Short-time work and unionisation. When is short-time work more effective?

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Abstract

Short-time work (STW) has been widely used both during the Great Recession and the COVID crisis to preserve jobs. In most European countries the implementation of STW schemes is often the result of bargaining between trade unions and employers, still very little is known about the role of unions. In this paper, we investigate how the effects of STW on a number of economic outcomes is mediated by the presence of unions and collective bargaining. We use a rich firm-level panel data, for the metal-engineering industry (from 2006 to 2015), with information on industrial relations attributes, merged with balance sheet data. We estimate the elasticity of employment, working hours, wages and labour productivity with respect to the STW utilization. The empirical strategy relies on a Fixed-Effects Instrumental Variable estimator, with instruments based on the institutional rules governing firms' access to the scheme. We find that a more intensive use of STW is an effective policy to preserve jobs in all firms, but this effect is largest where workers are not covered by strong unions and firms face liquidity constraints. Furthermore, larger employment gains usually come at a cost of lower wages and labour productivity, except for firms with strong unions.

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1 Introduction

Short-time work schemes have been extensively used to stabilize employment and income during periods of low demand or deep restructuring. Their effectiveness has been often associated with the presence of strict employment protection legislation (EPL) for permanent workers, and other labour market institutions limiting the adjustment of employment and wages. The Great Recession and the COVID crises have seen an unprecedented increase of STW schemes to contain the negative employment effect of the economic recession. Only in 2020, over 50 million jobs were supported, at some point, in OECD countries by STW schemes. In Germany, Japan, and Italy, more than 4% of the labor force were on a STW scheme during the global financial crisis of 2009. In this context, labour market institutions and unions have had a central role since STW schemes are heavily regulated, and their implementation is generally negotiated with local unions. While STW schemes generally have a strong take-up and help firms to reduce hours of work while preserving worker's job and pay, their effect on employment levels and firm's overall performance is more controversial (Cahuc, 2019).

One aspect is related to labour market mismatch, as workers remain attached to their job, instead of actively searching for another job elsewhere. Another feature is that firms may retain more workers than it is optimal, such that the excess in labour hoarding turns out in a lower productivity and profitability. Also, as the current debate on "zombie" firms makes it clear (Laeven et al., 2020), it is always difficult to distinguish between temporary and permanent shocks with the risk of keeping alive jobs and firms for which previous levels of demand will never recover. Finally, while unions negotiate with employers access to STW schemes to preserve the largest possible number of jobs and protect insiders from the risk of layoff, quite often this is done at the expense of company's discretion in employment and other margins of adjustment.

The massive use of STW schemes over the recent crises has renewed attention on the economic effect of such schemes, and a number of relatively recent studies have investigated the short term impact of STW on job retention, job quality and company's performance, particularly during downturns (Arpaia et al., 2010; Boeri and Bruecker, 2011; Sacchi et al., 2011). However, relatively little is known about the role of unions and collective bargaining in access to STW and on company's performance.

In this paper we investigate the heterogeneity in the effects of STW intensity of use on some relevant firm-level outcomes, paying attention to the role played by union power at the workplace. We exploit detailed firm-level panel data for the metal-engineering industry covering the period 2009 to 2015. In particular, we estimate the elasticity of employment, working hours, wages and labour productivity to the number of hours of STW

per employee. Since social partners, with the support of the Government, bargain over the implementation of STW schemes to preserve jobs over economic downturn, simple correlations between STW scheme and employment outcomes might be biased. To address the endogeneity issues, our identification strategy relies on two instruments exploiting different size thresholds that affect the company's incentive to rely on STW. Our paper contributes to two different strands of literature. First, we add to the literature on the evaluation of labor market policies providing clean evidence on the effects of an important policy - short-time work - on a variety of firm-level outcomes. Second, this paper contributes to the economic literature on unions by studying the interaction of STW with variables measuring the strength of industrial relations in the firm.

Most studies using microdata on workers and firms cover European countries with a long tradition of STW. Germany has attracted particular attention due to the fact that very few jobs were lost despite the depth of the 2009 recession (Crimmann et al., 2010). Brenke et al. (2013) find that STW has certainly contributed to the positive response of the German labor market to the crisis, but this is likely due to the country-specific context. Exploiting data on firms in the manufacturing sector in Germany, Hoffmann et al. (2011) find that small firms are less likely to utilize STW. Furthermore, they suggest that STW is significantly negatively correlated with employment growth. This points to a period of jobless growth after utilization of STW. Kruppe and Scholz (2014) estimate the treatment effect of STW on employment at establishment level, their results do not indicate any effect of STW on employment. Cooper et al. (2017) suggest that even if STW can prevent increases in unemployment during a recession it leads to a decrease in the allocative efficiency of the labor market, resulting in significant output losses. These effects arise from a reduction in the vacancy filling rate resulting from the policy. A recent paper (Tilly and Niedermayer, 2016) evaluates the long-term effects of STW and stresses that - in contrast to unemployment - STW is not associated with a long-term loss in earnings. The main determinants of STW take-up are workers human capital and the duration of productivity shocks. They find that short-time work substantially reduced job loss in the recession. However, the welfare gains are limited, because workers who would have been laid off without STW are workers for whom the earnings loss associated with unemployment is low.

Cahuc and Carcillo (2011) using French data suggest that STW programs used during the 2009 downturn had significant positive effects on employment. However, these programs can have the unintended effect of inducing inefficient reductions in working hours and reduce the prospects of outsiders if used too intensively. Thus, the design of STW should include an experience-rating component. Boeri and Bruecker (2011) also find that STW should be temporary as during upturns may negatively affect employment and that

specific design features such as experience-rating and disincentives to 100% reductions in working hours are important in improving the cyclical properties of STW. Evidence on the expansion of STW in France during the 2009 recession (Cahuc and Nevoux, 2018) shows that the reforms were mostly to the benefit of large firms which are recurrent STW users. The authors find that STW leads to significant production losses compared to an unemployment insurance scheme with experience rating. Finally, Cahuc et al. (2018) demonstrate that STW saved jobs in firms facing large drops in their revenues during the Great Recession, in particular when highly levered, but only in these firms. The measured cost per saved job is very low relative to that of other employment policies. Recent studies confirm that STW schemes help to retain the workforce during recessions. However, they can create inefficiency in the labor market (Cooper et al., 2017; Giupponi and Landais, 2018; Cahuc, 2019).

Some studies distinguish between the rule-based and the discretionary component of STW, finding that - while the first is cost-efficient at saving jobs - the second does not have any effect (Balleer et al., 2016). The effects of discretionary STW are time dependent and non-linear over the business cycle: it is effective at saving jobs in deep economic crises while in normal times and expansions, the effects are smaller or even negative (Gehrke and Hochmuth, 2018). This cyclical effect of STW is also found by Hijzen and Martin (2013). Using quarterly data on a panel of countries, they find that STW helped avoiding job losses during the crisis, but its continued use during the recovery may have slowed the job-content of the recovery. By the end of 2010, the net effect of STW on employment was negligible or even negative.

Very few studies investigate the effect of STW on firm level outcomes, with two recent exceptions. Kato and Kodama (2019) use data from Japanese firms, they find that STW leads to improved profitability. Giupponi and Landais (2018) provide evidence of the effects of STW on a variety of firms' and workers' outcomes, and on reallocation in the labor market. They find negative effects of STW treatment on hours, but large and positive effects on headcount employment. Results on profitability and most other firm-level outcomes are not statistically significant. Employment effects disappear when the program stops, since STW offers no long term insurance to workers. They also find evidence of negative reallocation effects of STW, with reduced employment growth of untreated firms in the same local labor market.

Empirical papers discussing the potential interactions of STW with other institutions such as employment protection legislation and the degree of centralization of bargaining are almost non-existent (Boeri and Bruecker, 2011). The aim of this paper is to provide a first contribution to help filling this gap in the literature. Empirical evidence on the interaction between STW and other labor market institutions is especially relevant for countries with

tightly regulated markets, as is the case in many European countries.

In this respect Italy provides an interesting case study. First, STW has been widely used in Italy as a mechanism to protect jobs in relatively large firms. Secondly, industrial relations - especially national unions - have a very important role in Italian labor markets. Unions participate, for example, in the bargaining process for the determination of wages, that are set at the centralized national level in Italy, with relatively limited scope for firm-level bargaining.

We find that STW has a positive short-term effect on employment even after accounting for the mechanical effect of STW that keeps workers attached to the firm. However, STW has a negative effect on productivity. Estimating the interactions between STW intensity and industrial relations we find a stronger effect for firms with weak unions.

The paper proceeds as follows. Section 2 describes the institutional context. In Section 3 we present our data. Section 4 explains the identification strategy, whose results are commented on in Section 5. Finally, Section 6 summarises the main findings and concludes the paper.

2 The institutional setting: Short time work in Italy

Short-time work (STW) schemes have a long tradition in Italy (they date back to the mid Forties of the previous century) and were extensively used to stabilize employment and income in all the main manufacturing recessions occurred in the last decades. In a context of strict employment protection legislation (EPL) for permanent workers, their main aim was to avoid costly lay-offs in case of temporary product demand shocks. In Italy STW benefits have been traditionally much more generous than the ordinary unemployment insurance, thus creating distorted incentives in using these schemes also in case of permanent demand decline, especially in large manufacturing firms. Nonetheless, during the 2008 Great Recession, STW proved to be a crucial tool to prevent a steep unemployment increase and was then extended also to categories of workers and firms not covered yet. STW was further reformed in 2012 with the so called Fornero Law and more substantially with the 2015 Jobs Act, with the main aim to reduce deadweight losses and to foster complementarities with the new and more generous unemployment benefit. The use of these schemes has been further potentiated and extended during the COVID-19 crisis. Focusing on the relevant time spell for our empirical analysis (2009-2015), STW consisted of three main schemes that all go under the Italian name of Cassa Integrazione Guadagni (CIG): Ordinary CIG (Cassa integrazione guadagni ordinaria, CIGO), Extraordinary CIG (Cassa integrazione guadagni straordinaria, CIGS) and Derogatory CIG (Cassa Integrazione Guadagni in Deroga, CIGD). Figure 1 summarizes the main features of these

three schemes. The three schemes differ mainly in terms of scope and target firms: while ordinary CIG is used in case of product demand declines in manufacturing and construction companies due to temporary events that cannot be ascribed to the company, such as adverse weather or business conditions, extraordinary CIG is used in case of business crisis or restructuring by manufacturing companies with more than 15 employees (or 50 employees in services sectors)[1]. Derogatory CIG was introduced in 2009 to cover firms and workers (such as small firms and temporary workers or apprentices) not covered by the previous two schemes. In practice all firms, workers and industries were eligible for this new STW scheme between 2009 and 2015. Furthermore, this scheme could be used also by firms eligible for the previous two schemes once they exhausted all the corresponding benefits. This new scheme differs from the previous ones also in terms of financing, since it is the only one fully financed by general taxation. While both ordinary and extraordinary CIG are partly financed by social security contributions paid by the employers, such contributions were rather low and without an experience-rating component over the period considered[2]. Another important feature of the Italian STW schemes is that only extraordinary CIG is characterized by sharp discontinuities in eligibility by industry and firm size, which may be exploited to control for endogeneity of STW hours. This STW scheme has been actually the most used during the Great Recession, especially in the manufacturing sector and to cope with the second dip caused by the 2011 sovereign debt crisis. Figure 2 reports the total number of STW hours officially granted to applying firms in the metal-engineering industry from 2009 to 2016 by type of scheme. The figure shows that, with the exception of 2009, extraordinary CIG has been the most used scheme in this industry, registering a relatively large increase especially since 2012[3]. Another relevant institutional aspect refers to the relationship between the use of STW and the strictness of Employment Protection Legislation (EPL). Cross-country evidence shows that short-time work schemes are more developed in countries with stricter employment protection legislation, such as Belgium, Germany and Italy (Cahuc and Carcillo, 2011). In countries with high firing costs, working hours reduction through STW is often used to adjust labour input to demand shocks (Cahuc, 2019). Over the period considered, in Italy strictness of EPL and subsequent firing costs varied significantly by firm size. More specifically, in case of unfair dismissals, establishments with more than 15 employees or multiplant firms with more than 60 employees (even if with less than 15 employees in each establishment) were required to reinstate dis-

[1]Eligible firms can apply for extraordinary CIG once ordinary CIG expires (and viceversa). Since 2015, eligible firms can also use both schemes simultaneously, but for different workers.

[2]An experience-rating component was introduced in 2015.

[3]This is not true for the entire economy, where hours of derogatory CIG were higher since it was the major scheme used by many firms not eligible for the other two STW schemes in private services, especially in the trade sector.

missed workers and to reimburse forgone earnings in the months/years in which the worker was dismissed unfairly. These firing costs could be relevant due to the slowness of the judicial system and the uncertainty on the final decision. These rules do not apply to establishments with less than 15 employees or to multiplant firms with less than 60 employees where, in case of unfair dismissals, workers are only entitled to a monetary compensation that cannot exceed the value of 6 months of pay. While the 15-employee threshold is the one used also to define eligibility for extraordinary CIG in manufacturing, the 60-employee threshold applies only in case of unfair dismissals. However, both discontinuities create different incentives in using STW hours by firm size. We shall exploit these institutional features to control for potential endogeneity of STW in our empirical strategy.

3 Data

3.1 Data sources and sample selection

The empirical analysis is based on a unique firm-level panel dataset combining detailed survey information with accounting data for a sample of metal engineering firms in Italy. The survey is carried out by the main national employers association of this industry with the aim to collect information on issues that may be relevant for industry collective bargaining, such as employment, wages and industrial relations. More specifically, the survey provides information on the following main aspects[4]: 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 and job title; firm-level bargaining and industrial relations[5]. This survey is run every year since 2009; for our analysis, we could access data referred to the 2009-2015 period[6]. 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. Three quarters of the firms participated to the survey more than once, thus allowing to create an unbalanced panel over the period considered. Although the survey does not collect information on firms economic or financial performance, we could merge survey data with accounting data from AIDA dataset (*Analisi Informatizzata delle Aziende Italiane* - Computerized Analysis of Italian Firms) using the unique firm identifier (VAT number). This database is updated

[4]Corresponding to different Sections of the questionnaire.

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

[6]We thank Federmeccanica for having provided the data used for the empirical analysis.

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). This procedure allowed us to successfully merge information for 3,392 different firms, corresponding to around 68% of the firms in the initial sample. We then dropped observations with missing or negative values for the variables used in the empirical analysis and excluded outliers (i.e., below and above the 1st and 99th percentile). The final sample for the baseline employment regressions consists of 2489 firms, for a total of 6434 firm-year observations.

3.2 Main variables and descriptive statistics

The aim of the empirical analysis is to investigate the effect of the use of STW on labour adjustment and firm performance. To this end, one of the valuable features of our dataset is that it provides detailed information on working hours, including total hours of STW by skill (blue and white collars). Using this information, first we classify firms into two groups: STW users and other firms. In Figure 3 we plot the share of firms in our sample making use of STW over time. A clear cyclical trend can be observed, with more than 50% of firms taking up STW in 2009, the worst year of the Great Recession in Italy, followed by a sharp decline until 2011 and a new upsurge during the 2012/2013 second dip.

Regarding firm performance, in the following empirical analysis we shall focus mainly on labour adjustments. More specifically, we consider three different measures of labour inputs: total working hours net of STW, per-capita hours net of STW and total employment. While changes in the first variable should capture the overall labour adjustment, the other two indicators are aimed at decomposing such adjustment along the intensive (per-capita hours) and extensive margin (employment). Furthermore, we look at the effect on total labour costs and labour productivity, as measured by the average wage and value added per capita. Table 1 reports the main firm characteristics by STW use. Figures in the table clearly show that firms using STW are larger than those not using it (107 employees, compared to 82.6). Furthermore, firms never using STW have a significantly higher share of white collar workers and of temporary workers, while the share of women employed is similar in the two groups. In terms of other indicators of firm performance, as expected STW users tend to be less productive (as measured by value added per worker and TFP[7]) and less profitable (as shown by the much lower ROE compared to the one in firms never using STW). Financial indicators confirm the overall weaknesses of these firms, which are more heavily indebted and have more liquidity problems compared to firms not relying on STW. STW users have higher levels of debt - measured by the financial leverage (debt over

[7]TFP is computed using the AckerbergCavesFrazer method in Ackerberg et al. (2015).

total revenues) - and lower liquidity with respect to other firms. The two groups of firms differ also in terms of industrial relations, with firms taking up STW displaying on average a strong union presence (both in terms of workforce unionization and presence of union representative within the firm). Furthermore, they are also more likely to have a firm-level agreement on top of the industry-level contract. However, industrial relations climate may be more conflictual in STW firms compared to the other ones, as testified by the highest share of firms reporting a positive number of hours of strike per worker.

Going beyond a simple dichotomization of firms on the basis of STW use, we then compute the number of STW hours per employee as a measure of STW intensity. Figure 4 plots firms distribution by number of STW hours over the period considered. The figure clearly highlights great heterogeneity on the use of STW: among firms reporting some STW use, the mean firm used 210.8 hours per worker while the median value is 123.1. We have only 36 observations reporting a use of STW per worker above 1000 hours. This finding suggests that most firms are not heavy users of STW programs.

Figure 5 plots the relationship between union density - measured by the share of workers which are members of a union - and STW hours PC at the 2-digit sector level. We find a positive association between the two meaning that sectors with higher shares of workers joining unions tend to use STW more intensively.

Finally, in Table A1 we present summary statistics by union strength. On average, the yearly growth rate in employment is 2% for firms with weak unions and -1% for highly unionized firms. This may reflect the fact that weak unions firms are on average smaller and with better profitability indicators. As expected, firms with weaker unions also have lower wages.

4 Empirical strategy

Our baseline empirical strategy – relying on the panel nature of the dataset – is based on a fixed-effects specification that is described by the equation:

$$Y_{ijt} = \alpha_0 + \alpha_1 STW_{it} + \sum\nolimits_i \alpha_{2i} D_i + \sum\nolimits_{jt} \alpha_{3jt} D_j \cdot D_t + \epsilon_{ijt} \tag{1}$$

where i, j and t are firm, sector and year subscripts, respectively. Y_{ijt} is the logarithm of our outcome variable [8], STW_{it} – the variable of interest – is the logarithm of the number of hours of STW used by a firm in a given year, D_i is a set of dummies defined at the firm-level – or firm-specific fixed effects – and $D_j \cdot D_t$ are sector-year fixed effects. ϵ_{ijt} is an error term. In this equation α_1 captures the relationship between the intensity of use of STW by a firm

[8] We selected six dependent variables: total hours worked net of STW, hours per worker net of STW, total number of employees, average wage, total wage bill and value added per worker.

and its own employment level (i.e. a within effect). We always include firm fixed effects, to control for time-invariant firm idiosyncratic components [9] and industry-year fixed effects to control for time-varying sector-specific changes in the employment outcomes.

However, firms applying for STW may experience different time trends in the outcomes than the ones that did not decide to take up STW. Furthermore, we are potentially omitting some relevant time varying controls from the equation that would lead to an omitted variables bias in our estimates. Finally, in the context of our study we cannot rule out a reverse causality problem. It is possible that a deterioration in labour market outcomes induces a firm to resort to STW. In this case what is observed is the effect of the outcomes on STW use, while we are interested in the causal effect of (the intensity of) STW use on the outcomes.

To solve the possible endogeneity problem we rely on an instrumental variables specification. As an instrument for STW intensity of use we exploit plausibly exogenous variation in the rules of another important labor market policy: Employment Protection Legislation (EPL). Firms with at least 15 employees are subject to a much stricter EPL regime with respect to smaller firms (Cingano et al., 2016). For this reason we use as a first instrument a binary variable for the firm being above the 15 employees threshold. The idea behind the instrument is that firms that move to a stricter EPL regime will experience a substantial increase in firing costs and viceversa. This shock to firing costs changes the incentives for firms to use STW more or less intensively. However, at the 15 employees threshold we could have a problem with confounding policies such as STW itself and other - arguably less relevant - laws such as the possibility to form workers' councils for firms with at least 15 employees (Bratti et al., 2019). For example, while all manufacturing firms in our sample are potentially eligible to apply for CIGO and CIGD, only firms with more than 15 employees can access CIGS (Giupponi and Landais, 2018).

To solve the issue of confounding factors we exploit an additional source of variation in EPL. The same EPL regime of large (above 15) firms applies to plants that are part of a firm with at least 60 employees, independently of the size of the single plant. Therefore, the identification of the effects is based on the combination of two instruments: a dummy for having at least 15 FTE employees and the interaction between being a multi-plant firm and having at least 60 employees. In the case of unfair dismissal for firms below the 15 employees threshold, the employer had the possibility to choose whether to reinstate the worker (without paying any forgone wages) or make a severance payment, which ranged from 2.5 to 14 months in the case of very senior workers (Hijzen et al., 2017; Bratti et al., 2019). For larger firms the costs of unfair dismissals were much higher, ranging from 36 to

[9] Both observed and unobserved.

160 months for a blue-collar worker with 8 years of tenure (Gianfreda and Vallanti, 2017)[10].

Since we use firm-level fixed effects we exploit for identification changes in the size of a given firm over time, in particular the fact that a firm crosses one of the two thresholds. In our data we observe 62 firms moving above the 15 threshold and 68 firms going in the opposite direction. In the same period, 60 multiplant firms moved above the 60 employees threshold and 53 went the other way. We estimate the instrumental variables specification using the same controls as in equation (1). We then move to investigating the heterogeneity of the effects with respect to the strength of financial indicators (liquidity) and industrial relations (union density) of the firm. The interaction between STW and these variables is still unexplored in the literature. However, there are reasons to expect a relevant amount of heterogeneity along these dimensions. Firstly, unions affect firms' decisions to apply for STW and they participate in the process of allocating workers to STW. Furthermore, we expect highly unionized workers to be able to insure better against employment and wage cuts than workers in firms with weak unions. If this is true we could find a more important role of STW in firms with lower union density. A second potential mechanism behind heterogeneous effects of STW is the financial strength of the firm. Firms tend to apply for STW when they experience liquidity problems and we expect the effect of STW on employment outcomes to be negatively related to (pre-determined) liquidity indicators.

5 Results

5.1 Baseline estimates

Table 2 reports the main Fixed Effects (FE) estimates of a change in the number of STW hours on different measures of labour adjustment (total working hours net of STW in column 1, per-capita hours net of STW in column 2 and total employment in column 3), cost (average annual wage) and productivity (value added per employee). Since we estimate log-log models, coefficients can be interpreted as elasticities. We report OLS estimates in panel A, IV estimates based on the identification strategy discussed in the previous Section in panel B. As expected, OLS estimates show that an increase in STW hours is associated to a decline in total and per-capita working hours, with no significant changes in employment. Furthermore, since STW hours are subsidised by the central government, an increase in STW hours is associated to lower wages. Finally, a greater intensity in the use of STW is associated with lower labour productivity. Once we take into account the potential endogeneity of STW hours, IV estimates confirm a positive and statistically significant effect on total working hours: a 10% increase in the number of hours of STW causes a

[10]The costs depend on seniority of workers and the length of labour trials. According to Gianfreda and Vallanti (2017) the average length of labour trials ranged from 313 days in Trento to 1397 days in Salerno.

1.2% increase in total working hours. Differently from OLS estimates, such effect is due to an increase in employment that more than compensates the decline in per-capita working hours: a 10% increase in STW hours is associated to a 1.4% increase in total employment and a 0.2% decline in working hours. Hence, our IV estimates highlight that STW, by reducing the intensive margin of labour input, is effective in saving jobs. Furthermore, higher intensity in the use of STW is associated with slightly lower wages, but this does not compensate for the overall employment increase and the effect on total wage bill is actually positive: a 10% increase in STW hours reduces the average wage by 0.5%, while increasing the wage bill by 0.8%. Employment benefits come also at the cost of slightly lower productivity: a 10% in STW hours causes a reduction of 0.3% in value added per employee[11]. Considering that the median STW use is 5760 hours and the corresponding firm size is 64 employees, it means that an increase in STW by 576 hours (which means 9 hours more per employee) saves approximately 0.9 jobs. At the same time the median wage decreases by 210 euros and the value added per employee decreases by 153 euros.

We conducted a number of tests to check the robustness of our estimates. The main results are reported in Table A2 in Appendix. First, we estimate our model using only the instrument that influences directly the use of some forms of STW, namely the 15-employees threshold (panel A). Second, to check if our results are driven by changes in firms around the two thresholds, we drop from the estimation sample firms with a maximum of less than 10 employees or a minimum of more than 75 employees in the sample period (panel B). Third, we estimate a richer specification by including firm-level time-varying variables that may be correlated with unobserved firm-specific shocks and with the use of STW[12].

Finally, to check whether our results hold also if, as in most of the literature, we simply measure the extensive margin of STW, we replace in our model the number of STW hours with a dummy equal to one for firms using STW and zero otherwise (panel D). All these robustness checks confirm the IV baseline estimates discussed above. As a further step of the analysis, we test whether these results are driven mainly by those firms that are more likely to benefit the most from an intensive use of STW. In the literature there is evidence that such schemes are more effective when firms have to cope with temporary shock, while they seem to work less well in firms that are structurally less productive (Cahuc et al., 2018). Another important source of heterogeneous effects comes from firms financial wealth, especially in terms of liquidity constraints. Short-time work may be beneficial especially for firms dealing with large revenues shocks and facing liquidity constraints due to severe credit crunch: by engaging in labour hoarding through public subsidies, these

[11]We used also TFP as dependent variable. Estimates are qualitatively similar to those reported for labour productivity and are available upon request.

[12]We control for female share, white collar share, share of temporary workers and growth in total revenues.

firms can overcome their liquidity constraints and recover rapidly once the revenue shock is over (Cahuc et al., 2018). Giupponi and Landais (2018) provide indirect evidence on the fact that liquidity constraints may amplify the employment effects of STW. Finally, in a long-run perspective, if STW allows to save jobs and to prevent productivity losses especially in high-tech firms, this may reflect into higher levels of human capital, innovation and economic growth. To this extent, it is crucial to test whether employment gains caused by STW vary with firm technology.

Table 3 reports IV estimates of the coefficient of the logarithm of STW hours by time span of STW use (panel A), pre-treatment productivity (panel B), liquidity (panel C) and technological intensity (as proxied by the share of employees with a STEM university degree; panel D). Firms are classified into two groups according to their position relative to the median of each variable distribution.

Estimates in panel A shows that positive employment effects are significantly larger in firms that used STW for a relatively short period of time (less than one year; see column 3 in panel A), but they registered also larger losses in labour productivity (column 5). If we consider the time span of STW use as a proxy for shock persistency, our estimates confirm that STW is more effective in saving jobs in firms dealing with less persistent shocks.

Results by pre-treatment productivity reveal that the overall effect on total working hours is roughly the same between the two groups of firms, but it hides quite different effects on hours per employee and total employment: compared to highly productive firms, those starting with relatively low productivity register larger employment effects combined with larger reduction in working hours per employee[13]. This translates into a relatively larger decline in average wages, but similar increase in total wage bill. The estimated effects on productivity is negative for both groups, but they are not precisely estimated and neither of them is statistically significant.

Regarding the role of liquidity constraints, estimates in Panel C show that the overall effect on working hours is larger in firms with more liquidity constraints (column 1), but employment gains are rather similar across the two groups of firms (column 3). Quite interestingly, we find a significant decline in wages only for firms with liquidity constraints (column 4), which reflects into a smaller increase in total wage bill compared to liquid firms. As in our baseline estimates, larger employment gains are associated also register a significant decline in labour productivity (column 5).

Finally, estimates by technological intensity in panel D clearly show that employment

[13]This result is partly coherent with Giupponi and Landais (2018), who also found that low productivity firms tend to reduce hours more than high productivity firms in response to STW treatment. On the contrary, they show that firms that were experiencing high productivity levels before the 2008 recession seem to exhibit a much larger positive effect of STW on employment.

gains are significantly larger in high-tech firms compared to low-tech ones. Such gains are associated to larger decline in hours and wages per employee, but also to a significant decline in labour productivity.

If we focus on employment effects, our results confirm that a more intensive use of STW saves more jobs in firms hit by temporary shocks and high-tech firms, but larger gains are registered also in firms that are structurally less productive. In the latter case, labour hoarding may prevent a more efficient allocation of workers, causing negative effects on aggregate productivity growth in the long run. We do not find significant differences in employment effects by initial liquidity conditions; however, a higher number of STW hours is effective in reducing labour costs especially where it is more needed, that is firms with more binding liquidity constraints.

Notice that our results should be interpreted as short-run effects of STW hours on firm's performance. It may be interesting to test whether such effects are persistent over time. Unfortunately the size of our sample and the longitudinal nature of the data allow to consistently follow the same firms over time for no more than three years. Exploiting this information, in Table A3 in Appendix we estimate the effect of lagged STW hours (at t-1 and t-2) on the same firm outcomes. Our estimates show that both employment gains and productivity loss seem to be temporary effects, which fade away once firms reach the maximum legal length related to the use of STW (i.e., two years). Our results are in line with the temporary employment effects found by Giupponi and Landais (2018) and confirm that STW does not guarantee long-term employment insurance to workers.

5.2 The role of strong unions and firm-level bargaining

Union presence and the climate of industrial relations within the firm are likely to play a key role in influencing the effect of STW intensity on firm performance. This is a crucial aspect in institutional settings, like the Italian one, where such schemes before the Covid pandemic were usually negotiated between the employer and local unions. The latter usually favour the adoption of STW to prevent large employment losses. Descriptive evidence provided in Section 3 actually shows that union density is significantly higher in firms using STW compared to those that never used it and the number of hours of STW per employee increases with union density. Local unions often bargain with the firms also the list of employees that should be eligible for STW; workers selection is officially based on objective criteria, such as workers experience and family status, aimed at minimizing socio-economic inequalities and workers discontent. If this allows to select on average low productive workers, employment gains may be associated to lower productivity losses where unions are present. Furthermore, unions may have other channels to provide employment insurance to their workers beyond the use of STW schemes. For example, strong unions

may favour information sharing, improving work organization and internal flexibility, thus reducing labour turnover and potentially enhancing productivity (Addison, 2005)[14].

In light of these considerations, we investigate whether the main effects of STW intensity on labour adjustment changes with unions strength within the firm. More specifically, we compute the long-run (time invariant) mean of firm union density and split the firms into two groups: firms with weak unions (i.e., with union density below the median) and those with strong unions (i.e, with union density above the median)[15]. We then estimated our FE-IV models separately for these two groups.

Main results are reported in Table 4: Panel A refers to firms with weak unions, while panel B to firms with strong unions. Our estimates point out that a more intensive use of STW is effective in saving jobs in both groups of firms (a 10% increase in STW hours increases total employment by 1.4% in firms with weak unions, compared to 1.2% in firms with strong unions, see column 3), but only in highly unionized firms it is associated with a significant reduction in per-capita working hours (column 2). Furthermore, average wages are roughly unaffected by the use of STW in such firms (see column 4 in Panel B). On the contrary, a more intensive use of STW significantly reduces wages in firm with weak unions (a 10% increase in STW hours significantly reduces wages by 0.7%), thus causing a much lower increase in total wage bill compared to firms with strong unions (columns 4 and 5). Labour productivity costs are in size rather similar between the two groups of firms, but the estimated elasticity is statistically significant only for weakly unionized firms (columns 6). It may be argued that union density is a poor measure of actual union strength or, more in general, that other characteristics of firm-level industrial relations are more relevant in influencing the effect of STW on labour outcomes. For example, if the use of STW is bargained at the firm level, the presence and number of union representatives within the firm pr the presence of a firm-level agreement may be more crucial than workforce union density in determining the design of STW schemes (such as the list of employees involved). Thanks to the richness of our dataset, we replicate a similar analysis using alternative indicators of industrial relations at the firm level, namely: the number of local union representatives, the presence of a firm-level agreement and hours of strike per capita[16].

[14] In the case of the US, Black and Lynch (2004) found that workplace innovation is positively associated with labour productivity especially in unionized establishments. One potential explanation is that workers in unionized workplaces feel that unions will protect their employment security and this makes workers more willing to participate in employee involvement programs and voice.

[15] Differently from accounting data, we do not have pre-treatment information on firm-level union density or other indicators of industrial relations.

[16] Firms are split into two groups using the median value as a threshold in the case of the number of union representatives and hours of strikes. In the case of local bargaining, firms are simply classified as those with a firm-level agreement and those without it.

Our results are rather robust to how unions strength is measured: while employment gains are rather similar (and always statistically significant) across all groups of firms, no significant effects on either wages or labour productivity are found in firms with a relatively high number of local union representatives or with a firm-level agreement. On the contrary, an increase of 10% in STW hours reduces average wages and value added per employee by 0.5-0.6% and almost 4%, respectively, in firms with a low number of local union representatives or without a firm-level agreement. Quite interestingly, estimates by strike intensity reveal positive and significant employment effects in both groups of firms, although the estimated elasticity is as twice as large in firms with lower strike intensity compared to firms with more hours of strike per employee. Furthermore, while wage decline is larger in firms with a lower number of hours of strike, productivity losses are larger in firms with a more intense strike activity. If we consider the number of hours of strike as a proxy of industrial relation climate, our results suggest that a more intensive use of STW saves less jobs, but it preserves wages in firms with more conflictual industrial relations. On the employers side, more hours of strike are associated to larger productivity loss.

5.3 Unionized firms and liquidity constraints

Our analysis points out that STW hours are an effective policy to preserve jobs, especially when firms are hit by temporary shocks, but employment gains come at the cost of lower wages and declining labour productivity, especially in firms where such schemes are more needed, either because of liquidity constraints or because workers are not protected by strong unions. It may be interesting to investigate whether such effects are further amplified in firms combining both weak unions and financial distress. To this end, we combine previous information on firm-level liquidity and union density in order to classify firms into four groups: firms with weak unions and low liquidity, firms with weak unions and high liquidity, firms with strong unions and low liquidity and firms with strong unions and high liquidity.

As in previous estimates, we used the median value of each variable distribution as the reference threshold to put firms into the four clusters. FE-IV estimates for each group are reported in Table 5. Our results point out that STW hours produce the largest (and statistically significant) employment effects where actually it is more needed, that is firms with weak unions and low liquidity: in this firms, a 10% increase in STW hours causes an increase of 1.7% in employment (panel A, column 3). Such effect is not associated to significant changes in per-capita working hours, thus reflecting into the largest change in total hours worked (that is 1.8%, see column 1 in panel A). The same percentage change in STW hours produces a much lower employment effect in firms with strong unions and low liquidity (0.9%, panel C, column 3). However, while in the latter wages are roughly

unaffected, firms with weak unions and low liquidity experience also the largest decline in average wages (-1.5% following a 10% increase in STW hours, see column 4 in panel A). Furthermore, they also register a significant, although small, decline in labour productivity (around 0.5%, comparable to the productivity decline registered by firms with weak unions and high liquidity, see column 6 in panel B). Firms with weak unions and high liquidity are characterized by relatively large employment gains combined with a statistically significant decline in working hours per employee (panel B, columns 3 and 2 respectively); this makes the overall effect on changes in total working hours similar to that registered in firms with strong unions and low liquidity (compare column 1 in panel B and C). The latter actually experience much lower employment gains, but no significant changes in per-capita working hours. [17] Furthermore, once we introduce the role of financial conditions in the picture, the win-win game associated to the presence of strong unions (i.e., employment gains associated to no wage or productivity decline reported in Table 4) is apparently more blurred: the presence of strong unions seems associated to no significant wage changes especially in firms with liquidity constraints (compare column 4 in panels C and D), while no productivity losses are found in firms with high liquidity (compare column 6 in panels C and D). However, all these estimates are not statistically significant and, given the size of corresponding standard errors, it is not possible to draw clear-cut conclusions. Nonetheless, a robust result we can draw from these estimates is that STW is an effective policy to preserve jobs in all firms, but this effect is largest where workers are not protected by strong unions and firms are likely to face more liquidity constraints. A more intensive use of STW hours in this firms is also associated to short-run decline in both average wages and value added per employee.

6 Concluding remarks

In this paper we investigated whether and how firm-level unions and collective bargaining influence the effect of STW hours on employment, working hours, wages and labour productivity. Once we take into account of potential endogeneity of STW hours, our estimates show that a more intensive use of STW is effective in saving jobs by allowing labour adjustment through a significant reduction in working hours per employee. Furthermore, an increase in STW hours is associated to slightly lower wages and lower labour productivity.

Our estimates for the median firm show that, for each employee, wage saving caused by a 10% increase in STW hours (corresponding to roughly 9 hours per employee per year)

[17] Our estimates suggest the existence of large positive employment and negative per-capita working hours effects also in firms where STW schemes are potentially needed the least, that is firms with strong unions and high liquidity; however, these estimates are highly imprecise and never statistically significant.

is 22% larger than the corresponding productivity loss. This implies that STW may be beneficial for firms' profits both in the short and in the long run, assuming that labour hoarding allows firms to potentially retain skills and human capital that could be lost in absence of STW.

When we consider the role of unions, we find larger employment effects in firms with weak unions, which seem those bearing also the largest adjustment costs in terms of lower wages and lower labour productivity, although the gap between wage cut and productivity loss is significantly larger than what we estimated for the whole sample, mainly due to the largest effect of STW hours on wages. On the contrary, the presence of strong unions seems to prevent such negative effects. Hence, a more intensive use of STW may generate a win-win game in highly unionized firms, with workers preserving their jobs and wage levels, and firms experiencing lower productivity losses. Focusing on employment effects, our results confirm that a more intensive use of STW saves more jobs in firms hit by temporary shocks and high-tech firms, but larger gains are registered also in firms that are structurally less productive. In the latter case, labour hoarding may prevent a more efficient allocation of workers, causing negative effects on aggregate productivity growth in the long run. We do not find significant differences in employment effects by initial liquidity conditions, unless we consider also the local unionization rate: firms with weak unions and low liquidity are those registering the largest employment gains. Overall our results point out that STW is an effective policy in saving jobs especially where workers are not protected by other institutions that are likely to operate in the same direction, such as strong union representatives or firm-level collective bargaining. These results may provide useful insights to implement future reforms of STW systems across Europe, given the dramatic increase in STW hours during the COVID crisis and the role played by unions in both designing short-time work schemes with national governments and negotiating them within firms.

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Figure 1: STW schemes in Italy, 2009-2015

	Type of STW scheme:		
	Ordinary STW (CIGO)	**Extraordinary STW (CIGS)**	**Derogatory STW (CIGD)**
Scope	Short temporary product demand decline due to reasons not ascribable to the firm, sich as: aderse weather conditions; shortage of raw materials; natural disasters.	Firm crisis; Firm reorganization or restructuring; Insolvency or bankruptcy judicial procedures.	Not specified.
Target firms	Manufacturing and construction firms; firms in transportation industry.	Manufacturing firms with more than 15 employees. Services firms with more than 50 employees.	All firms in all industries.
Target workers	Permanent employees with at least 3-moth tenure. Temporary workers and managers are excluded.	Permanent employees with at least 3-moth tenure. Temporary workers and managers are excluded.	All workers, including temporary workers.
Benefit	80% of forgone earnings, up to a max threshold.	80% of forgone earnings, up to a max threshold.	80% of forgone earnings.
Max duration	13 continuous weeks, up to 52 weeks in two years.	12 months in case of firm crisis, 24 months in case of firm restructuring. It can be extended up to 36 months in five years in special cases .	Duration is defined by local agreements, but it cannot last more than 36 months in five years.
Financing	Social security contributions (1.9% of taxable earnings in firms with less than 50 employees, 2.2% in larger firms).	Social security contributions (0.9% in all eligible firms). General taxation in case of firm closure or complex industry-level crisis.	General taxation.

Figure 2: Authorized STW hours by type, 2009-2016

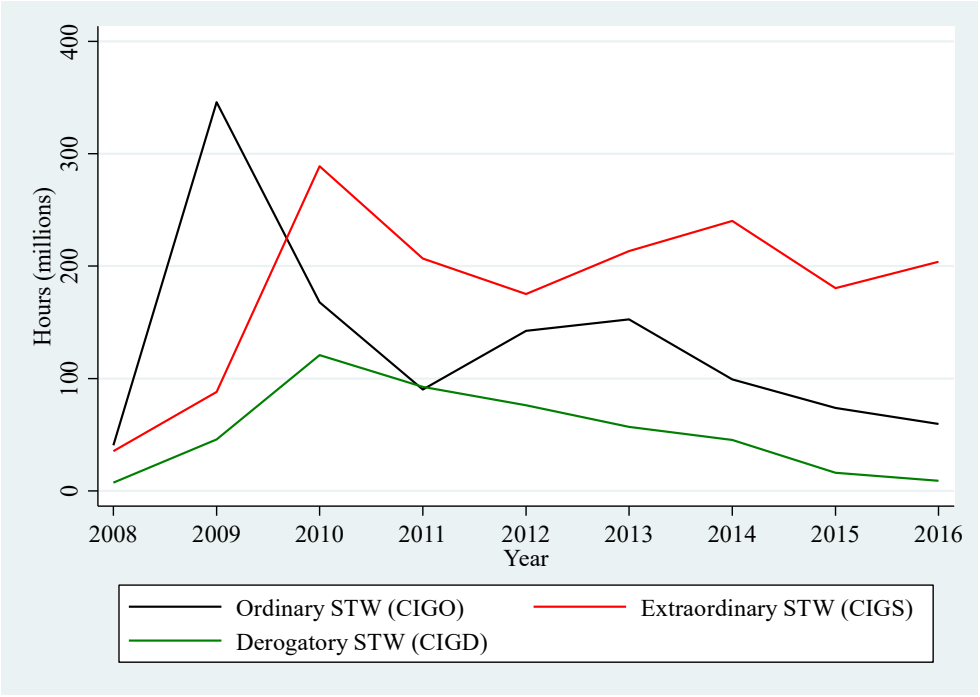
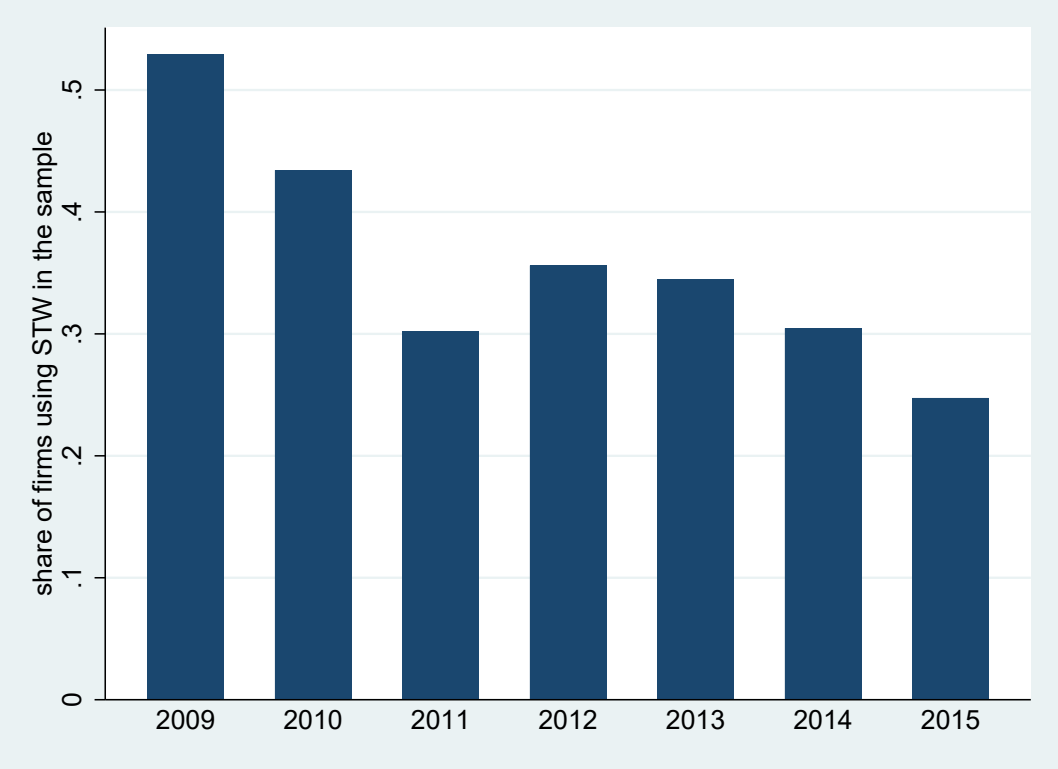


Table 1: Summary statistics

	STW users mean	Never users mean	Difference
Dependent variables			
Total hours worked - net of STW (th)	168.613	138.639	-29.974***
Hours per employee - net of STW	1,568.684	1,671.395	102.711***
Total employment	107.039	82.604	-24.435***
Value added per employee (th€)	61.510	75.093	13.583***
Average wage (th€)	49.805	51.702	1.897**
Controls			
total factor productivity	1.182	1.307	0.125***
liquidity index	1.385	1.523	0.139***
share STEM employees	0.044	0.088	0.044***
total revenues (M€)	27.939	25.707	-2.232
white collar share	0.366	0.437	0.071***
female share	0.218	0.213	-0.005
temporary workers share	0.039	0.064	0.025***
Industrial relations			
unionized firm	0.728	0.598	-0.130***
union density	23.959	15.127	-8.833***
firm-level contract	0.559	0.468	-0.091***
firm-specific union	0.595	0.407	-0.188***
strikes in the firm	0.580	0.371	-0.209***
Observations	3857	2577	6434

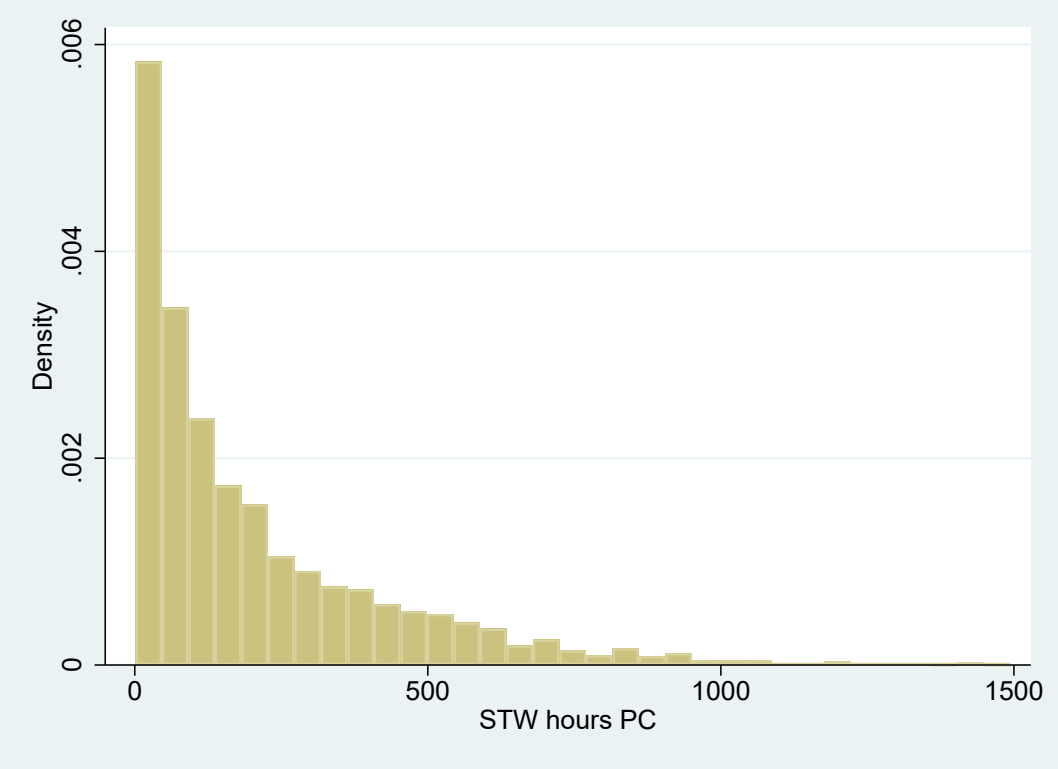
Note: all differences are statistically significant at 1% except for total revenues, share of female employees and the average wage (significant at 5%).

Figure 3: Share of firms using STW in the sample by year



Note.

Figure 4: STW hours per worker



Note.

Figure 5: plot union density - STW

Note.

Table 2: Baseline effects – OLS and IV

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A. OLS						
log(Hours)	-0.015***	-0.016***	0.001	-0.006***	-0.005***	-0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.979	0.609	0.986	0.859	0.990	0.800
Obs.	5458	5458	5458	5458	5458	5458
Panel B. IV						
log(Hours)	0.117***	-0.020*	0.138***	-0.055**	0.082***	-0.034**
	(0.032)	(0.011)	(0.030)	(0.025)	(0.023)	(0.014)
Hansen J statistic	0.73	0.73	0.73	0.73	0.73	0.73
Kleibergen-Paap F statistic	17.40	17.40	17.40	17.40	17.40	17.40
Obs.	5458	5458	5458	5458	5458	5458
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker, total wage bill and value added per worker. The final sample size decreases from 6433 to 5458 observations (1583 firms) because 975 singleton observation have been dropped.

Table 3: Heterogeneity

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A1. Max 1 year STW						
log(Hours)	0.190***	-0.020*	0.210***	-0.086*	0.123**	-0.046**
	(0.068)	(0.012)	(0.066)	(0.052)	(0.051)	(0.023)
Obs.	3200	3200	3200	3200	3200	3200
Panel A2. More than 1 year STW						
log(Hours)	0.068	-0.034*	0.102***	-0.045	0.057**	-0.018
	(0.042)	(0.018)	(0.038)	(0.029)	(0.029)	(0.022)
Obs.	2195	2195	2195	2195	2195	2195
Panel B1. Low TFP						
log(Hours)	0.115*	-0.059***	0.174**	-0.101**	0.073*	-0.034
	(0.070)	(0.021)	(0.071)	(0.048)	(0.044)	(0.032)
Obs.	2712	2712	2712	2712	2712	2712
Panel B2. High TFP						
log(Hours)	0.100***	-0.006	0.106***	-0.042*	0.064***	-0.023
	(0.032)	(0.011)	(0.028)	(0.025)	(0.020)	(0.015)
Obs.	2493	2493	2493	2493	2493	2493
Panel C1. Low Liquidity						
log(Hours)	0.147***	0.005	0.143***	-0.095**	0.048**	-0.046**
	(0.054)	(0.016)	(0.049)	(0.046)	(0.023)	(0.022)
Obs.	2586	2586	2586	2586	2586	2586
Panel C2. High Liquidity						
log(Hours)	0.081*	-0.056***	0.137***	-0.024	0.114**	-0.018
	(0.042)	(0.017)	(0.045)	(0.018)	(0.047)	(0.025)
Obs.	2621	2621	2621	2621	2621	2621
Panel D1. High tech firms						
log(Hours)	0.095***	-0.031***	0.126***	-0.054*	0.072***	-0.036**
	(0.031)	(0.009)	(0.032)	(0.028)	(0.027)	(0.017)
Obs.	2723	2723	2723	2723	2723	2723
Panel D2. Low tech firms						
log(Hours)	0.051**	-0.017	0.068***	-0.023	0.045**	-0.010
	(0.026)	(0.013)	(0.024)	(0.020)	(0.022)	(0.016)
Obs.	2664	2664	2664	2664	2664	2664
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker and value added per worker. In panels A1 and A2 we present the estimates for firms using STW for at most 1 year and more than 1 year respectively. In panels B1 and B2 results for firms below and above the median of the Total Factor Productivity distribution are displayed. Panels C1 and C2 show the results for firms below and above the median of the share of employees with a STEM university degree - used as a proxy of the technological intensity of a firm. Finally, panels D1 and D2 report estimates for firms with a liquidity index below and above the median respectively.

Table 4: IV - heterogeneity by union strength

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A. Weak union						
log(Hours)	0.126***	-0.018	0.144***	-0.070**	0.074***	-0.039***
	(0.043)	(0.013)	(0.040)	(0.035)	(0.027)	(0.015)
Obs.	2584	2584	2584	2584	2584	2584
Panel B. Strong union						
log(Hours)	0.072	-0.046**	0.117**	-0.006	0.111*	-0.031
	(0.048)	(0.023)	(0.052)	(0.022)	(0.060)	(0.037)
Obs.	2703	2703	2703	2703	2703	2703
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker, total wage bill and value added per worker. In panel A and B estimates are presented for firms below and above the median of a time-invariant measure of union membership among workers respectively.

Table 5: IV - union-liquidity interactions

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A. Weak union and low liquidity						
log(Hours)	0.181**	0.009	0.172**	-0.148*	0.024	-0.046*
	(0.092)	(0.027)	(0.082)	(0.080)	(0.025)	(0.027)
Obs.	1209	1209	1209	1209	1209	1209
Panel B. Weak union and high liquidity						
log(Hours)	0.087*	-0.044***	0.131***	-0.019	0.111**	-0.045*
	(0.050)	(0.014)	(0.050)	(0.018)	(0.051)	(0.027)
Obs.	1231	1231	1231	1231	1231	1231
Panel C. Strong union and low liquidity						
log(Hours)	0.089*	-0.003	0.092**	0.003	0.095*	-0.065
	(0.049)	(0.014)	(0.044)	(0.022)	(0.051)	(0.044)
Obs.	1277	1277	1277	1277	1277	1277
Panel D. Strong union and high liquidity						
log(Hours)	0.037	-0.125	0.162	-0.023	0.139	0.010
	(0.103)	(0.100)	(0.160)	(0.037)	(0.173)	(0.096)
Obs.	1284	1284	1284	1284	1284	1284
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker and value added per worker. In the panels above we present the estimates for sample splits of the union and liquidity variables above and below the median.

Appendix

A Additional results

Table A1: Summary statistics by union strength

	Weak unions mean	Strong unions mean	Difference
Total hours worked - net of STW (th)	111.742	206.948	95.207***
Hours per employee - net of STW	1,620.354	1,600.550	-19.803***
Total employment	68.491	129.429	60.937***
% change employment	0.018	-0.008	-0.026***
Value added per employee (th€)	67.913	66.558	-1.355
Average wage (th€)	49.141	52.456	3.315***
total factor productivity	1.269	1.192	-0.077***
liquidity index	1.502	1.383	-0.119***
share STEM employees	0.076	0.047	-0.029***
total revenues (M€)	18.266	36.668	18.402***
white collar share	0.440	0.347	-0.093***
female share	0.233	0.197	-0.036***
temporary workers share	0.064	0.034	-0.030***
STW user	0.273	0.467	0.194***
STW hours PC	51.422	105.645	54.223***
union density	5.250	35.775	30.525***
firm-level contract	0.339	0.730	0.391***
firm-specific union	0.218	0.832	0.614***
strikes in the firm	0.282	0.736	0.454***
Observations	3026	3034	6060

Note: all differences are statistically significant at 1% except for value added per employee.

Table A2: Robustness

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A. Only 15 threshold						
log(Hours)	0.124***	-0.023*	0.147***	-0.058*	0.088***	-0.035**
	(0.039)	(0.014)	(0.035)	(0.030)	(0.028)	(0.015)
Obs.	5458	5458	5458	5458	5458	5458
Panel B. Close to thresholds						
log(Hours)	0.139***	-0.018	0.157***	-0.078***	0.079***	-0.034**
	(0.038)	(0.012)	(0.035)	(0.029)	(0.024)	(0.014)
Obs.	3244	3244	3244	3244	3244	3244
Panel C. Time-varying controls						
log(Hours)	0.122***	-0.023*	0.145***	-0.051**	0.094***	-0.047***
	(0.036)	(0.013)	(0.034)	(0.025)	(0.029)	(0.016)
Obs.	4283	4283	4283	4283	4283	4283
Panel D. STW dummy						
STW user	1.083***	-0.191*	1.274***	-0.511**	0.764***	-0.316**
	(0.308)	(0.109)	(0.304)	(0.241)	(0.223)	(0.135)
Obs.	5458	5458	5458	5458	5458	5458
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker and value added per worker. In panel A we present estimates using as a single instrument a dummy for being above the 15 employees threshold. Panel B presents estimates excluding firms far from the threshold (that is with a maximum number of employees in the period below 10 or a minimum number above 75). In panels C we add time-varying controls for female share, white collar share, share of temporary workers and growth in total revenues. Finally, in D we use a dummy for STW use instead of the intensity measure.

Table A3: Dynamic effects

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A1. Effect STW t-1						
log(Hours)	0.053**	0.013	0.040**	-0.018	0.023	-0.055**
	(0.026)	(0.022)	(0.019)	(0.014)	(0.017)	(0.022)
Obs.	2407	2407	2407	2407	2407	2407
Panel A2. Effect STW t-2						
log(Hours)	-0.007	-0.008	0.000	-0.014	-0.013	0.013
	(0.058)	(0.049)	(0.014)	(0.020)	(0.026)	(0.033)
Obs.	1217	1217	1217	1217	1217	1217
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker and value added per worker. In panels A1 and A2 we present estimates for STW intensity of use in t-1 and t-2.

Table A4: IV - other measures of IR

	(1) Total hours worked	(2) Hours worked per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per employee
Panel A1. Weak firm-level union						
log(Hours)	0.096***	-0.017*	0.113***	-0.050**	0.063***	-0.038***
	(0.031)	(0.010)	(0.028)	(0.025)	(0.021)	(0.014)
Obs.	2585	2585	2585	2585	2585	2585
Panel A2. Strong firm-level union						
log(Hours)	0.078*	-0.029*	0.107**	-0.024	0.082*	-0.004
	(0.043)	(0.017)	(0.051)	(0.020)	(0.047)	(0.040)
Obs.	2777	2777	2777	2777	2777	2777
Panel B1. Firm-level contract - no						
log(Hours)	0.109***	-0.013	0.122***	-0.062**	0.061***	-0.037**
	(0.033)	(0.011)	(0.029)	(0.025)	(0.021)	(0.014)
Obs.	2380	2380	2380	2380	2380	2380
Panel B2. Firm-level contract - yes						
log(Hours)	0.118*	-0.037	0.155**	-0.015	0.140**	0.010
	(0.064)	(0.024)	(0.070)	(0.029)	(0.070)	(0.047)
Obs.	2991	2991	2991	2991	2991	2991
Panel C1. Low Strike						
log(Hours)	0.127***	-0.005	0.132***	-0.075**	0.057**	-0.032*
	(0.042)	(0.014)	(0.037)	(0.033)	(0.024)	(0.018)
Obs.	2493	2493	2493	2493	2493	2493
Panel C2. High Strike						
log(Hours)	0.067**	-0.043***	0.110***	-0.013	0.097***	-0.050***
	(0.031)	(0.013)	(0.036)	(0.017)	(0.037)	(0.019)
Obs.	2907	2907	2907	2907	2907	2907
control variables:						
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: hours worked net of STW (estimated annual hours worked minus hours of authorized STW), hours per worker net of STW (variable in column (1) divided by the number of workers), total number of workers, wage bill per worker and value added per worker. In panel A1 and A2 we present estimates for firms with above and below the median levels of firm-specific (local) union membership, respectively. In panels B1 and B2 we present sample splits by the presence (or absence) of firm-level bargaining on the workers' contracts. Finally, in panels C1 and C2 we show estimates split by hours of strike below or above the median.