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Labour, unions and R&D in Italian firms

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ABSTRACT

How and to what extent does organized labour contribute to shaping firms' competitive strategies by fostering innovation and investments in R&D? Drawing on insights from evolutionary theories and industrial relations studies, this paper empirically investigates how firm-level collective bargaining impacts firms' investments in intangible assets, including R&D. The paper underlines how in the workplace context, where workers and managers pursue conflicting interests, the presence of a strong trade union able to bargain can empower workers' voice and persuade management to invest in innovation related assets rather than compete through cost cutting strategies. We leverage a comprehensive and representative survey of Italian non-agricultural companies conducted by the National Institute for Public Policy Analysis to test these predictions. Baseline estimates indicate that firm-level bargaining, particularly in highly unionized firms, is linked to investments in R&D and other intangibles. Further analysis suggests that work organization clauses are key drivers of this positive relationship.

1. Introduction

The impact of labour market institutions on growth and innovation has been at the center of political and scientific debate in the last decades. At the beginning of 90 s a strong consensus was established among national and international actors on the necessity of reducing labour rigidities to increase productivity and foster employment (OECD, 1994; Scarpetta, 1996; Saint-Paul, 2002). However, several scientific contributions have documented how labour deregulation and weakening of trade unions have negatively affected firms' innovative capabilities (Cetrulo et al., 2019; Hoxha and Kleinknecht, 2020; Reljic et al., 2023), worsened the functional distribution of income (Stansbury and Summers, 2020) and hindered the creation of good and stable jobs (Piasna and Myant, 2017; Pianta and Reljic, 2022).

Nowadays, given the increasing labour fragmentation and sluggish productivity growth, some rethinking of the role of labour market protections is underway. In particular, the implementation of social dialogue and participatory practices in the sphere of labour is healed as crucial to improve working conditions (Cazes et al., 2019), and ensure a fair transition to a more sustainable production (ILO, 2022). Concurrently, the labour economics literature has shown a renewed interest in studying how trade unions can affect innovation dynamics (Bryson and Dale-Olsen, 2020; Belloc et al., 2022a), wage equality (Card et al., 2017) and productivity (Barth et al., 2020), highlighting the emergence of several positive linkages and possible virtuous circles (Pianta and Reljic, 2022).

This paper aims to contribute to the ongoing debate by examining the role of trade unions and collective bargaining in promoting firms' investment in R&D and intangible assets. Our analysis focuses on Italy, a country characterized by low and declining investment in innovation inputs (Calvino et al., 2022). Italy has also been a focal point for structural reforms intended to enhance productive competitiveness, which, however, have resulted in growing wage inequalities and an increase in non-standard forms of employment (Cetrulo et al., 2023; Cirillo et al., 2017).

Moreover, not only the Italian economy went through important labour reforms, but it also shows a specific two-tier industrial relation model, based on industry and firm level collective agreements that cover respectively around 80 % and 20 % of Italian companies (Dorigatti et al., 2021). Although its modest degree of diffusion across companies, the second level bargaining has a specific scope focused on work organisation issues as well as training, participatory practices and, most of all, performance related pay schemes (Cardinaleschi, et al., 2015), while sectoral bargaining mainly sets pay scales and working time for all

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companies covered by the same CCNL.[1]

The main theoretical assumption guiding our analysis is that the decision to invest in R&D and intangibles is not exclusively the result of technological conditions, as stated in the literature on technological (learning) regimes' (Breschi et al., 2000), but it also depends on firms' specific characteristics in terms of routines and coordination mechanisms among the actors belonging to the organization (Coriat and Dosi, 1995; Lorenz and Lundvall, 2006). In this framework, the setting of productive strategies and investment choices aimed at expanding the firm's specific knowledge base, as in the case of R&D, will be the complex outcome of technological and market constraints, together with specific managerial models (Wang et al., 2022; Franco and Landini, 2022) and organizational practices oriented towards a greater involvement of workers (Vidal, 2022; Cirillo et al., 2023b).

Often, especially when being close to the technological frontier is not binding for firms' market position (e.g., low and mid-tech industries), investments in innovation related assets are the consequences of political economy considerations. In such contexts, the risk and costs of these investments may discourage firms from pursuing a competitive strategy centered on innovation, favouring safer alternatives based on cost and asset retrenchment. As widely discussed in the literature on high-road vs. low-road employment, however, such alternatives are not neutral from the perspective of the workers (Osterman, 2018). While innovation-centered strategies tend to trigger good jobs-high productivity virtuous cycles that benefit the workers (Pianta and Reljic, 2022), cost-based strategies shift the burden of competition to labour, through low paid and highly uncertain jobs (Arrighetti et al., 2022). Thus, if workers are disorganized and external technological constraints do not bind, employers can have stronger incentives to curtail R&D and intangible investments, seeking low costs as drivers of competitiveness. On the contrary, when labour is well organized and endowed with adequate institutional tools to collectively bargain, it can introduce "beneficial constraints" (Streeck, 1997) that push firms towards the adoption of competitive strategies based on innovation, rising investments in related assets. Moreover, a firm characterized by a higher involvement of workers in decision making (through collective bargaining) can promote the adoption of advanced models of work organization that strongly relies on knowledge accumulation and learning dynamics (Lorenz and Lundvall, 2006; Lucidi and Kleinknecht, 2010), further supporting the investment in innovation related activities.

To empirically test these hypotheses, we exploit the last two longitudinal waves of the 'Rilevazione Imprese e Lavoro' (RIL) survey conducted by the National Institute for Public Policy Analysis (INAPP) in 2015 and 2018. The survey is part of the National Statistical Programme and covers a representative sample of non-agricultural firms. It provides detailed information about employee representations, collective bargaining, together with data on performance and innovation. Our econometric analysis reveals that investments in R&D and other intangibles are positively associated with the joint presence of firm-level collective agreement (on top of national collective agreements) and a highly unionized workforce across firms. This result holds in a battery of robustness checks, where we control for an extended set of covariates, including proxies for firm performance. When we split the sample across industry groups, we find that this positive association persists only in sectors where frontier technologies are less decisive as competitive lever, such as Pavitt's scale intensive and supplier dominated sectors and Peneder's low innovation intensity industries. We also find that the positive effects of unionization and firm-level collective bargaining are more pronounced when such agreements explicitly address work organization clauses, including employee training, work schedules, environmental concerns, health and safety issues, or internal labour market aspects such as employment contract types and job tenure. Our findings suggest that when a second-tier collective agreement is signed and backed by a sufficiently powerful workforce (as proxied by the unionization rate) an effective mechanism of workers' voice representation at the firm level is activated, leading to an innovation-enhancing outcome that mediates between clashing interests, such as those pursued respectively by trade unions (seeking to ensure job stability and high wages) and managers (eager to increase profitability and competitiveness) (Russo et al., 2019; Cirillo et al., 2023b).[2]

The paper proceeds as follows: Section 2 offers a critical synthetic review of the theoretical and empirical literature on the topic; Section 3 provides details, on the one hand, of the Italian institutional context in terms of interactions and coverage of firm-level collective bargaining with respect to sectoral/national agreements and, on the other hand, of the diffusion of investments in intangible assets and R&D across Italian companies. Section 4 describes the database and presents some descriptive evidence. The empirical strategy is illustrated in Section 5 as well as econometric results. Section 6 brings the contribution to conclusion.

2. Setting the scene: trade unions and collective bargaining in context

From the publication of the book "What unions do?" by Freeman and Medoff in 1984, an increasing number of scholars have engaged the debate on the economic impact of trade unions, mostly looking at how firms' investment decisions are affected by the presence of a unionized workforce. Such research agenda has been developed through a variety of approaches, mainly belonging to the field of labour economics and industrial relations which, however, tend to neglect the role of institutional constraints on the one hand and the importance of knowledge accumulation dynamics on the other.

Mainstream economic scholars have privileged views grounded on parsimonious analytical approaches, which conceive of firms as nexuses of contracts among maximizing agents. In this setting, unions are often modelled as rent seeking monopolistic actors, prone to reap profits from capitalists' investment and focused on satisfying the claims of their members. Not surprisingly, these theories nearly unanimously predict that through hold-up problems (Grout, 1984) and other distortion of market mechanisms, unions can discourage investments in capital assets, including R&D and intangibles (Connolly et al., 1986; Sulis, 2015), with detrimental impacts on profitability (Menezes-Filho, 1997) and shareholders revenues (Hirsch and Link, 1987; Becker and Olson, 1992).[3]

Despite some consensus in the theoretical framework, when turning to empirical evidence, important heterogeneities emerge from country based and comparative studies, calling into question the prevalence of a unique (and detrimental) effect of unions on company performance (Menezes-Filho and Van Reenen, 2003; Bradley et al., 2017; Belloc et al., 2022b).

Most studies focused on North America usually find a negative effect of unionization, not only on R&D (Hirsch and Link, 1987; Hirsch, 1991;

[1] CCNL stands for Contratto Collettivo Nazionale del Lavoro and corresponds to the national collective agreement at the sectoral level.

[2] We acknowledge the intense debate surrounding conflicting interests at the board level of companies, particularly among managers, owners, and shareholders. However, since analyzing these clashing interests at the top of companies falls outside the scope of this study, we will, for simplicity, refer to them collectively as 'managers.' The same considerations may apply to unions, which might prioritize the interests of specific groups of workers (e.g., permanent employees) over others (e.g., temporary employees).

[3] Institutional drivers of R&D have been usually overshadowed in previous contributions mainly focusing on other important drivers such as firm size (Klepper and Cohen, 1996), market power (Aghion et al., 2005), demand pull (Piva and Vivarelli, 2007), technological opportunity (Klevorick et al., 1995), 'appropriability' conditions of the market in which firms operate (Lerner, 2009) and more recently as a source of corporate power and strategic behaviour of companies (Rikap et al., 2021).

Betts et al., 2001), but also on other types of investment related more generally to plants equipment (Bronars and Deere, 1993), innovation and patent activity (Acs and Audretsch, 1988; Bradley et al., 2017). On the contrary, studies performed on European data provide quite divergent results (Menezes Filho and Van Reenen, 2003). In the case of Germany, the effect of unionizazion on innovation seems to be overall null (Schnabel and Wagner, 1992; Addison and Belfield, 2004), while the impact of organized labour on R&D expenditure differs depending on the institutional channel, being negative for union density council, but positive for work councils (Schnabel and Wagner, 1994).[4]

Similar results are found on the UK data, where the relation between unionization and R&D expenditures becomes statistically insignificant once crucial explanatory variables are included in the analysis, such as firm age, sector, and technological opportunities (Menezes-Filho et al., 1998a,1998b; Addison and Wagner, 1994). More recent works by Berton et al. (2021) and Wang et al. (2022) document a positive and statistically significant association between unions and innovation respectively in Italian and British companies. On similar ground, Cardullo et al. (2020) and Bryson and Dale-Olsen (2020) stress the role that participatory practices can play in explaining such positive relations respectively looking at Italian, British and Norwegian companies.

Clearly, when embracing a comparative and institutionally grounded perspective, the relationship under study becomes more complex and diversified, as it is strongly affected not only by national production structures, but also by the employment relations rooted at the firm and sectoral levels. As underlined by industrial relations scholars, contrasting results between liberal and coordinated economies, as the ones synthesized above, need to be explained in light of the institutional varieties, that translate into different settings of firm's incentives, political legitimacy and power endowment attributed to social actors (Hall and Soskice, 2001; Korpi, 2018).

In this framework and following the seminal contribution of Hirschman (1970), unions should be interpreted as the expression of workers' voice as their presence allows workers to express their grievances in a collective way and develop a sense of attachment to the organization that will prevent from exit in case of conflicts and disaffection. The concept of voice has been widely investigated in the field of industrial relations studies (Wilkinson et al., 2020), mainly distinguishing between individual and collective forms. While the individual voice mechanisms consist of practices of participation and involvement that are mandated by the law or led by the management (Marsden, 2013), collective voice mechanisms – such as those discussed in our paper - take place essentially through the negotiation channel, pursued by representative trade union bodies. Collective bargaining can therefore be interpreted as the concrete process through which the collective voice is institutionally represented (Doellgast and Benassi, 2020) and has been shown to positively influence firms' innovation strategies (Addison et al., 2017) and workers wellbeing (Bryson et al., 2013). However, much of this literature tends to overlook the heterogeneous dynamics that arise from the production processes in which actors operate, particularly when distinguishing between sectors and technological trajectories. How and to which extent collective voice mechanisms interact with technological patterns of industries? Is their effectiveness related to the peculiar aspects that characterize industries and shape their technological trajectories?

Adopting the lens of evolutionary theory can be particularly useful in advancing theoretical reasoning and addressing gaps in standard industrial relations and labor market studies, as the evolutionary approach offers a different conception of the firm. Namely, companies are not merely collections of contracts; rather, they are social organizations where dynamic capabilities are continuously shaped by learning processes and knowledge accumulation (Teece and Pisano, 2003). At the same time, organizations are inhabited by diverse actors with conflicting interests, and their interactions can influence the functioning of the organization itself (Coriat and Dosi, 1995). In such framework, high wages and good jobs do not only represent a source of costs, but they can also act as positive incentives in promoting technological upgrading aimed at ensuring competitiveness and growth (Nelson and Winter, 1982; Sylos Labini, 1984, 1993). Hence, employees' representative bodies do not simply behave as rent-seeking agents, but through the defense of high-quality jobs and the promotion of participatory mechanisms, they further enhance a process of learning and productivity rise (Pianta and Reljic, 2022). In particular, the possibility of expressing workers' voice through the agency of unions can allow to collect ideas and suggestions on how to improve working conditions and solve inefficiencies (Freeman, 1976), mitigating the risk of shirking - or preventing workers' exit in presence of viable alternatives (Hirschman, 1970).

Although innovation scholars have widely emphasized the role of workers and organizational routines in contributing to the development of dynamic capabilities (Dosi and Nelson, 2010), the link between innovation and the distribution of power among actors within firms remains largely unexplored from an evolutionary empirical perspective (see Dosi et al., 2021, for a recent theoretical appraisal). Little attention has been devoted to understanding the concrete ways through which the "power resources" available (Lévesque and Murray, 2010) within organizations are enacted (Leap and Grigsby, 1986), as in the case of institutionalized forms of collective bargaining.[5]

More in detail, Fig. 1 outlines the conceptual background on which our analysis is grounded and the channels we aim to test. As illustrated in the figure, the presence of an "organized labour", intended as a unionized workforce able to bargain collective agreements (central red box) can foster the innovative performance of the firm through the imposition of "beneficial constraints" for the employers (Streeck, 1997) – solid black arrow pointing downward -, on the top of sectoral, technological and market boundaries that also shape the firm's set of choices (grey box on the left). In fact, the activation of an institutionalized voice mechanism (as it is the case of second-level bargaining), through which workers feel collectively involved and entitled to bargain on the labour process, can induce a virtuous circle fostering competitiveness through the adoption of strategies based on technological upgrading and knowledge accumulation, rather than cost-based strategies.

Such constraints can indeed induce firms to ensure job stability, push the improvement of the production standards also to preserve profits in front of higher wages and organizational costs (Freeman and Medoff, 1984), increase the company's spending on performance enhancing activities such as training and upskilling programs. Specific investments in intangible assets, such as R&D, that contribute more directly to the development of the firms' capabilities through the absorption of outside knowledge and the activation of learning processes (Cohen and Levinthal, 1989) can be therefore positively affected by such participatory industrial relations.

3. Institutional and innovation context: the case of Italy

Our analysis focuses on Italy, a country presenting peculiar features both with respect to its productive structure and industrial relations setting. First, it should be stressed that the Italian economy is characterized by a large share of small and micro enterprises with generally low adoption of digital technologies and low accumulation of complementary intangible assets (Calvino et al., 2022). According to many scholars, these patterns have contributed to the sluggish trend in labour productivity of the country over the last decades (Bugamelli et al., 2018;

[4] Examining the impact of the German co-determination law introduced in 1976, Kraft et al. (2011) find that co-determined firms record a higher number of granted patents compared to the other German firms.

[5] For a comprehensive overview of the main empirical contributions on the relations between trade unions and innovation see Table A1 in the Appendix.

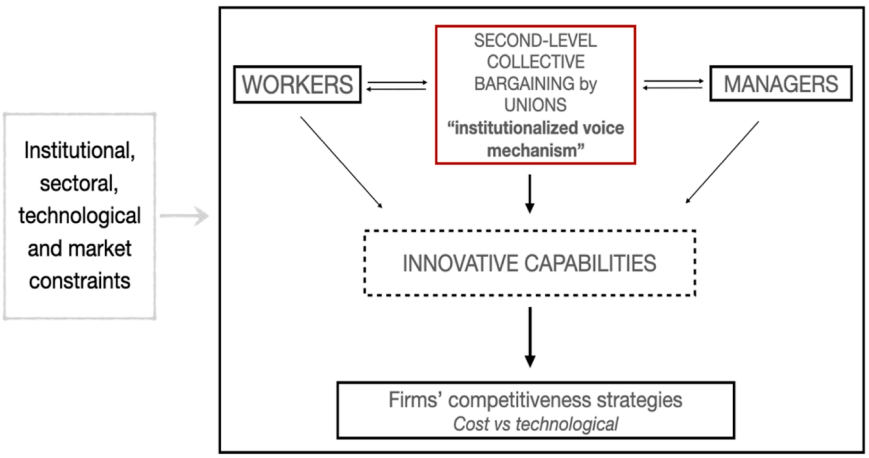


Fig. 1. Conceptual background: second-level bargaining, unions and innovation.

Dosi et al., 2012), as well as to the widening gap between best performing firms and the rest of the economy, also within narrowly defined industries (Andrews et al., 2016; Berlingieri et al., 2017, 2020; Cirillo et al., 2022).

Among the main drivers explaining the poor performance of a large fraction of Italian companies, the lack of investment in R&D, alongside other factors associated with firm characteristics (e.g., firm size and age, sector of activity) and capabilities (e.g., quality of the workforce and management), has been widely acknowledged (Costa et al., 2023). In Italy both the R&D expenditure by business enterprises and the number of researchers involved in R&D activities stand well below the European average and that of Germany, France, and the United Kingdom (according to OECD data). This gap in R&D spending seems to be particularly relevant among small firms.

Similar evidence can be derived from the European Innovation Scoreboard 2021, which reports that in Italy the top R&D spending enterprises per 10 million population is 6.4 compared to 16.2 in Europe. Furthermore, intangible investments in Italy are not only low, but also highly heterogeneous across firms and regions (Arrighetti et al., 2014). Indeed, large companies and in particular firms located in the Northern regions of the country exhibit the highest levels of expenditure and investment in R&D, confirming the amplification of regional divides (Daniele and Malanima, 2014). Such stylized facts underscore the importance of analyzing the factors influencing R&D and intangible investments in Italy, particularly from a policy point of view.[6]

Moreover, with respect to the system of industrial relations, since the mid-1990s Italy is characterized by a two-tier collective bargaining system, which implies two main levels of negotiation (Dorigatti et al., 2021). The first tier corresponds to CCNL (National Collective Labour Agreements) signed by social actors at sectoral level, applicable to all firms operating within the same industry and dealing primarily with matters related to minimum wage floors for occupational titles, as well as working hours, paid leaves, and training related to health and safety issues. The second tier consists in firm level agreement, covering negotiations aimed at setting changes in work organization, working hours, flexible practices (i.e., remote work), workloads, vocational training, and performance-related pay (Cardinaleschi et al., 2015).

Negotiations also take place with less frequency at regional and territorial level. These agreements usually include few and quite general provisions related to education and job classification systems, while also promoting the establishment of bilateral commissions (De Sario and Leonardi, 2022). Moreover, tripartite pacts and inter-confederal protocols are another important expression of national social dialogue and have played historically an important role in setting the features of the industrial relation system (Regalia et al., 2004).

While sectoral level agreements are signed by national trade unions and employee confederations agreeing upon a common platform of demands (Fulton, 2021), firm-level collective agreements are negotiated by the RSU ("Rappresentanza Sindacale Unitaria"), the employees representative body introduced in 1993, whose members are elected by all workers in a company. In companies without RSU, the collective bargaining can be carried out by the RSA ("Rappresentanza Sindacale Aziendale"), that is a representative body introduced by the Italian Workers' Act (Statuto dei Lavoratori) in 1970, whose members can only be elected by unionized workers. However, in most Italian companies RSA has been taken over by RSU, given the impossibility to exercise simultaneously the same function in the two organizations.[7]

Important differences must be considered when looking at the degree of diffusion of the two main levels of bargaining. According to CNEL, national collective bargaining covered in 2021 around 12.991.632 private employees, corresponding to about the 80 % of dependent workers in the private sector. Despite the huge and increasing number of sectoral contracts currently available (933 texts), the 14 % of them covers around 10 million and 660 thousand workers (CNEL, 2021). On the contrary, collective bargaining at firm level reaches around 30 % of the workforce, as estimated by trade unions and employers' associations in their annual surveys.[8] Moreover, this type of agreement tends to be far more prevalent among large companies compared to small ones. Specifically, the vast majority - approximately 69.1 % - of firms with 500 or more employees engage in firm-level collective bargaining, whereas <20 % of small firms are covered by such agreements (Cardinaleschi et al., 2015).

For what concerns unionization, according to the OECD/AIAS

[6] According to available Eurostat data the incidence of private R&D spending on total turnover for Italian firms is below the EU average for firms with <10 employees, while it is above the average for firms with >250 employees. Data available at: Statistics | Eurostat.

[7] Slightly different rules apply if firm-level agreements are negotiated by RSU or RSA. If there is a RSU at the plant level, a company agreement is valid if approved by a majority of RSU members. Conversely, in companies where the union body is RSA, the agreement must be approved by the representatives, who together or separately have the support of a majority of union members in the company and all employees can be required to vote on the agreement (Fulton, 2021).

[8] For instance, consider the report published by Confindustria, available at: https://www.confindustria.it/home/centro-studi/temi-diricerca/valutazione-delle-politichepubbliche/dettaglio/indagine-confindustria-sul-lavoro-2023.

ICTWSS database, the 30 % of the entire workforce is member of a trade union in Italy, with significant differences across sectors.[9] Since the 1970, a significant decline in the unionization rate has been recorded, together with the progressive deregulation and fragmentation of the labour market and the systematic exclusion of trade unions from the national policy agenda (Pulignano et al., 2018).

In this context, it is important to acknowledge that the Italian two-tier system is marked by an excessively long process of contract renewal. On average, workers with an expired CCNL face a waiting time of 33.9 months, while the overall average for all employees is 17.2 months (ISTAT, 2022). This structural delay poses a significant obstacle to strengthening social dialogue, with particularly adverse effects on workers' purchasing power and labor conditions. In such a scenario, social actors capable of engaging in decentralized collective agreements have the opportunity not only to complement the provisions established at the national and sectoral levels but also to address unexpected challenges in a timely manner. These challenges include adopting new technologies and working time reduction schemes (Piasna et al., 2024), but also managing market demand uncertainty, and mitigating supply chain disruptions, as recently demonstrated during the COVID-19 pandemic (Cetrulo et al., 2021; Romens et al., 2022).

To summarize, examining second-level bargaining is particularly important from both economic and innovation perspectives for several reasons. First, there are significant differences in scope and content between national and firm-level collective bargaining, with the latter focusing exclusively on firm-specific characteristics and management decisions (as discussed in the next section). Second, activating this institutional channel—through which workers give voice to their concerns—can promote the development of cooperative and innovation-oriented practices, leading to productivity gains for firms and improved working conditions. This is particularly valuable in a national context characterized by weakened institutions, sluggish capital investment, and declining union density.

However, it should also be acknowledged that shifting the entire management and implementation of key bargaining topics—such as decisions on wage growth—to the second level raises concerns, as it risks amplifying disparities in working conditions and wages across companies, an issue of particular relevance in the Italian context.

4. Data and descriptive statistics

4.1. Data

Given the above described economic and institutional setting, we now turn to the empirical analysis of the link between firm-level collective bargaining, unionization rate at the workplace level and investment in R&D and intangibles. We exploit an original database drawn from the 'Rilevazione Imprese e Lavoro' (RIL) survey conducted by INAPP during 2015 and 2018 on a representative sample of partnerships and limited liability firms. Each wave of the survey covers over 30,000 firms operating in non-agricultural private sectors. A sub-sample of the firms included in the survey (around 45 %) is followed over time, making the RIL dataset a partial panel over the period under investigation.[10]

The RIL-INAPP survey collects a rich set of information about the composition of the workforce, including the number of investments in training, hiring and separations, the use of flexible contractual arrangements and other workplace characteristics. Extensive information is available on management and corporate governance, productive specialization and other variables that proxy firms' strategies (such as the share of export on value added). Furthermore, the RIL-INAPP survey includes a specific set of questions designed to collect information on industrial relations. In the section "Industrial Relations", firms have been asked several questions concerning: (i) affiliation to industry association; (ii) adherence to national collective agreements; (iii) decentralized bargaining (firm-level agreement and territorial-level contract); (iv) topics covered by firm-level bargaining; (v) forms of employee representation in the company; (vi) unionization rate; (vii) existence of performance-related pay; (viii) forms of corporate welfare. Another relevant section of the questionnaire is "Credit and Investments" containing a set of specific questions on: (i) amount of investments; (ii) access to incentives; (iii) types of investments; (iv) access to credit; (v) amount of sales and other financial information. More in detail, firms have been asked whether in 2017 they invested in R&D and other related intangibles such as certifications, patents, licences, trademarks, and software.

In this paper we focus on R&D and other intangible investments, that correspond to a dichotomous variable taking value of 1 if the firm has invested in this specific category of goods and 0 otherwise.[11] Therefore, given the richness of the survey we can explore how and to which extent: (i) firms having a unionized workforce actively engaging in collective bargaining (through the signature of firm level agreement) register a higher probability to invest in R&D and other intangibles, all other things being equal; (ii) exploring how specific differences in terms of technological accumulation regimes proxied by sectors affect the relation under study.

4.2. Descriptive evidence

As first step of our empirical analysis, we consider descriptive evidence about the diffusion of firm-level collective bargaining among Italian companies and its association with investments in R&D and other intangibles. Table 1 shows that firm-level collective bargaining is by far the most common form of complementary negotiation being present in about 11 % of the firms in the sample (2 % at the population level - see Table A2 in the Appendix), whereas the alternative form, i.e., territorial-level bargaining, exhibits a very low incidence (around 1 % in the sample and 0.2 % in the population).

At the same time, however, complementary negotiation remains a relatively uncommon practice. On average, only 1 in 10 companies that have signed a national collective agreement (and 1 in 3 companies with an employee representative body) are also engaged in firm-level bargaining.[12] With regard to investments in R&D and other intangibles, approximately 15 % of the firms in the sample (compared to 5 % in the overall population) report making such investments. Fig. 2 illustrates that this value is higher in firms with

[9] Further data can be retrieved from https://www.oecd.org/employment/ictwss-database.htm

[10] The RIL survey is administered to the so-called 'official entrepreneur' as the communication is addressed to the owner. The respondent is most frequently the general manager, the owner, or an associated partner. The sample is stratified by size, sector, geographical area, and the legal form of firms. Inclusion depends on firm size, measured by the total number of employees. This choice has required the construction of a 'direct estimator' to consider the different probabilities of inclusion of firms belonging to specific strata. In particular, the direct estimator is defined for each sample unit (firm) as the inverse of the probability of inclusion in the sample. For more details on RIL questionnaire, sample design and methodological issues see: http://www.inapp.org/it/ril.

[11] In the RIL questionnaire, companies have been asked if they had realized investments in 2017 for different types of items: (i) marketing and advertising; (ii) research and development, certifications and patents, licences, and trademarks, software; (iii) land and buildings; (iv) plant, machinery, and industrial equipment; (v) computer equipment; (vi) other. Our outcome variable is based on (ii) and takes value equal to 1 if the company provides a positive answer to such question and 0 if it was registered as investment inactive in 2017 or invested in other forms of capital goods such as land and building, computer equipment, plant, machinery, and industrial equipment.

[12] The limited diffusion of complementary negotiations in Italy is confirmed also by other studies using different data sources (D'Amuri and Giorgiantonio, 2014).

Table 1
Descriptive statistics.

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
R&D and other intangibles	The firm has invested in R&D, patents, licences, trademarks, software in the last year (yes/no)	8109	0.146	0.353	0	1
Firm-level contract	The firm has signed a firm-level collective agreement (yes/no)	8109	0.108	0.311	0	1
Territorial-level contract	The firm has signed a complementary collective agreement at the territorial level (yes/no)	8109	0.01	0.1	0	1
Share Union	The share of workers who are union members	8109	0.086	0.1849	0	1
Number of employees	Number of employees currently working at the firm	8109	72.2	268.13	0	9775
% 50+ employees	% employees >50 years old	8109	0.242	0.22	0	1
% Emp. with tertiary edu.	% employees with tertiary education	8109	0.603	0.327	0	1
% Emp. with non-standard contract	% employees with a part-time or temporary contract	8109	0.215	0.269	0	1
Business group	The firm belongs to a national or foreign business group (yes/no)	8109	0.158	0.365	0	1
Multi-establishment	The establishment is one of a number of establishments belonging to the same company (yes/no)	8109	0.543	0.499	0	1
Exporting firm	The firm export goods or services abroad(yes/no)	8109	0.348	0.476	0	1
Multinational enterprise	The firm has carried out FDI or acquisition of foreign companies in the last 2 years (yes/no)	8109	0.043	0.198	0	1
Patents	The firm has filed or acquired patents during the last 3 years (yes/no)	8109	0.072	0.259	0	1
R& D incentives	The firm has benefited from incentives (e.g. tax break) to invest in R&D during the last 3 years (yes/no)	8109	0.145	0.353	0	1
Rate of change of sales	Log change of sales	8109	0.052	1.486	−13.84	15.75

Notes: Data from RIL 2015 and RIL 2018. For R&D and other intangibles the statistics are computed using RIL 2018. For all the other variables the statistics are computed using RIL 2015.

firm-level collective bargaining compared to those without. This difference is significant across all firm size groups, but it is especially pronounced in companies with >250 employees, i.e., very large companies. The same pattern is observed when focusing on highly unionized large companies. When analyzing technological sectors, companies with firm-level contracts show a higher incidence of R&D and related investments, particularly in science-based and scale-intensive industries. This notable difference in outcomes is also observed in supplier-dominated industries, although it is not seen in specialized supplier sectors. A similar trend emerges when comparing low-unionized firms to highly unionized ones. The latter group exhibits a higher rate of R&D investments across all sector types, irrespective of the knowledge accumulation regimes employed (Peneder, 2010).

Moreover, Fig. 3 provides an overview of the main topics addressed in second-level bargaining. In addition to supplementary or performance-based salaries, work organization issues—such as scheduling working hours, employee training, and addressing environment, health, and safety concerns—play a significant role, with an incidence rate of 46 % among companies engaging in firm-level bargaining. Notably, companies that include work organization issues in their second-level contracts are more actively involved in R&D and other types of intangible investments (Fig. A1 in the Appendix).

Overall, the descriptive analysis provides fairly encouraging preliminary evidence on the role of firm-level collective bargaining in supporting innovation activities. For most groups of firms, the presence of this type of bargaining is associated with higher incidence of investment in R&D and other intangibles. This is true especially for large firms. Obviously, this result can be driven by many factors, which are not accounted for in the descriptive analysis. Cleaner evidence requires a multivariate investigation, which is indeed the objective of the following section.

5. Results

5.1. Firm-level collective bargaining and investments in R&D

The following Probit specification model is applied to account for the binary dimension of our dependent variable (having invested in R&D and other intangible assets):

$$P(y = 1|\mathbf{x}) = G(\beta_0 + \beta_1 x_1 + ... + \beta_k x_k) = G(\beta_0 + \boldsymbol{x\beta}) \quad (1)$$

As common in this setting, $P(y = 1|x)$ represents the probability of success (the firm reports investment in R&D and other intangibles), given a set of explanatory and control variables, defined as follows:

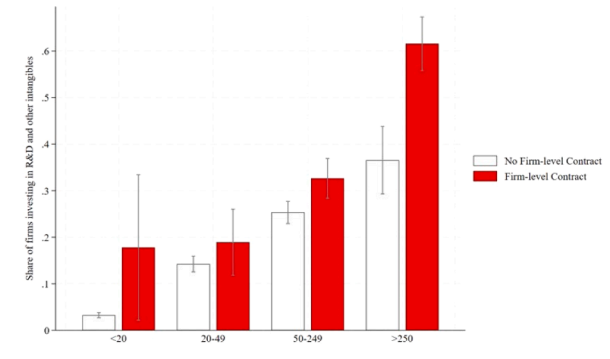
$$\boldsymbol{x\beta} = \beta_1 FC_{i,t-1} + \beta_2 TC_{i,t-1} + \beta_3 UR_{i,t-1} + \beta_4 X_{i,t-1} + \gamma_1 Z_j + \gamma_2 W_z + \epsilon_{i,t} \quad (2)$$

As for main explanatory variables, FC_i is a dummy variable taking value 1 if the firm has signed a firm-level collective agreement, and 0 otherwise; TC_i is a dichotomous variables taking value 1 if the firm has signed a territorial-level, and 0 otherwise; and UR_i is a variable on the firm level unionization rate. As discussed above, in the Italian institutional context companies signing firm-level agreements are usually classified as multi-employer bargaining actors since they apply agreements classified by EUROSTAT as "enterprise or single employer agreements" or "agreements applying only to workers in the local unit", in addition to – or departing from – agreements signed at more centralised levels (national or sectoral level), which cover the large majority of firms in Italy (82 % in our sample).

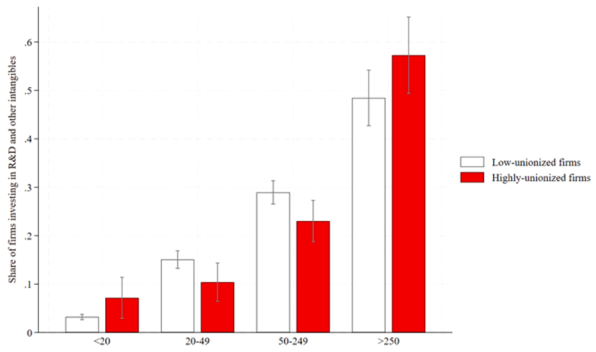
To enhance the interpretability of our estimated coefficients, we restrict our analysis to firms covered by a national-level collective agreement and with a minimum organizational setup (i.e., more than one employee). This implies that the base category in Eq. (1) is given by firms that are covered by such national agreement but lack any additional form of complementary negotiations.

Eq. (1) includes a wide set of firm-level time-varying controls X_i referring to: (i) firm structural features such as firm size expressed through categorical variables; (ii) employees' characteristics such as share of employees over 50 years, share of employees with tertiary education; (iii) labour institutional settings, proxied by the share of employees having a non-standard job contract (temporary or part-time); (iv) firms' features concerning type of management (business unit part of a business group or multinational company; multi-establishment enterprise); (v) firm strategies concerning export and innovation (exporting firms, patents and reliance on R&D incentives).

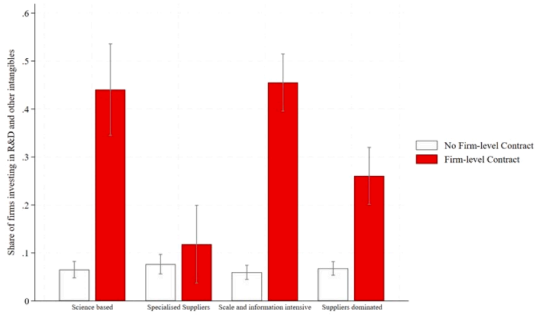
Moreover, among our control variables, we also include firm sales, interpreted as a proxy of firm performance, being aware of the risk of high correlation between firm performance, complementary negotiations, and investments in intangibles. Due to data limitations,



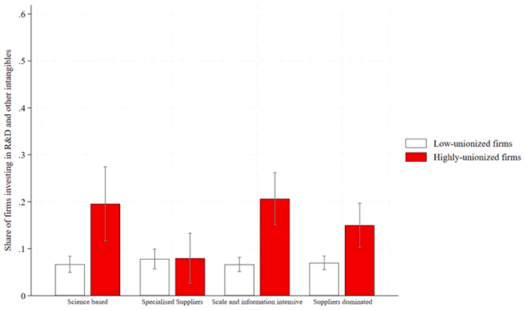
a) R&D investment and firm-level collective agreement



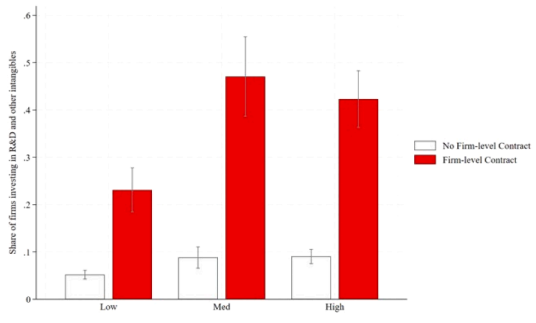
b) R&D investment and unionization rate



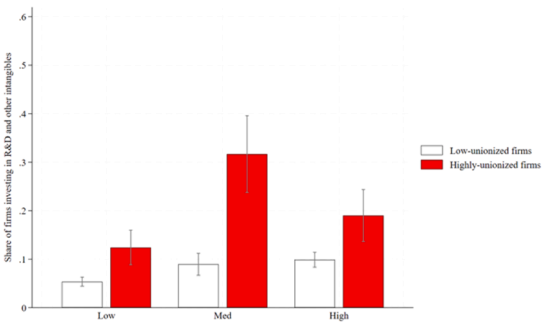
c) R&D investment, firm-level collective agreement and Pavitt taxonomy



d) R&D investment, unionization rate and Pavitt taxonomy



e) R&D investment, firm-level collective agreement and regimes of accumulation accumulation



f) R&D investment, unionization rate and regimes of knowledge

Fig. 2. R&D and other intangibles by firm size, Pavitt and Peneder classes.

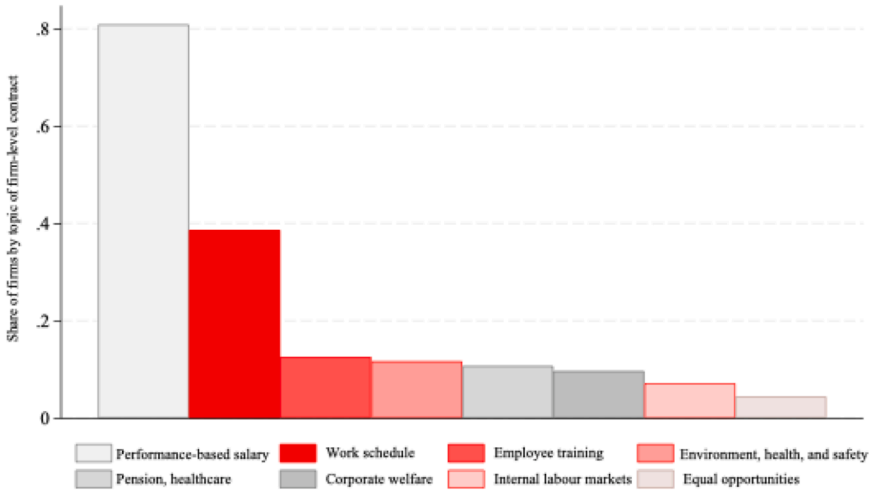


Fig. 3. Share of companies by topic of firm-level bargaining (work organization clauses in red boxes)
Source: RIL-INAPP data, sampling weight applied (companies with more than one employee).

we cannot merge outside firm-level information, but we have to rely on a set of self-reported measures available in the survey.[13]

All controls are lagged and therefore predetermined capturing firms features measured in 2015 to mitigate issues of reverse causality. We include industry Z_j and regional dummies W_z,[14] while the parameter $\epsilon_{i,t}$ indicates an idiosyncratic error term. The set of lagged controls referring to bargaining institutions, firm-level and employee characteristics, international and past innovation activities have been included in a stepwise fashion in order to check the robustness of relationships.

Our key variable of interest is the interaction between the strength of the union at the workplace (measured by the unionization rate) and the adoption of firm-level collective agreements. This allows us to assess the impact of a unionized workforce capable of bargaining on firms' innovation strategies.

We hypothesize that in workplaces, typically marked by an uneven distribution of power and opposing interests between managers and workers, the ability to engage in collective bargaining makes conflicts explicit and fosters the adoption of cooperative solutions. Furthermore, more balanced power relations within firms—facilitated by the development of institutional tools for dialogue—are likely to amplify workers' "voice" through collective agreements. This dynamic can encourage management to invest in resources such as R&D, which helps alleviate competitive pressure on wages.

To test the plausibility of this argument more thoroughly, we include two different proxies for workers' bargaining power in the regressions. First, we use a continuous variable representing the unionization rate (i.e., the share of workers currently enrolled in a union). Second, we include a dummy variable that takes the value of 1 if the unionization rate exceeds one-third and 0 otherwise, allowing us to capture the potential impact of a particularly strong trade union.

As shown in columns 1 and 3 of Table 2, while the coefficients for firm-level agreements and unionization rate are negative but not statistically significant, their interaction is positive and statistically significant. This finding remains robust even when considering different size thresholds (Tables A3–A7), suggesting that beyond specific organizational structures associated with company size, firm-level bargaining in strongly unionized workplaces significantly increases the likelihood of R&D and other intangible investments. In columns 2 and 4, we repeat the same analysis, this time focusing on the presence of a strong union at the workplace. Once again, we find a positive and statistically significant coefficient for the interaction term.

Fig. 4 presents the estimated marginal effect of signing a firm-level collective contract at different levels of unionization, with panel A and panel B showing results with and without the inclusion of sales among the control variables, respectively. The results indicate that once unionization rates exceed 20 %, the effect of firm-level collective agreements becomes positive and continues to increase with higher levels of unionization.

The combination of these results suggests that the bargaining power of unions can indeed be a relevant channel through which firm-level complementary negotiation affects investments in R&D and other intangibles. This type of negotiation provides workers with a collective voice channel that allows them to influence investment decisions. In particular, in a competitive business environment that tends to put strong pressure on costs, investments in innovation-related activities such as R&D are likely to encounter strong support on the side of the workers to shift competitive pressure away from wages. If workers have the strength (high unionization rate) and the institutional tools (firm-level collective agreements) to make their voice heard, then this type of investments is more likely to rise. Moreover, contrary to what advanced by the "hold-up" literature according to which unions hinder investment and innovation at firm level, the presence of a unionized workforce does not seem to exert any significant effect in our empirical setting. This result confirms our intuition that the ability of organized labour to shape investments in intangibles rests more on the presence of institutional channels that enable collective negotiation, than on bodies of mere representation.

Concerning the other types of bargaining institutions, interesting differences emerge. Having signed a territorial-level collective agreement is positively (although weakly) correlated with investment in R&D and other intangibles, suggesting that negotiation on context-specific institutional settings and productive structures can be an additional driver of innovation activities within firms, with respect to solely national collective agreements.

Turning now to the other control variables, we notice first of all that the presence of non-standard employees (with temporary and part-time job contracts) shows a negative relation with innovative capabilities of

[13] We focus on total sales, which is available in both waves (2015 and 2018) of the RIL-INAPP survey and construct the following two variables: first, total sales growth, which is computed as log difference of total sales between 2018 and 2015; second, labour productivity, which is defined as the ratio of total sales over the number of employees in 2015. Both measures present some weaknesses, among which the large number of missing values is certainly one of the most relevant. However, their inclusion as control variables helps to clean the estimates from heterogeneity in performance, which can bias our results. When we do so, our main finding is confirmed.

[14] Regions have been classified according to NUTS-2 level of disaggregation.

Table 2
Probit Models with unions and types of collective bargaining.

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level Agreement	−0.0756	0.0243	−0.113	−0.0199
	(−0.77)	(0.33)	(−1.09)	(−0.26)
Territorial Level Agreement	0.385***	0.397***	0.396**	0.408**
	(2.45)	(2.52)	(2.30)	(2.35)
Unionization Rate	−0.108		−0.193	
	(−0.84)		(−1.37)	
Firm level Agreement # Unionization Rate	0.756***		0.807***	
	(2.98)		(2.98)	
Strong Union		−0.101		−0.156*
		(−1.29)		(−1.84)
Firm Level Bargaining # Strong Union		0.360***		0.417***
		(3.00)		(3.25)
10–49 Employees	−0.737***	−0.737***	−0.763***	−0.760***
	(−13.60)	(−13.74)	(−12.79)	(−12.90)
50–249 Employees	−0.337***	−0.337***	−0.324***	−0.322***
	(−6.56)	(−6.58)	(−5.90)	(−5.89)
250 and more Employees	0.495***	0.501***	0.510***	0.516***
	(6.76)	(6.82)	(6.56)	(6.61)
Over 50 Years Old Employees (%)	−0.230**	−0.226**	−0.165	−0.164
	(−2.36)	(−2.33)	(−1.56)	(−1.55)
Tertiary Education Employees (%)	0.402***	0.398***	0.439***	0.435***
	(5.81)	(5.76)	(5.77)	(5.74)
Non Standard Employees (%)	−0.214**	−0.216**	−0.242**	−0.242**
	(−2.54)	(−2.56)	(−2.56)	(−2.56)
Business Group	0.0395	0.0379	0.0542	0.0531
	(0.78)	(0.75)	(1.01)	(0.99)
Multi-Establishments	0.0309	0.0313	0.00714	0.00751
	(0.78)	(0.79)	(0.17)	(0.17)
Exporting Firms	0.291***	0.288***	0.289***	0.285***
	(6.00)	(5.95)	(5.45)	(5.39)
Multinational Enterprises	0.154**	0.147*	0.158*	0.150*
	(1.98)	(1.90)	(1.90)	(1.80)
Patents	0.459***	0.459***	0.503***	0.503***
	(7.39)	(7.37)	(7.68)	(7.67)
R&D Incentives	0.384***	0.384***	0.399***	0.399***
	(8.04)	(8.04)	(7.92)	(7.92)
Sales Growth (Log)			0.0318***	0.0322***
			(2.60)	(2.62)
REGION AND INDUSTRY FE	YES	YES	YES	YES
Constant	1.633***	1.615***	1.608***	1.592***
	(−8.53)	(−8.50)	(−7.85)	(−7.84)
Observations	9402	9402	7723	7723
Pseudo R-squared	0.2328	0.2329	0.2366	0.2369

t- statistics in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

the firm, confirming previous findings on European companies (Cetrulo et al., 2019; Reljic et al., 2021; Ikeda et al., 2024; Hoxha and Kleinknecht, 2024). Moreover, firm size plays an important role in explaining investment in R&D and other intangibles, together with other firm-specific characteristics such as belonging to a multinational group and exporting products, as their coefficients are large, positive, and always statistically significant. The same result holds for the percentage of workers with tertiary education, while a negative effect is instead associated with the percentage of workers over 50 years. This result can be explained by the fact that, especially in the absence of adequate training, old workers tend to have less competences than younger cohorts of employees in technologies that are complementary to intangible investments, such as ICT. This may in turn reduce incentives to undertake such type of investment in line with previous evidence on the complementarities between workers' skills and digital investments (Cirillo et al., 2023a). Finally, past patenting activity, both in terms of filing and acquisition, is an important positive predictor of investment in R&D, which confirms the relevance of knowledge cumulativeness in the innovation processes.

5.2. Technological heterogeneity and bargaining content

Having established a positive association between organized labour and investments in R&D and other intangibles, we now investigate whether this relationship holds when firms are categorized according to their technological paradigms. This analysis employs the Pavitt (1984) and Peneder (2010) taxonomies, both of which are well-established frameworks within the evolutionary research tradition.

In essence, referring to Fig. 1, we aim to test whether the observed relationship remains consistent across varying technological constraints external to the firm—such as the methods of knowledge appropriation, the intensity of technological diversification, and its direction—or whether, alternatively, the results are particularly significant within specific technological contexts.

The empirical results presented in Table 3 show that, the presence of an organized labour can be an important incentive to innovation in absence of tight technological constraints, consistent with the evolutionary framework that attributes a crucial role to sectoral and technological factors in firms' strategies. Indeed, our findings reveal that the interaction term representing a unionized workforce engaging in firm-level bargaining is positive and statistically significant in firms belonging to scale-intensive and supplier-dominated industries, as defined by Pavitt's taxonomy (Pavitt, 1984). These industries are characterized by low knowledge cumulativeness and limited innovative capabilities, as proxied by the Peneder taxonomy (Peneder, 2010).

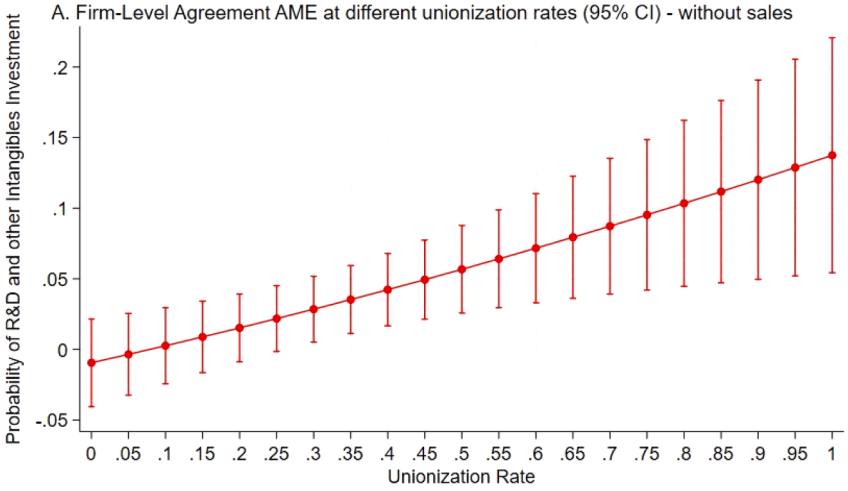
This suggests that in production contexts already geared toward knowledge accumulation and technological competitiveness—such as science-based and specialized supplier industries—the collective voice mechanism does not appear to play a significant role in driving investments in intangible assets. Conversely, a different pattern emerges in companies predominantly focused on cost-cutting strategies and dependent on external sources of innovation. In these cases, the presence of advanced collective bargaining and a unionized workforce can positively influence the adoption of strategies aimed at enhancing the firm's knowledge base and absorptive capacity through investments in intangible assets.[15]

Until now, we have explored the specifics of what is negotiated at the firm level only from a descriptive perspective (Fig. 3). Second-level bargaining typically focuses on work organization practices, often encompassing the introduction of training programs, job rotation schemes, employee participation in upward problem-solving initiatives, and the adoption of high-involvement work practices (Appelbaum et al., 2000).

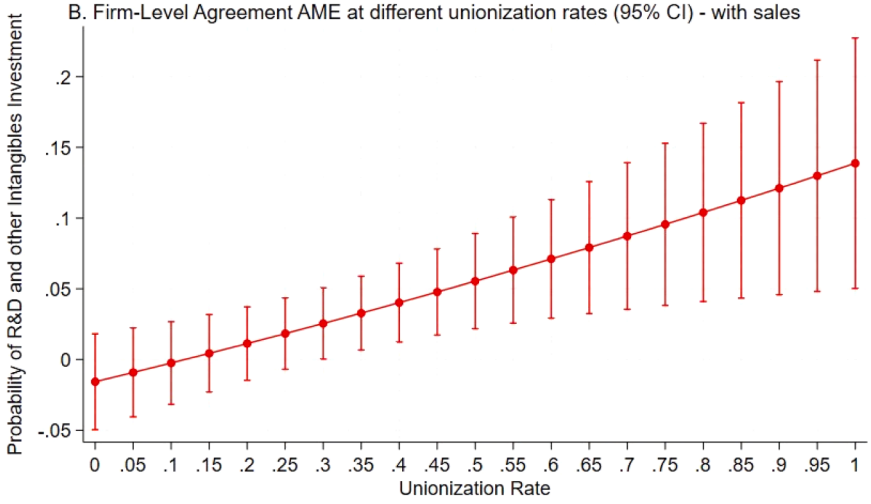
All these practices, usually demanded by unions may influence the success of technical change occurring at the level of production departments once R&D labs provide their inputs and, more generally, can contribute to the development of production processes inspired by continuous improvement and learning (Lorenz and Lundvall, 2006). Thus, in the empirical specification presented in the last column of Table 3, we narrow the analysis to companies engaged in second-level bargaining, distinguishing those that negotiate work organization-related clauses from all others. These work organization clauses include issues such as employee training, work schedules, environmental concerns, health and safety issues, and aspects related to internal labor markets.

As shown in the last column of Table 3, only in the former case the

[15] Tables A8 and A9 in the Appendix present the results for Pavitt and Peneder sectors interacted with unionization and firm-level bargaining. In the case of Pavitt sectors, the positive and significant coefficient for the interaction in Supplier-Dominated industries is confirmed.



a) *Average marginal effects on Probit Model 1*



b) *Average marginal effects on Probit Model 3*

Fig. 4. Marginal Effects.

coefficient of the interaction term (between unionization and firm level collective bargaining on work organization clauses) is positive and statistically significant. This confirms that bargaining matters especially if the subject of bargaining is directly related to how the labour process is organized, as also shown by qualitative studies on advanced bargaining and technology adoption in Italy (Cirillo et al., 2021; Moro and Virgillito, 2022; Cetrulo and Moro, 2022).

6. Conclusions

The economic impact of "organized labor" – intended both as unionized workforce and collective bargaining - has been a highly debated topic in economic and sociological literature between 80 s and 90s. It has gained renewed attention in the last decades also pushed by international organizations, which started discussing the role of industrial relations in promoting economic growth and social equality (Cazes et al., 2019; Eurofound, 2022). Within this context, Nordic models of co-determination have become object of special interest (Jäger et al., 2021; Harju et al., 2021; Belloc et al., 2022a), as they offer solutions that can partially tamper conflicts between diverse stakeholders populating modern firms (Rodrik, 2020). Furthermore, the discourse on trade unions and, more broadly, industrial relations has taken center stage in economic and policy debates regarding the adoption of digital and automation technologies associated with the Industry 4.0 and 5.0 paradigms (Bosch and SchmitzKießler, 2020; Doellgast and Benassi, 2020; Cirillo et al., 2023a).

With this paper we aim to contribute to this research revival by focusing on a specific aspect of the industrial relation systems related to the diffusion of firm-level collective agreements, on top of national level bargaining. As we described above, Italy has a specific industrial relation setting with a prevalence of national collective agreements applying to most Italian companies. Some of these companies have also signed second-level agreements, mainly through collective bargaining between managers and unions at the workplace. Firm-level collective agreements primarily regulate work organization practices, performance-based incentive schemes, the provision of training programs, and the setting of work schedules. These companies are at center stage of our analysis, as we are interested in the interplay between firm-level collective bargaining, unionization, and investments in R&D and other intangibles. By making use of a rich and representative survey of Italian non-

Table 3
Probit models by technological regimes and work organization clauses.

	Investments in R&D and other intangibles					
	Pavitt *Science Bas. & Spec. Suppl.*	Pavitt *Scale Int. & Supp. Dom*	Peneder *Low Cumulativeness*	Peneder *Medium Cumulativeness*	Peneder *High Cumulativeness*	Clauses *Work Organization*
Firm Level Agreement	0.008	−0.033	−0.005	−0.241	0.090	
	(0.04)	(−0.30)	(−0.03)	(−0.90)	(0.49)	
Unionization Rate	−0.176	−0.106	−0.264	0.144	−0.335	−0.105
	(−0.72)	(−0.72)	(−1.21)	(0.43)	(−1.14)	(−0.83)
Firm Level Agreement # Unionization Rate	0.800	0.633**	0.905**	0.514	0.248	
	(1.56)	(2.19)	(2.20)	(0.74)	(0.48)	
Firm Level Agr. & No Work Org. Clauses						−0.0281
						(−0.22)
Firm Level Agr. & No Work Org. Clauses # Unionization Rate						0.466 (1,39)
Firm Level Agr. & Work Org. Clauses						−0.114 (−0,87)
Firm Level Agr. & Work Org. Clauses # Unionization Rate						1.030*** (3.09)
FIRM-LEVEL CONTROLs	YES	YES	YES	YES	YES	YES
REGION AND INDUSTRY FE	YES	YES	YES	YES	YES	YES
Constant	−1.337***	−1.304***	−1.327***	−0.901***	−1.206***	−1.617***
	(−8.33)	(−16.27)	(−10.93)	(−4.05)	(−7.37)	(−8.46)
Observations	1904	7498	2935	851	1888	9402
Pseudo R-squared	0.1967	0.2213	0.1619	0.2104	0.2438	0.2332

t statistics in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

agricultural firms, we document that organized labour - proxied in our framework by the presence of a unionized workforce able to bargain second-level agreements on top of national agreements - does not discourage investment. Rather, it exerts a positive effect on the firm's propensity to invest in R&D and other intangible assets.

Our evidence is consistent with the hypothesis that participatory mechanisms can mediate opposing interests within unbalanced power relations, thus favouring the orientation of firm strategies towards conducts that are more friendly to labour, i.e., less focused on cutting labour costs and depressing wages, relying more on value creation through innovation and therefore pursuing 'high road' and virtuous circles paths (Pianta and Reljic, 2022). These results are tested across various econometric specifications, where we account for technological regimes and content of firm level collective agreements. Once distinguishing among sectoral characteristics, the crucial role of collective voice via bargaining is confirmed in those firms that face loose technological constraints. Moreover, the capability of unions to bargain on issues specifically concerning the internal work organization of the firm grants workers a crucial channel to influence strategic decisions, encouraging the pursue of productivity enhancement and pushing managers to rise investments in assets that shift the drivers of competition from low wages to innovation.

Overall, it is worth acknowledging some limitations of our study. First, our analysis focuses on one single country. Although firm-level collective bargaining is widespread in many advanced capitalist economies, each industrial relation system tends to be characterized by specific political and socio-institutional features (Hall and Soskice, 2001) that affect collective bargaining and thus make our results difficult to generalize (Anzolin et al., 2024). As discussed above, the early literature on the interplay between unions and innovation clearly outlined an "Atlantic divide" - with a negative effect of unions on innovation in the US, but null or weakly positive effect in Europe (Machin and Wadhwani,1991; Menezes-Filho and Van Reenen, 2003; Doucouliagos et al., 2017). We leave to future research the task to assess whether this divide is still valid nowadays. Second, we acknowledge the lack of data measuring R&D and intangible intensities, which limits our ability to take adequately into account the heterogeneity of investments across firms, despite investment decisions already allow to distinguish quite sharply innovative firms from the rest.

Finally, although we provide a detailed analysis of the effect of organized labour on innovation inputs, we do not discuss the extent to which this translates also in innovation outputs, i.e., actual innovations. Although we expect that higher investment in R&D and intangibles are likely to rise the chances of innovative breakthroughs, we cannot exclude the possibility that bottlenecks can occur at later stages of the innovation process given the complex nature of the innovative activity. Previous studies have suggested that stronger unions are in a better position than weaker unions to attain workplace cooperation (Belloc et al., 2022a) and that when the workforce is organised by means of a cohesive trade union, this enables the firm to better appropriate the gains of technological and organisational improvements (Haipeter, 2020), positively affecting the technological advancement (Berton et al., 2024).

Indeed, the new wave of advanced digital and automation technologies has paved the way for a revitalized role of trade unions envisaging a major involvement of workers in both organizational aspects as well as investments decisions (De Stefano and Doellgast, 2023). From this point of view, Italy represents a peculiar case, since the involvement of trade unions in technological and investment decisions has only recently gained a renewed attention even in the union strategies. Qualitative type of research revealed that this usually takes place among a small niche of technologically advanced and, more in general, dynamic firms (Cirillo et al., 2023b). A valuable extension of our work would be to complement the empirical analysis combining a textual inspection of more representative firm-level agreements (Russo et al., 2019) and data on company unionization rate, to validate the mechanisms here only sketched.

Overall, assessing the linkage between collective bargaining and investments in intangible assets can contribute to the debate on the role of social dialogue and trade unions in fostering labour productivity and improving firms' innovative capabilities. Our findings can inform the design of innovation policy, which has tended to relegate labour institutions to a second-order role compared to other policy levers, such as academic-industry relations. Labour institutions and in particular collective bargaining may operate as an important complement to help firms pursue competitive strategies based on larger investments, including on intangibles. At a more specific level, our results highlight firm-level collective bargaining and strong unionization as key channels through which workers can positively affect firms' capability to generate new knowledge and therefore foster innovation. This may open up new avenues of research and policy debate about the most adequate set of

capital-labour relations in the knowledge economy.

Statement

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CRediT authorship contribution statement

Armanda Cetrulo: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Valeria Cirillo:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Fabio Landini:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.strueco.2025.01.004.

Appendix

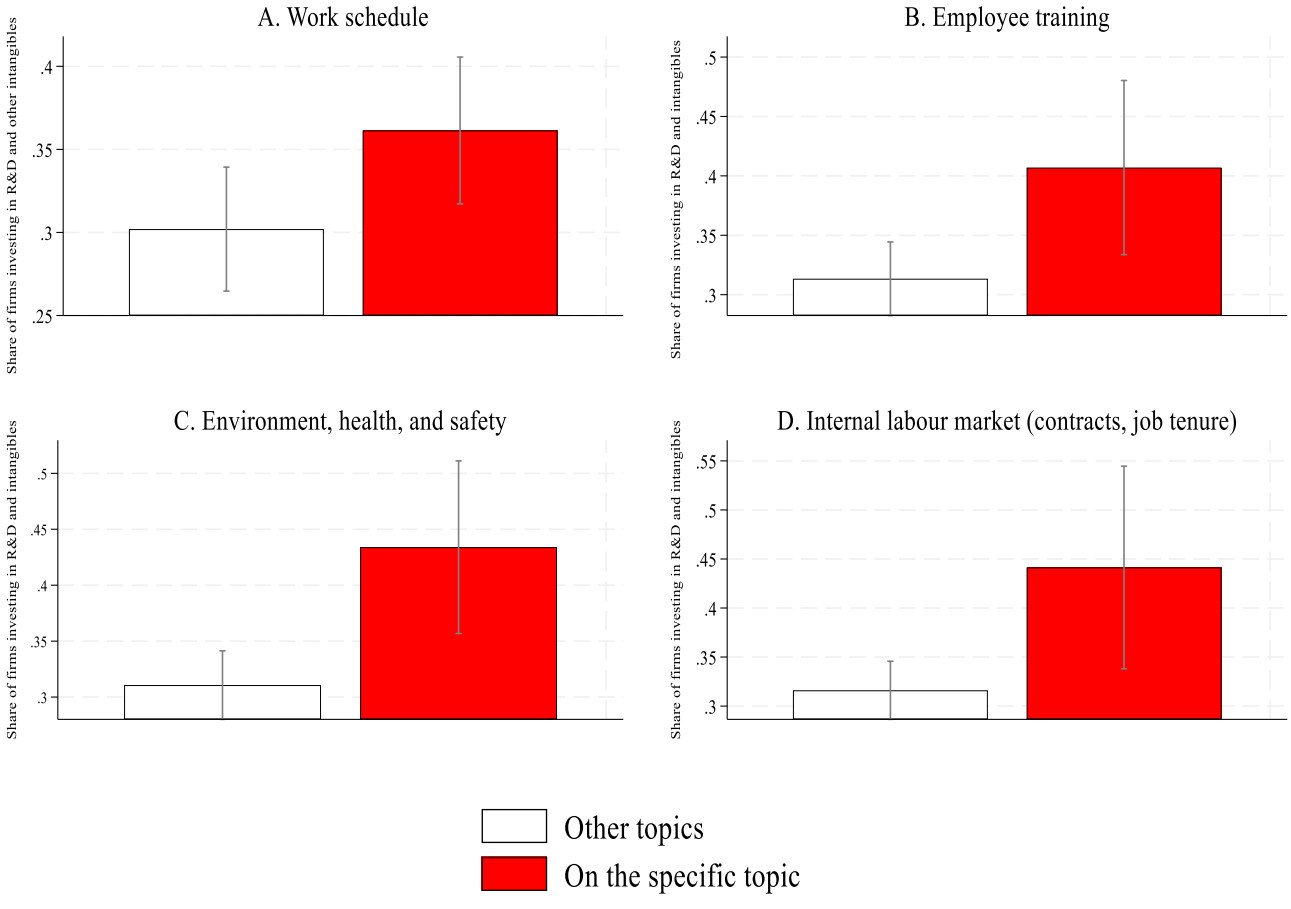

Fig. A1. R&D and other intangibles by topic of bargaining.

Table A1
Selected literature review on the relation between trade unions and innovation variables.

Authors	Data, Country, Time	Econometric Model	Key Explanatory Variable(s) (KEV)	Impact of KEV on innovation
Connolly et al. (1986)	○ 367 firms ○ US ○ 1977	2SLS Regressions	○ Proportion of eligible workers who are union members in each firm's principal three-digit industry	○ Profitability of R&D in terms of firm's market value **(-)**; ○ Investment in R&D seen as non-marketable and intangible capital **(-)**;

(*continued on next page*)

Table A1 (*continued*)

Authors	Data, Country, Time	Econometric Model	Key Explanatory Variable(s) (KEV)	Impact of KEV on innovation
				○ Advertising capital investments **(n.s.s.)**.
Hirsch and Link (1987)	○ 315 manufacturing firms ○ New York ○ 1985	Ordered Probit Model	○ Binary variable equal to 1 if firms report a rate of unionization equal or higher than 50 %, 0 otherwise	Likert-scale response data on: ○ Product-related technological innovation comparative advantage **(-)**; ○ Degree of innovativeness in the development of new products **(-)**.
Acs and Audretsch (1988)	○ 247 four-digit SIC industries ○ US ○ 1982	Cross-section Log Regression	○ Rate of unionization (% of employees belonging to a union)	○ Total number of innovation **(-)**.
Betcherman (1991)	○ 1000 establishments ○ Canada ○ 1985–1986	OLS Regressions	○ Collective bargaining coverage at establishment level (dummy variable)	○ Introduction of any computer-based technological change in 1980–1985 **(n.s.s.)**; ○ Expenditures on computer-based technologies as % of sales over the period 1980–1985 **(n.s.s.)**; ○ % of employees working directly with these technologies in 1985 **(n.s.s.)**; ○ Introduction of any computer process technologies in 1980–1985 **(n.s.s.)**.
Machin and Wadhwani (1991)	○ 630 establishments ○ UK ○ 1987	Probit Econometric Model	○ Presence of trade union	○ Introduction of new plant, machinery or equipment, not incorporating micro-electronics and excluding routine replacement **(n.s.s.)**; ○ Introduction of new plant, machinery, or equipment, that includes the new microelectronics technology **(n.s.s.)**.
Schnabel and Wagner (1992)	○ 101 firms in manufacturing industries ○ Lower Saxony and Baden-Wiirttemberg (Germany) ○ 1990–1991	Probit Econometric Model	○ Presence of a works council ("collective voice") ○ Average difference between the product innovation wage level agreed at the industry level and the wage paid by the firm ("union power")	○ Product innovation **(n.s.s.)**.
Bronars and Deere (1993)	○ 667 firms ○ US ○ 1970–1976	Cross-section Log Regression	% of workers in an industry that are members of a trade union	○ Natural logarithm of the ratio of the expenditure on new plant and equipment to the book value of existing plant and equipment **(-)**; ○ Natural logarithm of the ratio of expenditures on advertising on the book value of existing plant and equipment **(-)**; ○ Natural logarithm of the ratio of expenditure on R&D to the book value of existing plant and equipment **(-)**.
Schnabel and Wagner (1994)	Industries: ○ 26 industries ○ Germany ○ 1983 or 1984; Establishments: ○ 101 establishments in manufacturing industries ○ Niedersachsen and Baden-Wiirttemberg Germany	Least Median of squares, Reweighted Least Square and Tobit Regression Models	○ Union density at industry level: % unionized employees; ○ Presence of the works council (dummy variable)	At the industry level: ○ % of revenues spent on R&D **(n.s.s.)**; At the establishment level: ○ % of revenues spent on R&D (**union density:; work council:** +).
Addison and Wagner (1994)	○ 38 industries ○ UK ○ 1989	Least Median Squares Regression and Cross Country Test comparing the British and German case to control for endogeneity	○ Number of union members divided by the total number of employees	○ Expenditure on R&D divided by gross value added **(n.s.s.)**.
Menezes-Filho et al. (1998a)	○ 339 firms and 826 plants ○ UK ○ 1982–1990	Heckman two-step Selection Equation, Tobit Equation	○ % of the firms' workforce members of a trade union; ○ Recognition of at least one union to bargain on wage).	○ Ratio of the firm's R&D expenditure over its sale **(n.s.s.)**.
Menezes-Filho et al. (1998b)	○ 446 companies ○ UK ○ 1983 and 1990; ○ 2000 plants ○ UK ○ 1990	OLS and Tobit Regression Models	○ Proportion of workers members of a trade union in a company; ○ Recognition of at least one union to bargain on wage.	For firms: ○ Ratio of firm's R&D expenditure to its total revenue **(n.s.s.)**; For plants: ○ R&D as a proportion of total expenditure **(n.s.s.)**; ○ Number of R&D workers as a proportion of total workers **(n.s.s.)**.

(*continued on next page*)

Table A1 (*continued*)

Authors	Data, Country, Time	Econometric Model	Key Explanatory Variable(s) (KEV)	Impact of KEV on innovation
Addison et al. (2007)	○ >1500 plants ○ Germany ○ 1998–2003	OLS Regression Models	○ Regime shift in the presence/absence of the work council within the plant (never present, formation, dissolution, always present)	○ Investment divided by sales averaged over the period 2000–2003 **(formation or dissolution of work council: n.s.s.)**.
Kraft et al. (2011)	○ 148 firms ○ Germany ○ 1971–1976 and 1981- 1990	Negative Binomial and Zero-Inflated Negative Binomial Models	○ Co-determination dummy variable (right to a 50 % representation on the supervisory board in firms with at least 2000 employees)	○ Number of granted patents **(+)**.
Cardullo et al. (2015)	○ Sectoral data ○ OECD countries (Australia, Austria, Belgium, Finland, Greece, Italy, Japan, South Korea, Portugal, Spain, and the United Kingdom) ○ 1980–2000	OLS and IV Regression Models	○ % of employees covered by wage bargaining agreements over all wage and salary earners in employment	○ Average level of investment per worker **(union coverage interacted with sunk capital intensity:)**.
Bradley et al. (2017)	○ 8809 union elections data ○ US ○ 1980–2002	OLS and RDD Econometric Model	○ Unionization (measured looking at union election results)	○ Num. of patents granted to a firm **(-)**; ○ Num. of citations received by each patent **(-)**.
Addison et al. (2017)	○ 16,000 establishments ○ Germany ○ 2007–2012	Pooled Cross Section and DID on joining/leaving collective bargaining	Four possible combinationsof IR: 1. No sectoral agreement – no works council (base group); 2. No sectoral agreement–works council; 3. Sectoral agreement – no works council; 4. Sectoral agreement – works council	○ Incremental product innovation **(2: n.s.s.; 3:; 4: +)**; ○ Imitative product innovation **(2: n.s.s; 3: n.s.s; 4: n.s.s.)**; ○ Radical product innovation **(2:; 3: n.s.s.; 4: n.s.s)**; ○ Process innovation **(2: n.s.s.; 3:; 4: +)**.
Berton et al. (2021)	○ >5000 companies ○ Italy ○ 2010, 2015 and 2018	Pooled OLS, Fixed Effects and IV Econometric Models	○ Presence of trade union at the workplace (dummy variable)	○ Product innovation **(+)**; ○ Process innovation **(n.s.s.)**.
Belloc et al. (2022b)	○ 20,052 establishments ○ European countries ○ 2019 ○ 13,000 firms ○ Italy ○ 2015–2018	Linear Probability Model on European data RDD Analysis on Italian firm-level data	○ Presence of shop-floor employee representation (dummy variable)	On European data: ○ Use of robots (dummy variable) **(+)**; ○ Use of data analytics to improve the process of production and service delivery (dummy variable) **(+)**; On Italian data: ○ Dummy variable on previous investment in robots **(n.s.s.)**; ○ Investments in other advanced digital tools (i.e., big data analytics, the internet of things, virtual reality and cybersecurity) **(+)**; ○ Investments in conventional ICT assets (i.e., computers and hardware) **(+)**.
Wang et al. (2022)	○ 1384 firms ○ UK ○ 2013	Probit Econometric Model and Karlson–Holm-Breen (KHB) Method for Comparative Analysis	○ Presence on site of trade union representative/shop steward (dummy variable); ○ Presence of employee representation structure at the establishment or company (dummy variable),	○ Introduction of any new or significantly improved marketing methods **(+)**; ○ Introduction of any new or significantly changed products or services **(n.s.s.)**; ○ Introduction of any new or significantly changed processes **(+)**.

Notes: + stands for positive and statistically significant coefficient; - stands for negative and statistically significant coefficient; n.s.s. stands for non-statistically significant coefficient.

Table A2
Descriptive statistics (sample weights applied).

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
R&D and other intangibles	The firm has invested in R&D, patents, licences, trademarks, software in the last year (yes/no)	8109	0.052	0.223	0	1
Firm-level contract	The firm has signed a firm-level collective agreement	8109	0.020	0.140	0	1
Territorial-level contract	The firm has signed a complementary collective contract at the territorial level	8109	0.002	0.043	0	1
Share Union	The share of workers who are union members	8109	0.025	0.116	0	1
Number of employees	Number of employees currently working at the firm	8109	14.91	97.779	1	9775
% 50+ employees	% employees >50 years old	8109	0.258	0.302	0	1
% Emp. with tertiary edu.	% employees with tertiary education	8109	0.650	0.362	0	1
% Emp. with non-standard contract	% employees with a part-time or temporary contract	8109	0.318	0.363	0	1

(*continued on next page*)

Table A2 (*continued*)

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Business group	The firm belongs to a national or foreign business group (yes/no)	8109	0.056	0.230	0	1
Multi-establishment	The establishment is one of a number of establishments belonging to the same company (yes/no)	8109	0.434	0.495	0	1
Exporting firm	The firm export goods or services abroad(yes/no)	8109	0.225	0.417	0	1
Multinational enterprise	The firm has carried out FDI or acquisition of foreign companies in the last 2 years (yes/no)	8109	0.009	0.098	0	1
Patents	The firm has filed or acquired patents during the last 3 years (yes/no)	8109	0.031	0.174	0	1
R& D incentives	The firm has benefited from incentives (e.g. tax break) to invest in R&D during the last 3 years (yes/no)	8109	0.059	0.235	0	1
Rate of change of slaes	Log change of sales	8109	−0.039	1.329	−13.841	15.756

Notes: Data from RIL 2015 and RIL 2018. For R&D and other intangibles the statistics are computed using RIL 2018. For all the other variables the statistics are computed using RIL 2015. Sample weights have been applied.

Table A3
Companies with >10 employees (base category: companies 50–250 employees).

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level agreement	−0.0720	0.0174	−0.113	−0.0290
	(0.0977)	(0.0738)	(0.103)	(0.0777)
Territorial level agreement	0.366**	0.378**	0.382**	0.393**
	(0.156)	(0.157)	(0.170)	(0.171)
Unionization Rate	−0.136		−0.234	
	(0.134)		(0.147)	
Firm level agreement # Unionization Rate	**0.712*** **		**0.782*** **	
	(0.254)		**(0.273)**	
Strong Union		−0.124		−0.186**
		(0.0799)		(0.0864)
Firm Level Baragining # Strong Union		**0.354*** **		**0.420*** **
		(0.120)		**(0.128)**
Between 10 - 20 employees	**−0.538*** **	**−0.536*** **	**−0.587*** **	**−0.582*** **
	(0.0618)	**(0.0614)**	**(0.0677)**	**(0.0673)**
20 - 49 employees	**−0.352*** **	**−0.352*** **	**−0.339*** **	**−0.336*** **
	(0.0517)	**(0.0515)**	**(0.0553)**	**(0.0550)**
>250 employees	**0.509*** **	**0.515*** **	**0.526*** **	**0.532*** **
	(0.0729)	(0.0732)	(0.0777)	(0.0780)
Over 50 Years Old Employees (%)	−0.113	−0.108	−0.0455	−0.0441
	(0.122)	(0.122)	(0.131)	(0.131)
Tertiary Education Employees (%)	0.417***	0.412***	0.446***	0.441***
	(0.0797)	(0.0796)	(0.0861)	(0.0860)
Non Standard Employees (%)	−0.152	−0.154	−0.156	−0.155
	(0.108)	(0.108)	(0.118)	(0.118)
Business Group	0.0143	0.0129	0.0305	0.0297
	(0.0518)	(0.0518)	(0.0548)	(0.0548)
Multi-Establishments	−0.00117	−0.000819	−0.0144	−0.0141
	(0.0438)	(0.0438)	(0.0473)	(0.0473)
Exporting Firms	0.283***	0.280***	0.282***	0.279***
	(0.0537)	(0.0537)	(0.0582)	(0.0582)
Multinational Enterprises	0.163**	0.157**	0.155	0.147
	(0.0793)	(0.0793)	(0.0844)	(0.0844)
Patents	0.448***	0.448***	0.489***	0.489***
	(0.0643)	(0.0643)	(0.0674)	(0.0675)
R&D Incentives	0.371***	0.371***	0.389***	0.389***
	(0.0503)	(0.0503)	(0.0527)	(0.0528)
Sales Growth (Log)			0.0318**	0.0320**
			(0.0128)	(0.0128)
REGION AND INDUSTRY FE				
Constant	−1.483***	−1.461***	−1.452***	−1.433***
	(0.208)	(0.206)	(0.220)	(0.218)
Observations	6253	6253	5329	5329
Pseudo R-squared	0.1902	0.1904	0.1963	0.1968

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$.

Table A4
Companies with >20 employees (base category: companies 50–250 employees).

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level agreement	−0.0722	0.0125	−0.0942	−0.0264
	(0.0993)	(0.0745)	(0.105)	(0.0784)
Territorial level agreement	0.390	0.400	0.387	0.401
	(0.164)	(0.164)	(0.179)	(0.180)
Unionization Rate	−0.170		−0.237	
	(0.149)		(0.163)	
Firm level agreement # Unionization Rate	**0.722*****		**0.728**	
	(0.269)		**(0.288)**	
Strong Union		−0.150		−0.211
		(0.0868)		(0.0933)
Firm Level Baragining # Strong Union		**0.370*****		**0.428*****
		(0.125)		**(0.134)**
20 - 49 employees	−0.340***	−0.340***	−0.326***	−0.325***
	(0.0526)	(0.0524)	(0.0561)	(0.0558)
>250 employees	0.502***	0.510***	0.523***	0.530***
	(0.0733)	(0.0735)	(0.0780)	(0.0783)
Over 50 Years Old Employees (%)	−0.0784	−0.0714	−0.00755	−0.00137
	(0.144)	(0.144)	(0.154)	(0.154)
Tertiary Education Employees (%)	0.446***	0.439***	0.498***	0.491***
	(0.0896)	(0.0895)	(0.0964)	(0.0963)
Non Standard Employees (%)	−0.0914	−0.0931	−0.0840	−0.0823
	(0.129)	(0.129)	(0.142)	(0.142)
Business Group	0.0324	0.0315	0.0466	0.0469
	(0.0546)	(0.0546)	(0.0579)	(0.0579)
Multi-Establishments	0.00555	0.00507	−0.0143	−0.0155
	(0.0501)	(0.0501)	(0.0537)	(0.0537)
Exporting Firms	0.283***	0.280***	0.283***	0.278***
	(0.0623)	(0.0622)	(0.0663)	(0.0663)
Multinational Enterprises	0.160	0.154	0.148	0.141
	(0.0818)	(0.0818)	(0.0866)	(0.0866)
Patents	0.463***	0.462***	0.502***	0.502***
	(0.0684)	(0.0684)	(0.0715)	(0.0716)
R&D Incentives	0.350***	0.351***	0.362***	0.362***
	(0.0547)	(0.0547)	(0.0570)	(0.0571)
Sales Growth (Log)			0.0253	0.0255
			(0.0142)	(0.0142)
REGION AND INDUSTRY FE	YES	YES	YES	YES
Constant	−1.489***	−1.462***	−1.435***	−1.406***
	(0.230)	(0.229)	(0.243)	(0.241)
Observations	4447	4447	3840	3840
Pseudo R-squared	0.1732	0.1735	0.1735	0.1744

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table A5
Companies with >50 employees (base category: companies 50–250 employees).

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level agreement	−0.0186	0.0662	−0.0106	0.0400
	(0.107)	(0.0801)	(0.114)	(0.0854)
Territorial level agreement	0.360**	0.387**	0.417**	0.454**
	(0.176)	(0.176)	(0.197)	(0.198)
Unionization Rate	−0.00879		−0.0389	
	(0.198)		(0.218)	
Firm level agreement # Unionization Rate	0.583*		0.500	
	(0.310)		(0.334)	
Strong Union		−0.0962		−0.152
		(0.106)		(0.116)
Firm Level Baragining # Strong Union		0.298**		0.343**
		(0.141)		(0.152)
>250 employees	0.552***	0.560***	0.575***	0.582***
	(0.0744)	(0.0745)	(0.0794)	(0.0796)
Over 50 Years Old Employees (%)	0.145	0.167	0.242	0.260
	(0.193)	(0.192)	(0.208)	(0.207)
Tertiary Education Employees (%)	0.459***	0.446***	0.581***	0.567***
	(0.118)	(0.118)	(0.128)	(0.129)
Non Standard Employees (%)	−0.240	−0.247	−0.213	−0.215
	(0.162)	(0.162)	(0.181)	(0.181)

(*continued on next page*)

Table A5 (*continued*)

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Business Group	−0.0804	−0.0812	−0.0734	−0.0725
	(0.0632)	(0.0632)	(0.0676)	(0.0676)
Multi-Establishments	−0.0462	−0.0473	−0.0570	−0.0597
	(0.0662)	(0.0662)	(0.0717)	(0.0718)
Exporting Firms	0.249***	0.246***	0.220**	0.216**
	(0.0830)	(0.0829)	(0.0894)	(0.0892)
Multinational Enterprises	0.146	0.140	0.115	0.109
	(0.0919)	(0.0919)	(0.0985)	(0.0987)
Patents	0.370***	0.368***	0.412***	0.411***
	(0.0812)	(0.0812)	(0.0851)	(0.0852)
R&D Incentives	0.327***	0.327***	0.368***	0.367***
	(0.0674)	(0.0674)	(0.0710)	(0.0709)
Sales Growth (Log)			0.0150	0.0151
			(0.0174)	(0.0175)
REGION AND INDUSTRY FE	YES	YES	YES	YES
Constant	−1.425***	−1.378***	−1.412***	−1.356***
	(0.318)	(0.316)	(0.339)	(0.337)
Pseudo R-squared	0.1392	0.1392	0.1454	0.1462
Observations	2466	2466	2136	2136

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table A6
Companies with >100 employees (base category: companies 100–250 employees).

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level agreement	−0.0170	0.0776	0.00917	0.0482
	(0.135)	(0.104)	(0.143)	(0.111)
Territorial level agreement	0.0781	0.113	0.161	0.208
	(0.214)	(0.213)	(0.236)	(0.236)
Unionization Rate	0.183		0.101	
	(0.291)		(0.331)	
Firm level agreement # Unionization Rate	**0.663***		**0.516**	
	(0.401)		**(0.439)**	
Strong Union		−0.0502		−0.136
		(0.147)		(0.165)
Firm Level Baragining # Strong Union		**0.366****		**0.414****
		(0.183)		**(0.202)**
>250 employees	**0.554*****	**0.568*****	**0.588*****	**0.599*****
	(0.0838)	**(0.0836)**	**(0.0894)**	**(0.0893)**
Over 50 Years Old Employees (%)	0.170	0.229	0.285	0.334
	(0.286)	(0.282)	(0.312)	(0.308)
Tertiary Education Employees (%)	0.384**	0.368**	0.492***	0.479***
	(0.171)	(0.171)	(0.182)	(0.182)
Non Standard Employees (%)	−0.451**	−0.466**	−0.433*	−0.437*
	(0.228)	(0.226)	(0.246)	(0.244)
Business Group	−0.138*	−0.138*	−0.140	−0.136
	(0.0839)	(0.0837)	(0.0900)	(0.0899)
Multi-Establishments	−0.143	−0.144	−0.121	−0.120
	(0.0989)	(0.0987)	(0.107)	(0.106)
Exporting Firms	0.274**	0.270**	0.232*	0.226*
	(0.121)	(0.120)	(0.131)	(0.131)
Multinational Enterprises	0.194*	0.180	0.162	0.146
	(0.111)	(0.111)	(0.118)	(0.119)
Patents	0.393***	0.390***	0.449***	0.451***
	(0.106)	(0.106)	(0.112)	(0.112)
R&D Incentives	0.261***	0.264***	0.324***	0.326***
	(0.0903)	(0.0904)	(0.0954)	(0.0956)
Sales Growth (Log)			0.00839	0.00850
			(0.0233)	(0.0233)
REGION AND INDUSTRY FE	YES	YES	YES	YES
Constant	−1.446***	−1.381***	−1.395***	−1.334***
	(0.469)	(0.459)	(0.506)	(0.491)
Observations	1293	1293	1131	1131
Pseudo R-squared	0.1513	0.1513	0.1636	0.1652

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$,*$p < 0.1$.

Table A7
Companies with >250 employees.

	Investments in R&D and other intangibles			
	(1)	(2)	(3)	(4)
Firm level agreement	−0.313	−0.0633	−0.199	−0.0172
	(0.219)	(0.175)	(0.234)	(0.188)
Territorial level agreement	0.256	0.199	0.511	0.437
	(0.277)	(0.270)	(0.313)	(0.305)
Unionization Rate	−0.532		−0.896	
	(0.518)		(0.618)	
Firm level agreement # Unionization Rate	**1.363****		**1.383***	
	(0.639)		**(0.725)**	
Strong Union		−0.106		−0.278
		(0.247)		(0.270)
Firm Level Baragining # Strong Union		**0.331**		**0.452**
		(0.293)		**(0.317)**
Over 50 Years Old Employees (%)	0.364	0.345	0.526	0.479
	(0.518)	(0.506)	(0.576)	(0.565)
Tertiary Education Employees (%)	0.210	0.209	0.321	0.329
	(0.281)	(0.280)	(0.299)	(0.298)
Non Standard Employees (%)	−0.291	−0.299	−0.173	−0.181
	(0.381)	(0.379)	(0.406)	(0.406)
Business Group	0.0731	0.0586	0.124	0.113
	(0.139)	(0.138)	(0.147)	(0.147)
Multi-Establishments	−0.317*	−0.307*	−0.339*	−0.326
	(0.185)	(0.183)	(0.203)	(0.202)
Exporting Firms	0.320	0.309	0.195	0.188
	(0.212)	(0.211)	(0.225)	(0.224)
Multinational Enterprises	0.0713	0.0729	−0.0382	−0.0296
	(0.162)	(0.162)	(0.172)	(0.172)
Patents	0.496***	0.483***	0.489***	0.483***
	(0.174)	(0.173)	(0.185)	(0.184)
R&D Incentives	0.239	0.254*	0.286*	0.296*
	(0.150)	(0.150)	(0.160)	(0.160)
Sales Growth (Log)			−0.0318	−0.0328
			(0.0338)	(0.0342)
Constant	−1.124	−1.096	−0.970	−1.063
	(0.719)	(0.725)	(0.748)	(0.743)
REGION AND INDUSTRY FE	YES	YES	YES	YES
Observations	495	495	439	439
Pseudo R-squared	0.1434	0.1388	0.1519	0.1491

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$,*$p < 0.1$.

Data availability

The authors do not have permission to share data.

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