Anno LV, 2021, 2 *Economia & Lavoro* *Saggi, pp. 135-150*

FIRM-LEVEL LABOUR DEMAND IN ITALY FROM THE GREAT RECESSION TO THE PANDEMIC CRISIS*

by Enrico D'Elia, Alessandra Righi

The paper analyses labour demand at firm level, and its relationships with the turnover outlook, as correct understanding of firm behaviour is crucial to designing effective employment incentives. The descriptive analysis shows low elasticity, as micro-level estimates tend to underestimate total effects of demand shocks. We therefore use ordered logit models so as to analyse main firm characteristics and business strategies influencing the firm response to a 10% permanent output increase. The demand outlook, firm size, and plant capacity utilisation are the variables that, in addition to the activity sector, make the difference in the elasticity of labour. According to the estimated models, in the period after 2016, the year of the *ad hoc* module of the Business Surveys carried out by the Italian National Institute of Statistics (Istat), the activity sectors showing greater elasticity of labour are: information and communication, financial and insurance activities, professional, scientific and technical activities, and administrative and support service activities.

Keywords: ordered logit model, labour demand, Business Surveys.

Si analizza la domanda di lavoro a livello di impresa e le sue relazioni con le attese di fatturato in quanto una corretta comprensione del comportamento dell'impresa è fondamentale per progettare incentivi all'occupazione efficaci. L'analisi descrittiva mostra bassi livelli di elasticità, poiché le stime a livello micro tendono a sottovalutare gli effetti totali degli shock della domanda. I modelli *ordered logit* permettono di analizzare le principali caratteristiche dell'impresa e le strategie di business che influenzano la risposta dell'impresa a un aumento permanente della produzione del 10%. Le prospettive della domanda, le dimensioni dell'impresa e l'utilizzo della capacità degli impianti sono le variabili che, insieme al settore di attività, determinano le differenze in termini di elasticità del lavoro. Secondo i modelli stimati, nel periodo successivo al 2016, anno del modulo *ad hoc* delle Indagini sul clima di fiducia delle imprese dell'Istat, i settori di attività che mostrano una maggiore elasticità del lavoro sono: informazione e comunicazione, attività finanziarie e assicurative, attività professionali, scientifiche e tecniche, e attività di servizi amministrativi e di supporto.

Parole chiave: modello *ordered logit*, domanda di lavoro, Indagini sul clima di fiducia delle imprese.

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* Enrico D'Elia and Alessandra Righi analysed and interpreted data, with Alessandra Righi being a major contributor as to paras. 3.1 and 4.1, and Enrico D'Elia being a major contributor as to paras. 2, 3.2, 4.2, and 4.3.

Codici JEL / JEL codes: D24, J23, D22, D23, C8.

ISSN 0012-978X

1. Introduction

The aggregate employment matches approximately the patterns of the output, although the Organisation for Economic Co-operation and Development (OECD) (OECD, 2015) noticed that the historical relationships between output and employment have weakened in the last few years. Nevertheless, firm-level estimates show that the output elasticity of labour demand usually lies only between 0.10 and 0.25, as reported in the extensive international surveys by Kapsos (2005), Crivelli *et al.* (2012), and Gorg *et al.* (2018) for the last decades. Contrarily, the output elasticity of aggregate employment is close to 0.5 in most macroeconometric models, as the European Central Bank (2016) and Mourre (2004) noticed, although there is some evidence that it is increasing due to the slowdown of productivity, as Carlsson *et al.* (2021) pointed out.

Firms typically hoard labour in downturns, so that they have to hire fewer workers in upturns, and can save rehiring costs in the future as documented extensively in Biddle (2014). This evidence makes weaker the relationship between output and employment changes. Nevertheless, during and after the Great Recession, it seems that labour hoarding did not work (Barth *et al.*, 2017). A better understanding of the hiring policy of firms in Italy after the Great Recession and the sovereign debt crisis is the main aim of our work.

The divergence between micro and macro-evidence is crucial for many issues. Acemoglu and Autor (2011) argued that technical progress is making most low and medium-skilled jobs redundant, but we should not expect necessarily mass unemployment, since firm-level productivity gains could increase the overall output, and consequently aggregate employment, as foreseen by Schumpeter (1942), and pointed out even recently by Vivarelli (2014). The structural change observed during the post-2008 recession, characterised by increasing capital intensity, and the acceleration of the digitalisation process occurred during the Covid-19 pandemic could generate another jobless recovery. Furthermore, firm behaviour is crucial in designing effective employment incentives (Rao, 2016; Dechezleprêtre *et al.*, 2016). Others, including Salomons (2018), estimated the output elasticity of employment from firm-level data, but estimates are flawed by most unobservable characteristics of the firms, such as the attitude of the entrepreneur, his/her ability, preferences, risk propensity, etc. The Italian National Institute of Statistics (Istat) included a special question in the February 2016 Business Survey on Manufacturing and Services to study directly entrepreneurs' propensity to expand the workforce in line with the output. The firm-specific factors that influence labour demand (e.g. entrepreneurs' general preferences, expectations, and strategy) can be derived from the answers that the respondents gave to this survey. We have had the almost unique opportunity to directly measure the output elasticity of employment among Italian firms after the end of the Great Recession and the following sovereign debt crisis, an event not affected by large shocks, and before the Covid-19 pandemic, an event that has made plans and expectations of most firms unfeasible. We should better understand the employment trends if the data on the subjective factors dominant at firm level systematically integrate the traditional macroeconomic approach to labour demand analysis.

Our research question is focused on the main explanatory factors influencing the elasticity of labour at firm level, considering both structural or short-term variables and subjective indicators. The use of the Business Surveys allows us to take into consideration most of the firm-specific factors discussed in the literature, hardly considered within other quantitative surveys, such as matching difficulties, the recourse to atypical and temporary

contracts, agreements on working time, and so-called "solidarity contracts". The *ad hoc* nature of this qualitative survey, unfortunately, does not allow us to analyse the trends of workforce adjustment over time, but we can verify our findings with the observed trends in employment in the years following the *ad hoc* survey.

The demography of firms, the multiplicative effects of demand, and intersectoral trade make the number of workers grow almost by the same percentage as the overall *ex post* output, which is usually larger than the initial demand change faced by each business. However, only the microeconomic approach adopted here may shed some light on how firms revise their plans and expectations. Our analysis focuses on the relationships between labour demand and the specific characteristics of the firm that cannot be taken into account properly through a macroeconomic or a sectoral approach, because their effects are unobserved at aggregate level, or tend to compensate within each branch of activity. Microeconomic evidence presented here provides suggestions for designing effective firm-level incentives for creating new jobs. Job creation in a single firm is all but a linear, smooth process, since adjustment and sunk costs, investment irrevocability, and other discontinuity factors make entrepreneurs wait some time before hiring and firing workers even in case the market outlook makes it profitable, as argued by Caballero and Engel (1993). Thus, effective incentives should reduce this "inaction interval", otherwise, most incentives would go to entrepreneurs who have already decided to hire new workers, as documented by Faini and Schiantarelli (1987). Only an in-depth investigation at firm level can contribute to this goal.

Our study is organised as follows. The background of the theory of labour demand is briefly surveyed in Section 2. The description of the database and the models used to evaluate the marginal effect of a firm-level explanatory factor on the elasticity of labour are included in Section 3. The main descriptive findings of the ordered logit models used at sectoral level are in Section 4, together with some features of the employment trend at sectoral level during the post-2016 period. A comparison to the output elasticity of aggregate employment is also provided. Some concluding remarks close the analysis.

2. Background

In the short and medium run, labour demand per unit of output is mainly driven by existing technology, rather than by labour cost, since production factors, including workforce, can hardly be quickly relocated among different sectors (Carlsson *et al.*, 2021). A large percentage of overall employment changes come from the newly established firms, as Haltiwanger *et al.* (2013) argued. In addition, while at macro-level the adjustment costs of reallocation are small compared with total output, within a firm search and training of new staff may turn out to be very expensive depending on its workforce size.

A firm's growth (or decline) seldom follows a quasi-continuous sequence of small changes of staff and equipment. Coad (2009) and Nilsen and Schiantarelli (2003), among others, reported international evidence that a firm's size usually "leaps" over time discontinuously, generating peaks of investment and employment that can be almost invisible at macroeconomic level (Fahr and Yao, 2009). Thus, firm-level labour demand is expectedly much more volatile than at macro level, and fluctuations do not depend on some factors observable at the overall economic level, since enterpreneurs' decisions largely depend on many idiosyncratic shocks, which may tend to compensate in the macroeconomic statistics, but determine occasional jumps at firm level.

Labour demand models discuss employers' decisions in response to marginal changes in product demand and factor prices, deriving them from the production theory. In its simplest version, a representative firm maximises profit, and adjusts the labour input at no cost. Within this very simplified framework, labour demand tackles an optimisation problem, assuming that the production function is strictly increasing and strictly concave to each input. The preferred functional forms in empirical works are the Cobb-Douglas, the constant elasticity of substitution (CES), and the trans-log functions. The output elasticity of labour ranges approximately from 0 to 0.5 if the capital to output ratio varies from 3 to 2 in the usual aggregate Cobb-Douglas function, with a constant return to scale, and a labour share close to 0.65.

However, Hamermesh (1993) warned against the risk that this elasticity is flawed by the capital-skills complementarity, which can bias the estimates. The heterogeneity of workers and firms should be considered in determining the labour demand. Malchow-Miller (2009) pointed out that labour demand is strongly firm-specific, and only an employer-employee database gives the opportunity to control for multiple effects related to firms and workers. The financial situation of the firm and its competitive position on the market, but also the high training cost for newly hired workers (Oi, 1962), may affect the firm's labour demand.

Adjusting staff is burdensome for firms, both for economic reasons and due to institutional constraints; adjustment costs are strongly discontinuous, resulting in large increases in employment followed by prolonged periods of inaction over time (Caballero *et al.*, 1997). Nilsen *et al.* (2007) remarked that many simplifying (and less realistic) assumptions about the smoothness of staff adjustment should be made when estimating a labour demand function. Nilsen *et al.* (2009) and Asphjell *et al.* (2014) pointed out that non-convexities and discontinuities may affect the adjustment of other production inputs, other than workforce. Therefore, a comprehensive approach should consider simultaneously all variables subject to the firm's decision (e.g. capital, technical changes, funding, market strategy, etc.). Otherwise, the estimated elasticity of labour can be severely biased.

Firms may reduce adjustment costs by preferring temporary employment contracts, which quickly adapt the amount and quality of the workforce in response to changing market conditions. Faccini (2008) and Bucher (2010) noticed that temporary contracts could also be used to reduce search costs. Booth (2014) remarked that bargaining links the elasticity of employment to many non-economic and non-technical factors, and exposes it to large fluctuations over time and to strong heterogeneity among firms. However, changing working time, instead of workforce, may significantly reduce the apparent short-term output elasticity of employment.

At macroeconomic level, an initial demand shock faced by a single firm tends to have multiplicative effects on other firms (mainly those providing intermediate goods and services), which raise to almost one the observed elasticity between overall output (measured after the multiplicative effects) and final worked hours. Harrison *et al.* (2014) estimated that the reallocation of output could be up to 30% of the net employment effects created by new products. Aggregate elasticity also takes into account the actual demography of firms. The output elasticity of workforce is arguably very large exactly for new entrants, who have to recruit the full staff although their initial turnover is well below its normal level, and the closing firms, where the output drops to zero while the whole workforce is fired.

Firm behaviour is crucial to designing effective incentives, and the microeconomic evidence examined here can shed some light on the expectations and actual behaviour

of each firm, but not on the overall effect of output changes on the workforce and hours worked.

3. Data source and model

3.1. Database

In February 2016, Istat submitted an *ad hoc* module to a sample of manufacturing industry and market service firms responding to the Harmonised Business Survey[1]. The *ad hoc* questionnaire focuses on the employment choices made by firms in 2015, concerning, among others, the output elasticity of employment, the reasons behind hiring decisions, and the strategies and factors promoting employment growth.

We matched the 2016 February *ad hoc* module information with that collected in the ordinary Business Surveys, setting up a database with about 3,700 firms in the manufacturing industry, and 1,700 in market services. Besides the basic structural variables (e.g. location, sector of activity, and firm size), the database included the following variables: *a*) judgments and expectations on total order books (only for manufacturing industry) and turnover (for market services); *b*) expectation on the economic outlook for the country; *c*) capacity utilisation; *d*) output elasticity of employment declared by firms (measured by the labour input growth required in response to a possible permanent 10% increase in the output)[2]; *e*) the firm's employment and human resource strategies; and *f*) perceived (economic or institutional) obstacles to the economic recovery.

3.2. The method

Usual econometric techniques for quantitative variables are not suitable to treat Business Surveys data, which are mainly qualitative assessments of firms about their achievements and expectations and the macro-economic outlook[3]. When a categorical variable admits more than two outcomes, as in our case, Cameron and Trivedi (2005) present several methods developed to treat the problem, the simplest one is running ordinary least squares (OLS) and logit or probit regressions for each category of the response variable. A more sophisticated approach assumes that a latent quantitative variable, say Y, drives the qualitative answers of respondents, so that

$$P(X=j \mid \mathbf{Z}) = P(T_{j-1} < Y = a_0 + a_1 Z_1 + \ldots + a_k Z_k + u \leq T_j) \qquad [1]$$

[1] Harmonised European Tendency Surveys are qualitative monthly surveys geared to measuring operators' opinions regarding the evolution of the major economic variables. The surveys use panels extracted from the Italian Statistical Register of Active Enterprises (ASIA) stratified – by firm size, sector, and geographical area – according to the robust optimal allocation with uniform stratum threshold (ROAUST) criterion of stratification and allocation for units with fewer than 1,000 employed persons, while this is a total survey for bigger firms. The *ad hoc* module has the same sample as the Business Surveys, and data are weighted with a ratio between the number (by each sampling stratum) of firms in ASIA, and the number of firms in the sample.

[2] The bracketed quantitative answers (preferred in the questionnaire to a direct quantitative assessment of the output elasticity of workforce) of the workforce change considered are: 'No change'; 'Up to 5%'; 'Between 5% and 7%'; and '7% and over'. D'Elia and Martelli (2000) showed that, in such cases, treating bracketed data often yield more reliable results than a traditional quantitative survey, due to reduction in misreporting and missing answers.

[3] D'Elia (2005), amongst others, provides a review on how to exploit the aggregate results of the Business Surveys in economic analysis and econometric models, by converting into ordinary quantitative indicators the time series of percentages of consensus on each statement envisaged by the survey. However, quantification techniques may be unfeasible in analysing firm-level data.

where P(.) is the logistic or the normal distribution function conditioned to the set of explanatory variables **Z**, a_i are parameters to be estimated, and *u* is a stochastic disturbance. The respondent is supposed to give the j-th answer if Y is comprised in a range between the thresholds T_{j-1} and T_j, which should be estimated as well. Noticeably, the parameters of [1] are less than those to be estimated by running separate logit models for each answer envisaged by the questions, unless the number of categories exceeds the number of explanatory variables. Long and Freese (2014) describe maximum likelihood estimators for the parameters a_i and the thresholds T_j in [1]. Since the model [1] is non-linear, Agresti (2002) describes a maximum likelihood method based on iteratively reweighted least squares. Oral (2006) shows that the choice between logit and probit function is less influential, particularly in a large sample, as in our case study.

Our dependent variables is the workforce change required if the firm's output permanently increases by 10%, and four brackets are considered. The explanatory and control variables are the main structural characteristics of each firm collected in the survey, and the other qualitative variable mentioned in Section 3.1. Sampling results are weighted by a double step procedure ensuring consistency with the structure by location, size, and sector[4].

On the basis of the variable of the Business Surveys, we could take into account most of the firm-specific factors discussed in the literature, such as matching difficulties, the recourse to atypical and temporary contracts, agreements on working time and solidarity contracts[5], etc., which are hardly taken into account in normal quantitative surveys. Unfortunately, the *ad hoc* nature of the survey does not allow us to analyse the patterns of workforce adjustment over time.

The results of model [1] should be interpreted mainly as statistical correlations since the dependent variable comes from a simple one-off survey, so that a dynamic relationship among the variables cannot be estimated.

4. Results

4.1. Descriptive analysis

A large majority of firms (about 60% in the manufacturing industry, and 70% in services) do not plan to change their workforce although they face permanent output growth of 10%. Fewer than 12% of manufacturing firms, and 19% of service firms report elasticity beyond 0.5, and only 7% in the manufacturing industry, and 11% in services report elasticity above 0.7. Only the administrative and support service workforce seems quite responsive to an output increase, with more than 20% of firms declaring elasticity close to one.

The rightmost columns of Table 1 show that elasticity seldom exceeds 0.2, regardless of the threshold[6] chosen for the open upper bracket (since the percentage of firms falling

[4] Comparisons of the survey data with the business register data show that, in the manufacturing industry, manufacture of basic metals, and manufacture of fabricated metal products, except machinery and equipment, are slightly over-represented among the respondents, while the "other" manufacturing sector is under-represented. Within the service sector, smaller firms (under 50 employees) are over-represented. This could be partly due to a time gap between business registers and survey results.

[5] Company-level collective agreements may allow the permanent reduction in working time and pay to be complemented by the hiring of new staff under open-ended contracts, to increase the number of employees.

[6] We derived this quantification of the output elasticity of labour by assuming that the answers to the question

in the upper open class of answers is too low to substantially affect the average elasticity). Moreover, the differences amongst sectors are unexpectedly low. On average, only B2B services show elasticity close to 0.2, while other traditionally labour-intensive sectors, such as accommodation and professional services, seem almost insensitive even to the permanent output growth. This would confirm that most sectors have already adopted labour-saving technologies, so we expect a strong reaction of employment to output in low-productivity sectors.

There could be some explanations for the low elasticity of employment, other than those sketched in Section 2. Firstly, the survey is necessarily addressed to existing firms, which have already a stable organisation, including management, sales, and administrative departments, which do not need any upgrade in case of a 10% increase in the output. Secondly, the production level can be increased even by raising per capita worked hours, particularly if the utilisation ratio of plants is low, as after a crisis. However, estimated elasticity is in line with international empirical firm-level evidence reported by Kapsos (2005) and Crivelli *et al.* (2012).

Table 1. Employment change in response to a 10% increase in the output by NACE rev 2 sector

		Any change	0-5%	5-7%	7% and over	Average response (*)	
						A	B
C	Manufacturing	59.2%	28.9%	4.4%	7.4%	1.80%	1.99%
H	Transportation and storage	69.4%	17.3%	4.5%	8.9%	1.68%	1.90%
I	Accommodation and food service activities	72.1%	19.8%	0.5%	7.6%	1.36%	1.55%
J	Information and communication	59.6%	23.8%	5.8%	10.9%	2.14%	2.41%
K	Financial and insurance activities	72.9%	15.7%	4.9%	6.5%	1.40%	1.56%
L	Real estate activities	77.0%	18.9%	0.0%	4.0%	0.91%	1.01%
M	Professional, scientific, and technical activities	74.7%	10.6%	3.0%	11.7%	1.73%	2.02%
N	Administrative and support service activities	62.7%	13.6%	1.5%	22.2%	2.87%	3.43%

Source: estimates of the authors on Istat data.
* Assuming that the response is linearly distributed within each class, and the upper class has an upper limit at 15% (column A) or 20% (column B).

in the survey are equally distributed around the middle point of each bracket, except for the open upper bracket, for which some assumptions about the frequency distribution must be adopted. We tested the following probability distributions for the open upper class: rectangular, triangular, exponential, power-law, and average. The results presented in the table refer to a triangular distribution of answers within the upper open class, assuming that the maximum elasticity is 1.5 and 2, respectively.

4.2. Model test

In Table 2, we present the main results of the fit of the estimated ordered logit models on workforce adjustment[7]. Model A considers as explanatory variables the main structural and economic short-run characteristics of the firm, information on how the firm has responded to the crisis, human resource strategies adopted by firms, and sectoral dummies (not listed in Table 2 for brevity reasons). Model B derives from Model A, excluding the sectoral dummies.

We found a quite poor fit for both estimated ordered logit models (the pseudo-R^2 is 0.044 for Model A), although the χ^2 *test* strongly rejects the hypothesis that the explanatory variables are redundant. This confirms a large heterogeneity among firms.

Table 2. Main results of estimates

	Model A		*Model B*	
Explanatory variables	(with sectoral dummies)		(without sectoral dummies)	
Location (North-West as reference item)				
North-East	0.213	*	0.213	*
Centre	0.099		0.114	
South	0.328	**	0.353	**
Size (fewer than 7 employees as reference item)				
7-15 employees	–0.180		–0.076	
15-47 employees	–0.173		–0.040	
47-170 employees	0.121		0.270	**
Beyond 170 employees	0.259		0.403	***
Order books / Turnover expectations (next three months, decreased as reference item)				
Unchanged	–0.012		0.002	
Increasing	0.269		0.277	*
Order books / Turnover judgments (past three months, decreased as reference item)				
Unchanged	0.030		0.013	
Increasing	0.059		–0.013	
Expectations on economic outlook for the country (decreased as reference item)				
Unchanged	0.179		0.166	
Improved	0.184		0.145	

(*continued on next page*)

[7] The results of probit estimates match almost perfectly with those presented in this study, thus they are omitted for brevity, but are available on request, together with the results of some robustness checks referenced in the main text.

Table 2. Main results of estimates (*continued from previous page*)

Capacity utilisation (less than 60% as reference item)				
60-70%	–0.098		0.070	
70-80%	–0.131		0.218	
80-90%	–0.095		0.236	*
Beyond 90%	0.083		0.410	***
Human resource strategies adopted				
Permanent reduction in the number of workers	0.183	*	0.184	*
Recruitment freeze (employees and external workers)	–0.110		–0.092	
Only replacement of the outflows	0.177		0.197	*
Use of Wage Supplementation Fund (CIG) or solidarity contracts	0.154		0.129	
Increase in external workers	–0.113		–0.109	
Increase in atypical/flexible contracts	0.115		0.120	
Increase in fixed-term employment	–0.027		–0.057	
No strategy	0.306	***	0.287	***
Perceived obstacles to the economic recovery				
Weak demand	–0.220	**	–0.231	**
Concern on public finance	0.020		0.024	
Concern on international and political instability	–0.215	**	–0.205	**
Credit access difficulties	–0.132		–0.144	*
Technological backwardness	–0.016		–0.004	
Difficulty in finding specific qualified workers	0.052		0.082	
Other problems	–0.229	**	–0.276	**
Statistics				
Number of observations	2666		2666	
McFadden pseudo R^2	0.044		0.032	
χ^2	245.969		176.523	
p value for χ^2	0.000		0.000	

Note: the estimates of sectoral dummies in Model A are omitted for brevity, but are available on request.
Significance level: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$
Source: estimates of the authors on Istat data.

Findings show that firms operating in the north-eastern and southern regions of Italy seem comparatively more disposed than the north-western ones to adapt their staff if the demand trend changes, all other conditions being the same. A possible explanation is that these firms adopt technologies that still require repeated human interventions in the production process, as argued by Cavasino (2019). Thus, a significant and permanent change in the output must be associated almost necessarily with staff adjustment, with limited scope for productivity gains.

The estimates suggest that employment reacts to the output increase faster in larger firms[8]. Arguably, small businesses find it more difficult to adapt their employees to the demand outlook since even hiring (or firing) few workers often involves large search efforts and organisational changes. Medium and large businesses can adjust their workforce more quickly. The size effect is robust with respect to different definitions of the firm size, for instance using deciles instead of the quintiles of the distribution, or considering sectoral averages of employed persons as a reference.

High current order books or turnover and, even more, high expectations on these economic variables make firms hire more workers, while a better general economic outlook[9] for the country seems less relevant for firms' decisions. This evidence confirms the crucial role of the individual demand trend in shaping employment in the last decades in Italy, pointed out by Deleidi and Paternesi Meloni (2019) and by Cipolletta (2019). Surprisingly, the capacity utilisation rate of the plants[10] turns out to be almost irrelevant, possibly because it is a consequence of the sectoral environment and of the level of demand, better captured by other explanatory variables.

Model A shows also that firms having adopted either no special human resource strategy or permanent reduction of workers are more likely to adjust the workforce to the demand and that entrepreneurs are less disposed to adjust the workforce if the ongoing and expected demand is weak, and the international and political environment is cloudy. Two opposite types of firms seem more reactive to a permanent increase in demand: those who reduced their staff during the crisis, and those who did not change their workforce, waiting for the end of the recession. The first group confirms its higher propensity to adapt the workforce to market trends (reducing the staff during a crisis, but being ready to increase it if a 10% recovery is envisaged as well), while the second group of firms probably has an asymmetric reaction to the business cycle (retaining the staff during bad times, and hiring new workers during recovery). Comparing the results of Models A (including sectoral dummies) and B, it comes out that, controlling for the sector of activity, credit shortage, technological backwardness, and the lack of qualified workers seem less relevant to firms' decisions about their staff. Indeed, Schivardi *et al.* (2017) remarked the misallocation of credit among the sectors during the last decade, and the typically sector-specific skill mismatch, as pointed out also by a survey carried out by the National Institute for Public Policy Analysis (INAPP) (see Esposito and Scicchitano, 2019).

The high significance of the sectoral dummies shows that the propensity to hire and fire increases with the ongoing and expected demand, but remains strongly related to the industry. Although, in Table 2, the estimates of sectoral dummies are not reported for brevity, it comes out that about 25% of them are statistically significant at the usual confidence level. This percentage is above 40% in the service sector, where labour demand is also significantly less reactive to the changes in the output, with the noticeable exception of B2B services, particularly in the case of computer programming. Output per employee may vary slightly where human intervention is strictly necessary, but not in highly automated

[8] To catch possible non-linear effects, the empirical quintiles of firm size distribution are considered. The size effect was robust with respect to different definitions of firm size.

[9] The scarce explanatory capacity of general macroeconomic indicators is a frequent finding in microeconomic models since firms are much more concerned about the trends of their local and sectoral market.

[10] We used in the model the empirical quintiles of the distribution of the capacity utilisation rate to catch possible non-linear effects.

factories and in a number of services, such as financial services, where the same staff can handle very different amounts of transactions.

Excluding the sectoral dummies in Model B, the results of the logit regression seem to emphasise the role of some structural characteristics of the firms, such as size and capacity utilisation (albeit with reduced statistical significance). Employment becomes more reactive to output only if the capacity utilisation rate exceeds a given threshold (from 80% to 90%), following a discontinuous model of the firm's decisions, as argued by D'Elia *et al.* (2019). Below the threshold, an even increasing plant utilisation rate hardly tempts the firm to hire new staff, while, conversely, firms tend to keep their headcount unchanged when the utilisation rate temporary drops. Only a permanent and significant overutilisation of machinery and workforce may induce the firm to adjust its staff. Credit conditions become statistically significant, even though only at a 10% confidence level.

4.3. A breakdown by sector

We obtained a medium to low explanatory capacity by running Model B separately for each two-digit branch of the manufacturing industry and for each one-digit branch of services[11]: the pseudo-R^2 never reaches 0.7, is beyond 0.4 only in three sectors (electronic appliances, printing, and miscellaneous products), and is below 0.2 in seven sectors out of 23. The different model fittings show that the different attitude of firms at sectoral level depends heavily on factors that the model cannot control for[12], such as the specific risk aversion of the entrepreneur, but also on different levels of productivity, market positioning, and profitability of firms. The heterogeneous behaviour of firms is also pointed out by Brugamelli *et al.* (2012) and by Dosi *et al.* (2019). The intra-sector variability of the output elasticity of employment seems related mainly to the demand outlook, whose estimated coefficient is statistically significant in about 40% of sectors. Considering also the concern about demand weakness, the percentage of firms responding to the demand conditions with a change in their workforce rises to 60%. Most of the firms, even facing a 10% permanent increase in demand, tend to hire only if the turnover is accelerating. This conduct recalls the investment acceleration principle, according to which investment does not respond simply to the level of demand, but to its continuing growth. Thus, a 10% increase in future demand would have a weaker impact on the workforce if not associated with steady growth over time, confirming that firms often consider the staff as an asset rather than a simple production input.

However, the workforce tends to respond in a relatively stronger way to any demand change in larger firms. Another influential factor within each sector is capacity utilisation; firms are more disposed to adjust their workforce where plants are overutilised. Only manufacturing of basic metals and furniture does not seem to follow this rule.

The recourse to fixed-term employment as a human resource strategy is associated with higher output elasticity of workforce in about one in six sectors (including manufacturing of motor vehicles and other transport equipment, miscellaneous products, and financial services), whereas in other seven industries it is correlated to lower elasticity (i.e. leather, chemicals, electrical equipment, transportation, and postal services). Arguably, the first group of firms chose short-term contracts because the

[11] Detailed results, omitted here for brevity, are available upon request.
[12] This could be partly due to the scarcity of observation in some of the two-digit branches.

demand outlook is uncertain, but they are ready to permanently expand their workforce, as the demand would rise by 10% – cf. Vidal and Tigges (2009). The second group of firms would continue to resort to short-term contracts even in case the demand permanently increases, because they are strongly risk-averse, or need a low-qualified workforce, easily found on the market – therefore they are not pushed into taking on the burden of hiring open-ended workers.

Firms that reduced their staff during the previous year tend to be more reactive to the 10% growth of the demand in five sectors out of 23. Only for metal products (except machinery and equipment), the estimated coefficient shows a negative link. Firms having made larger recourse to CIG benefits and solidarity contracts look more reactive to a possible increase in order books / turnover in at least these three sectors: B2B and professional services, printing, and rubber and plastic. Social protection schemes seem to be used only to face temporary hardships without recurring dismissals, and firms continue to be disposed to hire new workers as demand increases again. Contrarily, coefficients are negative in the electric and electronic appliances and the financial service sector.

The concern about technological backwardness is another relevant explanatory factor at sectoral level not emerging in the aggregate model. Firms worried about the technological issue seem less willing to adjust their workforce to demand trends, possibly because they wait for an overall adjustment of plants and organisation before changing their workforce. This seems to be the case of firms operating in sectors more impacted by technical change – e.g. ICT services, broadcasting, publishing, transportations, postal services, printing, and production of machinery and appliances not elsewhere classified (n.e.c.).

4.4. Actual employment trends after the survey

National accounts figures, which measure overall *ex post* changes in the output and workforce, provide very different results from the previously analysed firm-level estimates, as shown in Table 3. The figures intentionally exclude the period of the pandemic, which arguably interrupted any recruitment plan. As expected, for the economy as a whole, the response of employment to output was close to that in the four years following the survey. The changes in the number of persons employed were greater than the number of hours worked, possibly because of some generous incentives to recruit new workers, particularly in southern Italy and for young and female workers. Elasticity drops to 0.4 in the manufacturing industry, which is more than double the estimate at firm level. This confirms the great impact of the second-round effects on the labour market, compared with a shock affecting a single company in the sector in isolation. National accounts data also strengthen evidence of a larger effect on employment of any demand change in the service sector, such as: information and communication; financial and insurance activities; professional, scientific, and technical activities; and administrative and support service activities. The overall elasticity is a multiple (about 10 times) of firm-level response in the abovementioned branches of activity. When the final demand grows in the service sector (excluding trade), the benefits for employment are distributed to the rest of the economy faster and in greater quantity than in the manufacturing sector. The latter sector has a higher propensity to import, which reduces the impact of demand on domestic businesses.

Table 3. Actual trends of output and employment between 2016 and 2019

Sector	Value added (volume index)	Number of persons employed	Total hours worked	Apparent elasticity of employment	Apparent elasticity of hours worked
A_U: Total	0.90%	0.86%	0.79%	0.96	0.87
C: Manufacturing	1.84%	0.77%	0.73%	0.42	0.40
G_I: Wholesale, retail trade, accommodation, food services, transportation, and storage	1.40%	1.37%	0.94%	0.98	0.68
J: Information and communication	0.85%	2.16%	2.25%	2.55	2.66
K: Financial and insurance activities	-0.42%	-1.45%	-1.05%	3.44	2.51
MN: Professional, scientific, and technical activities, and administrative and support service activities	0.80%	2.35%	2.53%	2.95	3.18

Source: Istat, national accounts.

5. Concluding remarks

The first finding of our analysis is that the output elasticity of employment in Italy in 2015 lies between 0.1 and 0.2 at firm level. This is in line with the results of other international firm-level studies on the recent decades, but is much lower than the corresponding aggregate value estimated in most macro-econometric models (ranging from 0.5 to 1) before the crisis. This finding may indicate that the labour-capital ratio at firm level is reducing during the post-2008 crisis, but not necessarily at an aggregate level, where the Schumpeterian scale and interaction effects dominate. It seems that productivity gains taken into account or planned by the entrepreneurs surveyed reduce firm-level labour demand, but the resulting output growth generates additional labour demand, which partially compensates for the initial loss. In addition, the estimated elasticity refers to the overall workforce, including administrative staff, sales force, and engineering – they arguably do not change too much in response to a 10% output change in operating firms.

Thus, the elasticity estimated at firm level could turn out to be so low simply because it does not take into account the composition effects and the demography of businesses at industry level, and second-round effects of any shock on demand, as argued by Peterman (2016). However, the low elasticity of employment associated the economic recovery in the post-2016 period to a rise in competitiveness and export, virtually without inflationary tensions, contrarily to what typically happened in Italy in the past decades.

The estimated ordered logit models on labour demand show that, in addition to the sector of activity, demand outlook, firm size, and plant capacity utilisation are the variables making the difference in the elasticity of labour. Even the preference for fixed-term contracts, and the concern about technological backwardness proved to be relevant explanatory factors, particularly in the manufacturing industry.

Firms envisaging a buoyant demand are more willing to hire new staff in case of a permanent increase in their demand, possibly because they have little scope for further

productivity gains. Models confirm that the reactivity of employment to output depends on the sector of activity, and is larger for manufacturing firms, which earlier adopted labour-saving technologies, allowing now for only minor further productivity gains. In the service market, on the other hand, there is a larger scope for improvements in this field.

Our analysis confirms that the capacity utilisation rate of plants has some effects on hiring new staff only if it exceeds 80-90%, while it is almost irrelevant otherwise. This evidence is consistent with a discontinuous model of a firm's growth, in which market shocks and policy incentives work only if they are strong enough, and are concentrated on firms already close to some critical threshold. Otherwise, the entrepreneur tends to do business as usual, with only minor adjustments. This threshold effect may explain the swift recovery of output and employment observed after the Covid-19 pandemic.

Firms that are inclined to recruit are often frustrated by the shortage of workers with the required skills; this mismatch seems significant for medium-sized firms, particularly in the service sector. Surprisingly, credit shortage is not considered as the main restriction by firms willing to expand their staff along with their output, and this is especially the case for firms with medium-level labour demand.

Firms that are more willing to adapt their staff in case of permanent demand growth have often used CIG, overtime work, or part-time contracts as human resource strategies. This may be due to a positive effect of demand growth, which makes it possible to transform these alternative contracts into open-ended contracts.

The manufacturing sectors and some service sectors, such as B2B, food services, and logistics, show higher propensity to hire than the average. The trend in hours worked registered in these sectors in the years 2016-2017 confirmed our finding. Therefore, measures that help specific sectors to be rather dynamic could accelerate job creation. Policy measures to stimulate employment should take account of the fact that the firm's decision on the desired workforce, and capacity utilisation are non-linear, and the measures to improve the liquidity of firms give only a relatively modest contribution to employment growth.

The comparison between evidence at firm and aggregate level showed differences due to great heterogeneity of performance between firms, also highlighted by Bugamelli *et al.* (2012), Dosi *et al.* (2019), and Cirillo and Ricci (2020). This substantiates our choice of approach at company level, and allows us to outline policy recommendations. As the main factors determining aggregate employment are relocation and other second-round effects, measures to encourage new enterprises and the relocation of businesses should complement (if not partially replace) incentives for firm recruitment. In addition, we should not expect large increases in employment due to lower labour costs and labour market rigidity, as such reductions could increase the propensity to hire at firm level, but discourage business relocation and investment in new technologies.

With regard to the limits and possible further developments of our work, the *ad hoc* nature of the qualitative survey used has not allowed us to analyse the workforce adjustment patterns over time and to make international comparisons. Problems of comparability in time and space may arise due to changes in the framework of employment incentives that are linked to legislative changes over time and across countries. In addition, the estimated models left unexplained a large part of labour demand variability. Evidence suggests that the analysis should be extended to take into account the effects of other relevant explanatory factors, such as the competitiveness of undertakings, productivity, market positioning and profitability, or the role of idiosyncratic factors.

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