Wage dispersion in Italy

An exploration based on linked employer-employee data

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This article analyzes wage dispersion in a sample of Italian firms, by taking advantage of a unique Linked Employer-Employee dataset (LEED) merging four data sources from the National Institute of Statistics. An in-depth descriptive analysis conveys that knowledge-intensive services record the highest within- and between-firms wage dispersion in the sample. Regression-based results show that innovation does not drive up inequality in large companies. However, it can contribute to enlarge the within-firm wage dispersion as well as the wage gap across small firms. Overall, we argue that institutional factors should be called upon to explain the dramatic increase in wage disparities in the Italian economy.

L'articolo analizza la dispersione salariale in un campione di imprese italiane, sfruttando un dataset di tipo LEED, ottenuto integrando quattro differenti fonti di dati prodotte dall'Istat. L'analisi mostra che i servizi, soprattutto quelli ad alta intensità di conoscenza, mostrano la più alta dispersione salariale a livello di singola impresa e tra le imprese considerate nel campione. L'analisi econometrica suggerisce che l'innovazione non aumenta la disuguaglianza nelle grandi imprese, ma può contribuire ad ampliare il divario salariale all'interno e fra le piccole. Nel complesso, fattori istituzionali dovrebbero essere chiamati in causa per spiegare l'aumento della disuguaglianza nell'economia italiana.

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Introduction

Inequality has sharply increased in most developed countries in recent decades (Atkinson 2007; OECD 2015; Piketty *et al.* 2018) and Italy is not an exception (Franzini and Raitano 2019). The share of pre-tax national income that goes to the bottom 50 per cent of the distribution has declined from 22% in 1980 to 16% in 2021, conversely, the top 10 per cent has increased its share of national income by about ten percentage points – from 28% in 1980 to 37% in 2021. The top

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1% has almost doubled its share of national income in the last forty years[1]. These figures have been recently confirmed by Guzzardi *et al*. (2022) estimating the distribution of Italian net national income, including both labour and capital incomes, from 2004 to 2015, by combining several data sources[2].

Essentially, regardless of the measurement applied, economic inequalities – both of income and wealth – today are higher than they were two or three decades ago (Atkinson 2015). Inequalities are generated and amplified in labour markets due to increasing disparities in market incomes compared to disposable incomes. Excluding the effects of public redistribution through taxes and transfers, inequalities would have been even sharper (De Arcangelis *et al*. 2021).

When focusing on the sources of income, it clearly emerges that wages and pensions (for the bottom 50 per cent) are the two main sources of income along the entire income distribution up to the 90th percentile[3]. The loss of real income, which worsened since after the 2008 economic crisis, then with the outbreak of the Covid crisis and nowadays with inflation, has not affected all individuals equally, even within the bottom 50 per cent, since the composition of this group is far from being homogeneous. For instance, in Italy young people aged between 18 and 35, women and citizens of Southern regions were the most affected by the 2008 economic crisis (Guzzardi *et al*. 2022) and more recently by the Covid pandemic (Carta and De Philippis 2021; Casarico and Lattanzio 2022).

Wages and salaries account for 75% of household incomes among working-age adults, thus representing the main driver of income inequality (OECD 2011). Therefore, they are a crucial dimension to investigate in order to grasp the sources of inequalities and identify how these latter stratify across individuals and, specifically, workers. To what extent current wage inequality is related to workers' skills or firms' characteristics is still a matter of debate since it is of paramount importance to design policy interventions that can reverse the current trend.

Are wage gaps explained by specific characteristics of workers and jobs, such as education, skills or tasks performed at work? Or are they related to structural features of sectors and firms? In a nutshell, what are the main sources of wage dispersion? And above all, is the explosion of income inequalities to be attributed to a weakening of labour?

Indeed, in recent decades we have observed that advanced economies have polarized along 'winning' and 'losing' trajectories: sectors, firms and workers have experienced heterogeneous outcomes with respect to multiple dimensions. Large and persistent productivity differences among economic units have been traced to various factors, such as technology, demand, market structure, and workers' human capital. Firm-level heterogeneity reverberates in wage asymmetries such that it is increasingly more important 'where' the worker works, rather than his or her specific characteristics. Furthermore, the outbreak of the pandemic has accelerated the dispersion of productivity and wages, also due to the adoption of different strategies to respond to the crisis: some firms have increased the digitization of their interactions along the value chain, while others significantly reduced plans to investment in R&D. The coexistence of segments – firms and workers – characterized by increasing heterogeneity in labour productivity, work organization, patterns of innovation (firms) and working conditions (workers) is a salient feature of neoliberal societies in the current regime of production.

Against such background, in this article, we explicitly focus on wages and provide a description of the dimensions that can explain wage gaps in Italy, one of the main sources of overall income inequality, jointly considering individual and firms characteristics. Our aim is to dissect the main channels of stratification of wage dispersion. To this purpose we analyze the distribution of within- and between-firms wage inequality by firm size, sectors, and geographical localization of companies, taking advantage of a unique sample of Italian firms based on a Linked Employer-Employee structure, endowed with a comprehensive set of information on firms, jobs, workers' characteristics and wages earned.

1 Data are from the World Inequality database.

2 The authors merge different statistical sources: (i) IT-SILC performed by ISTAT on income and living conditions; (ii) SHIW surveys produced by the Bank of Italy; (iii) the Irpef tax returns issued by the Ministry of Economy and Finance and (iv) the inheritance tax records collected by Acciari *et al.* (2021).

3 Capital and financial incomes prevail at the top 10 and 0.1 per cent of the distribution, although recent studies (Iacono and Ranaldi 2023) have documented a weaker relationship between the functional and personal distributions of income in Italy between 1989 and 2016. They highlight an increase in capital income shares accruing to the bottom 50 per cent mainly explained by imputed rents that have been moving toward the bottom of the income distribution.

In detail, following Cirillo *et al.* (2017), we estimate an augmented Mincerian equation to compute robust measures of, respectively, a within-firm inequality based on the 90th to 10th percentile ratio of the estimated equation within-firm residuals and between-firms inequality based on the difference between the 90th and the 10th percentiles of the estimated firm-level fixed effects. Our first research question can be formulated as follows: *After controlling for main workers and firms' features, how does inequality polarize workers in the Italian economy by firm size, sector of activity and geographical location?*

Among the relevant factors of stratification, due to the particular nature of our dataset, we acknowledge the role of technological change and inspect how and to which extent it represents a further channel of polarization within and between companies if not accompanied by other institutional factors, such as trade union negotiations, capable of influencing the distribution of productivity gains among workers. Although we are not able to take into account the role of trade unions explicitly, we can investigate how and to which extent investments in technologies may represent a factor of further stratification across companies by firm size. Since the outbreak of the Covid crisis, descriptive evidence has shed light on the coexistence of at least two clusters of companies: the ones accelerating the digitization of their customer and supply-chain interactions and of their internal operations and, on the other hand, firms whose plans of investments in R&D have significantly shrunk. In the first phase of the Covid crisis (March-April 2020) investments have fallen – mostly for small companies with fewer than 50 employees not fully consolidated on international markets and suffering financial constraints. The recovery has been very unbalanced across firms and divergences have been deepening between more productive and reactive firms and a large population of small firms pursuing cost-competitiveness strategies. Thus, it is likely that the Covid crisis accelerated a pattern of neo-dualism that already characterized the Italian industrial structure in recent decades (Costa *et al.* 2021; Dosi *et al.* 2021). In this direction, we attempt to unfold the role of technological change in shaping wage gaps between firms, providing new evidence on our second research question: *Do investments in innovation at the company level contribute, in normal times, to increase within and between wage dispersion? If so, how does this relationship change according to firm size (and possibly workers' bargaining power)?*

To investigate these research questions and start to dissect wage inequalities, we take advantage of a unique source of information obtained by merging four different databases provided by the Italian National Statistical Institute (Istat). This dataset is one of the outputs of the 2019-2022 Istat-Bank of Italy TRASPI *Analisi delle trasformazioni del sistema produttivo attraverso (micro)dati amministrativi* project, aimed at analyzing the main characteristics of the Italian national production system, the role of human capital, as well as innovation and the adoption of new technologies. The innovative dataset used for this analysis[4] drawn from the integration of the sample of the Istat *Community Innovation Survey* (CIS) with selected information from two LEED (Linked Employer-Employee Dataset) data sources plus a firm-level dataset that allows us to explore wage inequality across workers and decompose it accounting for within and between wage components. All in all, the dataset is drawn from the integration of: (i) the *Community Innovation Survey,* providing information on innovation practices performed by companies; (ii) the *ASIA-Business Register*, collecting information on firm characteristics; (iii) the *ASIA-Employment Register*, accounting for workers characteristics and (iv) the *RACLI Register* on earnings, hours and labour cost for persons and enterprises, collecting wages of all workers employed in Italian companies. In detail, the latter provides information on hourly wages earned by each job within each firm, which represents our key variable.

Despite the richness of the database, we acknowledge that this analysis suffers from some limitations.

We are able to study the structure of wage gaps in Italy only for one year, that is 2016, and for a specific sample of firms – those drawn from the *Community Innovation Survey.* The latter is designed to provide information on the innovativeness of business economy sectors and its core target population

4 The earlier version of this work, titled Innovation, firm characteristics and within-firm wage inequalities: exploring Linked Employer-Employee data for the Italian economy, has been presented at the final workshop of the TRASPI project held at the Bank of Italy, on 17th February 2023. Furthermore, a previous analysis based on the same dataset has been developed in Istat (2019).

includes three main size classes of enterprises: 10-49 employees; 50-249 employees; 250 or more employees. Therefore, our analysis excludes micro-enterprises – the segment of enterprises under 10 employees – which employ over a quarter of the total number of employees in Italy. Notwithstanding this limitation, it should be acknowledged that micro-enterprises can be very heterogeneous with a large proportion of companies with few employees and the inclusion of this portion of companies would result in an increase in the wage dispersion across firms. In a similar vein, OECD (2023) has restricted the analysis to the private sector excluding the own-account workers and focusing on firms with two employees or more. Furthermore, the lack of a panel structure represents a major limitation for our analysis since we cannot econometrically account for the heterogeneity of workers and firms by applying, for instance, an AKM approach (Abowd *et al.* 1999). Lastly, our analysis is silent with respect to the consequences of Covid on earnings and inequality[5] and can only provide indirect indications on the institutional factors that contribute to shape wage gaps in Italy by referring to the size of companies and sectoral heterogeneities featuring different regimes of accumulation and technological trajectories. Both these elements correlate with quality of work and labour strength.

In spite of these limitations, the article offers a first glimpse of wage distribution within and between companies, a research field that has not yet received substantial attention in Italy, often due to a lack of reliable micro-data.

The remainder of the article is structured as follows. After a brief discussion on drivers of wage dispersion in Section 1, we describe the integration of the database based on four different Registers in Section 2. Section 3 provides a set of descriptive evidence on within- and between-firms' wage inequality, with a focus on the association of the wage dispersion in light of some relevant dimensions (namely, innovation and firm size). Finally, the last Section brings the contribution to a conclusion, offering some suggestions for further research.

1. Wage differentials: a polarized productive structure

The existence of wage differentials in the labour markets has always been neglected by neoclassical economists, at least from a theoretical perspective, since the market-clearing wage is conceptualized as unique and linked to productivity and, in theory, workers with similar characteristics should earn the same wage. However, wage disparities exist and have proven to consolidate over time in most advanced economies. Wage differentials between employees have been related to heterogeneities in their characteristics and those of their workplace (even, regional differences).

Therefore, after more than a decade of studies concentrated on estimating the effects of skills' rewards on wage disparities across workers, in recent years the economic debate has acknowledged the relevance of firms' pay practices in shaping wages, wage inequality and, the gender wage gap.

According to OECD (2023) on average across 20 OECD countries, between-firm wage inequality can account for about one-half of overall wage inequality, both in levels and changes. Therefore, a large portion of overall wage inequality can be explained by gaps in pay between firms rather than differences in the level and returns to workers' skills. Such a result has been linked to another major evidence concerning the increasing dispersion in productivity across establishments. Gaps in business performance in the form of productivity have widened, even with respect to investments in digital technologies that have enabled technological leaders to increase their performance gap with laggard firms (Andrews *et al.* 2016; Gal *et al.* 2019; Cirillo *et al.* 2023) and to unleash 'winner takes all' dynamics in the global market.

This pattern of 'neo-dual' or 'winners take the most' configurations with the strengthening of an almost dichotomous production structure with respect to organizational skills, technological innovation and presence on foreign markets, matched by a progressive spread of firms' productivity performance, represents a specific trait of the current phase of contemporary capitalism (Costa *et al.* 2021). The segmentation of the productive structure

5 The impact of Covid on within and between firm inequality will be assessed through a specific research project started in 2023 titled Employment quality and wage inequality: the role of technological change and enterprise characteristics. Structural aspects and consequences of the pandemic, whose aim is precisely to explore the heterogeneity of the effects of technological change, with particular reference to new digitization and automation technologies, on wages in the years 2014-2021.

has increased as a consequence of the economic crisis of 2008 (Dosi *et al.* 2021) and, nowadays, it has been further fuelled by the outbreak of the Covid pandemic (Criscuolo *et al.* 2020).

Evidence of microeconomic character reports a remarkable heterogeneity of the levels of productivity among enterprises, with a few high-performance units (in terms of productivity and sales) with respect to a large population of companies that exhibits modest and stagnant levels of value added per employee (Calligaris *et al.* 2016; Daveri e Jona-Lasinio 2008; Cirillo and Ricci 2022). Large and persistent productivity differences have been linked to several features, such as technology, demand, market structure, organizational features (Syverson 2011). In the labour economics literature, dispersion in productivity has been linked to workers' human capital (Abowd *et al.* 2005), to the use of incentive pay and various human resources and managerial practices (Bloom *et al.* 2007). In the evolutionary theory of the firm, dispersion in labour productivity arises from specific organizational routines and capabilities not easily acquired by firms in the short-term, such as those related to innovation, engagement in international transactions, exporting and patenting activities (Dosi *et al.* 2008; Dosi *et al.* 2012).

Heterogeneity in firms' productivity performance, reflecting an increasing dispersion in wages between firms (Barth *et al.* 2016; Card *et al.* 2018), is deemed also to widen the gap in the working conditions (i.e., career paths, safety at work).

Wage disparities existing between firms are reported in numerous studies and, similarly to productivity dispersion, are linked to several factors ranging from technological change to participation in international markets (Amiti and Davis 2011; Faggio *et al.* 2010; Wolszczak-Derlacz and Nikulin 2022).

Between-firms inequality also points to the importance of institutional factors. According to Zwysen (2022) and Tomaskovic-Devey *et al.* (2020), among others, between-firm earnings inequality is driving the increase in wage dispersion in Europe, and this occurs where institutions are weakened. Beyond national specific factors (i.e. minimum wage, national laws on labour markets, employment protection), the relative bargaining strengths of workers and firms are shaped by the strength of the workers' representation systems and national/sectoral regulations on wage agreements. As suggested by the literature, strong unions may bargain over wages by pushing for a redistribution of profits that employers may obtain on the markets (Dencker and Fang 2016). However, strong trade unions may also affect the distribution of wages among workers compressing the within-firm wage distribution (Barth *et al*. 2012). Furthermore, the level of collective agreements contributes also to reshape the distribution of wages within and between firms (Cirillo *et al.* 2019): a more coordinated system compresses the wage differences between firms (Guertzgen 2009; Skans *et al.* 2009); whereas firm-level agreements should increase the differences in pay between firms (Garnero *et al.* 2020; Ramos *et al.* 2018). Indeed, earnings also differ within firms due to pay settings, including bonuses and rewards to senior management and executives, and differences in the bargaining power of specific groups of workers.

From this perspective, the role of the institutional setting or, more broadly, of the environment wherein firms operate, is central in recent developments of organizational approaches to stratification that discuss the firm as the central locus of wage inequality creation (Stainback *et al.* 2010; Cobb 2016). This literature stresses the interaction between environmental factors external to the firm and key factors internal to the firm, that is the relative balance of power among groups within the organization (Cirillo *et al.* 2019). Closely related to the discussion of the balance of powers within the firm, there is also the recognition, coming mostly from sociological or socio-economic studies, that the power of different employees in the hierarchical and organizational structure originates from the type of tasks they perform and the occupation they enjoy (Goldthorpe and Hope 1972; Wright 1980; Erikson and Goldthorpe 2002). This literature shows that occupational structures are crucial to explain social stratification and income disparities, suggesting that occupations must be considered as a relevant dimension in examining how wages of different groups of employees may be differently affected for instance by technological changes (Cetrulo *et al.* 2020; 2023).

From an empirical standpoint, the availability of micro-level data and mainly employee-employer databases have contributed to the growth of empirical studies assessing the relation between wage inequalities occurring across and within establishments (Barth *et al.* 2016; Card *et al.* 2018; Handwerker

and Spletzer 2016; Song *et al.* 2019; Criscuolo *et al.* 2020; Tomaskovic-Devey *et al.* 2020; Baumgarten *et al.* 2020; Zwysen 2022). Most of them have highlighted the increasing relevance of between firm inequalities on overall wage dispersion going so far as to say that "It's Where You Work" (Barth *et al.* 2016) to drive up the dispersion of earnings.

Yet, it is worth mentioning that the role played by within firm inequality should not be neglected (Cirillo *et al.* 2017; 2019).

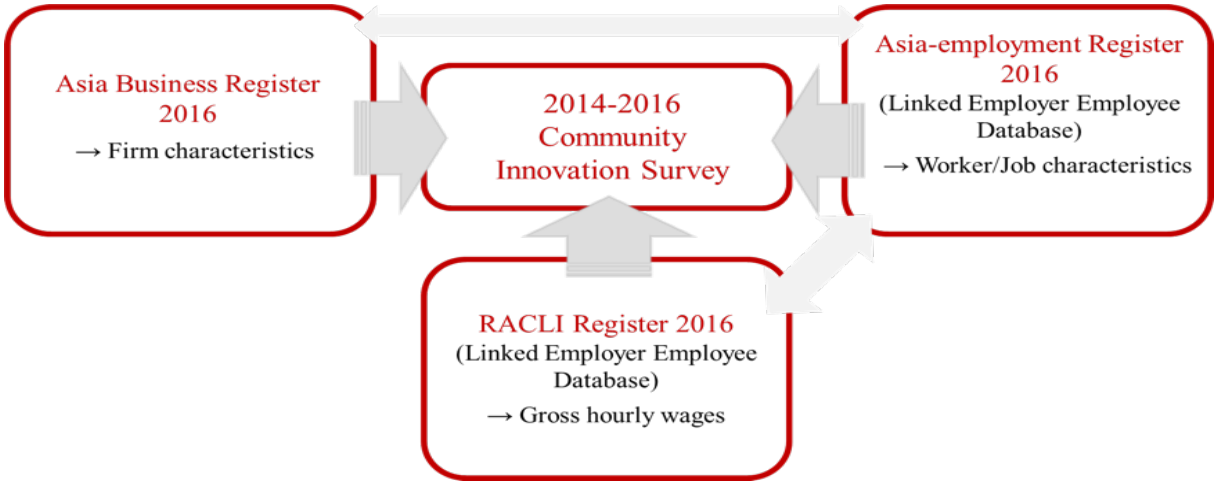
Overall, few studies have focused on the Italian economy, such as Bingley and Cappellari (2018), Devicienti *et al.* (2019), Franzini and Raitano (2019), and more recently Briskar *et al.* (2022) highlighting rather heterogeneous results, but all stressing the importance of firm-related heterogeneity as an important factor for explaining wage differences among workers.

2. Data sources

As already pointed out, the empirical analysis developed in this article is based on a unique source of information obtained merging four different sources available from Istat, namely: (i) the *Community Innovation Survey* – CIS, run by Eurostat for each Member country and containing a very detailed information on innovation strategies performed by firms; (ii) the *ASIA Business Register* compiling information on companies operating in the Italian economy such as number of jobs, employees, value added, geographical location, sector of activity; (iii) the *ASIA-Employment Register*, collecting information on workers such as education, main job title, age and sex; (iv) *the RACLI Register* recording workers' wages in terms of jobs and employees.

These sources have been merged to obtain a Linked Employer-Employee data structure. In detail, the *Community Innovation Survey* containing information on innovation activities pursued by a representative sample of Italian companies in the 2014-2016 time span has been merged with the ASIA Business Register in order to obtain a more comprehensive set of information on firms. Then, the dataset was further merged with the ASIA-Employment Register allowing the identification of each job position and worker within the company along with their main characteristics (age, education, job title, sex, job contract, citizenship). Finally, the RACLI Register, containing detailed data on wages for each job[6] and worker, was linked to build within-firm measures of hourly wage dispersion as well as to compute average firm wages for between-firm measures of inequality. The reference year of the data sources is 2016.

Figure 1. The Linked Employer-Employee data structure



Source: Authors' illustration

6 It is important to note that the reference unit of the RACLI Register we used in this paper is the average annual 'job' (i.e. not 'person employed') defined in terms of the number of workweeks of paid work by the employee over the total workweeks of the year. Compared to persons, it provides a measure of the labour input more closely related to the amount of labour input actually employed by the firm.

The figure 1 displays the connection among the four different data sources and the information drawn from each of them. All sources are linked to the *Community Innovation Survey* providing the final sample of Italian companies, jobs and workers on which our analysis is developed.

The integration of the aforementioned sources provides a dataset that consists of 14,510 firms with at least 10 employees (due to the above-discussed CIS sample threshold), covering the business units operating in the following 2-digit Nace Rev.2 sections (sectors are identified by alphabetical letters): manufacturing (C) – with the exception of Tobacco (Nace division 12); wholesale and retail trade repair of motor vehicles and motorcycles (G); transportation and storage (H); information and communication (J); professional, scientific and technical activities (M, with 69 and 75 divisions excluded). The distribution of the final sample includes 7,908 small firms (10-49 employees), 4,246 medium firms (50-249 employees) and 2,356 large firms (at least 250 employees). One of the strengths of the paper is precisely the possibility to decompose wage dispersion taking into account not only medium-sized and large companies, but also small businesses.

The dataset includes 5,895 manufacturing firms, 4,981 companies operating in the wholesale and retail trade repair of motor vehicles and motorcycles sector; 1,428 firms from the Transportation and storage industries; 873 from Information and Communication and 1,333 from Professional, scientific and technical activities. In the final sample, about 54% of firms are located in the Northern regions, while about a quarter (26%) are in the Southern regions and in the Islands.

3. Dissecting inequalities

A deeper investigation of within- and between-firms wage dispersion measures

To provide a first look at the wage distribution in our sample, we simply decompose the total variance of earnings (hourly wages in logarithm per job) in our sample in two components[7]. The first one – between-firms variation – reflects the variation in the so-called 'firm premium' – i.e., the differences in how firms pay similar workers. The second one – within-firm variation – is a measure of the wage dispersion of the workforce employed in a firm. A simple decomposition of log-hourly wage variance in our sample highlights that between-firm wage inequality accounts for 39% compared to 61% due to within-firm inequality. In analyzing these values, we should consider that our (unweighted) sample is biased towards large firms. Our descriptive results are in line with Zwysen (2022), showing that in Italy the within-firm dispersion accounts for 54% of total variance in 2018 relying on the Structure of Earnings Survey data. A slightly different picture emerges from OECD (2023) analyses based on administrative data drawn from the National Institute for Social Security, which have recently highlighted that in Italy the between-firm dispersion reached 60% in 2015 being the main component driving up the overall change in wage dispersion that occurred between 2002 and 2015.

Regardless of the database used and the time span covered, several factors are likely to affect both within- and between-firms wage disparities. To this respect, in this paper we compute robust inequality measures taking into account both workers' and firms' characteristics based on a fixed-effects estimation of a Mincerian-type wage equation (Winter-Ebmer and Zweimüller 1999; more recently Cirillo *et al.* 2017)[8]. The latter predicts individual gross hourly wage with respect to workers' characteristics and firm-level fixed effects. The within-firm dispersion is computed taking the ratio of 90th to 10th percentile of the residuals of the Mincerian regression, for each firm ($WD_{90/10,j}$) providing a first insight on the within-firm inequality that could not otherwise be explained directly by workers and main occupational features. As clarified in Cirillo *et al.* (2017), what remains to be explained after taking the residuals from the augmented Mincer equation, are within-firm differences in the components of wages that are not due to personal characteristics or to the average tendency of firms to pay

7 To decompose the overall variance of earnings a random-effect one-way analysis-of-variance (ANOVA) model has been fitted, based on the LEED dataset, where the group-detail is the firm identifier. The estimation is implemented by the command, loneway, in STATA 15 (Marchenko 2006). The weights of, respectively, the between- and the within- component are computed as the share of the estimated standard deviation of each component on the overall standard deviation.

8 The output of the augmented Mincerian equation estimation is available upon requests from the authors, though it is not shown in the present version of the paper for the sake of brevity.

more or less their employees (i.e., the firm-fixed effects in the Mincer regression).

In formulas, we apply a fixed-effects estimation to the following Mincerian-type wage equation based on Winter-Ebmer and Zweimüller (1999) and Cirillo *et al.* (2017):

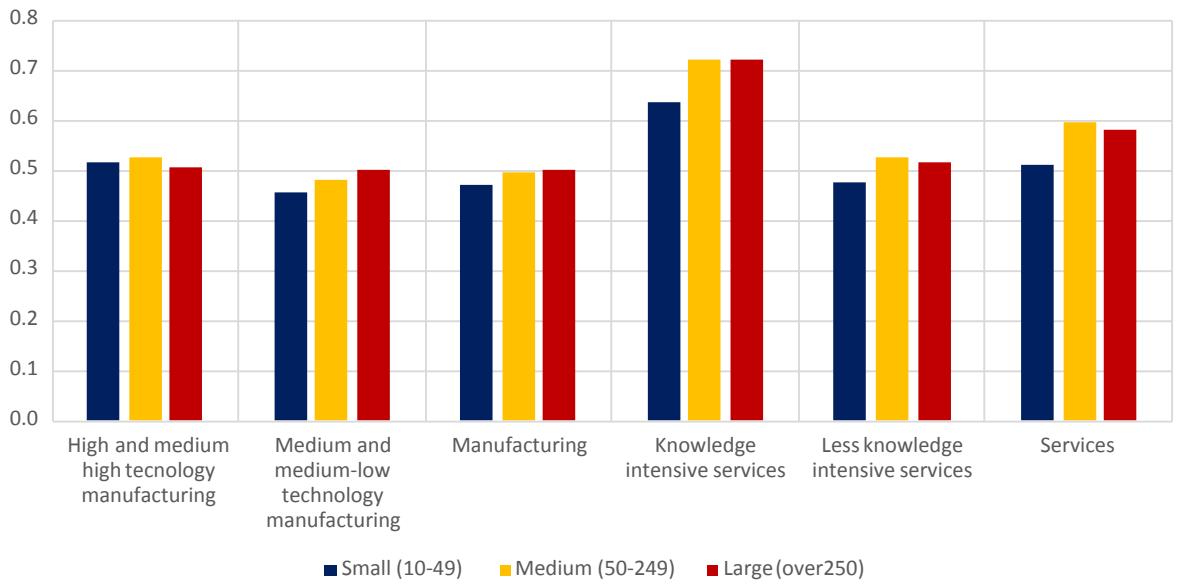
$$\log(W_{ij}) = \alpha_0 + \beta(WC)_i + \theta FE_j + e_{ij} \quad (1)$$

where W_{ij} represents the gross hourly job wage (job/worker *i* employed in firm *j*), WC_i stays for worker characteristics (age, age-squared, sex, educational level, fixed-term contract, part-time contract, citizenship, working area), while FE_j is a firm-level fixed effect and e_{ij} are the residuals. Estimated residuals $\hat{e}_{ij}$ are retrieved from (1) to compute the within-firm dispersion as: $WD_{90/10,\,j} = \hat{e}_{ij}\ p^{90} - \hat{e}_{ij}\ p^{10}$. In Figure 2, we dissect the within-firm wage dispersion by firm size and sector of activity, where the average of the within-firm dispersion measure $WD_{90/10,\,j}$ has been computed per groups of sectors and size.

Some main patterns arise. First, within-firm inequality is higher in services than in manufacturing, which can be due to the internal hierarchical layer and larger heterogeneities in remunerations negotiated with workers, even with very similar working profiles. Second, within-firm wage dispersion is sensibly higher in knowledge-intensive sectors[9], regardless of size, but also high and medium-high tech manufacturing sectors show on average a wider dispersion than less technological ones. Third, as expected, within-firm wage dispersion is generally higher in medium and large companies compared to small businesses – with the exception of high and medium-high tech manufacturing. The prevailing evidence of a wider wage heterogeneity in larger firms is on the one hand due to the wider hierarchical layers in large firms, while on the other hand it points to stronger bargaining power of specific workers – usually high-skilled or managerial figures – able to negotiate higher wages resulting in a less compressed wage internal distribution.

Figure 3 sheds more light on the distribution of within-firm wage inequality by geographical location and size of Italian companies[10]. Those located in Northern and Center regions show higher within-firm wage dispersion with respect to those located in Southern ones. As already pointed out, this evidence is also likely to reflect the heterogeneity in the productive structure among Italian regions.

Figure 2. Within-firm log-hourly wage dispersion by firm size and technological sectors

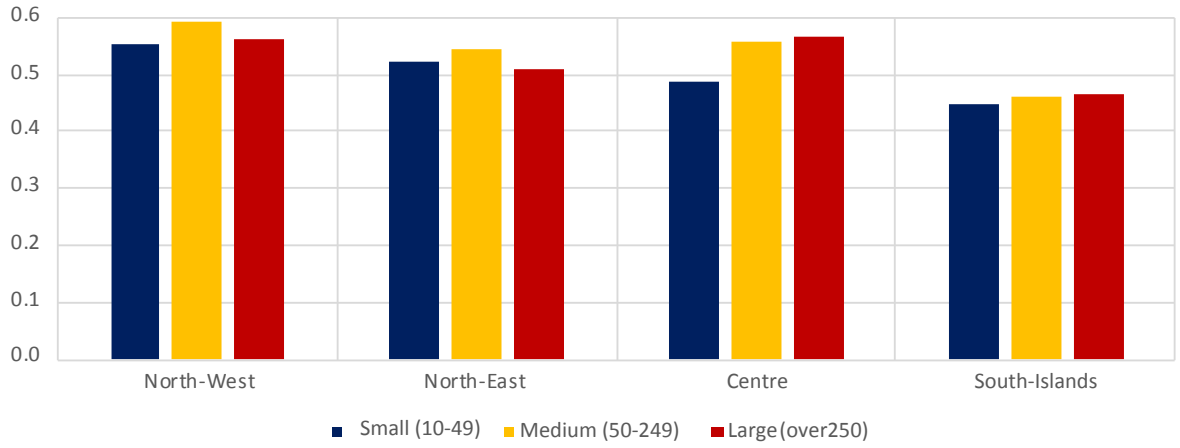


Source: Authors' elaboration based on our sample

9 We adopt the taxonomy of the technology intensity of sectors used by Eurostat (at 2-digit level, Nace classification). Cfr. https://shorturl.at/twBH5.

10 We refer to the location of the head office.

Figure 3. Within-firm log-hourly wage dispersion by firm size and geographical location



Source: Authors' elaboration based on our sample

In particular, Southern Italy shows a smaller average size compared to Northern regions, and a lower share of high-tech manufacturing and knowledge-intensive services. Indeed, according to what is shown in Figure 2, both these elements could be associated with a compressed within-firm dispersion of wages.

Further, we analyze the between-firm dispersion computed as the difference between the 90th and the 10th percentiles of the firm fixed-effects ($BD_{90/10,j}$), retained from the estimated Mincerian wage equation [1]. In formulas:

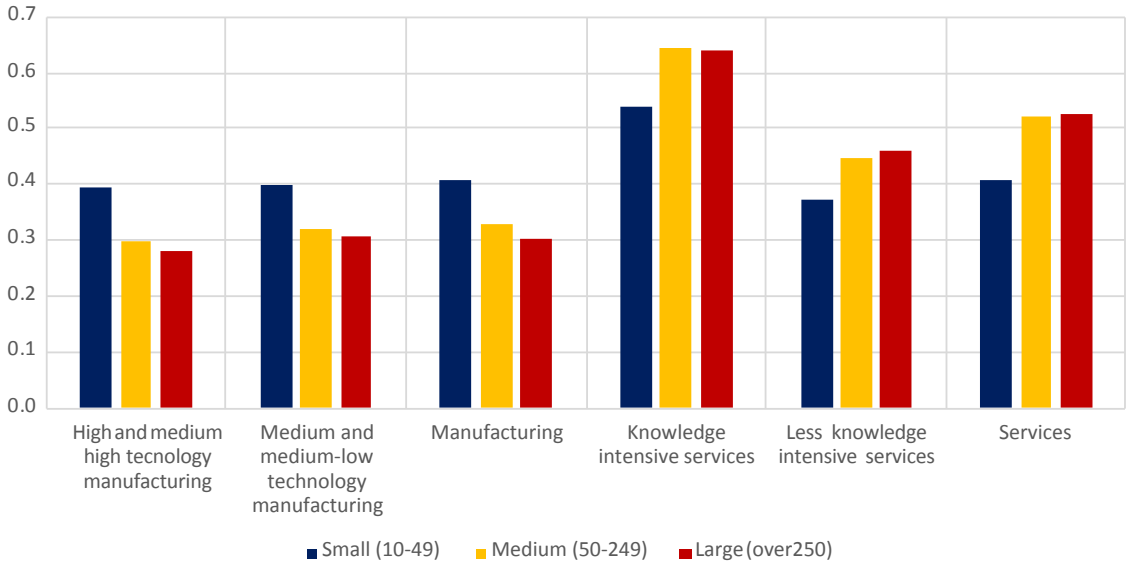
$$BD_{90/10,j} = \mathrm{FE}_j^{p90} - \mathrm{FE}_j^{p10}$$

This measure highlights the difference in average wages paid to workers across firms, once having controlled for individual characteristics of the workforce. The greater the difference, the greater the wage distance between companies. To some extent, it highlights the coexistence of high and low-wage companies in the same size class and macro sector.

Figure 4 suggests that firms' heterogeneity in wages is stronger in services, and specifically in knowledge-intensive ones, suggesting a stronger dualism of high versus low-paying firms with respect to manufacturing.

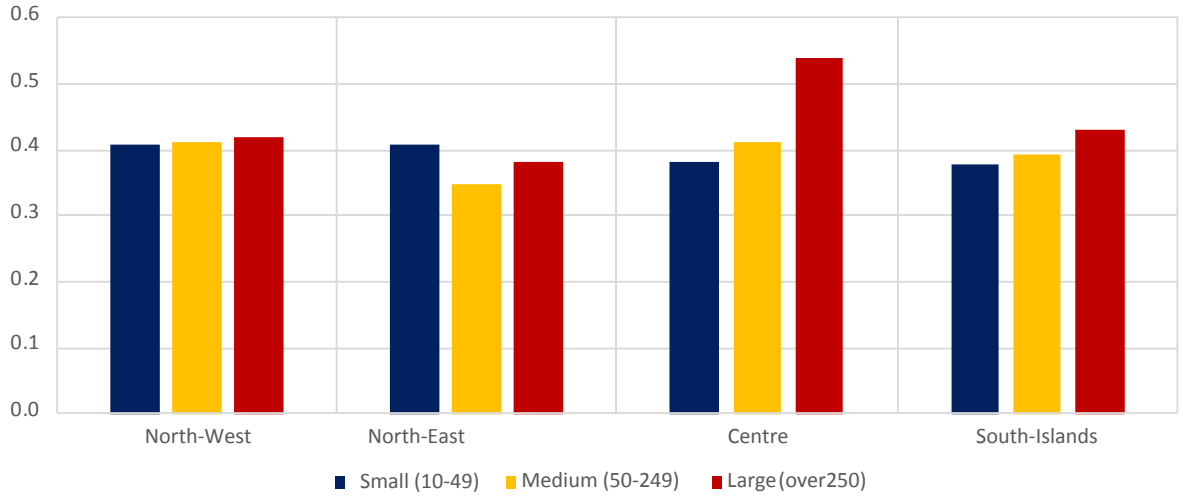
Furthermore, in services, firm size is strongly associated with between-firm wage dispersion for both

Figure 4. Between-firm log-hourly wage dispersion by firm size and technological sectors



Source: Authors' elaboration based on our sample

Figure 5. Between-firm log-hourly wage dispersion by firm size and geographical location



Source: Authors' elaboration based on our sample

knowledge-intensive and less knowledge-intensive sectors, while the opposite occurs in manufacturing. In large manufacturing firms, where trade unions are stronger, the average wage is usually higher and more homogeneous across companies – for instance, workers are covered by collective bargaining agreements – conversely, services show higher productivity heterogeneity, which is usually reflected in higher wage dispersion, even across large companies.

Finally, we dissect between wage dispersion by firm size and geographical location (Figure 5). Here the pattern is more heterogeneous since large companies located in Center Italy are the ones showing the highest level of wage dispersion followed by large companies in Southern Italy. However, the link between firm size and wage dispersion seems to be less clear-cut when dissecting companies by geographical location. A large proportion of between-firm wage dispersion in large companies of Centre and Southern Italy can be a hint of higher productivity dispersion.

Linking innovation to wage dispersion

Thanks to the nature of our dataset, we are able to inspect the relationship between wage dispersion and a firm's propensity to invest in innovation[11]. Recent empirical literature has pointed to a general positive association between innovation and wage dispersion, either across (Aghion *et al.* 2017) or within firms (Zwysen 2022; Cirillo *et al.* 2017).

Focusing on within-firm wage dispersion, the descriptive analysis highlights that investments in innovation do not display a strong association with wage inequality, with the exception of small companies – where firms with a positive expenditure in innovation show a slightly higher within-firm dispersion with respect to small non-innovative companies (Figure 6).

However, when we focus on between-firms inequality, it clearly emerges that more innovative companies are less polarized (Figure 7), evidencing a reduced wage dispersion compared to non-innovative ones[12]; in addition, this effect seems stronger for medium and large firms.

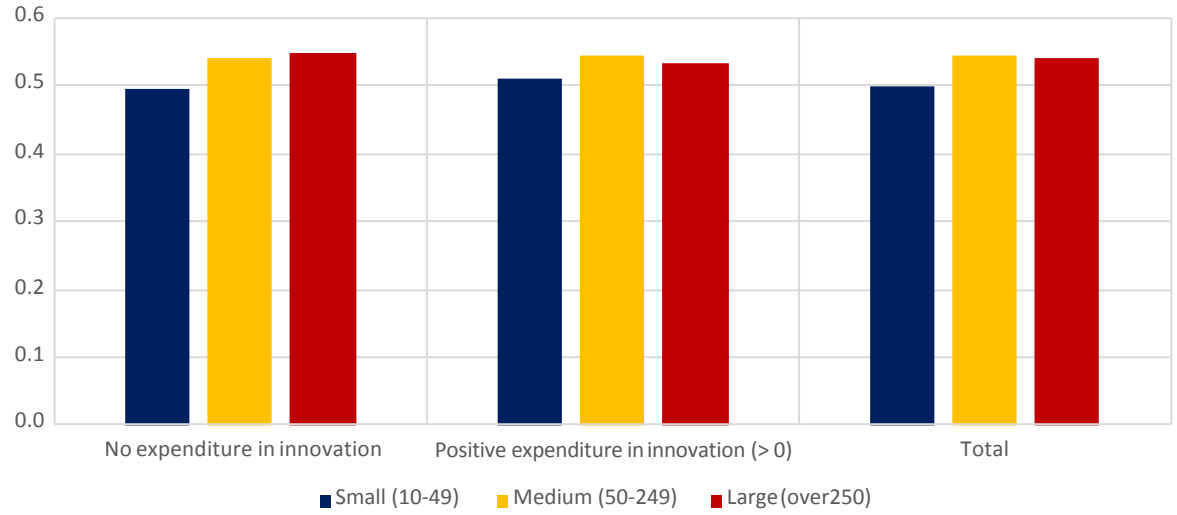
A simple econometric investigation of the innovation/wage dispersion nexus

To provide an econometric analysis of the association between innovation and wage dispersion, in this Section we present some results by multivariate estimates. Concerning within-firm dispersion, we run an OLS regression of $WD_{90/10}$ on the innovation

11 In this analysis, we refer to the whole amount of firms' investments in innovation in 2016 as measured by the Community Innovation Survey; in detail, we take the per-employee sum of the expenditures on R&D, machinery and equipment and other expenditures due to innovation, performed by innovative seeking firms.

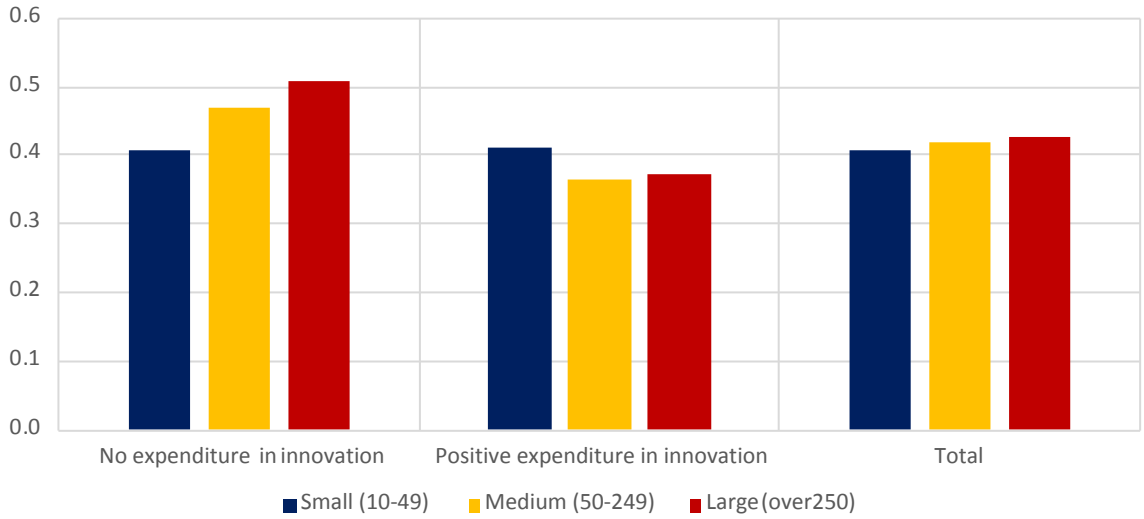
12 It is worth noting that, according to our data sample, average wages for innovative companies are higher than non-innovative ones.

Figure 6. Within-firm log-hourly wage dispersion by firm size and investments in innovation



Source: Authors' elaboration based on our sample

Figure 7. Between-firm log-hourly wage dispersion by firm size and investments in innovation



Source: Authors' elaboration based on our sample

term (log per-employee expenditure in innovation in 2016)[13] plus a number of variables capturing relevant firm structural dimensions and average measures referred to the firm's workforce. In order to jointly take into account both innovation and size, we also include an interaction term between the two dimensions, with large firms considered as reference category.

The firm-level analysis is performed by estimating the following equation:

$$WD_{90/10,j} = \alpha_0 + \theta INN_j + \rho INN_j xSIZE_j + \beta FLC_j + yWC_j + \epsilon_j \quad (2)$$

where INN is the log of per-employee total expenditure on innovation in 2016 (which includes, among other types, R&D and machinery and equipment expenditures performed by innovative seeking firms); $SIZE$ is a categorical variable (denoting small/medium/large firms) interacted with the innovation term whose associated coefficient accounts

13 The inclusion of the innovation term poses a selection-bias problem that calls for an ad-hoc treatment of this variable. Following a sound existing literature on the issue (Hall *et al.* 2009), we resort to a two-step strategy, estimating a Heckman model (Heckman 1979) whose fitted prediction is, then, included in the main regression as an explicative variable.

Table 1. Two-step Robust OLS estimates for within-wage dispersion

Dep: Within-firm dispersion (90th-to-10th residual from the Mincerian equation)		
	Two-step - OLS	
Total expenditure on innovation per employee (a)	0.004	
	(0.007)	
Dummy small size	-0.306	***
	(0.051)	
Dummy medium size	-0.049	
	(0.046)	
Small x innovation interaction	0.043	***
	(0.007)	
Medium size x innovation interaction	0.011	*
	(0.006)	
Public company	-0.027	**
	(0.013)	
Dummy (Member of a group)	0.035	***
	(0.002)	
Log Firm age	0.003	
	(0.002)	
Dummy (Higher modal age of employees within 2-digit sector)	-0.010	**
	(0.004)	
Dummy (Higher firm average tenure of employees within 2-digit sector)	-0.031	***
	(0.004)	
Dummy (Higher level of education of employees within 2-digit sector)	0.058	**
	(0.004)	
% managers	0.005	***
	(0.0003)	
% temporary contracts	0.001	***
	(0.0003)	
% part-time contracts	0.0001	
	(0.0002)	
% males	0.0002	
	(0.0001)	
Constant	0.379	***
	(0.052)	
Economic sector (2-digit NACE rev.2) dummies	Yes	
Regional dummies	Yes	
Observations/Firms	14,487	
R^2	0.2467	

Note: (a) Predicted value of the variable obtained by the Heckman model estimation. Standard errors in parentheses, robust estimation. Significance levels: * p < 0.1 , **p < 0.05, *** p < 0.01.

Source: Authors' econometric analysis based on our sample

Table 2. Two-step Unconditional Quantile estimates for between-wage dispersion

Dep: Firm fixed-effect from the Mincerian equation										
Two-step - Unconditional Quantile Regression (s.e. are boostrapped over 500 runs)										
	q10		q25		q50		q75		q90	
Total expenditure on innovation per employee (a)	-0.0041		0.009		0 .011		0.003		-0.024	
	(0.005)		(0.006)		(0.008)		(0.012)		(0.018)	
Dummy small size	-0.173	***	-0.167	***	-0.153	**	-0.358	***	-0.705	***
	(0.043)		(0.046)		(0.061)		(0.092)		(0.139)	
Dummy medium size	-0.059	*	-0.062		-0.023		-0.010		-0.206	
	(0.035)		(0.045)		(0.061)		(0.133)		(0.094)	
Small x innovation interaction	0.015	**	0.015	*	0.019	**	0.056	***	0.113	***
	(0.006)		(0.006)		(0.008)		(0.012)		(0.019)	
Medium size x innovation interaction	0.007		0.008		0.006		0.011		0.041	**
	(0.004)		(0.006)		(0.008)		(0.013)		(0.018)	
Public company	0.0528	***	0.023	*	-0.006		-0.085	***	-0.112	***
	(0.012)		(0.013)		(0.017)		(0.024)		(0.039)	
Dummy (Member of a group)	0.0165	***	0.025	***	0.037	***	0.058	***	0.059	***
	(0.004)		(0.004)		(0.005)		(0.008)		(0.012)	
Log Firm age	0.003		0.003	**	0.006	**	0.002		0.0002	
	(0.002)		(0.002)		(0.002)		(0.008)		(0.006)	
Dummy (Higher modal age of employees within 2-digit sector)	-0.0186	***	-0.013	***	-0.011	**	-0.012	*	-0.003	
	(0.005)		(0.004)		(0.005)		(0.007)		(0.010)	
Dummy (Higher firm average tenure of employees within 2-digit sector)	-0.015	**	-0.022	***	-0.026	***	-0.046	***	-0.057	***
	(0.005)		(0.004)		(0.005)		(0.007)		(0.012)	
Dummy (Higher level of education of employees within 2-digit sector)	0.030	***	0.042	***	0.060	***	0.081	***	0.083	***
	(0.004)		(0.004)		(0.004)		(0.008)		(0.011)	
% managers	0.0001	***	0.002	***	0.003	***	0.009	***	0 .014	***
	(0.0008)		(0.0002)		(0.0002)		(0.0004)		(0.001)	
% temporary contracts	0.0004	**	0.0002	*	0.0001		-0.0000		0.0006	*
	(0.0001)		(0.0001)		(0.0001)		(0.0002)		(0.0003)	
% part-time contracts	0.0002	*	0.0003	***	0.0001		-0.0003	**	-0.0002	
	(0.0001)		(0.0001)		(0.0001)		(0.0001)		(0.0002)	
% males	0.0003	**	0.0002	**	0.0002	**	-0.0001		-0.0004	*
	(0.0001)		(0.0001)		(0.0001)		(0.0001)		(0.0003)	
Constant	0.3857	***	0.314	***	0.399	***	0.756	***	1.241	***
	(0.056)		(0.068)		(0.079)		(0.141)		(0.347)	
Economic sector (2-digit NACE rev.2) dummies	Yes		Yes		Yes		Yes		Yes	
Regional dummies	Yes		Yes		Yes		Yes		Yes	
Observations/Firms	14,487		14,487		14,487		14,487		14,487	
R^2	0.0844		0.1406		0.1877		0.2215		0.1751	

Note: (a) Predicted value of the variable obtained by the Heckman model estimation. Standard errors in parentheses, robust estimation. Significance levels: * p < 0.1, **p < 0.05, *** p < 0.01.

Source: Authors' econometric analysis based on our sample

for the role of innovation on wage dispersion of small and medium firms compared to large firms; *FLC* includes a set of variables at the firm level (firm size, firm-age, group-firm, public control, NACE-rev.2 divisions; NUTS 2 controls); finally, WC contains variables obtained as a synthesis of some relevant worker's characteristics (workers modal age; average years of education; tenure of employees, job title, share of managers, fixed-term workers, part-timers, males).

According to the results shown in Table 1, regression-based analysis confirms the descriptive evidence presented in Figure 6: innovation turns out not to enhance significantly within-dispersion in large firms (the innovation term is not significant), whereas small firms are significantly associated with lower $WD_{90/10}$ compared to large firms. In addition, within-firm wage dispersion is higher in small innovative companies compared to large innovative ones, with less clear-cut evidence for medium firms.

Results for the other variables confirm what is expected. Concerning firm-level characteristics, we find that group-membership represents a WD-augmenting factor. Indeed, group-member firms are likely to put in place more complex managerial and organizational practices. By contrast, being a publicly owned company is associated with a reduced wage dispersion, which is very reasonable as in this type of company a higher job security is accompanied by, on average, a more egalitarian wage structure due to e.g., a relatively higher union density. Workforce composition is also relevant: the role of embodied human-capital in the firm fosters wage dispersion, possibly suggesting the presence of some SBTC/RBTC factors at stake, whereas a higher average tenure and age of employees reduces wage differentials. In addition, a higher share of temporary contracts correlates with a higher dispersion in wages, though the direction of the latter is not clear ex-ante – at least in theory. Indeed, short-term contracts record lower wages with respect to their permanent counterpart mostly at the bottom of the wage distribution, conversely, they can enjoy higher retributions for very specific and qualified competences.

To inspect econometrically the evidence concerning the dispersion across firms (between-firms inequality), we also estimate a(n) (unconditional) quantile regression (Firpo *et al.* 2009; 2018) based on the Recentered Influence Function (RIF) of the fixed effects retrieved by the Mincerian equation (cfr. Subsection *A deeper investigation of within- and between- firms wage dispersion measures*) on the same set of explicative variables used to explore the relations for our measure of within-firm dispersion. The RIF approach allows us to evaluate the association between the variables of interest (namely, innovation and firm size) at the different percentiles of the distribution of the average firm-specific (log-hourly) wage. Put in other words, we are able to detect a possible enhancing/shrinking dynamic of between-firms wage dispersion in association with innovation expenditure, firm size and their interaction.

Again, taking into account size and innovation dimensions jointly (Table 2) we find that, once differences due to workers' characteristics are taken into account, innovation in large firms does not seem to be relevant with regard to the average wage paid across the quantile distribution. By contrast, significant negative coefficients of size dummies for small firms, decreasing from p10 to p90, denote lower wages than large firms and imply a shrinking of dispersion across companies, which is in line with Figure 6. However, innovative small firms exhibit higher wages, with an increasing intensity along the wage distribution and with the largest effect for the upper decile, suggesting a dispersion-widening implication.

Conclusions

The upsurge in income inequality and the spread of in-work poverty due to low-wage jobs require a deep investigation not only of the sources of inequalities but also of the *locus* where these are generated and fuelled. In this respect, several studies are showing that nowadays a larger part of overall wage inequality can be increasingly explained by looking at the place where individuals work, rather than ascribed to their specific skills and occupations.

Theoretically, the existence of firms paying different wages to similar workers would require new analytical tools beyond the standard neoclassical framework. Indeed, the latter may not adequately account for wage differentials which would be better described by models allowing for firms heterogeneity.

From an empirical standpoint, this contribution sought to explore wage dispersion in Italy by focusing on firms, as mentioned one of the main – although not the only – place where inequalities are exacerbated.

By means of a unique and innovative source of information, we have performed a detailed descrip-

tive analysis on a sample of Italian companies drawn from the 2016 edition of the Community Innovation Survey. Three main patterns have emerged. First, service industries record the highest level of inequalities, regardless of the measurement of wage dispersion applied. Dissecting wage dispersion in this sector is of utmost importance to trace relevant policy implications. In particular, our analysis conveys that within-firm inequality – not explicitly related to individual, job and firms' characteristics, but possibly explained by differences in power among workers and informal negotiations of remunerations – is higher in services – especially in knowledge-intensive ones – than in manufacturing. We argue that a wider internal hierarchical layer and the huge heterogeneities in remunerations negotiated with workers, even with very similar working profiles, may drive this evidence and institutional aspects – related to union coverage and/or the presence of firm/individual-level bargaining and negotiation – are likely to underpin the broader internal dispersion found in both knowledge-intensive services and high-tech manufacturing, compared to their respective lower-knowledge/technological counterpart.

Second, between-firms inequality should be carefully taken into account. It could be linked to productivity dispersion pointing to a dualistic structure, especially in services where low-productive and low-paying firms coexist with high-productive and high-paying companies. In addition, we find that firm size is strongly associated with between-firms wage dispersion in services, whereas the opposite occurs in manufacturing. This can be explained by heterogeneous workforce-management relationships, for instance, small service companies are more likely managed by either the founder or a family member who is usually less prone to adopt second-level bargaining – that usually leads to higher wages compared to national agreements.

Third, the peculiarity of our dataset has allowed us to explore the role of innovation in shaping inequalities within and across companies. According to our analysis, we argue that in usual times – namely, well before the outbreak of the Covid crisis – investments in innovation do not seem to display a solid association with wide disparities within Italian companies, whereas the heterogeneity of compensations between firms looks sensibly lower in innovative firms. Innovation does not lead per se to increasing dispersion, at least in large companies where institutional factors such as strong trade unions are expected to play an important role. Regression-based analysis somewhat enriches the picture offering a sort of econometric validation of the descriptive evidence. According to the estimates, innovation does not turn out to enhance significantly within-dispersion in large firms, whereas it contributes to widen the internal dispersion of wages in smaller companies. In addition, investments in innovation are not associated with increasing wage dispersion across large firms, but they can contribute to enlarge wage disparities among small companies, as evidenced by major wage increases occurring at the top of the average wage distribution.

Taking stock of these results, we may argue that services need to be properly monitored since major wage disparities occur in those firms. Such a result can be linked to the weakness of trade unions in services compared to manufacturing, to the application of discretionary wage policies and/or to productivity dispersion. Our analysis, in line with previous evidence raised by Andrews *et al.* (2016) and OECD (2023), highlights the relevance of between-firms wage dispersion. From this perspective, public policies and institutions may engage in the shaping of the dispersion productivity across firms by, e.g., improving firm wage policies and defining fine-tuned policies supporting investments in innovation – though paying attention not to enlarge wage dispersion across firms.

This paper also suggests that other mechanisms – beyond innovation per se – are at play in influencing wage inequality, ones that are more grounded in the institutions of the labour market. From this perspective, it would be crucial for future research to integrate databases including information on institutional factors such as the level and coverage of contractual agreements and the union density at the firm level. The lack of these crucial elements has limited the analysis of this article together with the lack of intertemporal variation of inequality impeding to link within and between firm inequalities to macroeconomic factors.

Notwithstanding these limitations, this contribution – which is a first and preliminary attempt to link structural characteristics of the economy to distributional issues – has highlighted the strategic value of the integration of multiple data sources to dissect the sources of wage inequality and trace policy implications to revert the increasing disparities we are experiencing in market incomes.

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