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Confindustria Milano Monza e Brianza

The performances of European firms: a benchmark analysis

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The performances of European firms: a benchmark analysis

This work was edited by Assolombarda Confindustria Milano Monza e Brianza Research Department under the scientific coordination of Carlo Altomonte. The report was written by Francesca Bartoli, Andrea Coali, Francesca Coppola, Valeria Negri.

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Contents

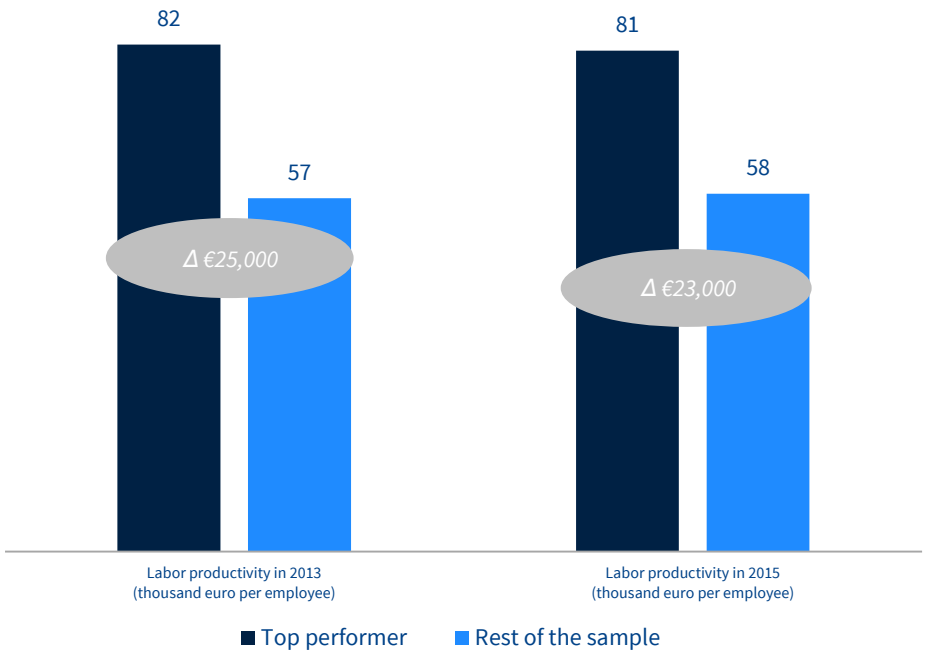
Executive summary

“The performances of European firms: a benchmark analysis” is a survey conducted by Assolombarda Confindustria Milano Monza e Brianza. It aims at providing a closer look at the constraints, challenges and strategies that since 2009 have been determining the performance of the manufacturing sector in five of the most productive European regions – Lombardy, Baden-Württemberg, Bayern, Cataluña and Rhône-Alpes. This edition includes, on an experimental basis, Emilia-Romagna as well.

The first edition of the survey, drawn up in 2016 on 2011-2013 data, allowed to take a snapshot of the European industry right after the sovereign debt crisis. Data extracted from a representative sample of firms on items such as management, labor, innovation, internationalization not directly inferable from balance-sheet data allowed to profile the competitiveness dynamics of firms, and provide interesting policy insights.
The 2017 edition, based on 2013-2015 data, carries on with this interpretative effort and integrates it in a number of ways. First, the new representative sample of 692 firms keeps on guaranteeing that results are not only significant but also, and most importantly, comparable to those of the previous edition, allowing to delve deeper into the strategies adopted by European firms to exit the crisis and sustain the recovery.
Moreover, this second edition includes, for the first time on the basis of regional data, an entire section dedicated to a comparative assessment of the adoption of the Manufacturing 4.0 paradigm by firms at the European level.

In general, also this second edition confirms the finding that a combination of managerial organization, innovation and internationalization is the set of characteristics that qualify a firm as top performer. As a matter of fact, those firms that implement performance-based remuneration policies, present a medium to high degree of digitalization, use Intellectual Property Protection mechanisms and participate in Global Value Chains (GVC) earn on average €23,000 more per employee than the rest of the sample. The result is fully consistent with the equivalent figure in 2013 (+€25,000). Besides, in line with the previous edition, the impact on productivity associated to each of these characteristics individually considered is statistically significant, as always controlling for region, industry and size fixed effects.

Top performers versus the rest of the sample (2013 and 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza and Orbis – Bureau van Dijk
Note: Top performers are those firms that (1) implement performance-based remuneration policies; (2) participate in Global Value Chains; (3) present a medium degree of digitalization;[1] (4) have used Intellectual Property Protection instruments.[2]

The second edition of the survey also confirms the nuances of the relationship between unit labor costs (ULCs), innovation and international competitiveness. Data show that highly innovative firms manage to succeed internationally notwithstanding eventually high ULCs: with reference to these firms, there is a very weak relationship between the probability to export and ULCs, because the key determinant of the success on international markets is the quality of innovation rather than prices. On the contrary, in the case of non-innovative firms whose international competitiveness mainly relies on prices, an increase in ULCs is associated to a decline of 25% in the probability to export, a figure that is roughly constant across the two editions of the survey. The bottom line is that the relationship between ULCs and export is on average quite weak, and only driven, if anything, by non-innovative firms, which are affected by labor costs to a higher degree.

In comparison with the previous edition, the importance of participating in Global Value Chains (GVCs) increases. For those firms displaying a high level of GVC participation the productivity premium turns out to be higher[3] than the one retrieved in the 2013 survey, increasing from +38.9% to +48.3% in 2015.

[1] *In 2013 the medium degree of digitalization is measured with respect to the use of at least two of the following: enterprise resource planning systems (e.g. SAP/ERP); advanced management systems (e.g. CRM, Groupware); systems for the automatic sharing of information between customers and suppliers (e.g. virtual marketplaces). In 2015 instead, taking into account new technologies and developments in industrial policies, the medium degree of digitalization is measured with reference to the smart manufacturing paradigm, considering those firms that do not use single machines, but employ at least one mechanically or digitally integrated machine and at least one smart technology among industrial robots, 3D printers and machines integrated with electronic devices for information and data exchange wireless and in real time.*
[2] *Data for 2013 refer to 2011-2013; for 2015, to 2013-2015.*
[3] *The result is statistically significant at a 1% confidence level.*

Beyond these two general findings, the 2015 survey purports also some differences in the behavior of firms in single EU regions with respect to the dynamics recorded in 2013.[4]

The propensity to innovate generally increases over the 2013-2015 period, especially when considering product and process innovation combined. Results suggest that Lombardy, Rhône-Alpes and Cataluña are catching up to German regions, both for what concerns innovation in general and Intellectual Property Protection through patents and other instruments.

In particular, while between 2011 and 2013 in Lombardy only 15.8% of firms combined product and process innovation, that share doubled at 31.4% in the 2013-15 period, setting Lombardy above the sample average (31.1%).

Also, the share of firms that have conducted R&D has increased (+6.3% in the sample average). Nonetheless, undertaking research activity is not enough, as competitiveness stems from the ability to manage and foster technological transfer. Indeed, to those firms that conduct R&D activities and apply for patents, community trademarks and community designs is associated a productivity premium of 12.5%. Technological transfer is an acknowledged weakness of the Italian innovation ecosystem. Yet, the 2015 survey shows that the share of firms in Lombardy that use Intellectual Property Protection instruments has increased from 7.6% in 2011-2013 to 19.1% in 2013-2015, hence reducing the gap with the sample average (22%).

With regard to smart manufacturing (the new topic added to this edition), data show that firms in Lombardy, Rhône-Alpes and Cataluña are advancing slowly compared to their German peers. Baden-Württemberg and Bayern are the most advanced regions when it comes to the digitalization of production processes: around 12% of firms show a high degree of digitalization,[5] compared to a sample average of 9.3% (Lombardy 8.9%, Emilia-Romagna 7.6%). In addition, in the same German regions, around 20% of firms integrate their equipment mechanically or digitally, while in Rhône-Alpes, Cataluña, Emilia-Romagna and Lombardy the equivalent figure is three times smaller (7-8%).

Not surprisingly advanced production process digitalization is a key driver of firm competitiveness: to those firms already at an advanced stage of adoption of the smart manufacturing model is linked a productivity higher by 18%. There exists also a positive and significant correlation between the adoption of these technologies and the probability to implement process innovation (+42.2% above the sample average) and organizational innovation (+18%). This bears on the definition of policies for the economic recovery of the manufacturing sector. Indeed, since a high degree of digitalization is positively associated to process and organizational innovation, and since highly innovative firms manage to be competitive internationally even in the presence of high ULCs, then fostering corporate reorganization is a further element on which to insist at policy level.

Focusing on internationalization, in line with the findings of the 2013 survey, firms in the sample have a good commercial presence on international markets: 51% systematically export – over 60% including firms that export occasionally. The share of exporting firms is particularly high for Cataluña and Lombardy (as a whole 10 p.p. above the sample average, in 2015 and 2013 as well). This figure and its stability across waves are symptomatic of the

[4] *The executive summary purposefully focuses on the key findings that emerge through time at the international level, comparing in particular the developments in Lombardy across the two waves with those in the other four European regions considered.*
[5] *Smart manufacturing is here defined with reference to the level of equipment integration and the employment of the technologies typical of the Industry 4.0 paradigm, focusing on those that are most operative and directly affect production processes, i.e. industrial robots, 3D printers and machines integrated with electronic devices for information and data exchange wireless and in real time.*

structural weakness of both the Italian and Spanish domestic markets. As to imports, the extensive margin of German firms proves again to be small: the share of importing firms is 9.6% in Baden-Württemberg and 21.6% in Bayern versus a sample average of 32.1%. This validates the hypothesis put forward in the previous edition of the survey of a German manufacturing sector being structurally characterized by a development of domestic value chains and vertically integrated industries stronger than elsewhere.

In comparison to the previous edition, the share of firms involved in international activities more sophisticated than exports, such as international outsourcing and offshoring, is higher but still very low (5.0% versus 3.7% in 2013). De facto steady with respect to 2013 is also firms' participation in Global Value Chains (GVCs): on average, around 56% of the internationally active firms are at low GVC participation, 31% at medium participation and finally slightly less than 15% are at high participation. Against such context, the repositioning of Lombardy has to be highlighted: firms at low participation lose share, shifting from 71.1% in 2013 to 49.3% in 2015, while firms at high participation grew from 5.6% in 2013 to 14.6% in 2015 (for a national comparison, in Emilia-Romagna firms at low participation are around 70% in 2015, whereas those at high participation 3.6%).

Regarding business management and structure, Lombardy, Cataluña and Rhône-Alpes all experienced relevant developments. In 2013, compared to Baden-Württemberg taken as benchmark, Lombardy turned out having significantly more family-run businesses, or more businesses where at least 50% of managers belong to the owner family. Moreover, fewer firms with decentralized management and which paid bonuses resulted in Lombardy vs. the German counterparts. In 2015 these systematic differences with respect to Baden-Württemberg are not found anymore.
Firms in Cataluña took decentralization up even more markedly: compared to Baden-Württemberg in 2015 in Cataluña there is a higher probability to find firms with decentralized management (+25.6%, higher than in 2013)[6]. Moreover, although the probability to find firms paying bonuses is lower than in Baden-Württemberg, the share of those firms almost doubles between 2013 and 2015.
Rhône-Alpes is again found to be the region in the sample where group structures are most common – 25.6% of firms belong to a group, compared to a sample average of 16.2% – and family businesses least spread (63.9% compared to a sample average of 84.6%).

To conclude, in line with an improving economic environment, those firms claiming to have experienced financial difficulties in 2015 are 9.2% of the total sample, around half of what recorded in 2013. In addition, the share of firms whose request for more credit was rejected noticeably declines (18% in 2013, 6.5% in 2015).

Finally, some "historical" delays of the national system persist for firms in Lombardy, especially with regard to enduringly low capitalization.

In line with the findings of the previous edition of the survey, the share of equity over total assets in 2013-2015 is 25% in Lombardy, whereas German firms would reach shares of 50%. Firms in Lombardy that conduct R&D activities or have increased their exports to non-EU countries show a higher degree of capitalization than the total (28-29%). Nevertheless the figure is still far from the sample average (43%). Finally, essentially unchanged from 2013 and still excessive is the exposure towards short-term bank loans (28% compared to a sample average of 21.7%), which is combined with a significant decrease in long-term bank loans, although smaller than the one recorded in the sample as a whole (-5.33 p.p. compared to a sample average of -9.6 p.p.).

[6] *The result is statistically significant at a 1% confidence level.*

Preface

Providing an in-depth analysis of the strategies, constraints and challenges that characterize the European industry. It was the goal of Assolombarda Confidustria Milano Monza e Brianza when it decided to finance, within its 2014-2016 Strategic Plan, the survey "The performances of European firms: a benchmark analysis", now in its second edition.

The first edition of the survey, drawn up in 2016 on 2011-2013 data, allowed to take a snapshot of the European industry right after the sovereign debt crisis. Data extracted from a representative sample of firms on items such as management, labor, innovation, internationalization not directly inferable from balance-sheet data allowed to profile the competitiveness dynamics of firms, and provide interesting policy insights.
Created after the 2010 survey "European Firms in a Global Economy: Internal Policies for External Competitiveness" (EFIGE)[7], the first edition would focus on five key regions to the European industry, with similar structural characteristics – Lombardy (Italy), Baden-Württemberg and Bayern (Germany), Cataluña (Spain) and Rhône-Alpes (France).

The second edition, based on 2013-2015 data, carries on with this interpretative effort and integrates it in a number of ways. First, the sample of regions analyzed now includes Emilia-Romagna. Moreover, for the first time on the basis of regional data, there is a new section entirely dedicated to a comparative assessment of the adoption of the Manufacturing 4.0 paradigm by firms at the European level. Last but not least, the second edition ensures continuity with the first edition and EFIGE. A set of firm-level representative data, monitored and updated in the years from 2009 up to 2015, and comparable across six of the main European regions, is thus provided, allowing to derive increasingly accurate policy implications for the recovery of the manufacturing sector.

The 2017 report on the survey findings is organized as follows. Chapter 1 considers innovation in its evolution across 2011-2013 and 2013-2015 and then the current state regarding research and development (R&D) activities, organizational, product and process innovation, as well as Intellectual Property Protection. Chapter 2 follows with an evaluation of the state of the art of the evolution 4.0, also called smart manufacturing, based on data about equipment and production digitalization.
Chapter 3 focuses on firms' internationalization, both considering trade (exports and imports) and production (offshoring, international outsourcing and participation in Global Value Chains).
The report concludes with data on management and structure (Chapter 4), labor force (Chapter 5), financing (Chapter 6) and bureaucracy (Chapter 7).

The Appendix provides details as to the profiles of the benchmark regions and the methodology followed in the construction of the sample.

[7] *The survey "European firms in a global economy: Internal policies for external competitiveness" (EFIGE) conducted in 2010 is an international research project coordinated by Bruegel (Brussels) and financed by the Seventh Framework Programme of the European Union. It is publicly available at www.efige.org.*

1. Innovation

Over 2013-2015, the propensity to innovate increases, especially with reference to integrated process-product innovation. Data suggest firms in Lombardy, Rhône-Alpes and Cataluña are catching up to their German peers relative to innovation but also to patents and other instruments for Intellectual Property Protection.

1.1 Innovation and exit from the crisis

«An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organizational method […]».[8] In particular, innovations are (combinations of) inventions that become commercially relevant, subsequently creating new jobs and new markets.
Innovation is hence crucial to firms willing to compete on international markets. Moreover, in a context of subdued recovery, a faster innovation pace would serve as a driver for a stronger productivity growth and more sustainable GDP levels.

Innovation results from many and different strategic choices that are not ascribable to research and development (R&D) – *intra muros* or in collaboration with other entities; it also includes investments in plants and equipment, ICT and production processes digitalization, as well as the use of Intellectual Property Protection instruments.[9]
In order to avoid a partial overview of firms' level of innovation, similarly to the Community Innovation Survey (CIS)[10] this survey assesses firms' performance in all fields that are to be considered innovation activities. Unlike the CIS though, this survey has the merit of being at the regional level. As a matter of fact, in light of productive structures' often high within-country heterogeneity as to advancement and dissemination of technologies and knowledge, national data might provide a distorted picture of regions like Baden-Württemberg, Bayern, Cataluña, Emilia-Romagna, Lombardy and Rhône-Alpes that excel in their own countries as to manufacturing vocation and innovation level.

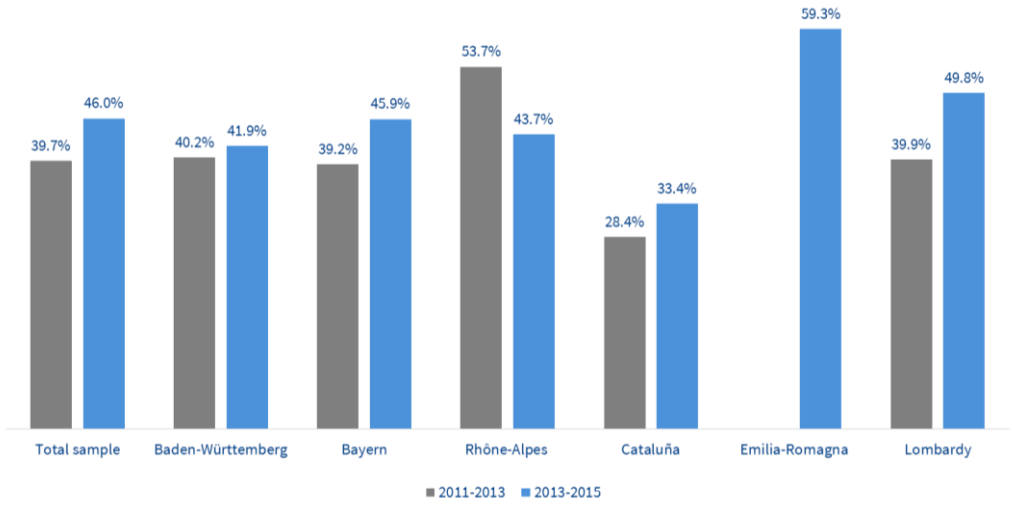
Leaving to the chapter on smart manufacturing the in-depth analysis of investments in equipment and, more in general, the digitalization of production processes, the next paragraphs focus on R&D (1.2), organization, product and process innovation (1.3) and technological transfer (1.4).
First and foremost though, it is useful to present the evolution in firms' propensity to innovate in the regions considered, comparing the findings of this second edition with the first.

Like other types of expenditure, investments in R&D and innovation are strongly pro-cyclical. Comparing firms' propensity to innovate through time allows to partly assess

[8] *OECD, Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, p. 46
[9] *OECD, ibid.*, pp. 47-52
[10] *The* Community Innovation Survey *(CIS), jointly managed by Eurostat and EU Member States' national offices for statistics (in collaboration with the European Commission), is a carried out every two years and aims at collecting information on innovation activity in European industry and service firms. In particular, the survey provides wide and diversified information about innovative firms broken down by size and sector, types of innovation, innovation expenditure (R&D spending included), innovation objectives and their impact on revenues, public funding and cooperation agreements, keeping into consideration the structural differences of the regions analyzed.(Istat)*

whether and to what extent economic recovery is spreading at regional level. In particular, an improvement in economic conditions should be reflected in a larger spread of innovative activities. It is thus positive to find that in 2013-2015, compared with 2011-2013, the share of firms in the sample that conducted R&D increased (Figure 1.1). Lombardy particularly stands out, with a share that increases by around 10 p.p., compared with average increases of 4 p.p. and a decrease in Rhône-Alpes.

Figure 1.1 – Firms that conducted R&D activities (% of total firms, 2011-2013 and 2013-2015)



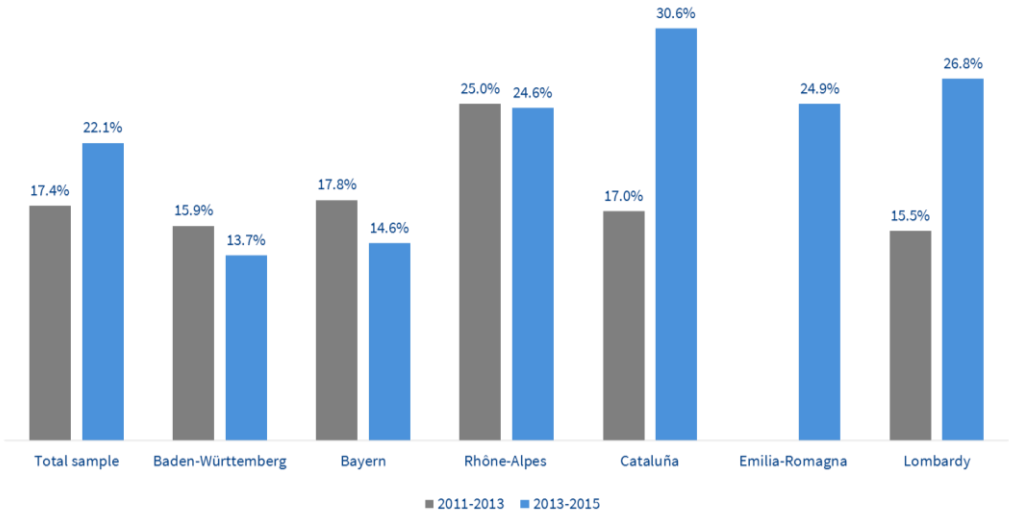
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

The number of firms that introduced organizational innovation[11] increased as well (Figure 1.2), together with that of firms that invested in product and process innovation jointly (Figure 1.3). As to the latter, the sample average almost doubled, shifting from 18.2% in 2011-2013 to 31.3% in 2013-2015. Except from Baden-Württemberg – essentially stable – the increase is relevant in all regions, with a peak of 25 p.p. in Cataluña.

For what concerns firms introducing organizational innovation, Cataluña still outstands the sample average with a share of 30.6%, almost twice the figure of the previous edition. Lombardy and Emilia-Romagna can anyway boast firms involved in business reorganization processes for around a quarter of the total.

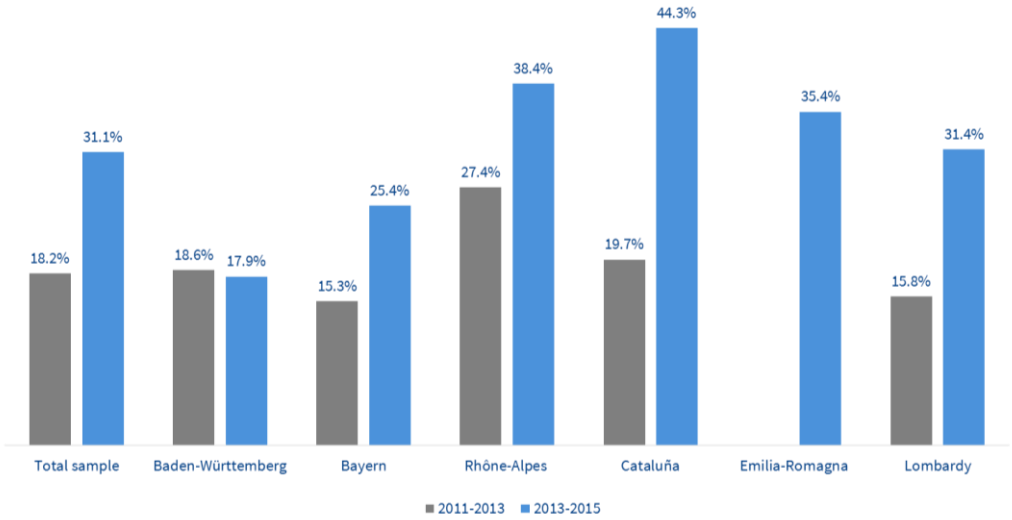
[11] *In this edition the figure results from the weighted average frequency of positive responses to the four items making up organizational innovation – new modalities of job organization; change in external relationships; new (or significantly improved) good or service sales or distribution practices; new practices of purchase management. At the same time, the figure relative to the 2011-2013 period has been computed accordingly, which is why values differ from those published in the 2016 report.*

Figure 1.2 – Firms that introduced organizational innovation (% of total firms, weighted average on multiple answers, 2011-2013 and 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 1.3 – Firms that integrated product and process innovation (% of total firms, 2011-2013 and 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Baden-Württemberg's and Bayern's relatively weak performance might surprise at first, especially when their GDP growth rates are similar to those of the other regions, if not higher.[12] One should however consider that business innovation in Germany has been proceeding constantly, especially since the first part of the last decade, and has hence become a structural phenomenon, less dependent on economic trends. The recovery of business R&D expenditure in the European Union is mainly due to Germany, where business R&D expenditure picked up again in 2009, offsetting stagnation in other countries.[13] In addition, as it might be inferred from the chapter on smart manufacturing as well, German regions have long been reorganizing and restructuring their productive processes with an eye to innovation and digitalization.

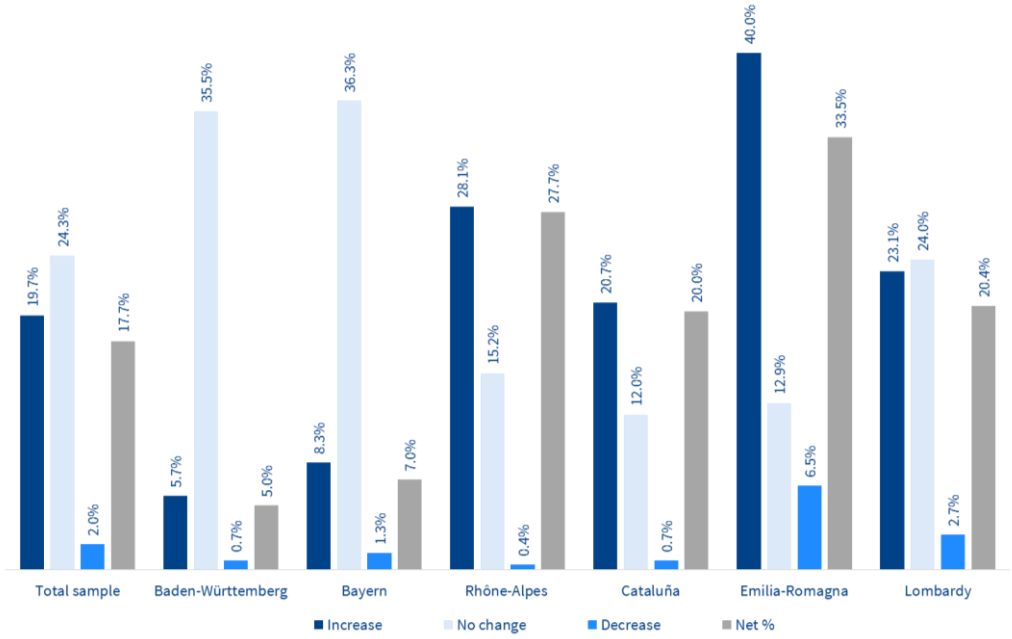
Such conclusion is validated by data on the change in R&D and innovation activities with respect to previous years (Figure 1.4 and Figure 1.5). The average share of firms in Baden-Württemberg and Bayern that claim their level of R&D and innovation is essentially the same as in previous years are around 36% and 42% respectively, compared with sample averages of 24.3% and 35.7%. Only 5% and 10% declare an increase, versus a sample

[12] *The latest available data mark for 2014 a GDP growth rate at current prices of 1.5% and 1.9% in Baden-Württemberg and Bayern respectively, compared with 0.7% in Lombardy, 1% in Rhône-Alpes and 1.7% in Cataluña. (Istat and Eurostat)*

[13] *OECD,* The Science, Technology and Industry Scoreboard 2013, *p. 27*

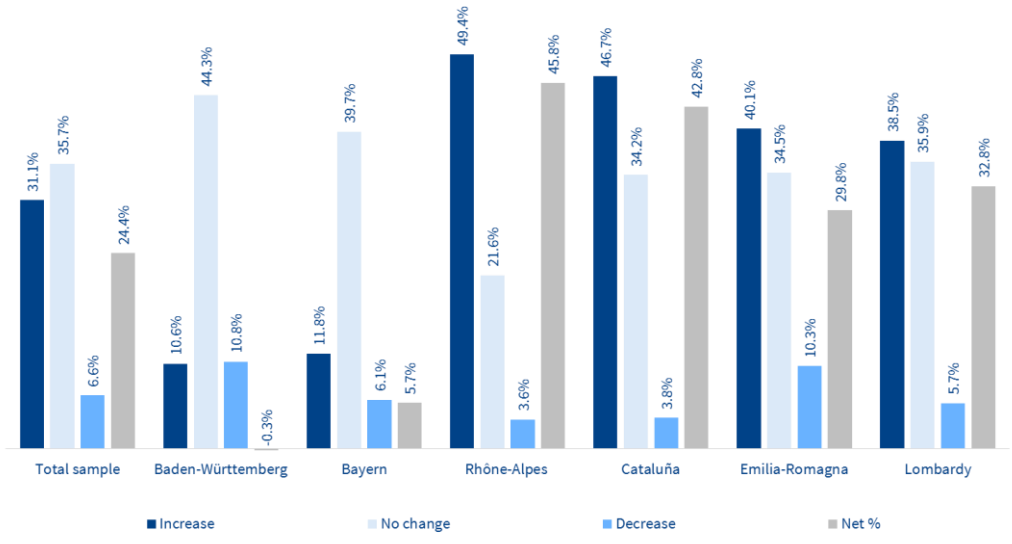
average of at least three times as much. Arguably then German firms are in the consolidation phase, while the other regions are expanding. In other words, Baden-Württemberg's and Bayern's performance might be interpreted in the light of a historically-higher propensity to research and innovation. Concurrently, the better performances of firms in Rhône-Alpes, Cataluña, Emilia-Romagna and Lombardy might owe to catch-up dynamics relative to Baden-Württemberg and Bayern.

Figure 1.4 – Change in R&D activities relative to previous years (% of total firms and net % of positive and negative responses, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 1.5 – Change in innovation activities relative to previous years (% of total firms and net % of positive and negative responses, 2013-2015)



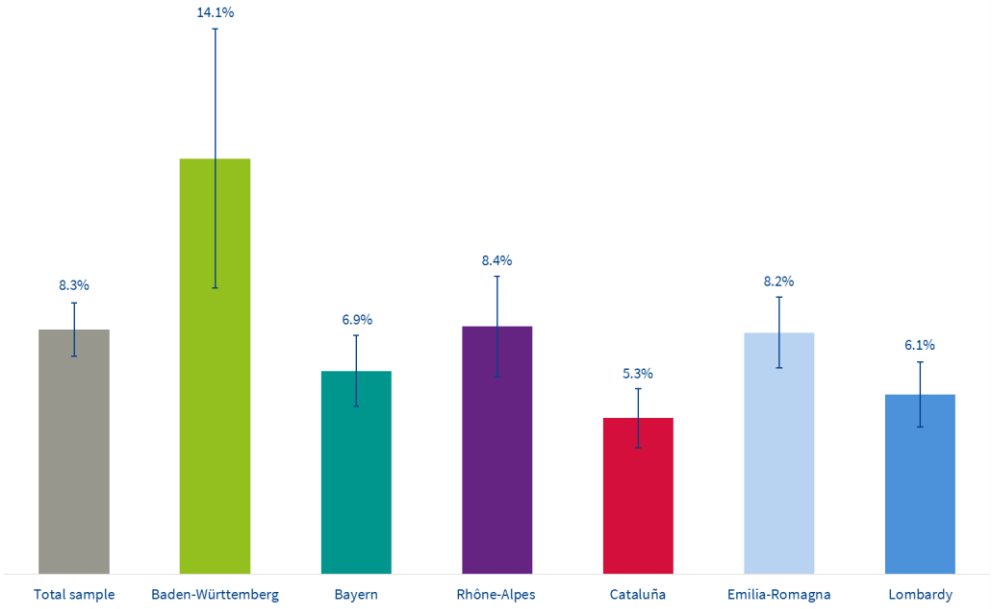
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

1.2 Research and development

The larger spread of R&D is undoubtedly a positive finding, being R&D one of the factors enabling innovation. However, besides the extensive margin (i.e. the number of firms), investments in R&D over total turnover (i.e. intensive margin) also have to be monitored.[14]

On average, firms in the sample invest 8.3% of their turnover in R&D activities, a highly heterogeneous figure across regions (Figure 1.6). The top performer is Baden-Württemberg, where firms invest on average 14.1% of their turnover – even though it has to be noted that the standard deviation is higher than in the other regions. In Rhône-Alpes and Emilia-Romagna the shares fall to 8.4% and 8.2% respectively, while in Lombardy (6.1%) and Cataluña (5.3%) more than halve.

Figure 1.6 – Average share of investment in R&D over total turnover (% and standard deviation, 2013-2015)



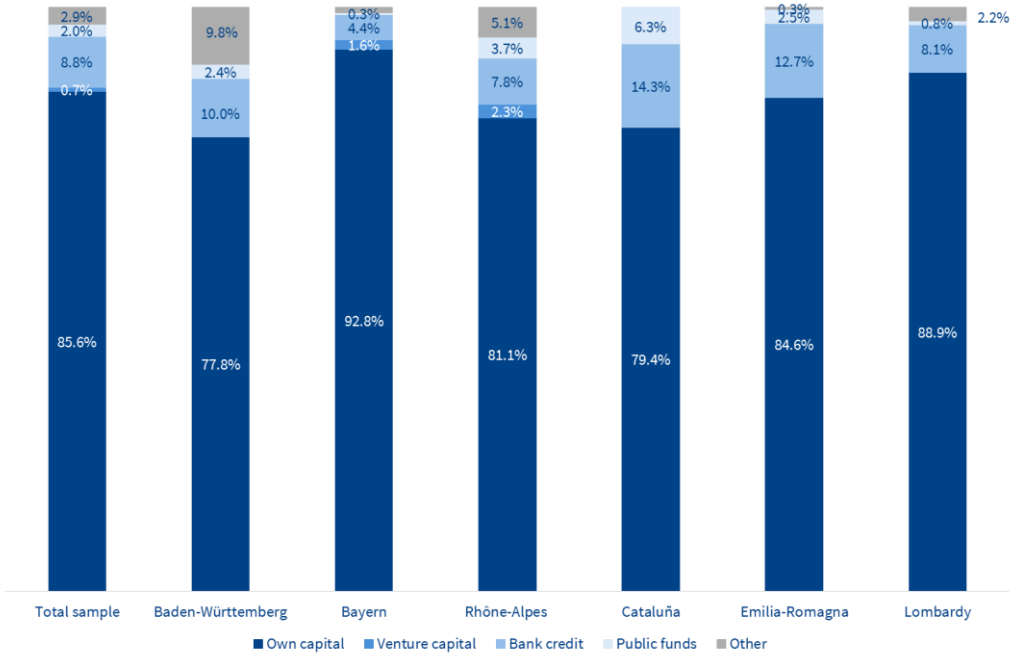
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Given the presence of high fixed costs, both the extensive and the intensive margin crucially depend on how the economy allocates the necessary funds to finance innovation activities. Figure 1.7 shows the distribution by source of R&D financing. Firms in the sample finance 85.6% of their total investment in R&D through their own capital. Residual is the role of the public sector (2%), while banks are relatively present (8.8% on average, 13-14% in Cataluña and Emilia-Romagna).

Venture capital is still not widespread across European regions: on average the share of total investments is as little as 0.7%, peaking at 2.3% in Rhône-Alpes. Yet, venture capitalists would be ideal for financing innovation. By their own nature they are eager to invest in projects that, individually considered, are highly uncertain and at high loss probability, hence risky, with a view of getting paid off by proportionally high profits in case of success – typically all distinctive features of innovative projects.

[14] *Rispetto a dimensione d'impresa e diffusione della R&S, «è la spesa in R&S ad avere l'impatto maggiore: raddoppiandone il valore, la probabilità di realizzare innovazioni aumenta del 20 per cento per quelle di processo, del 25 per cento per quelle di prodotto» (B. Hall, F. Lotti e J. Mairesse,* Innovazione e produttività nelle piccole e medie imprese. Evidenza empirica per l'Italia*)*

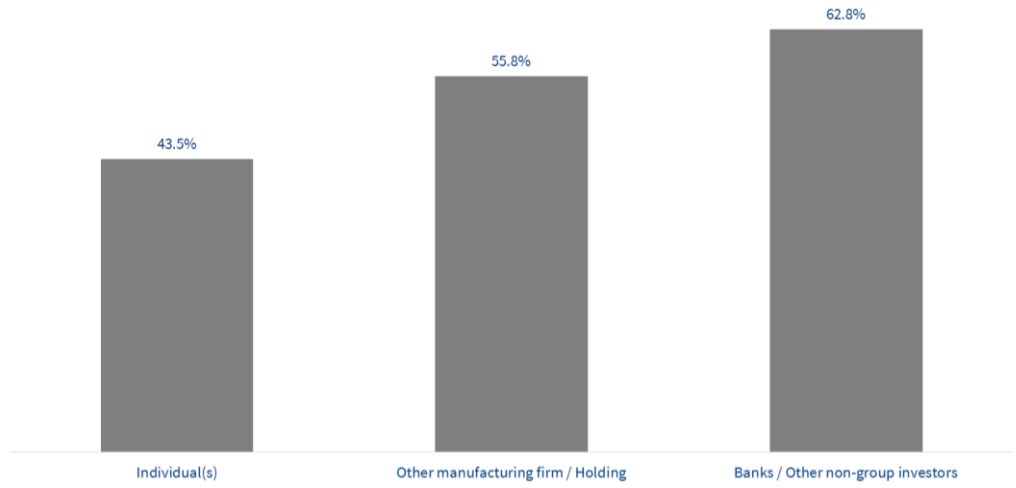
Figure 1.7 – Sources of financing for R&D activities (% distribution over total invested by firms conducting R&D, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Besides, venture capital is a form of equity financing which is concluded through the sale of shares. It might then have an impact on firm capitalization and management structure, on which would appear to depend the spread of innovation activities. In fact, the share of firms that conduct R&D is 43.5% in case the majority shareholder is an individual, 55.8% in case of other manufacturing firm or holding, 62.8% in case of banks or other investors (the category including venture capitalists) (Figure 1.8).

Figure 1.8 – Firms that conducted R&D by type of majority shareholder (% of total firms, 2013-2015)



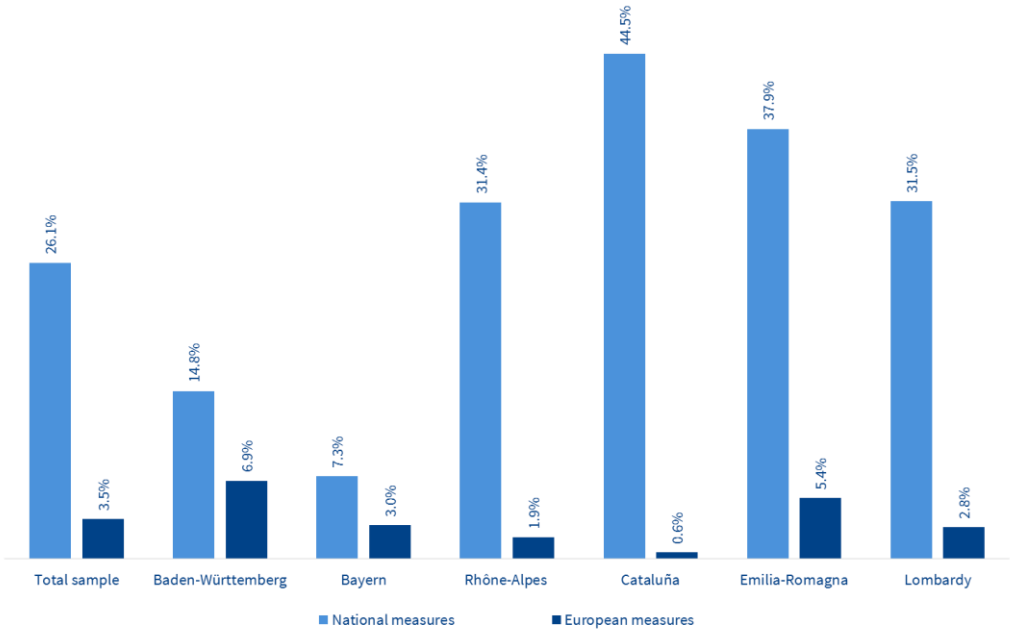
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Firm size also influences the adoption of innovation strategies. Given that R&D has to be financed mainly through internal resources, either by choice or because of objective difficulties of getting financed, lacking the proper critical mass might imply the

impossibility to make investments. In particular, the literature[15] finds that innovation and R&D are driven by larger and more productive firms, because they manage to better take advantage of economies of scale and scope. This survey coherently observes that, while 41.2% of small firms conduct R&D, the equivalent figure grows to 65.9% for medium firms and 92.6% for large firms. Not by chance, large firms tend to excel also as to internationalization, which results highly correlated to innovation.

Even though innovation is not exclusive to the large firm élite, appropriate provisions would be necessary to at least in part ease size constraints. Among the instruments that make the greatest contribution to reducing the cost of innovation are fiscal and financial subsidies (Figure 1.9). On average, 26.1% of firms that conducted R&D between 2013 and 2015 took advantage of national subsidies, while 3.5% benefited from European subsidies. The low shares in Baden-Württemberg and Bayern are connected to the almost total absence of fiscal incentives in Germany, which might explain why in German regions firms make little if any use of public funding.[16]

Figure 1.9 – Use of fiscal or financial subsidies to finance R&D (% of total firms, 2013-2015)



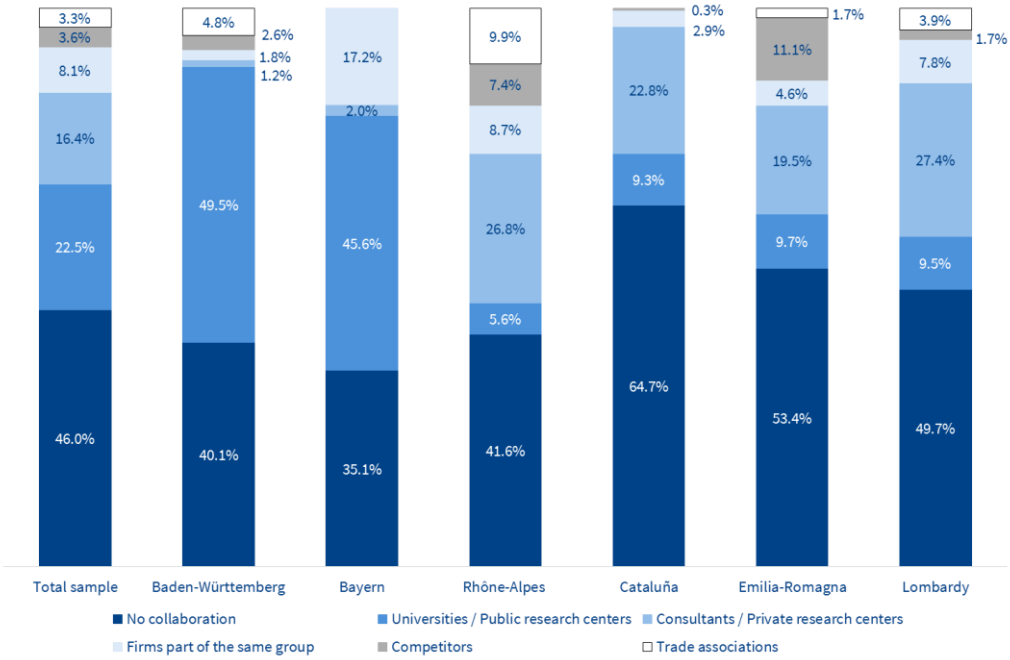
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

The chosen form of collaboration matters as well. Each allows small firms, already in the short-term, to implement strategies and behaviors similar to those of larger firms. It is however found that, rather than collaborating, firms tend to go solo when it comes to innovation (Figure 1.10): R&D activities are conducted *intra muros* in 46% of sample cases, with a peak of 64.7% in Cataluña.
Among the firms that have activated collaborations, the preferred partners are usually research centers, either public (22.5%) or private (16.4%). Fewer are instead the firms working in synergy with enterprises part of the same group (8.1%) or competitors (3.6%). Finally, only 3.2% benefited from the technical support offered by trade associations. However, regions differ according to their structure.
In Baden-Württemberg and Bayern the role of universities and public research centers is outstandingly strong (49.5% and 45.6% respectively), in Rhône-Alpes and Lombardy

[15] *On firm size, internationalization and innovation please refer to e.g. C. Altomonte, T. Aquilante, G. Békés, G. I.P. Ottaviano,* Internationalization and innovation of firms: evidence and policy*; B. Hall, F. Lotti e J. Mairesse,* Innovazione e produttività nelle piccole e medie imprese. Evidenza empirica per l'Italia
[16] *Germany tends to prefer direct financing to fiscal subsidies. For instance, considering Industry 4.0, revenues from venture capital investments in companies residing in Germany are exempt from taxes, while incentives for R&D expenditures, patents and trademarks, or superamortization are not envisaged (C. Bussi,* Industria 4.0: ecco gli incentivi Ue Paese per Paese*).*

consultants and private research centers stand out instead (shares of around 27%). In Bayern collaborations with firms belonging to the same group also play an important role (17.2%), in Emilia-Romagna[17] those with competitors (11.1%).

Figure 1.10 – Collaborations on R&D activities by type of partner (% distribution over total firms conducting R&D, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

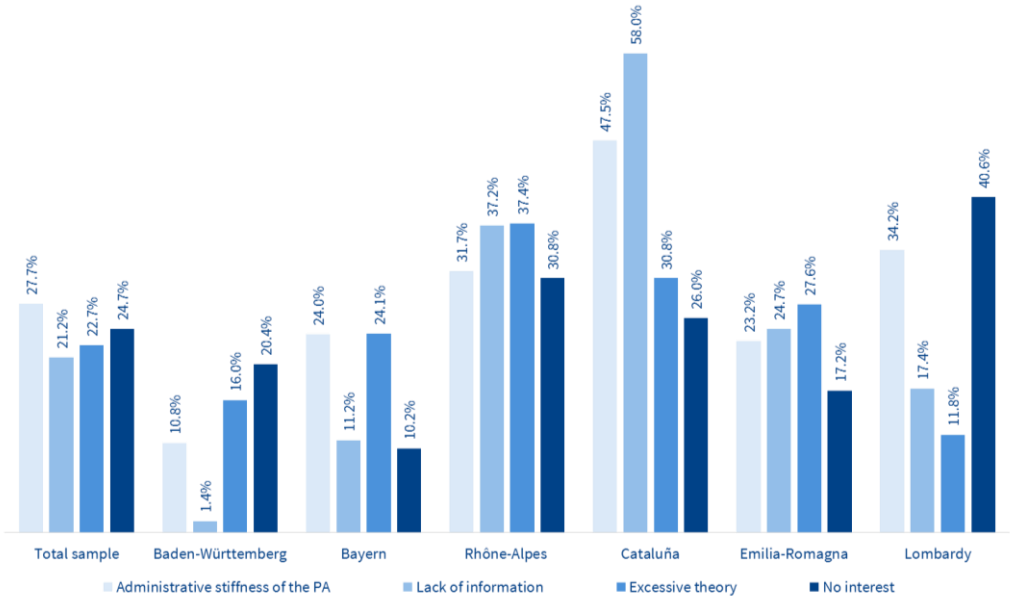
It being understood that the added value that any cooperation agreement might bring is high, the collaboration with the academia and public research centers should be particularly fruitful, since scientific production is largely concentrated there. To partly explain the low share of firms that decide to collaborate with universities, firms involved in R&D activities were thus asked the reasons why they seek alternative solutions (Figure 1.11).

The relative majority (27.7%) criticizes the public sector for its bureaucratic and administrative stiffness, while 21.2% complain about the lack of information about the technologies and activities that are available or could be jointly developed. Others claim the issue is academics' excessive focus on the theory (22.7%). Finally, the remaining 24.7% assert not to be interested in this type of collaboration, either because already involved in other partnerships, or because R&D activities are conducted only within firms.

The share of negative opinions is pretty low in German regions, where it's no coincidence that the share of firms collaborating with the public sector is higher than the sample average. The opposite, in the other regions the public sector is more criticized, especially in Rhône-Alpes and Cataluña, but also in Lombardy with reference to excessive rigidity.

[17] *Emilia-Romagna is among the Italian regions where firm networks are most common, for a total of 1,615 firms involved (as of April 3rd, 2017 on contrattidirete.registroimprese.it/reti/). Plus, in 2011, the region has launched a program for promoting the innovative connotation of industrial districts, in particular in order to improve the efficiency of business innovation processes and enhance the demand for more qualified and organized industrial research by part of SMEs to the labs in Emilia-Romagna's High Technology Network (Retimpresa,* Le Regioni a favore delle Reti d'Impresa. Studio sui finanziamenti per le aggregazioni, *pp. 69-70). As of 2015, 93 were the networks founded to develop innovative projects, for a total of 281 firms involved (ibid.).*

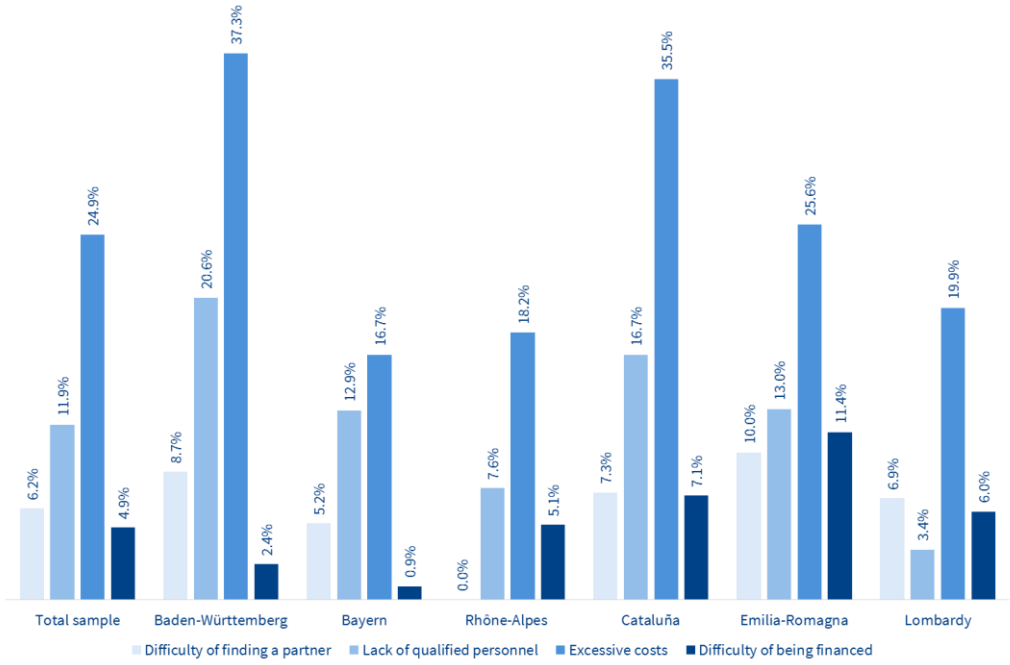
Figure 1.11 – Difficulties of activating collaborations with universities / public research centers (% of firms over total firms conducting R&D activities, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Finally, it might be useful to review those firms that do not conduct R&D activities. Besides size or sector- or firm-level contingencies, the results in Figure 1.12 convey that the main obstacle seems to be structural: 24.9% of the surveyed firms hold that costs imputable to R&D are excessive. Such perception owes in part to the fact that usually the economic returns from R&D are in the long-term, while the costs are immediate; in part to the difficulties of finding the necessary financial resources on the market. Relevant is then the lack of skilled workers (11.9%), as proof of the key role played by education in fostering growth and business development. Finally, the difficulty of finding and/or activating collaborations plays only a marginal role (6.2%), together with the difficulty of being financed (4.9%). The ranking resulting from the sample average is by and large equivalent to that found in all regions, except from Lombardy, where the lack of skilled workers is less felt, and Rhône-Alpes, where finding partners is not perceived as an issue at all.

Figure 1.12 – Factors that prevent R&D (% of firms over total firms not involved in R&D, multiple choice, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza
Note: Firms that have selected the option "other factors" are excluded, because the category refers to firm- or sector-specific characteristics.

1.3 Organizational, product and process innovation

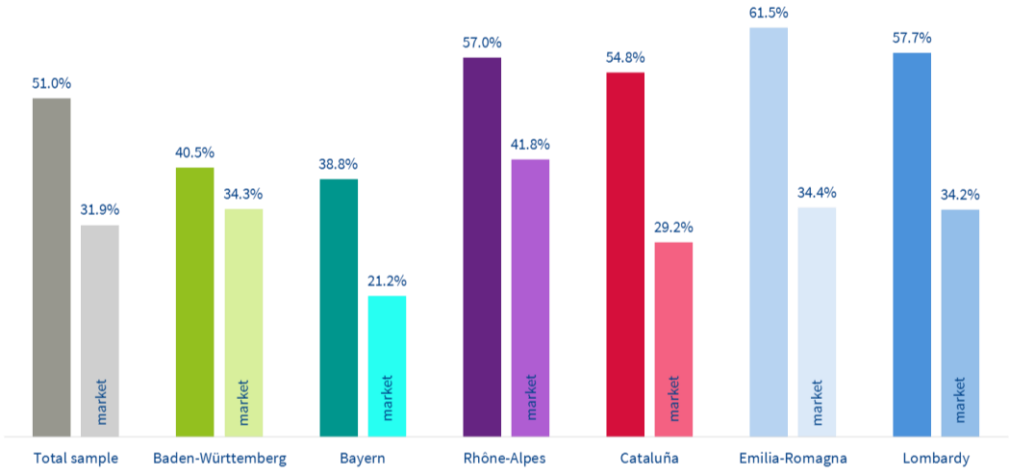
Innovation is not limited to research and development. It also includes the introduction of new products, changes in business processes, as well as business reorganization.

The spread of product innovation in the sample results high (Figure 1.13). Indeed, in 2013-2015 51% of firms introduced product innovations – and in more than half of the cases (31.9%) such innovations are a real novelty on the market.[18] The sample average hides the contrast between Baden-Württemberg (40.5%) and Bayern (38.8%) and the other regions, which range from 54.8% in Cataluña to 61.5% in Emilia-Romagna. Bayern is below average also for what concerns market innovations (21.2%), an item on which Rhône-Alpes stands out (41.8%). The share of innovations introduced in the 2013-2015 period being a flow, still valid are the considerations made with reference to R&D activities in Germany (see paragraph 1.1).

The sale of innovative products relevantly covers 20.8% of firms' turnover (Figure 1.14). In line with what observed relatively to the spread of product innovation, it is found that in Bayern earnings from innovative products account for only 15% of firms' turnover, while in Lombardy and Baden-Württemberg the equivalent figure is 25%, though the standard deviation is high.

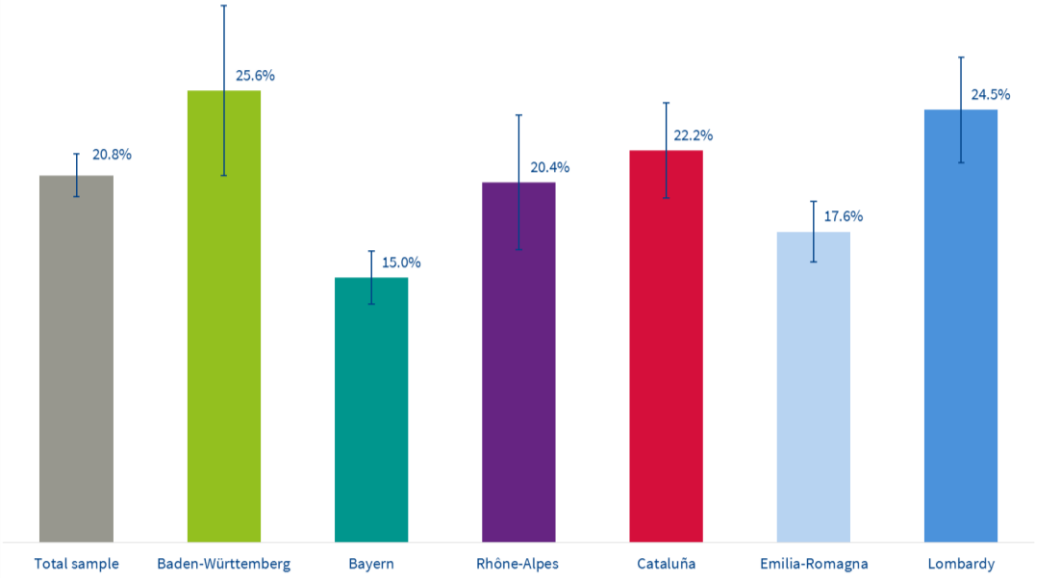
[18] *Products that before then not only did not figure in the firm's portfolio, but also in general had never been sold.*

Figure 1.13 – Firms that introduced product and market innovations (% of total firms, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

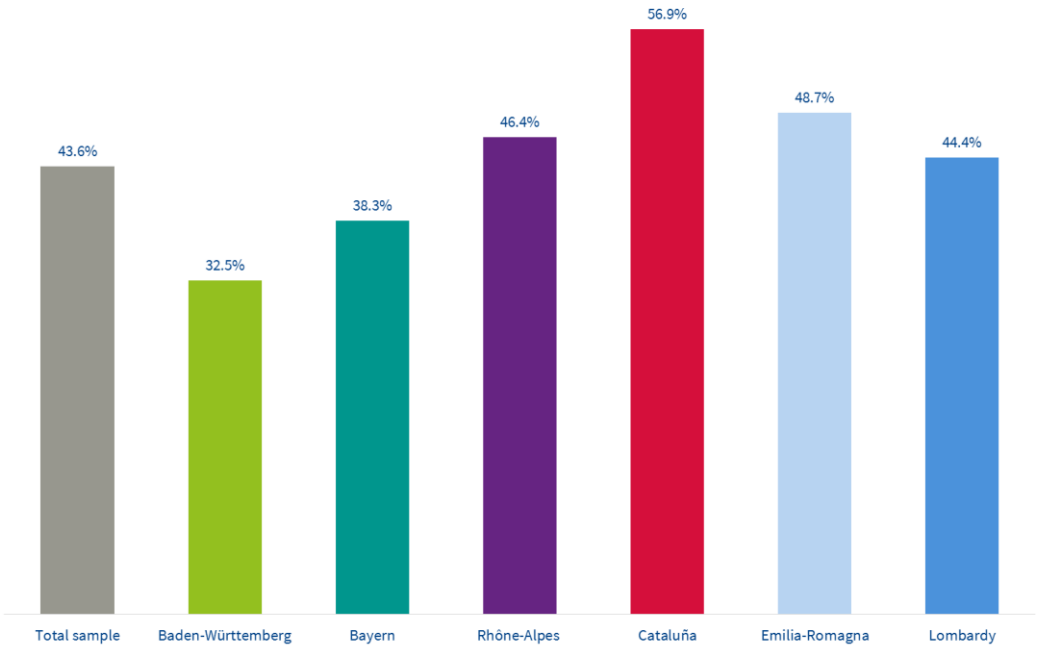
Figure 1.14 – Average share of turnover from sales of innovative products (% and standard deviation, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Compared to product innovation, process innovation is slightly less widespread and concerns only 43.6% of firms (Figure 1.15). Moreover, regional performances differ to a greater extent. At the bottom of the list is Baden-Württemberg, where firms that introduced process innovations in 2013-2015 are 32.5% of the total. Cataluña is instead the top performer, with a share of 56.9%. Slightly above average are then Lombardy (44.4%) and Emilia-Romagna (48.7%).

Figure 1.15 – Firms that introduced process innovation (% of total firms, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

As already highlighted in paragraph 1.1, compared to 2011-2013 the share of firms that introduced product and process innovations jointly increased, with the sample average reaching 31.1%. It is interesting to break down the figure by firm size. Due to the presence in innovation activities of economies of scale and given how sophisticated the combination of product and process innovation is, it has indeed been verified that the share of firms conducting both types of innovation increases according to size, shifting from 26.7% in the case of small firms, to 49.4% in the case of medium firms, up to almost 63.9% when it comes to large firms.

Last but not least, organizational innovation is considered. It is linked to changes in internal structure, the division of labor, marketing and sales activities, client relations.[19] Always in paragraph 1.1 the increase from 17.4% to 22.1% between 2011-2013 and 2013-2015 of firms involved in business reorganization processes was considered as positive. The shares reach 24.9% in Emilia-Romagna, 26.8% in Lombardy and the maximum (30.6%) in Cataluña, likely reducing the gap with German regions.

[19] *Compared to "technological" forms of innovation, such as those concerning processes and products, organizational innovations is influenced by and, at the same time, implied a cultural change in the way in which business activities (e.g. more or less independence accorded to workers; built-to-order production processes), but also external relations (e.g. enhanced cooperation and lateral communication, with competitors) are managed. The goal is mostly to reduce administrative costs, foster knowledge-sharing both between and within firms and enhance satisfaction on the workplace. (OECD,* Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, *pp. 51-52)*

In Box 1 the link between innovation and business performance is analyzed, differentiating between organizational and process innovation.

Box 1 – Innovation and business performance

In order to measure whether business reorganization has an impact on firms' development and growth, *Labor Productivity* has been considered in relation to *Organizational innovation* e *Product innovation*, controlling for size (*Medium firms*=1 if the firm employs between 50 and 250 persons; *Large firms*=1 if the firm employes 250 persons or more) and regional and sector fixed effects. Process innovation results positively correlated to labor productivity, adding a premium of 15 p.p., which further increases to 18 p.p. for medium firms. There would seem to be instead no statistically significant direct link between productivity and organizational innovation.

Variables	*Reg*
	Labor productivity
Process innovation	0.150 ***
	0.048
Organizational innovation	-0.040
	0.049
Medium firms	0.181 **
	0.070
Large firms	0.063
	0.201
Observations	496

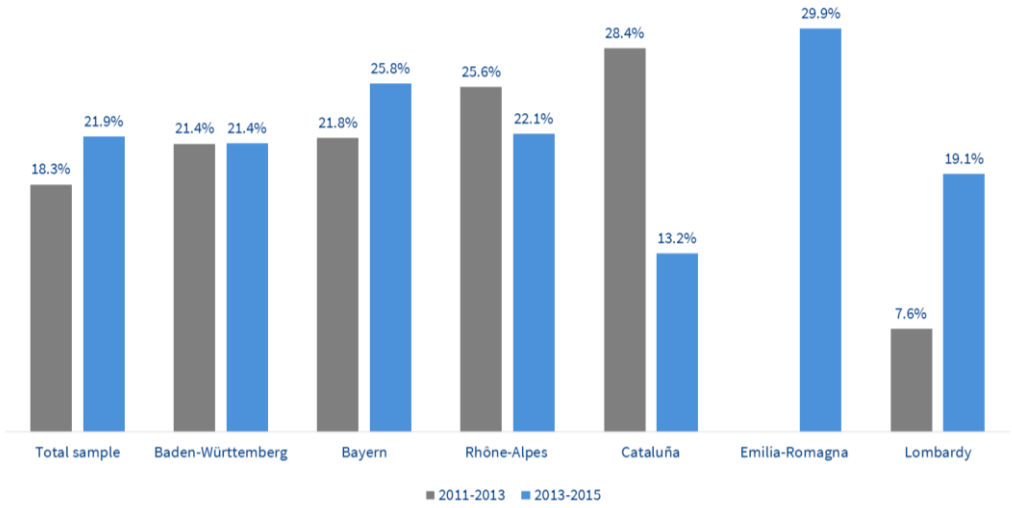
Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

1.3 Intellectual property

In order for firms to turn their innovation potential into capital, R&D and organizational, product and process innovations are not enough. It is also necessary to manage and enhance the technological transfer, i.e. the transformation of science and knowledge in applied technology. In evaluating firms' and their regions' competitiveness it is hence important to consider patents and other forms of Intellectual Property Protection, such as trademarks, industrial design and copyrights.

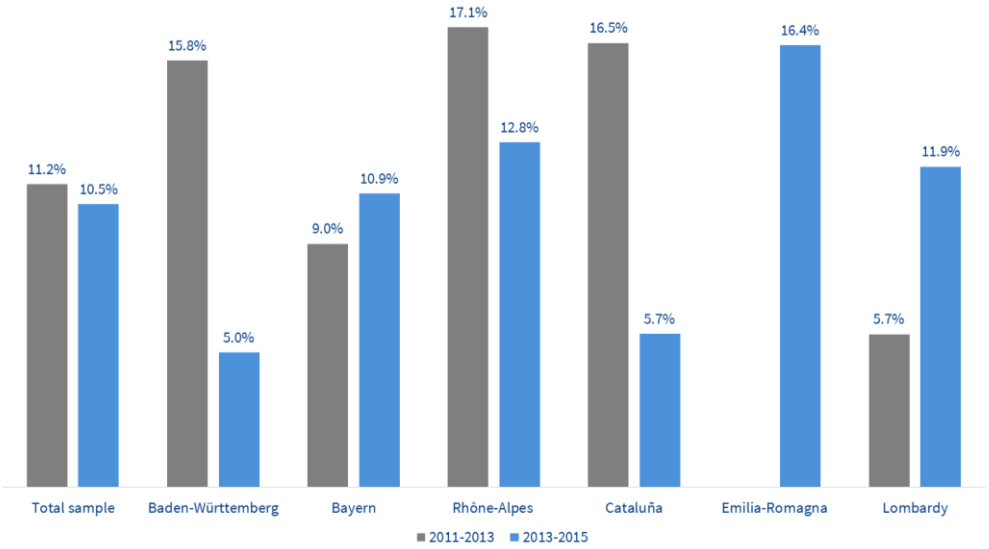
Over the 2013-2015 period, 21.9% of firms in the sample used some form of intellectual property (Figure 1.15); in particular, 10.5% has applied for at least one patent – the privileged instrument when it comes to scientific-technological innovations (Figure 1.16). When comparing regions it is possible to speculate on a likely catch-up of Lombardy to German regions, relatively not only to R&D and innovation, but also technological transfer. In 2011-2013 Lombardy's firms negatively stood out, penalized by a gap in terms both of use of intellectual property protection instruments in general (7.6%, a third compared to German firms, a quarter even compared to the French) and patent applications (5.7%). Instead, in 2013-2015, Lombardy's firms that claim having used some form of intellectual property protection are 19.1%, almost a 10 p.p. increase compared to the equivalent figure in 2011-2013 and in line with Baden-Württemberg (stable at 21.4%) and Rhône-Alpes (decreasing). Similarly, for what concerns patent applications, the share of firms shifts from 5.7% to 11.9%, in line with Bayern and Rhône-Alpes and higher than Baden-Württemberg and Cataluña.[20]

Figure 1.15 – Firms that used Intellectual Property Protection Instruments (% of total firms, 2011-2013 and 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 1.16 – Firms with at least one patent application in three years (% of total firms, 2011-2013 and 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[20] *The improvement in Lombardy is recorded also when considering the latest available data on the number of patent, community trademark and community design applications to the European Patent Office. From 2015 to 2016, the number of patents per million inhabitants increased from 129 to 144; between 2013 and 2015, community trademarks grew from 227 to 254, while community designs kept stable at 46. (European Patent Office and Eurostat)*

Box 2 assesses how far the use of intellectual property instruments impacts productivity.

Box 2 – Intellectual Property Protection

In order to measure whether Intellectual Property Protection matters in terms of competitiveness, the relationship between *Intellectual property* (=1 if the firm has used patents, trademarks or industrial designs in a 3-year timeframe) and *Labor productivity* was considered, focusing on firms that conduct R&D and controlling for size, together with regional and sector fixed effects. Those firms that use some form of intellectual property are more productive (+12.5%), and the productivity gain results higher as size increases.

Variables	*Reg1*	*Reg2*
	Labor productivity 2013 (log)	**Labor productivity 2015 (log)**
Intellectual property	0.335 ***	0.125 **
	0.068	*0.058*
Employment (log)	-0.021 **	0.061 *
	0.033	*0.033*
Observations	534	501

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

2. Smart manufacturing

To those firms already at an advanced stage of adoption of the smart manufacturing model is linked a productivity higher by 18%. Also, the adoption of these technologies and the probability to implement process innovation (+42.2% above the sample average) and organizational innovation (+18%) are positively correlated. When it comes to the digitalization of production processes, Baden-Württemberg and Bayern are the most advanced regions: around 12% of firms show a high degree of digitalization, compared to a sample average of 9.3% (Lombardy 8.9%).

2.1 Smart manufacturing and industrial renaissance

In pursuing the objective of revitalization of the EU economy, the European Commission has endorsed the idea of an "industrial renaissance", with the aspiration of raising the contribution of industry to GDP from 15% to 20%.[21] A key pillar to this revitalization is the transition towards a new entrepreneurial and production model: smart manufacturing, also known as Manufacturing or Industry 4.0.[22] The concept of "4.0" purposefully refers to a fourth industrial revolution, built on digital technologies which can integrate spaces, people and information within the single factory and along the entire production chain. Such technologies might relate to information and communication, such as the Internet of Things, Big Data and Cloud Computing, or be more operational, for instance industrial robots, Advanced Human-Machine Integration and 3D printing.[23]

The potential benefits in terms of productivity from adopting the new industrial paradigm are huge. Digitalization allows indeed to organize production and labor differently. This might lead to a more effective and efficient use of resources, besides inspiring a new range of products and services to better satisfy market demand. Different studies have demonstrated that the degree of diffusion and adoption of technologies, as also higher levels of employment in ICT sectors are fundamental in explaining the comparative advantage in terms of productivity achieved by the United States over Europe in the 90s.[24]

Digitalization and technological progress are in sum an essential source of competitiveness for the European industry and thus have to be boosted. Many Member States, including Italy,[25] have hence welcomed the Commission's aspiration to revitalize the manufacturing sector, integrating the digital evolution in a reviewed approach to industrial policy. Nevertheless, it is difficult to gather accurate information about the state of the art and the

[21] *European Commission,* For a European Industrial Renaissance*, p. 25*
[22] *Assolombarda Confindustria Milano Monza e Brianza, Centro Studi e Area Industria e Innovazione (a cura di),* La strada verso la Manifattura 4.0. Progetto di ricerca "Focus Group Manifattura 4.0"*, pp. 63 - 66*
[23] *Per approfondimenti sul tema si vedano: Assolombarda Confindustria Milano Monza e Brianza, op. cit.; Politecnico di Milano,* Osservatorio Smart Manufacturing*; Roland Berger,* Think Act. Industry 4.0: The new industrial revolution, how Europe will succeed
[24] *Si vedano: B. Van Ark et al.,*ICT and productivity in Europe and the United States. Where do the differences come from?*; D. Pilat et al.,* Production and use of ICT: A sectoral perspective on productivity growth in the OECD area
[25] *Italy presented its Piano nazionale Industria 4.0 in September 2016 [Ministero dello Sviluppo Economico,* Presentato il Piano nazionale Industria 4.0 *(http://www.sviluppoeconomico.gov.it)]*

spread of the smart manufacturing in the real economy. In a particular way, at the time of writing, there is no knowledge of other studies that assess the progress towards the fourth industrial revolution at the regional level.

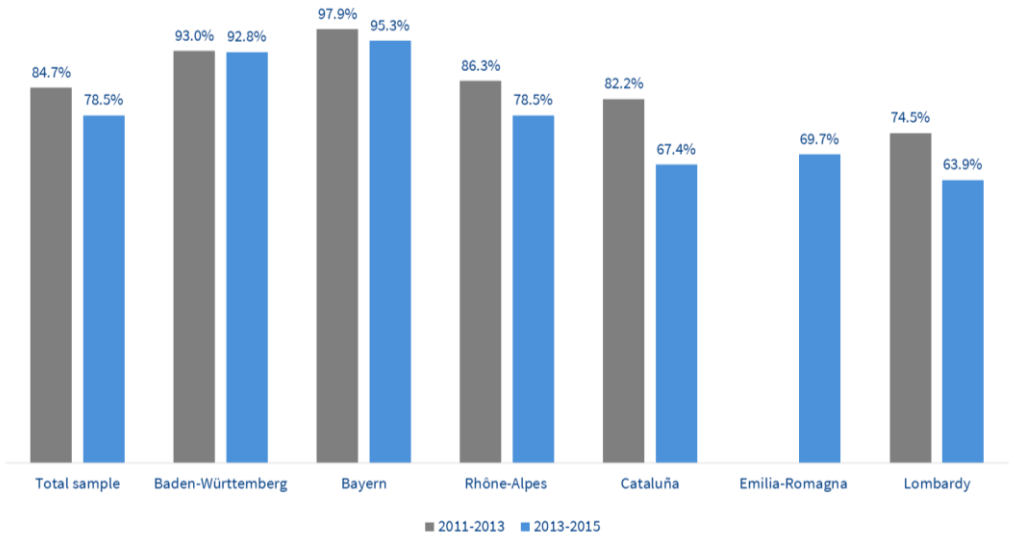
In this respect, this second edition of the survey includes an entire section dedicated to a comparative assessment, for the first time on the basis of regional data, of the adoption of the Manufacturing 4.0 paradigm by firms at the European level.

2.2 Investments in equipment and ICT

Investments in equipment are a good proxy both firms' readiness to the evolution 4.0 and their propensity to change.

Over the period 2013-2015, 78.5% of firms in the sample invested in new machinery. Shares range from 63.9% in Lombardy to 95.3% in Bayern (Figure 2.1). Although regions are ranked the same as in 2011-2013, investments in new machinery appear to be on a declining trend, from a minimum of -0.8 p.p.in Baden-Württemberg to the maximum of-14.8 p.p. in Cataluña.

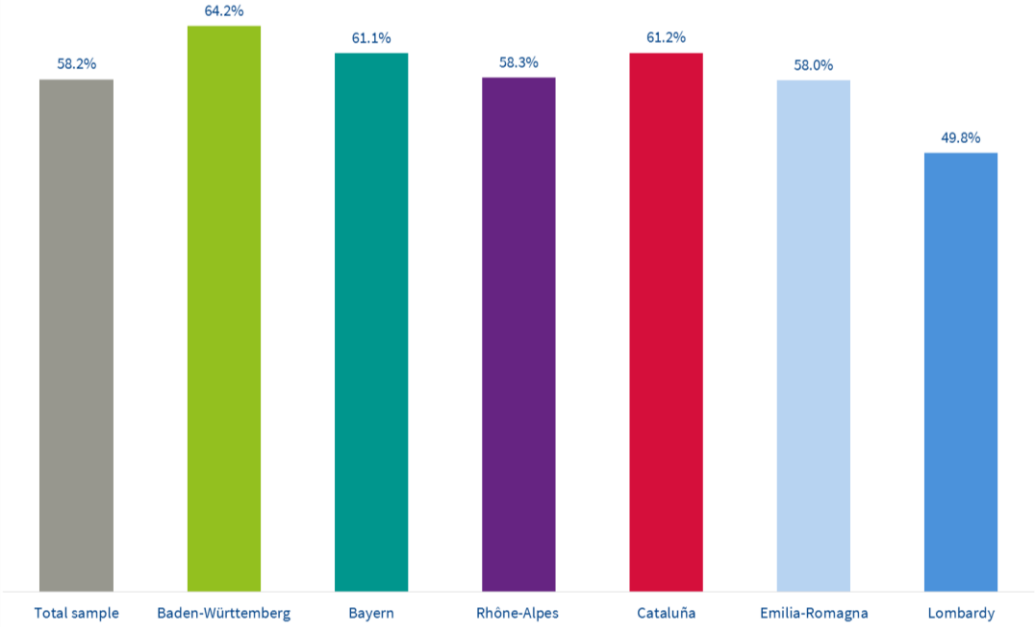
Figure 2.1 – Firms that invested in plants, equipment, tools and/or ICT (% of total firms, 2011-2013 and 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Considering 2015 only, the sample average equals 58.2%, while maximum and minimum fall to Baden-Württemberg's 64.2% and Lombardy's 49.8% respectively (Figure 2.2).

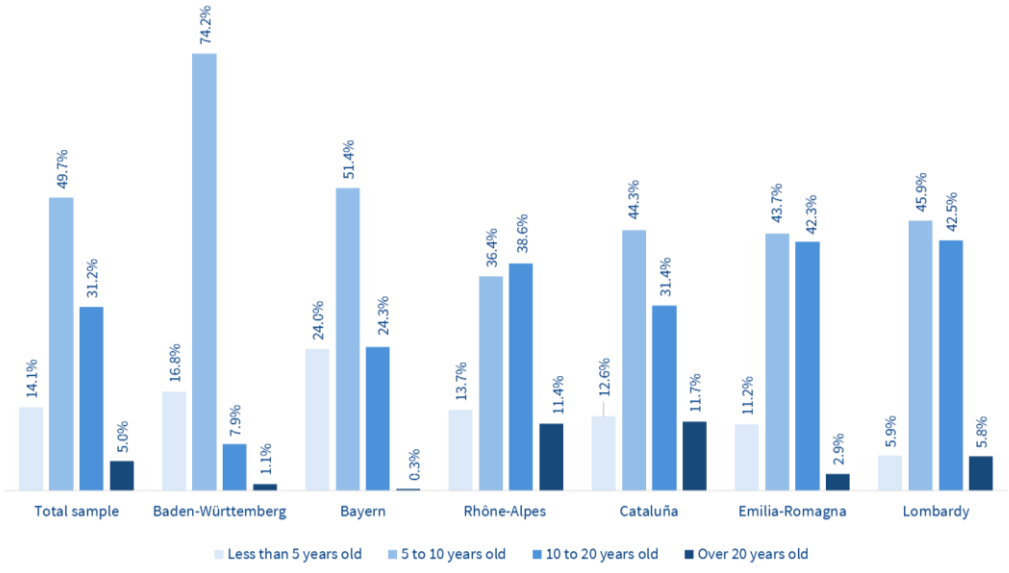
Figure 2.2 – Firms that invested in plants, equipment, tools and/or ICT (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

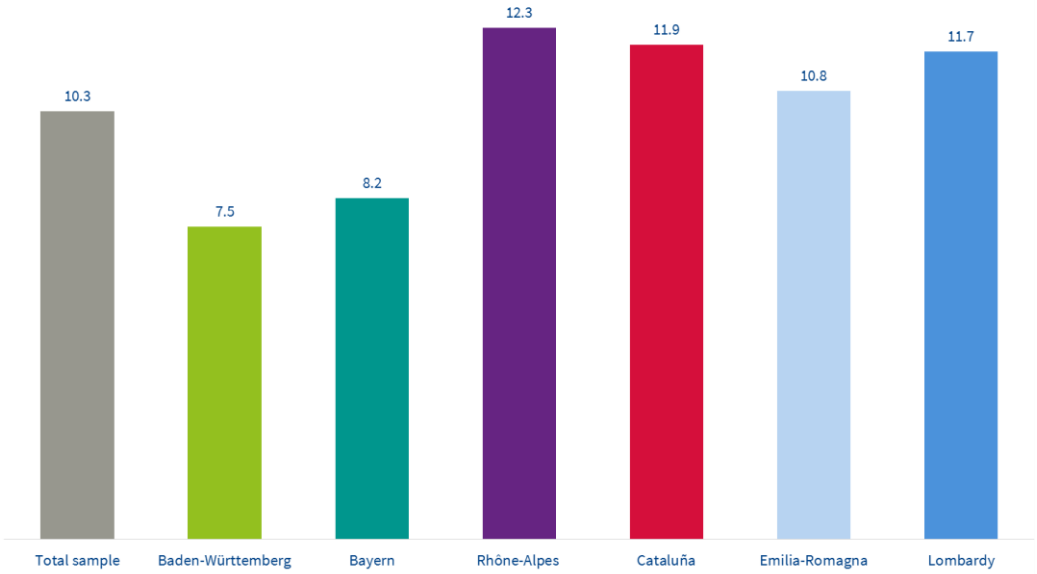
An optimistic interpretation of the data would lead to the conclusion that an increasing number of firms has already renovated its equipment. As a matter of fact, over the total sample, 63.8% of firms have plants and machinery that are less than 10 years old (Figure 2.3). Yet such a conclusion cannot be homogenously applied to all regions. It's actually German firms that have modernized their equipment to a larger extent: compared to a sample average of 14.1%, as many as 16% and 24% of firms in Baden-Württemberg and Bayern respectively have machines less than 5 years old. Moreover, the average age of firm equipment in the same regions is 8 years, compared to a sample average of 10 (Figure 2.4). In Rhône-Alpes and Cataluña the average age is 12 years. Therefore, while on the one hand around 13% of firms renovated their equipment less than 5 years ago, on the other hand almost another 11% has not done so for at least 20 years.
In Lombardy, in particular, firms are updating at a relatively slower pace: although only 5.8% have hold machines for more than 20 years, an equally scarce 5.9% result having bought new ones in the last 5 years (less than half the sample average and a quarter of the equivalent figure in Bayern).

Figure 2.3 – Firms by age of their equipment (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

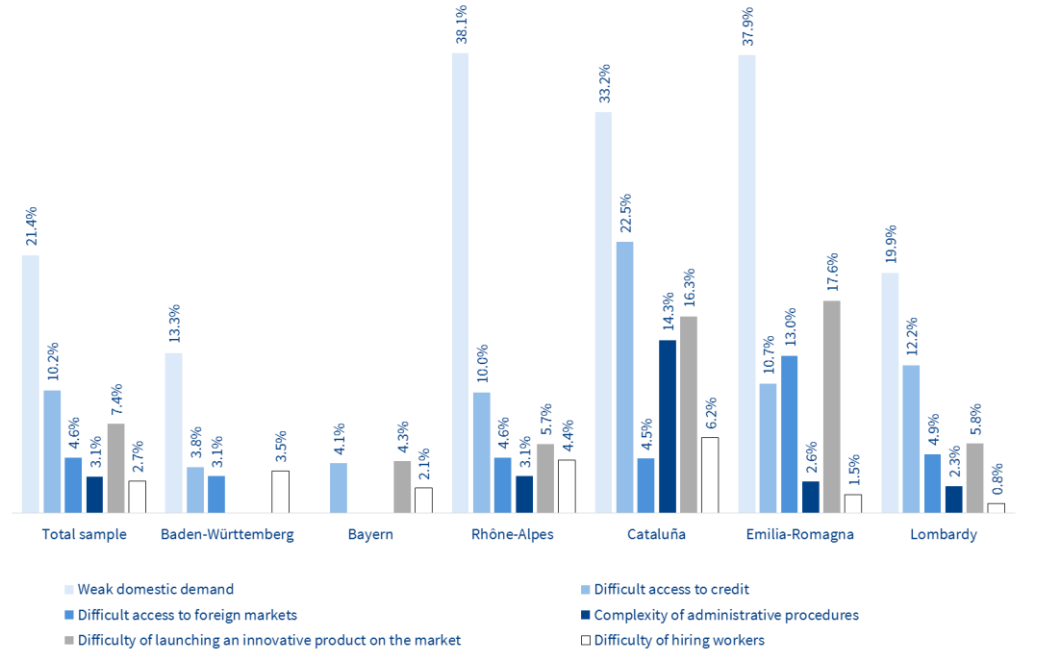
Figure 2.4 – Average age in years of firm equipment (2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Among the causes of missed investment (Figure 2.5) are first and foremost a weak domestic demand (21.4% of firms, peaking at around 38% in Rhône-Alpes and Emilia-Romagna), the difficult access to credit (10.2% of firms, with a maximum of 22.5% in Cataluña) and the difficulty of launching an innovative product on the market (7.4%, with a maximum of 17% in Cataluña and Emilia-Romagna). Instead, issues about foreign markets (4.6%), bureaucracy (3.1%) and availability of an adequate labor force (2.7%) result to be marginal. Firms in Lombardy generally are in line with the sample average, although with slightly higher shares concerning credit (12.2%) and lower shares when considering domestic demand (19.9%), bureaucracy (2.3%), innovative products (5.8%) and labor force (0.8%).

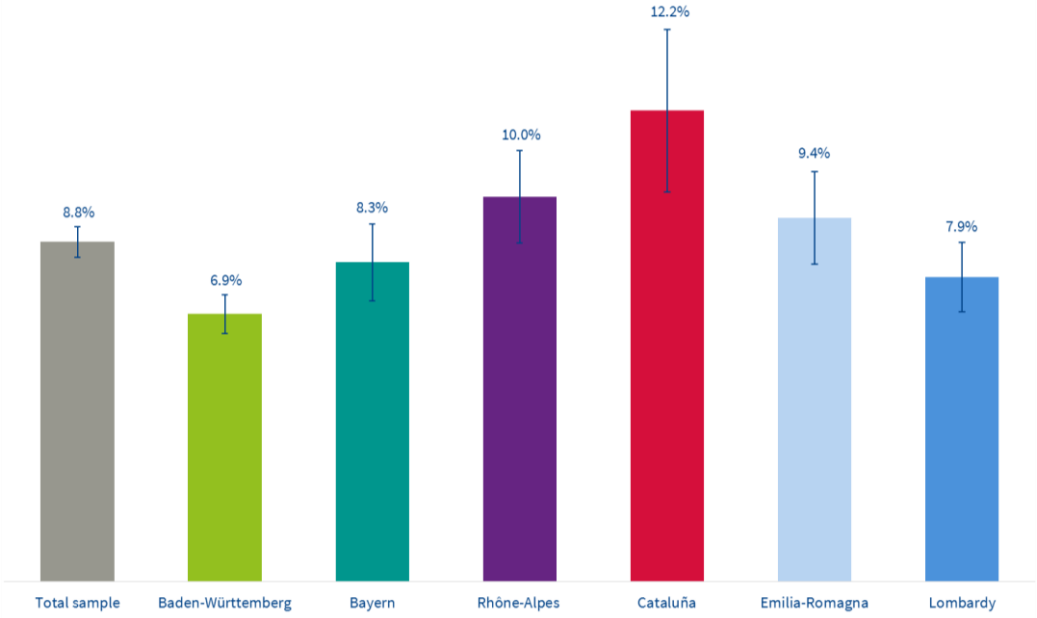
Figure 2.5 – Obstacles to investments in plants, equipment, tools and/or ICT (% of firms over total firms which did not do any investment, multiple choice, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Firms that invested in equipment did so for an average amount equal to 8.8% of turnover (Figure 2.6), in line with what already registered over 2011-2013. Investments in Cataluña and Lombardy now amount to 12.2% 7.9% of turnover respectively, shares that are markedly higher than the 9.7% and 6.1% found in 2011-2013.

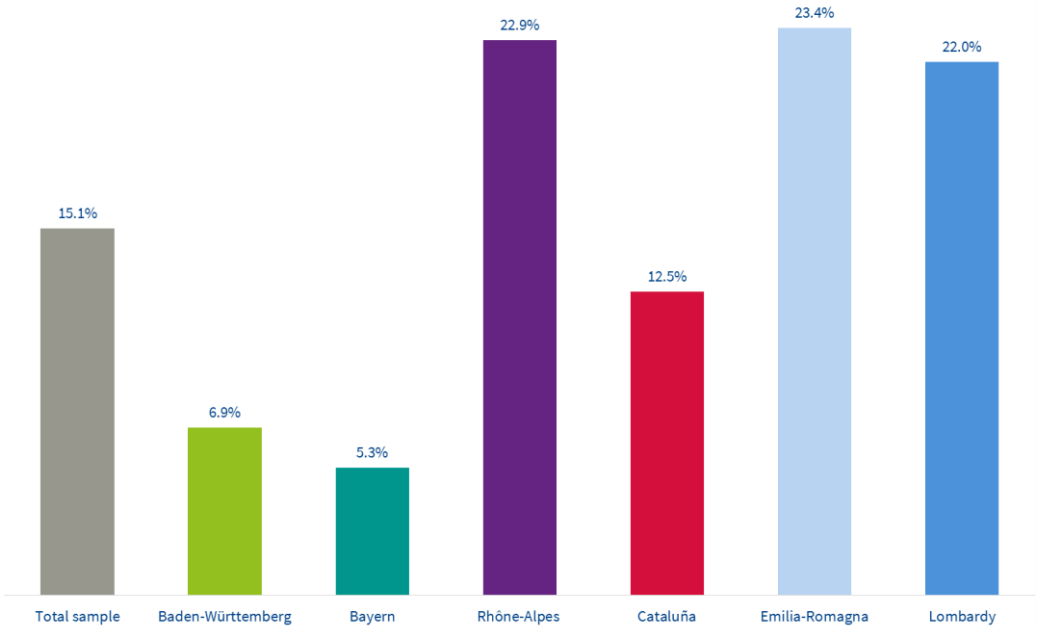
Figure 2.6 – Average investment in plants, equipment, tools and/or ICT as percentage of turnover (% and standard deviation, 2013-2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Finally, 15.1% of firms that invested between 2013 and 2015 took advantage of fiscal or financial subsidies, with firms in Rhône-Alpes, Emilia-Romagna and Lombardia well above the sample average (Figure 2.7).

Figure 2.7 – Firms that took advantage of fiscal or financial subsidies when investing in plants, equipment, tools and/or ICT (% of total firms, 2013-2015)

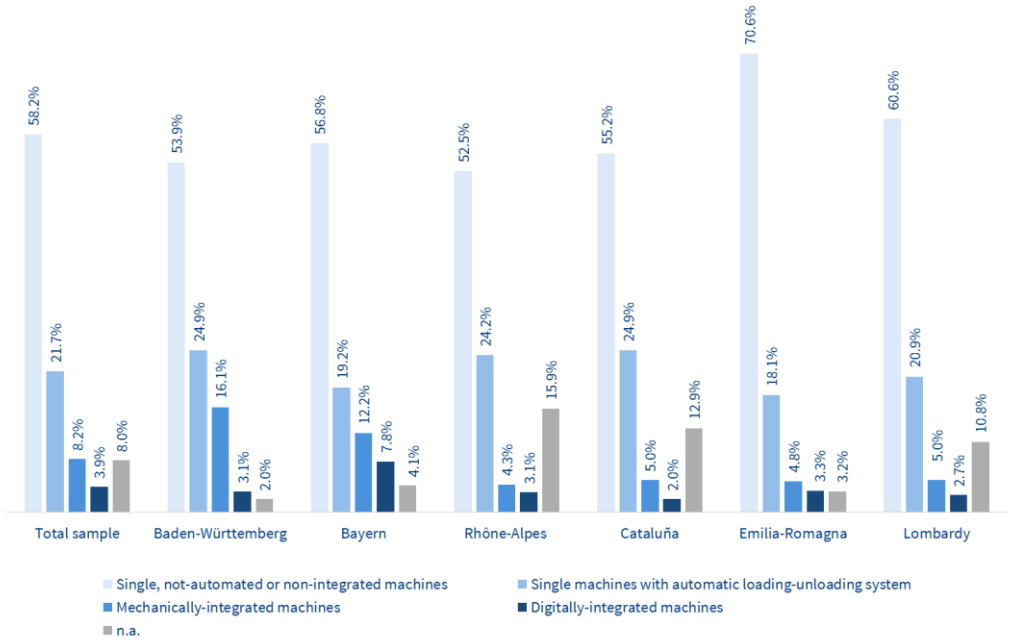


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

2.3 Digitalization and integration of production processes

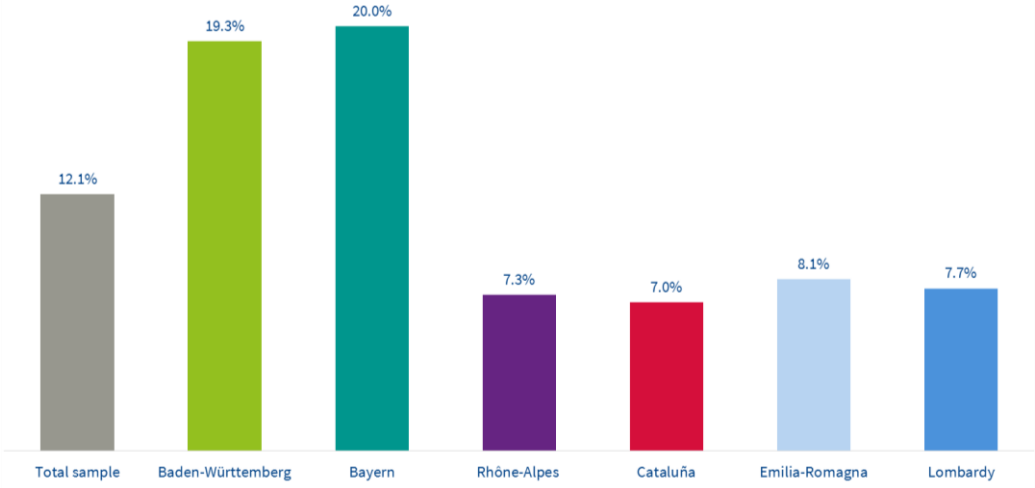
As to the level of readiness to Industry 4.0, further clarifications might be provided thanks to the data on the type of machines used (Figure 2.8 and Figure 2.9). Besides the fact that in all regions most firms still use single machines, at best equipped with an automatic loading-unloading system, it is clear that Germany is ahead in the dash for Industry 4.0. The firms analyzed might indeed be split into two groups: on the one side the two German regions, where around 20% of firms already have mechanically- or digitally-integrated machines; on the other side, Rhône-Alpes, Cataluña, Emilia-Romagna and Lombardy, where the equivalent figure is three times smaller (7-8%).

Figure 2.8 – Firms by type of machines used in production (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 2.9 – Firms that use mechanically- or digitally-integrated machines (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

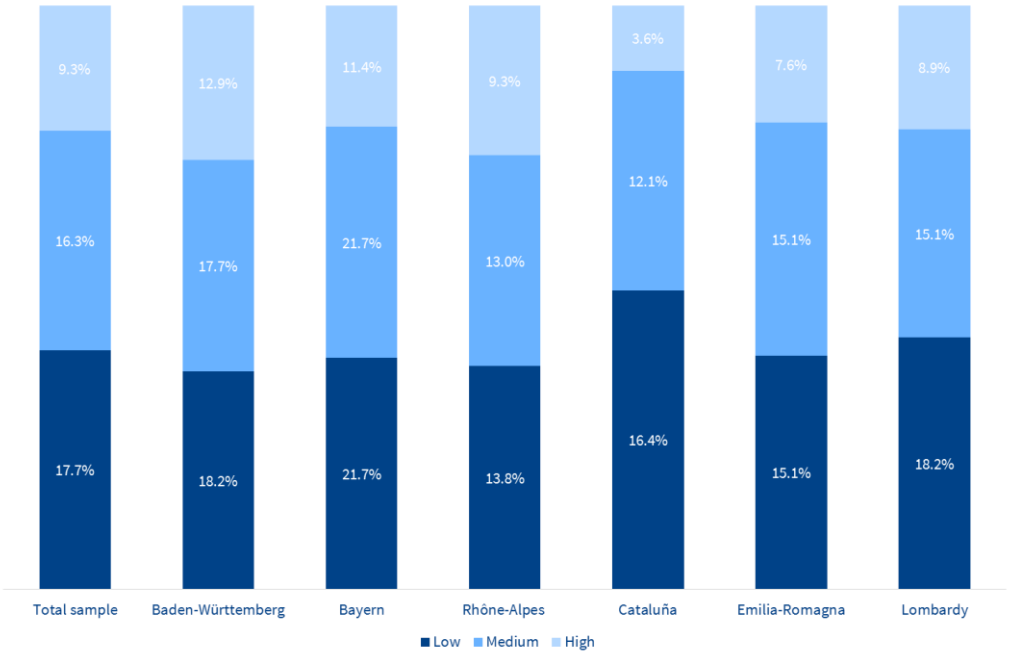
Measuring the spread of mechanically- or digitally-integrated equipment per se is not sufficient to quantify firms' actual level of smart manufacturing. Besides the level of integration, it is necessary to consider the use of Industry 4.0 technologies.[26] It is particularly useful to focus on the most operational technologies that directly affect production, i.e. industrial robots (*Advanced manufacturing*), 3D printing (*Additive manufacturing*) and machines equipped with integrated electronic devices. Drawing the attention to firms that are already past the use of single, not-automated/non-integrated machines only (around 42% of the sample), the advancement towards the smart manufacturing model is measured through a specific indicator that combines the type of equipment used, the level of integration and the spread of strictly operational 4.0 technologies. The indicator clusters firms in the sample according to the following levels of smart manufacturing:

(1) "low" when firms use at least one machine that either has an automatic loading-unloading system, or is mechanically- or digitally-integrated, and are equipped with at least one of the smart technologies mentioned above;
(2) "medium" when firms use at least one either mechanically- or digitally-integrated machine and are equipped with at least one of the smart technologies mentioned above;
(3) "high" when firms have both a mechanically- and a digitally-integrated machine and are equipped with at least one of the smart technologies mentioned above.

The smart manufacturing level hence depends on the firm having at least one 4.0 technology among industrial robots, 3D printing and machines equipped with integrated electronic devices and it increases as the level of equipment integration grows. The firms that arguably have already started adopting the technological innovations conveyed by the new production paradigm thus fall into the high smart manufacturing category. Once again, it is German firms that stand out as the most advanced when it comes to Manufacturing 4.0 (Figure 2.10). In Baden-Württemberg and Bayern respectively 12.9% and 11.4% of firms show a high level of smart manufacturing, while in Cataluña (3.6%), Emilia-Romagna (7.6%), Lombardy (8.9%) and Rhône-Alpes (9.3%) the equivalent figure is lower. Based on this report's definition of smart manufacturing, the real selection happens when shifting from a medium to a high level. On the contrary, the shift from low to medium is not as selective. In Emilia-Romagna and Bayern in particular indeed, the average share of firms at a low level of smart manufacturing is equal to that of firms at a medium level of smart manufacturing. In general anyway, also in the other regions those shares do not excessively differ (-1.5 p.p. considering the sample average), whereas there is a noticeable decrease when shifting from a medium to a high level (-7 p.p.).

[26] *The technologies and applications on which Industry 4.0 builds fall in 6 categories: Internet of Things (IoT), Cloud Manufacturing, Industrial Analytics, Advanced Human-Machine Integration, 3D printing and industrial robots.*

Figure 2.10 – Smart manufacturing (% of total firms, 2015)

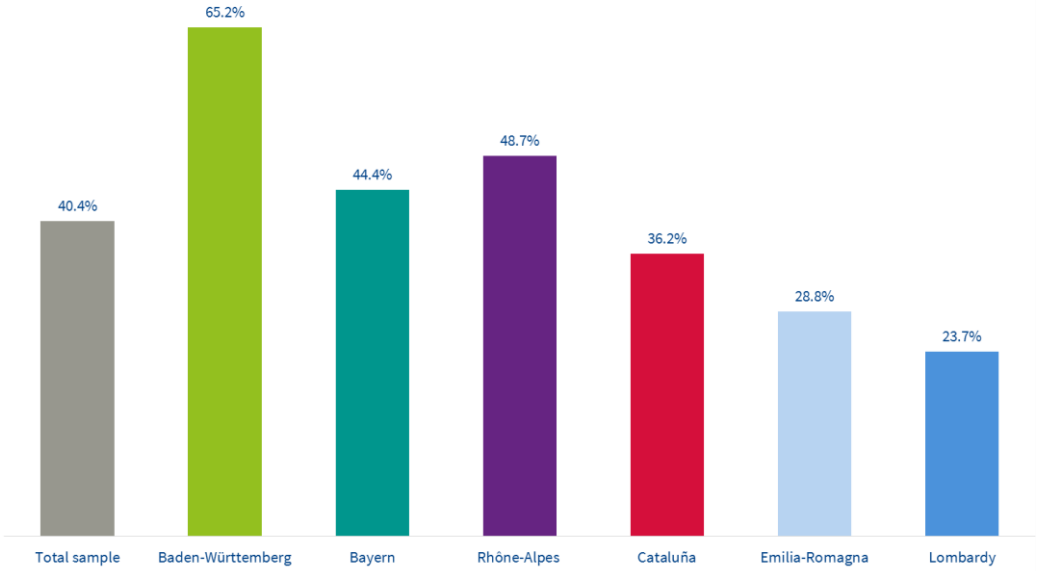


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Although the path towards Industry 4.0 should preferably be handled by the top management and not by the ICT Director Chief Operating Officer (COO),[27] operationally speaking it is worthwhile to expressively allocate someone to the digitalization of production. However, this is not common practice among the firms in the sample yet. With the exception of Baden-Württemberg (65.2%), less than half of firms foresees a job position for digitalization, a share that drops to 23.7% in Lombardy and 28.8% in Emilia-Romagna (Figure 2.11).

[27] *Assolombarda Confindustria Milano Monza e Brianza, Centro Studi and Area Industria e Innovazione (edited by),* La strada verso la Manifattura 4.0. Progetto di ricerca "Focus Group Manifattura 4.0", *p. 18*

Figure 2.11 – Firms allocating someone specifically to the digitalization of production (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Box 3 highlights the advantages of adopting the Manufacturing 4.0 paradigm in terms of productivity, ability to export and innovation.

Box 3 – The role of digitalization

The adoption of the technological innovations conveyed by the Manufacturing 4.0 paradigm is not immediate. It is not only about introducing smart instruments, but also integrating spaces, people and information by means of the same instruments. Subsequently, compared to the definition of smart manufacturing provided in this chapter, purposedly the focus is here on firms at a medium and a high level of smart manufacturing, investigating whether there is a link between them and business performance in terms of labor productivity, ability to systematically export, and within-firm production and organizational choices. The analysis was conducted controlling for size (*Medium firms*=1 if the firm employs between 50 and 250 persons; *Large firms*=1 if the firm employes 250 persons or more), together with regional and sector fixed effects.

When *Medium smart manufacturing* equals 1, all things being equal there is a productivity premium of 24%, while there is no statistically significant association to exports, which are instead influenced by firm size (Table 2.1). There is also a higher probability to introduce process innovations (+35.8%) or organizational innovations (+12.4%).
Since *Medium smart manufacturing* selects firms with an already good level of equipment integration, when *High smart manufacturing* equals 1 there is a productivity premium for firms at a high level of smart manufacturing, but a relatively smaller one (17.9% vs. 24%). There is still no link to systematic exports, but *ceteris paribus* the probability to innovate process and organizational structure increases (+42.1% e +18% respectively) (Table 2.2).

Finally, the role of human capital in digitalization processes was considered (Table 2.3). Size, productivity, sector and region being equal, there is a positive correlation between both *Medium* and *High smart manufacturing* and the presence of a person in charge of digitalization.

Table 2.1 – Medium smart manufacturing, performance and innovation

Variables	*Reg1*	*Reg2*
	Labor productivity (log)	**Systematic exporters**
Medium smart manufacturing	0.240 ***	0.081
	0.066	*0.052*
Medium firms	0.178 **	0.228 ***
	0.070	*0.054*
Large firms	0.076	0.423 ***
	0.200	*0.124*
Observations	496	691

Variables	*Reg1*	*Reg2*
	Process innovation	**Organizational innovation**
Medium smart manufacturing	0.358 ***	0.124 **
	0.050	*0.051*
Medium firms	0.162 ***	0.187 ***
	0.051	*0.052*
Large firms	0.328 ***	0.127
	0.118	*0.120*
Observations	691	691

Note: Each table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 2.2 – High smart manufacturing, performance and innovation

Variables	*Reg1*	*Reg2*
	Labor productivity (log)	**Systematic exporters**
High smart manufacturing	0.179 **	0.038
	0.085	*0.067*
Medium firms	0.190 ***	0.235 ***
	0.070	*0.054*
Large firms	0.084	0.438 ***
	0.202	*0.125*
Observations	496	691

Variables	*Reg1*	*Reg2*
	Process innovation	**Organizational innovation**
High smart manufacturing	0.422 ***	0.180 **
	0.064	*0.065*
Medium firms	0.157 ***	0.181 ***
	0.052	*0.052*
Large firms	0.278 **	0.094
	0.121	*0.122*
Observations	691	691

Note: Each table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 2.3 – Competences and smart manufacturing

Variables	*Reg1*	*Reg2*
	Medium smart manufacturing	**High smart manufacturing**
Digitalization manager	0.086 ***	0.041 *
	0.029	*0.023*
Medium firms	0.142 ***	0.131 ***
	0.039	*0.031*
Large firms	0.406 ***	0.457 ***
	0.089	*0.070*
Observations	691	691

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

3. Internationalization

In line with the previous edition, the share of firms involved in international activities more sophisticated than exports, such as international outsourcing and offshoring, is higher but still very low (5.0% versus 3.7% in 2013). Around 15% of them has a high participation to Global Value Chains (GVC). In this respect, Lombardy has markedly improved compared to 2013, with around 10% more firms at high GVC participation.

3.1 Internationalization and productivity

Global trade seems to be back being a driver for growth. It is indeed expected to return to grow faster than GDP, although not at the rates of the past 20 years.[28] The latest IMF estimates for 2017 in particular show the world GDP growing by 3.5% and world trade concurrently increasing by 3.8% (3.6% and 3.9% the respective estimates for 2018).

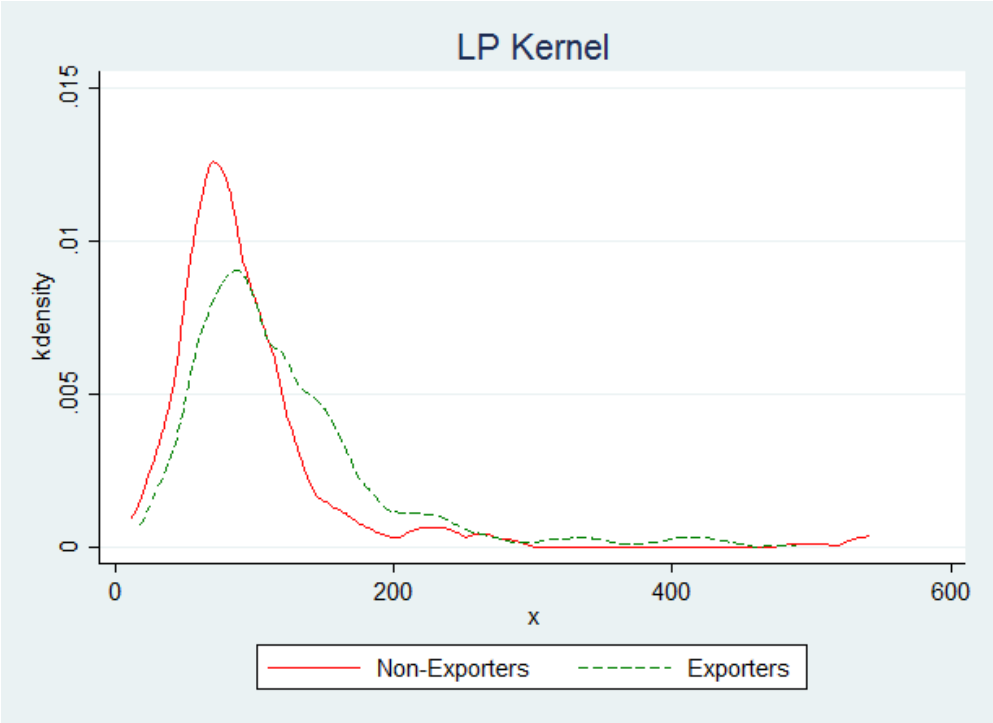
The benefits in terms of growth and regional development stemming from international openness should not be overlooked. On the one hand, firms connected to foreign markets might diversify risks related to demand fluctuations. On the other hand, there are important spillovers: different products and organizational models can be compared, incentives to production efficiency increase, new perspectives get to influence innovation practices. In particular, internationalization and innovation are strongly correlated. The higher the firm productivity is, the higher the benefit from combining innovation and export activities.[29] Moreover, one might assume that firms use innovation in order to strengthen their international presence.[30] For instance, product innovation (and to a lesser extent, process innovation) would appear to implicate in part choices with regard to exports.[31]

As put by Mayer and Ottaviano,[32] internationalization is an elusive concept. «From the point of view of a policymaker, it refers to the presence of countries in international markets as measured by their shares of exports, imports and FDI», preferably from a sectoral perspective. «From the point of view of a manager, it refers to the ability of firms to generate value through international operations», notwithstanding the high costs that these operations inevitably imply.
Especially thanks to the availability of firm-level data, such as those provided by this survey, the two perspectives might be reconciled and policy instruments made more effective and efficient. In particular, the availability of disaggregate data allows not only to measure the intensive margin, i.e. how much firms export, participate in GVCs or make FDIs, but also to estimate the extensive margin, i.e. the number of firms on international markets.

[28] *In those years world trade would grow at more than twice the pace of GDP (C. Altomonte, I. Colantone and E. Zaurino,* Has globalisation 'peaked'? Trade and GDP growth in the post-crisis context)
[29] *B. Y. Aw, M. J. Roberts and D. Y. Xu,* R&D Investment, Exporting, and Productivity Dynamics
[30] *C. Altomonte, T. Aquilante, G. Békés and G.I.P. Ottaviano,* Internationalization and Innovation of Firms: Evidence and Policy
[31] *B. Cassiman and E. Golovko,* Innovation and internationalization through exports
[32] *T. Mayer and G. I. P. Ottaviano*, The Happy Few: The internationalisation of European firms. New facts based on firm-level evidence, *p. 4*

In analyzing the extensive margin it is found that the international competitiveness of a country is built upon a limited number of firms. Consistently with the theory of the selection of firms on international markets ("the happy few"),[33] Altomonte *et al.*[34] purport that only 15% of European manufacturing firms on international markets are involved in all or all but one international activities – defined as imports, exports, outsourcing and FDI; in turn, these firms are 3.5 times larger in terms of employment than internationally inactive firms, and at least twice as productive.
After all, from the comparison between exporters and non-exporters in terms of productivity, it stems that there is a higher probability to select a more efficient firm among exporters (Figure 3.1).

Figure 3.1 – Labor productivity: comparing exporters and non-exporters (k-density, total sample, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

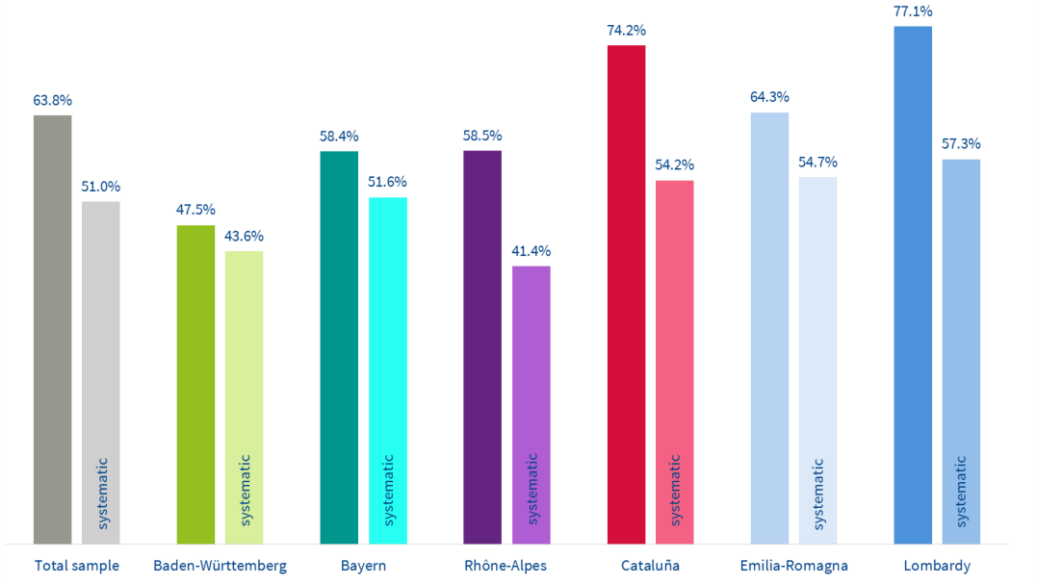
The rest of the chapter analyzes in depth commercial internationalization, i.e. exports and imports (3.2), international outsourcing and offshoring (3.3) and finally the participation in Global Value Chains (3.4).

3.2 Commercial internationalization

With reference to commercial internationalization, overall in the sample 51% of firms systematically export to foreign markets – over 60% if firms occasionally selling abroad are considered as well (Figure 3.2).[35]

[33] *Per una rassegna della letteratura esistente si veda, tra gli altri, M. Melitz e S. Redding,* Heterogeneous firms and trade
[34] *C. Altomonte, T. Aquilante, G. Békés and G.I.P. Ottaviano*, op. cit.
[35] *This result is influenced by the slant of the survey, which focuses on manufacturing firms with at least 10 persons employed, more prone to exporting compared to firms in other sectors or of a smaller size.*

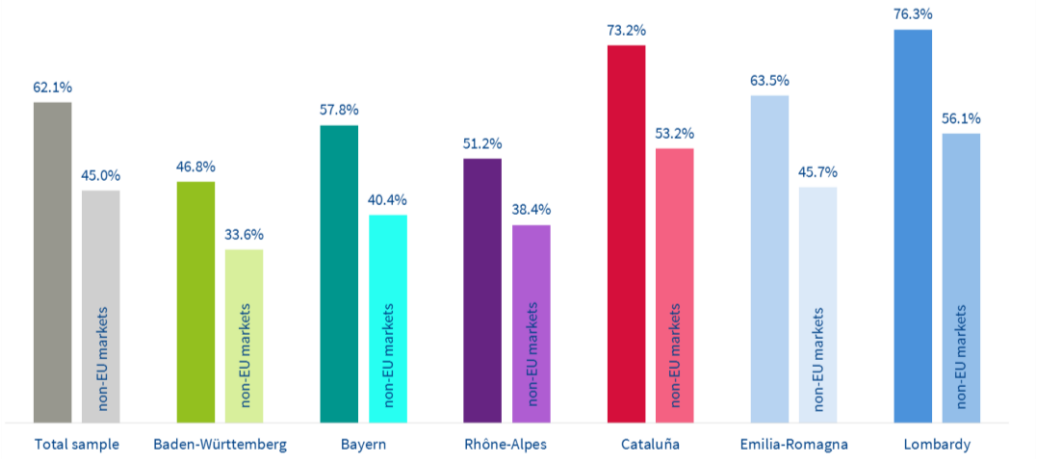
Figure 3.2 – Firms that sell their goods on international markets (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

The data in Figure 3.2 refer to all firms that sell their goods on international markets, including those that rely on intermediaries while still producing domestically, and those that produce abroad and successively export. The extensive export margin might be better quantified focusing on direct exporters that produce domestically (Figure 3.3). Lombardy and Cataluña, as already evident from Figure 3.2, have a particularly strong international presence: as many as 76.3% and 73.2% of firms respectively are exporters strictly speaking, above the sample average (62.1%). An equally relevant extensive export margin concerns extra-EU markets, which are more difficult to penetrate, but at the same time more profitable.[36]

Figure 3.3 – Extensive export margin: direct exporters that produce domestically (% of total firms, 2015)

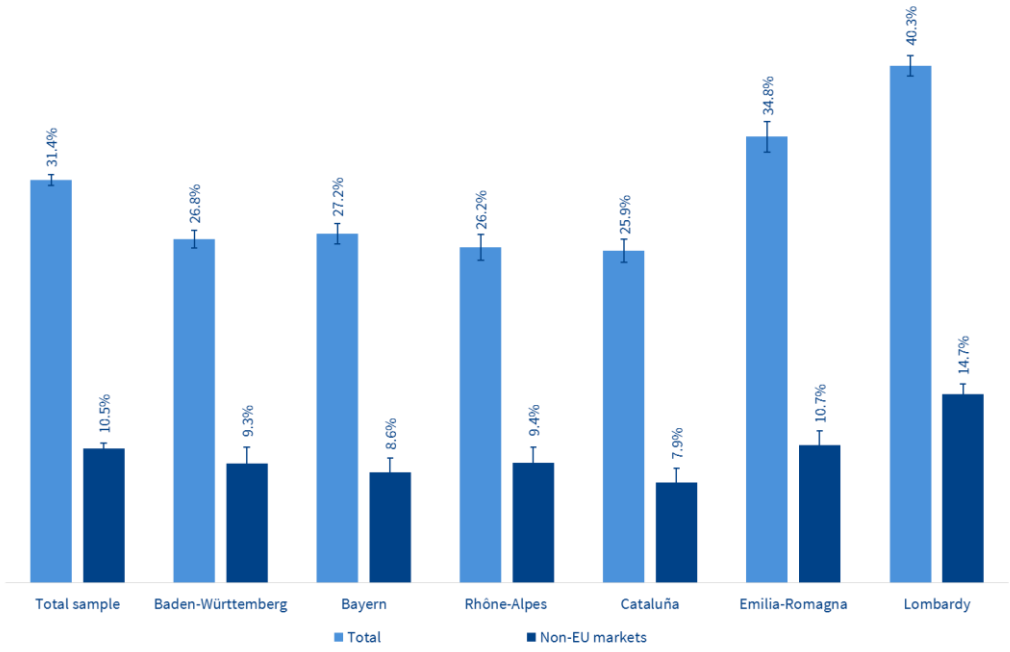


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[36] *In particular, especially since the last decade, investors seeking higher returns have increasingly turned to emerging markets, so much so that in 2012 for the first time those markets attracted more FDI than advanced economies. (R. Cristadoro e S. Federico,* L'internazionalizzazione del sistema produttivo italiano, *pp. 11-12)*

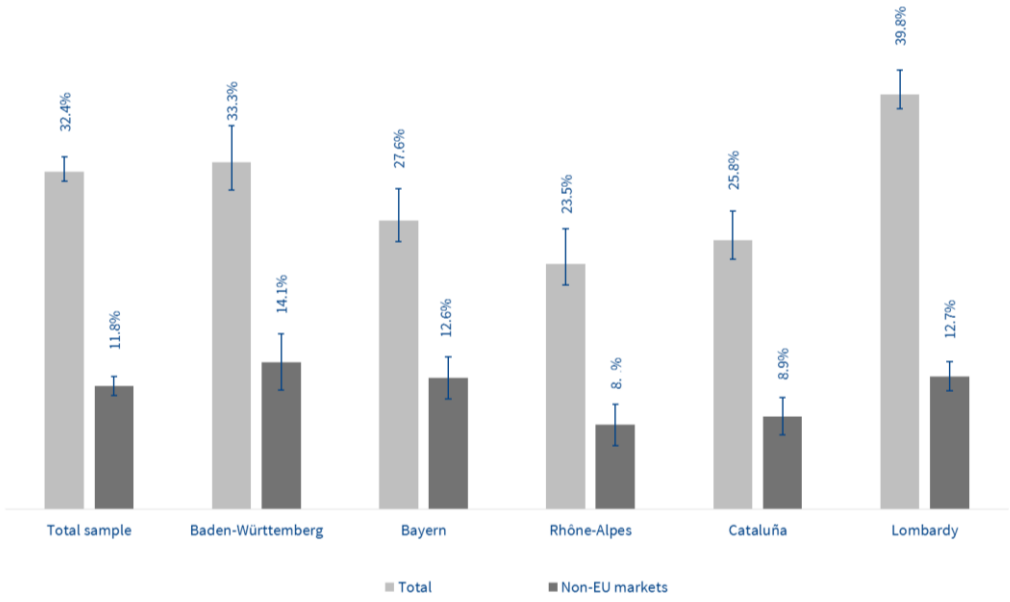
Together with the extensive margin, it is interesting to consider the intensive margin, i.e. the share of total turnover earned from exports. Figure 3.4 confirms the vocation to export of the European manufacturing sector. On average, a third of exporters' turnover is from sales on foreign markets, a share that falls to 10.5% when considering non-EU markets. Lombardy stands out together with Emilia-Romagna, with shares of 40.3% and 34.8% respectively – shares that keep high also when considering markets outside the EU (14.7% and 10.7%).
The comparison with 2013 data (Figure 3.5) highlights Lombardy's performance: the share of turnover from exports is stable (+0.5 p.p.), that on non-EU markets increases by 2 p.p.. In particular, as also in the other regions considered, the standard deviation has substantially decreased, from ±2.3% for the total turnover and ±1.4% for non-EU markets in 2013 to ±0.8% in both cases in 2015.

Figure 3.4 – Intensive export margin: average share of turnover from export (% of total turnover; values and standard deviation, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

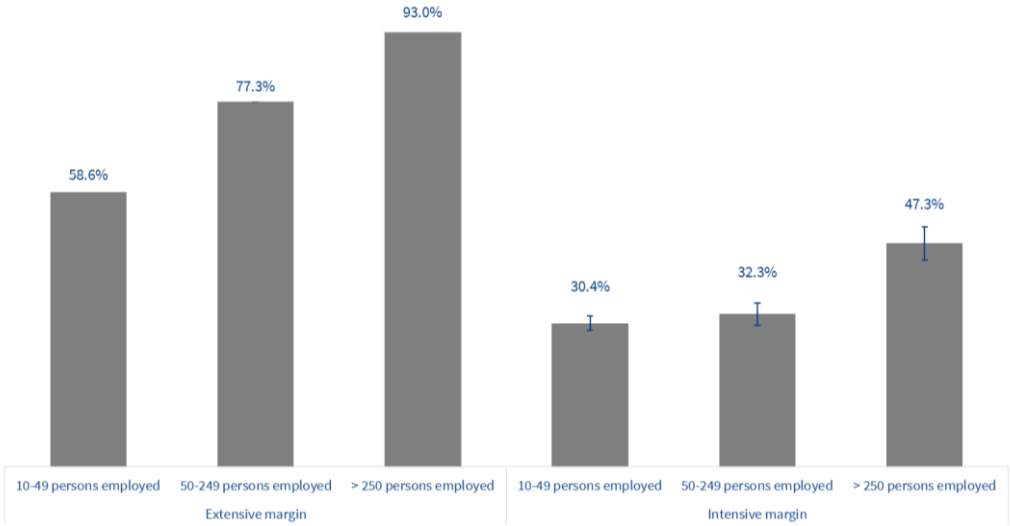
Figure 3.5 – Intensive export margin: average share of turnover from export (% of total turnover; values and standard deviation, 2013)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Both the intensive and extensive margin significantly vary according to firm size (Figure 3.6). Exports are 58.6% of the total in the case of small firms (10-49 persons employed), 77.3% considering medium firms and 93% in the case of firms with at least 250 persons employed. Similarly to the extensive margin, also the intensive margin is proportionate to size, although less markedly so. Small and medium firms' turnover from export sets at 31.3% of the total, while the same share in the case of large firms reaches 47.3% (±3.5% the standard deviation). Underlying this result is the relevance of fixed costs that, as in the case of innovation, are better managed by larger firms by virtue of their ability to take advantage of economies of scale and scope.

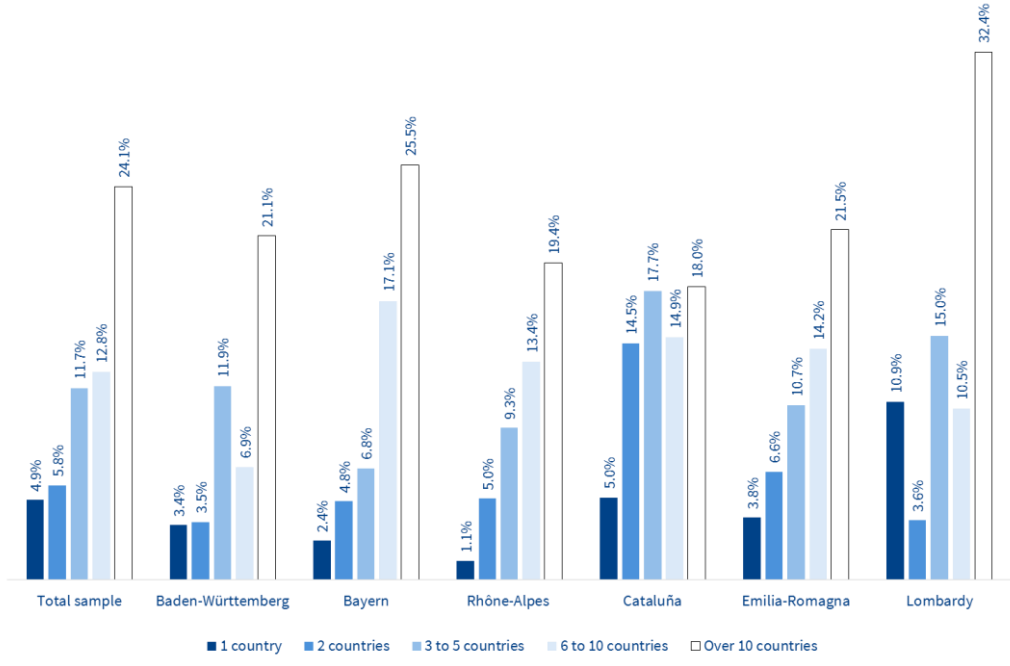
Figure 3.6 – Extensive and intensive export margin by firm size (% of total firms by number of persons employed, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

When considering exporters' geographic diversification, the regions in the sample prove their international openness. 24.1% of firms in the sample export to over 10 markets (Figure 3.7), which hints at a good level of dynamism and risk diversification – thus easing the link between earnings and the performance of commercial partners. Lombardy turns out really competitive, with 32.4% of firms that export to more than 10 markets.

Figure 3.7 – Number of markets (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Finally, in line with economic theory and previous editions of this survey, balance-sheet data relative to sample firms support the claim that systematic exporters are more competitive compared to internationally inactive or occasional exporters (Table 3.1).

Table 3.1 – Turnover: exporters versus non-exporters (2015)

	Average turnover of a systematic exporter (thousand euro)		Average turnover of an internationally inactive firm or occasional exporter (thousand euro)	
	2013	2015	2013	2015
Total sample	10,528.33	10,970.74	3,571.19	6,557.94
Lombardy	8,934.77	13,119.68	3,422.19	7,767.74

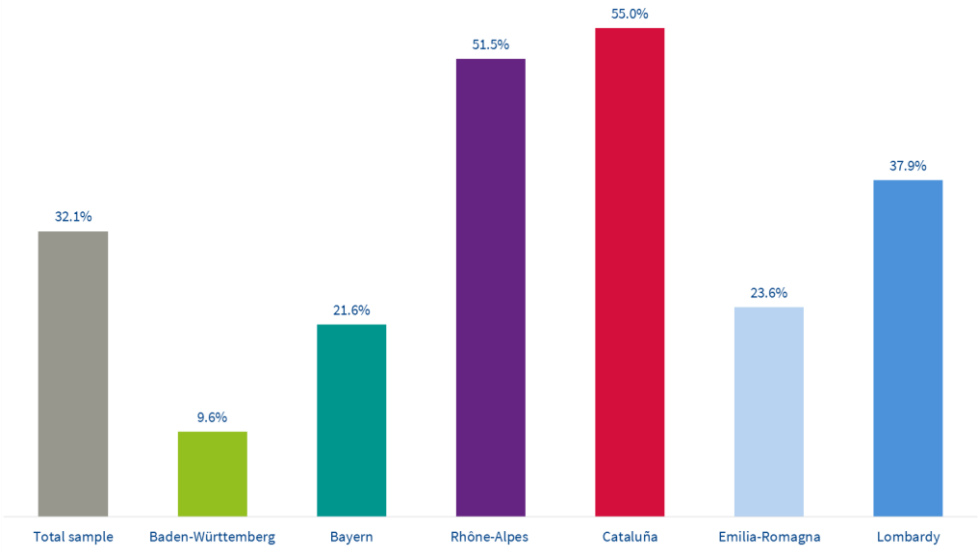
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza and Orbis – Bureau Van Dijk

Based on the data presented, it can be stated that Lombardy has proven to be a dynamic region, able to enlarge its product-destination combination and at the same time preserve the value of its exports. Indeed, compared to 2013, both the extensive and intensive margin increased.

Lombardy's international openness is further corroborated when considering imports. Around 30% of firms in the sample buy goods and intermediate inputs on foreign markets, for 9% of their turnover (Figure 3.8 and Figure 3.9). In Lombardy the share of importers rises to 38%, for an average expenditure of 10% of turnover.
Germany provides interesting results. First, both regions in the sample have a lower share of importers by at least 10 p.p. than the sample average, the same gap recorded in the previous edition. It is hence upheld the hypothesis previously put forward of a larger presence in Germany of vertically integrated industries and domestic value chains, likely due to the strong delocalization of production stages and production plants from Western to Eastern Länder starting from the first half of the '90s.[37]
Second, as in the previous edition the two regions differ as to the relationship between extensive and intensive margin.[38] In Baden-Württemberg, to a relatively low extensive margin (9.6%) corresponds the greatest intensive margin within sample (14.1%). In Bayern instead, to a larger share of importers (21.6%) corresponds a share of imports relative to total turnover lower than the sample average (6.0%). The production specialization is however similar. Indeed both regions boast two particularly performing industries, automotive and aerospace,[39] that increasingly import from Central and Eastern European countries high-value added, hence likely low-unit cost, components.[40] While this backs the results for Bayern, unfortunately it is not enough to explain the larger expenditure on imports in Baden-Württemberg. Based on the results presented in the chapter on innovation[41]and in line with the Regional Innovation Scoreboard,[42] it might however be assumed that Baden-Württemberg is more specialized in research, high-tech manufacturing and knowledge intensive services than Bayern, hence more markedly tends both to domestically retain value added (leading to a lower share of importers) and to import more highly-technological, thus more expensive, components.

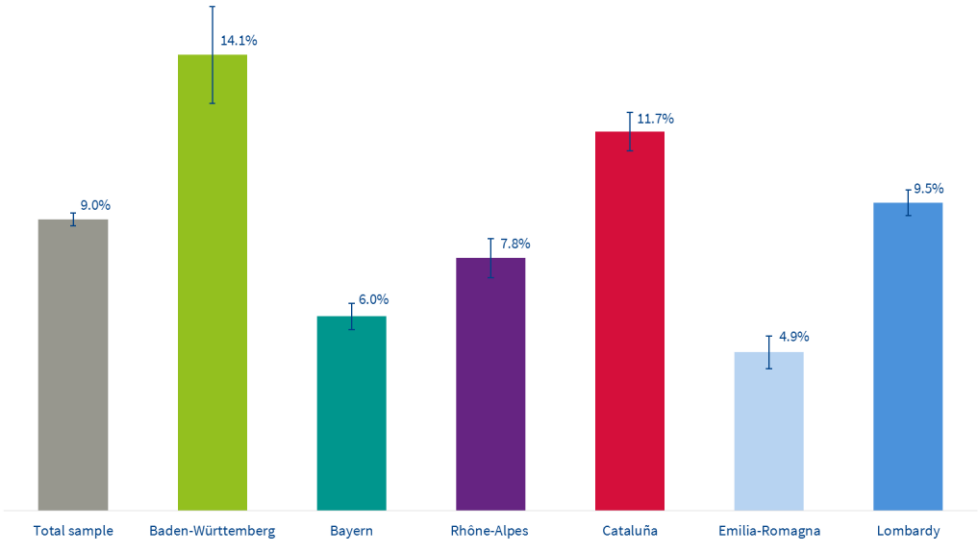
[37] *For an in-depth analysis of the German riunification see for instance J. Oliva,* Riunificazione intertedesca e politiche per la convergenza
[38] *In 2013, in Baden-Württemberg, to an extensive margin of 19.2% corresponded an intensive margin of 10.0%. Instead in Bayern to a larger share of importers (23.7%) corresponded an expenditure on imports relative to total turnover of 4.3%.*
[39] *By way of example, consider that Bayern is home to BMW, Volkswagen, Audi, Airbus; Baden-Württemberg to Daimler, Bosch, Porsche.*
[40] *« […] vehicle manufacturing and mechanical engineering sectors, on the other hand, source a rising amount of added value from Central and Eastern European countries. […]. However, at 3.6% of export value, Central and Eastern European countries still account for a very small share of value added» (R. Aichele, G. Felbermayr and I. Heiland,* Bazaar Economy Trend Remains Uninterrupted in Germany)
[41] *In line with 2013 findings, for instance in Baden-Württemberg the extensive margin for R&D is greater than in Bayern, as well as the share of firms that introduce product innovations.*
[42] *European Commission,* Regional Innovation Scoreboard 2014, *p. 64*

Figure 3.8 – Extensive import margin: firms that buy intermediate components on foreign markets (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 3.9 – Intensive import margin: average input value bought on foreign markets (% of total turnover and standard deviation, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

3.3 International outsourcing and offshoring

Firms' internationalization strategies differ according to the underlying motivation.[43] Two in particular are considered in this survey: international outsourcing, by which production stages are contracted to local companies; offshoring, i.e. when production is located to foreign countries. Not for all firms competitive enough to export offshoring and international outsourcing are viable options. As a matter of fact, there is a tradeoff between exporting and producing abroad due to, on the one hand, higher fixed costs when replicating abroad domestic production plants – hence giving up economies of scale – and, on the other hand, the advantage of not paying export variable costs such as transports and tariffs (*proximity-concentration tradeoff*).[44] Consequently, the best firms are those large and structured enough to stand the costs linked to the international relocation or outsourcing of all or some production stages.

When it comes to production, firms are not as internationally active as in terms of trade. Only 5.6% of firms in the sample internationally outsources their production and only 5.1% relocate abroad (Figure 3.10).[45] Consider Rhône-Alpes especially, where offshoring involves 10.2% of firms – a result likely owing to the larger spread of groups that distinguished the region also in the previous edition[46] (see chapter 4).

Figure 3.10 – Firms that internationally relocate or outsource all or some production stages (% of total firms, 2015)

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[43] *J. Dunning (The eclectic paradigm as an envelope for economic and business theories of MNE activity, pp. 164-65) considers in particular 4 not-mutually-exclusive motivations: 1) locating production (horizontal FDI) or downstream phases of the value chain (logistics, distribution, customer service) abroad to avoid tariffs, lower transport costs and better satisfy foreign demand (market seeking); 2) purchasing raw materials and other resources only available abroad (resource seeking); 3) locating production stages abroad to take advantage of lower production costs (vertical or efficiency seeking FDI); 4) acquiring patents, technologies and know-how or other advantages linked to owning a foreign company, typically via M&A (strategic asset seeking).*

[44] *R. Cristadoro and S. Federico,* op. cit., *p. 10*

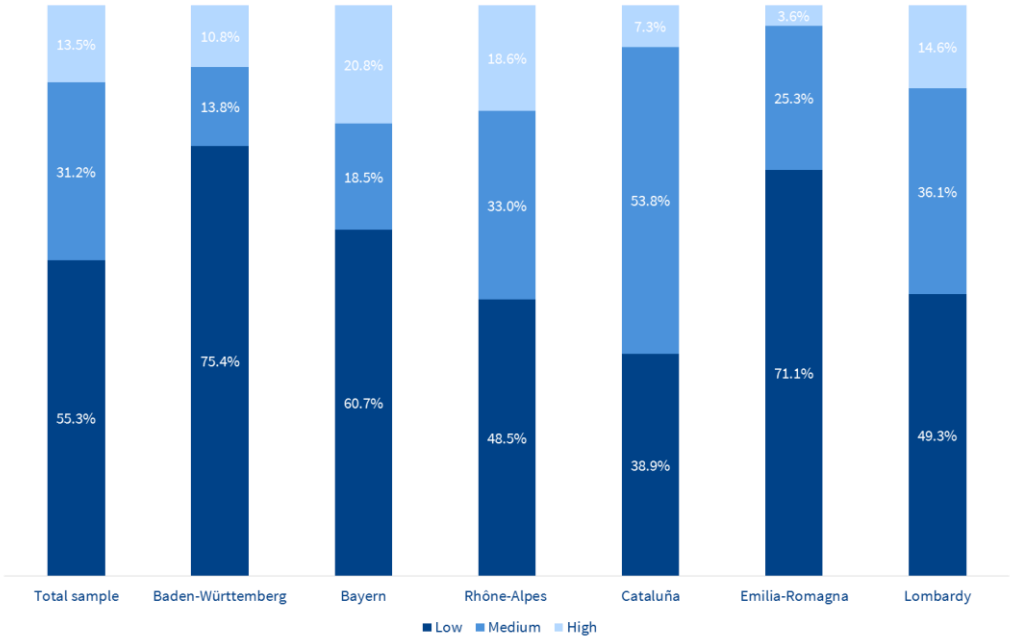
[45] *The share of firms that offshore their production includes both firms that produce through foreign affiliated or controlled companies and firms that have a minority share in foreign companies or are involved in joint ventures.*

[46] *In Rhône-Alpes in 2013 the share of firms directly producing abroad was 11.8%, compared to a share of firms belonging to a group equal to 37.3% - two values both above the sample average.*

3.4 Global Value Chains

The complexity of the international strategies pursued (from export to offshoring) and their combination earn a firm its international status. In other words, they reflect on the level of participation in Global Value Chains (GVC).[47]
Three levels of participation in GVCs are here defined: (1) low, when the firm either imports or exports; (2) medium, when the firm both imports and exports; (3) high, when the firm either imports or exports and at the same time internationally outsources or offshores.
There are some differences across regions as to the level of participation in GVCs (Figure 3.11). The number of firms at low GVC participation is definitely higher in German regions, consistently with the high degree of domestic integration mentioned in paragraph 3.3, and in Emilia-Romagna. At the same time, the number of firms at high GVC participation is not negligible either. In particular, Bayern is top performer (20.8%), followed by Rhône-Alpes (18.6%) and Lombardy (14.6%), while in Baden-Württemberg the share anyway is 10.8%.
To be highlighted is Lombardy's quality shift compared to 2013, when firms at low GVC participation were 71.1%, firms at high participation 5.9% - an impressive improvement, especially considering that elsewhere in the sample an equal trend is not registered.

Figure 3.11 – Participation in GVCs (% of total internationally active firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

It being understood that exports are key to development and growth given the current state of the economy, the data – consistent across surveys – convey that the higher the participation in GVCs, the larger the firm size and the higher labor productivity are (Table 3.2).

[47] *GVCs, due to globalization-driven unbundling of production, have shifted firm competition and competitiveness from sectors to production stages. The positioning within GVCs determines the added value from internationalization and, from a macroeconomic point of view, the distinction between factory economies (specialized in low value added activities) and headquarters. See for instance R. Baldwin,* Trade and Industrialisation After Globalisation's 2nd unbundling: How Building and Joining A Supply Chain Are Different and Why it Matters

Table 3.2 – Employment, value added and labor productivity by level of participation in GVCs (2013 and 2015)

2013		Level of participation in GVCs			
		None	Low	Medium	High
Persons employed	Mean	26	32	51	151
	Median	18	21	21	35
Labor productivity (thousand euro per person employed)	Mean	52.63	58.70	62.14	66.02
	Median	45.79	49.07	51.54	55.78

2015		Level of participation in GVCs			
		None	Low	Medium	High
Persons employed	Mean	28	41	42	93
	Median	19	20	20	34
Labor productivity (thousand euro per person employed)	Mean	48.80	59.21	59.68	71.11
	Median	45.41	53.92	59.66	57.69

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza and Orbis – Bureau van Dijk

The relationship between GVC participation and productivity is further analyzed in Box 4, comparing 2013 and 2015.

Box 4 – The relationship between GVCs and growth

From the participation to GVCs stems a productivity premium, which increases as the involvement in GVCs grows deeper.
Below are reported the results of the regression analyses on the three levels of GVC participation defined in the chapter – *GVC low*, *GVC medium* and *GVC high* – controlling for regional, size and industry fixed effects, but also for innovative capacity (*R&D*, *Functional innovation*[48], *Relational innovation*[49]) and management (*Bonus* and *Decentralization*).
Compared to 2013, this edition purports that the higher the participation in GVCs, the higher the productivity premium; premium that in 2015 turns out higher (and significant at 1% confidence level) for firms at high GVC participation.

Table 3.3 – Low GVC participation, innovation and management (2013 and 2015)

Variables (year 2013)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC low	0.241 ***	0.244 ***	0.256 ***
	0.070	*0.071*	*0.070*
R&D		-0.011	-0.049
		0.075	*0.075*
Bonus		0.068	0.062
		0.084	*0.082*
Decentralization		-0.016	-0.018
		0.090	*0.089*
Functional innovation			0.098
			0.081
Relational innovation			0.023 ***
			0.082
Observations	353	353	353

[48] Functional innovation *equals 1 when the firm has introduced new job management or new purchase management modalities.*
[49] Relational innovation *equals 1 when the firm has introduced new practices in managing its relationship with other firms or in the commercialization and distribution of goods and services.*

Variables (year 2015)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC low	0.264 ***	0.237 ***	0.248 ***
	0.062	*0.064*	*0.064*
R&D		0.106 *	0.146 **
		0.062	*0.066*
Bonus		0.008	0.031
		0.063	*0.064*
Decentralization		0.039	0.052
		0.081	*0.081*
Functional innovation			0.015
			0.059
Relational innovation			-0.128 **
			0.064
Observations	291	291	291

Note: Each table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 3.4 – Medium GVC participation, innovation and management (2013 and 2015)

Variables (year 2013)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC medium	0.332 ***	0.302 ***	0.305 ***
	0.073	*0.077*	*0.076*
R&D		0.079	0.054
		0.074	*0.075*
Bonus		0.106	0.093
		0.075	*0.075*
Decentralization		-0.023	-0.037
		0.081	*0.082*
Functional innovation			-0.011
			0.081
Relational innovation			0.148 *
			0.081
Observations	295	295	295

Variables (year 2015)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC medium	0.282 ***	0.253 ***	0.260 ***
	0.069	*0.075*	*0.075*
R&D		0.004	0.027
		0.072	*0.073*
Bonus		0.214 ***	0.220 ***
		0.070	*0.070*
Decentralization		0.049	0.057
		0.085	*0.085*
Functional innovation			-0.096
			0.067
Relational innovation			-0.058
			0.069
Observations	232	232	232

Note: Each table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 3.5 – High GVC participation, innovation and management (2013 and 2015)

Variables (year 2013)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC high	0.389 ***	0.377 ***	0.316 ***
	0.125	*0.140*	*0.140*
R&D		-0.010	-0.049
		0.104	*0.103*
Bonus		0.051	0.027
		0.102	*0.102*
Decentralization		-0.041	-0.079
		0.108	*0.108*
Functional innovation			0.118
			0.107
Relational innovation			0.198 *
			0.102
Observations	179	179	179

Variables (year 2015)	*Reg1*	*Reg2*	*Reg3*
	Labor productivity (log)	**Labor productivity (log)**	**Labor productivity (log)**
GVC high	0.483 ***	0.534 ***	0.615 ***
	0.108	*0.116*	*0.119*
R&D		-0.071	0.053
		0.114	*0.124*
Bonus		-0.048	-0.004
		0.108	*0.108*
Decentralization		-0.227	-0.222
		0.138	*0.137*
Functional innovation			-0.053
			0.105
Relational innovation			-0.283
			0.118
Observations	133	133	133

Note: Each table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

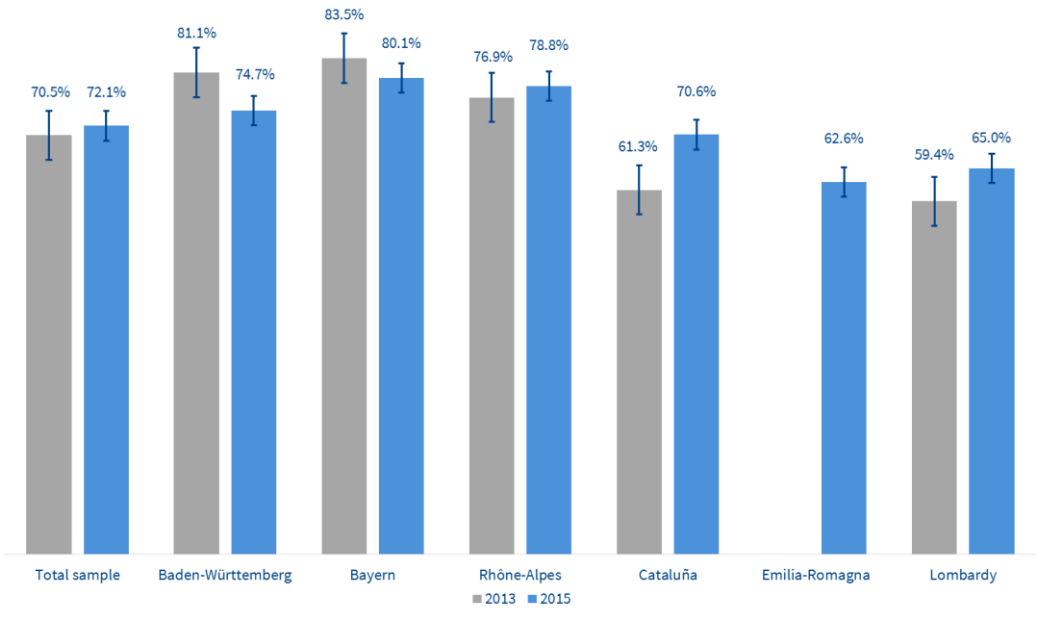
4. Management and structure

Around two thirds of family-owned businesses in Lombardy are also family-run. At the same time, the level of decentralization and the spread of performance-based remuneration policies is below the European average. Nevertheless, Lombardy is taking the right steps forward, so much so that there is no more the systematic difference recorded in 2013 with respect to Baden-Württemberg as to the probability to find family-run, decentralized management or paying-bonuses firms.

4.1 Ownership and management

Economic performance depends on the strategies adopted, such as internationalization and innovation. In turn though, those depend on firm structure and characteristics. A highly concentrated ownership is distinctive of European firms. The majority shareholder on average holds a share slightly above 70% (Figure 4.1), ranging from relatively high values in Germany (Baden-Württemberg 74.7%; Bayern 80.1%) and in Rhône-Alpes (78.8%), to relatively low ones in Italy (Emilia-Romagna 62.6%; Lombardy 65%). The standard deviation is not particularly high (± 1.1% the sample average), nor there are great differences across regions, consistently with 2013 findings.

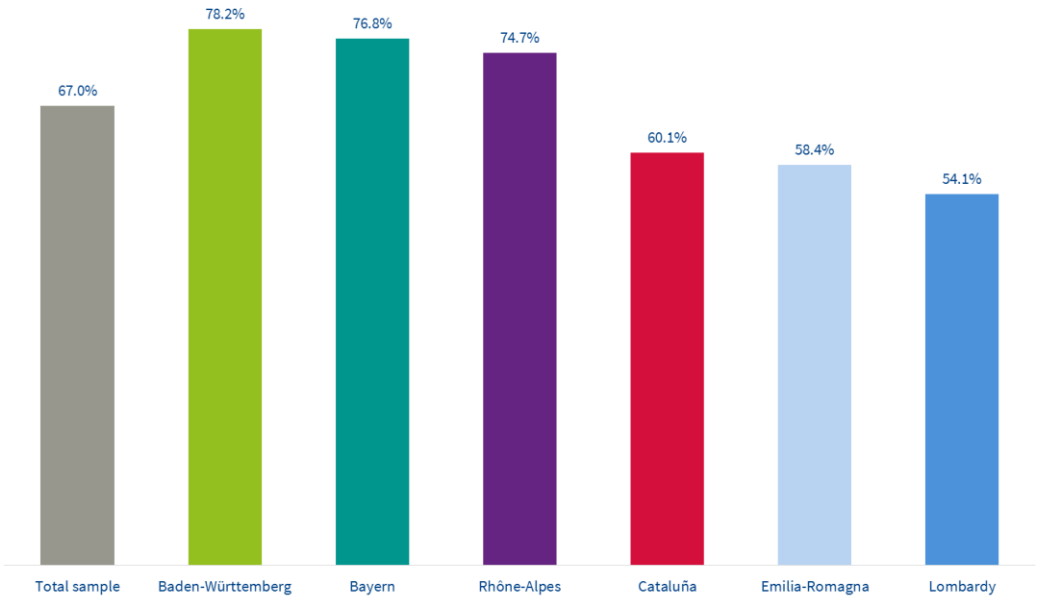
Figure 4.1 – Average share hold by the majority shareholder (% of total capital and standard deviation, 2013 and 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Besides, low is the degree of separation between ownership and control. Firms where the majority shareholder is also absolute, i.e. holds more than half the capital and, subsequently, has direct control over the firm, amount to 67% of the total sample, peaking at 77% in German regions and dropping to 56% in Italian regions (Figure 4.2).[50]

Figure 4.2 – Firms where the majority shareholder holds more than 50% of the capital (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Emilia-Romagna and Lombardy turn out to be the regions with the lowest degree of ownership concentration, closely followed by Cataluña. This result might be due to the larger fragmentation which characterizes production and entrepreneurship in Italy and Spain. After all, there is no empiric evidence of a specific link between firm size and average share of capital hold by the majority shareholder (Table 4.1). Although usually a higher level of capital openness is typical of more sophisticated corporate structures, which are more common to larger firms, it is nonetheless true that a larger firm size is more likely to belong to a group, in which the holding often owns 100% of corporate capital.[51]

Table 4.1 – Average share hold by the majority shareholder by firm size (% of total capital, 2015)

	Firm size		
	10-49	**50-249**	**>250**
Baden-Württemberg	80.8%	57.1%	64.7%
Bayern	82.8%	66.9%	75.3%
Rhône-Alpes	77.5%	84.1%	100.0%
Cataluña	71.0%	67.9%	71.2%
Emilia-Romagna	60.8%	80.9%	54.6%
Lombardy	65.7%	59.1%	67.6%
Total sample	73.1%	66.9%	69.6%

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[50] *This figure is essentially stable with respect to 2013: 64.0% the sample average, around 76% in German regions and Rhône-Alpes, 53% in Lombardy.*
[51] *See paragraph 4.3*

Besides the distribution of property across a large or limited number of shareholders, the type of owner also plays a key role in the control over a firm. An ownership concentrated in the hands of one or more individuals might indeed be matched by a stricter control over the firm. The survey findings, substantially unchanged from 2013, highlight that ownership in Europe is not anonymous (Table 4.2). In more than 80% of cases, the majority shareholder is an individual. Other manufacturing firms and holdings follow (16.1%), together with banks and other financial investors not belonging to a group (4.7%), while public entities play only a marginal role (0.2%). In Rhône-Alpes, where ownership in the hands of individuals is most common anyway (59%) in line with the other regions, network structures are widespread (40.6% of firms are owned by other manufacturing firms or holding).

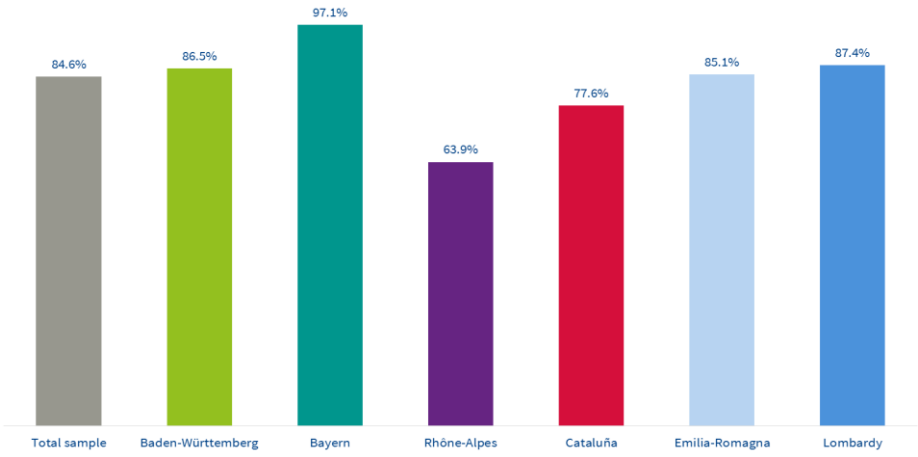
Table 4.2 – Type of majority shareholder (% of total firms, 2015)

	Individual(s)	Other manufacturing firm / Holding	Banks / Other non-group investors	Public entities
Baden-Württemberg	88.4%	10.2%	0.7%	0.8%
Bayern	89.6%	9.9%	0.1%	0.3%
Rhône-Alpes	59.0%	40.6%	0.4%	0.0%
Cataluña	79.6%	16.5%	3.9%	0.0%
Emilia-Romagna	85.3%	12.7%	1.9%	0.0%
Lombardy	81.8%	12.8%	1.1%	0.0%
Total sample	81.5%	16.1%	4.7%	0.2%

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

The peculiarity of Rhône-Alpes also concerns family-owned businesses,[52] which cover a share of less than 65% compared to a sample average of 84.6% (Figure 4.3).The result confirms findings for 2013, when family-owned businesses in the French region were 56.0%, once again the lowest in the sample, for which the average was 80.5%. It is interesting to note that, as also found in 2013, individual- or family-owned businesses are widespread across all regions and not typical of Lombardy and Emilia-Romagna, as the fragmentation of production in Italy would perhaps lead to assume.

Figure 4.3 – Family-owned businesses (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[52] *Family-owned are all firms that are directly or indirectly controlled by an individual or a family. Indirect control stands for forms of control different from ownership, linked to contracts (voting rights, shareholder agreements) or even informal agreements, such as kinship and trust.*

Everywhere in the sample, more than 80% of family-owned firms nominates as CEO the owner or a member of the owner family (Table 4.3). In Emilia-Romagna almost all firms make such choice, while in Lombardy the share is 86.4%, lower than in Baden-Württemberg and Rhône-Alpes.

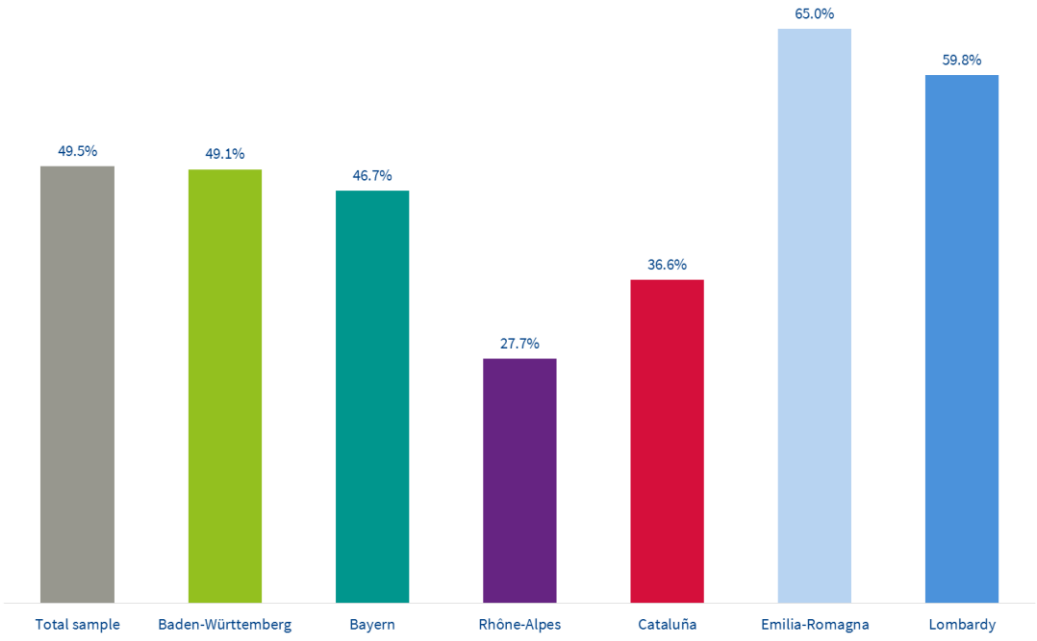
Table 4.3 – CEO in family-owned businesses by type (% of total family-owned firms, 2015)

	Owner / Controlling individual/family	Manager from outside the firm	Internally-selected manager	Other
Baden-Württemberg	94.9%	1.3%	3.7%	0.0%
Bayern	84.4%	8.9%	6.2%	0.5%
Rhône-Alpes	90.5%	4.0%	4.4%	1.2%
Cataluña	83.4%	3.8%	11.3%	1.5%
Emilia-Romagna	99.2%	0.0%	0.0%	0.8%
Lombardy	86.4%	3.0%	2.2%	8.4%
Total sample	89.0%	4.0%	4.4%	2.6%

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

The Italian model of capitalism reveals its peculiarity when a distinction is made between family-ownership and family-management (Figure 4.4). On average, around two thirds of family-owned businesses in Lombardy and Emilia-Romagna count among their management only members of the owner or controlling family, versus a sample average of 49.5%. The opposite happens in Rhône-Alpes (27.7%), where firms are relatively more open, and Cataluña (36.6%). Nevertheless, similarly to Cataluña that goes back to a more managerial structure after rising to 41.3% in 2013, also Lombardy seems to be moving along a virtuous path (59.8% compared to 63% in 2013).

Figure 4.4 – Family-owned firms managed by members of the owner or controlling family only (% of total family-owned firms, 2015)

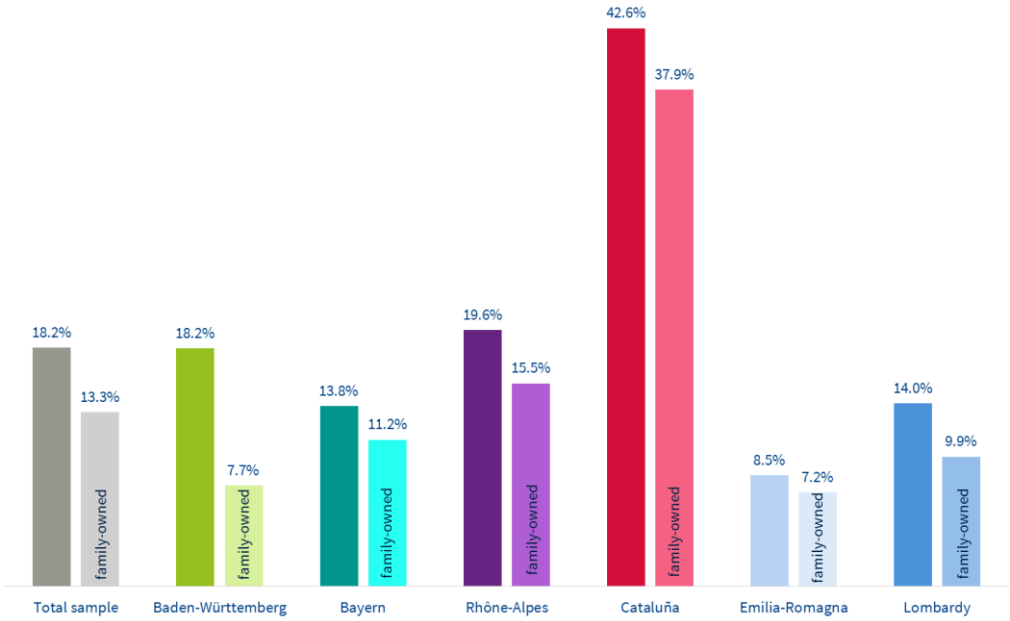


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

4.2 Corporate structure

An ownership structure centered on the entrepreneur influences the corporate model adopted. On average, in the European regions considered the management decides autonomously relative to some business areas in 18.2% of cases (Figure 4.5). Management decides less autonomously in family-controlled firms, only 13.3% of which adopt a decentralized management model.

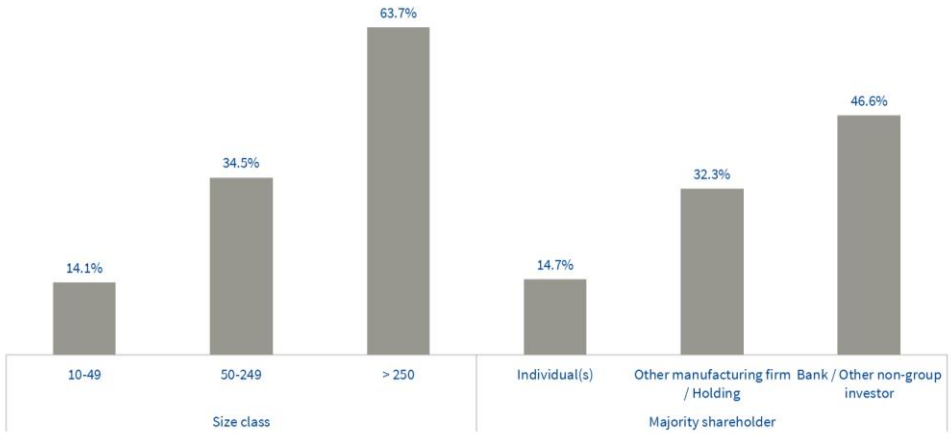
Figure 4.5 – Decentralized management (% of total firms and % of total family-owned firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Decentralization seemingly depends on firm size and the type of majority shareholder (Figure 4.6). When a business is large and complex, delegating is necessary to efficiency. The share of firms in which management is autonomous increases from 14.1% in the case of small firms to 63.7% in the case of firms employing more than 250 persons, a gap that widened through time (20.7% and 43.4% respectively the figures for 2013). For what concerns the type of majority shareholder, in the case of individuals the share of decentralized firms (14.7%) is around half the one registered when firms are controlled by another manufacturing firm or holding (32.2%), and a third of the share of firms controlled by a bank or other non-group investors, such as private equity investors (46.6%).

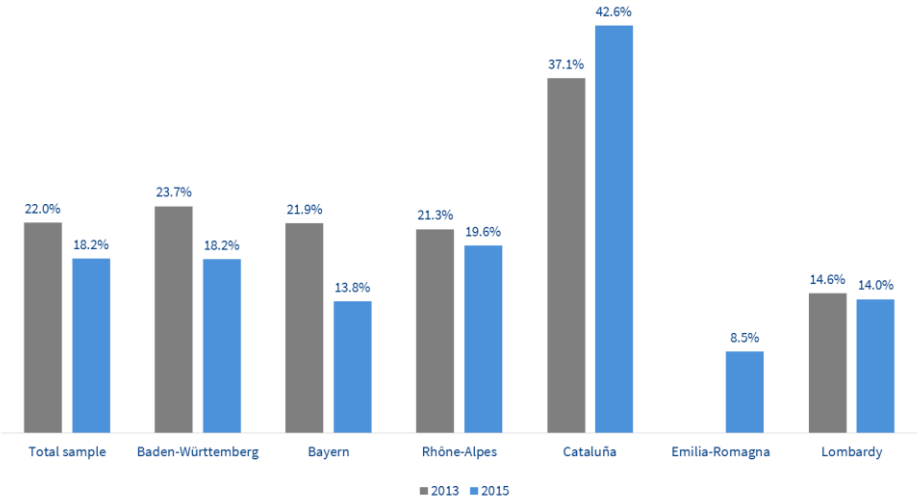
Figure 4.6 – Decentralized management by firm size and type of majority shareholder (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

When comparing regions over time, interesting dynamics come up (Figure 4.7). Except from Cataluña (42.6%), centralized management is the dominant model, whereby most decisions are the hands of the CEO or, more in general, the head of the firm. In Emilia-Romagna only 8.5% of firms have decentralized management. Lombardy is essentially stable at 14%, Rhône-Alpes at 20%. Both German regions show instead a relevant decrease in the share of decentralized firms compared to 2013 (from 21.9% to 13.8% in Bayern, from 23.7% to 18.2% in Baden-Württemberg).

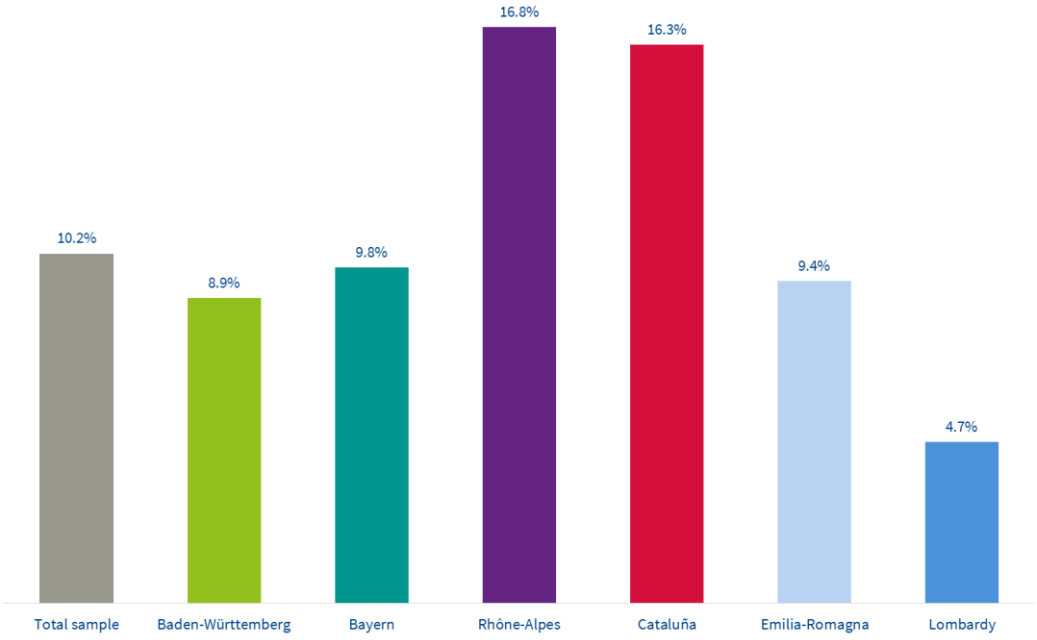
Figure 4.7 – Decentralized management (% of total firms, 2013 and 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

In order to get the fuller picture, firms were explicitly asked whether and how their level of decentralization had changed through time (Figure 4.8). In Cataluña and Rhône-Alpes around 16% of firms claim their management is more autonomous, a share above the sample average by as much as 6 p.p.. Manufacturing firms in Lombardy come across as the least keen to decentralize: fewer than 5% of firms claim their management decides more autonomously on strategic matters.

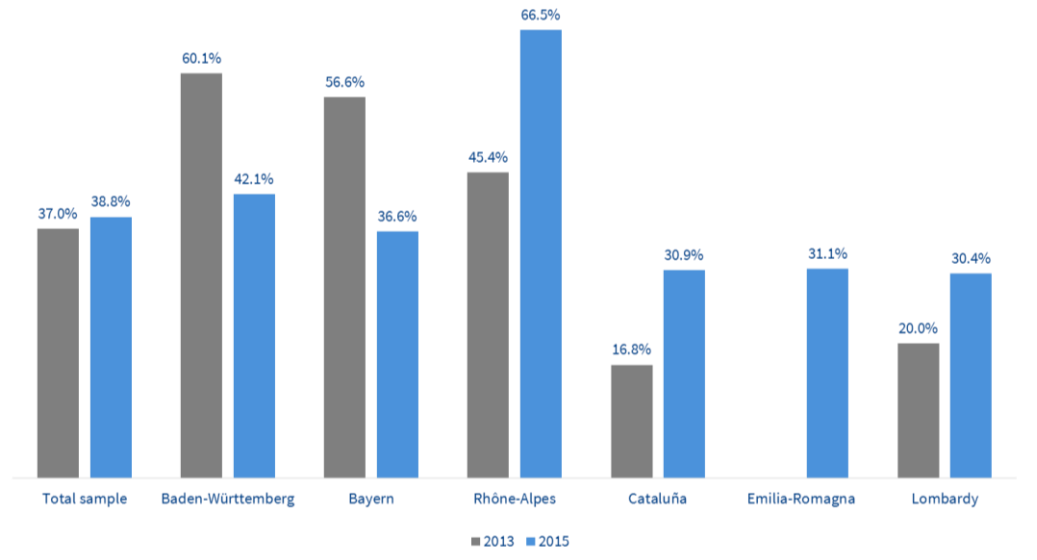
Figure 4.8 – Increase in the level of decentralization on strategic decisions compared to the past (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Yet in Lombardy firms implementing performance-based remuneration policies have substantially increased in share (from 20% in 2013 to 30% in 2015), hence getting closer to the sample average (40%) (Figure 4.9).

Figure 4.9 – Firms adopting performance-based remuneration policies: 2013 and 2015 compared (% of total firms, 2013 and 2015)

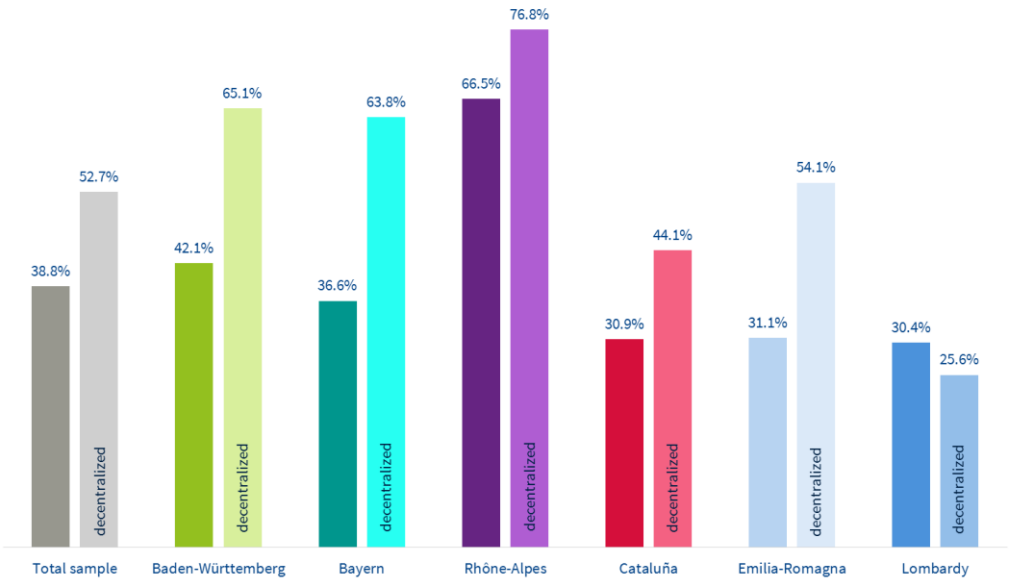


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Unlike in Cataluña and Rhône-Alpes, firms in Lombardy still do not combine performance-based remuneration policies with decentralized management, as shown in Figure 4.10. On average in the sample there is a link between decentralization and performance-based remuneration policies (52.7% of decentralized-management firms pay bonuses, compared to 38.8% when considering all firms). In Lombardy instead there is almost no difference

between the total sample and the sub-sample of decentralized firms. Yet change is happening. Indeed, Lombardy seems on the right path towards managerial corporate structures, as shown in Box 5.

Figure 4.10 – Firms adopting performance-based remuneration policies (% of total firms and % of total decentralized firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Box 5 – Organizational structures: do institutions matter?

While there are basically no differences from the point of view of ownership and control structures (all regions having in common a widespread presence of individual owners compared to other entities), there are more specificies when it comes to the organizational model and remuneration policies adopted. Such differences might depend on firm size, or other institutional factors. In order to verify the existence of a link between organizational choices and firm size, as well as the significance of a regional fixed effect, family-run businesses – where management is 100% or 50% made up of family members – decentralized-management firms and firms paying bonuses were compared. Throughout the analysis, Baden-Württemberg is the benchmark region.

As the number of persons employed increases, family-run businesses decrease (Table 4.4), while decentralization and the use of performance-based remuneration policies become more spread (Table 4.5).

Lombardy results being on a virtuous path towards managerialization. In 2013, compared to Baden-Württemberg taken as benchmark, Lombardy turned out having significantly more family-run businesses, or more businesses where at least 50% of managers belong to the owner family. Moreover, fewer firms with decentralized management and which paid bonuses resulted in Lombardy vs. the German counterparts. In 2015 these systematic differences with respect to Baden-Württemberg are not found anymore.

Table 4.4 – Family management: 2013 and 2015 compared

Variables	*Reg1*	*Reg2*	*Reg3*	*Reg4*
	Family management 2013	**Family management 2015**	**Family management 50% 2013**	**Family management 50% 2015**
Employment (log)	-0.154 ***	-0.157 ***	-0.146 ***	-0.091 ***
	0.027	*0.026*	*0.027*	*0.026*
FE Bayern	-0.045	0.025	-0.060	-0.026
	0.066	*0.066*	*0.064*	*0.066*
FE Lombardy	0.127 **	0.095	0.120 **	0.047
	0.061	*0.067*	*0.059*	*0.066*
FE Emilia-Romagna		0.150 *		0.122
		0.078		*0.077*
FE Rhône-Alpes	-0.324 ***	-0.168 **	-0.218 ***	-0.265 ***
	0.087	*0.081*	*0.084*	*0.080*
FE Cataluña	-0.125 *	-0.104	-0.111	-0.157 **
	0.073	*0.079*	*0.071*	*0.078*
Observations	502	560	502	560

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 4.5 – Decentralized management and bonuses: 2013 and 2015 compared

Variables	*Reg1*	*Reg2*	*Reg3*	*Reg4*
	Decentralization 2013	**Decentralization 2015**	**Bonus 2013**	**Bonus 2015**
Employment (log)	0.052 ***	0.081 ***	0.085 ***	0.075 ***
	0.020	*0.017*	*0.022*	*0.022*
FE Bayern	-0.030	-0.046	-0.044	-0.078
	0.053	*0.048*	*0.058*	*0.061*
FE Lombardy	-0.103 **	0.002	-0.404 ***	-0.088
	0.048	*0.047*	*0.053*	*0.060*
FE Emilia-Romagna		-0.077		-0.086
		0.055		*0.070*
FE Rhône-Alpes	-0.017	0.016	-0.140 **	0.223 ***
	0.060	*0.053*	*0.066*	*0.067*
FE Cataluña	0.155 ***	0.256 ***	-0.403 ***	-0.124 *
	0.057	*0.054*	*0.062*	*0.069*
Observations	635	687	635	687

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Finally, it was verified in general the existence of a significant link between *Labor productivity*, *Decentralization* and *Bonus*. It has to be noted that business reorganization with a view to decentralization (Table 4.6) gains importance compared to performance-based remuneration policies (Table 4.7). Indeed in 2015 the impact of Bonus on productivity, though still positive, decreases both in magnitude and significance. Instead, the effect of Decentralization becomes highly significant and larger.

Table 4.6 – Productivity and decentralization: 2013 and 2015 compared

Variables	*Reg1*	*Reg3*
	Labor productivity 2013 (log)	**Labor productivity 2015 (log)**
Decentralization	0.063	0.152 ***
	0.062	*0.060*
Employment (log)	0.021	0.042
	0.033	*0.033*
Observations	534	501

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

Table 4.7 – Productivity and performance-based remuneration policies: 2013 and 2015 compared

Variables	*Reg1*	*Reg3*
	Labor productivity 2013 (log)	**Labor productivity 2015 (log)**
Bonus	0.189 ***	0.090 *
	0.058	*0.051*
Employment (log)	0.002	0.046
	0.033	*0.033*
Observations	534	501

Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

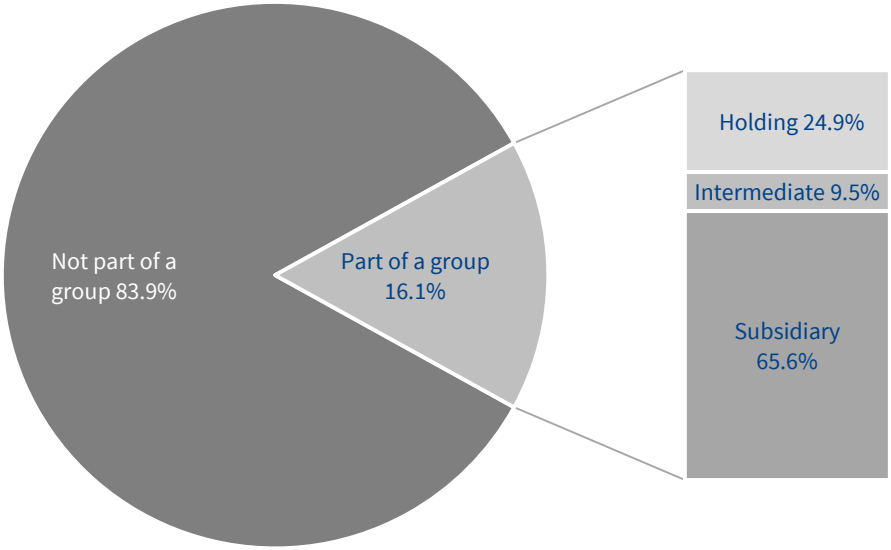
4.3 Groups and supply chains

In defining business strategies, besides the internal structure, also the way firms relate to each other matters. Relations among firms might be manifested either as formal aggregations (e.g. groups, consortiums, joint ventures, franchising, cartels) or informal ones (e.g. districts and supply chains). This survey focus on two types of aggregations, one formal – groups – and the other not – supply chains.

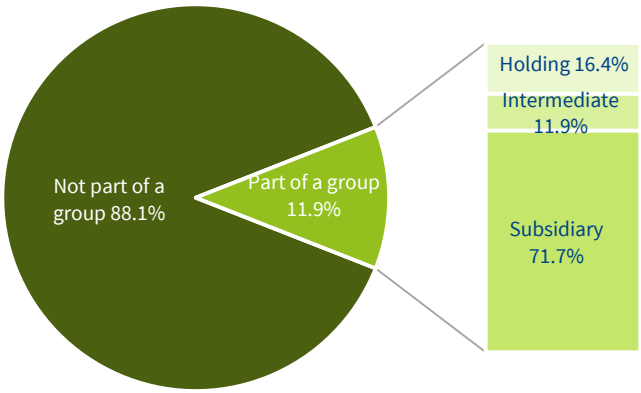
A group structure is not widespread across firms in the sample, a feature that links back to the high level of ownership concentration and the dominant role of individuals compared to other entities. On average, only 16.1% of firms in the sample belong to a group, in the majority of cases as a subsidiary (Figure 4.11). 9.5% of firms part of a group are in an intermediate position, meaning they are a subsidiary to, but at the same time control, other firms in the group, while 24.9% are the holding.

Rhône-Alpesis the exception, with 25.3% of firms belonging to a group, in 15.5% of cases an international group (Figure 4.12). Also Cataluña and Emilia-Romagna get characterized by a larger presence of groups than the average (23.4% and 19.6%), while in the German regions and Lombardy such aggregation form is less common (little above 10%).

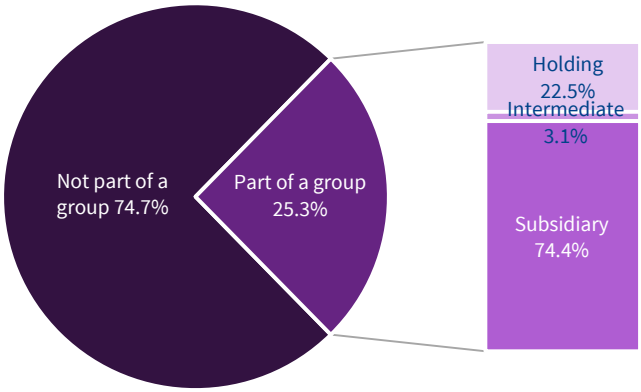
Figure 4.11 – Firms part of a group and their role (% of total firms and % of total firms part of a group, 2015)



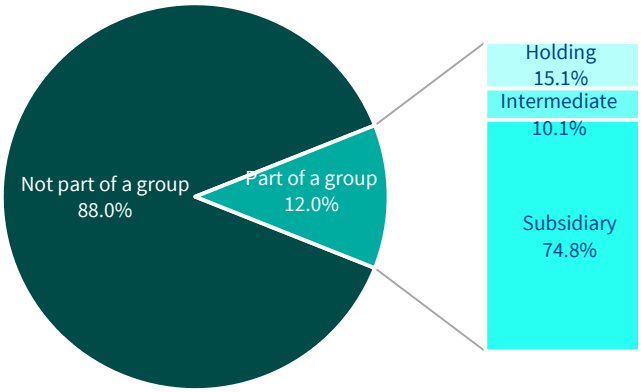
Baden-Württemberg



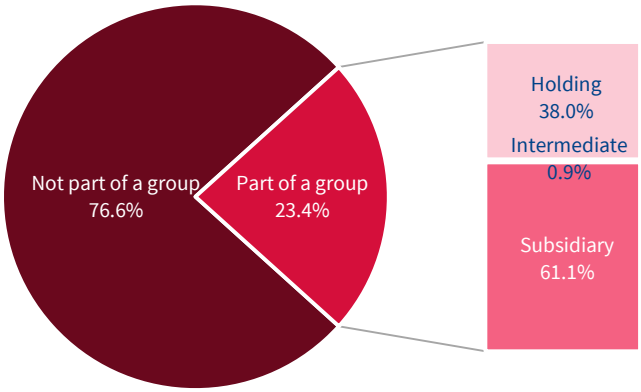
Rhône-Alpes



Bayern



Cataluña



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

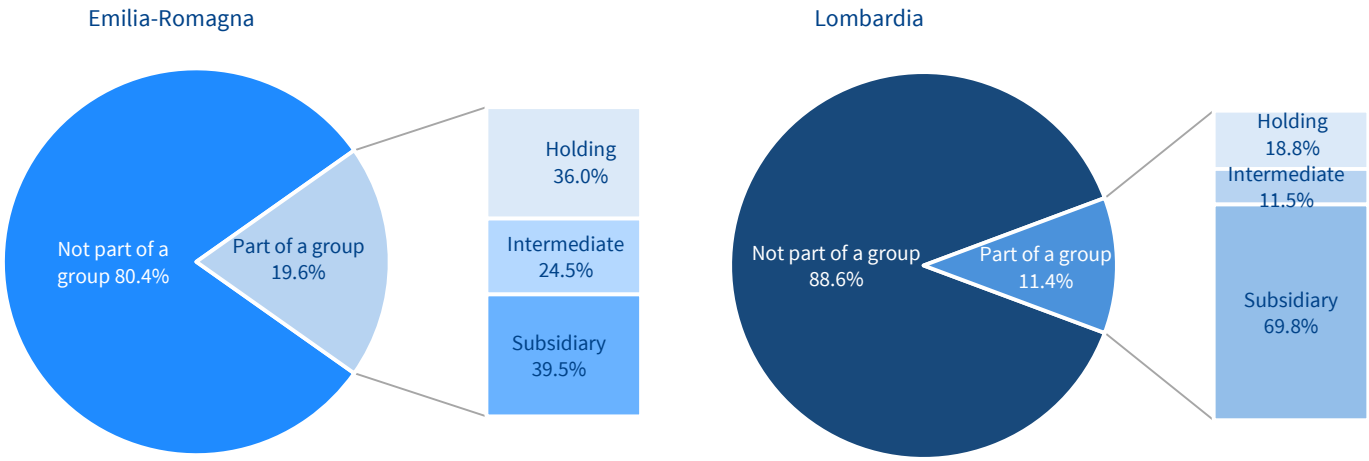
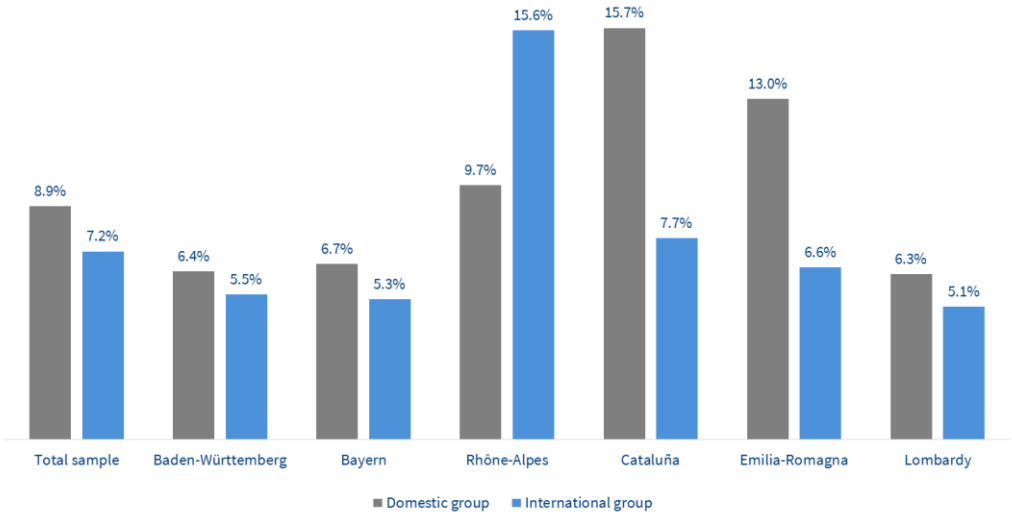


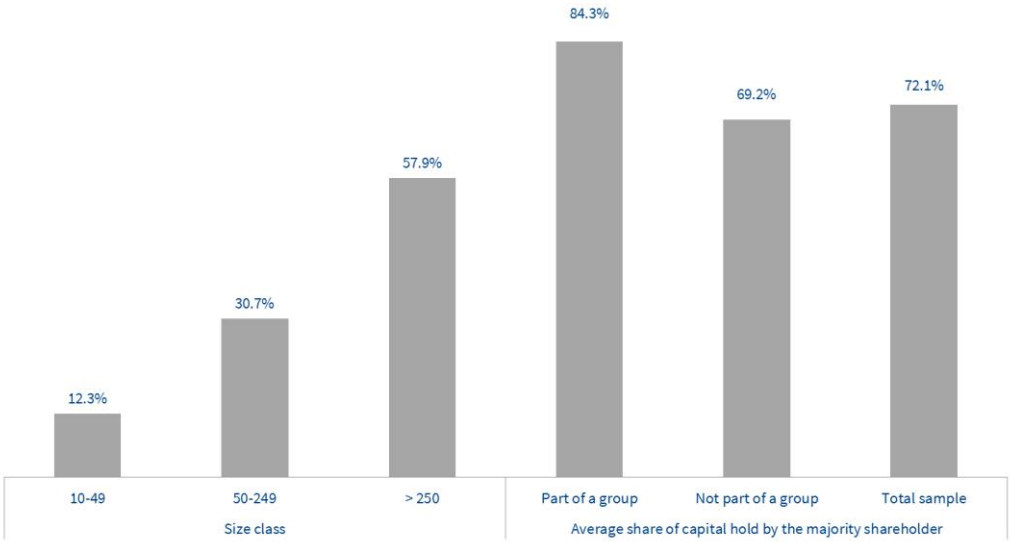
Figure 4.12 – Type of group (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Results vary significantly according to firm size (Figure 4.13). 12.3% of small firms belong to a group; vice versa, among large firms the same figure is larger than the sample average, reaching 57.9%. The link between firm size and being part of a group owes to the organizational necessities of more articulated structures and more diversified range of activities. On belonging to a group might also depend the level of control concentration: the average share of capital hold by the majority shareholder is as high as 84.3% when firms belong to a group, versus an equivalent figure of 69.2% for firms not part of a group (72.1% the sample average).

Figure 4.13 – Firms part of a group by firm size (% of total firms, 2015) and average stake hold by the majority shareholder depending on whether the firm is part of a group or not (% of total capital, 2015)



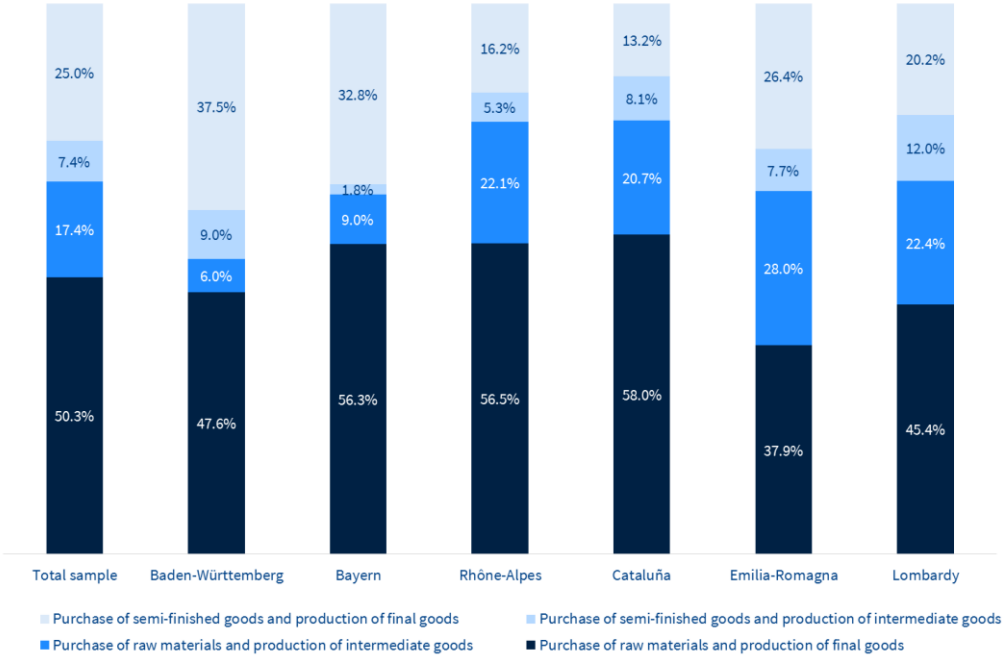
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Alongside formal business aggregations, among which groups mainly, there are other ways in which setting the relationships with other firms and that are not directly linked to a corporate structure: supply chains. A supply chain might take different connotations, each determining a different modality of firm interaction.[53]
The stage of production covered within the supply chain hence matters. In particular, one might classify production stages in (1) upstream – purchase of raw materials and production of semi-finished goods; (2) intermediate – purchase of semi-finished goods from suppliers and production of intermediate goods; (3) downstream - purchase of semi-finished goods from suppliers and production of final goods. From a strategic point of view, it is essential that firms in the upstream phases start reorganization processes that allow them to move down towards more remunerative phases – i.e. the downstream ones, at higher value added – characterized by higher entry barriers.

On average in the sample, half of the surveyed firms claims to be vertically integrated, covering all phases of the value chain, i.e. purchasing raw materials and producing final goods, while the other half is part of a supply chain (Figure 4.14).Of those, 17.4% are upstream, 7.4% intermediate, while the remaining 25% are downstream.

[53] *In particular, it is possible to distinguish among: a) modular supply chains, where suppliers of intermediate goods are largely independent and have many buyers; b) relational supply chains, where the buyer and the supplier are more closely linked and mutually dependent, as in industrial clusters; c) captive supply chains, where suppliers depend on one large buyer. At the high and low end are, respectively, the market, where price and product specificities are the only form of coordination between buyer and supplier, and the vertically-integrated hierarchic groups. (B. Cattero,* Le trasformazioni dell'impresa e i contesti socioistituzionali*)*

Figure 4.14 – Type of production (% of total firms, 2015)



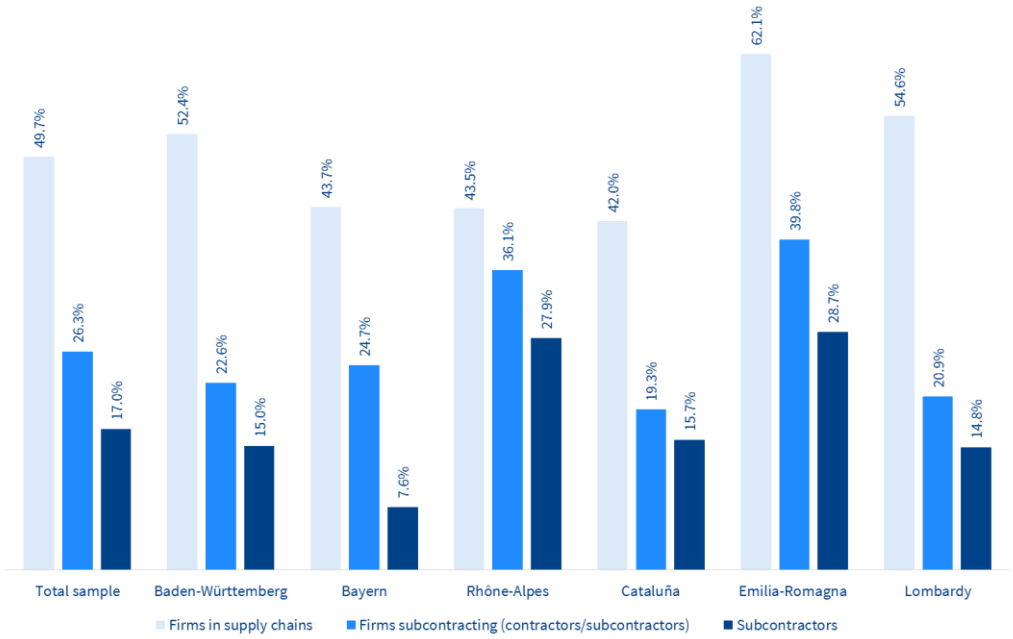
Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Italian regions stand out for their higher participation in supply chains, Emilia-Romagna especially since fewer than 40% of firms take part in a supply chain. Nevertheless, compared to their German peers, Italian firms are strong in the first processing of product, i.e. the lower value added phases, while they are relatively weaker when it comes to the final, more profitable phases. Firms in the upstream phases are indeed 25% of the total, versus 9% in Bayern and 6% in Baden-Württemberg; those in the downstream phases are around 23%, while in German they cover a share larger than 30%. In Italy then, the participation in supply chains is widespread, but likely less qualified. Rhône-Alpes and Cataluña display a very similar business structure: around 20% of firms cover the first processing phases, 6-7% the intermediate ones and around 15% the final stages.

Within the supply chain, a specific production modality is subcontracting. The latter is an agreement whereby a firm (the contractor) delegates to another firm (the subcontractor) the production of components of the final good or some production stages, under specified terms and conditions. Such agreement creates strong, sometimes even close to dependence, linkages between firms.

Figure 4.15 shows the share of firms part of a supply chain (regardless of the position covered), the share of firms having signed a subcontracting agreement (whether as subcontractor or contractor) and the share of subcontractors. On average, subcontracting is an instrument used by around half of firms in the supply chain. In particular, in Emilia-Romagna and Rhône-Alpes the share of firms that only produce under subcontracting is larger than elsewhere. The instrument appears to be less widespread in Lombardy, which is overall in line with German regions and Cataluña.

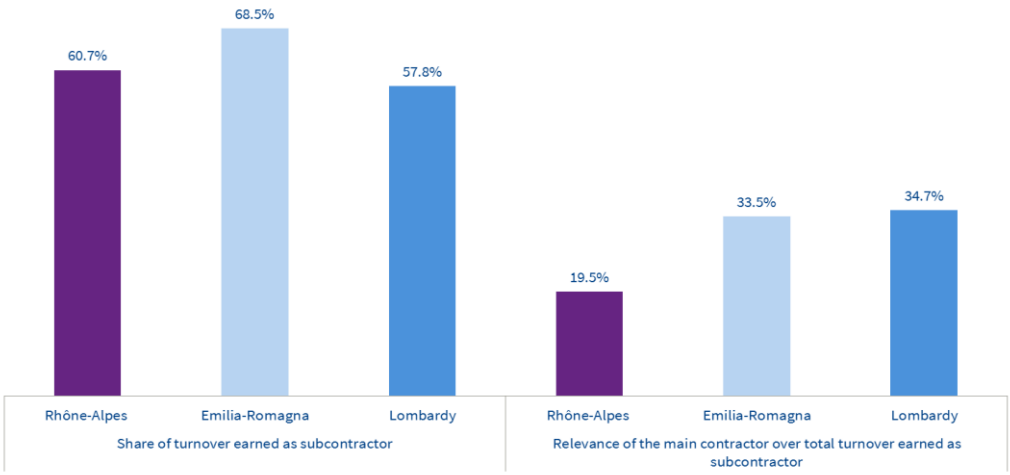
Figure 4.15 – Firms participating in supply chains (% of total firms)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Nevertheless, in terms of intensive margin, Lombardy (57.8%) proves similar to Rhône-Alpes (60.7%) and, to a lesser extent, to Emilia-Romagna (68.5%) (Figure 4.16).[54] Thus in all the three regions subcontracting is relevant in terms of firms' turnover. However, in Emilia-Romagna and Lombardy firms have less bargaining power: more than 30% of total turnover under subcontracting is imputable to the main contractor, almost twice the equivalent figure in the French region.

Figure 4.16 – Turnover earned from subcontracting (% of total turnover of firms that produce as subcontractors)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[54] *The small number of firms that produce as subcontractors in the other regions causes the average share of turnover computed not to be reliable.*

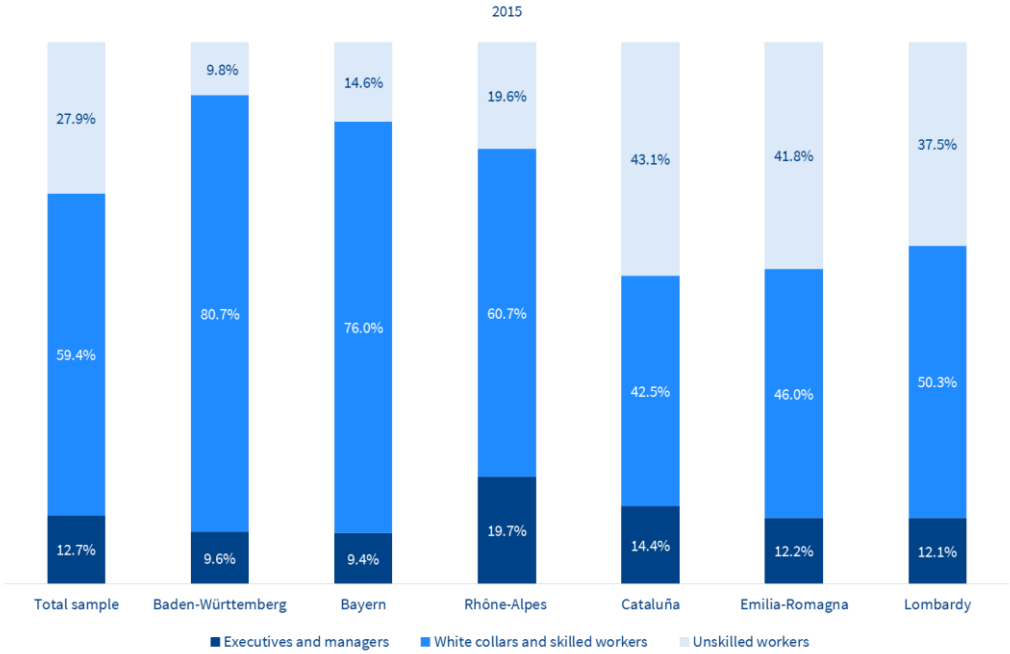
5. Workforce

As the share of graduates increases, productivity goes up by 0.5%. This relatively disadvantages Cataluña, Emilia-Romagna and Lombardy, where not only firms hire fewer white collars and skilled workers, but also fewer graduates compared to their German peers. The second edition of the survey also confirms the nuances of the relationship between unit labor costs (ULCs), innovation and international competitiveness: for innovative firms the relationship disappears between 2013 and 2015, while it is roughly unchanged for non-innovative firms.

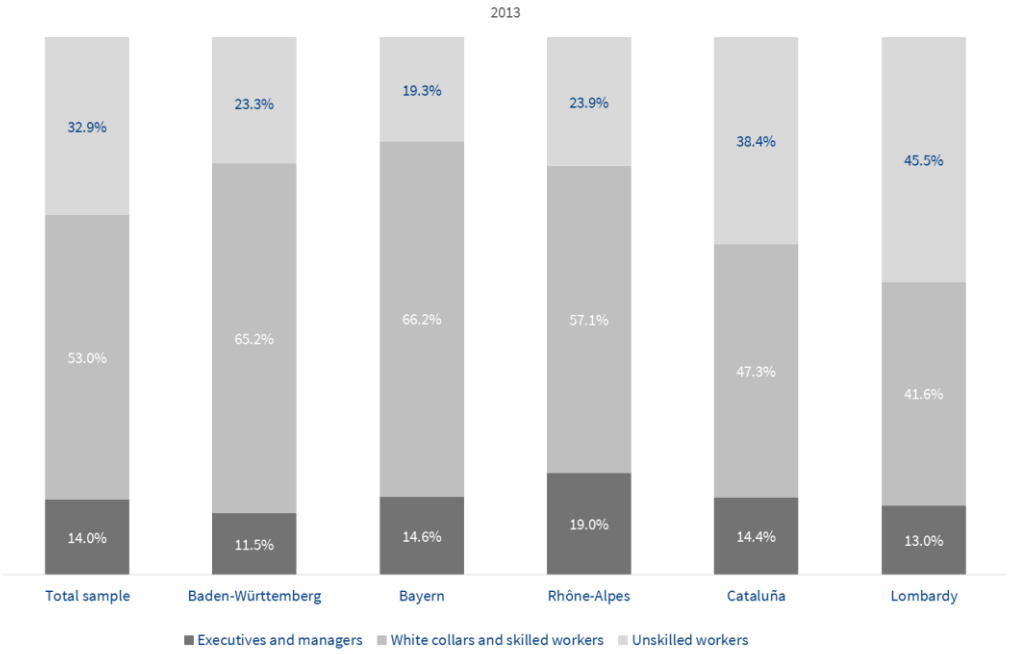
5.1 Composition of the workforce

Figure 5.1 shows the composition of firms' workforce. In the sample, executives and managers together account for 13% of employment. White collars and skilled workers[55] are instead just below 60%, while the remaining 28% is made up of unskilled workers. Compared to 2013, in Lombardy as well as in German regions the share of unskilled workers is declining.

Figure 5.1 – Composition of the workforce (%, 2015 and 2013)



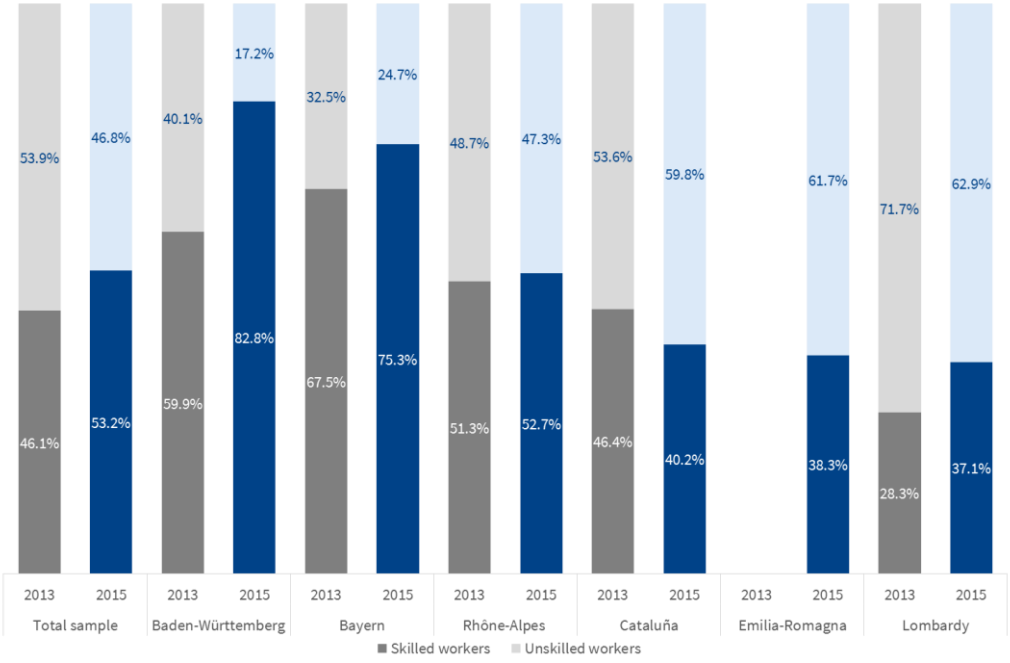
[55] *To clean the data from time-varying misperceptions as to what makes a worker "skilled", shares were computed excluding those firms that claim to have only skilled workers.*



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

In particular, it would seem that the share of skilled workers is increasing to the disadvantage of unskilled workers everywhere apart from Cataluña (Figure 5.2). Since the data are at least in part cleaned of possibly distorted perceptions of the qualification of workers,[56] it might be assumed that the trend owes to the requalification of the workforce through traning and new hires (see paragraph 5.2).

Figure 5.2 – Skilled and unskilled workers (% of total workers, 2015 and 2013)

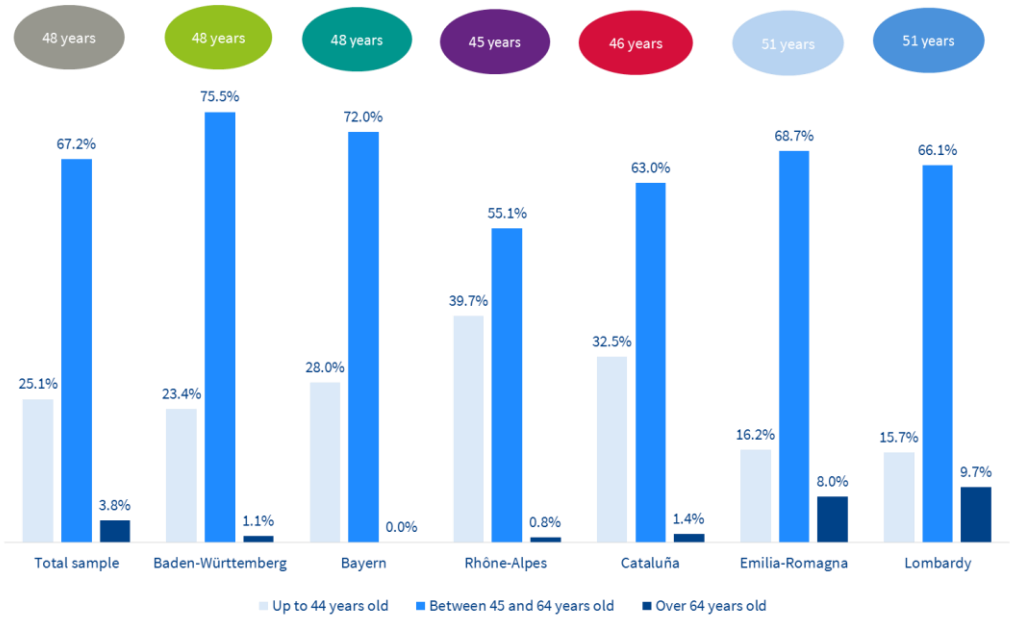


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[56] *Compare note 55.*

The average age of management was also considered (Figure 5.3) and it results having roughly staid the same since 2013. Age would seem to correlate to the ownership and control model adopted. In Rhône-Alpes, where larger is the presence of groups or majority shareholders other than individuals, management is the youngest (45 years old). In Italian regions, characterized by a management model strongly centered on the individual and a large presence of family-run businesses, on average the management is 51 years old (in 8-9% of cases even older than 64, more than the 4.9% registered for Lombardy in 2013).

Figure 5.3 – Age of management and share of firms by age of management (mean and % of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

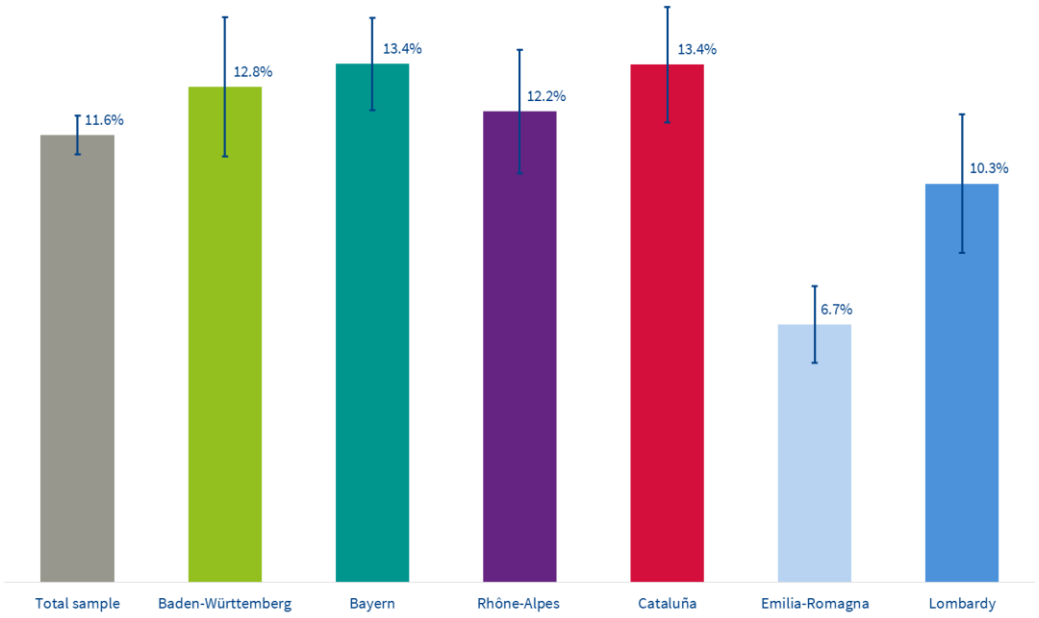
5.2 Workforce skills

Advanced economies' competitiveness shift from standardized, low value added production to diversified, highly innovative sectors and the rise of a new production paradigm centered on digitalization (see chapter 2) have brought renewed attention to the necessity to invest in human capital and training.[57]

For firms in the sample, graduates amount to 11.6% of the workforce (Figure 5.4). Interesting is the comparison with the findings on skilled workers in general shown in Figure 5.2. In the regions where the share of skilled workers is larger than the sample average (Baden-Württemberg, Bayern and Rhône-Alpes) is also higher the share of graduates. The opposite in Lombardy and Emilia-Romagna. Cataluña is an exception, as it presents the lowest share of skilled workers (42.5%), but also the largest share of graduates together with Bayern (13.4%).

[57] *In this respect, consider that for ICT professionals, the European Commission's latest forecast estimates up to 825,000 unfilled vacancies by 2020 if no decisive action is taken for training. (European Commission,* Questions and answers - Digital Single Market Strategy*)*

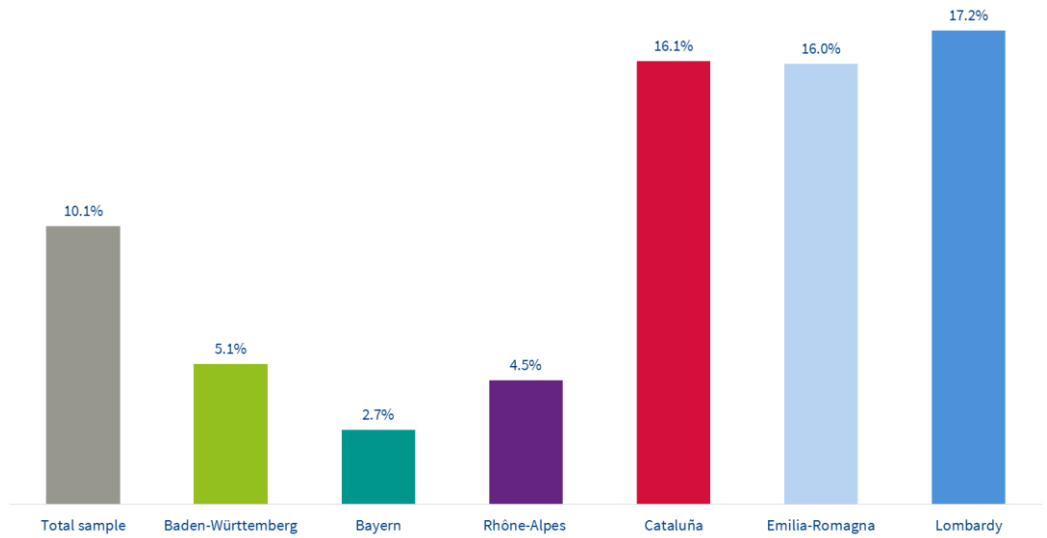
Figure 5.4 – Average share of graduates (% of total workforce and standard deviation, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Besides hiring graduates or qualified personnel, firms that aim at boosting the skills of their workforce have to arrange recurrent training (Figure 5.5). Around 10% of surveyed firms states that its entire workforce was provided training opportunities, a share that gets above 15% in Cataluña, Emilia-Romagna and Lombardy – the three regions with the lowest share of skilled workers over total workforce. Viceversa, in Baden-Württemberg (5.1%), Bayern (2.7%) and Rhône-Alpes (4.5%) the equivalent figures shrink, in line with a larger presence of skilled workers already.

Figure 5.5 – Firms where all workers took on training (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Breaking down the figure by firm size, there is evidence that while graduates tend to concentrate in larger firms (17% compared to 11.3% in small firms), training for the entire workforce is especially widespread across small firms (11.1%, almost three times the share registered for large firms).

Figure 5.6 – Graduates and training by firm size (% of total workforce and % of total firms, 2015)

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Box 6 highlights the importance of human capital for business growth.

Box 6 – The role of human capital

In order to verify whether human capital plays a role in business development and growth, it was considered how graduates and traning for the total workforce correlate with labor productivity, controlling for size, industry and regional fixed effects.

Consistently with 2013 findings, a higher share of graduates positively reflects on productivity (+0.5%). There is instead no statistically significant link between training and productivity. Hence total workforce training is arguably insufficient to fit competences and skills to what would be required to boost business performance.

Variables	*Reg*	*Reg*
	Labor productivity 2013 (log)	**Labor productivity 2015 (log)**
Graduates (%)	0.005 ***	0.005 ***
	0.002	*0.002*
Training	0.030	-0.080
	0.052	*0.052*
Observations	566	467

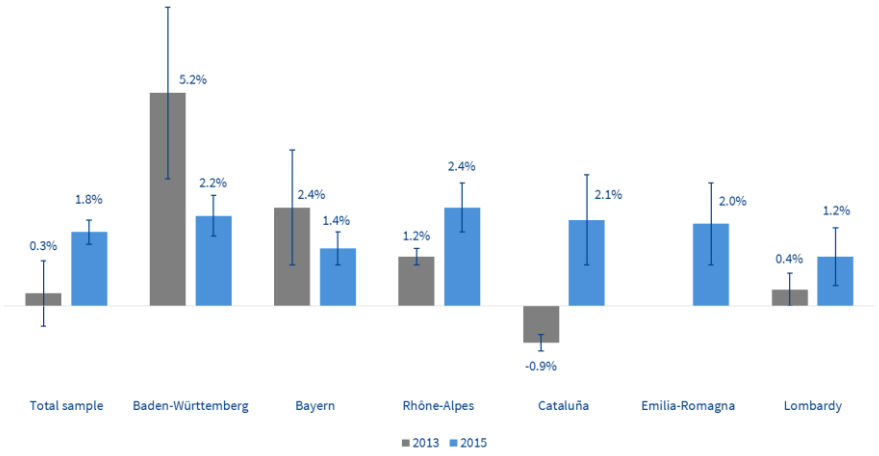
Note: The table reports the estimated coefficients and the associated standard error (in italics). The dependent variable and the empirical methodology adopted is reported on top of each column. As additional controls, regional and sector fixed effects were added (macro-sectors HT, MHT, MLT, LT).
* statistical significance at 10% confidence level
** statistical significance at 5% confidence level
*** statistical significance at 1% confidence level

5.3 Workforce trends

Trends in total hiring are a useful indicator of firm performance. As shown in Figure 5.7, in all regions the workforce increased between 2013 and 2015, from a minimum of +1.2% in Lombardy[58] to a maximum of 2.4% in Rhône-Alpes. The data positively suggest a widespread recovery across European regions, contrary to 2013 when only in Baden-Württemberg (+5.2%)and Bayern (+2.4%) the workforce was increasing, while it was roughly steady in Lombardy (+0.4%) and shrinking in Cataluña (-0,9%).

[58] *The finding is consistent with Assolombarda Confindustria Milano Monza e Brianza's calculations on Inps data, which are based on fiscal entries and measure firms' incoming and outcoming flows of workers. According to these, total hiring in Lombardy between January and September has indeed increased from 699,902 in 2013 to 857,577 in 2015 (+22.5%). Data on total hiring shall not be confused with stock data on the employed and the unemployed measured by Istat through a sample survey.*

Figure 5.7 – Overall change in the workforce (% and standard deviation, 2015 e 2013)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

5.4 ULCs, internationalization and innovation

Unit labor costs (ULCs), defined as the average cost of labor per unit of output produced, figure among the traditional macroeconomic (typically price/cost-based) indicators viewed as a broad measure of the competitiveness of a firm and its region. Even recent discussions about the need to regain competitiveness in the euro area have long concluded that workers are too expensive, especially given labor productivity levels.[59]

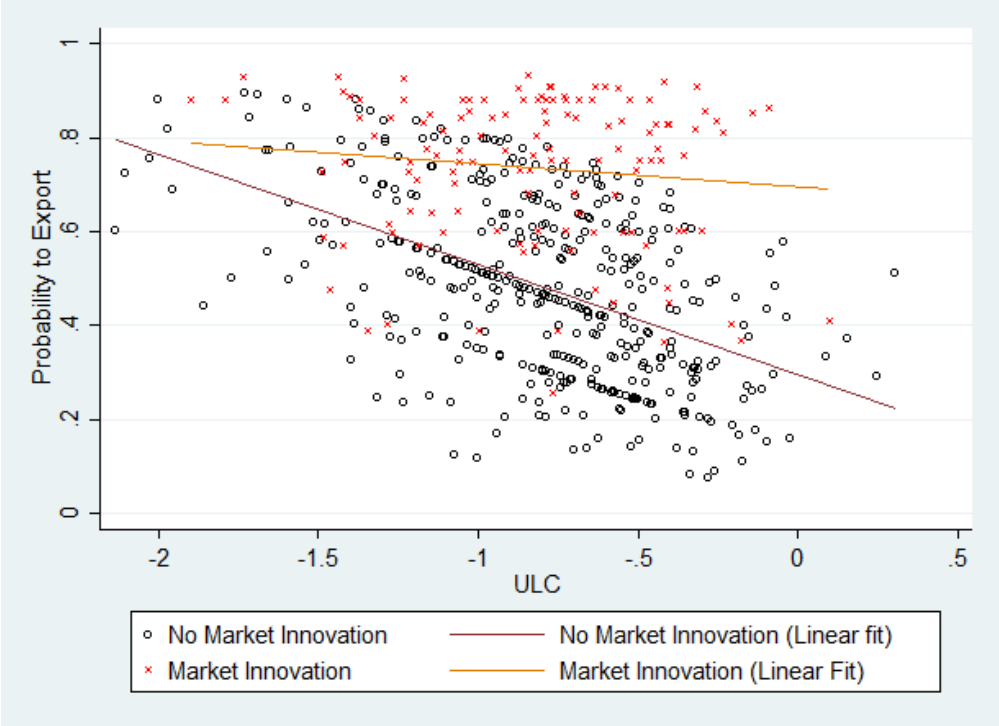
However relevant though, low ULCs are not necessarily the reason behind competitiveness. The literature[60] shows that cost-price dynamics exhibit a weak explanatory power for export growth in recent years. Factors such as quality, innovation, trade-facilitating services play a role too. This might be inferred from firm-level data as well. This survey provides indeed an additional insight into the relationship between the ability to export and quality-adjusted cost competitiveness, controlling for structural factors (industry) and regional fixed effects.

To each point in the graph corresponds a firm with a specific combination of ULCs (x-axis) and probability to export (y-axis). The slope of the regression line quantifies by how much the probability to export varies as ULCs change, industry and region being equal. Both in 2013 (Figure 1.1) and 2015 (Figure 1.2), for the same level of ULCs the firms that have introduced market innovations have a higher probability to export compared to not-innovative firms. In particular, with reference to innovative firms, there is a very weak relationship between the probability to export and ULCs, because the key determinant of the success on international markets is the quality of innovation rather than prices. On the

[59] *For instance, J. Felipe and U. Kumar,* Unit Labor Costs in the Eurozone: The Competitiveness Debate Again
[60] *For instance, ECB*, Competitiveness research network: First year results*; K. Benkovskis and J. Wörz,* Non-price competitiveness of exports from emerging countries*; F. di Mauro and K. Forster,* Globalisation and the competitiveness of the euro area

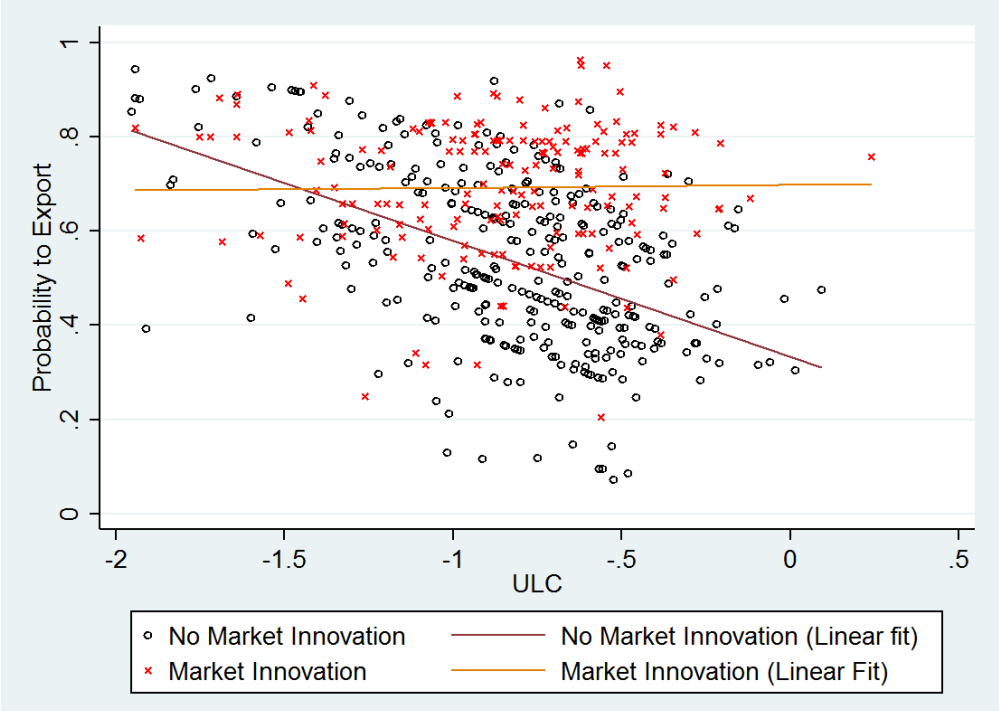
contrary, in the case of non-innovative firms whose international competitiveness mainly relies on prices, an increase in ULCs is associated to a decline of 25% in the probability to export, a figure that is roughly constant across the two editions of the survey.

Figure 5.8 – Probability to export and ULCs by innovation activity (2013)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 5.9 – Probability to export and ULCs by innovation activity (2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

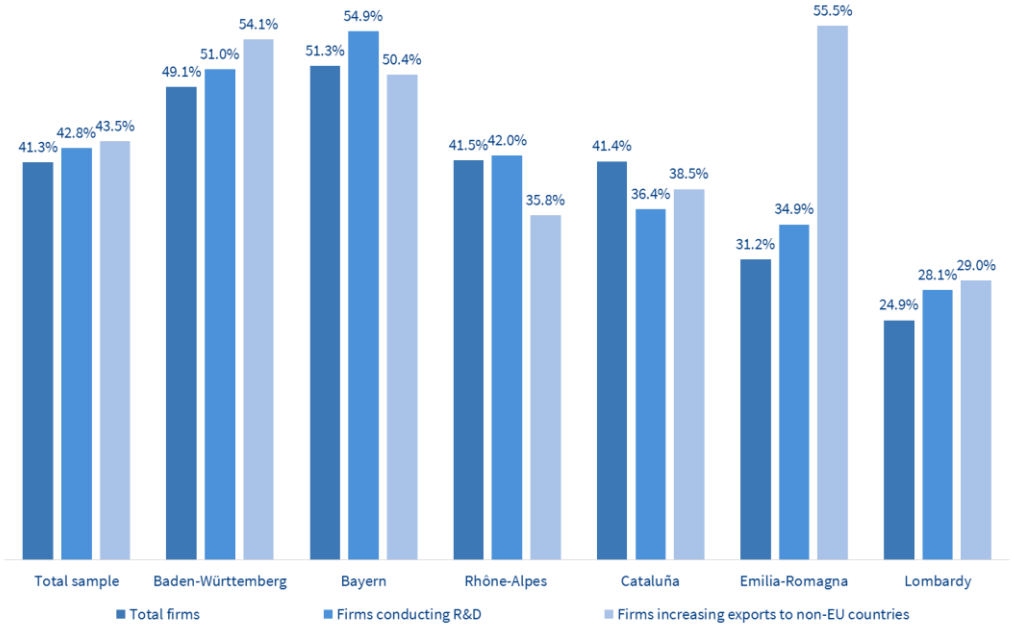
6. Financing

In all regions considered, the banking system is the preferred source of financing. In line with 2013, Italian and Spanish firms have a larger share of short-term debt, which is less apt to finance long-term term and at-high-fixed-cost projects, e.g. innovation and internationalization. On a positive note though, credit selection affects fewer firms than in 2013.

6.1 Financial structure

Firm financial structure has a crucial impact on business strategies. In particular, a solid balance sheet is key to the success of innovation and internationalization strategies. Sample data prove consistent with such idea. Overall, regions in the sample are quite differ as to capitalization (Figure 6.1).Compared to their German peers, Italian firms are less inclined to self-financing: in line with the findings of the previous edition of the survey, the share of equity over total assets is as little as 24.9% in Lombardy in 2013-2015, whereas German firms would reach shares of 50%. Cataluña and Rhône-Alpes do fairly better (around 41%), although the gap with Baden-Württemberg and Bayern is still relevant. Firms in Lombardy that conduct R&D activities or have increased their exports to non-EU countries show a higher degree of capitalization than the total (28-29%). Nevertheless the figure is still far from the sample average (43%). In Emilia-Romagna the same figure shifts from 31.2% to 34.9% in the case of innovative firms and reaches 55.5% in the case of exporters.

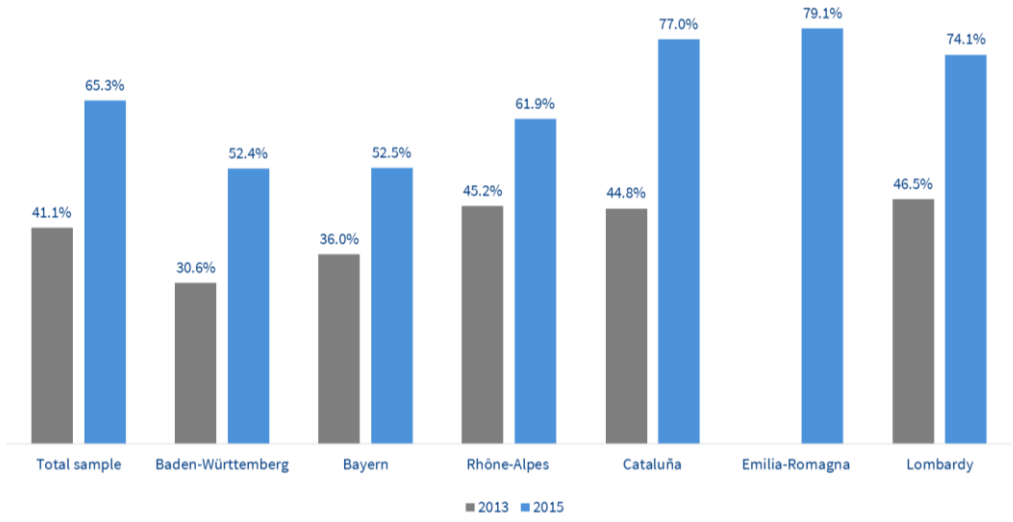
Figure 6.1 – Average equity share over total assets for total firms, firms doing R&D over 2013-2015 and firms increasing their exports to non-EU countries compared to 2013 (%, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Low equity entails a high dependency on third parties. Consistently with data in Figure 6.1, Cataluña, Emilia-Romagna, Lombardy and, to a lesser extent, Rhône-Alpes all resort to external financing throughout the life of the firm more than their German peers (Figure 6.2). The use of external financing has however increased in all regions since 2013.

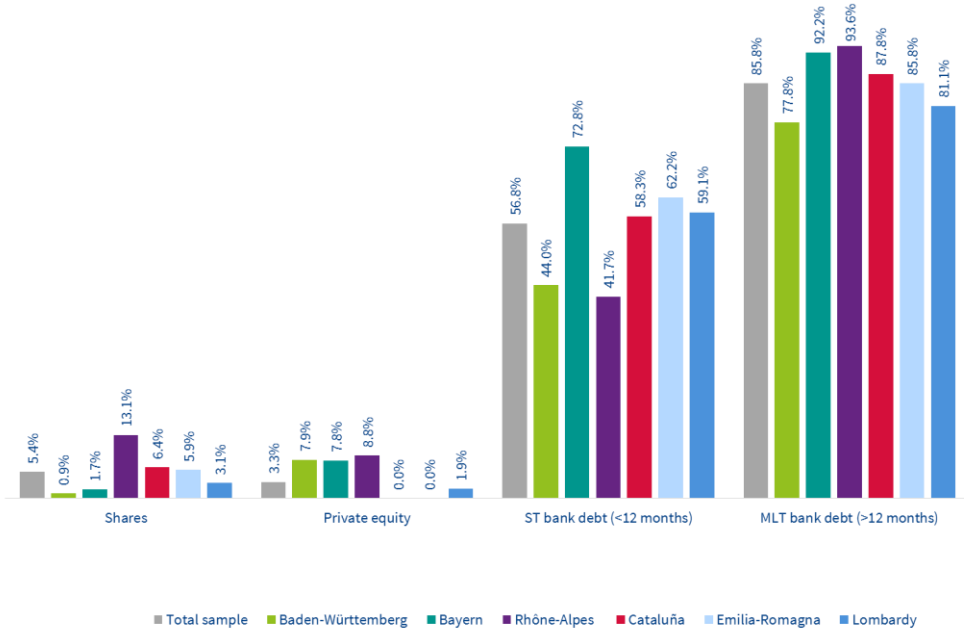
Figure 6.2 – Firms that resort to external financing (% of total firms, 2013 and 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Firms turning to external financing tend to rely on banks, while stocks and private equity are in general not that widespread (Figure 6.3). Baden-Württemberg, Bayern and Rhône-Alpes are the only regions proving minimally open to non-bank financing. For instance, in those regions around 7-8% of firms have used private equity instruments in 2013-2015, versus the sample average of 3.3%.

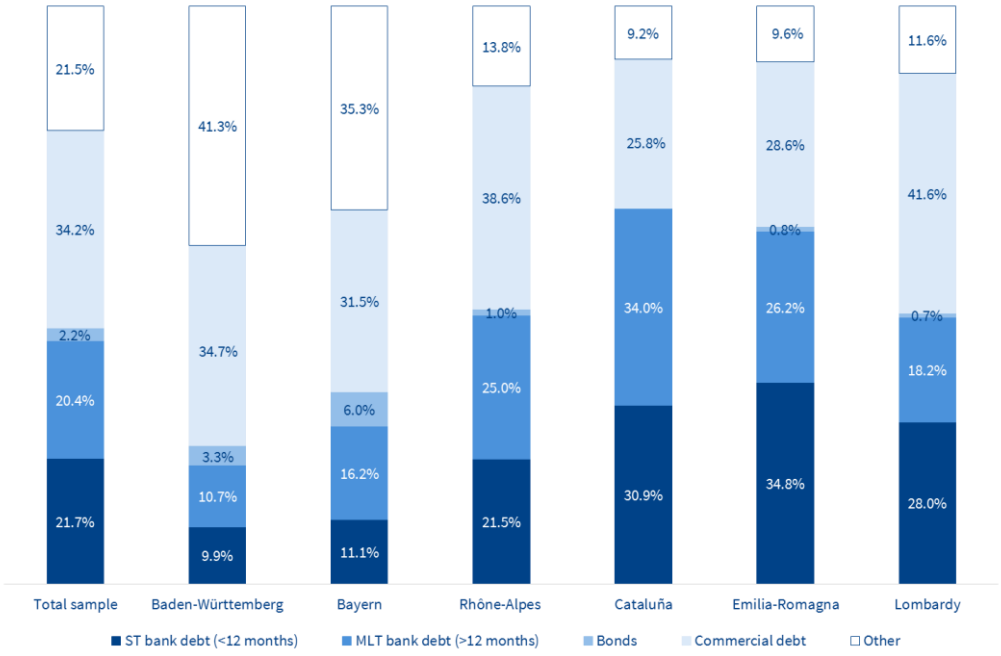
Figure 6.3 – External financing over 2013-2015 by type of instrument (% of total firms resorting to external financing)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

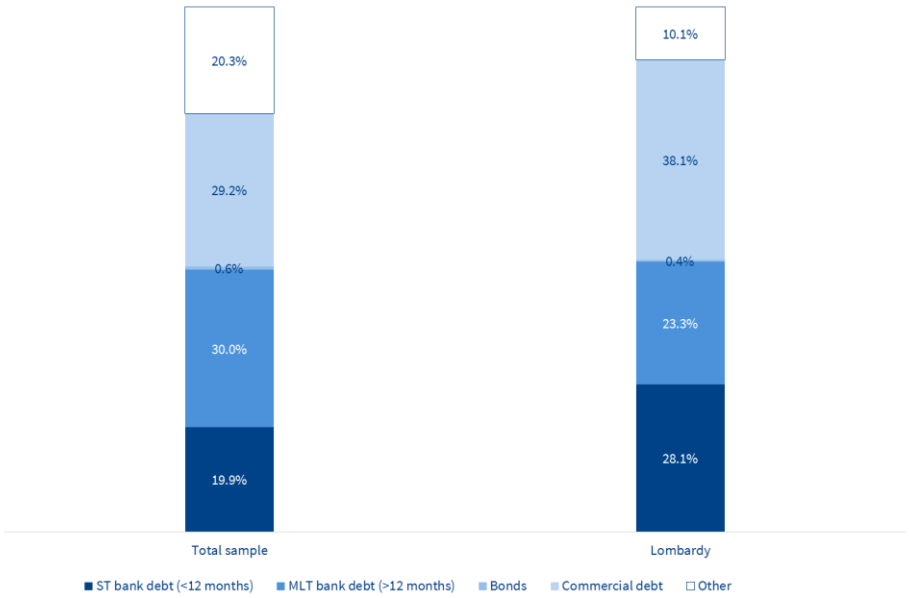
The preference for external financing leads to high debt levels. Based on the debt structure, it is possible to measure firms' financial vulnerability (Figure 6.5).
The diversification of the debt portfolio is one indicator. On average, banks account for 40% of overall debt, suggesting a high vulnerability to banking crises. Commercial debt (35%) follows, while bonds and other forms of financing are marginal. However German regions outperform the sample average with a share of 20%.
A second indicator is when the debt comes due. Here the distinction is made between short-term (less than 12 months) and long-term bank debt. Firms in Emilia-Romagna (34.8%), Cataluña (30.9%) and Lombardy (28.0%) result the most exposed to short-term debt.
As to Lombardy in particular, essentially unchanged from 2013 and still excessive is the exposure towards short-term bank loans (28% compared to a sample average of 21.7%), which is combined with a significant decrease in long-term bank loans, although smaller than the one recorded in the sample as a whole (-5.33 p.p. compared to a sample average of -9.6 p.p.) (Figure 6.6).

Figure 6.5 – Debt structure (%, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Figure 6.6 – Debt structure (%, 2013)

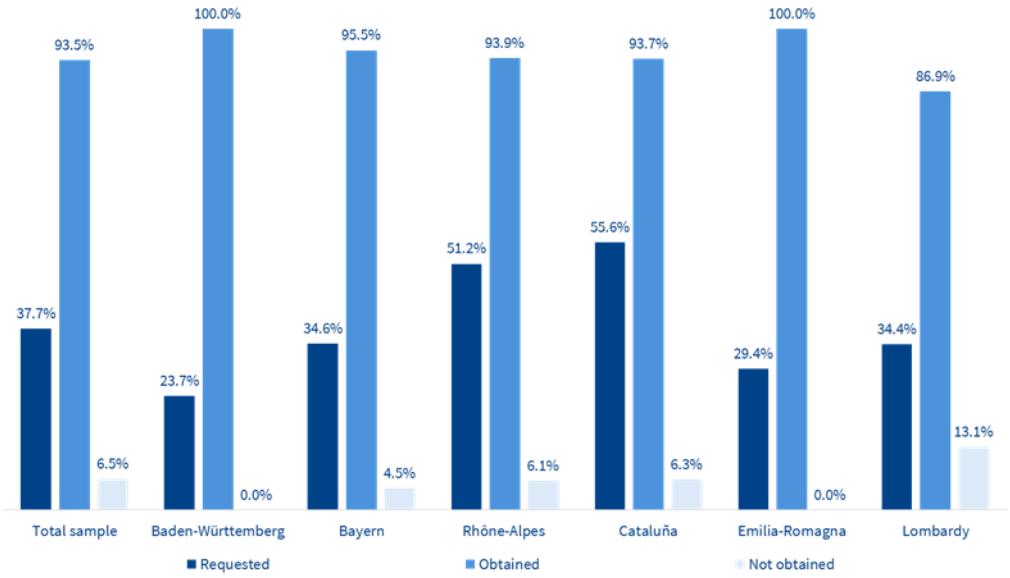


Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

6.2 Bank financing

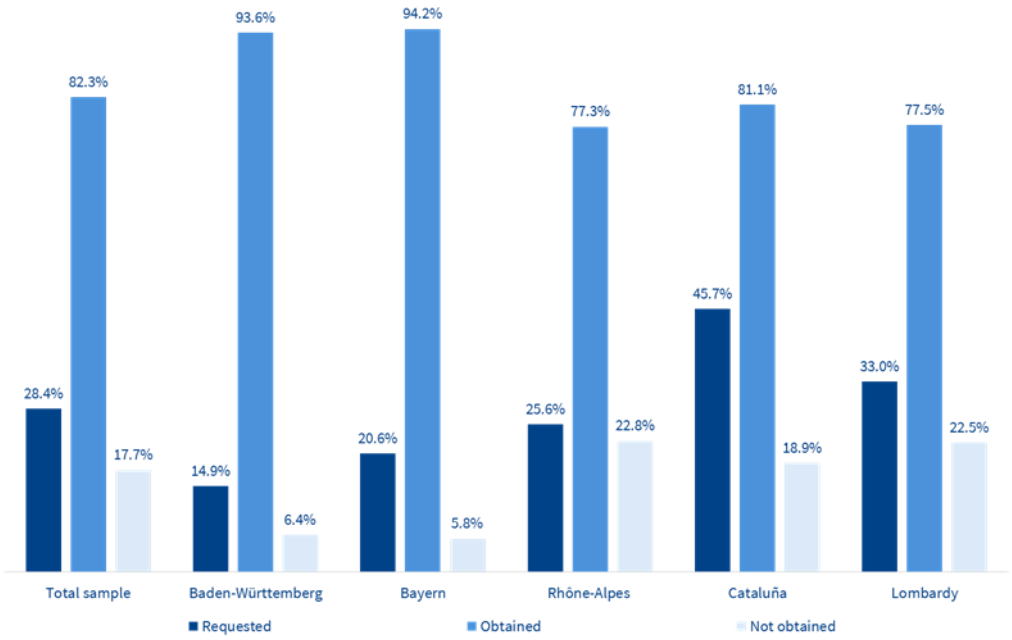
In 2015 almost 40% of firms in the sample requested more credit from banks.
The need was especially felt in Rhône-Alpes (51.2%) and Cataluña (55.6%).
Almost all firms requesting more credit obtained it. Nonetheless still 6.5% of firms saw their request being rejected (13% in Lombardy). However, since 2013, it has become less of an issue (Figure 6.8).

Figure 6.7 – Requests for credit (% of total firms) and credit selection (% of total firms having requested credit, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

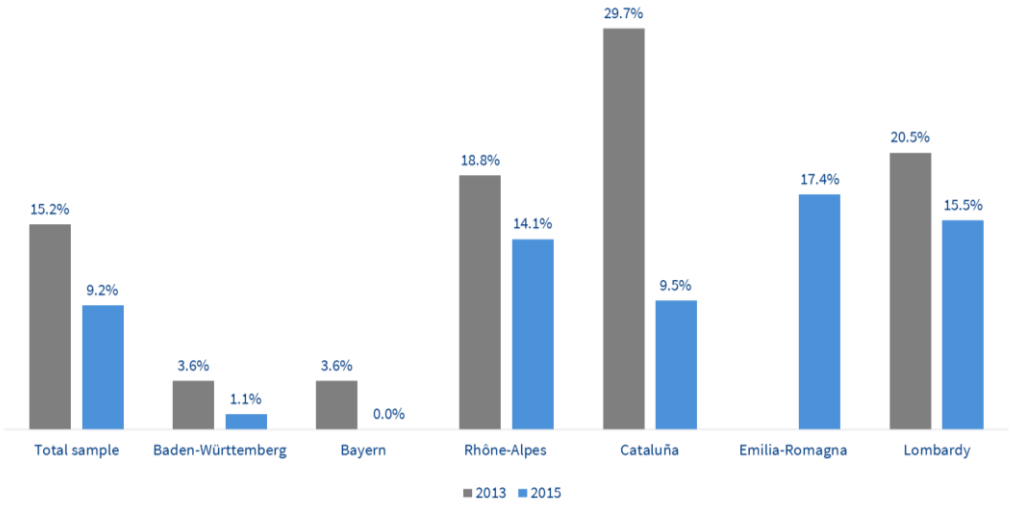
Figure 6.8 – Requests for credit (% of total firms) and credit selection (% of total firms having requested credit, 2013)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

As further proof of the improvement in economic conditions, firms claiming to have suffered from financial difficulties in 2015 are 9.2% of the total, around half of the equivalent figure in 2013 (Figure 6.9). Regional data are in line with findings on capitalization and bank financing needs. Still in 2015 more than 10% of firms in Rhône-Alpes, Cataluña, Emilia-Romagna and Lombardy suffered from financial difficulties, while in Baden-Württemberg and Bayern the equivalent figure is negligible.

Figure 6.9 – Firms suffering from financial difficulties (% of total firms, 2015 and 2013)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

7. Bureaucracy

Bureaucracy affects firms especially in Rhône-Alpes, Lombardy and Emilia-Romagna. In Lombardy, small firms are particularly disadvantaged, with bureaucratic costs accounting for up to 4.0% of turnover compared to 2% in the case of medium firm and having increased since 2013.

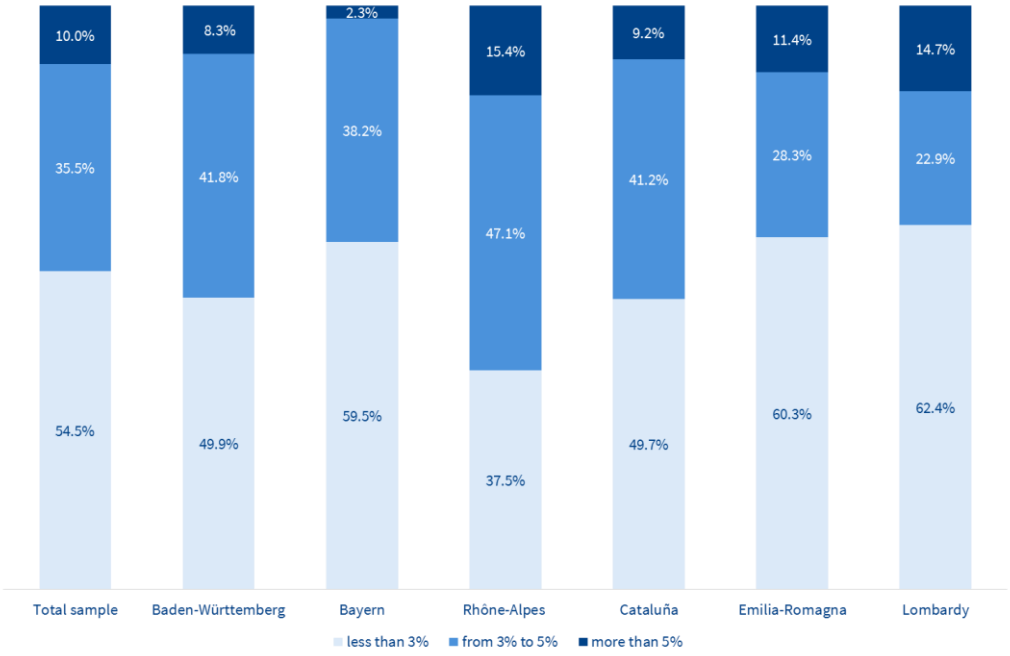
7.1 Bureaucratic costs

Quantifying how much bureaucracy costs to firms requires to go beyond direct financial costs, such as the amount paid in taxes and stamp duties. The efficiency and effectiveness of administrative procedures has to be considered as well. A slow and complex bureaucracy is costly and affects firm competitiveness and regional attractiveness. Three are the key issues to focus on: (1) the complexity of procedures; (2) the overlap between norms and their discretionary implementation; (3) the time necessary to release a permit.

Bureaucratic costs cannot always be directly measured. For instance, with reference to the time to complete a procedure, there are opportunity costs imputable to the management of the procedure in monetary terms (paying an external consultant requires a firm to give up another investment opportunity), or in terms of human resources (one or more employees have to temporarily drop their daily tasks). Moreover, there are “shadow costs”, i.e. sunk cost in terms of earnings lost when deferring investments until permits are released.

This survey allows for an evaluation of bureaucratic burden by asking firms themselves how much the management of procedures costs in terms of turnover in general, when managed internally and when outsourced (Figure 7.1). Overall in the sample, roughly half of firms claims bureaucracy costs less than 3% of their turnover, somewhat more than a third pays between 3% and 5%, while only 10% pay more than 5%.Breaking down the figure by region, bureaucratic costs result particularly high in Rhône-Alpes, followed by Lombardy and Emilia-Romagna. Particularly relevant is the gap relative to firms paying more than 5% of their turnover, ranging from 2.3% in Bayern to 14.7% in Lombardy and 15.4% in Rhône-Alpes.

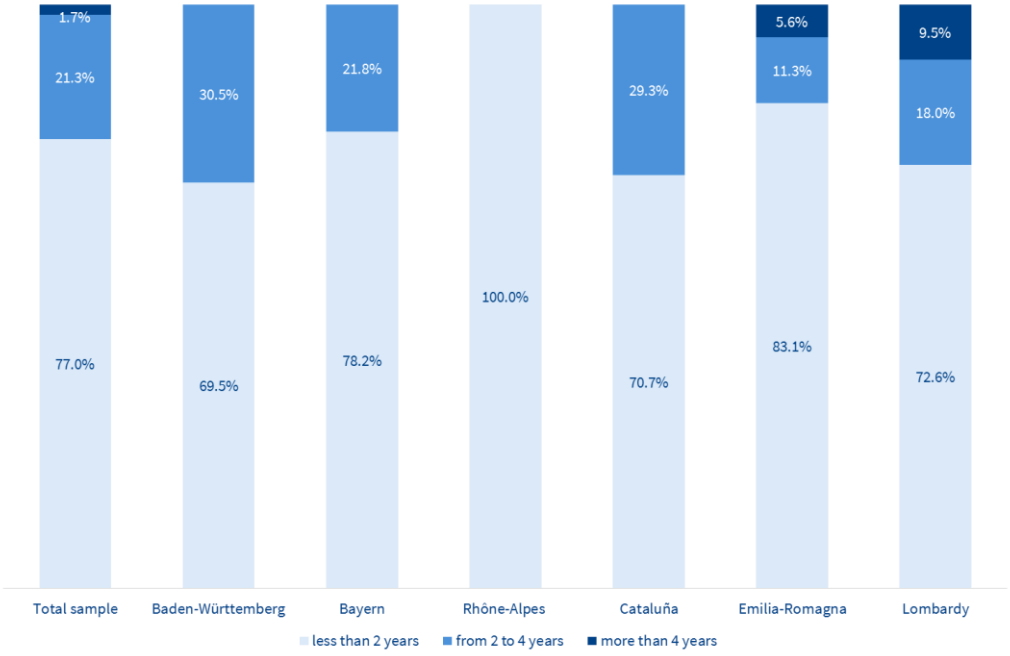
Figure 7.1 – Procedural costs over total turnover (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

This survey then focuses on two procedures: the Planning permission and the Integrated Pollution Prevention and Control (IPPC).
As to the Planning permission, in all regions firms wait for less than 2 years (4 tops) before opening a new plant (Figure 7.2). Lombardy and Emilia-Romagna are the exceptions, since firms might even wait for more than 4 years.

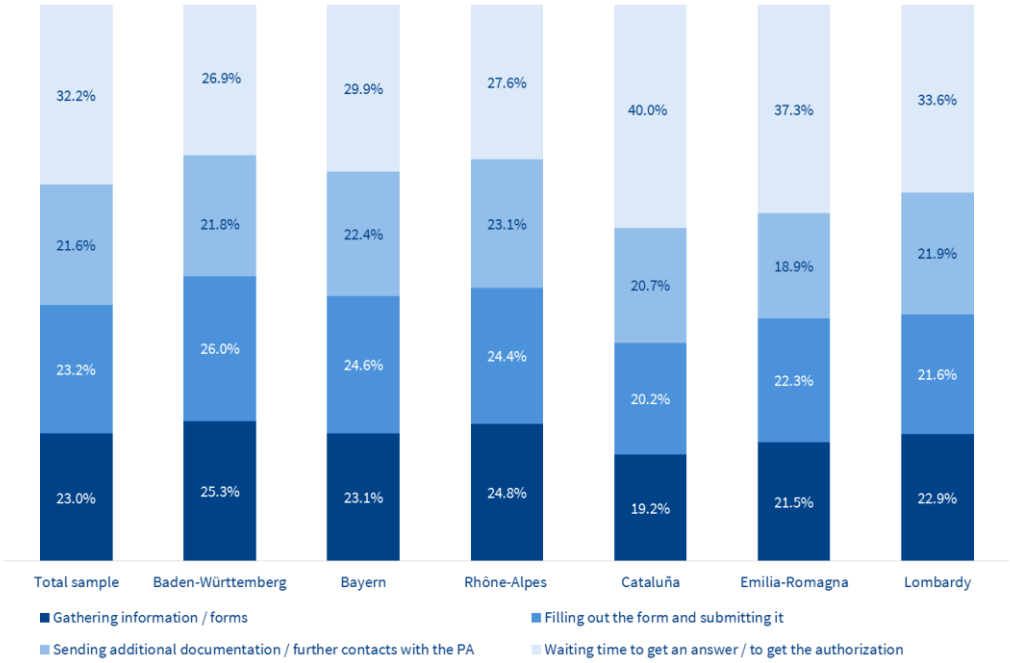
Figure 7.2 – Time necessary to open a new plant (% of total firms, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Unlike in the case of the Planning permission, regions widely differ as to the time necessary for the release of an IPPC.[61] Nevertheless, the impact of the procedure on businesses in terms of costs and waiting time is quite homogenous across the different stages of the procedure, with no particular difference across regions (Figure 7.3). Still, to be precise, the most expensive stage is in terms of time to wait before the release, especially in Cataluña (40%), Emilia-Romagna (37.3%) and Lombardy (33.6%).

Figure 7.3 – Impact on business of the different stages of the IPPC release procedure (%, 2015)



Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

7.3 Bureaucratic costs in Lombardy

This survey only provides a starting point to further analysis. In order to quantify bureaucratic costs it is necessary to delve deeper. Indeed, those costs vary depending on (a) the sector, because different are the procedures necessary and (b) the firm size, because for the same procedure different is the cost relative to total turnover.
The issue has been analyzed in depth in Lombardy, based on the findings of the 2017 edition of the "Osservatorio sulla Semplificazione" by Assolombarda Confindustria Milano Monza e Brianza.[62] The procedures considered are in Table 7.1.

[61] *Italy is the European country where both the PA and the firm have to invest the most resources: it takes from 14 to 21 months to get an IPPC – even more than 5 years in the case of the chemical sector – despite the European directive prescribing maximum 150 days. For a comparison, in Germany it takes from 7 to 12 months, in Finland and Denmark 6 months on average.(Confindustria,* Valutazione comparativa della disciplina di autorizzazione integrata ambientale a livello europeo e nazionale: effetti sullo sviluppo industriale del Paese, *p. 16)*

[62] *The "Osservatorio sulla Semplificazione" provides a yearly update on the cost of bureaucracy to firms in Lombardy. It focuses on the 10 bureaucratic procedures that affect the most business activity and analyzes some case studies. The 2017 edition builds on 2016 data and was edited under the scientific coordination of professor Roberto Zoboli (Università Cattolica del Sacro Cuore di Milano).*

Table 7.1 – Administrative procedures

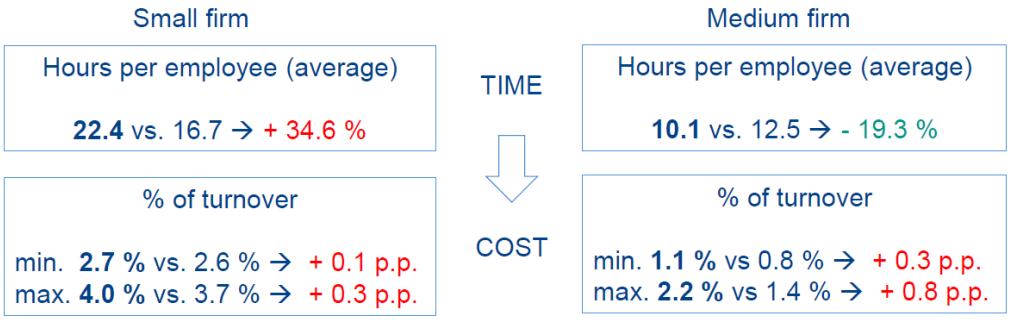
Field	Procedure
Environment	Integrated Pollution Prevention and Control (IPPC) Autorizzazione Unica Ambientale
Constructions	Planning permission
Treasury	Modello 770 and CU Spesometro VAT refund
Labor and pensions	Hiring – Apprenticeship Extraordinary CIG
Health and safety on the workplace	Richiesta CPI- Attività cat. C medio semplice Richiesta CPI- Attività cat. C complessa

Source: Osservatorio sulla Semplificazione, Assolombarda Confindustria Milano Monza e Brianza

Each procedure has been mapped in its phases and sub-phases, so to delineate the complying process, peculiarities and bottle-necks, the number of man-hours overall necessary. A distinction is then made by sector and size class. In particular, the benchmark are four typical firms in chemicals and mechanics, two small and two medium. Once the respective procedures are associated to the firm based on the sector of belonging, the administrative costs were computed based on the average number of employees and the average cost of labor. Also other costs were considered: shadow costs; consultants; other costs (e.g. management software update). The total cost, given by the sum of all costs (administrative or other) has then been divided by the average turnover of the firm by sector of activity.

Table 7.2 sums up the results of the latest edition of the "Osservatorio", based on 2016 data (in bold), compared with the previous edition. An cost increase is marked in red, a decrease in green.

Table 7.2 – The cost of bureaucracy (absolute valuesand % change, 2015 and 2016)



Source: Osservatorio sulla Semplificazione, Assolombarda Confindustria Milano Monza e Brianza

Small firms result disadvantaged compared to medium firms. In terms of time, on average small firms invest 22.4 man-hours, more than twice the equivalent figure for a medium firm. Moreover, compared to 2015, in 2016 man-hours increase by 35% in small firms, while they decrease by 19.3% in medium firms. Since it takes longer to close the procedure, for a small firms also costs as share of turnover are higher, varying between 2.7% and 4.0%, than for a medium firm (1.1% - 2.2% range). However, through time, costs seem to have increased less for small firms than medium firms.

In particular, an excessive cost of bureaucracy stems from the difficulty of gathering information about the procedure; the complexity of the paperwork required;[63] the lack of digitalization; the lack of homogeneity and efficiency; the length of permit release or re-exam.

[63] *A feature frequently linked to the lack of a sufficiently skilled personnel.*

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Appendix 1. Benchmark regions

In order to capture and analyze the constraints, challenges and strategies that determine the performance of the European industry, six structurally-similar regions were selected: Baden-Württemberg and Bayern (Germany), Rhône-Alpes (France), Cataluña (Spain), Lombardy and Emilia-Romagna (Italy).

Table 1 – Area and population (2016)

	Population on 1 January		Area	
	Number	% of total EU28	sq.km.	% of total EU28
Baden-Württemberg	10,879,618	2.1%	35,751	0.8%
Bayern	12,843,514	2.5%	70,550	1.6%
Cataluña	7,408,853	1.5%	32,090	0.7%
Emilia-Romagna	4,448,146	0.9%	22,453	0.5%
Lombardia	10,008,349	2.0%	23,864	0.5%
Rhône-Alpes	6,574,708	1.3%	43,698	1.0%

Source: Eurostat

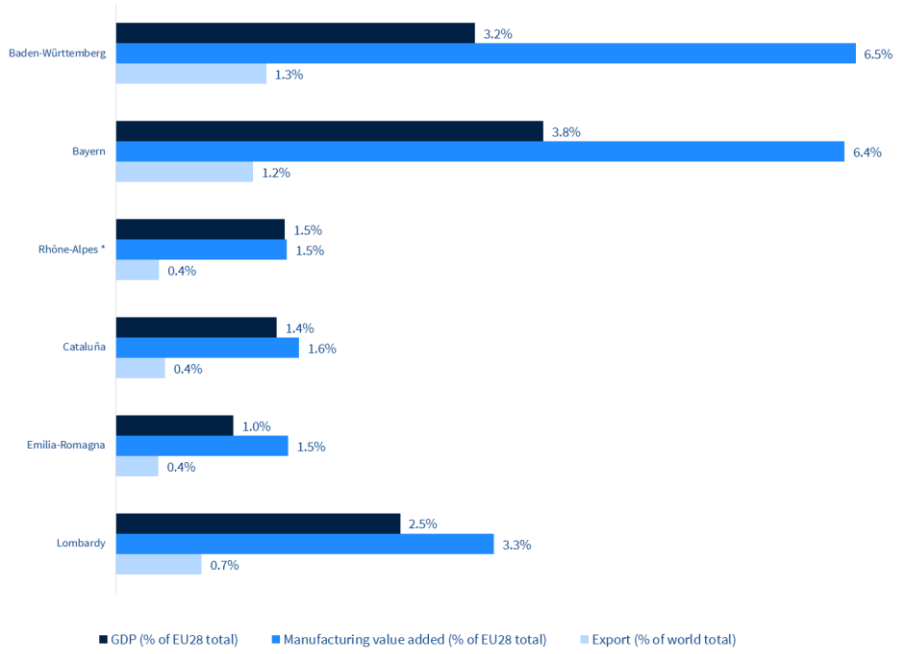
In light of their strong manufacturing sector, all these regions are among the most productive in Europe.[64] On average indeed, they account for 15.4% of GDP and 20.3% of manufacturing value added in their own country. Together they make up for 13.2% of GDP and 20.8% of manufacturing value added of the EU28. Their share over global exports is 4.5%.

In Figure 3.1 are the data by region. Although German regions perform slightly better, GDP and manufacturing value added as a share of the EU28 total and exports as a share of world total are essentially equal, proving regions in the sample to be comparable.

Nevertheless some differences emerge in terms of firm size within the manufacturing sector (Figure 3.2). In the German regions on average there are 40 persons employed per local unit, while the equivalent figure in Rhône-Alpes, Cataluña, Emilia-Romagna and Lombardy drops to 11 (all regions where micro-firms, i.e. firms employing less than 10 persons, are widespread)[65].

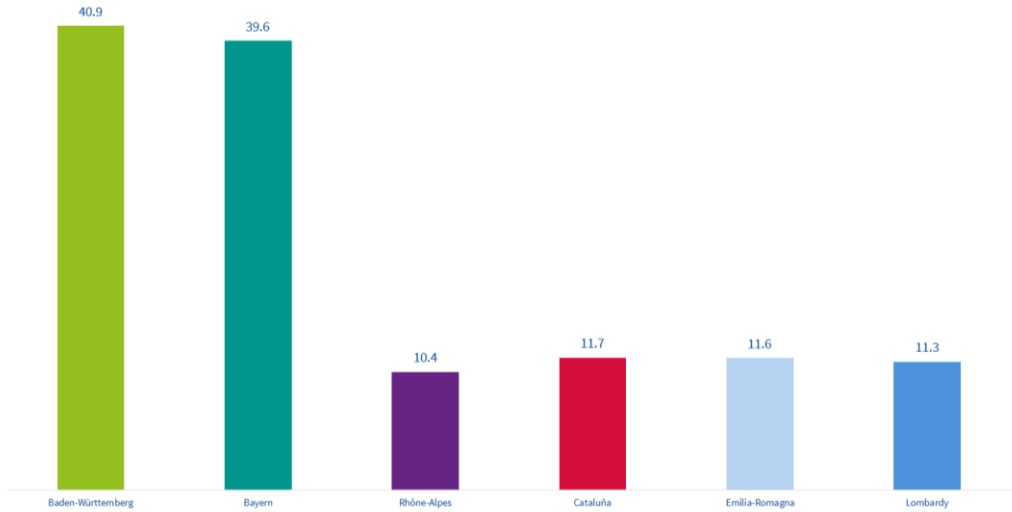
[64] *What follow are the latest available data as of May 2017.*
[65] *Compared to Cataluña Emilia-Romagna and Lombardy, in Rhône-Alpes there are more firms employing 50 or more persons. However, in relative terms, the share of medium and large firms is still below German regions'.*

Figure 1 – GDP (% of EU28 total), manufacturing value added (% of EU28 total) and export (% of world total)



Source: Eurostat, WTO and national offices for statistics
Note: Export data for Rhône-Alpes refers to Auvergne-Rhône-Alpes

Figure 2 – Average size of manufacturing firms (persons employed per local unit, 2014)



Source: Eurostat

The distribution of firms in the sample by size – consistently with previous editions of the survey and official statistics – confirms the strong role played by small firms in all regions, with the exception of Baden-Württemberg and Bayern only, where relatively higher is the share of firms with more than 250 persons employed (Table 2).

Table 2 – Sample distribution by size (% of total firms and average size, 2015)

	Firms by size class			Average size
	10-49	50-249	>250	
Baden-Württemberg	72.3%	21.6%	6.1%	63
Bayern	81.6%	14.8%	3.6%	63
Rhône-Alpes	83.0%	16.3%	0.7%	35
Cataluña	86.3%	12.4%	1.3%	35
Emilia-Romagna	89.3%	9.4%	1.3%	34
Lombardy	86.5%	12.3%	1.1%	31
Total sample	83.1%	14.5%	2.4%	36

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

Appendix 2. Methodology

2.1 The sample

The survey focuses on manufacturing firms employing at least 10 persons.

The questionnaire deals with 6 different themes, for a total of around 100 questions:

- Business structure, production and organization;
- Labor force and training;
- Investments, innovation, research and development, smart manufacturing;
- Internationalization;
- Financial structure, credit and payments;
- Bureaucracy.

Data were collected through CATI (Computer Based Telephone Interview) by GFK-Eurisko[66] over autumn 2016. In general, data refer to2015, although in some cases questions relate to a three-year period (2013-2015) or entail a comparison with 2012.

In order to build a representative sample, two criteria were followed.

Criterion 1: availability of a sufficiently large sample for each region. Specifically, 100 manufacturing firms make up the sample for Baden-Württemberg, Bayern, Rhône-Alpes, Cataluña and Emilia Romagna, around 200 for Lombardy, for a total sample of 692 firms (Table2.1).

Table 2.1 – Observations by region

Region	Number of firms
Baden-Württemberg	100
Bayern	100
Cataluña	100
Emilia-Romagna	101
Lombardy	191
Rhône-Alpes	100
Total sample	692

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza

[66] *Società di rilevazione specializzata operante a livello europeo.*

Criterion 2: appropriate sample stratification so to make it representative. Weights are based on

1. sector – in particular, 4 macro-sectors by technological intensity according to the classification of manufacturing sectors Eurostat-NACE Rev. 2 2 digits (Table 2.2)
2. size class – in particular,10-49 persons employed (small firms); 50-249 persons employed (medium firms); more than 250 persons employed (large firms).

Table 2.2 – Manufacturing sectors by level of technological intensity

Technological intensity	NACE 2 digit	Sector
High technology (HT)	21	Pharmaceuticals
	26	Electronics
Medium-high technology (MHT)	20	Chemicals
	27	Electrical equipment
	28	Machinery and equipment
	29	Automotive
	30	Other transport equipment
Medium-low technology (MLT)	19	Coke and refined petroleum products
	22	Rubber and plastic
	23	Other non-metallic mineral products
	24	Metallurgicals
	25	Metal products
	33	Repair and installation of machinery and equipment
Low technology (LT)	10	Food products
	11	Beverages
	12	Tobacco products
	13	Textiles
	14	Wearing apparel
	15	Leather and related products
	16	Wood
	17	Articles of paper and paper products
	18	Printing and reproduction of recorded media
	31	Furniture
	32	Other

Source: Eurostat

The distribution by macro-sector and size in each region shows that the over a total of 100 firms the number of large firms surveyed is not sufficient to guarantee representativeness (Table 2.3). In order to achieve a balanced sample, small firms (10-49 persons employed) were attributed a lower weight to compensate for their high number, while large and medium firms were given a larger weight.

The details of the weighting system adopted are in Box A.

Table 2.3 – Representative distribution and sample (number of firms per sample cell)

Representative distribution

Baden-Württemberg	10-49	50-249	> 250
HT	6	1	1
MHT	18	6	4
MLT	31	6	2
LT	19	4	2

Bayern	10-49	50-249	> 250
HT	7	1	1
MHT	17	4	3
MLT	30	5	2
LT	24	4	2

Rhône-Alpes	10-49	50-249	> 250
HT	2	1	1
MHT	13	5	2
MLT	36	7	1
LT	25	6	1

Cataluña	10-49	50-249	> 250
HT	2	1	1
MHT	17	6	1
MLT	25	5	1
LT	32	7	2

Emilia-Romagna	10-49	50-249	> 250
HT	2	1	0
MHT	23	6	2
MLT	33	5	1
LT	22	4	1

Lombardy	10-49	50-249	> 250
HT	7	2	1
MHT	39	12	3
MLT	66	13	2
LT	43	10	2

Sample

Baden-Württemberg	10-49	50-249	> 250
HT	6	1	**2**
MHT	18	6	4
MLT	**29**	6	**3**
LT	**18**	**5**	**2**

Bayern	10-49	50-249	> 250
HT	**6**	**2**	1
MHT	**16**	**5**	**4**
MLT	**28**	5	2
LT	**23**	**5**	**3**

Rhône-Alpes	10-49	50-249	> 250
HT	2	1	1
MHT	**12**	**6**	**3**
MLT	**34**	**8**	**2**
LT	**23**	6	**2**

Cataluña	10-49	50-249	> 250
HT	2	1	1
MHT	**16**	**7**	**2**
MLT	**24**	5	1
LT	**30**	**9**	2

Emilia-Romagna	10-49	50-249	> 250
HT	2	1	0
MHT	**21**	**7**	**3**
MLT	**31**	**6**	**2**
LT	**21**	4	**2**

Lombardy	10-49	50-249	> 250
HT	**6**	2	1
MHT	**38**	**14**	**4**
MLT	**63**	**14**	**3**
LT	**41**	**11**	**3**

Source: GFK-Eurisko on Eurostat data

Box A – The weighting system

In order to guarantee sample representativeness, data were weighted on the basis of sample arithmetic means. Specifically, absolute weights were computed by splitting the sample in 72 cells based on 24 NACE Rev. 2 2-digit manufacturing sectors and three size classes (10-49 persons employed; 50-249 persons employed; over 250 persons employed).

First, for each region, the effective distribution of firms by sector and size was computed based on Eurostat data (population distribution). Then the same was done on survey data (sample distribution). The sample weight of firms in sector *k* and size class *j* was hence computed as:

$$Weight_{kj} = \frac{Nfirms_{kj}/Nfirms}{Sfirms_{kj}/Sfirms}\left(\frac{Nfirms}{Sfirms}\right)$$

where $Nfirms_{kj}$ is the number of firms in sector k and size class j in the region's population; $Sfirms_{kj}$ is the number of firms in sector*k* and size class *j* in the sample; *Nfirms* and *Cfirms* are, respectively, the total number of firms in the population and in the sample. By construction, firms belonging to the same sample cell (i.e. have the same sector/size combination) have the same weight. For each region the sum of weights is equal to the total number of firms in the reference population.

2.2 Comparability over time

The survey "The performances of European firms: a benchmark analysis" was created after the 2010 survey "European Firms in a Global Economy: Internal Policies for External Competitiveness" (EFIGE).[67] This way, a set of firm-level representative data is provided, which is monitored and updated in the years from 2009 up to 2015, common to six of the main European regions, allowing to derive increasingly accurate policy implications for the recovery of the manufacturing sector.

Both editions of the survey were constructed so to be comparable to EFIGE, by using a similar stratification method and questionnaire with a focus on manufacturing firms

[67] *The survey "European firms in a global economy: Internal policies for external competitiveness" (EFIGE) conducted in 2010 is an international research project coordinated by Bruegel (Brussels) and financed by the Seventh Framework Programme of the European Union. It is publicly available at www.efige.org.*

employing at least 10 persons. In turn, EFIGE data were properly adjusted to the territorial level of analysis chosen by Assolombarda. Table 2.4 sums up the main descriptive variables relative to the three waves (on 2015, 2013 and 2009 data) based on balance-sheet data.

Table 2.4 – Assolombarda Confindustria Milano Monza e Brianza 2016 (on 2013 data) and 2017 (on 2015 data)descriptives compared to EFIGE 2010 descriptives (on 2009 data)

Year 2015

Region	Persons employed		Turnover (thousand €)
	mean	median	
Baden-Württemberg	63	24	10.038,4
Bayern	63	25	8.211,1
Rhône-Alpes	35	22	7.521,3
Cataluña	35	25	8.973,7
Emilia-Romagna	34	20	6.980,8
Lombardy	31	17	10.737,8
Total sample	36	20	8.949,1

Year 2013

Region	Persons employed		Turnover (thousand €)
	mean	median	
Baden-Württemberg	66	26	8.419,0
Bayern	57	25	8.604,3
Rhône-Alpes	39	19	8.828,8
Cataluña	24	19	4.619,2
Lombardy	33	18	6.888,8
Total sample	43	20	7.081,2

Year 2009

Region	Persons employed		Turnover (thousand €)
	mean	median	
Baden-Württemberg	63	28	9.344,7
Bayern	62	27	8.685,0
Rhône-Alpes	43	18	6.718,7
Cataluña	39	20	7.772,1
Lombardy	43	20	7.570,4
Total sample	51	23	8.045,7

Source: Indagine Benchmark, Assolombarda Confindustria Milano Monza e Brianza and Orbis – Bureau van Dijk

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