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ABSTRACT

Short-Time Work and Unionization*

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, yet very little is known about the role of unions. In this paper, we investigate the effects of STW schemes on a number of firms' economic outcomes, considering the role of unions and collective bargaining. We use firm-level panel data, for the metal--engineering industry (from 2009 to 2015), with information on firms characteristics, STW use, industrial relations attributes, merged with accounting data. We estimate the elasticity of employment, working hours, wages and labour productivity to STW hours using an IV-FE estimator. We find that STW is an effective policy to preserve jobs in all firms. The positive effect on employment is supported by quite different mechanisms, which depend on unions presence and power in the firm. In low unionized firms wage cuts are the prevailing adjustment mechanisms, while in highly unionized firms, per-capita wages are insensitive to STW and adjustment mainly occurs through a reduction in working hours. These results are coherent with the use of STW as a work sharing device to protect incumbent workers who are mainly union members.

JEL Classification: J08, J38, J58

Keywords: short-time work, employment, wages, labour productivity, unions

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1. Introduction

The Great Recession, and more recently the Covid-19 pandemic, exposed most firms to unprecedented large and persistent product demand shocks. Firms reacted to these shocks using different margins to adjust production costs to changing output. For example, focusing on labour costs, firms reacted by adjusting wages or working hours. In this respect, short-time work (STW) schemes have been one of the most used policies in many OECD countries, especially in Europe, to reduce working hours, subsidize workers' earnings while preserving their jobs. These schemes are defined as public programmes that allow firms experiencing economic difficulties to temporarily reduce the hours worked while providing their employees with income support from the State for the hours not worked (European Commission, 2020). As a matter of fact, STW schemes have been used more extensively in those contexts where the costs to adjust either employment or wages are higher, due to a more rigid institutional setting (such as strict employment protection legislation or widespread collective agreements). Limitations to the ability of firms to lay-off workers implemented in some countries during the COVID pandemic further increased the use of STW. Only in 2020, in OECD countries at some point in time, over 50 million jobs were supported by STW schemes. At the peak of the first wave of the pandemic in the second quarter of 2020, more than one third of employees were on such schemes in countries, such as France, Italy, Germany and the UK (these are, *Furlough* scheme in the UK, *Kurzabeit* in Germany, *Activite' partielle* in France, and *Cassa Integrazione Guadagni* in Italy). While STW schemes are usually appealing for both employers and workers, since they help firms to reduce hours of work while preserving worker's job and earnings, their effect on employment levels and other indicators of firm's performance is more controversial (Cahuc, 2019). Also, unions play a central role in the actual implementation of these schemes at the firm level, still little is known about the effects that the presence of unions at the workplace and their bargaining power may have on firms' overall performance. In this paper, we study the effects of STW on a number of outcomes using firm-level panel data for the metal engineering industry in Italy, from 2009 to 2015. In particular, we focus on the role of firm-level unionization and collective bargaining in the

utilization of STW hours and on the elasticity of STW to employment and other labour market outcomes.

The role of unions on firms' performance is widely debated in the economic literature (Freeman and Medoff, 1984; Booth, 2002). Traditional models of trade unions behaviour focus on the objective of maximizing union's member utility, which depends on their employment and wages, thus protecting incumbent workers on permanent contracts (*insiders*), at the expense of workers on fixed-term contracts and the unemployed (*outsiders*). In this perspective, unions are likely to resist real wage cuts and support working hours reduction instead, to preserve employment levels. This is more likely where STW schemes are generously subsidized by the State. In some countries, local unions also play a crucial role in the actual implementation of STW at the workplace. In Italy, for example, STW schemes are negotiated between the employer and union representatives in the firm. The negotiations also involve selecting employees who are eligible for STW, using as criteria tenure and family status, with the aim of protecting both the value of the job match (i.e. tenure is likely to be correlated with employees productivity) and household well-being.[1] Finally, unions 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; Devicienti et al., 2018). In the empirical analysis, we estimate the elasticity of total employment, working hours, wages and labour productivity to changes in STW hours comparing unionized and non-unionized firms, as well as those covered by firm-level collective bargaining. Since the adoption of STW schemes is unlikely to be randomly distributed across firms, to account for the endogeneity driven by firms self-selection into STW schemes and other confounding factors that influence both STW hours and firm performance, we rely on an Instrumental Variables Fixed-Effects estimator. We build our instruments

[1] For example, if a LIFO (*Last In First Out*) rule is applied in STW, workers with shorter tenure – who are on average less productive than experienced workers – are more likely to be laid-off, while those with longer tenure are retained. In this context, STW can cause lower productivity losses where unions are present. Furthermore, since public subsidies associated to the use of STW cover 80 percent of workers' earnings, local unions often negotiate with the employer a lower wage reduction.

leveraging on specific institutional features of STW schemes and Employment Protection Legislation (EPL). More specifically, we exploit exogenous changes in firing costs that firms experience around specific size thresholds (defined in terms of number of employees) set by the law, which change the relative cost of employment *versus* hours adjustment through STW schemes. Our findings contribute to the existing literature on STW in a number of ways. First, we provide new evidence on the elasticity of various firm-level outcomes to STW hours. Second, we uncover the role of unions as a mechanism to explain the heterogeneous effects of STW on firm performance. Third, we delve deeper into the interaction between unions and firm's financial conditions in mediating the effects of STW at the firm level. Most of the existing studies which have investigated the effect of STW focus on labour market outcomes, typically exploit cross-country differences before and during the Great Recession and find positive effects of STW on employment (among others Boeri and Bruecker (2011); Cahuc and Carcillo (2011); Hijzen and Venn (2011); Abraham and Houseman (2014)). In some countries, however, the inefficient design of STW led to a sizable deadweight loss (Boeri and Bruecker, 2011). For example, Hijzen and Venn (2011) suggest that the positive impact of STW is limited to workers with permanent contracts, underlining the risk of increasing labor market segmentation between workers in regular jobs and those on temporary and part-time contracts. A more recent strand of literature based on microdata at the worker or firm-level finds more heterogeneous results, also due to differences in identification strategies and country-specific institutional features. Interestingly, even studies based on the same country, but using different methods or covering different regions, find quite different results. For example, in the case of Germany, Tilly and Niedermayer (2016) merge different data sources on workers in the Nuremberg metropolitan area and find that STW significantly increases employment, while Kruppe and Scholz (2014) estimate dynamic propensity score models using IAB survey data merged with administrative data on STW and find no statistically significant effects on employment. A few recent papers use high quality administrative data for different European countries and exploit eligibility rules related to STW implementation. Using Difference-in-Differences (Kopp and Siegenthaler, 2021) or IV approaches (Giupponi and Landais, 2020; Cahuc

et al., 2021), most of these studies find positive short-run effects of STW on employment but not long-run effects, thus implying that STW may simply delay dismissals. In the case of Switzerland, Kopp and Siegenthaler (2021) conclude that the effects of STW on employment are more persistent. In one study for Italy, Giupponi and Landais (2020) show that the positive effect of STW on employment disappears once the scheme has expired. This result seems to be driven by low-productivity firms being hit by a persistent shock. In other words, while preserving jobs in low productivity firms may cause negative effects on firms performance and delay workers' reallocation, such effects are found to be rather limited. Cahuc et al. (2021) point out that the magnitude of the shock helps to explain part of the heterogeneous effects of STW on employment and hours. Their estimates show that in France STW significantly increases both employment and hours, but mainly in firms hit by large negative shocks, while no significant employment effects are found in firms hit by relatively smaller shocks, even though they registered lower working hours for workers under the STW scheme. These estimates point to large deadweight losses in firms hit by mild shocks, since they use STW to reduce hours of work for employees that are not at risk of being laid off. On the whole, these estimates point out that STW is an effective policy to preserve jobs, but the overall effect may be temporary or quite heterogeneous across different types of firms. Very few studies have investigated the effects of STW on firm outcomes beyond employment and hours of work. Other than Giupponi and Landais (2020), one recent example is Kato and Kodama (2019), who study the effect of STW on firm's profitability estimating Propensity Score Matching with Difference-in-Differences models using panel data for a sample of Japanese firms from 2008 to 2014. They show that STW significantly increases a firm's profitability (as measured by ROA), at least a few years after the implementation of STW and due to higher sales growth, without significant effects on labour costs.

Our main finding shows that STW hours have a positive short-term effect on employment, and a small negative impact on both productivity (measured by added value per employee) and wages. Estimates for the median firm suggest that wage cuts more than compensate productivity losses: the reduction in average labour costs, caused by a 10% increase in STW hours (corresponding to roughly

9 hours per employee per year) is 22% larger than the corresponding productivity losses. Hence, labour hoarding induced by STW may be beneficial to firms' profits both in the short and in the long run. One channel we discuss could be that labour hoarding allows firms to retain skills and human capital that would be otherwise lost. We also find that STW determines larger employment gains in firms that are (structurally) less productive, yet we are unable to assess whether labour hoarding associated with STW, in these firms, prevents a more efficient reallocation of workers to more productive firms. When we consider the role of firm-level unions, we find that the estimated elasticity of employment to total STW hours is larger in low unionized firms compared to highly unionized ones. The positive effect on employment is supported by quite different mechanisms in the two groups of firms: lower wages in low unionized firms, lower working hours per employee in highly unionized ones. In the latter, per-capita wages appear to be rather insensitive to STW hours. These results are coherent with strong unions pushing for the use of STW as a work sharing device to protect incumbent workers, who are mainly union members (the so-called "insiders effect"; Saint-Paul (1996)). Our estimates are robust to alternative definitions of unions presence and additional indicators of industrial relations at the workplace. Finally, we investigate the heterogeneous effects associated with firms' liquidity constraints. This is a relevant issue, which is widely discussed in the literature: by engaging in labour hoarding through public subsidies, firms with low liquidity may effectively cope with temporary shocks and recover rapidly once the shock is over. Giupponi and Landais (2020) show that firms that are liquidity constrained are more likely to use STW and to experience larger employment gains. Quite interestingly, we do not find statistically significant differences in employment effects by firm's liquidity, except when we interact it with union density: the combination of weak unions and liquidity constraints deliver the largest employment gains. Overall, our results show that STW is an effective policy in preserving jobs especially where workers are not protected by other institutions that are likely to operate in the same direction, such as strong unions.

2. The institutional setting: Short time work in Italy

Short-time work (STW) schemes have a long tradition in Italy (they were set up in the post- war recovery period) and were extensively used to stabilize employment and income during most economic recessions that occurred over the last decades. Given the strict employment protection legislation (EPL) for permanent workers in Italy, their main aim was to avoid costly lay-offs in case of temporary product demand shocks. STW benefits have been traditionally much more generous compared with ordinary unemployment insurance schemes, which contributed to their extensive use 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 (L. n. 92/2012) and more substantially with the 2015 Jobs Act (L. n. 183/2014), 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 of our empirical analysis (2009-2015), STW has been structured in three main schemes, known as *Cassa Integrazione Guadagni* (CIG): (i) Ordinary CIG (Cassa integrazione guadagni ordinaria, CIGO), (ii) Extraordinary CIG (Cassa integrazione guadagni straordinaria, CIGS) and (iii) Derogatory CIG (Cassa Integrazione Guadagni in Deroga, CIGD). Table 1 summarizes the main features of these three schemes. The three schemes differ mainly in terms of scope and target firms: CIGO is used in case of product demand declines in manufacturing and construction companies due to temporary (exogenous) shocks, such as adverse weather or business conditions, CIGS is used in case of business crisis or restructuring by manufacturing companies with more than 15 employees (or more than 50 employees in the service sector).[2] CIGD was introduced in 2009 to cover firms and

[2] Eligible firms can apply for CIGS once CIGO has expired. Since 2015, eligible firms can also use both schemes simultaneously, but for different workers.

workers (such as small firms and temporary workers or apprentices) which previously were not eligible. In practice all firms, workers and industries, between 2009 and 2015, became eligible under the new STW scheme. Furthermore, this scheme could be used also by firms eligible for the previous two schemes once they exhausted all the corresponding benefits. In particular, while both CIGO and CIGS are partly financed by social security contributions paid by the employers, the new STW scheme is fully financed by general taxation.[3]

[[Table 1 near here]]

Another important feature of the Italian STW schemes is that only CIGS is highly selective in terms of eligibility criteria by both industry and firm size. This component of the STW scheme has been actually the most used over the Great Recession, especially in the manufacturing sector and during the double-dip caused by the 2011 sovereign debt crisis. Figure 1 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, CIGS has been the most used scheme in this industry, registering a relatively large increase especially since 2012.[4]

[[Figure 1 near here]]

Another relevant institutional aspect concerns the relationship between STW utilization and Employment Protection Legislation (EPL), whose strictness differs by firm size thus affecting the relative cost of adjusting hours relative to employment.[5] For example, in case of unfair dismissals, single plants with more than 15 employees or multiplant firms with more than 60 employees (even with less than 15 employees in each plant) were required to reinstate dismissed workers and to reimburse forgone earnings for the period in which the worker was unfairly dismissed. These firing

[3] Notice that, up until 2015, employers contributions were rather low and without an experience-rating component. This was changed after 2015 when an experience-rating component was introduced in the scheme financing.

[4] This is not true for the entire economy, where CIGD turned out to be the main scheme used by many firms not eligible for the other two STW schemes in private services, especially in the trade sector.

[5] Evidence from the literature shows that STW schemes are more diffused in countries with stricter EPL – such as Belgium, Germany and Italy (Cahuc and Carcillo, 2011) – and working hours reduction are more often used to adjust labour input to demand shocks (Cahuc, 2019).

costs could be relevant due to the slowness of the judicial system and the uncertainty on the final decision.[6]

While the 15-employee threshold is the one used also to define eligibility for CIGS in the manufacturing industry, the 60-employee threshold applies only in case of unfair dismissals. In any case, firms crossing one of the two thresholds experience a significant (exogenous) increase in firing costs. We shall exploit these institutional features to control for potential endogeneity of STW hours in our empirical strategy.

3. Data

Data sources 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 sample of metal engineering firms in Italy. The survey is administered by Federmeccanica (i.e. the main national employers association in the industry) and records information on: employment levels (also by skill, gender, education and type of contract); working hours and absenteeism; wage levels and composition (by skill and job titles); collective bargaining and other industrial relations features. This survey has been run every year since the late eighties, however due to a change in the firm identifier in our analysis we could only use data from 2009. More than 1,500 firms employing over 225,000 workers are surveyed each year, corresponding to almost one fifth of total employment in the industry. Overall over 5,000 firms were surveyed at least once in the time period considered, while three quarters appear in more than one wave. Hence, we have an unbalanced panel with 7 waves, covering the 2009 - 2015 period. We also merged survey

[6] 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., 2021). For larger firms the costs of unfair dismissals were much higher, ranging from 36 to 160 months for a blue-collar worker with 8 years of tenure (Gianfreda and Vallanti, 2017). 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.

data with balance sheet information drawn from the AIDA dataset[7] using the unique firm identifier (VAT number). We successfully merged information for 3,392 firms, corresponding to around 68% of the firms in the initial sample. After dropping observations with missing or negative values, our working sample consists of 2,558 firms, for a total of 6,433 firm-year observations.

Main variables and descriptive statistics

In this section, we define the main variables we use in the empirical analysis to estimate the effect of STW utilization on employment levels and firm performance. We use detailed information on working hours, including total hours of STW by skill (blue and white collars), to classify firms into two groups: STW users and other firms. In Figure 2 we plot the share of firms in our sample making use of STW at any point in time. A clear cyclical pattern 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 double-dip.

[[Figure 2 near here]]

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 defined along the 'intensive' (per-capita hours) and 'extensive' margins of employment. Furthermore, we consider additional measures for the firm's performance in terms of total labour costs and labour productivity (measured as value added per-capita). Table 2 reports the main firm characteristics by STW use. Figures in the table show that firms using STW are larger (107 employees, compared to 82.6), compared to those never using STW, have a lower share of white-collar and workers on temporary contracts, while the share of women employed is similar in the two groups. Other indicators of firm performance, show that STW users

[7] The Analisi Informatizzata delle Aziende Italiane is a computerized analysis of Italian firms, distributed by Bureau van Dijk, with the financial statements of all Italian companies, with the exception of banks, insurance companies and public bodies).

are less productive (as measured by value added per worker and TFP[8]) and less profitable (as shown by the much lower ROE). Financial indicators confirm the overall weaknesses of STW users, which are characterized by higher levels of debt (financial leverage, debt over total revenues), and less liquidity compared to the other firms. The two groups of firms differ also in terms of industrial relations patterns, with STW users having higher unionization rates, union representatives in the firm, as well as more likely to have a firm- level collective agreement. Finally, the higher share of firms reporting (per-capita) hours lost for strikes, among STW users, seem to suggest a more conflictual industrial relations climate compared to non-STW users.

[[Table 2 near here]]

Going beyond a simple dichotomization of firms on the basis of STW utilization, we compute the number of (per-capita) STW hours as a measure of STW intensity. Figure 3 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 employee, while the median value is 123.1. The above figures suggest that most firms are not heavy users of STW schemes.

[[Figure 3 near here]]

Figure 4 plots the relationship between union density - measured by the share of workers which are members of a union - and STW hours per employee 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.

[[Figure 4 near here]]

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

[8] TFP is computed using the Ackerberg, Caves and Frazer method in Ackerberg et al. (2015).

reflect the fact that weak unions firms are on average smaller and with better profitability indicators. As expected, firms with weak unions also pay lower wages.[9]

4. Empirical strategy

Our empirical strategy exploits the longitudinal nature of the data and relies on a fixed-effects estimator. Our baseline specification is as follows:

$$Y_{ijt} = \alpha_0 + \alpha_1 STW_{it} + \mu_i + \mu_{jt} + \epsilon_{ijt} \qquad (1)$$

where i, j and t are firm, industry and year subscripts, respectively. Y_{ijt} is the logarithm of an indicator of firm performance, STW_{it} – the variable of interest – is the logarithm of the number of hours of STW used by a firm in a given year, μ_i are firm fixed effects and μ_{jt} are industry-specific time fixed effects, ϵ_{ijt} is the error term. We selected six indicators of firm performance as outcome variables of interest: total hours worked (net of STW), hours per worker (net of STW), total number of employees, average wage, total wage bill and labour productivity (measured by value added per worker).[10] In our model specification, α_1 measures the elasticity of each outcome variable to STW hours. We always include firm fixed effects to control for time-invariant unobservable characteristics that can influence both STW hours and performance at the firm level, and industry-specific time fixed effects[11] to control for

[9] To support statistical representativeness of our final sample, in Table A2 we provide summary statistics for the original survey sample (which consists of over 10 thousands firm-year observations), for the sample successfully merged with balance sheet data (7258 observations) and for the final sample. Firms in the final sample are smaller due to our sample selection criteria: in line with the literature exploiting thresholds for identification, we dropped firms very far from the two thresholds (that is, firms with less than 5 employees or with more than 500 employees over the period considered). When we look at variables that do not depend directly on size, the differences between firms in the original sample and in the final sample are relatively small and mostly statistically insignificant. The two groups are almost identical in terms of value added per employee, employment composition, STW use and unionization.

[10] Results using TFP as an alternative measure of productivity, not reported here but available upon request, are qualitatively the same.

[11] We use the 2-digit industry classification.

sector-specific shocks. However, since firm-specific shocks that simultaneously affect firm performance and firm's choice of STW utilization are not controlled for, our baseline equation may suffer from an omitted variable bias. Also, changes in some outcome variables, such as employment or productivity, can feed back on the firm's choice of STW, thus causing a reverse causality problem in our estimates. To account for these endogeneity issues, we rely on a Instrumental Variables Fixed-Effects (IV-FE) estimator. As instruments for STW utilization, we exploit exogenous variation in firing costs caused by the regulation of both Extraordinary CIG (CIGS) and Employment Protection Legislation (EPL). As previously discussed, firms with 15 or more employees are subject to a much stricter EPL regime with respect to smaller firms (Cingano et al., 2016) and are also eligible for CIGS.[12] Hence, firms moving from below to above the 15-employees threshold are likely to experience a large increase in firing costs, while also becoming eligible for CIGS. Both features are likely to increase the cost of adjusting employment relative to working hours, thus increasing unambiguously the incentives to use STW hours.[13] To exploit this change of regime, we define our first instrument as a binary variable, equal to 1 when the firm has 15 or more employees, and 0 otherwise. An additional source of (exogenous) variation in firing costs, for large firms (above 15 employees), is associated with EPL regulation which, in the case of a multiplant firm with at least 60 employees, applies to all units independently of the size of each single plant. Hence, a multiplant firm, whose plants employ less than 15 employees, moving from below to above the overall 60-employee threshold experiences a significant increase in firing costs, with a comparable increase in the relative cost of adjusting employment compared to working hours. We exploit this regime change in EPL regulations, to construct our second instrument as a dummy variable equal to one for multiplant firms with more than 60 employees, and 0 otherwise.[14] Given the firm fixed effects

[12] For a detailed description, see the previous Section on the institutional context.

[13] We do find that firms above the threshold use STW more than smaller firms. The firms with size between 6 and 15 employees in t-1 used STW for 62.4 hours on average, while firms with 16 to 25 employees used STW for 85.5 hours.

[14] Notice that, in this case, there is no change in the rules to apply for extraordinary CIG. Hence, we expect that the changes in the relative cost of adjusting working hours compared to employment will be larger with the first instrument than with the second one.

specification, identification relies on firms crossing one of the two firm size thresholds over time. In our data, we observe around 8% of the firms moving around any of the two thresholds over the period considered.[15] To test the robustness of our IV estimates to the instrument used, we re-estimate the empirical model using one instrument at a time, or restricting the sample to those firms with employment levels around the two thresholds.

5. Results

Baseline estimates

Table 3 reports the main Fixed Effects (FE) estimates of a change in the number of STW hours on different measures of labour inputs (total working hours net of STW in column 1, per-capita hours net of STW in column 2 and total employment in column 3), wages (average annual wage in column 4 and total wage bill in column 5) 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-FE estimates based on the identification strategy discussed in the previous Section in panel B.

[[Table 3 near here]]

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. When we move to IV-FE estimates, results from the first stage show that our instruments significantly influence STW hours in the expected direction: moving above one of the two size thresholds increases the number of STW hours. As expected, the change in STW hours caused by the first instrument (i.e.,

[15] More specifically, 62 firms move from below to above the 15 threshold and 68 firms go in the opposite direction. In the same period, 24 multiplant firms moved from below to above the 60 employees threshold and 16 went the other way.

moving from below to above the 15-employee threshold) is larger than the change caused by the second instrument (i.e., moving from below to above the 60-employee threshold in the case of multiplant firms). Furthermore, the F test is above 17, confirming the relevance of our instruments (see Table A3 in Appendix). IV-FE estimates confirm the positive and statistically significant effect on total working hours: a 10% increase in the number of hours of STW causes a 1.2% increase in total working hours. Differently from OLS estimates, such an 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 increases total employment by 1.4%, while it reduces working hours by 0.2%. Hence, our IV estimates highlight that STW, by reducing the intensive margin of labour input, is effective in preserving employment. Estimates by type of contract, reported in Table A4 in Appendix, reveal that the positive effect on employment is driven by open-ended contracts, confirming that such policy, at least before its universal extension during the Covid pandemic, could exacerbate labour market segmentation between permanent and temporary workers. A higher number of STW hours 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 per employee by 0.5%, while increasing the wage bill by 0.8%. Employment benefits come also at the cost of slightly lower productivity: a 10% increase in STW hours causes a reduction of 0.3% in value added per employee. Considering that the median firm employs 64 employees and uses 5760 hours of STW per year, our estimates imply that an increase in STW by 576 hours (which means 9 hours per employee) saves approximately 0.9 jobs. At the same time, the median (yearly) wage decreases by 210 euros and the value added per employee declines by 153 euros. Overall our estimates point out that STW contributes to preserving employment, especially on permanent contracts. Subsequent labour hoarding causes a decline in labour productivity, but wage subsidies allow to cut also wages, with positive effects on firm profits.

The role of unions and firm-level bargaining

Union presence and bargaining within the firm are likely to play a key role in influencing the effect of STW hours on firm performance. This is a crucial aspect in institutional settings, like the Italian one, where such schemes are usually negotiated between the employer and local unions. Unions can influence not only the adoption of STW, but also its effect on firm performance through both direct and indirect channels. First of all, unions may directly influence both employment and per-capita working hours by supporting the use of STW as a work sharing device to prevent large employment losses. Second, unions may negotiate with the employer to minimize the impact of STW on wages of their incumbent workers. Third, union may influence firm productivity through the definition of the list of workers that should be put on STW. Workers' selection is officially based on objective criteria, such as tenure and family composition, but some of these criteria may allow to select on average less productive workers, thus reducing the negative impact of STW on productivity. Finally, unions may negotiate other working conditions, such as working hours, tasks organization and other forms of internal flexibility, to provide employment insurance to their workers beyond the use of STW schemes. This can in turn reduce labour turnover and potentially enhance productivity (Addison, 2005).[16] In light of these considerations, we investigate whether the main effects of STW intensity on labour adjustment is mediated by 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).[17] We then estimated our IV-FE 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 higher number of STW hours is effective in saving jobs in both groups of firms (a 10% increase in STW hours increases total employment by 1.4% in

[16] In the case of the US, Black and Lynch (2004) found that workplace innovation is positively associated with labour productivity especially in unionized plants. 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.

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

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 firms 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).

[[Table 4 near here]]

Overall, these estimates highlight that strong unions favor the use of STW as a work sharing device, aiming at preserving both employment and pay of their members. In this perspective, strong unions at the workplace clearly operate maximizing the utility of the ”insider workers”, who are likely older, with longer tenure and on permanent contracts (Saint-Paul, 1996). We replicate a similar analysis in Table A5 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.[18] 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 0.4%, 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 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

[18] 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.

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 losses.

STW and firm liquidity

As a further step of the analysis, we investigate the effects of STW by firm's financial conditions. Empirical evidence shows that STW may be beneficial especially for firms with low liquidity: labour hoarding subsidized through STW can help these firms to cope with the lack of liquidity and recover rapidly once the shock is over (Giupponi and Landais, 2020). To this end, we use 2006-2008 accounting data to compute pre-treatment liquidity and use the median to classify firms into low liquidity firms (below the median) and high liquidity ones (above the median). IV-FE estimates by liquidity conditions reported in Panels A and B of Table 5 show that the decline in total working hours is larger in firms with low liquidity (column 1), but employment gains are rather similar across the two groups of firms (column 3). Quite interestingly, we find a significant decline in average wage only for firms with low liquidity (column 4), which reflects into a smaller increase in total wage bill compared to liquid firms. There is also evidence showing that low liquidity (or high leverage) can create conflicts in labour relations, reducing employees job security and increasing the need for costly workforce reductions (Matsa, 2018). In this perspective, STW can help to preserve employment especially in firms with weak unions and financial distress, where the lack of other institutions sheltering employment from a negative shock makes STW more needed. 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. Once we combine unionisation and liquidity constraints (Panels C-F in Table 5), our results point out that STW

hours produce the largest (and statistically significant) employment effects in firms with weak unions and low liquidity: a 10% increase in STW hours causes an increase of 1.7% in employment (panel C, 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 C). The same percentage change in STW hours produces a much lower employment effect in firms with strong unions and low liquidity (0.9%, panel D, 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 C). 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 D, 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 D and E). The latter actually experience much lower employment gains, but no significant changes in per-capita working hours.[19]

[[Table 5 near here]]

Overall these estimates point out that STW is an effective policy to preserve jobs in all firms, but this effect is the 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 these firms is also associated with a short-run decline in both average wages and value added per employee.

Robustness checks and further estimates

We conducted a number of tests to check the robustness of our estimates. The main results are reported in Table A6 in the 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 actually driven by changes in firms around the two thresholds, we

[19] 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.

restrict the estimation sample to firms with 10-75 employees (panel B). Third, we estimate a richer specification by including firm-level time-varying controls that may be correlated with unobserved firm-specific shocks and with the use of STW.[20] Fourth, to check whether our results hold 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. Finally, we may still be concerned that, since our instruments rely on firm's size thresholds defined also for EPL, our estimates may also capture potential effects of EPL on firm performance. In order to control for this confounding factor, we exploit that the law prescribes that all plants belonging to multiplant firms with more than 60 employees are subject to EPL, independently of their size, but STW thresholds always apply at the plant level (hence, only to plants with more than 15 employees). For this reason, we replicate our analysis on the subsample of multiplant firms with more than 60 employees, using as an instrument for STW only the 15 employees threshold. Results in panel E are similar to the ones in other specifications, although they are less precise due to the smaller sample size. The slightly different size in coefficients is due to the fact that multiplant firms are more likely to use STW (40.1% vs 35.6% for other firms) and with a higher number of hours (log(STW Hours) 3.60 vs 2.99). We then test the existence of heterogeneous effects by type of shock and firm characteristics. In the literature there is evidence that such schemes are more effective when firms have to cope with a temporary shock (Brey and Hertweck, 2018), while they can prevent a more efficient workers reallocation in the case of low productivity firms hit by a persistent shock (Giupponi and Landais, 2020). On the contrary, 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 in the long run. Table A7 reports IV-FE estimates of the coefficient of the logarithm of STW hours by time span of STW use (panel A), pre-treatment productivity[21](panel B), and technological intensity

[20] We control for the share of female, white collar and temporary workers and for the growth in total revenues.
[21] Productivity is calculated as pre-crisis averages over years 2006-2008.

(as proxied by the share of employees with a STEM university degree; panel C). Firms are classified into two groups according to their position relative to the median of each variable distribution. Estimates in panel A show that positive employment effects are significantly larger in firms that used STW for a relatively short period of time (one year or less; see column 3 in panel A), but they also registered larger losses in labour productivity (column 5). If we consider the time span of STW use as a proxy for shock persistence, 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 gains combined with larger reduction in working hours per employee.[22] This translates into a relatively larger decline in average wages, but similar increase in total wage bill. The estimated effects on productivity are negative for both groups, but they are not precisely estimated and neither of them is statistically significant. Estimates by technological intensity in panel C clearly show that employment gains are significantly larger in high-tech firms compared to low-tech ones. Such gains are associated to a larger decline in hours and wages per employee, but also to a significant decline in labour productivity. Notice that our results should be interpreted as short-run effects of STW hours on firms' 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 us to consistently follow the same firms over time for no more than three consecutive years. Exploiting this information, in Table A8 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 losses 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

[22] This result is partly coherent with Giupponi and Landais (2020), 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.

results are in line with the temporary employment effects found by Giupponi and Landais (2020) and confirm that STW does not necessarily guarantee long-term employment insurance to workers.

6. Concluding remarks

In this paper we investigated the effect of STW hours on employment, working hours, wages and labour productivity margins, focusing on the role of unions and collective bargaining in mediating the impact of STW on firm performance. Our estimates show that a more intensive use of STW is effective in preserving jobs, mainly allowing the adjustment of labour inputs via a reduction of working hours per employee. We also show that an increase in STW hours is associated with lower wages and lower labour productivity, but the decline in wages more than compensates productivity losses. 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) is 22% larger than the corresponding productivity loss, implying that STW may be beneficial for firms' profits both in the short and in the long run. One mechanism at work could be that labour hoarding allows firms to potentially retain skills and human capital that could be lost in absence of STW schemes. When we consider the role of unions, we find that the estimated elasticity of employment to total STW hours is slightly larger in low unionized firms compared to highly unionized ones. The positive effect on employment is associated to lower wages in low unionized firms, lower working hours per employee in highly unionized ones, where per-capita wages are rather insensitive to STW hours. These estimates are in line with the role of unions maximizing utility of the incumbent workers (the so-called 'insiders effect'). Strong unions are able to negotiate the use of STW as a work sharing device, which allows to absorb a negative shock mainly through reduction in working hours, protecting both employment and wages of their members. Focusing on employment effects, our results confirm that a higher number of STW hours saves more jobs in firms hit by temporary shocks and high-tech firms, but large 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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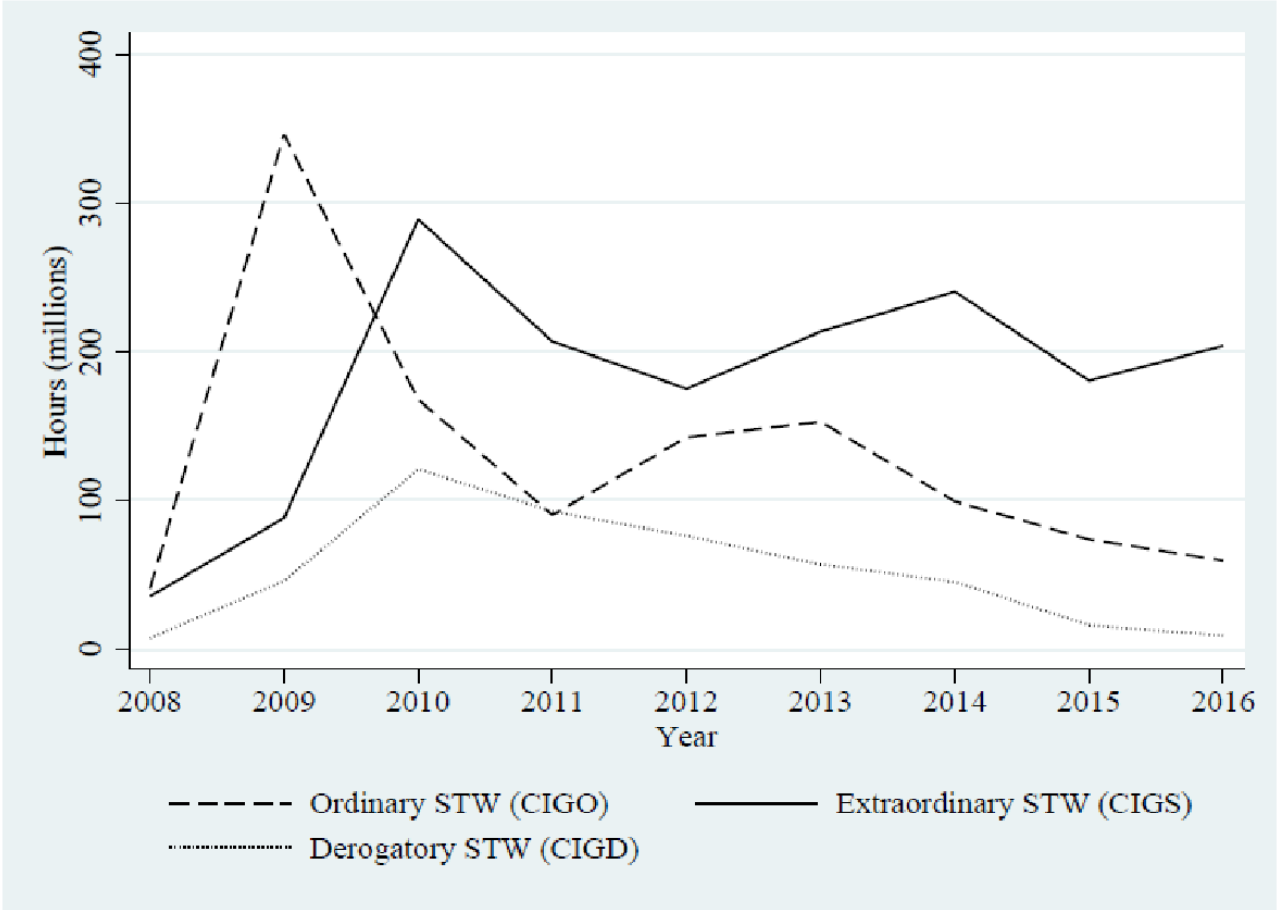
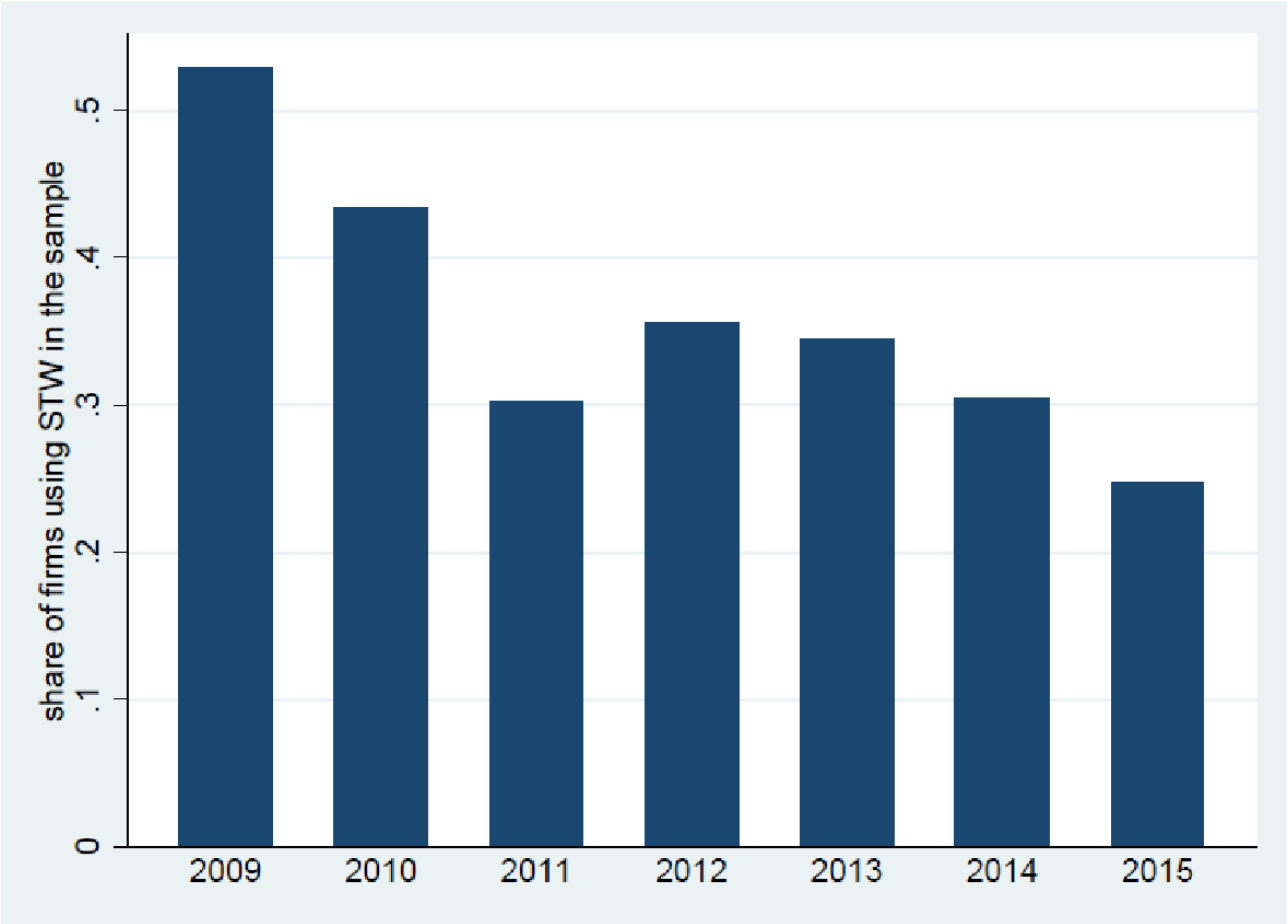
Figure 1: Authorized STW hours by type, 2008-2016



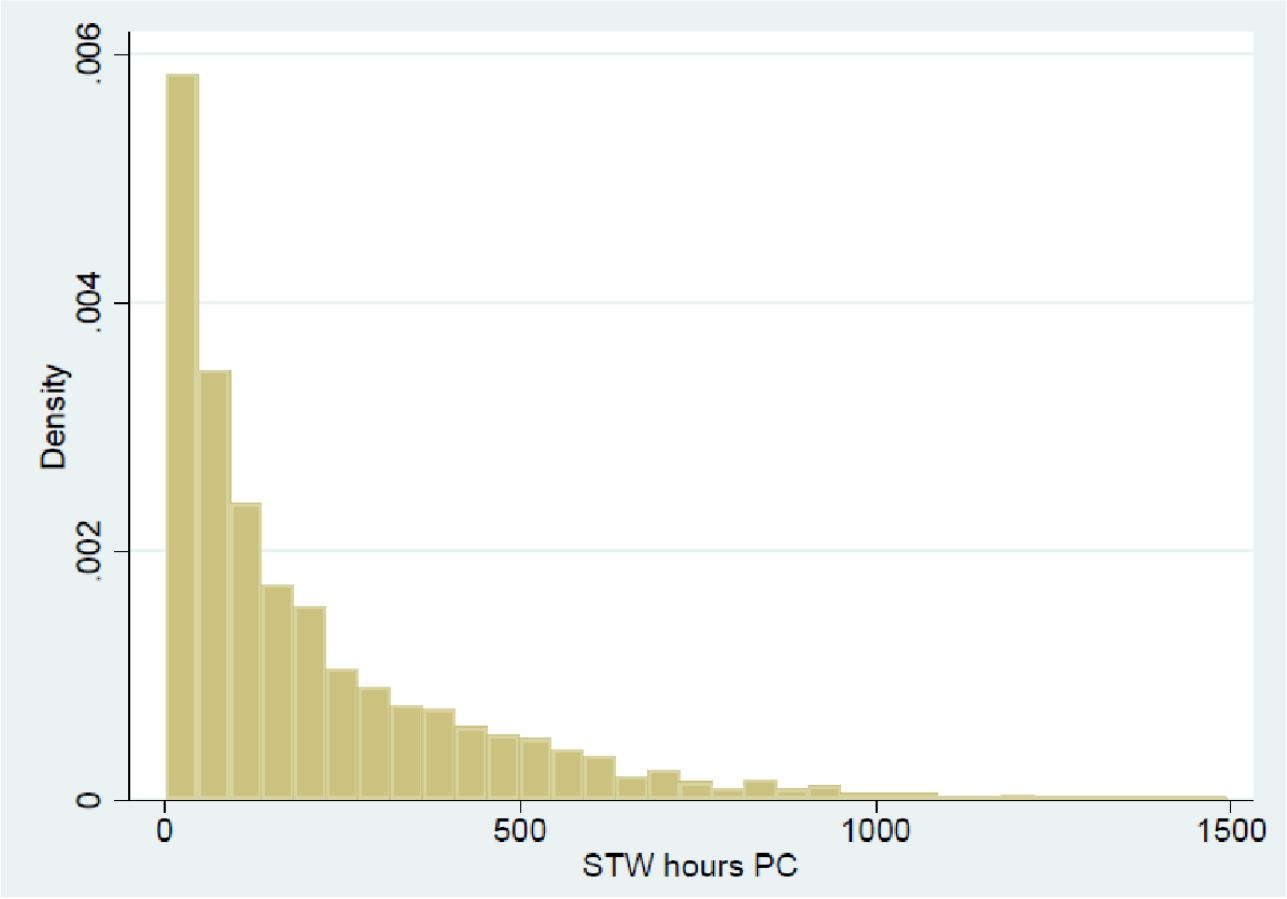
Note: The graph shows the number of STW hours authorized by the National Institute of Social Security (Istituto Nazionale Previdenza Sociale, INPS) in the metal-engineering sector for each year from 2008 to 2016. Data source: INPS

Figure 2: Share of firms using STW in the sample by year



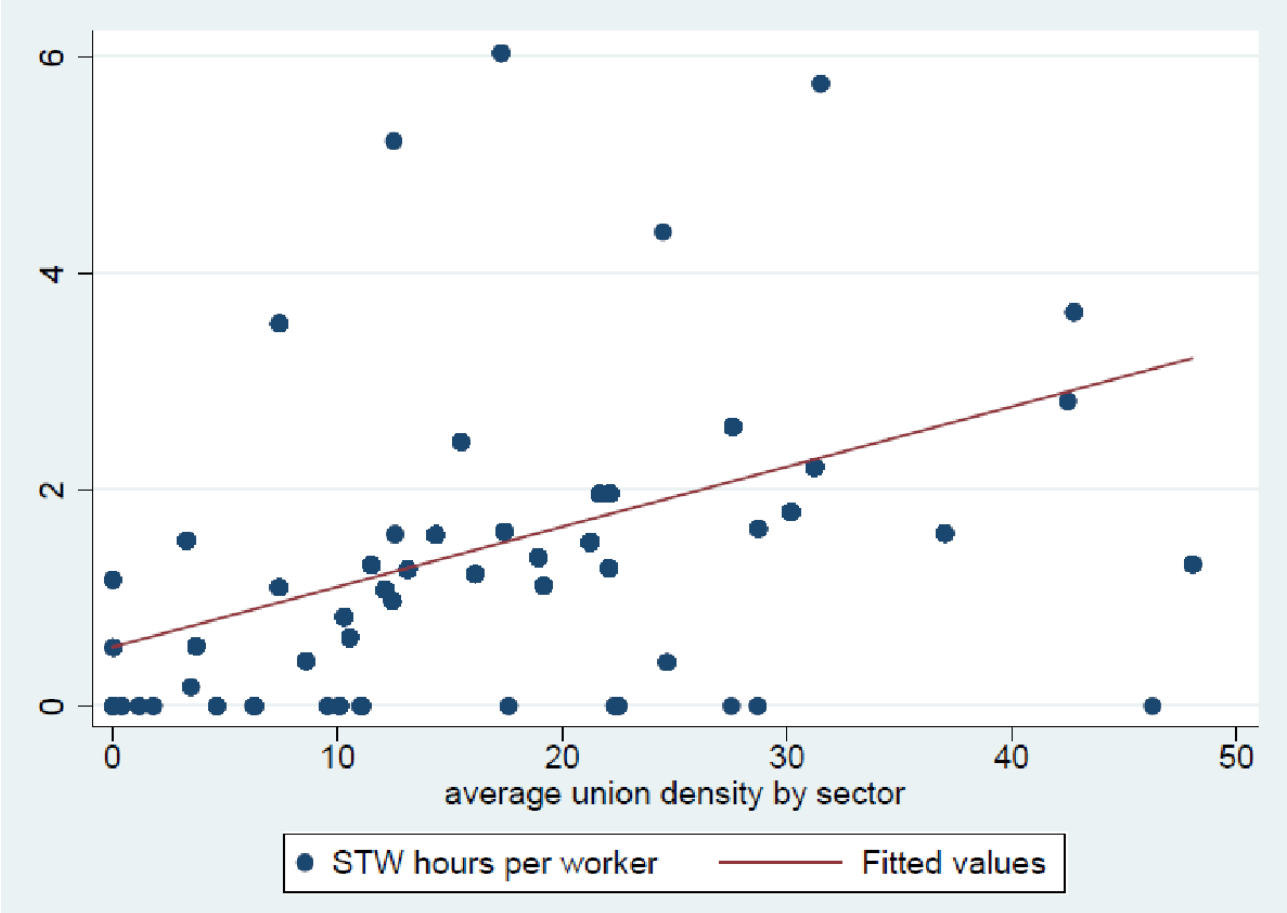
Note: The graph shows the share of firms in the sample using STW in years from 2009 to 2015. Source: authors' elaboration from Federmeccanica data.

Figure 3: STW hours per worker



Note: The graph shows the probability density function of STW hours per employee for firms reporting a positive amount of authorized hours in the survey year. Source: authors' elaborations from Federmeccanica data.

Figure 4: plot union density - STW



Note: The figure plots the relationship between average union density at the 2-digit (Ateco) sector level and the average number of authorized STW hours per worker. Source: authors' elaborations from Federmeccanica data.

Table 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.

Table 2: 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
share of temporary workers	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: *, **, *** statistically significant at the 10, 5 and 1% levels. In column (1) and (2) we present mean values of the variables for firms using STW for at least one year and for firms that never use STW, respectively. Column (3) shows the difference in the means.

Table 3: Baseline estimates –Fixed Effects and IV Fixed Effects

	(1) Total hours worked	(2) Hours per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per empl.
Panel A. FE						
STW 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)
R2	0.979	0.609	0.986	0.859	0.990	0.800
Obs.	5458	5458	5458	5458	5458	5458
Panel B. IV-FE						
STW 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	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, average wage, total wage bill and value added per worker. The final sample size decreases from 6433 to 5458 observations (1583 firms) because 975 singleton observations have been dropped.

Table 4: STW effects on firm performance: the role of firm-level unionization. IV-FE estimates.

	(1) Total hours worked	(2) Hours per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per empl.
Panel A. Low unionized firms						
STW 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. Highly unionized firms						
STW 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, average wage, 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 workers' union membership respectively.

Table 5: STW effects, firm's financial conditions and unionization. IV-FE estimates.

	(1) Total hours worked	(2) Hours per employee	(3) Total employment	(4) Average wage	(5) Wage bill	(6) Value added per empl.
Panel A. Low liquidity						
STW 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 B. High liquidity						
STW 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 C. Low liquidity in low unionized firms						
STW 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 D. High liquidity in low unionized firms						
STW 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 E. Low liquidity in highly unionized firms						
STW 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 F. High liquidity in highly unionized firms						
STW 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, average wage, total wage bill and value added per worker. Panels A and B report estimates by pre-treatment liquidity index (mean 2006-2008). We use the median value of this indicator to classify firms into low liquidity (below the median, panel A) and high liquidity firms (above the median, panel B). Estimates in panels C-F refer to four sub-groups of firms: firms with both liquidity and union density below the corresponding median values (panel C); firms with liquidity above the median and union density below the median (panel D); firms with liquidity below the median and union density above the median (panel E); firms with both liquidity and union density above the corresponding median values (panel F)

Appendix

A Additional results - not intended for publication

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. In column (1) and (2) we present mean values of the variables for firms with union density below and above the median, respectively. Column (3) shows the difference in the means.

Table A2: Sample selection

	(1) Mean survey sample	(2) Mean merged sample	(3) Mean selected firms	(4) Difference (2) and (3)
Total hours worked - net of STW (th)	238.809	275.892	156.606	119.286***
Hours per employee - net of STW	1601.264	1604.465	1609.829	5.364**
Total employment	149.937	173.320	97.252	76.068***
Value added per employee (the)		67.048	66.950	0.097
Average wage (the)	51.255	51.540	50.565	0.974**
total factor productivity		1.316	1.232	0.084***
liquidity index		1.414	1.440	0.026*
share STEM graduates	0.065	0.067	0.062	0.005***
total revenues (Me)		51.880	27.045	24.835***
white collar share	0.402	0.399	0.394	0.005*
female share	0.217	0.217	0.216	0.001
temporary workers share	0.052	0.049	0.049	0.000
STW user	0.369	0.381	0.369	0.012**
STW hours PC	81.998	81.898	78.242	3.656
unionized firm	0.645	0.664	0.677	0.013**
union density	20.047	20.765	20.533	0.232
firm-level contract	0.476	0.529	0.523	0.006
firm-specific union	0.483	0.527	0.522	0.005
strikes in the firm	0.453	0.519	0.496	0.023***
Observations	10289	7258	6434	

Note: In column (1) - (3) we present mean values of the variables for all observations, for the merged sample and for the selected sample, respectively.

Table A3: First stage – IV

	(1) STW hours
Above 15 FTE employees in t-1	1.792***
	(0.339)
Multiplant above 60 employees in t-1	0.648**
	(0.250)
R^2	0.634
F-stat	17.4
Obs.	5458
Control variables:	
Firm FE	Yes
Sector–Year FE	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variable is the logarithm of STW hours used by a firm in a given year.

Table A4: Effects by type of contract – OLS and IV

	(1) Total employment	(2) Permanent employment	(3) Temporary employment
Panel A. OLS			
STW hours	0.001	0.002***	-0.032***
	(0.001)	(0.001)	(0.007)
R^2	0.986	0.986	0.735
Obs.	5458	5458	5458
Panel B. IV			
STW hours	0.138***	0.138***	0.124
	(0.030)	(0.030)	(0.083)
Hansen J statistic	0.73	0.73	0.73
Kleibergen-Paap F statistic	17.40	17.40	17.40
Obs.	5458	5458	5458
control variables:			
Firm FE	Yes	Yes	Yes
Sector–Year FE	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the firm level. The dependent variables are: the number of workers and the number of permanent and temporary workers (in logs). The final sample size decreases from 6433 to 5458 observations (1583 firms) because 975 singleton observations have been dropped.

Table A5: IV - Alternative measures of firm-level unionization

	(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						
STW 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						
STW 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						
STW 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						
STW 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						
STW 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						
STW 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, average wage 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.

Table A6: Robustness and sensitivity tests

	(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						
STW 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						
STW 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						
STW 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
Panel E. Multiplant						
STW hours	0.176	-0.059***	0.234	-0.261	-0.026	-0.042
	(0.197)	(0.013)	(0.196)	(0.191)	(0.028)	(0.043)
Obs.	994	994	994	994	994	994
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, average wage, total wage bill 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 panel C we add time-varying controls for female share, white collar share, share of temporary workers and growth in total revenues. In D we use a dummy for STW use instead of the intensity measure. Finally, in E we keep only multiplant firms and we run IV regressions using as an instrument the 15 employees threshold.

Table A7: Heterogeneous effects by length of STW use, TFP and technological intensity

	(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						
STW 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						
STW 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						
STW 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						
STW 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. High tech firms						
STW 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 C2. Low tech firms						
STW 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, average wage, total wage bill 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 pre-crisis TFP 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.

Table A8: 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						
STW 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						
STW 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, average wage, total wage bill and value added per worker. In panels A1 and A2 we present estimates for STW intensity of use in t-1 and t-2.