong unions may also limit firm's ability to adjust wages, particularly when collective agreements last several periods (Holden 2004). Alternatively, unions may oppose employment reduction by renegotiating more working hours flexibility, pushing for an extensive use of short-time work schemes (Adamopoulou et al 2016, Adamopoulou and Villanueva, 2020).

The economic implications of labour market institutions on aggregate employment flows and unemployment have been widely studied in the economic literature (Bertola and Rogerson 1997), less is known about the firm's specific response to demand shocks under different collective bargaining arrangements, strictness of employment protection legislation and union power.

Much of the more recent research on the firm's margins of adjustment in European countries face to economic shocks, which regained momentum after the 2008 economic crisis, mainly uses cross-section survey data and qualitative information based on self-reported answers (Wage Dynamics Network project) [3]. While evidence from studies based on the WDN data confirms that downward nominal wage rigidity is a relevant phenomenon with important implication for economic policy, there are many aspects of the data which impose limits to the empirical analysis (Bertola et al., 2012; Babecky et al., 2012; Branten et al 2018).

For example, Marotzke et al. (2017) explore whether firms with more constraints in cutting wages are also those declaring larger employment losses and show that, compared to firms with unchanged base wage, the probability that employment falls is significantly lower in firms cutting wages. Fabiani et al. (2015) confirm that labour cost reduction through the adjustment of quantities (i.e., employment) rather than price (i.e., wage) was the prevailing strategy that most European firms adopted to cope with demand shocks during the crisis.

Babecky et al. (2012) argue that, although workers' nominal base wages are seldom cut, firms can more easily adjust other wage components, such as bonuses and non-pay benefits. Their analysis confirms that European firms make extensive use of other components of compensation to adjust the cost of labour, especially in the case of firms facing base wage rigidity. Similar results are found by Dias et al (2013) using the WDN data matched with firm-level administrative data for Portugal.

In light of this evidence, Babecky et al. (2012) conclude that the impact of downward wage rigidity on labour costs might be lower than previous research has suggested. However, the qualitative nature

[3] The WDN project was promoted by 25 National Central Banks of euro and non-euro area EU Member States. WDN carried out three firm-level surveys (in 2007, 2009 and 2014) with information on labour market adjustments following the 2007 Great Recession. For further details on WDN, see https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_wdn.en.html

of the questions in the WDN surveys does not enable to assess the quantitative dimension of the process of substitution between base wage flexibility and flexibility of other wage components, employment and hours.

Quantitative evidence concerning wage adjustment comes from US research based on detailed information on wages from payroll records. Kurmann and McEntarfer (2019) and Jardim et al. (2019) use personnel records for a large sample of workers in the State of Washington over the 2005-2015 period and find that on average 20% of job stayers experience nominal wage reductions in each quarter over the period considered, with a sharp increase during the Great Recession. This evidence confirms that nominal wages are more flexible in the US compared to Europe also due to differences in labor market institutions between the two areas, especially related to collective wage bargaining. Furthermore, Kurmann and McEntarfer (2019) show that total annual earnings exhibit even larger reductions than hourly wage rates, due to adjustment in hours worked. Focusing on the years of the Great Recession, they also point out that firms more subject to nominal wage rigidity register larger employment cuts, mainly due to significantly lower hiring rates. However, using similar data from the largest payroll processing company in the US, Grisby et al. (2019) show that, when considering only the base wage (and the latter is the most appropriate wage component to measure wage stickiness in many macro models), only 2% of US job stayers experience nominal base wage cuts during a given year, confirming that wage adjustments occur manly through changes in flexible, usually performance-related wage components or adjustment in working hours. One drawback of most studies using payroll records is that, while they provide accurate information on wage, employment and hours, they are a sort of "black box" for what concerns other firm characteristics, such as firm performance, work organization and industrial relations.

This paper uses a unique firm-level panel data of metal engineering firms in Italy (from 2009 to 2015), providing detailed information on wages as well as firm's performance indicators, to bridge different strands of the literature on firm's margins of adjustments. In particular, we analyse firms' margins of adjustments to firm-level product demand shocks (i.e. changes in real sales) and implement a Bartik-type methodology (Bartik, 1991) to address the endogeneity of firm's sales. We investigate both the "extensive" and the "intensive" margins of adjustment, by estimating the elasticities of the total wage bill, and of the different wage and employment components. In terms of the "extensive" margin, we decompose firm's resilience in per-capita wage and total employment. We further delve into the "extensive margin" of adjustment separately analysing the sensitivity of different wage (base wage and wage cushion) and employment components (permanent full-time, permanent part-time and temporary employment) to demand shocks. Given the firm's extensive use of furlough schemes and short-time work measures during the recent crises (Arpaia et al, 2010; Boeri and Bruckner, 2011), we

also extend the analysis of the intensive margin of adjustment computing an accurate measure of the number of hours worked and estimate the contribution of such schemes. In this respect, Italy provides an interesting case study since it is the country in Europe with the highest share of workers on furlough and short-time work schemes, and because it is the country with the most generous scheme, whose eligibility was (temporarily) extended over the recent crises to both firms and workers previously excluded (Eurofound, 2010).

While the role of institutional features, such as unions, collective bargaining and employment protection legislation have been extensively investigated in the macro literature (Blanchard and Wolfers, 2000; Bassanini and Duval, 2009), less attention has been paid to the micro-level institutional features (Addison, 2016). We exploit rich information available on firm-level industrial relations practices (such as union members, presence of formal employee representative bodies and employment protection) and collective bargaining (such as firm-level collective agreement, also covering bargained collective performance-related-pay) to investigate their interactions with firm's wage rigidity (Cardoso and Portela, 2009; Cardoso and Portugal, 2005; Dickens et al., 2007; Du Caju et al., 2015; Messina et al., 2010) and firm's choice of the preferred margins of adjustment. Combining firm level characteristics with the features of labour market institutions, we investigate the heterogeneous response of firms to demand shocks. Finally, since in an industry open to international competition, such as the metal engineering sector, increases in labour (and capital) costs cannot be easily passed onto prices, we ask whether price rigidity coupled with other institutional rigidities causes other margins to be adjusted. In practice, we investigate whether there is any effect of demand shocks on firms' economic performance, such as profitability or other financial indicators (Bertola et al. 2012).

We find that the total wage bill is sensitive to changes in firm's real sales, though the estimated elasticity is rather small: a 10% increase in sales determines an increase in the wage bill of approximately 1.5%, which is almost entirely driven by employment changes while wages remain largely unaffected. We show that employment resilience to the shocks conceal heterogeneous effects across different types of employment, such as permanent and temporary contract, part-time employment and working hours. Still, given the prevalence of full-time permanent employment in the metal-engineering industry, much of the adjustment to changes in sales is driven by changes in full-time permanent employment. However, in firms where unions are present and powerful, the adjustment in permanent employment is much lower, compared to firms in which unions are not present or are weak. The counterpart of strong union power and the associated constrains to labour (re)allocation is a larger effect on firm's performance, namely on profitability.

The remainder of the paper is organized as follows. In Section 2 we discuss the main institutional features that influence downward wage rigidity in Italy. In Section 3 we present the dataset, the main variables of interests and some preliminary descriptive evidence. In Section 4 we discuss the main results of the econometric analysis regarding the margins of adjustments to demand shocks, in Section 5 we provide further estimates and some robustness checks and in Section 6 we investigate heterogeneous effects. The last Section concludes.

2. The institutional setting

Collective bargaining in Italy operates within a relatively weak legal regulation and is centered around the role of the most representative employers and workers' organizations. The main labour law, the so-called *Statuto dei lavoratori* of 1970[4], voluntarily did not regulate industrial relations leaving to social partners responsibility for setting the rules through collective bargaining. Due to a number of institutional loopholes concerning the measurement of the representativeness of social partners, information on unions and employers membership in Italy is scarce and rather uncertain. Recent available estimates set union membership, in the private sector, around 30-40%, and employers association close to 50% (Visser, 2019). Collective wage bargaining is organized in a two-tier system: base wages are set in industry-level collective agreements (*Contratto Collettivo Nazionale di Lavoro, CCNL*), while additional wage components can be bargained at the firm or local level. A collective agreement is in general only binding for the partners who sign the contract, as there are no formal extension mechanisms to other firms or workers. However, a surrogate of an *erga omnes* extension exists, as Labour Courts take wage levels set in collective agreements as reference for the application of Art. 36 of the Italian Constitution (e.g. stating that workers have the right to a 'fair wage'). In practice, collective bargaining is structured as a two-tier system (the so called the "1993 Protocol"), whereby industry-level collective agreements set the base wage (the so-called *minimi tabellari*) targeted to preserve the purchasing power of wages (i.e. indexed to inflation), while firm-level (or local) bargaining is linked to specific indicators of productivity, profitability or other measures of firm performance (the so called "1993 Protocol"). Interestingly, this second tier of collective bargaining has always been subordinated to the national level, and it is subject to the *in melius* or favorability principle: that is, wages and working conditions cannot be worse than those agreed at the sector-level. Since collective agreements cannot be typically derogated, in 2009 after the economic crisis, the "1993 Protocol" came under pressure for its excessive wage rigidity (IMF 2016). New rules

[4] The Italian *Statuto dei lavoratori* has been in force for almost 50 years, only partially modified over time in some respects.

were introduced allowing firms in economic distress to temporarily opt-out from industry-level collective agreement - though wages have been excluded from the issues that could be derogated. Even if industry-level base wage cannot be adjusted downward, when a firm-level agreement is present the overall responsiveness of wages can count on the adjustment of the flexible wage components linked to the firm's own productivity or to other indicators of firm performance (e.g. wage cushion). Despite the progressive diffusion of collectively negotiated performance-related-pay schemes, their actual incidence on the total wage is rather small (e.g. close to 5-6% of the total gross wage; Casadio, 2003; Brandolini et al., 2007). Furthermore, firm-level bargaining is still largely confined to the largest firms and in the Northern regions (D'Amuri and Giorgiantonio, 2014).[5]

Workers with an open-ended contract also enjoy considerable employment protection due to a combination of severance payment and reinstatements rights in case of labour disputes which makes firing extremely costly for firms (Sestito and Viviano, 2018). The "Jobs Act", introduced in 2015, reformed substantially firing rules for new hires, allowing employers greater discretion in workforce reduction in order to increase labour market overall flexibility and extending passive and active policies. In Italy also short-time work schemes have been extensively used by firms to adjust employment to negative demand shocks.[6] Particularly in the years following the 2008-2009 economic crisis and in the current Covid-19 pandemic crisis, Italy features as one of the EU Member States with the highest share of workers on short-time work schemes (Eurofound, 2010 and 2020), and the country with the most generous scheme (corresponding to 80% of the previous gross earnings and lasting up to three years). Furthermore, this benefit was significantly higher than ordinary unemployment benefit and hence it was very attractive for both employers and workers. Finally, in 2009 its coverage was temporarily extended to firms and workers previously excluded (Arpaia et al, 2010; Giupponi and Landais, 2018). Quite interestingly, using data for 20 EU Member States from

[5] Available data from the Survey of Industrial and Service Firms (INVIND) by the Bank of Italy suggest that in 2010 only 21 percent of firms had some form of second-level agreement.

[6] *Cassa Integrazione Guadagni* (CIG) is the main short-time work scheme in Italy. CIG is made of three main programmes: Ordinary CIG (*CIG ordinaria*), Extraordinary CIG (*CIG straordinaria*) and Derogatory CIG (*CIG in deroga*). The Ordinary CIG is used in case of product demand declines in manufacturing companies due to temporary events that cannot be ascribed to the company, such as adverse weather conditions or natural disasters. The maximum duration is 13 weeks, which can be extended up to 52 weeks. The Extraordinary CIG is used in case of business crisis or restructuring by manufacturing companies with more than 15 employees (or 50 employees in the services sectors). Derogatory CIG was introduced in 2009 to cover firms and workers (such as small firms and temporary workers) not covered by the previous two short-time work schemes. In all these schemes, public subsidy covers 80% of forgone earnings up to a threshold (the highest benefit amounts to around 1200 Euros). The use of these schemes has been further potentiated and extended during the COVID-19 crisis. For more institutional details, see: https://www.eurofound.europa.eu/it/observatories/emcc/erm/support-instrument/short-time-allowances-ordinary-wages-guarantee-fund-cigo-and-extraordinary-wages-guarantee-fund-cigs#

the third wave of the WDN survey, Lydon et al. (2018) find that the take up rate of short-time work schemes is higher in firms operating in countries with stringent Employment Protection Legislation or in sectors where wages are more rigid. Hence, short-time work schemes appear as a relevant margin of adjustment, especially where both wage and employment are difficult to adjust due to institutional constraints.

The current debate in Italy is still centred around the role of collective bargaining and wage rigidity preventing labour reallocation, particularly in times of economic crises when the need for wage adjustments is higher. Moreover, given the existing large productivity differentials across firms and regions in Italy, another issue hotly debated is whether industry-level collective bargaining, by compressing the wage distribution, might be another source of inefficiency due to biased incentives for worker job mobility, factors misallocation, higher unemployment and lower resilience across regions (Boeri et al 2019). This paper contributes to the above debate providing an empirical framework to analyse the different margins of adjustment and firms' resilience to demand shocks.

3. Data and descriptive statistics

Data and sample selection

The empirical analysis is based on a unique firm-level panel dataset combining detailed survey information with balance sheet data for a representative sample of metal engineering firms in Italy. This industry accounts for almost 40% of the firms and employment in manufacturing in Italy and is a leading industry for issues related to industrial relations and decentralized bargaining. While the focus on a single industry may limit the external validity of the results when applied to other industries, there are also beneficial effects since the lower (within) industry heterogeneity may reduce the role of confounding factors in the empirical analysis. The survey is carried out by the main national employers' association of this industry, with the aim to collect information on issues related to the labour market, firm-level bargaining and industrial relations. It is run every year since 2009; for our analysis, we could access data referred to the 2009-2015 period. On average, approximately 1,500 firms employing around 225,000 workers are surveyed each year, corresponding to almost one fifth of the employees in this industry. Overall almost 5,000 different firms took part to the survey in at least one of the years considered. Since three quarters of the firms participated to the survey more than once, we have an unbalanced panel covering a large number of firms over the period considered. The survey provides information for each firm on: employment levels, composition and changes (with some information by skill, gender, education and type of contract); working hours and absenteeism;

wage levels and composition by skill (*qualifica*) and job title (*livello di inquadramento*); firm-level bargaining and industrial relations.[7]

We also merged the survey data, using a unique firm identifier, with balance-sheet data drawn from AIDA dataset (*Analisi Informatizzata delle Aziende Italiane* - Computerized Analysis of Italian Firms) for the 2006-2015 period.[8] With this procedure we successfully merged information for 3,392 different firms, corresponding to around 68% of the firms in the initial sample. To select the final sample used in the empirical analysis, we dropped observations with missing or negative values for the main variables of interest (sales, wage components and employment), and trimmed each wage component dropping observations below and above the 1st and 99th percentile of the corresponding distribution. The final sample consists of around 2,300 firms, corresponding to almost 70% of the merged sample.[9]

Main variables of interest and descriptive evidence

The empirical analysis investigates firms' margins of adjustment to demand shocks, using detailed information on wage levels and composition, employment and working hours. Demand shocks are defined as changes in firm-level sales at 2015 prices. We deflated accounting nominal sales using production prices indexes computed at the fourth digit of industry classification. Trends in real sales of the metal-engineering industry nicely mirror the Italian business cycle after the 2008-2009 economic crisis, characterized by a short recovery in 2010-2011, followed by a decline in sales in 2012-2013 (corresponding to the "double-dip" recession caused by the sovereign debt crisis) and the subsequent recovery since 2014.

Regarding wages of full-time permanent employees, the survey provides information on total gross monthly wages, annual collective performance-related-pay and other annual bonuses. Detailed information on different components of the monthly wage is also available: base wage (set by industry collective agreements), seniority premia and other individual monthly premia (that may be either fixed or variable).[10] This information exists for different job titles within each skill [11], which means

[7] In specific waves, there are also additional questions on specific policies related to human resources management or labour market reforms implemented over the period covered by the survey.

[8] The AIDA database is updated and distributed by Bureau van Dijk and it contains the financial statements of all the active and bankrupt Italian companies (excluding banks, insurance companies and public bodies). AIDA is the main Italian source feeding Amadeus, the international Bureau van Dijk's dataset containing similar comparable information on public and private companies across Europe.

[9] The comparison of the average observable characteristics between the final sample and, respectively, the initial and the merged samples does not reveal any systematic difference between groups. Differences in observable characteristics are small and usually not statistically significant, except for a few variables (such as the number of temporary employees, the wage cushion and the unionization rate). Estimates and standard t-tests are available upon request.

[10] The latter is a wage component that adds up to the base wage, agreed directly between the employer and the employee at the time of employment, or as a supplement to the employment contract.

[11] Metal-engineering workers are classified into two main skill categories (blue and white collars, the latter including managers) and eight job titles broadly defined in the national agreement for the metal-engineering industry. The basic pay

that we can match wage levels and composition for sixteen different types of jobs within each firm (i.e. close to a matched employer-employees dataset)[12]. This is a considerable advantage compared to household and administrative datasets, which usually do not contain details about the different components of total pay. As pointed out by Grigsby et al (2019), this is a crucial issue, especially when firms and workers are interested in long-term employment relationships. In this context, it is not the spot wage of new hires that matters, but rather the user cost of labour defined as the expected present value of costs to the firm associated with a new hire in current period compared to wait and hire the worker in the following period (Kudlyak, 2014). Grigsby et al (2019) show that base wages are a better proxy of the user cost of labour relative to measures of compensation inclusive of bonuses. Using the available information, we compute for each skill and job title the annual gross wages (e.g. total monthly wage*13 + bargained performace-related pay + other annual bonuses) and disaggregate it into its main components: base wage and wage cushion, the latter computed as the difference between total wage and base wage.

The corresponding firm-level wage measures are then computed as weighted averages, using as weights the distribution of full-time permanent employees by skill and job title. We also compute the overall wage bill, as the product between the average wage and total number of employees within each skill, then summing up across skills. Concerning firm's employment levels and composition, we distinguish between temporary and permanent employees and, within the latter, between full-time and part-time workers. Information on employment by type of contract is relevant because firms may use temporary employment as a buffer stock to cope with changes in product demand, especially in presence of high firing costs of permanent workers caused by strict employment protection legislation (Bertola, 1999; Kugler and Pica, 2005). Furthermore, resorting to part-time contracts has been used by firms during the crisis to prevent excessive employment cuts (Horemans et al., 2016). It should be noticed that both temporary and part-time employment, in the metal engineering industry, represent only a small share of total employment (around 5% of total workforce is employed on a temporary contract, and a similar share for part-time).

Finally, detailed information on contractual weekly hours, annual hours of short-time work schemes and absenteeism are also available, allowing to compute two accurate measures of annual working hours per employee, where the difference between the two is given by the exclusion of short-time work schemes per employee.[13] Given the relevance of short-time work schemes in the Italian context,

is parameterized on these levels. The same kind of normalization is sometimes used to determine the actual amount of collective performance related pay bargained at the firm level.

[12] Data on employees are available, within each skill, as job title cell means, with on average 8 full-time permanent employees per cell.

[13] See Appendix I for the procedure we used to estimate working hours.

we also consider the total number of hours of short-time work schemes used by the firm as a further margin of adjustment to demand shocks.

As a first descriptive evidence on variation of the different margins of adjustment, Figure 1 plots percentage annual changes in base wage, wage cushion, total employment and per-capita working hours (net of short-time work hours) by firm and year. In each panel, a solid red line indicates the zero change, while for the two wage components the dashed green line indicates the target inflation rate defined in the industry collective agreement, which may be considered the threshold for real wage rigidity. However, since the years on the analysis are characterised by very low inflation, it is difficult to statistically distinguish between nominal and real wage rigidities (Adamopoulou et al. 2016). Hence, we shall interpret any spike between 0 and the inflation rate as a signal of wage rigidity, without distinguishing between nominal and real one.

The two upper panels of the figure confirm that wage rigidity is relevant mainly when we consider the base wage, given the mass of the distribution between zero and the inflation rate. Such mass is less evident when we consider the wage cushion, which is characterized by a longer and thicker left tail compared to the other wage components.

On the whole, descriptive evidence suggests that rigidity of total annual wage is due to the rigidity of the base wage set by industry collective agreements, which on average accounts for almost 80% of total wage, but with great variability across firms (ranging from 60% at the 1st percentile to 100% at the 99th one).

The two bottom panels show also in the case of total employment a mass at zero, implying some rigidity also in terms of employment adjustment. Nonetheless, the overall distribution looks less skewed than those reported for wages, especially the base wage component. Much more variation emerges when we consider annual per-capita working hours, whose distribution is also characterized by a relatively long tail driven by the reduction in the use of short-time work during the recent recovery years.

(FIGURE 1 AROUND HERE)

4. Empirical strategy

To estimate the elasticity of the wage bill to demand shocks, we specify and estimate the following baseline model:

$$\log(Y)_{it} = \alpha + \beta_1 \log(sales)_{it} + \tau_t + \mu_i + \varepsilon_{it} \qquad [1]$$

where Y_{it} represents wage or labour input indicators, as previously discussed, in firm *i* at time *t*, τ_t are time fixed effects, μ_i are firm fixed effects and ε_{it} is the error term.[14] The main coefficient of interest is β_1, which measures the elasticity of the margin of adjustment considered to changes in real sales. The baseline specification is parsimonious in the number of covariates included to minimize potential endogeneity problems; however in the robustness section we check the sensitivity of our main results to the inclusion of firm-level time-varying controls or to industry-specific time fixed effects. Identification of β_1 as a causal effect requires the conditional exogeneity of real sales. In our specification, firm fixed effects control for unobserved time invariant firm characteristics correlated with both demand shocks and firm's margins of adjustment, while time fixed effects control for time varying common shocks. Since other sources of endogeneity may be relevant, such as reverse causality (for example, in a production function framework, changes in employment reflect into changes in output) or firm-level time varying unobserved factors (such as a new management who simultaneously changes both sales, hiring and compensation policies)[15], we adopt an IV estimator using a shift-share approach to construct our instrument for firm-level real sales. More specifically, we use the pre-determined firm's market shares (defined at the 4-digit industry level and measured before the time period covered by our analysis) interacted with industry shocks.

More specifically, the instrument is defined as follows:

$$\text{IV}\log(sales)_{it} = share_{ij2007} * \log(rsales_{jt}) \qquad [2]$$

where $share_{ij2007}$ is the market share of the i-th firm in industry j in the pre-estimation period (i.e. 2007) and $rsales_{jt}$ is total real sales in industry j at time t. This empirical strategy implies an exposure research design, where market shares measure the differential exposure of different firms to a common industry shock (Goldsmith-Pinkham et al, 2020). We then assume that a differential exposure to a common shock should differently affect outcome variables at the firm level. In this setting, identification relies on the exogeneity of the initial shares. For this reason, we computed initial shares using 2007 data: other than being two years before our estimation period, they are determined before the outburst of the 2008 crisis and hence they should be uncorrelated with subsequent industry-level shocks conditional on firm and time fixed effects.

[14] Since we are using an unbalanced panel dataset, we prefer to estimate the model in levels rather than in first differences because the latter may exacerbate measurement error in the independent variables, introducing bias in the coefficients (Pozzi and Schivardi, 2016).

[15] The issue of reverse causality may be less relevant in the years of the crisis, when severe demand shocks were initially driven by external demand and were further exacerbated by credit crunch, especially in smaller firms. These shocks fell disproportionally strongly on manufacturing firms (Fabiani et al 2015).

Although there is not a formal test for exogeneity of initial industry shares, Goldsmith-Pinkham et al (2020) suggest to check whether industry shares are correlated with other factors that may influence the outcome variables other than the differential exposure to a common shock described above. If these correlated factors suggest other channels through which the shares affect outcomes in the relevant period, this can cast some doubts on the identification strategy.

In our setting, industry shares may be correlated with other firm's characteristics (such as firm size, workforce composition, productivity and profitability) that can actually predict changes in wages and employment other than the differential exposure to a common sales shock. In order to test this hypothesis, we looked at the correlation between initial industry shares and, respectively, the share of white collar, the added value per employee, ROA and total assets. More specifically, given our fixed effects model specification, we computed the demeaned values of these variables and regressed each of them on initial industry shares, controlling also for time fixed effects. Results reported in Table A1 in Appendix does not reveal any statistically significant correlation between initial industry shares and each of these variables, thus supporting our identifying assumption relying on exogeneity of industry shares.[16]

5. Results

Baseline estimates

As a first step, we estimate the elasticity of the annual wage bill and its main components (i.e. per-capita annual wage and total employment) to changes in real sales. The main estimates are reported in Table 1, where the various columns refer to the different estimation methods -- fixed effects (FE) or Instrumental Variables (IV), respectively -- and the dependent variable used: total wage bill (columns 1 and 2), per-capita annual wage (columns 3 and 4) and total employment (columns 5 and 6).[17] The estimated elasticities show that the total wage bill is significantly correlated with changes in real sales, but the size of the elasticity is rather small, even accounting for the potential endogeneity of real sales: IV estimates show that a 10% increase in sales causes an increase in the wage bill of approximately 1.5%, slightly higher than the corresponding FE estimate (1.37%). Quite interestingly, when we look separately at the two main components of the wage bill, we find that wages are largely unaffected by changes in sales, while total employment appears more resilient: a 10% increase in sales is associated to around 1% increases in total employment (IV estimates). These results overall confirm that firms partly adjust labour costs when facing a demand shock and that, given the

[16] We obtain similar results also for other profitability indicators (ROE and ROI) and if we do not control for time fixed effects. Results are available upon request.

[17] Table A2 in Appendix reports first stage estimates.

substantial rigidity of wages, the adjustment falls onto employment and on other factors not fully captured by these aggregate variables.

(TABLE 1 AROUND HERE)

One explanation for the lack of resilience of total wages to changes in sales may be related to the large incidence of base wages set in industry-level (national) collective agreements (i.e. for most of the low-skilled job titles base pay accounts for over 90% of the total compensation), which are only renewed every three years. However, there are other pay components that should be more resilient to changes in demand, such as collective performance-related pay, which are typically set in firm-level agreements and are aligned to indicators of firm's performance. Similarly, the relatively small estimated resilience of total employment may hide heterogeneous effects across different types of employment contracts. For example, much of the employment adjustment may occur through the use of temporary employment or changes in working hours acting as a buffer stock.

In order to test the elasticity of specific wage and employment components, we estimated equation [1] separately for the base wage and the wage cushion; while for total employment, we differentiate between extensive (permanent full-time, permanent part-time and temporary workers) and intensive employment margins (per-capita annual contractual working hours and hours of short-time work).

Table 2 reports the main coefficients of interest. IV-FE estimates show, as expected, a relatively higher elasticity to changes in real sales of the wage cushion compared to the base wage, but both estimated coefficients are not statistically significant and smaller than those estimated for almost all the employment components. Among the latter, a much larger elasticity is estimated for both part-time and temporary employment compared to permanent employment, though for temporary employment the estimated coefficient is less precise (and not statistically significant). Since both these forms of atypical labour contracts represent only a small share of total employment in the metal-engineering industry, changes in total employment face to changes in sales are mainly driven by full-time permanent employment. The estimated elasticity for permanent full-time employment is indeed very close in magnitude to that estimated for total employment.

Despite the use of part-time work has been widely used in Italy as a mean to reduce working hours and prevent lay-offs during the 2008-2009 crisis and afterwards, as mentioned above in the metal-engineering industry part-time contracts have always covered a very small share in total employment (around 5.7% on average, although increasing from less than 5% in 2009 to almost 6.5% in 2012-2014), as firms typically relied on overtime during recoveries and short-time work schemes during downturns. As discussed in Section 2, short-time work and furlough schemes have actually be one of

the main policy instrument used by large manufacturing firms to cope with the 2008-2009 crisis, as well as during the early phase of the Covid-19 pandemic crisis.

In light of these features, it is crucial to consider also changes in working hours in order to get a full picture on the margins of adjustments that firms can use to react to demand shocks.

Results in the last two columns of Table 2 clearly show that working hours set in collective agreements are rather insensitive to demand shocks: a 10% increase in real sales is associated to 0.23% increase in contractual per-capita working hours. Conversely, total short-time work hours display a much larger elasticity: a one percent increase in real sales causes a 3.6% decline in total hours of short-time work. The latter, in line with the conventional view previously discussed, proves to be the most resilient margin of adjustment used by firms to cope with changes in product demand.

(TABLE 2 AROUND HERE)

Robustness checks and further estimates

In this Section we present a set of further estimates we carried out to test the robustness of the baseline estimates. The main results are reported in Table 3.

Each cell displays the estimated IV-FE elasticity to real sales of the dependent variable reported in each column. Rows differ for either the sample or model specification used.

First, in order to control for time-varying factors that may be correlated with changes in sales and have a direct effect on either wages or employment components, we estimated a richer model specification, controlling for a vector of firm-level characteristics, including workforce composition, union density and the presence of a firm-level agreement. Alternatively, to take into account of time varying industry-specific confounders, we re-estimated our models including industry-specific time fixed effects, defined at either 2- or 3-digit level. Corresponding estimates reported in Table 3 show that our results are robust to the inclusion of time varying controls or different sets of fixed effects. If any, compared with the baseline estimates, in most cases the estimated elasticities are larger and more precisely estimated. Furthermore, regardless of model specification, we obtain a statistically significant elasticity of temporary employment to real sales, whose magnitude is similar to the one estimated with our baseline model, or even larger when we control for industry-specific time fixed effects. The estimated elasticities in column 5 for models 1-3 show that a 10% increase in real sales causes a 2.5%-4.2% increase in temporary employment, compared to a 0.9%-1.4% increase in permanent employment (column 4).

Second, we test whether our estimates, especially those related to the wage components, are driven by genuine changes in wage levels or by composition effects. To disentangle the two sources of wage

variations, studies based on worker-level or linked employer-employee data usually distinguish between job stayers and job changers (Grisby et al, 2019). Most papers investigating nominal wage rigidities actually concentrate on wage changes experienced by the first group of workers (see, for example, Devicienti et al., 2007; Dickens et al., 2007; Adamopolou et al., 2016). Unfortunately, our data do not allow to distinguish between these two types of workers, but we can test whether our main results hold once we restrict our sample to firms with a relatively low turnover rate. Estimates reported in the last rows of Table 3 for the sub-sample of firms with a turnover rate lower than, respectively, the median and the 25th percentile, overall confirm most of the results discussed above, especially referring to the large elasticity of working hours through the use of short-time work and the partial employment adjustment, also through changes in permanent employment.[18] Given the criterion used to select the sample (i.e., firms with a limited turnover rate), the elasticity of total employment, especially permanent employment, is lower than that estimated for the whole sample, but quite interestingly the estimated elasticity of temporary employment is very similar to that estimated for the whole sample.

(TABLE 3 AROUND HERE)

Finally, as noted by Jaeger et al. (2018), we should consider that adjustment to shocks may take some time. In this case, the error term of equation [1] can also include factors that reflect the ongoing adjustment to past shocks. If this is the case, a shift-share IV estimator may mix quite different short-term and long-term responses, such as a fall in wages in the short term caused by declining real sales, followed by an increase in wages once other factors, such as capital, have time to adjust. In order to take into account of potential adjustment dynamics, Jaeger et al. (2018) propose to enrich the model specification with a lagged term for the shock (in our case, real sales), instrumenting this term with a lagged analogous instrument as the one used for current real sales.

IV-FE estimates of this dynamic model are reported in Table 4. The estimated elasticities for current sales confirm all the results we obtained with our baseline model. However, the estimated elasticities for the lagged sales reveal also a slow but small resilience in the case of wages, which seems driven by adjustment in the base wage.

(TABLE 4 AROUND HERE)

[18] Estimates are less precise when we restrict to the sub-sample of firms with a very low turnover rate, but this may be due to the small sample size.

As a further step of the analysis, we test the existence of asymmetries in the adjustment to, respectively, positive and negative shocks. In presence of downward nominal wage rigidity, it may be the case that firms cannot reduce wages as they would like when they face a negative demand shock, but in principle they can fully adjust in case of a positive demand shock. When base wages are rigid because they are set by industry-wide collective agreements, this may occur through adjustment of the wage cushion, especially of bargained performance-related pay components depending on firm's productivity or profitability. To test the presence of asymmetries in the elasticity to demand shocks, we interact our measure of sales with two dummies capturing the sign, either positive or negative, of changes in sales. Overall our estimates (available upon request) show no large and statistically significant asymmetries in the adjustment of either wage or employment to sales shocks.

6. The role of union power at the firm level

The results shown so far provide interesting insight on how firms react, on average, to demand shocks, and how they rely on the different margins of adjustment. However, part of firms' actual behaviour may be significantly influenced by the institutional context and the institutional constraints they face when adjusting wages and employment, such as employment protection legislation, union power and collective bargaining. First, we investigate how the sensitivity of different margins of adjustment varies by firm-level union power, defined on the basis of time-invariant average of firm-level union density. More specifically, we capture the presence of strong unions with a dummy equal to 1 for firms with union density greater than the 75th percentile of this indicator in unionized firms (i.e., 40%).[19] We then interact this dummy with the logarithm of real sales in our main equation and instrument also the interaction term with the corresponding interaction instrument (obtained by interacting the original instrument with the union dummy).

The main estimated IV-FE elasticities are reported in Figure 2, which clearly shows interesting differences between the two groups. More specifically, we find that, in firms with strong unions, the resilience of the wage bill to demand shocks is significantly lower than in the other firms, mainly due to the lower sensitivity of the permanent employment component. This does not happen at the cost of higher elasticity of either wages or working hours. Strong unions seem then to resist any form of adjustment that can affect incumbent workers (i.e. the insiders). In other words, firms with strong unions manage to reduce overall employment fluctuations (both positive and negative) reinforcing the effect of employment protection in the firm, in line with the empirical evidence documented at the macro level (Checchi and Lucifora, 2002; Bertola and Rogerson, 1997).

[19] We experimented with other cut-offs along the union density distribution to define strong unions. While results are qualitatively the same, the estimated elasticity become larger in size and more statistically significant when we move the cut-off towards higher percentiles.

(FIGURE 2 AROUND HERE)

We then perform a similar exercise interacting the demand shock with a dummy for the presence of firm-level collective bargaining, defined on the basis of the time-invariant average presence of a firm-level collective agreement.[20] Estimates depicted in panel A of Figure 3 do not reveal significant differences in the margins of adjustment adopted by firms with a local agreement compared to non-bargaining firms, except for the lower elasticity of permanent part-time employment. As expected, the presence of a firm-level agreement increases the elasticity of the wage cushion, mainly through the adoption of bargained performance-related pay schemes, but the estimated difference between the two groups of firms is not statistically significant. However, this result is more clear-cut (and the difference between the two groups is statistically significant) when we condition on the presence of strong unions (see the graph on the wage cushion in panel B of figure 3). Notice that in most countries, including Italy, there is evidence of a non-liner relationship between the adoption of flexible pay schemes set at the firm level and workforce unionization, with a higher incidence of these wage components in firms with either a relatively low or high share of unionized workers (Bryson et al, 2013). While in the first group of firms it is likely that management unilaterally introduces or change flexible wage components paid on top of the minimum wages set by industry collective agreement, where unions are more powerful it is more realistic to assume that any substantial change in wages (or other working conditions) is bargained between the firm and local union representatives (Origo, 2009). Our estimates show that, conditional on the presence of strong unions at the firm level, local bargaining may provide firms with more degrees of freedom in terms of wage flexibility to partly adjust to demand shocks through the adoption of bargained performance-related pay.[21]

(FUGURE 3 AROUND HERE)

[20] More precisely, we classified as firms with a firm-level agreement those with an overall (time-invariant) mean of the dummy measuring the presence of a firm-level agreement equal to 1. This implies that the dummy is capturing firms which adopted a firm-level agreement for the entire period of observation. We obtain similar results if we set the dummy equal to one when the time invariant presence of a firm-level agreement is greater than 0.5.

[21] We also tested the existence of heterogeneous responses by strictness of EPL as proxied by firm size. More specifically, we estimate a model enriched with an interaction term between real sales and a dummy equal to 1 for firms with less than 15 employees. In order to take into account of potential endogeneity of firm size, we compute the size dummy using the time-invariant average number of employees over the entire period considered. The estimated elasticities (available upon request) do not reveal statistically significant differences between the two groups of firms, but estimates for the sub-sample of small firms are highly imprecise also due to the small sample size (15% of total observations have less than 15 employees).

Discussion

Institutional characteristics, especially union power and local bargaining, have been shown to matter when firms choose how to adjust to a change in sales. Powerful unions, in the firm, seem to be successful in moderating the impact of demand shocks on employment or wage changes. One explanation for the above results may be associated with an "insider effect", suggesting that strong unions reinforce the effect institutional constraints to protect incumbent workers (i.e. who are their members). In other words, when demand is growing working hours are adjusted increasing overtime, while when demand is contracting the short-time work margins is used mainly to protect employees with a permanent contract. An additional institutional margin of adjustment may be at work in firms with a firm-level collective performance-related pay agreement, which increases wage flexibility in a context of downward (base) wage rigidity caused by large coverage of industry-wide collective bargaining.[22] Quite interestingly, we found a relatively larger resilience of the wage cushion to changes in sales in highly unionized firms adopting a firm-level agreement, confirming that resilience may depend on the complex interactions between firm-level institutions and economic shocks.

Despite the larger elasticity of the wage cushion prompted by the adoption of bargained performance-related pay schemes, total wages remain substantially rigid because these wage components typically represent a negligible share of total compensation. The incidence of bargained performance-related pay in the total wage cushion is less than 10% and it is rather negligible (around 3%) in total wages (Lucifora and Origo, 2015).

Simple back-of-the-envelope calculations reveal that only a large increase in the share of collectively bargained performance-related pay in total wages, coupled with a significant elasticity of this wage component to real sales, is likely to guarantee a significantly higher elasticity of total wages to real sales. More specifically, we construct two alternative counterfactual scenarios: in the first, we double the share of bargained performance-related pay in total wage from 3 to 6%, while in the second we increase it up to 20% of total wage, which is like if the entire wage cushion were linked to any indicator of firm's performance. Using the estimated elasticity of collectively bargained performance-related pay to real sales for bargaining firms, we estimate that the elasticity of total wages to real sales increases by around 2% (from 0.046 to 0.047) in the first scenario, by almost 22% in the second one, although the overall elasticity of total wages to real sales remains rather small (0.056). However, in both scenarios we obtain significantly larger effects in highly unionized bargaining firms, which are

[22] Wage rigidity caused by collective bargaining has progressively caused a declining coverage of industry-wide agreements and the diffusion of pirate agreements (Garnero, 2018; Garnero and Lucifora, 2020). However, these phenomena should be less relevant for the sample of firms used in our analysis, since they are affiliated to the main national employer association of the metal-engineering sector and hence they should comply with the industry-wide collective agreement.

characterized by the highest elasticity of collectively bargained performance-related pay to real sales[23]: increasing the share of this flexible wage component in total wages would imply an overall wage elasticity of, respectively, 0.068 in the first scenario and 0.125 in the second one. The latter is similar to the estimated elasticity of total employment in Table 2, but it is anyway substantially smaller than the estimated elasticity of short-time work hours.

Finally, it is important to consider that the higher rigidity of labour costs adjustment estimated in highly unionized firms, also along the employment margin, is likely to shift the burden of the adjustment cost on the employers, who may react by changing either output prices or profit margins. However, given export-oriented vocation of metal-engineering firms, changes in output prices should be less likely to occur than changes in profit margins. While we have no direct information on firm-level prices in our data, we do exploit information drawn from firms' balance sheets to check whether firm's profitability is sensitive to changes in sales and if the estimated elasticity varies with firm-level union power. To this end, we estimate a model specification as the one used to get estimated elasticity by union power reported in Figure 2, using different profitability indicators (ROA, ROE and ROI) as dependent variables. IV-FE estimates reported in Table 5 show that the estimated coefficient of profitability margins to sales is larger in firms with strong unions compared to firms with weak unions. Furthermore, it is statistically significant only for the first group of firms.

(TABLE 5 AROUND HERE)

This suggestive evidence is coherent with declining profit shares registered at the aggregate level in the last decade in the manufacturing sector where, due to the weak economic environment prevailing for most of the period since 2008, increases in labour and capital costs could not be passed onto selling prices (ECB, 2015). Furthermore, our estimates complement the firm-level qualitative evidence based of WDN data, showing that adjustment of profit margins is a relevant strategy to cope with a cost shock for a lower share of firms compared to those adjusting costs or prices (Bertola et al., 2012).[24] In this respect, our results suggest that this strategy is more likely in highly unionized firms that are characterized by a stronger protection of incumbent workers' employment and wages.

[23] The estimated elasticity of bargained performance-related pay to real sales is 0.134 in bargaining firms, 0.467 in bargaining firms with strong unions.

[24] At the EU level, approximately 70% of the respondents indicate that a reduction of other costs and price increases are "very relevant" or "relevant" options, while around 57% declare that a reduction in profit margins is a relevant response.

7. Conclusions

In this paper we have investigated firms' margins of adjustments to demand shocks, when both wages and employment adjustments are rigidly regulated.

Our results, based on firm-level panel data for the Italian metal engineering industry over 2009-2015, confirm that firms have a number of margins of adjustments to cope with demand shocks, but in regulated labour markets they are significantly influenced by the strictness of labour market institutions.

More specifically, our estimates show that the total wage bill is significantly influenced by sales shocks, but such sensitivity is mainly driven by changes in working hours and partly by changes in employment, while total wages are largely unaffected. Wage rigidity to demand shocks is found to depend largely on the rigidity of the base wage set in multi-annual collective agreements at the industry level. While the latter prevent from cutting base wages, firms can adjust other variable flexible wage components bargained at the firm-level and linked to firm's performance. These flexible wage components show more resilience to changes in demand than other wage components. However, such channel of adjustment is shown to be largely insufficient if it accounts for only a negligible share of total wage compensation, as it is the case in the Italian metal engineering industry, and its buffering effect on employment reduction is rather limited. Our back-of-the envelope calculations suggest that it is necessary a large increase in the share of bargained performance-related pay in total wages, coupled with a significant elasticity of bargained performance-related pay to real sales, in order to make total wages at least as resilient as total employment to real sales.

When we turn to employment components, we find that resilience to demand shocks is larger for temporary employment compared to permanent one. However, since the first represents a small share of total employment in the metal-engineering industry, the estimated elasticity of total employment to sales is economically small and mainly driven by changes in full-time permanent employment.

The main adjustment mechanism firms rely upon remains that provided by changes in working hours and the activation of short-time work schemes.

Besides labour market regulation, strong unions also represent an additional source of rigidity reinforcing the effect institutional constraints to protect incumbent workers with a permanent contract (i.e. the "insiders" who are their members). The counterpart of this stronger job protection and wage rigidity effect of strong unions is reflected on firm's profitability margins which, in line with a rent-sharing behaviour, appear to respond more to demand shock compared with firms in which unions are weaker.

The policy implications of our results suggest measures to improve firms' resilience, particularly balancing the insurance effect of sector-level collective bargaining with the productivity-enhancing

effect of variable pay set in decentralised agreements, and reducing the divide between permanent employment *vis-à-vis* part-time and temporary employment. In this respect, the role of short-time work schemes proves to be an effective short-time adjustment margin, if not the only one, firms rely upon to cope with demand shocks, while most other channels are shut either by rigid regulations or by unions power.

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APPENDIX I - Estimation of annual working hours

Regarding working time, for blue and white collar full-time permanent employees, the survey provides the following information:

a. Number of days of paid holidays and other days off-work (defined in the industry collective agreement as "reduction of working time"*, riduzione dell'orario di lavoro*);
b. Weekly working hours defined by the industry collective agreement;
c. Number of minutes of paid breaks per week;
d. Number of annual hours of short-time work schemes

Furthermore, for each year we reconstructed:

e. Total number of days (365 or 366)
f. Number of Saturdays and Sundays
g. Number of days of bank holidays from Monday to Friday

Using this information, by year and firm we computed annual contractual working hours as follows:

$$\text{Annual contractual working hours} = (e-f-g-a)/5*(b-c/60) \quad [a1]$$

where the first term is the number of actual working weeks in a year and the second one is the number of contractual hours per week.

We then estimated annual working hours net of short-time work schemes as follows:

$$\text{Annual working hours net of short-time work} = \text{Annual contractual working hours} - d \quad [a2]$$

APPENDIX II – Additional Tables

TABLE A1 – Test on correlation between initial industry shares and other firm characteristics

VARIABLES	(1) % white collars	(2) labour productivity (thousands Euro)	(3) ROA	(4) total assets (thousands Euro)
shares2007	0.000	-431.028	0.080	-45.549
	[0.000]	[966.198]	[0.178]	[76.351]
Observations	5,651	5,164	5,537	5,651
R-squared	0.020	0.039	0.008	0.006

NOTE: Demeaned dependent variables. Labour productivity is measured as added value per employee. All model includes also time fixed effects. Robust standard errors clustered at the firm level in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table A2 – First stage estimates from IV-FE

VARIABLES	logsales
$shares_{2007}$*log(industry $sales_t$)	1.215***
	[0.167]
Observations	5651
Number of firms	2269
F test (Kleibergen-Paap)	53.019

NOTE: Model specification includes also time fixed effects. Robust standard errors clustered at the firm level in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 1 – Elasticity of the wage bill to real sales

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	wage bill		wage		employment	
	FE	IV-FE	FE	IV-FE	FE	IV-FE
logsales	0.137***	0.148***	0.006	0.037	0.155***	0.104**
	[0.027]	[0.052]	[0.004]	[0.026]	[0.026]	[0.046]
Observations	5651	5651	5651	5651	5651	5651
R-squared	0.046	-	0.344	-	0.08	-
Number of firms	2269	2269	2269	2269	2269	2269

NOTE: all dependent variables are logs; models include also time fixed effects. Robust standard errors clustered at the firm level in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 2 – Elasticity of wage and employment components to real sales
IV-FE estimates

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wage		Employment				
		Extensive margin			Intensive margin	
Base	Cushion	Permanent full time	Permanent part-time	Temporary	Per capita contractual hours	Short-time work (total hours)
0.035	0.081	0.105***	0.239**	0.218	0.023***	-3.647***
[0.030]	[0.212]	[0.039]	[0.122]	[0.144]	[0.008]	[0.843]
5651	5651	5651	5651	5651	5651	5651
2269	2269	2269	2269	2269	2269	2269

NOTE: all dependent variables are logs; models include also time fixed effects. Robust standard errors clustered at the firm level in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 3 – Robustness checks
IV-FE estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Employment		Working hours		
VARIABLES	wage bill	wage	employment	Permanent	Temporary	anual per-capita hours	short-time work	N obs [N firms]
1) Time varying controls (a)	0.150**	0.035	0.114**	0.114***	0.256**	0.024***	-3.705***	5,593
	[0.059]	[0.024]	[0.049]	[0.043]	[0.130]	[0.008]	[0.866]	2,258
2) Industry-specific time FE								
2 digit	0.153**	0.068***	0.151***	0.136***	0.375**	0.006	-3.618***	5,689
	[0.064]	[0.024]	[0.039]	[0.038]	[0.147]	[0.007]	[0.743]	2,291
3 digit	0.125**	0.086***	0.108***	0.094***	0.420**	0.019**	-3.782***	5,689
	[0.051]	[0.023]	[0.033]	[0.032]	[0.208]	[0.009]	[0.805]	2,291
3) Firms with low turnover								
<50th percentile	0.039***	0.000	0.038***	0.029**	0.267***	0.012	-2.199***	2,886
	[0.012]	[0.007]	[0.014]	[0.013]	[0.100]	[0.011]	[0.799]	1,151
<25th percentile	0.043	0.007	0.073	0.065	0.430*	0.064***	-5.330***	1,425
	[0.094]	[0.031]	[0.065]	[0.066]	[0.248]	[0.023]	[1.794]	641

NOTE: all model includes also time fixed effects. Robust standard errors clustered at the firm level in brackets
*** p<0.01, ** p<0.05, * p<0.1
(a) Time varying controls include: %females, %blue collars, % managers, %graduates, union density, union density squared, firm-level agreement (dummy)

Table 4 – Estimated elasticities to current and lagged sales
IV-FE estimates

	(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)
				Wage components		Employment		Working hours	
VARIABLES	wage bill	wage	employment	base wage	wage cushion	Permanent full-time	Temporary	anual per-capita hours	short-time work
logsales	0.161*	0.003	0.092*	0.008	0.264	0.099**	0.199	0.028***	-4.275***
	[0.084]	[0.013]	[0.056]	[0.017]	[0.306]	[0.049]	[0.164]	[0.008]	[0.699]
log sales lag	-0.022	0.052***	0.017	0.042**	-0.282	0.008	0.002	-0.009	1.092**
	[0.066]	[0.018]	[0.042]	[0.017]	[0.402]	[0.039]	[0.107]	[0.007]	[0.497]
Observations	5,648	5,648	5,648	5,648	5,648	5,648	5,648	5,648	5,648
Number of firms	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280

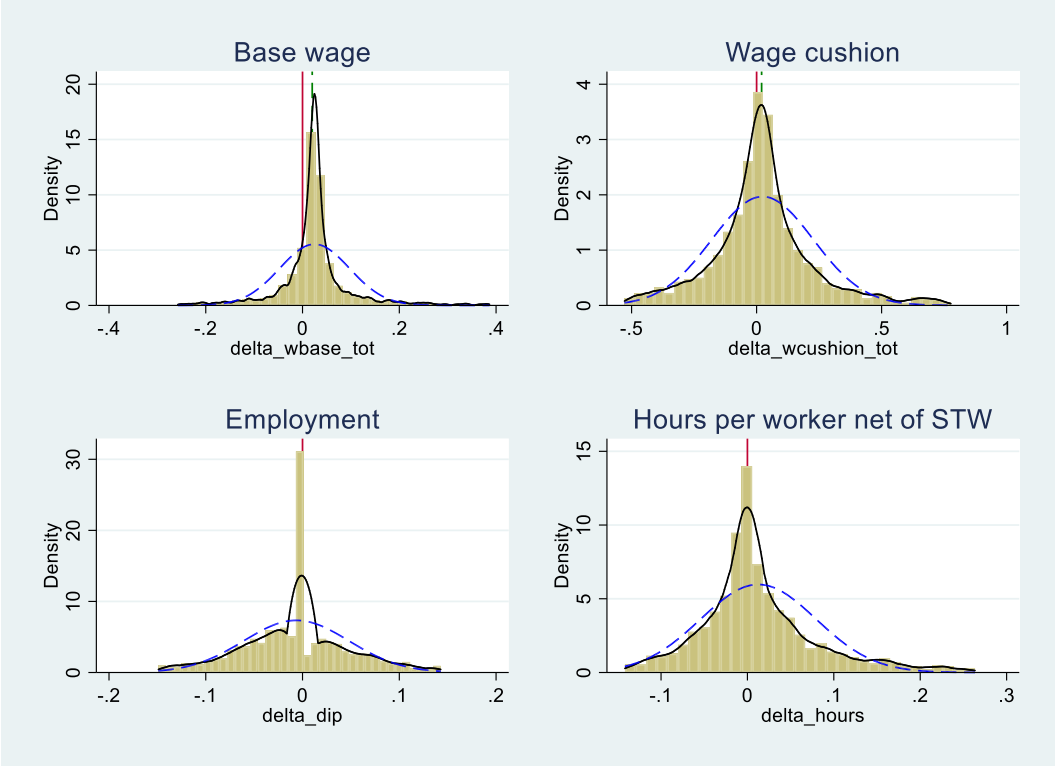
NOTE: all dependent variables are logs; models include also time fixed effects. Robust standard errors clustered at the firm level in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 – Estimated elasticity of profitability indicators to real sales by firm-level union power IV-FE estimates

VARIABLES	(1) ROA	(2) ROE	(3) ROI
logsales*strong unions	4.753**	9.686*	5.906**
	[2.017]	[5.655]	[2.431]
logsales*weak unions	2.634	4.657	2.659
	[3.354]	[8.737]	[5.907]
Constant	-26.853	-54.909	-28.365
	[23.803]	[62.652]	[41.566]
Observations	5,689	5,497	4,860
Number of firms	2,291	2,235	2,042

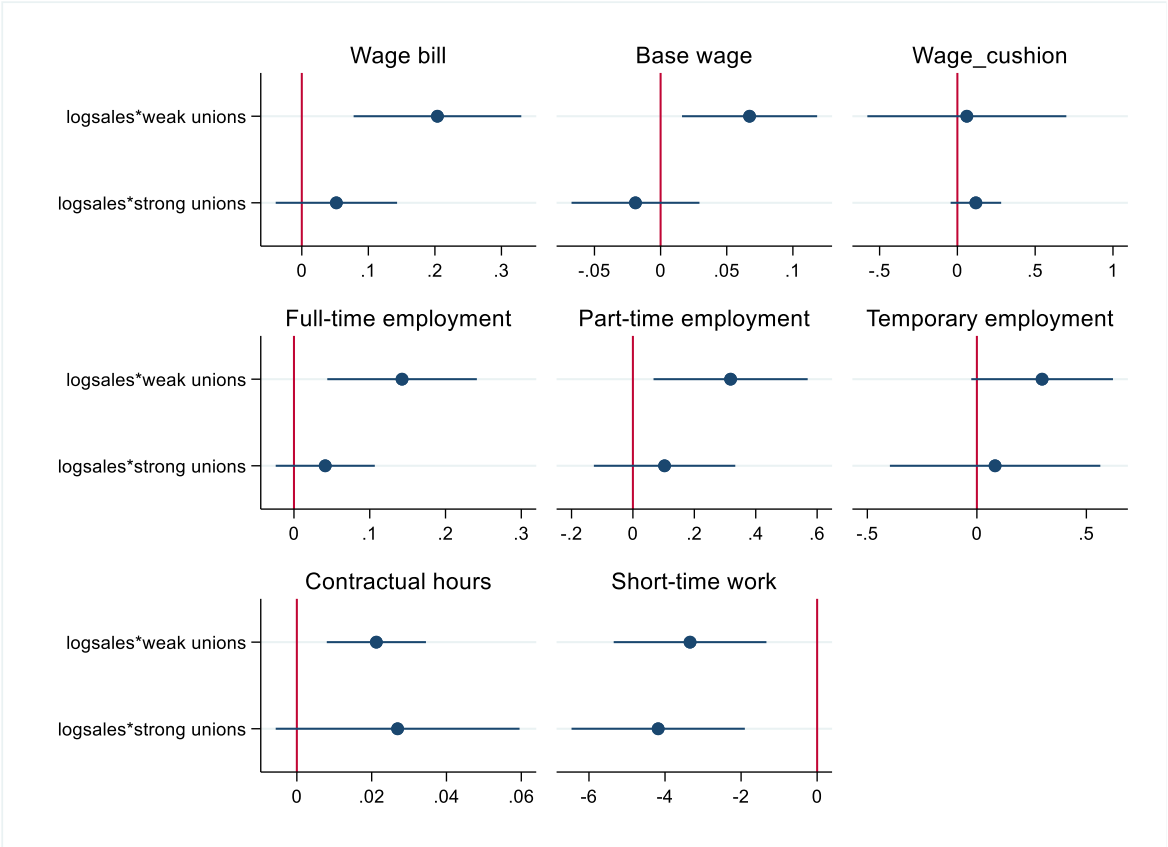
NOTE: models include also time fixed effects. Robust standard errors clustered at the firm level in brackets
*** p<0.01, ** p<0.05, * p<0.1
Strong unions are firms with time-invariant union density greater than the 75th percentile; weak unions are the remaining firms

Figure 1 – Annual changes in main wage and employment components, 2009-2015



Note: the red line corresponds to zero changes, the dotted green line in the two upper panels to the target inflation rate The solid black curve is the kernel density, while the dotted blue curve the normal density function.

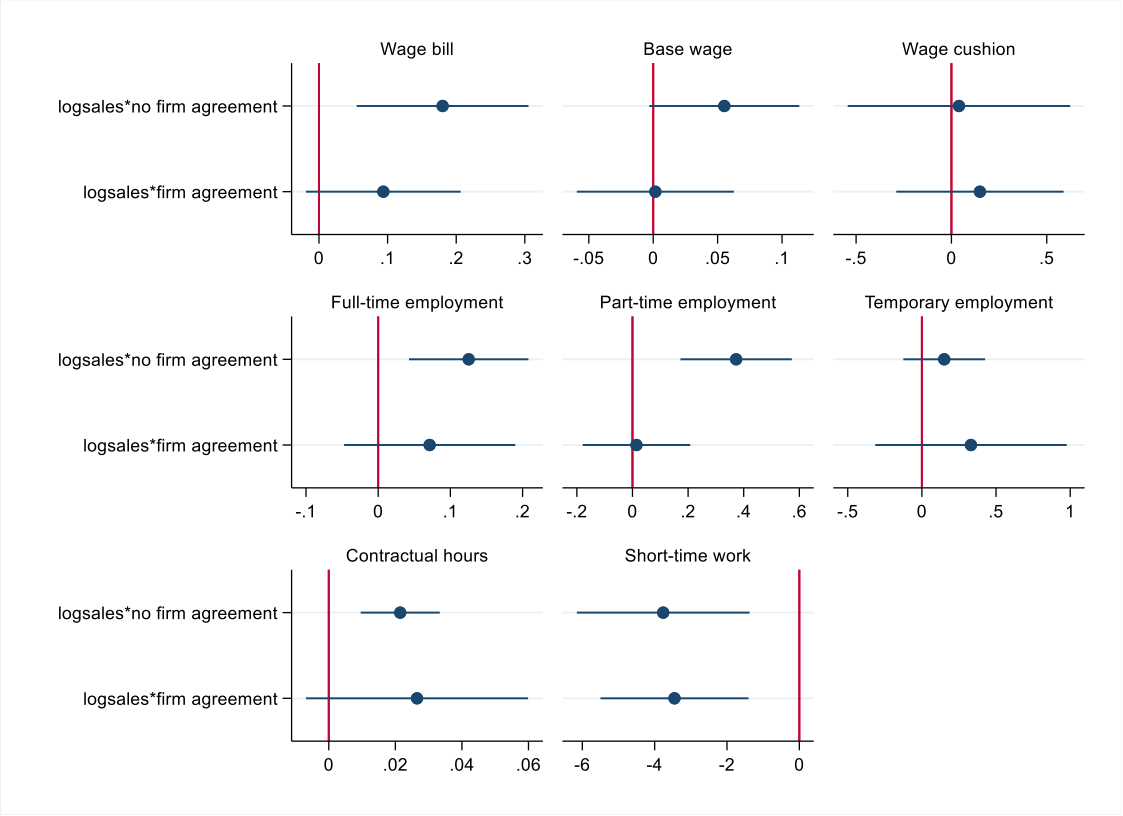
Figure 2 – Estimated elasticities of the wage bill and its main components to real sales by union power



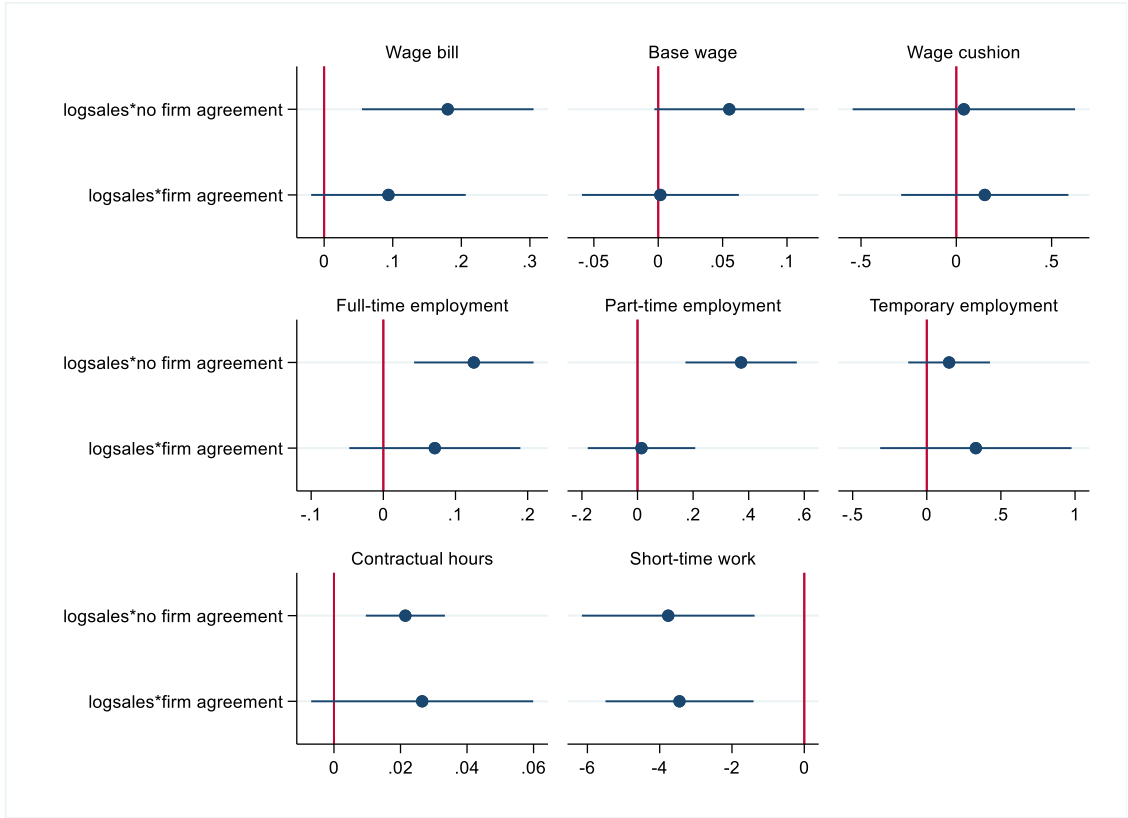
NOTE: Each graph refers to a specific dependent variable. IV-FE estimates from models with time fixed effects. Strong unions are firms with time-invariant union density greater than the 75th percentile; weak unions are the remaining firms.

Figure 3 – Estimated elasticities of the wage bill and its main components to real sales by presence of firm-level collective bargaining

A) All firms



B) Firms with strong firm-level unions



NOTE: Each graph refers to a specific dependent variable. IV-FE estimates from models with time fixed effects. Strong unions are firms with time-invariant union density greater than the 75th percentile; weak unions are the remaining firms.