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Firms' Margins of Adjustment to Wage Growth The Case of Italian Collective Bargaining

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Firms' Margins of Adjustment to Wage Growth

The Case of Italian Collective Bargaining*

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Abstract

This study analyses firms' adjustment behavior when facing higher labor costs. The empirical research design considers several firms' outcomes and exploits, as a source of variation in labor costs, discontinuities in contractual wages' growth set by Italian collective bargaining institutions. The results indicate that adjustment channels are highly heterogeneous across the firms' productivity distribution. Employment, revenues, productivity and the profit margin are negatively related to contractual wage growth among relatively less efficient companies. Instead, most efficient firms do not downsize, they substitute high- with low-skilled workers while preserving their productivity, and they increase profitability. We conclude that more efficient companies, which adjust through cost-saving and labor hoarding strategies, may benefit from cleansing effects, as their product market shares increase when costs of more constrained rivals are raised.

JEL Codes: J00, J23, J24, J31, J38, J58, L13.

Keywords: Collective Bargaining; Minimum Wage; Productivity; Employment; Matched Employer-Employee Data.

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1 Introduction

The problem of predicting firms' adjustment behavior to labor scarcity has long been debated in economics (see *e.g.* Acemoglu [2002]). Labor scarcity is relevant to firms since it typically takes the form of an increase in labor costs or of a reduction in the relative price of other production factors. It is a quite recurrent phenomenon that can be triggered by macroeconomic fluctuations, migration flows, technological shocks, including the availability of cheaper investment goods, but also by institutional factors, such as a growth in labor income taxes or tighter wage regulations.

This paper studies firms' adjustment path to the growth in relative labor costs induced by an institutional mechanism, namely by changes in the level of contractual minimum wages set within the system of industrial relations (contractual wages, for short). Our analysis evaluates the relative importance of a rich set of adjustment channels potentially used by firms when facing this shock, in particular: productivity, revenues, employment, profits, capital intensity, wages and workforce composition.

The contractual wages considered in our analysis operate similarly to a strictly binding statutory minimum wage. Rather than being regulated by the government, these pay levels are collectively bargained by trade unions and employers' associations. This wage setting mechanism can be found in various countries and tends to be quite common in Continental Europe (see OECD [2017]). Italy is an illustrative case for such an institutional setup, with pay negotiations that are carried out at the nation-wide industry level.[1] Several features make the Italian case particularly interesting to study, and motivate the detailed analysis we undertake in this paper.

Italian collective contracts' main purpose is to set wage floors at the level of the national sector. Other dispositions contained in these contracts are typically very stable across time, and they are often amendable by individual firms. For this reason, the policy context considered in this analysis is reminiscent of stylized models where unions set wage levels as a monopolist through centralized bargaining, while individual firms

[1] In 2016 the 150 largest collective contracts alone covered around 92% of all private sector workers in the country, affecting the pay levels of more than 15 millions employees.

choose employment levels on their labor demand schedule (see *e.g.* MaCurdy and Pencavel [1986]). Another peculiarity of Italian contractual wages is that they represent both a pay floor and a fixed pay component. Hence, their growth tends to affect pay levels of virtually all workers covered by the collective agreement, not only those close to the pay floor or at the bottom of the wage distribution.[2] Given this setting, economic theory provides several predictions on the adjustment channels available to firms when contractual wages grow.

According to the standard Hicks-Marshall theory of labor demand, firms adjust to positive labor cost shocks by capital-labor substitution and price increases, which lead to a reduction in output and employment levels (Hamermesh [1993]). Other non-competitive adjustment channels could also be relevant, such as profit reductions when rents are available to firms in the product or labor market, or managerial slack reductions. In these latter cases, output and employment effects could be more ambiguous.[3]

In this paper, we argue that there are relevant market-level interactions among the alternative adjustment mechanisms available to different types of firms. Specifically, firms that have rents to exploit when facing the wage shock also benefit from reduced competitive pressures from less efficient employers, which are typically subject to the negative employment and output effects predicted by the competitive model. In this setting, high-rents firms can even increase their profits when labor costs grow. That is, contractual wage growth can be characterized as an institutional shock that *raises the rivals' costs*. This form of profitable exclusionary strategy has been often considered relevant in the industrial organization literature (see *e.g.* Salop and Scheffman [1983]). Various forms of this argument have been proposed also in the theoretical literature on centralized wage setting, as this institutional mechanism could give rise to relevant cleansing effects (*e.g.* Williamson [1968], Moene and Wallerstein [1997], Haucap et al. [2001], Barth et al.

[2]A growth in the contractual pay floor usually implies that all wages have to be increased by the same fixed amount, even if they were already above the new minimum.

[3]These mechanisms, and the limited available evidence on them, have been recently discussed by Clemens [2021] with reference to the minimum wage literature. Other studies analyzing the effects of direct and indirect labor costs on firms' performance and employment have focused on the role of union density (*e.g.* Addison and Hirsch [1989]; Barth et al. [2020]) and the tax burden (*e.g.* Cahuc et al. [2018]). Card and Cardoso [2021] provide a recent contribution to this literature focusing on the effects of collective bargaining in Portugal.

[2014]). Despite this interest, empirical investigations on the salience of this phenomenon have been relatively scarce.

In our empirical analysis, we have adopted a fixed effects estimation strategy that exploits changes in the level of contractual wages in order to analyze employers' adjustment behavior. In this model, the parameters of interest are identified by comparing the growth in the outcomes of interest between firms affected and unaffected by changes in contractual wage levels, conditioning on a rich set of non-parametric time effects specific for each sector in each geographic location.

Our study is based on the most comprehensive panel of incorporated businesses' balance sheets available for Italy, as provided by CERVED. We have matched this database to social security records on the population of private-sector employees provided by the Italian Social Security Institute (INPS) and to a comprehensive hand-collected dataset on contractual wages set by the majority of Italian collective bargaining agreements. The final sample of analysis comprises almost 400,000 firms per year over the period 2006-2015, virtually covering the universe of Italian incorporated businesses in the private sector.

Our results show that, on average, higher labor costs induce a fall in employment and revenues, an increase in wages, and null effects on productivity, workers' average quality, the profit margin and capital intensity. However, we show that these results are highly heterogeneous across firms, and that there are relevant interactions across adjustment channels exploited by different employers that take place at the market level.

The main dimension that we have considered to characterize the heterogeneity in adjustment behavior across firms is their underlying productivity. This is an interesting dimension for several reasons. Productivity is closely related to quasi-rents available to firms in the product and labor markets (*e.g.* Card et al. [2018]). The empirical literature on centralized wage setting has often considered productivity as a good proxy to characterize more and less advantaged firms in similar systems of industrial relations (Boeri et al. [2021]; Bartolucci et al. [2018]; Manacorda and Petrongolo [2006]). Theoretical contributions also emphasize productivity differences across firms when characterizing

heterogeneity in the effects of collective bargaining (*e.g.* Barth et al. [2014]).[4]

We classified firms in four groups reflecting their relative productivity within collective contracts. We find that higher contractual wages have a relatively similar positive effect on the pay level of incumbent workers for all types of employers. In the group of relatively less efficient firms, contractual wage growth has strongly negative effects on employment, productivity, and revenues. The effects of this shock on the profit margin are also negative for less efficient employers. By contrast, the productivity effects associated to contractual wage growth are marginally positive in the group of most productive firms. For these firms, contractual wage growth has positive effects on revenues, profitability and employment as well (although not significant for this latter outcome). Instead, capital intensity is not significantly affected by the wage shock both at more and less productive firms, indicating that changes in technologies' adoption do not play a major role, at least for what concerns relatively short run adjustments.

This rich analysis of several firms' outcomes pinpoints important mechanisms arising from market-level interactions in the adjustment channels across different firms' types. First, the labor cost shock induces a loss in market shares of least productive firms. Sales reduce more the lower the firm's productivity, which implies that high value added firms increase their share of production as a result of higher contractual wages. This, in turn, benefits the most efficient competitors.

Secondly, least productive firms suffer strong employment losses, particularly among low skilled workers. Since productivity decreases for them, despite more positive selection in their workforce, this suggests that frictions and firing costs (which are typically higher for more qualified workers with open-ended contracts) may not allow these employers to adjust employment levels optimally. Instead, efficient competitors increase the use of cheaper unskilled workers while keeping employment levels constant after the labor cost shock.

After the growth in labor costs, the average age of employees, the share of open-

[4]Similar arguments have been proposed also in the minimum wage literature. For example, Dustmann et al. [2020] show that the German minimum wage has induced a shift of employment toward more efficient firms.

ended contracts and the quality of workers (as measured by AKM workers' fixed effects) decreases at more efficient companies and increases at less efficient firms. An increased reliance on cost-saving strategies and workers' reallocation may rationalize the employment composition effects among most efficient companies. In particular, low quality workers may become more easily available in the labor market after the labor cost shock, as they are laid off by least efficient firms. This induces more productive firms to use more extensively low quality workers, a cost-saving strategy that could become more appealing to these employers, which are precisely those that do not cut production levels after the growth in labor costs.

Given the above mechanisms, the highest quartile of relatively more efficient firms within a collective contract is actually able to increase profitability after the labor cost shock, while the profit margin tends to reduce elsewhere. That is, the increase in the product market share of relatively more efficient companies and the related reallocation of the workforce allow them to compensate for the growth in labor costs. Overall, our analysis shows that the effects of higher labor costs on firms' behavior are quite complex and heterogeneous, depending on the relative efficiency of firms that are hit by this shock. Moreover, interactions across adjustment channels exploited by different firms can even lead to profit gains among most efficient, high-rents employers, as costs of more constrained rivals, which are more subject to competitive pressures, are raised by centralized wage growth (Williamson [1968]; Salop and Scheffman [1983]).

Our results contribute to the literature on firms' margin of adjustments in the presence of higher labor costs, on which the evidence is still not abundant. The shock to labor costs from contractual wages that we are studying is expected to be stronger than that from a standard minimum wage change, as contractual wages are typically binding across the entire pay distribution, and not just at the bottom of it. This setting offers a fertile ground to better understand the elusive impacts of the minimum wage (e.g., Manning [2021]),[5] as well as the relevance of various adjustment margins and their interactions in

[5]Several adjustment margins considered in this paper have been analyzed in the context of standard minimum wage policies. See in particular Aaronson and French [2007] and MaCurdy [2015] for a discussion of product market price effects, Draca et al. [2011] for a discussion of the effects on profits, Riley and Bondibene [2017] for a discussion of the effects on productivity and Harasztosi and Lindner [2019] for a

the face of large labor cost shocks.

Finally, this study nicely complements the evidence in Dustmann et al. [2020] on the reallocation effects of minimum wages, by investigating the effects of a similar, yet distinct wage policy – collectively bargained floors.[6] On this respect, we show that a hitherto neglected dimension of heterogeneity in firms' adjustment behavior to a market-wide growth in relative input costs is given by product market shares, which tend to increase for firms that are more resourceful and able to cope with this shock. This mechanism could also represent an explanatory element for the secular growth in product market power and concentration, whose sources are quite debated in the recent literature (De Loecker et al. [2020]).

2 Institutional Context

According to the Italian Constitution (art. 36), each employee is entitled to a pay level that is commensurate to the tasks that he/she performs, and sufficient to guarantee an adequate standard of living. Italian labor courts have interpreted this provision as a disposition to apply to each worker the minimum contractual wage that is bargained by the most representative collective agreement relevant to the worker's occupation. Thus, contractual wages set within the Italian system of industrial relations *de facto* represent statutory pay floors that apply to all private-sector employees.

The Italian employers' association and trade unions negotiate contractual wages at a quite centralized level. There are several hundreds of collective contracts, but the 150 largest contracts cover most of private sector employees, as they are applied to more than 15 millions workers, representing more than 90% of the workforce. The 2017 classification of the Italian Social Security Institute included around 300 collective agreements. There are also several other contracts (typically those with very small coverage and often a dubious legal basis for their applicability) that are not included in this classification, but

joint analysis of several firms' adjustment margins. A detailed literature review is provided by Clemens [2021].

[6]The recent literature analyzing cleansing effects, reallocation and labor hoarding hypotheses in the presence of adverse shocks to the firm includes also Foster et al. [2016], Giroud and Mueller [2017], Berton et al. [2018], Faia and Pezone [2020]

the proportion of workers falling into this group of un-registered agreements was always below 2% during the years covered by our study.[7]

Contractual wages are considered by the Italian legislation not only as a wage floor, below which an employee in the relevant occupation and sector cannot be paid. They are in practice also a fixed component of the wage. This implies that whenever a contractual wage grows by a given amount, all pay levels in the relevant occupation must be increased by the same fixed amount, also those already above the new minimum level. There are clauses called *superminimi assorbibili* according to which employees that are paid above the minimum can agree to give up this fixed pay rise, as long as their wage remains above the relevant contractual wage. Even if there is no systematic evidence on the incidence of these clauses, they tend to be not very common. Indirect evidences on this phenomenon are provided by Adamopoulou and Villanueva [2020]. This study shows that Italian wages in the metal-manufacturing sector tend to increase across the entire within-contract earning distribution in response to the growth of negotiated pay levels, while, in recent years, the "wage cushion" (*i.e.* the difference between actual and pay levels) has always been quite stable across time. Importantly, the same study also documents negligible levels of non-compliance to contractual wage growth.

The influence of collective bargaining on wage differentials and inequality has been stressed in many studies, including Belloc et al. [2018] and Boeri et al. [2021] for what concerns geographic wage dispersion, Devicienti et al. [2008] and Faia and Pezone [2020] for what concerns wage rigidity and Erickson and Ichino [1995], Manacorda [2004] and Devicienti et al. [2019] for what concerns wage inequality and its evolution.[8] Discontinuities in the timing of collective contracts has been exploited as a source of variation also in other policy evaluation exercises (*e.g.* Cappellari et al. [2012] and Daruich et al. [2020] on temporary employment). In a complementary study, Fanfani [2020] analyzes employment losses and wage effects associated to contractual wage growth. While that study focuses

[7]See Lucifora and Vigani [2020] and Garnero and Lucifora [2020] for a discussion on these less representative agreements.

[8]Italian wage inequality has been recently analyzed also by Franzini and Raitano [2019] and by Hoffmann et al. [2020], while historical evidences on the effects of wage compression induced by collective bargaining have been recently re-evaluated by Leonardi et al. [2019].

on aggregate employment and wage effects across demographic and industry groups, the present analysis considers instead a large set of firm-level margins of adjustment to contractual wage growth.

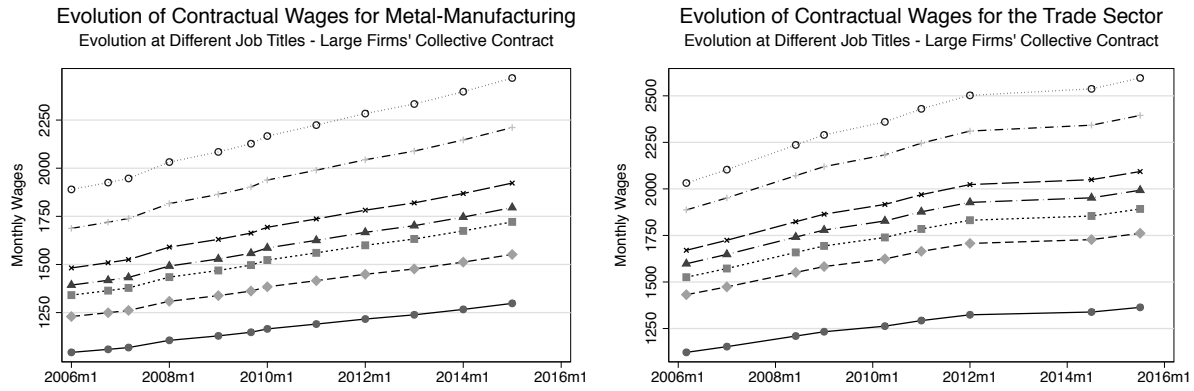
3 Data

Our empirical analysis is based on three main sources of information. First, we rely on the CERVED database on Italian incorporated businesses' balance sheets and profit and loss accounts for the years 2006-2015. These data cover virtually all Italian incorporated companies, and we are able to match each of these firms to the population of its employees registered in the INPS social security records archives, our second source. The INPS records are based on compulsory information compiled by all employers in the private sector that hire at least one employee, thus they cover the universe of workers to which the dispositions of collective bargaining apply. Finally, our third source of information is a hand-collected database on Italian contractual wages settled in around 160 nation-wide agreements periodically renewed between 2006 and 2015. Since the INPS archives contain information on the collective agreement applied to each worker, we have been able to match almost 80% of the private-sector employees' population to a contractual wage.[9]

To better understand how contractual wages work in Italy, Figure 1 plots the evolution of these wage floors over the period 2006-2015 for the two largest collective agreements, the metal-manufacturing and trade sector ones. Each contract sets more than one pay floor for different job titles. Which pay level applies depends on the occupation and sometimes on the seniority levels, but the INPS data do not provide information on the specific job title of each worker within collective contracts. Contractual wages are renewed at different dates, with changes that appear to be more frequent in the metal-manufacturing contract (each dot in the graph represent a contractual wage change). As mentioned, contractual wages represent both a wage floor and a fixed component of the pay, so that

[9]Contractual wages observable in our sample are the same available to INPS labor inspectors (applicativo "Vela") and to bookkeepers (Il Sole 24 ore archive). We have hand-collected and re-organized the data from these archives, where they are available only at the disaggregated collective contract-period of validity level. Contracts for which information on wages was unavailable tend to be the less representative ones, which often have a dubious legal validity for what concerns wage setting dispositions.

Figure 1: **Evolution of Contractual Wages in Selected Collective Agreements**



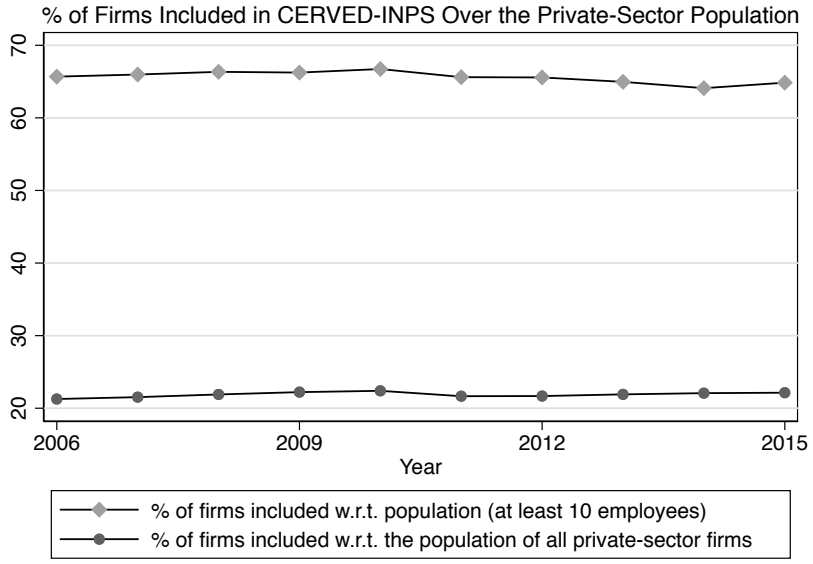
their growth typically implies that all wages in the relevant job title have to be adjusted. Our empirical analysis exploits variations in the timing and size of these shocks across collective agreements in order to identify firms' adjustment behavior.

Since our unit of analysis is the firm, we have identified for each company the most expensive collective contract, that is, which collective contract covered the largest proportion of the firm's wage bill.[10] Using this information, we have assigned each firm to a treatment, defined as the median contractual wage of the most expensive agreement. This minimum wage approximates quite well the dynamics of contractual wages observed among all job titles within an agreement. The correlation coefficient of the contractual wage growth across pay levels within the same contract at renewal dates was around 0.74 during the years covered in our sample. This feature is also visible from Figure 1, where the relative distance across different contractual pay levels is always quite stable for different job titles within the same collective contract. Thus, a growth in our treatment variable can be considered a good approximation to a shock in labor costs affecting most workers within the firm, even if the precise magnitude of this shock is potentially measured with error.

Our final sample of analysis includes only CERVED firms with at least one employee

[10]The average share of the wage bill covered by the largest contract within firms was 0.93 in our sample. While cases where a firm applies only one collective contract tend to be the vast majority (the 75th percentile of the main collective contract share is 1, while the 90th percentile is 0.94), in several instances a company may also apply different contracts to part of its employees. For example, managers' wages are sometimes negotiated in separate nation-wide collective agreements, while large firms may apply different contracts depending on the activities of its production units.

Figure 2: **Representativeness of the CERVED-INPS Matched Saple**



in the INPS archives, and whose most expensive collective agreement was present in our database on contractual wages. The number of firms included in this sample was approximately 600,000, which were observed for a period of nearly 6 years on average.

Figure 2 provides descriptive statistics on the representativeness of the CERVED-INPS-contractual wage matched sample across years, with respect to the universe of private-sector firms with at least one employee, which is observable through INPS' social security archives. The same statistic is computed also among firms with at least 10 employees. Our sample of analysis includes slightly more that 20% of all Italian firms with at least one employee, and this coverage rate grows to around 65% when considering the population of firms with at least 10 employees.[11] The over-sampling of larger firms is due to the fact that the CERVED data include only incorporated businesses, which are mandated to maintain balance sheets and make them publicly available via the Chambers of Commerce. The CERVED data, instead, do not include unincorporated enterprises, which are typically very small family-run businesses or other partnerships that are not subject to the above dispositions concerning balance sheets. Importantly, Figure 2 shows that the coverage rate with respect to the underlying population was quite stable across

[11]The proportion of workers employed by firms included in the sample over the population of private sector employees is instead close to 60% in all years.

Table 1: **Summary Statistics Weighted by Firms' Size (2006-2015)**

Variables	**Mean**	**St.dev.**	**Available Observations**
Log median contractual wage	4.099	0.109	3,515,332
Nominal contractual wage growth	0.024	0.014	2,650,312
Main coll. contract share in wage bill	0.928	0.138	3,515,299
Firms' closure	1.5%		3,515,332
Log full time eq. employees	4.367	2.358	3,515,332
Log firms' avg. wages	4.358	0.315	3,515,277
Incumbents' wage growth	0.027	0.087	2,693,455
Firms' avg. AKM worker fixed effects	0.000	0.188	3,515,332
Log value added p.w.	3.922	0.575	3,240,727
Log TFP	4.555	0.808	3,150,643
Log revenues	8.239	1.633	3,419,936
Log profit margin	-2.678	0.871	2,736,402
Log physical capital per worker	2.887	1.750	3,267,867
Total Number of Firms	603,855		
Total Number of Observations	3,515,332		

All means and standard deviations are computed weighting by the number of workers observed in the firm each year. Contractual wages refer to the nominal median pay level of the collective contract that covers the greatest proportion of the wage bill. Change in collective contract refers to the proportion of firms changing their main collective contract across years. Firms' closure is defined as a permanent exit from INPS' social security archives in the subsequent year. Balance sheet variables are derived from CERVED and are not always available for all firms in every year. AKM workers' fixed effects were computed using the Abowd et al. [1999] regression model and standardized as the difference from their mean value. TFP was derived from the Levinsohn and Petrin [2003] regression model.

time, which suggests that firms' selection into the sample is relatively homogeneous in all years.

Table 1 provides descriptive statistics for our sample of analysis computed after weighting for the number of workers in each firm. Overall, we have relied on an unbalanced panel of more than 600,000 firms and around 3.5 million firm-year observations. The average size of firms, measured in full-time equivalent number of workers (FTE) is of around 77 employees.[12] Median contractual daily wages are on average 30% lower and three times less dispersed than firms' actual daily average wages. The annual percentage growth of contractual wages is of 2.4%, a value that is slightly lower than the average growth of

[12]FTE workers are obtained as the total days worked in a year at the firm divided by 312, the standard length of full-time contracts.

incumbent workers' actual pay levels within firms (2.7%).

For each firm, we have computed also the average of its workers' fixed effects derived from an AKM regression model (Abowd et al. [1999]), which we have expressed as a difference from their mean value in the sample.[13] Appendix B provides more details on the AKM estimation procedure and its results. AKM worker fixed effects allow to rank employees time-constant relative earning abilities, conditional on employers' fixed effects and on observable time-varying characteristics. From Table 1, it can be noticed that the standard deviation of this measure of average workers' quality is 0.188. This dispersion accounts for around 60% of the total dispersion in firms' average wages, whose standard deviation amounts to 0.315.

For each firm, we have estimated a measure of total factor productivity (TFP) using the Levinsohn and Petrin [2003] method and adopting the value added-based regression approach. This method is based on the use of lagged intermediate goods to instrument for the choice of capital and labor levels, and allows to recover a measure of a firms' efficiency conditional on the amount of production factors employed. In general, firms' financial information is not always available due to missing variable problems arising in the CERVED database. The variable that is most affected by this problem is the profit margin (defined as earnings before taxes, interest and depreciation over revenues).

The percentage of firms that change their main collective contract (potentially starting to use a contract not included in our contractual wage sample) is only 3.4%. Appendix C provides a regression analysis on whether a firm's selection out of collective contracts is related to contractual wage growth, thereby assessing the relevance of this potentially endogenous sample selection mechanism. The percentage of firms that permanently disappear from INPS' archives in the subsequent year, typically because they run out of business or stop hiring any employee, is only 1.5%. Appendix C also assesses to what extent such firm exits are related to the wage growth stipulated by collective bargaining.

Table A1 provides additional statistics on yearly growth rates of the outcome and

[13] AKM worker fixed effects represent the difference in conditional wages with respect to an arbitrary reference worker, thus expressing them as a deviation from their mean value does not represent a loss of information.

treatment variables within firms. Since we have adopted a firm-fixed effect estimation strategy, this within firm variation is a close approximation of the variation actually used to identify the treatment effects of interests. As can be noticed, the yearly average contractual wage growth was 2.4% on average, with a standard deviation of only 1.4%. The outcome variables have instead a less persistent evolution within firms, as shown by higher standard deviations in their growth rates.

4 Regression Approach

In order to study the effects of higher labor costs on various firms' outcomes, we have exploited statutory changes in pay levels induced by collective bargaining. Since these shocks typically imply that firms need to adjust the wage of most of their workforce, contractual wage growth can be considered as a generalized growth in the cost of labor that hit all companies applying the same collective agreement.

We denote by w^c_{jt} the log median contractual wage bargained by a collective agreement c (that is, the median bargained pay level across the job titles defined by contract c). As mentioned, in cases were a firm applies more than one collective agreement to its employees, we have assigned this firm to the most expensive contract, *i.e.* the one that covers the largest proportion of its wage bill. The subscript j is a firm identifier, while t denotes the year. Whenever contractual wages were renewed in the middle of a year, w^c_{jt} was defined as the weighted average of the two (or more) pay levels applied during the year, with weights representing the number of months during which each level was in place.

The baseline specification of our regression model reads as

$$y_{jt} = \beta w^c_{jt} + j * c + s * l * t + e_{jt} \tag{1}$$

where $j * c$ is a firm by collective contract fixed effect,[14] $s * l * t$ is a Isic 38-sectors (s) fixed effect, specific for 107 administrative provinces (l), interacted by a year fixed effect

[14]In order to account for cases where the number of wage levels set within a collective contract had changed across time, we have also included in all specifications a collective contract by number of wage levels fixed effect. Results were qualitatively similar when excluding this further set of fixed effects.

t.[15] Finally, e_{jt} is the residual. Notice that sectors (s) and collective contracts (c) are different, albeit partially overlapping, categories. Indeed, many collective agreements are often specific for given firms' characteristics within sectors, such as their size or corporate structure. Similarly, several contracts cover either heterogeneous activities that can be found in more than one industry, or very specific tasks within a single sector.[16]

The main firm-level outcomes considered in our analysis are the following

$$y_{jt} = \begin{cases} \text{log value added per worker} \\ \text{log TFP} \\ \text{log FTE number of workers} \\ \text{log average daily wages} \\ \text{incumbents' average log wage growth} \\ \text{average AKM worker fixed effects} \\ \text{log revenues} \\ \text{log profit margin} \\ \text{log physical capital per worker} \end{cases}$$

In the case of incumbents' wage growth, we have excluded firm fixed effects from the specification in equation (1), since the outcome is expressed in first differences within firms.[17] Total factor productivity was computed using the Levinsohn and Petrin [2003] approach and adopting the value added-based regression approach. Profit margins were defined as earnings before interests, taxes and depreciations divided by revenues. In the Appendix, we present complementary evidences on further outcomes, namely: firms' closure, firms' switches in the collective contract applied to workers.[18]

Our treatment effect of interest (β) captures the effect of contractual wage growth on

[15] In the above equation, the symbol $*$ denotes an interaction operator, so that all time effects included in the model are specific for each sector in each geographic location.

[16] For example, professional counselors are typically hired under the trade collective agreement, but they are classified in the support service activities and not in the trade sector. Similarly, airlines' employees are covered by different agreements depending on whether a carrier is Italian or foreign.

[17] Given that the identity of incumbent workers changes in each period, adopting a standard fixed effects approach is not feasible for this outcome.

[18] The share of fixed-term employees and the average age of the workforce are two further outcomes that we have considered in complementary analyses.

the above firms' outcomes. This effect is estimated by comparing the evolution in the outcomes of firms affected by contractual wage changes with respect to a counterfactual group, represented by other firms in the same sector and geographic location that apply a different collective contract. Since equation (1) contains a firm by contract fixed effect and a year fixed effect that is interacted by 38 sectors' (using the Isic rev. 4 classification) and 107 Italian provinces' fixed effects, the regression model allows to control for a rich set of unobservable factors, such as local business cycle fluctuations and time constant differences between firms.

Identification Concerns and Interpretative Issues

Changes in contractual wages w_{it}^{c} could be potentially endogenous to the outcomes of our model, but this concern should not be overstated. Fanfani et al. [2023] show that contractual wage growth, during the period of our study, has been loosely related to productivity dynamics and mostly tied to coordinated inflation targets.[19] More generally, contractual wage growth in Italy is bargained at a quite centralized level, and it would be difficult for trade unions and employers' associations to account for business cycle dynamics that are not captured by the non-parametric sector- and geographic-specific time fixed effects included in our regression model. Indeed, contractual wages are uniformly set at the level of the national sector, while the granularity of our data, coupled with the usual presence of several collective contracts within standard industry groups, allows us to control for a rich set of local industry-specific shocks that would be difficult to incorporate into centralized wage negotiations.[20]

An interpretative issue concerning several outcomes derived from firms' financial statements involves the role of output and input prices. Firms could indeed pass-through the higher cost of labor on consumers, or they may cope with this shock by relying on cheaper

[19]Matano et al. [2019] documented that Italian contractual wages were slightly negatively affected by sector-wide import penetration during the late 1990s and early 2000s, but the size of these adjustments was quantitatively very small.

[20]In a robustness exercise, results were qualitatively similar excluding the largest firm of each collective contract. This suggests that the potential endogenous influence of the most powerful firm of the sector on wage negotiations is not particularly relevant in driving the results.

intermediate inputs.[21] In principle, these price dynamics have an influence on most variables derived from balance-sheet and profit and loss accounts, including productivity. Our regression model accounts for differences in input and output prices across firms, as long as such differences remain stable across time among companies belonging to the same industry and province. Any residual variation in prices is nevertheless going to affect our results, even if quantifying the relative importance of such idiosyncratic price dynamics is difficult, given the unavailability of firm-level price data.

In this regard, the joint availability of rich information on the workforce of all employers allows us to provide a more solid interpretative framework to characterize which mechanisms may be driving the treatment effects observed for outcomes derived form firms' financial accounts. For example, a reduction in revenues that coincides in magnitude with a reduction in physical employment can be more easily interpreted as an effect driven by a reduction in production quantities, even if residual output price dynamics may in principle mitigate or strengthen the size of the treatment effect on revenues.

Another identification concern is related to the potential strategic behavior of firms, which may decide to apply different collective agreements whenever a given contractual wage is raised. However, this possibility is typically limited by the law, according to which firms must apply the most representative collective contract given their activity. Moreover, the inclusion of firm by contract fixed effects in the regression model ensures that the parameter of interest is identified only by variations in the outcome of interest within firms whose most expensive collective contract identity did not change across time.

In Appendix C we explicitly account for the potential role of firms' self selection across collective contracts. In particular, we have estimated a model were the outcome of interest is an indicator for firms that change the main collective contract applied to their workforce in the subsequent year.[22] Results from this test show that firms' propensity to switch collective contract is not influenced by contractual wage growth.

A related issue concerns the possibility that firms may decide to apply more extensively

[21] See MaCurdy [2015] for a discussion on output price adjustments in the context of minimum wage hikes and on their welfare effects.

[22] As can be noticed from Table 1, around 3.4% of the firms switch collective contract in the subsequent year when considering our sample of analysis.

a less expensive collective contract to part of their workforce, even without changing the main one. On this respect, notice that all our outcomes of interest (including employment) are measured at the firm level and not at the contract-firm level. For example, if a decrease in employment in the main collective contract is compensated by a corresponding growth of workers hired under a secondary collective contract applied within the firm, this change in workforce composition would have no influence on our firm-level employment measure. This consideration also suggests that, in the presence of similar endogenous reshuffling of workers across collective contracts, our results can be interpreted as a lower bound of the policy effects that would be observed if non-compliance opportunities were completely absent.

Finally, the model of equation (1) includes only a contemporaneous contractual wage term w^c_{jt}, even if adjustments to the wage shock may take time to materialize (Baker et al. [1999]; Sorkin [2015]). A standard "event-study" analysis, where anticipatory and long-run effects are separately identified, would be unfeasible in the current setting. Contractual wages change quite frequently (on average more than once every 1.5 years), while our database is constructed at the yearly level. Thus, it is not possible to identify suitable treated and control groups over a sufficiently long observation window.

Since our treatment variable is continuous and relatively persistent across time, as it is typically characterized by small step-wise increments, the treatment effect estimated in our static specification is influenced also by long-run adjustments to the contractual wage growth. This occurs because the relevant lagged values of w^c_{jt} that are omitted from the model tend to be highly correlated with the included contemporaneous term.[23] This bias toward the cumulative effect of the policy is going to be stronger, the stronger the serial correlation among lags and leads of the treatment variable. Appendix D discusses the results obtained using a dynamic version of equation (1), where also leads and lags of w^c_{jt} are included.

[23]Lags of w^c_{jt} would capture long-run adjustments, since they measure the contemporaneous effect of a wage level applied in the past. In our static specification, these lags can be conceptualized as relevant omitted variables that are positively correlated with the treatment, given that w^c_{jt} is a persistent time series.

Table 2: **Effect of Contractual Wages on Firm's Outcomes - Baseline Regression Results**

Regressor	*Log median contractual wage*				
Outcomes	**Coeff.**	**St.err.**	**Adj.R^2**	**RMSE**	**Obs.**
Log value added p.w.	0.022	0.189	0.769	0.274	2,988M.
Log TFP	−0.163	0.146	0.829	0.331	2,911M.
Log full time eq. employees	−0.785*	0.330	0.977	0.356	3,257M.
Log firms' avg. wages	0.262*	0.115	0.909	0.094	3,257M.
Incumbents' log wage gr.	0.259**	0.048	0.062	0.001	2,642M.
Firms' avg. AKM worker f.e.	0.025	0.038	0.948	0.043	3,186M.
Log revenues	−0.647**	0.248	0.937	0.403	3,167M.
Log profit margin	−0.272	0.205	0.668	0.499	2,484M.
Log physical capital/worker	−0.140	0.347	0.903	0.536	3,028M.

*Significance levels: ** 1%; * 5%*

Results obtained by estimating the regression model of equation (1) *on several firms' outcomes. All regressions are weighted by the number of workers in the firm. Standard errors are clustered at the collective contract level. The number of observations in each model is computed excluding singleton groups, i.e. units that are perfectly identified by the fixed effects included in the regression. AKM workers' fixed effects were computed using the Abowd et al. [1999] regression model. TFP was derived from the Levinsohn and Petrin [2003] regression model.*

5 Baseline Regression Results

Table 2 provides the results obtained from the regression model of equation (1), which estimates the effect of the growth in contractual wages on several firms' outcomes. All regressions include year fixed effects interacted by 38 industry - 107 provinces fixed effects. Standard errors are always clustered at the collective contract level[24] and regressions are weighted by the number of workers in the firm.

As can be noticed, the baseline regression results show that, on average, the effect of higher contractual wages on value added per worker is not significant. A similar result is found also when using TFP as the dependent variable, which better accounts for heterogeneity in fixed costs across firms and for endogenous adjustments in the quantity of labor employed. Overall, our results suggest that higher labor costs do not trigger a generalised

[24]We have alternatively produced standard errors clustered at the firm level, and the statistical significance of the results was largely unaffected.

improvement in efficiency, which is consistent with previous findings in the context of the minimum wage by Draca et al. [2011], but which differs from other evidences on UK (Riley and Bondibene [2017]) and China (Mayneris et al. [2018]).

In principle, higher wage levels could potentially affect productivity through several channels. On the one hand, there could be a reduction in managerial slack, which could be used to align workers' marginal product to the new pay levels, or an improvement in workers' effort (*e.g.* Coviello et al. [2022]). On the other hand, there could be indirect effects on productivity triggered by firms' reliance on other adjustment margins, such as selective changes in the employment composition (*e.g* Horton [2017] and Clemens et al. [2021]), size reductions, output price increases, or higher investments in capital goods. Thus, it is interesting to investigate on which other adjustment margins firms rely when facing higher labor costs.

The third row of Table 2 shows that the average effect of higher labor costs on firms' employment is negative and sizable. Indeed, a one percent growth in contractual wages is associated to reductions in employment by almost 0.8 percent. Strong negative employment effects associated to contractual wage growth are documented also by Fanfani [2020] using the entire private-sector workforce and monthly-level administrative data for Italy. Several factors may concur in rationalizing this effect. First, contractual wages affect virtually all workers across the pay distribution, not only those at the bottom, as is the case for minimum wages. Secondly, economic growth has been always close to zero or negative during the period of our study, and statutory pay growth has been shown to be more detrimental for employment during economic downturns (Clemens and Wither [2019]). Finally, the very low inflation levels that have characterized the period of our study could have also contributed to strengthening the size of the employment effects, as low inflation implies that nominal contractual wage increases are not rapidly eroded in real terms.[25]

The fourth row shows that the elasticity of firms' average wages to the growth in contractual wages is positive and significant, but also smaller in magnitude to the respective

[25]Sorkin [2015] emphasizes the importance of inflation in affecting the size of employment adjustments in the context of the minimum wage.

employment elasticity. These results suggest that employment losses related to higher labor costs are more than proportional than the wage gains. Average firms' wages can be also influenced by employment composition, which changes across time. A more accurate measure of the direct effect of contractual wages on workers' pay is provided in the fifth row of Table 2, which shows that a one percent growth in contractual wages is associated to a 0.26 percentage point increase in the growth rate of incumbents' wages. Incumbents' pay growth is indeed computed on a fixed population of workers within firms, thus it is not affected by differences in composition across time.

Notice that contractual wage growth induces a less than proportional effect on the actual pay growth of incumbent workers. The size of this marginal effect can be rationalized by at least two mechanisms. First, contractual wage growth in principle should not directly affect the size of the wage cushion (*i.e.* the part of the pay representing the positive difference between actual and minimum statutory wage levels).[26] Secondly, the marginal effect of our model represents a relative difference between firms affected by positive contractual wage growth, and a counterfactual group for which pay floors are kept constant. Thus, if actual pay growth is still positive (but weaker) also in the absence of contractual wage growth, the treatment effect for this outcome can be less than proportional than the difference in contractual wage growth between the treated and control groups.

In order to shed more light on the adjustment channel of employee selection, we have estimated a measure of workers' quality based on the AKM regression model. This technique, which is presented in Appendix B, allows to recover an estimate of worker fixed effects that is conditional on observable characteristics and on firm-specific pay policies. Thus, these worker fixed effects can be interpreted as a measure of the employees' time-constant earning abilities. Since they are, by definition, constant across time, a firm can change the average level of its employees fixed effects only through selective hiring and firing.

The sixth row of Table 2 shows that the average quality of the workforce (defined using

[26] In some instances, the wage cushion could even be reduced if it is made up of pay premiums that are flexible enough.

AKM workers' fixed effects) is actually unaffected by higher labor costs. However, the next section further characterizes and discusses this result, by showing that the treatment effect is instead highly heterogeneous and different from zero across the distribution of firms' productivity, suggesting that companies rely on selective employment adjustments, but using differentiated strategies depending on their efficiency levels.

The seventh row of Table 2 shows that firms' revenues are negatively affected by the growth in contractual wages. This result suggests that the employment losses previously discussed translate also into lower sales. As discussed above, revenues are made up of two components, output prices and quantities. In our context, the presence of negative revenues effects seems likely to be driven mostly by quantity reductions, as the regression model controls for sector-wide price shocks at a quite granular level through sector- and geographic-specific time fixed effects, as well as for time-constant firms' heterogeneity in market power. Moreover, the reductions in physical employment that we have documented appear to be consistent with a drop in physical production levels. On this respect, the presence of potential pass-through mechanisms of higher wage floors to consumers via increases in product market prices would actually characterise the elasticity of revenues to contractual wages as a downward biased measure of the true effect on output quantities.

Finally, the last two panels of Table 2 show that the profit margin and the intensity in the use of physical capital are not affected by the growth in the cost of labor. The null effect on capital intensity implies an overall reduction in investments, since employment is also negatively affected by the shock. Thus, firms seem to have limited possibilities of adopting more capital-intensive (and potentially more productive) production processes (see *e.g* Acemoglu [2003] for a theoretical discussion of this point). Instead, the wage shocks to the firm analysed in this application produce mostly scale effects, as on average investments are reduced together with employment and production levels.

Overall, the results from our baseline regression model show that on average firms responded to higher contractual wages by decreasing production levels and employment. Average firms' wages are instead increased by this shock. Moreover, there are no effects on firms' productivity, on employees' quality, on the profit margin and on capital intensity.

From an aggregate perspective, these results suggest that growing contractual wages contribute to a modest increase in the labor share or, equivalently, to higher unit labor costs (given the positive effect on wages and the null effect on productivity), reducing total output and, more generally, the international competitiveness of Italian companies (see Dustmann et al. [2014]). The next section further characterize these results, by uncovering the heterogeneity in adjustment behavior along the distribution of firms' productivity.

6 Effects of Contractual Wages Across the Firms' Productivity Distribution

This section presents the heterogeneity in the effects of contractual wage growth across the distribution of firms' productivity, which we define as value added per worker. Results were qualitatively very similar when using instead TFP to rank firms. Productivity has been often considered a dimension along which the effects of centralized wage bargaining can be heterogeneous. According to models of firms' entry, a centralized wage favors relatively more efficient competitors (Moene and Wallerstein [1997], Barth et al. [2014]). The previous theoretical and empirical literature that has analyzed collective bargaining in Italy has also highlighted that productivity differentials do not map very well into wage differentials (Boeri et al. [2021]). In this context, it is reasonable to assume that the effects of centralized wage growth could be differentiated across the productivity distribution of firms hit by this shock.

To describe heterogeneities in the response to contractual wage growth, we have adopted a regression specification similar to the model provided in equation (1). Using the same notation, the estimated model reads as

$$y_{jt} = \sum_{\theta=1}^{4} \beta_\theta w_{jt}^c * q(\theta)_j + j * c + s * l * t + e_{jt} \tag{2}$$

We have interacted contractual wages w_{jt}^c with four indicator variables $q(\theta)_j$, denoting time-constant quartiles of productivity to which each firm j belongs. This approach is similar to running separate regressions on four split samples, but we have used interactions on the full dataset to improve efficiency in the estimation of β_θ, which represent the four parameters of interests.

The quartiles $q(\theta)_j$ were time-constant, defined using the contract- and year-specific distribution of value added per worker. We made these quartiles as always constant over time for each firm, by assigning them to their most common quartile across all years. For example, a metal-manufacturing firm was included in the fourth quartile of productivity if it was among the highest value-added per worker companies in the metal-manufacturing collective contract during most of the years of observation.[27]

Figure 3 presents the results obtained by estimating the model of equation (2). In each panel, the first quartile refers to the lowest productivity quartile of firms, while the fourth refers to the most efficient one. Each panel in the figure shows the marginal effect of higher contractual wages for each quartile, together with the 95% confidence interval.

The top panel in Figure 3 shows that higher contractual wages had a positive effect on pay levels among incumbents for all types of firms.[28] Thus, contractual pay levels have a similar and positive effect on wages for all types of firms. The panels in the second row of Figure 3 show that the overall null effect of higher labor costs on productivity is instead heterogeneous along its distribution. It is strongly negative for less efficient firms and small and positive for the two highest quartiles of the productivity distribution. Our joint analysis on several outcomes allows us to uncover more precisely how most efficient firms' adjustment margins differ from those exploited by less productive companies. Two main mechanisms seem to emerge from this analysis. First, efficient firms gain market shares with respect to less productive competitors. Second, employment levels and its composition are adjusted differently, depending on the relative productivity of each firm.

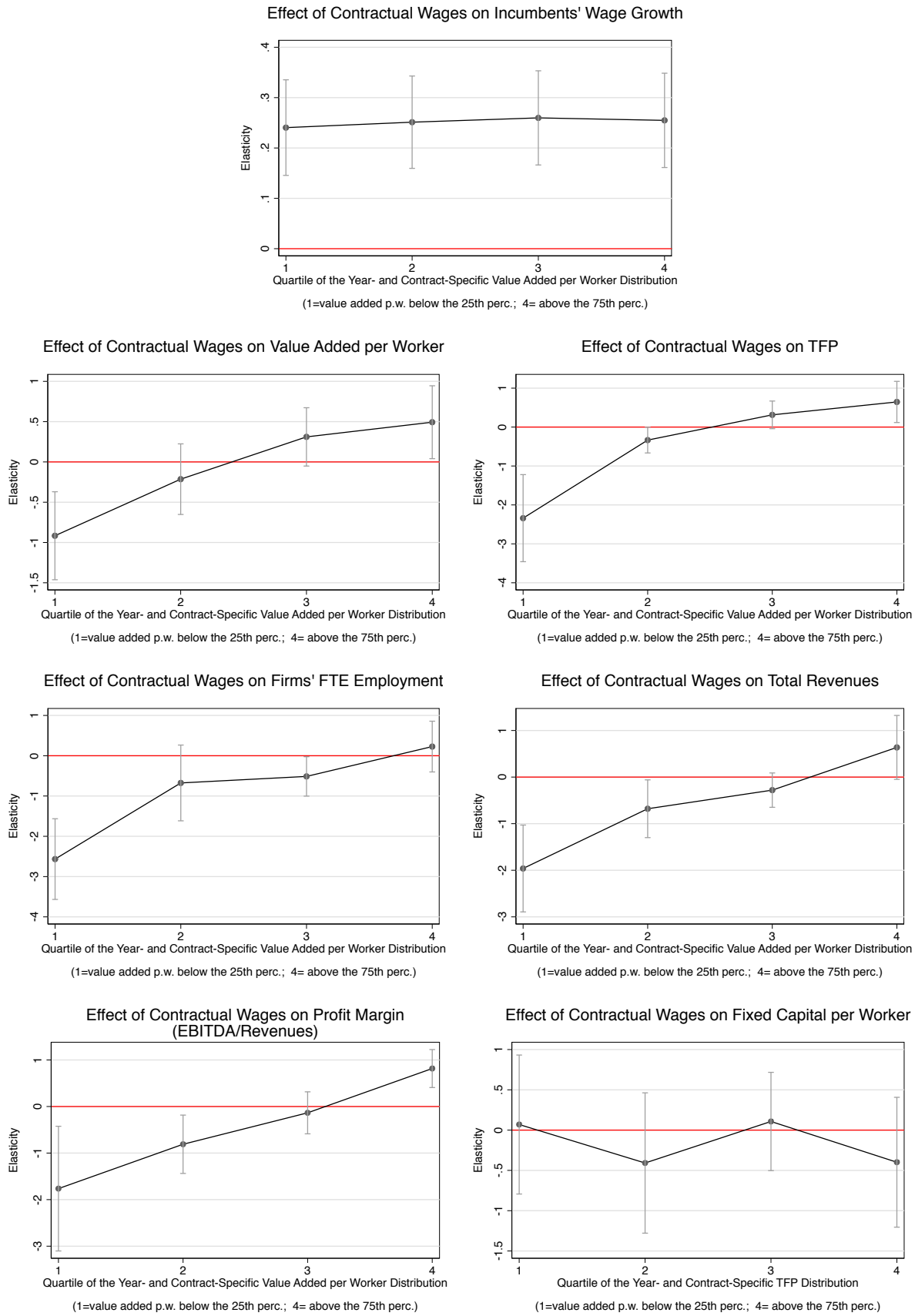
Employment, revenues and cleansing effects

The left panel in the third row of Figure 3 shows that the negative employment effects of higher labor costs are mostly borne by low-productivity firms, while they are not significantly different from zero in the highest quartile. Thus, firms that are more efficient

[27]Results were qualitatively robust to small changes in the classification of firms into different quartiles, such as when considering the contract-specific, rather than the year-contract specific productivity distribution.

[28]Focusing on incumbents' pay growth allows us to better capture wage effects net of the firms' overall employment composition, which may change from year to year.

Figure 3: **Heterogeneity of Wage Growth Effects Across the Contract-Specific Distribution of Value Added per Worker**



tend to be more resourceful, as they are able to absorb the cost shock without incurring in employment losses. This suggest that productive companies exploit non-competitive adjustment mechanisms that rely on rents that they may posses in the product or labor market. In this section, we show that these differences in adjustment mechanisms across firms provide profitable externalities to dominant firms within a collective contract.

The hypothesis that higher labor costs could provide a barrier to entry by dominant companies within a sector has a long tradition in economics (Williamson [1968]). Vintage models of firms' survival in the context of centralized wage setting, as developed by Moene and Wallerstein [1997] and Barth et al. [2014], similarly suggest that employment reallocation toward more productive firms could emerge in a context where wage moderation imposes similar pay levels to an heterogeneously efficient population of firms. The recent literature on regional misallocation further suggests that wage compression could produce perverse welfare effects and excess rents among employers in most productive regions (see in particular Boeri et al. [2021]). However, the importance of this mechanism has been rarely investigated in the empirical literature.

Figure 3 shows that while revenues reduce as a consequence of contractual wage growth for less efficient firms, they actually slightly increase in the highest quartile of most efficient companies. As mentioned, revenues are made up of prices and quantities. However, given the inclusion of year fixed effects by industry and geographic location, we can safely assume that heterogeneity in revenue effects across the contract-specific productivity distribution is mostly driven by relative differences in quantities produced. This evidence is consistent with an increase in the product market shares of more productive companies, as long as firms belonging to the same collective agreement are also likely to share the same product market.

An alternative hypothesis could be that efficient companies systematically select into segmented product markets characterized by a rigid demand or by monopolistic power, where price or markups adjustments are possible. On this last respect, it should be noticed that the drop in revenues and employment are very similar in shape and relative magnitude across the productivity distribution. This further suggests that revenues changes largely

map into output quantity changes, rather than in changes in output prices. That is, productive companies' market shares seem to increase, as heterogeneity in revenue effects does not seem to be simply driven by heterogeneity in price adjustments.

Another test for the hypothesis that differential cost-price pass-through across firms is not the major mechanism driving our results is provided by Figure A1 in the Appendix. In this robustness test, we interact the treatment effect by a dummy variable indicating industries (at the 3-digits level) characterized by a nation-wide Herfindal index above the median.[29] The industry-wide Herfindal index, computed on the basis of firms' revenues in each industry, can be considered a proxy for the level of product market competition and price setting power of firms. As can be noticed, also when estimating separately revenues and employment effects within more versus less competitive industries, a very similar shape emerges across the productivity distribution for both outcomes.

Notice that when considering profit margins, the effect of higher labor costs appears to be negative for relatively less productive firms, while the effect is instead slightly positive in the quartile of most efficient companies. This indicates that companies that are able to deal with higher labor costs without cutting production may actually increase their profits due to a cleansing effect on less productive competitors. The hypothesis that increasing own and rivals' costs can be profitable has a long tradition in the industrial organization literature (*e.g.* Salop and Scheffman [1983]), and it seems to be relevant for our results. The recent literature on cleansing effects during recessions (see in particular Foster et al. [2016] and Osotimehin and Pappadà [2016]) has shown that positive selection of firms can be limited during severe downturns, due to potential distortions in the credit market. On this respect, our evidence suggests that input cost shocks, as opposed to negative movements in the product market demand, tend to be more cleansing as they provide a competitive advantage to more productive firms.

To further explore this issue, Appendix C provides an analysis of the impact of contractual wage growth on firms' exit rates. Overall, we did not find significant changes in firms' closure rates in response to higher labor costs in our sample of analysis, which is

[29] Lacking firm-level data on output prices, this can be considered a more direct feasible test for the role of firm-level heterogeneity in price-setting power.

made up of incorporated businesses only. However, when extending this analysis on the entire INPS archives covering the private sector, we found significant increases in firms' exit rates among very small companies, *i.e.* those with less than five employees. This evidence suggests that relatively larger companies reduce output levels on the intensive margin, but the cost shock related to contractual wages is not strong enough to drive these employers out of the market. Instead, this can be the case among very small firms, which are less likely to be included in our main sample of analysis, as they tend to be unincorporated, while they also represent the group for which the wage bill tends to be more relevant in proportion to total costs. Overall, even if the more extreme event of a firms' closure was not affected by contractual wages in our sample, this mechanism appears to be relevant when focusing on a sub-group of firms that are smaller and more intensively hit by the labor cost shock. The exit channel thus further contributes to the determination of "cleansing effects", where the latter refers to a combination of firm closures (in the case of small enterprises) and a redistribution of market shares towards more efficient firms within the sample of surviving incorporated business.

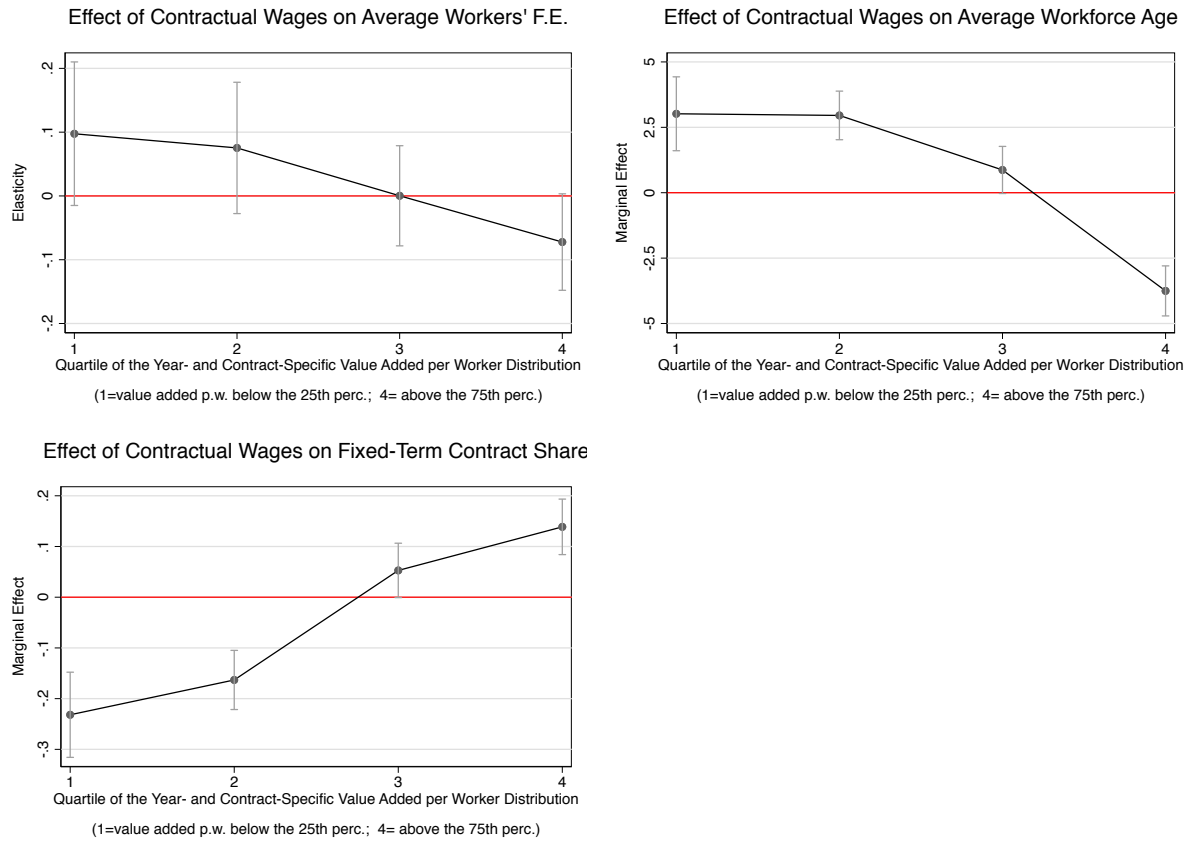
Figure 3 also shows that capital intensity is not affected by wage growth across the entire firms' productivity distribution. This evidence entails that investments in physical capital reduce at less efficient companies, for which we have documented a strong and significant employment reduction as a consequence of the contractual wage shock. It also implies that there is a reallocation of capital away from less productive firms, even if it is not accompanied by detectable improvements in investment levels among more efficient companies.[30]

Employment composition effects

In order to provide evidence on workforce selection, Figure 4 shows the effect of contractual wage growth on several measures of workforce quality. The top-left panel shows the effects on employee quality measured by AKM workers' fixed effects. While this measure tends to increase among least efficient companies, which also reduce employment, the quality of

[30]From an aggregate perspective capital misallocation tends to be particularly relevant in the Italian case (Cardullo et al. [2015] and Calligaris et al. [2018]).

Figure 4: **Heterogeneity of Wage Growth Effects Across the Contract-Specific Distribution of Value Added per Worker - Workforce Quality, Age and Fixed-Term Contract Share**



workers actually drops among most productive firms. Further evidences on this pattern are provided by considering as outcomes of interest the average age and the proportion of fixed-term employees within firms.[31] The right and bottom-left panels of Figure 4 show that, consistently with the pattern emerging from the analysis of AKM workers' fixed effects, average workers' age drops at more productive firms and it increases at less productive ones, while the share of fixed-term workers increases at efficient firms, while it decreases elsewhere.

The patterns of workforce selection described above are consistent with several mechanisms. First, low-productivity firms, which tend to cut employment, may concentrate

[31] Table A2 in the Appendix shows that on average there was a significant growth in the average age of the workers and a negative, but statistically not significant effect on the share of fixed-term contracts in response to higher contractual wages. Notice that a growth in the average share of fixed-term contracts does not necessarily imply a growth in fixed-term employment, as this depends also on whether fixed-term intensive firms adjust their employment differently from other companies. On this respect, in a complementary analysis of the employment effects of collective bargaining, Fanfani [2020] shows that employment losses associated with this policy are stronger among young- and fixed-term workers.

their production in most profitable market segments. Indeed, most of the employment losses observed at these companies hit lower-quality and marginal workers. Evidences on similar mechanisms are provided in the context of the minimum wage by Horton [2017] and Clemens et al. [2021]. However, productivity does not grow among less efficient firms as a result of this process, which suggests that their negative employment adjustments may be sub-optimal due to frictions and potentially high firing costs, which are considerably more pronounced for employees with open-ended contracts.

On the other hand, productive firms hit by the wage shock do not cut overall employment after the shock. In this context, their more intensive reliance on low-quality workers could be a cost-saving strategy. Indeed, the reduction in the average age of the workforce among efficient companies seems consistent with a "young-in old-out" strategy, where typically more expensive older workers with open-ended contracts are pushed to retire, while firms start relying more on cheaper young and fixed-term workers.[32]

Finally, when considering general equilibrium effects of the labor cost shock, it is also possible that productive companies are able to absorb part of the job losses observed at their less efficient competitors. In this context, as low quality workers become more easily available in the labor market, reallocation mechanisms, emphasized also in the context of minimum wage policies by Dustmann et al. [2020], could be a relevant channel through which less productive employees sort toward more productive firms.

7 Conclusions

Our analysis shows how higher contractual wages set by Italian collective bargaining affect firms' behavior. On average, the growth in contractual wages induced firms to cut employment and revenues. Instead, companies' average wages increased, while workers' quality, productivity, capital intensity and the profit margin were not affected by the shock.

When looking at the heterogeneity in adjustment behavior across the productivity dis-

[32]The relationship between employment selection across age groups and institutional mechanisms has been often emphasized in the Italian context with reference to tax credits and firing costs (*e.g.* Ardito et al. [2019]) or pension rules (*e.g.* Bianchi et al. [2021]). Evidences on the influence of collective bargaining are much less abundant (Fanfani [2020]).

tribution, higher labor costs induced a small growth in efficiency for more productive firms and a strong decline for the least efficient ones. We have argued that this heterogeneity in efficiency effects is partly driven by cleansing mechanisms that increase the product market share of relatively more productive firms. Consistently with this hypothesis, we have found that relatively more efficient companies within a sectoral collective agreement increase their revenues, they do not cut employment and investments and they slightly increase their profit margin in response to higher contractual wages. We did not find differences in exit rates among incorporated companies after a growth in labor costs, but we have found evidences of higher firms' closures when extending the sample of analysis to the entire private sector and focusing on very small firms.

Our results have more general implications, as they show that increases in relative labor costs can have nuanced effects on the economy, decreasing production levels and employment on average, but providing most productive establishments with a competitive advantage. Profitability of such companies can even increase due to greater product market shares, as as rival costs are raised (*e.g.* Salop and Scheffman [1983], Williamson [1968]). Cleansing mechanisms have been discussed in the literature with reference to other kinds of firm-level shocks. They have been linked to the presence of credit market imperfections, which tend to hit firms relying more on external finance (see *e.g.* Pagano and Pica [2012] and Giroud and Mueller [2017]) and which induce companies to increase workers' quality (*e.g.* Berton et al. [2018]). Instead, cleansing mechanisms have been found to be potentially weaker in the context of strong negative demand shocks (*e.g.* Foster et al. [2016] and Osotimehin and Pappadà [2016]). On this respect, the statutory increases in wage levels considered in our analysis seem to generate a more pronounced positive selection in the underlying composition of firms.

Our results are consistent with hypotheses linking average productivity to wage setting structures, as developed by Acemoglu [2003] to explain cross-country heterogeneities in inequality and productivity, or the vintage approach theories that explain differential survival rates of firms across the efficiency distribution in the context of collective bargaining (see in particular Moene and Wallerstein [1997] and Barth et al. [2014]). However, our

results show that productivity gains related to higher wage floors are not significant on average. Moreover, reallocation effects toward more productive firms are accompanied by overall reductions in employment levels. Less skilled workers tend to suffer most of the employment losses at less efficient companies, but, consistently with workers' reallocation evidences documented by Dustmann et al. [2020] in the context of the German minimum wage, we also find that their employment share at most efficient firms increases.

These evidences contribute to the literature on the Southern European productivity puzzle (see Calligaris et al. [2018] and Schivardi and Schmitz [2020]), as they show that labor market institutions have a relevant effect on the allocation of resources and market shares, which could potentially influence also management practices. The mechanism underlined in this study also shows how institutional factors related to the system of industrial relations may contribute to concentration in the product market, for which the recent literature has documented a positive secular trend (De Loecker et al. [2020]). Moreover, our results further support the conclusions of studies on the relationship between centralized wage setting and regional misallocation (see in particular Manacorda and Petrongolo [2006] and Boeri et al. [2021]), as we have shown the relevance of several mechanisms emphasized by this literature using granular data and a causal research design. Finally, by documenting the presence of rather sizable adjustments while analyzing wage shocks that were more extensive than those typically arising in the context of minimum wage hikes, where instead pay rises tend to affect only the bottom of the income distribution, we have provided novel evidences that could help rationalizing the elusive effects of the minimum wage discussed by Manning [2021].

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Appendix

A Other Figures and Tables

Table A1: **Growth Rates of Treatment and Outcome Variables (2007-2015)**

Variables' growth rates	**Mean**	**St.dev.**	**Available Observations**
Log median contractual wage	0.024	0.014	2,650,312
Log full time eq. employees	0.065	0.462	2,737,630
Log firms' avg. wages	0.025	0.121	2,737,559
Log incumbents' wages	0.027	0.087	2,693,455
Firms' avg. AKM worker fixed effects	-0.004	0.079	2,737,630
Log value added p.w.	-0.018	0.324	2,475,742
Log TFP	-0.007	0.391	2,421,887
Log revenues	0.054	0.463	2,654,520
Log profit margin	-0.031	0.603	1,939,900
Log physical capital per worker	-0.026	0.543	2,538,694

Growth rates are computed as log differences of each variable between consecutive years within firms. Averages and standard deviations are computed weighting by firms' size. The first year of the sample (2006) is omitted.

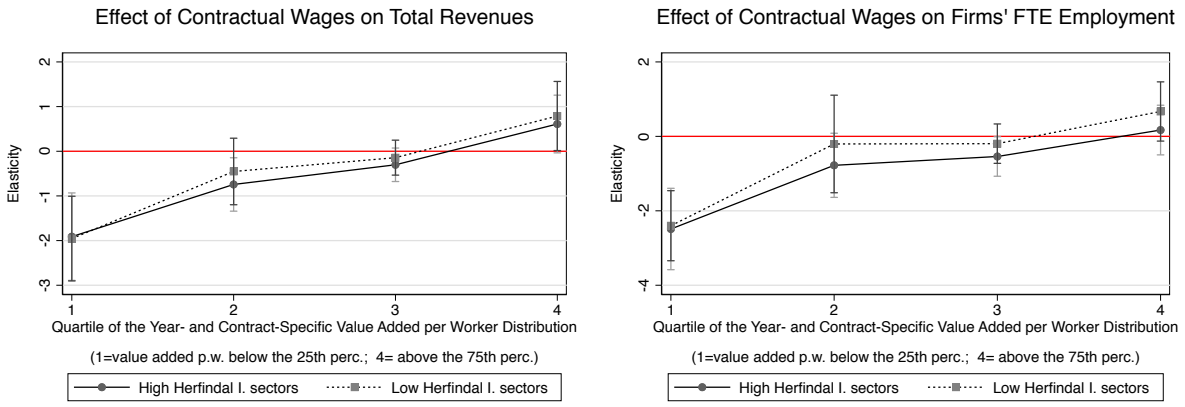
Table A2: **Effect of Contractual Wages on Average Workforce Age and Fixed-Term Share**

	Dependent variable: log median contractual wage				
Outcomes	**Coeff.**	**St.err.**	**Adj.R^2**	**RMSE**	**Obs.**
Workers' avg. age	0.827*	0.370	0.916	1.473	3,257M.
Fixed-term share	−0.030	0.023	0.830	0.107	3,257M.

*Significance levels: ** 1%; * 5%*

Results obtained by estimating the regression model of equation (1) *on several firms' outcomes. All regressions are weighted by the number of workers in the firm. Standard errors are clustered at the collective contract level. The number of observations in each model is computed excluding singleton groups, i.e. units that are perfectly identified by the fixed effects included in the regression. The specification of the regression model is provided in equation* (1).

Figure A1: **Heterogeneity of Wage Growth Effects Across the Contract-Specific Distribution of Value Added per Worker - Split Between More and Less Concentrated 3-Digit Industries Based on the Herfindal Index**



Revenues and employment effects of contractual wage growth. The treatment effect is interacted by quartiles of the contract-specific productivity distribution and by a dummy variable for high-Herfindal index 3-digit industries (those above the median Herfindal index level).

B AKM Regression Results

In order to build a time-constant measure of workers' quality, we have estimated an AKM regression model of the form

$$w_{ijt} = x_{ijt}\gamma + \eta_i + \psi_{j=\iota(i,t)} + \epsilon_{ijt}$$

on two panels created using the universe of social security records (including both men and women). The two datasets cover the years 2006-2010 and 2011-2015 respectively. The set of controls in x_{ijt} consisted of: three occupation dummies; a cubic polynomial in age interacted by sex and occupation; a part-time dummy interacted by sex; a fixed-term contract dummy; year fixed effects. Table B1 summarizes the AKM wage variance decomposition computed in the two panels, considering both, the full sample and the matched CERVED sample of incorporated businesses.

Notice that the AKM variance decomposition results provided by Table B1 look well identified. All covariances are positive and indicate that better paid workers are positively sorted in better paying firms, while more endowed workers in terms of observables also tend to have higher workers' fixed effects, as one would expect. The relative contributions

Table B1: **AKM Decomposition of the Wage Variance**

	$\text{Var}(\phi_j)$	$\text{Var}(\eta_i)$	$\text{Var}(x_{ijt}\beta)$	$\text{Var}(\epsilon_{ijt})$	$2\text{C}(\phi_j, \eta_i)$	$2\text{C}(\phi_j, x_{ijt}\beta)$	$2\text{C}(\eta_i, x_{ijt}\beta)$	$\mathbf{Var(w_{ijt})}$
ALL SAMPLE								
2006-2010	0.041	0.101	0.007	0.017	0.006	0.002	0.011	**0.186**
% of Total	*22.2*	*54.6*	*3.8*	*9.2*	*3.2*	*1.1*	*5.9*	***100***
2011-2015	0.048	0.104	0.007	0.016	0.001	0.002	0.008	**0.187**
% of Total	*25.8*	*55.9*	*3.8*	*8.6*	*0.5*	*1.1*	*4.3*	***100***
INPS - CERVED SAMPLE								
2006-2010	0.027	0.097	0.007	0.017	0.009	0.001	0.011	**0.169**
% of Total	*16*	*57.4*	*4.1*	*10.1*	*5.3*	*0.5*	*6.5*	***100***
2011-2015	0.030	0.100	0.007	0.016	0.004	0.001	0.007	**0.165**
% of Total	*18.2*	*60.6*	*4.2*	*9.7*	*2.4*	*0.6*	*4.2*	***100***

Percentage changes for a given quantity z from z_{t-1} to z_t are computed as $100(z_t - z_{t-1})/z_r$, where $z_r = (|z_t| + |z_{t-1}|)/2$

of firm fixed effects and of worker fixed effects to the total wage variance are always in a reasonable range, which is consistent with previous results on Italy (see *e.g.* Devicienti et al. [2019]). Notice also that the wage variance and its components are very stable across time, despite of the economic recession. In this regression model, workers' fixed effects η_i measure an employee's earning ability controlling for non-random selection of workers across firms and on time-varying characteristics. Thus, it can be considered a time-constant, comprehensive measure of workers' quality. In order to include the average level of workers' fixed effects as an outcome of our main regression model in equation 1, we have first normalized these parameters across the 2006-2010 and 2011-2015 panels. In particular, we have defined $\bar{\eta}_i$ as the difference from the panel-specific mean of η_i and considered for each worker the average of these normalized fixed effects $\bar{\eta}_i$ over the period 2006-2015, in order to make them time constant throughout these years.[33]

[33]See Card et al. [2016] for a discussion on normalization issues concerning firm and worker fixed effects in the context of AKM regression models.

C An Analysis on Firms' Exit and Contract Switching Behavior

In this section, we analyze two outcomes that could be potentially relevant in the context of contractual wage growth. First, we consider firms' exit from the labor market, defined as a permanent loss of all employees registered in the INPS archives. Second, we consider firms' change in the main collective contract applied to the workforce. Both outcomes allow us to quantify the importance of alternative adjustment mechanisms available to firms. On one hand, firms could shut down production completely, outsource production or rely on the black market when facing higher labor costs and, as a consequence, they could disappear from the archives covering formal employment relationships.[34] On the other hand, they could decide to not comply to contractual wage standards, by self-selecting into less expensive collective agreements after a growth in labor costs.

For what concern firms' closure, the outcome variable was defined as equal to one if a firm had zero employees registered in the INPS archives during the following three consecutive years. Contract switching was defined as an indicator variable for firms whose main collective contract applied to its workforce was different during the following year (including also changes to collective contracts whose contractual wage was unavailable in our hand-collected database on minimum wages).

We have adopted a different specification of equation (1) when studying these two outcomes, omitting firm fixed effects and replacing them with two-digit sector fixed effects. Indeed, only exiting or contract-switching companies would otherwise contribute to the identification of the parameter of interest if we were exploiting only within-firm variation in the outcomes. The regression model that we have adopted included also a cubic polynomial in firms' age in order to control for differences in the likelihood of closing down or switching contract along this dimension. Finally, year by 38 industry and 107 provinces fixed effects were also included, in order to account for general shocks in the probabilities of closing down or switching contract. We have estimated the regression model using OLS, so that the treatment effect associated log contractual wages can be interpreted as

[34] The relevance of firms' closure has been considered by several studies analyzing the impact of minimum wages, *e.g.* Draca et al. [2011], Luca and Luca [2019] and Alexandre et al. [2020].

Table C1: **Effect of Contractual Wages on Firms' Closure and Change of Contract - CERVED-INPS Sample**

	Treatment variable: log median contractual wage				
Outcomes	**Coeff.**	**St.err.**	**Adj.R^2**	**RMSE**	**Obs.**
Firm exit	0.013	0.013	0.019	0.075	2,635M.
Change of contract	−0.060	0.059	0.052	0.149	2,179M.

*Significance levels: ** 1%; * 5%*

Results obtained by estimating the effect of contractual wages on an indicator of firms' permanent exit from INPS archives and on an indicator for firms changing the main collective contract applied to its workers. The estimation method is OLS controlling for a cubic polynomial in firms' age, log of firms' size, collective contract and two-digit sector fixed effects, 38-industry by 107 province fixed effects interacted with year fixed effects. All regressions are weighted by the number of workers in the firm. Standard errors are clustered at the collective contract. The number of observations in each model is computed excluding singleton groups, i.e. units that are perfectly identified by the fixed effects included in the regression.

an additive effect on the probability of closing down or switching contract.

Table C1 summarizes the results for the two regression models described above. The sample of analysis was composed of all firms included in the marched INPS-CERVED-contractual wage database. As can be noticed, contractual wage growth had no significant effects on the probability of shutting down employment, nor on the probability of changing the main collective contract applied to the workforce. This last result is reassuring when interpreted as a robustness test on sample selection into our database of analysis. Indeed, endogenous changes in the collective contract applied to workers do not seem to play a relevant role. Instead, the result on firms' mortality suggests that this "hard" outcome is not relevant, at least for what concern our sample of analysis, which consists of incorporated businesses only. Thus, the employment losses associated to contractual wage growth, which we have documented, were driven mostly by generalized adjustments in the intensive margin of production, rather than by complete shut-downs of selected companies. Results were not significantly different from zero also when estimated across the distribution of value added per worker, although this output has been omitted for brevity.

We have replicated the same analysis considering the full sample in the INPS archives, in order gain a better understanding on whether focusing on the entire population of private-

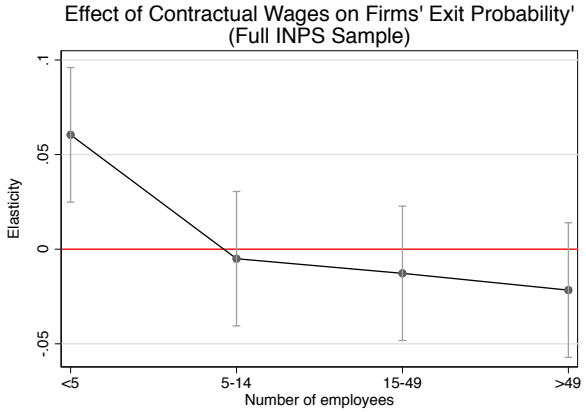
Table C2: **Effect of Contractual Wages on Firms' Closure and Change of Contract - Full INPS Sample**

	Treatment variable: log median contractual wage				
Outcomes	**Coeff.**	**St.err.**	**Adj.R^2**	**RMSE**	**Obs.**
Firm exit	0.073*	0.037	0.019	0.068	8,887M.
Change of contract	−0.016	0.041	0.065	0.143	6,910M.

*Significance levels: ** 1%; * 5%*

Results obtained by estimating the effect of contractual wages on an indicator of firms' permanent exit from INPS archives and on an indicator for firms changing the main collective contract applied to its workers. The estimation method is OLS controlling for a cubic polynomial in firms' age, log of firms' size, collective contract and two-digit sector fixed effects, 38-industry by 107 province fixed effects interacted with year fixed effects. All regressions are weighted by the number of workers in the firm. Standard errors are clustered at the collective contract. The number of observations in each model is computed excluding singleton groups, i.e. units that are perfectly identified by the fixed effects included in the regression..

Figure C1: **Heterogeneity of Firms' Closure Effects Across the Firm Size Distribution - Full INPS Sample**



sector firms leads to the same conclusions. In particular, we have estimated the same regression model on the full sample of INPS records over the years 2006-2015, matched with the contractual wage database used for the main analyses of the paper. The results are summarized in Table C2. As can be noticed, contract-switching is not significantly affected by the growth in contractual wages. Instead, firms' exit is positively affected by contractual wage growth, with a significance level that is close to 0.05. However, the size of the coefficient is not particularly strong, as a 10% growth in contractual wages increases the probability of firms' closure by 0.7 percentage points only.

One reason why the effect of contractual wage growth on firms' mortality is marginally significant in the full INPS sample could be the inclusion of very small firms with potentially one or few employees, which were much more likely to be excluded from the matched INPS-CERVED data. For these firms, labor costs are more likely to represent a larger share of total costs, so that changes in contractual wages may trigger their closure. To test this hypothesis, Figure C1 shows the heterogeneity in the effects of contractual wage growth across the firms' size distribution. As can be noticed, the positive effect on firms' mortality is driven by very small firms, those with less than five employees. For all other groups, the growth in contractual wages has no significant effects on their probability of exiting from the market. The size of the coefficient associated to the smallest group of firms is similar in size to the one estimated in the full sample, but the parameter is now estimated more precisely and it is significantly different from zero.

D Effects of Contractual Wages Across Time

We have tested the relevance of anticipatory or long-run effects of contractual wages on the outcomes of interest by estimating the following distributed lags regression model

$$y_{jt} = \sum_{i=-1}^{2} \beta_i w^c_{j(t+i)} + j * c + s * l * t + e_{jt} \tag{D1}$$

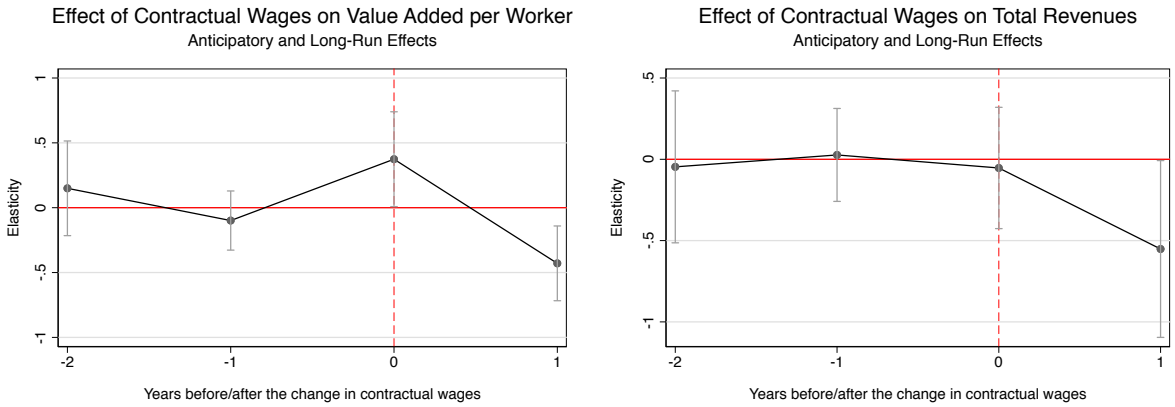
were we include the contemporaneous level of w^c_{jt} together with two leads one lag. In this model, we have adopted a similar specification of equation (1), including firm by contract and year by sector and province fixed effects. However, the inclusion of two leads of contractual wages, allows to estimate anticipatory policy effects, while the lagged term allows to study long-run adjustments one or more years after the change in contractual wages has occurred.

As noted by Fanfani [2020], this model tends to suffer from almost perfect multicollinearity due to the autocorrelation in policy levels, so that its results are often quite volatile. The model's volatility is a consequence of the fact that the same variation that is used to estimate one treatment effect in the specification of equation (1) is now used to estimate four treatment effects. Moreover, the strong persistence in contractual wages, which tend to be adjusted by small increments rather than drastically reduced or increased across time, makes the correlation among the terms $w^c_{j(t+i)}$ quite strong.[35]

The distributed lag model is typically applied in the minimum wage literature not only to measure long-run adjustments to the policy, but also as a placebo to test for the absence of differences in outcome trends across units before the policy change (see *e.g.* Meer and West [2016] and Cengiz et al. [2019]). However, as noted by Cengiz et al. [2019], this model is more demanding than standard falsification tests in event-study analyses, as distributed lags measure also the presence of differences in outcome trends in periods far away before the policy change. Indeed, in this model the first $t+i$ lead and last $t+i$ lag are typically interpreted respectively as the effect of the policy i years *or more* before (after) its level change.

[35] The consequences of near perfect multicollinearity are quite difficult to predict *ex-ante*, see Spanos and McGuirk [2002] and Hill and Adkins [2003].

Figure D1: **Long-Run and Anticipatory Effects of Wage Growth**



In the context of our analysis, when considering the relevance of anticipatory policy effects to test the robustness of the identification, two considerations should be taken into account. First, contractual wage changes are typically announced and scheduled before their actual implementation. Indeed, negotiations regarding wages take place typically only once every two years, and they tend to set a schedule of future pay rises that is made public well before its implementation. Therefore, policy announcement effects could be potentially relevant. Second, our treatment variable varies at the yearly level, while contractual wages can potentially change in the middle of the year. Since we define w^c_{jt} as the weighted average of the contractual wage in place in each month of the year, policy changes from $t-1$ to t may arise also when the contractual wage change is implemented in the middle of year $t-1$ (generating anticipation effects) and then kept constant throughout year t.

For these two reasons, policy effects taking place the year before the current one should not be considered as evidence against the solidity of our identification. Instead, anticipation effects taking place two or more years before the contractual wage change would be more difficult to interpret as simply driven by announcement mechanisms or anticipatory adjustments to the future policy change. Thus, the significance of the coefficient associated to the two-year lead ($w^c_{j(t+2)}$) provides a more reliable test on the presence of parallel trends between treated and control units before the occurrence of policy discontinuities.

Figure D1 presents the results obtained by estimating the dynamic model of equation

(D1) for revenues and value added per worker. These outcomes were selected since the presence of significant differences in revenues or productivity trends before contractual wage shock occurrence could be indicative of endogeneity problems related to our estimation approach. In all panels, the confidence intervals are computed at the 5% significance level using standard error clustered at the collective contract level.

It can be noticed that the effects of higher contractual wages on productivity were not significant before the policy change, they were slightly positive in the short run and negative afterwards. In the short run, revenues levels were not affected by the policy change, while this effect was negative in the longer run. This suggests that firms take time to adjust production levels when facing higher costs.[36] However, near perfect multicollinearity and estimation precision problems could also be relevant.

Overall, it appears that both outcomes were not affected by the policy of interest two or more years before its implementation. As mentioned, this marginal effect can be interpreted as a placebo test on the parallel trend hypothesis that should be expected in the presence of a correct identification strategy. Thus, the fact that none of the coefficients associated to the two-years lead was statistically significant can be interpreted as an evidence supporting the validity of our main identifying assumptions.

[36]See Sorkin [2015] for a theoretical discussion on this hypothesis.