ASSOLOMBARDA

The performance of European firms: a benchmark analysis

2019 edition

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Prepared by
Economic Research Department

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Main findings

With the aim of deriving policy suggestions for the competitiveness of European industry, Assolombarda's "The performances of European firms: a benchmark analysis"[1] provides an in-depth analysis of manufacturers' strategies and challenges, drivers and constraints in five key productive regions in the European Union: Lombardia (Italy), Baden-Württemberg and Bayern (Germany), Cataluña (Spain) and Auvergne-Rhône-Alpes (France).

This third edition of the Benchmark analysis further enriches a database of original, representative and comparable firm-level data that altogether in the three waves has reached a total of 1.926 enterprises (590 of which surveyed in the 2019 edition), covering a seven-year time span from 2011 to 2017 and seven thematic fields – internationalization, innovation, smart manufacturing, firm structure, labor force, finance and bureaucracy.

Across all waves, data show that highly innovative firms manage to succeed internationally even in the presence of high unit labour costs (ULCs): with reference to these firms, the key determinant of the success on international markets is the quality of innovation rather than prices. Even more so through the years: if in 2013 a weak relationship was found between the probability to export and ULCs, in 2015 that relationship was almost non-existent and in 2017 it resulted positive, suggesting even more strongly that there is a willingness to pay for a quality premium. On the contrary, in the case of non-innovative firms whose international competitiveness mainly relies on prices, an increase in ULCs remains associated to a decline in the probability to export. 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 labour costs to a higher degree.

Beyond these general findings, the 2019 Benchmark analysis confirms some highlights from previous editions concerning the behavior of firms in single European regions.

Although German regions remain the frontrunners, Lombardia, Cataluña and Auvergne-Rhône-Alpes are accelerating their efforts in the fields of research, innovation and smart manufacturing in an attempt to reduce the gap.

Research and development activities are reported by 45% of firms in 2015-2017 and activate investments for around 8% of turnover. As many as 60% of sampled firms in Lombardia reported having conducted R&D in 2015-2017 (compared to 50% in 2013-2015 and 40% in 2011-2013). At the same time, employment in R&D as share of the total grows, in particular in Lombardia, Cataluña and Bayern.

As to innovation propensity, almost 40% of firms in Germany are in the position to maintain rather than increase their innovation efforts with respect to previous years. Elsewhere the focus is on accelerating rather than consolidating: in Lombardia as many as 53% of firms increased their innovation activities in 2015-2017, in Cataluña 44%. Lombardia stands out for process innovation (50% of firms up from 44% in 2013-2015 and 31% in 2011-2013), while as to product innovation it is almost head-to-head with Baden-Württemberg and

[1] *Hencefoward referred to as "Benchmark analysis".*

Cataluña (47% of firms compared to 50% and 49% in the other two regions respectively).

There is also some evidence suggesting the transition toward the 4.0 paradigm is accelerating. Baden-Württemberg and Bayern remain the most advanced. Almost 70% of firms in German regions have machinery that is less than 10 years old, compared to 57% in Auvergne-Rhône-Alpes, 49% in Lombardia, 44% in Cataluña. At the same time, a fifth of German firms claim to abide by Industrial IoT and cloud manufacturing standards, and in Baden-Württemberg especially advanced production modes[2] are most widespread (15% of firms vs a sample average of 11%). However, the other regions are not standing still. Lombardia aligns to its German peers in terms of investments in ICT and equipment (76% of firms in 2015-2017, vs an average of 69% in 2013-2015 and 2011-2013) and its share of firms deploying advanced production modes nearly doubles from 6% in 2015 to 13% in 2017. Moreover, firms with digitally-integrated machines planning to further advance their smartness by getting 4.0 production and control technologies near 20% of the total, with prospective adopters increasing particularly in Cataluña (from 8% to 29%) and Lombardia (from 13% to 19%).

Compared to German regions though, technological transfer is still a critical issue, together with the type of approach to the 4.0 paradigm.

With regard to technological transfer it suffices to consider that, despite improvements, the share of firms having used at least one Intellectual Property Protection (IPP) instrument in Lombardia, Cataluña and Auvergne-Rhône-Alpes (roughly 15%) is half that recorded in Baden-Württemberg (30%). Focusing on patents, in 2015-2017 around 9% of firms have applied in Lombardia, Cataluña and Auvergne-Rhône-Alpes, a figure which pales versus the 21% recorded in Baden-Württemberg.

As to the different approach to the 4.0 transition, a first evidence stems from investment patterns. Compared to firms in Lombardia and Cataluña, German firms tend to invest to a larger extent in ICT, software and other intangible goods rather than land, equipment and other tangible goods – somehow closely imitated by Auvergne-Rhône-Alpes.
If the large majority of firms in all regions are still renovating their equipment, in Baden-Württemberg and Bayern firms dedicate on average 43% of investments to tangible goods and 23% to intangible goods. Their peers in Lombardia and Cataluña still allocate the bulk of their investments to equipment (63%), leaving a residual 15% to ICT, software and other intangibles.
In other words, outside Germany the focus of investments is arguably still on tangible assets to the detriment of intangibles. Considering that ICT and software support the most the functioning of 4.0 base technologies such as Cloud Computing, Big Data and IoT, thus providing connectivity and intelligence to production-oriented technologies such as 3D printing and robotics, these investment attitudes suggest different levels of implementation and readiness to further developments of the 4.0 paradigm – with German firms to remain the frontrunners at least still for a while.
This conclusion is further supported by evidence on the human capital approach to the smart manufacturing transition: while in Baden-Württemberg and Bayern around 50% of firms count a person in charge of digitalization, in the other regions the same figure drops to 30%. Besides, the distribution of employees in German regions is consistently and markedly tilted towards qualified and managerial positions. This suggests higher human capital standards upon which to leverage in order to boost productivity and build competitive advantage in a 4.0 era, whereas the other regions arguably have a larger formation and training gap to fill.

[2] *Defined as digital integration of equipment coupled with the deployment of industrial robots and either RFID technology or advanced human-machine interface.*

Based on extremely consistent results across waves, all regions confirm their solid presence on international markets.

Though in all regions a fair share of firms are exporters, in Lombardia almost all firms have an international orientation: 77% are active on international markets, vs a sample average of 61%. It might not just be the signal of a weak domestic market, but also of a progressive quality upgrade of exports (as indirectly suggested, for instance in this survey already, by enhanced product innovation and the evidence on ULCs).

All regions are widely active on international markets in terms of commercial activities. Yet, when it comes production, their global presence results far less marked. Only 6% of firms outsource part of their production abroad and 5% base some of their processes and services directly overseas. Overall, around 14% of firms results highly integrated in global value chains[3] (with Lombardia in line with the sample average together with Bayern, and Baden-Württemberg excelling with a share of 18%).

Although the dominant organizational model across regions remains the family-owned and family-run business, a gradual shift towards decentralization and performance-based remuneration policies is taking place.

It is true that decentralized management, whereby managers enjoy some degree of autonomy in decision making, applies to 26% of firms only (20% considering family-owned firms). Instead, performance-based remuneration policies are spreading faster, reaching 47% of firms in 2017 compared to 38% in 2015 and 2013.
However, European manufacturers appear oriented towards more decentralization: around 14% of firms claim having increased the degree of autonomy allowed to their managers over 2015-2017, vs averages of 9% between 2013 and 2015.
In Lombardia the trend is consistently positive: performance-based remuneration policies spread from 20% of firms in 2013 to 34% in 2017, while the share of firms increasing their decentralization efforts have reached 12% of the sample, twice the average in the 2013 and 2015.

Finally, in all regions the dependency on bank credit remains a potential weakness in future economic downturns, although, access to credit has improved in recent years.

The share of firms requesting bank credit grew to 47% in 2017 from 30% in 2013. The share of firms obtaining the requested loan increased as well to 97% in 2017 (vs 82% in 2013).

[3] *High integration in global value chains is when firms either export or import and, at the same time, either outsource or offshore.*

One last highlight from the 2019 Benchmark analysis stems from the new chapter on medium enterprises[4] in Lombardia.

Considering all firms observed over the three waves of the Benchmark analysis, **compared to the rest of the regional production system medium firms in Lombardia result particularly dynamic and innovative, with a stronger international presence and a better technological standing, and more responsive to the cultural transition towards managerialization**.

As a matter of fact, compared to the other firms in the region, medium firms are more innovative: the share of firms having conducted R&D and that of firms using IPP instruments are higher respectively by +25 p.p. and +13 p.p., and an advanced level of smart manufacturing[5] is almost four times more common. Considering internationalization, 86% is the share of systematic exporters in the case of medium firms, 55% the equivalent share for all other firms in Lombardia. As to managerialization, the share of firms implementing performance-based remuneration policies almost doubles (47% of medium firms vs 26% in the other firms in Lombardia).

The competitiveness of Lombardia's medium firms is still evident in the international comparison. However, consistently with previously-discussed findings on Lombardia's overall international stance, technological transfer and managerial culture remain critical issues.

Overall medium firms in Lombardia perform in line with their peers in the benchmark European regions, however there is a gap to bridge as to the share of firms using IPP instruments (-15 p.p. compared to medium firms in Europe) and the share of firms decentralizing management and implementing performance-based remuneration policies (both at -13 p.p. from European peers).

[4] *In line with the criteria set by the European Commission, medium firms are those employing between 50 and 249 persons employed.*
[5] *Please refer to note 2.*

Preface

Assolombarda's research "The performances of European firms: a benchmark analysis"[6] aims at deriving policy suggestions from an in-depth analysis of European manufacturers' strategies and challenges, drivers and constraints, in the aftermath of the 2008 crisis. Inspired by – and built to be comparable with – the 2010 survey "European firms in a global economy: internal policies for external competitiveness" (EFIGE),[7] Benchmark analysis focuses on five key productive regions in the European Union, similar by economic structure: Lombardia (Italy), Baden-Württemberg and Bayern (Germany), Cataluña (Spain) and Auvergne-Rhône-Alpes (France).

Published in 2016 on 2011-2013 data, the first edition of the survey explored firms' competitiveness beyond balance-sheet numbers, looking into internationalization and innovation, labour force and governance, finance and bureaucracy.

Since then, Assolombarda has continued in its analytic and interpretative efforts. The first edition was followed by the publication in 2017 of the report on 2013-2015 data. That second edition featured a focus on digitalization and smart manufacturing: for the first time it was possible to measure and compare the efforts of European regions in the transition towards the so-called 4.0 paradigm.

This third edition, based on 2015-2017 data, further stretches the timeline and enriches the database. The latter importantly includes updated, representative firm-level data from 2011 to 2017, comparable through time and across five of the most productive regions in Europe. This third edition also features a new in-depth analysis on medium firms in Lombardia. Benchmark analysis hence provides an ever more solid numeric base from which gathering insights and advancing policy suggestions for the competitiveness of European industry.

The 2019 report is organized as follows. Chapter 1 focuses on research and development (R&D), organizational, product and process innovation, and technological transfer. Chapter 2 describes the state-of-the-art in the transition towards Industry 4.0 focusing on investment in and use of advanced digital equipment. Chapter 3 considers internationalization, both in terms of trade (exports and imports) and in terms of production (international outsourcing, offshoring and global value chain participation). Chapter 4 on structure and labour force explores the way firms are organized (ownership and managerial models, labour force composition skills and trends) and their type of production (value chain segment and subcontracting). Chapter 5 investigates access to credit, debt composition and bureaucracy. Finally, Chapter 6 delves into the performance of medium firms in Lombardia in the comparison with the rest of the regional production system and with medium firms in Europe.

The Appendix profiles the regions chosen, provides details on the methodology, and includes the regression analyses exploring productivity dynamics and the correlation among a selection of key variables included in the report.

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[6] *Hencefoward referred to as "Benchmark analysis".*

[7] *EFIGE is an international research project run in 2010, coordinated by Bruegel (Brussels) and financed by the Seventh Framework Programme of the European Union. It is available at www.efige.org.*

Innovation

The propensity to research and innovate is spreading and growing among manufacturing firms. 2015-2017 data seem to support the hypothesis that firms in Lombardia, Cataluña and Rhône-Alpes are catching up to their German peers. However, in terms of technological transfer, especially compared to Baden-Württemberg the other regions still struggle.

1.1 Introduction

Innovation enables countries to be more competitive and more adaptable to change. It provides the foundations for new businesses and new jobs, it boosts growth and productivity, while also helping address social and global challenges such as health, climate change, energy and food security.

Innovation starts with research and development (R&D), and then moves far beyond the confines of research labs to consumers everywhere, from business to government, across sectors, across borders. Innovation is an ecosystem rather than a process: the interactions between the educational system and research, between companies and institutions are the driving forces for the creation and implementation of knowledge, triggering virtuous dynamics that lead to technological transfer and further innovation and development. This ecosystem is a fundamental source of competitive advantage for territories.

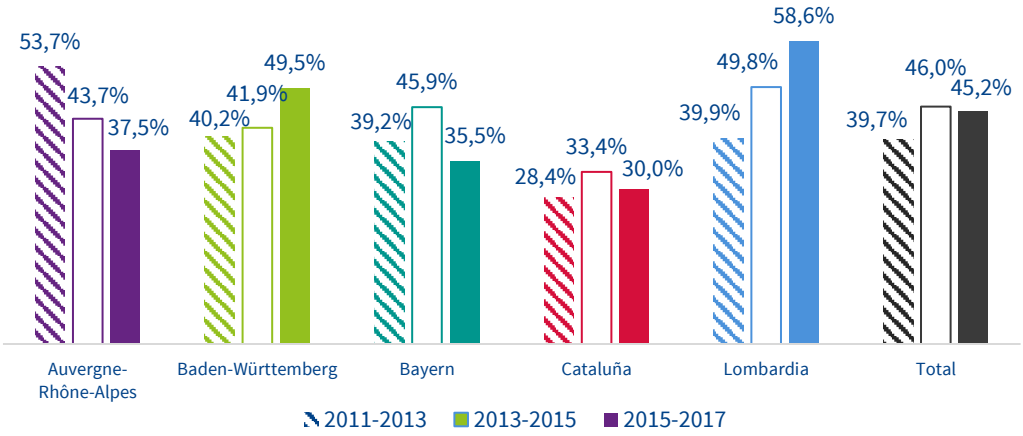
At the core, innovation has been measured along four categories: product, process, marketing, organizational. However, innovation is being transformed by technology in the way it happens. Digitalization indeed lowers production costs, promotes open innovation, creates new opportunities of stakeholder engagement and blurs the line between manufacturing and services. Innovation then results from different strategic choices which are not limited to R&D – intra muros or collaborative – but extend to investment in equipment, use of ICT and emerging technologies in production processes, new forms of labour and business organization, not to mention intellectual property protection.

In order to harness the full promise of innovation on the economy and the society, it is essential to better understand these evolutions in the innovation landscape – in particular as new opportunities might coincide with growing performance disparities across countries and regions. This chapter explores the performance of a key actor of the innovation ecosystem – manufacturing firms – from a regional perspective. Leaving the analysis of smart manufacturing trends to Chapter 2, the next paragraphs report on R&D activities, organizational, product and process innovation and technological transfer.

1.2 Research and development

Firms having reported some form of R&D over the period 2015-2017 are 45.2% of the total, up from 42.8% on average over the previous two periods (2013-2015 and 2011-2013). Lombardia and Baden-Württemberg set above the sample average, both regions showing an upward trend compared to 2011-2013. Lombardia improves the most, boasting as many as 58.6% of firms in the sample conducting R&D in 2015-2017 (compared to 49.8% in 2013-2015 and 39.9% in 2011-2013), while Baden-Württemberg comes in second-best with an equivalent figure of 49.5% (vs 41.9% and 40.2% in 2011-2013 and 2013-2015 respectively).

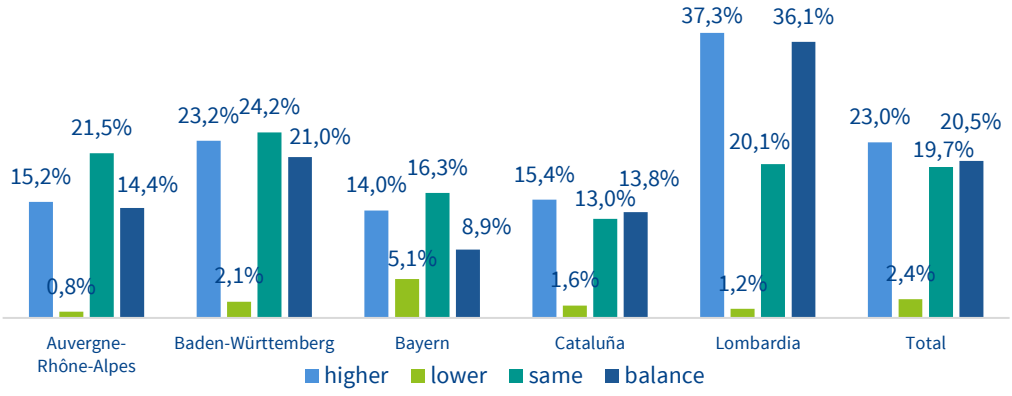
Figure 1.1 Firms having conducted R&D over the past three years (% of total firms, 2011-2013, 2013-2015 and 2015-2017)



Source: Assolombarda, Benchmark analysis

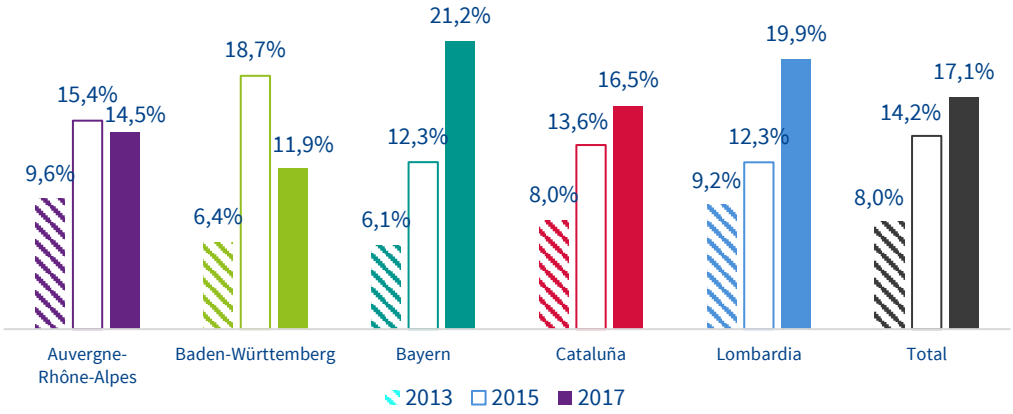
At the same time, in 2017 firms expanding or consolidating their R&D efforts compared to previous years are around 40% of the sample, whereas fewer than 3% of firms claim to have downsized their activities. Human capital investments follow the trend: on average, persons employed in R&D have raised to 17% of the total workforce in 2017, compared to 14% in 2015 and 8% in 2013 – with especially marked increases in Bayern, Cataluña and Lombardia.

Figure 1.2 Level of R&D efforts (% of total firms, 2015-2017)



Source: Assolombarda, Benchmark analysis

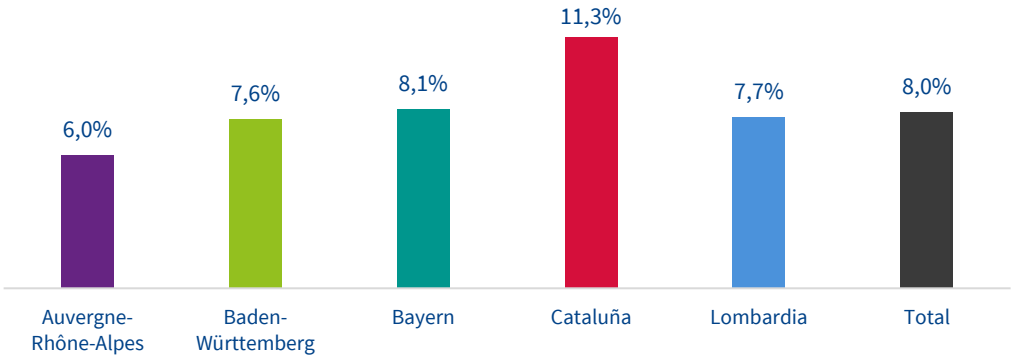
Figure 1.3 Persons employed in R&D (average % of total workforce, 2013, 2015 and 2017)



Source: Assolombarda, Benchmark analysis

On average firms incur R&D investments for 8% of their turnover, with shares ranging from 6% in Rhone-Alpes to 11% in Cataluña (with figures remaining essentially unchanged across waves) (Figure 1.4).

Figure 1.4 Investment in R&D (average % of turnover, 2015-2017)



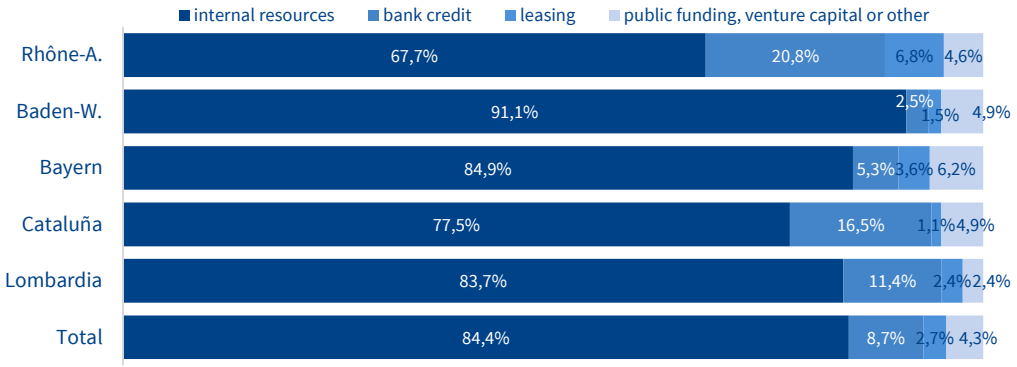
Source: Assolombarda, Benchmark analysis

Substantially unchanged is also the structure of R&D financing and the patterns of R&D collaborations (Figure 1.5 and Figure 1.6). The structure of R&D financing is largely the same everywhere in the sample: around 85% of firms rely on internal resources, 9% on bank credit and the residual 6% choose among leasing, public financing, venture capital or other sources of funding. As to patterns of R&D collaborations, these change across regions, with Lombardia standing out for the relevance of collaborations with private research centres (activated by 37% of firms vs a sample average of 22%).

To support their R&D activities, around a third of firms in the sample take advantage of the dedicated fiscal incentives (Figure 1.7). In Lombardia the figure reaches 53% (up from 32% both in 2015 and 2013), presumably reflecting the popularity of the R&D tax credit introduced in 2015 and reinforced in 2017.[8]

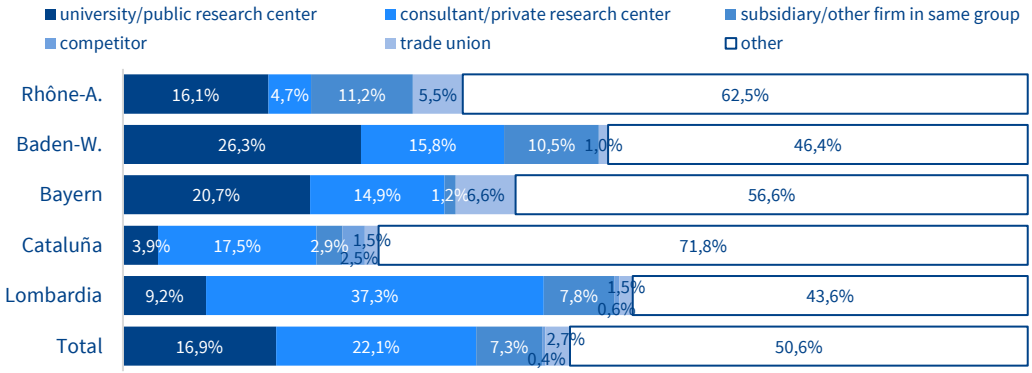
[8] *The tax relief ceiling increased indeed from €5 million in 2016 to €20 million in 2017.*

Figure 1.5 R&D financing by source (average % of total funding, 2017)



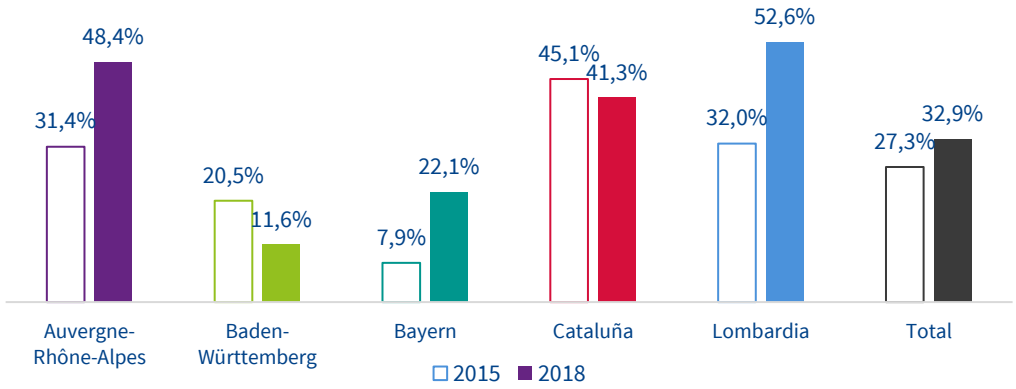
Source: Assolombarda, Benchmark analysis

Figure 1.6 R&D partern by type (% of firms conducting R&D, 2015-2017)



Source: Assolombarda, Benchmark analysis
Note: "other" includes "none" (no collaboration) and "other" (other forms of collaboration compared to those considered)

Figure 1.7 R&D incentives (% of firms conducting R&D, 2015-2017)

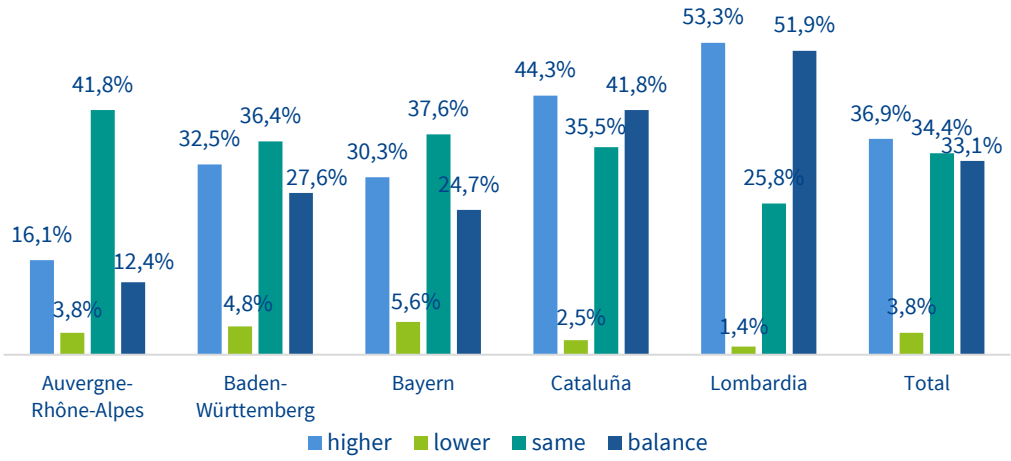


Source: Assolombarda, Benchmark analysis

1.3 Product, process and organizational innovation

Innovation propensity is growing and spreading among manufacturing firms (Figure 1.8). Those declaring to have increased their innovation activities in 2015-2017 are 37% of the total (up from 31% in 2013-2015 and 2011-2013).
The hypothesis[9] of Lombardia, Cataluña and Rhône-Alpes catching-up to their German peers arguably finds further supporting evidence. While the majority of German firms tend to have a similar (rather than higher) level of innovation with respect to previous years, Lombardia boasts as many as 53% of firms increasing their innovation activities in 2015-2017 (vs 39% in 2013-2015), Cataluña 44% (largely in line with 46% in the previous period). In the case of Rhône-Alpes the equivalent figure is 16%. However, this might reflect a consolidation rather than a setback, as 42% of firms are consolidating their innovation efforts in 2015-2017 while 50% were enhancing their innovation activities in 2013-2015.

Figure 1.8 Change in innovation activities (% of total firms, 2015-2017)

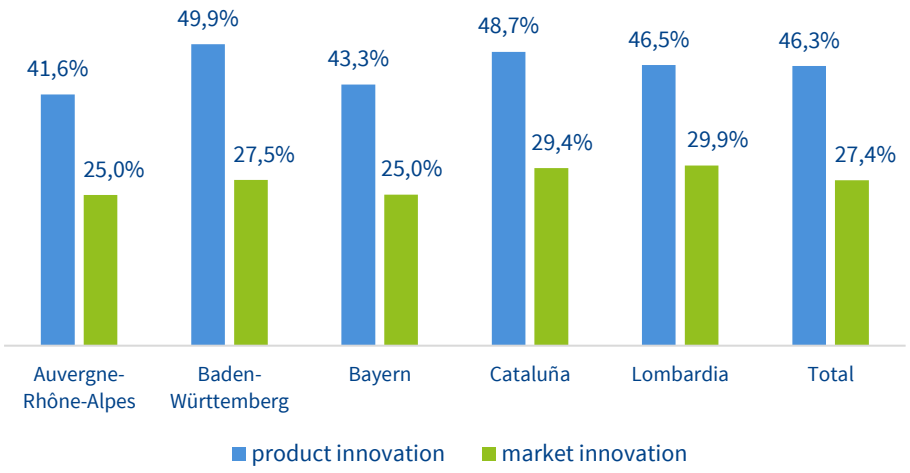


Source: Assolombarda, Benchmark analysis

The overall positive trend is visible at large across all types of innovation. Product innovation (Figure 1.9) continues to concern around 46% of firms in the sample, a figure largely stable across all regions except from Baden-Württemberg, which records a significant increase (50% of firms in 2015-2017 vs an average of 41% in the previous two periods). Around half the time, product innovation coincides with market innovation (27% of firms in the sample, ranging from 25% in Bayern and Rhône-Alpes to 30% in Lombardia). Similarly, process innovation is conducted by 40% of surveyed firms, in this case with Lombardia boasting the most relevant improvement (50% of firms up from 44% in 2013-2015 and 31% in 2011-2013) (Figure 1.10). In the case of Lombardia, this evidence gains in significance considering that in 70% of cases those firms conducting process innovation have also introduced product innovation, suggesting that innovation and 4.0 paradigms might be changing not just production output but also production logics in firms.
The economic returns of product innovations are evident: the sale of innovative products accounts for as much as 25% of turnover on average in the sample (29% in Lombardia).

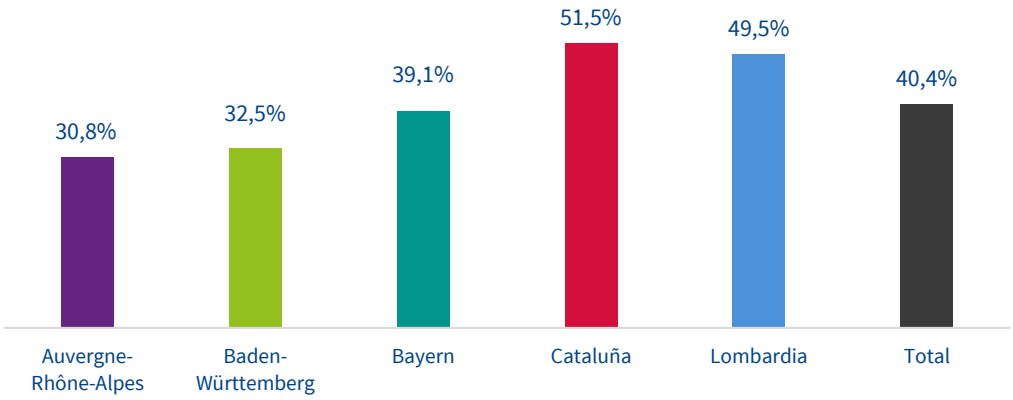
[9] *Already stated in the previous editions of the Benchmark Analysis. See for instance the 2017 Report.*

Figure 1.9 Product innovation and market innovation (% of total firms, 2015-2017)



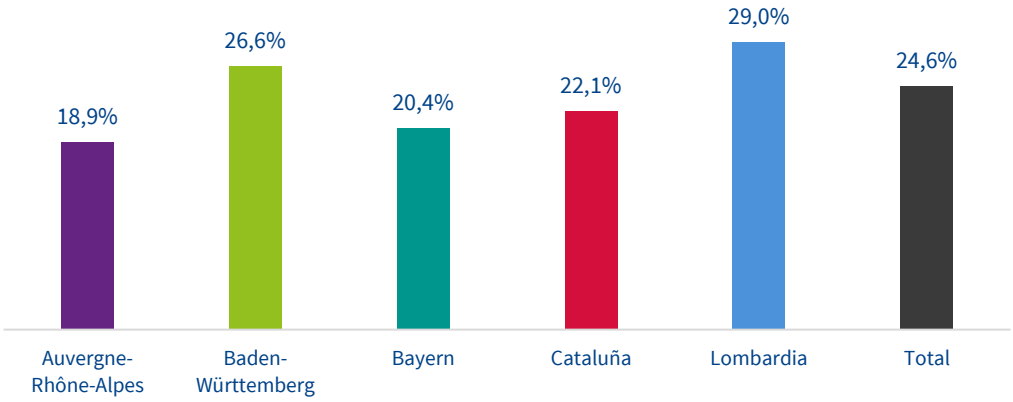
Source: Assolombarda, Benchmark analysis

Figure 1.10 Process innovation (% of total firms, 2015-2017)



Source: Assolombarda, Benchmark analysis

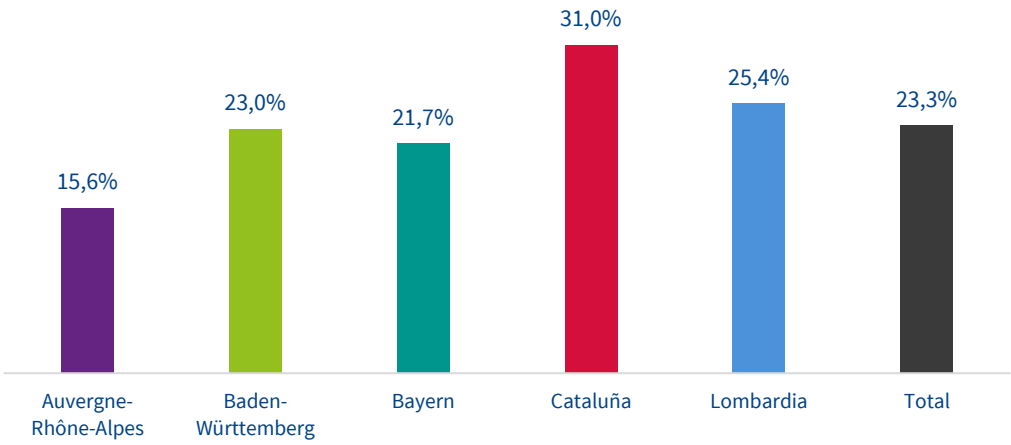
Figure 1.11 Sales of innovative products (average % of turnover, 2015-2017)



Source: Assolombarda, Benchmark analysis

Finally, largely consistent across periods is the share of firms conducting organizational innovation (23% in 2015-2017, vs 22% in 2013-2015), a figure which is confirmed higher than the sample average for Cataluña (31%) and Lombardia (25%) (Figure 1.12).

Figure 1.12 Organizational innovation (% of total firms, 2015-2017)

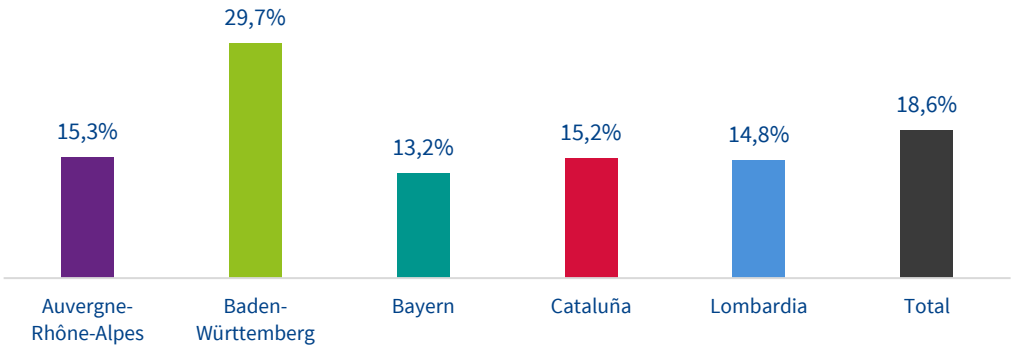


Source: Assolombarda, Benchmark analysis

1.4 Technological transfer

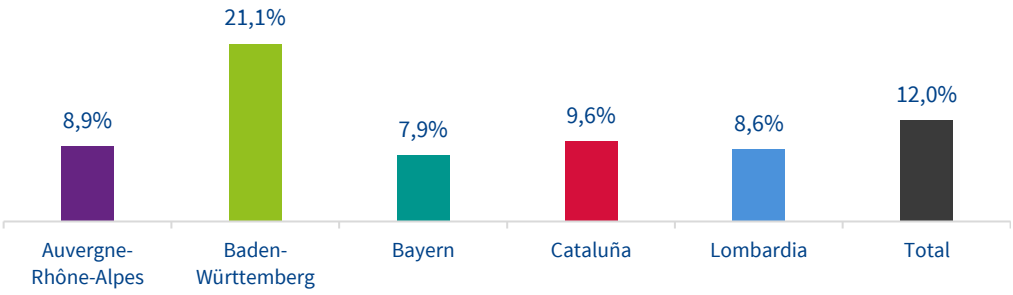
Some 19% of firms in the sample have used at least one Intellectual Property Protection (IPP) instrument in the years 2015-2017, substantially in line with the average of the previous two periods, 2011-2013 and 2013-2015 (20%) (Figure 1.13).
In Lombardia the same figure sets at 15%, slightly higher than the average of the previous periods (13%). Still, the share of firms doing technological transfer is half the share recorded in Baden-Württemberg (30%, up from an average of 21%).
Also, in 2015-2017 only 9% of firms in Lombardia have applied for a patent – the preferred IPP instrument when it comes to scientific-technological innovations. This figure being in line with the past two-period average and comparing to a solid 8% in Bayern, it positively suggests firms are consolidating their technological transfer efforts; however, it still pales against 21% in Baden-Württemberg (Figure 1.14).
In Bayern as few as 13% of firms have used IPP in 2015-2017, compared to an average of 24%; this figure reflects a drop in the use of trademarks rather than a general decrease in technological transfer though. Especially, patent applications have not markedly decreased and still concern 8% of firms (vs 10% in the previous two periods).

Figure 1.13 Firms having used at least one IPP instrument over the past three years (% of total firms, 2015-2017)



Source: Assolombarda, Benchmark analysis

Figure 1.14 Firms having applied for at least one patent over the past three years (% of total firms, 2015-2017)



Source: Assolombarda, Benchmark analysis

Smart manufacturing

Baden-Wurttemberg and Bayern remain at the forefront of the 4.0 paradigm in terms of investments, readiness and implementation. Lombardia and the other regions are trying to catch up.
Rather than investment, the challenge appears to be integrating 4.0 equipment into production processes, suggesting firms are still in a transition phase.

2.1 Introduction

The fourth industrial revolution – so-called «Industry 4.0» – relies on the adoption of digital technologies to gather data in real time and to analyse it, to integrate space, people and information within the firm and along the entire value chain, ultimately increasing the efficiency of production and adding value to the product entire life cycle.

Industry 4.0 relies on technologies such as the Internet of Things (IoT), Cloud Computing and Big Data and Analytics. These create the complex cyber-physical architecture of the new manufacturing system, providing connectivity and intelligence to production-oriented technologies such as 3D printing, robotics, advanced human-machine integration.

At the core of Industry 4.0 lies the *smart manufacturing* concept, which might be defined as a production system made to be flexible (i.e. responding to changing conditions and customer needs and, at the same time, extremely adaptable to multiple types of products), to deliver quality, and to enhance efficiency. Together with smart manufacturing comes an evolution of the human role in production, with new skills demanded but also new forms of job management, in relation to both time and place labelled *smart working*. Moreover, supply chains become digital, allowing to synchronize production with suppliers to reduce delivery times and information distortions (*smart supply chain*) while at the same time products become technology-embedded, favouring data feedback instrumental to predictive manufacturing and customization (*smart products*).

Considering the scale of the phenomenon, the impact of the 4.0 paradigm on industrial performance and productivity is expected to be massive. How then are manufacturing companies shifting towards the 4.0 paradigm? What technologies are they adopting and in which ways?

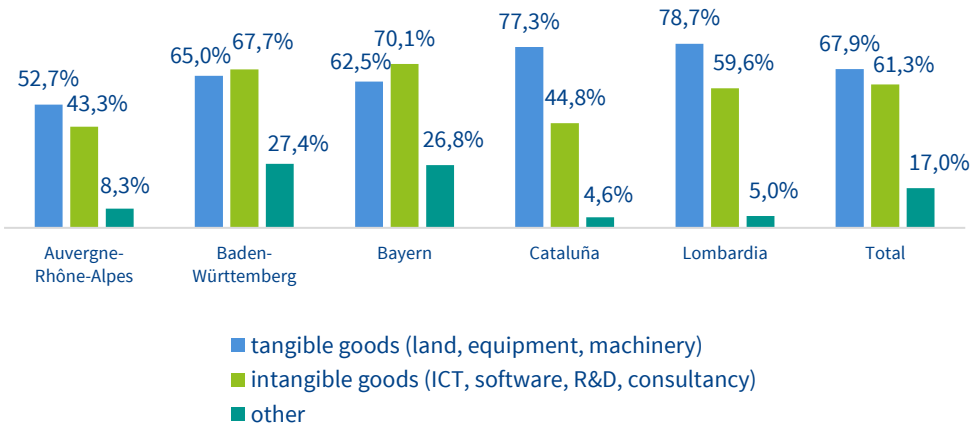
This survey capitalizes on the findings from the 2017 edition by focusing on adoption patterns of Industry 4.0 technologies in core European manufacturing regions.

2.2 Investment in equipment and ICT

The transition towards Industry 4.0 might be captured in part by looking at investment data.

Over the years, firms in the sample have tended to invest in tangible goods (67.9%) rather than intangibles (61.3%) (Figure 2.1). Compared to average, firms in German regions appear more prone to invest in ICT, software and other intangible goods rather than land and equipment (68.9% vs 63.8% of firms respectively). On the contrary, firms in Lombardia[10] and Cataluña largely focus on tangible goods. This evidence is in line with data on investments intensive margin (Figure 2.2): while firms in Baden-Württemberg and Bayern on average dedicate 43% of their total investments to tangible goods and 23% to intangible goods – closely imitated by firms in Rhône-Alpes – firms in Lombardia and Cataluña still see the bulk of their investment allocated to equipment, leaving a residual 14.5% to ICT, software and other intangibles.

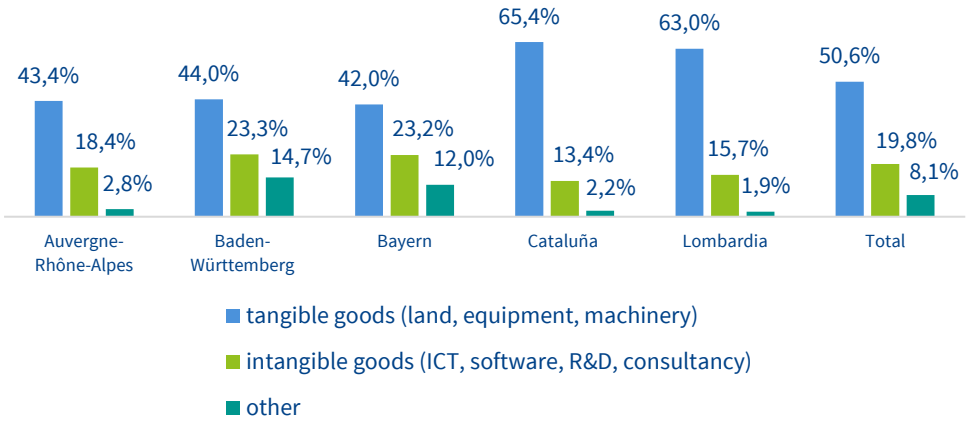
Figure 2.1 Investments by type of good (% of total firms)



Source: Assolombarda, Benchmark analysis

[10] *The evidence on Lombardia concerning investments by type is largely consistent with figures from other surveys, which all portray a lively investment cycle in the region especially in equipment and 4.0 technologies. According to a survey by Unioncamere Lombardia, 64% of manufacturing firms made an investment in 2017, the highest share since 2008, with investments in machinery being the most frequent (92% of cases, 63% of value invested) followed by software and ICT (63% of cases, 11% of value). Similarly, a survey by Banca d'Italia finds that in 2017 around 50% of manufacturing firms invested in 4.0 technologies.*

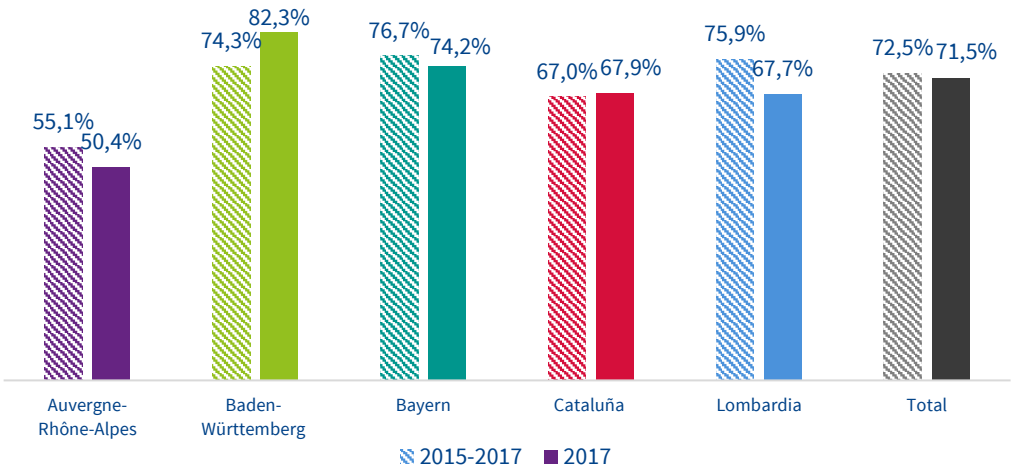
Figure 2.2 Investment by type of good (average % of total investment)



Source: Assolombarda, Benchmark analysis

Looking at data on more recent years, all in all surveyed firms investing in new equipment and ICT slightly decrease in 2015-2017, reaching 73% of the sample down from 80% in 2011-2013 and 2013-2015 (Figure 2.3). Firms in Lombardia experience the opposite trend (76% in 2015-2017 vs an average 69% of the previous periods), hence aligning to their German peers (the equivalent figure is indeed 74% in Baden-Württemberg and 77% in Bayern). Anyway in 2017 alone German firms are still those innovating their equipment the most, with around 80% of firms investing compared to a sample average nearly 10 percentage points smaller (72%; Lombardia 68%).

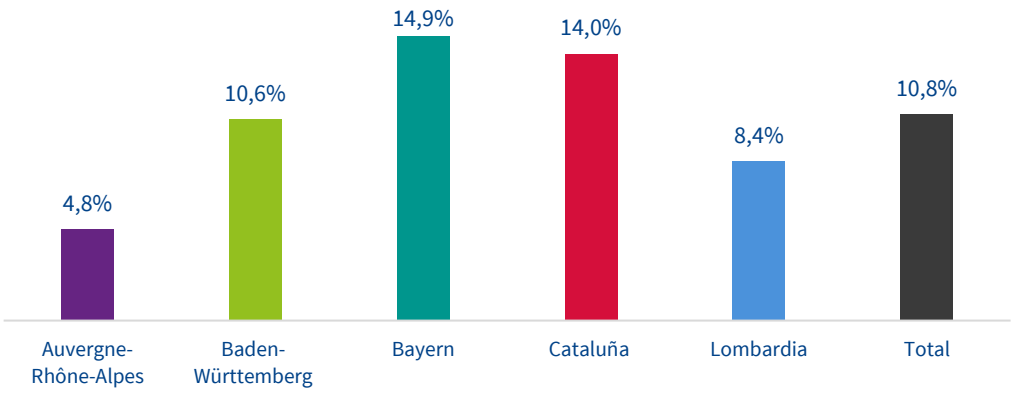
Figure 2.3 Investments in ICT and equipment (% of total firms, 2015-2017 and 2017)



Source: Assolombarda, Benchmark analysis

When looking at investment intensity, on average firms committed to ICT and equipment 10.8% of their turnover in 2015-2017 largely in line with 8.8% in 2013-2015 and 2011-2013 and without statistically significant discrepancies even when considering single regions (Figure 2.4).

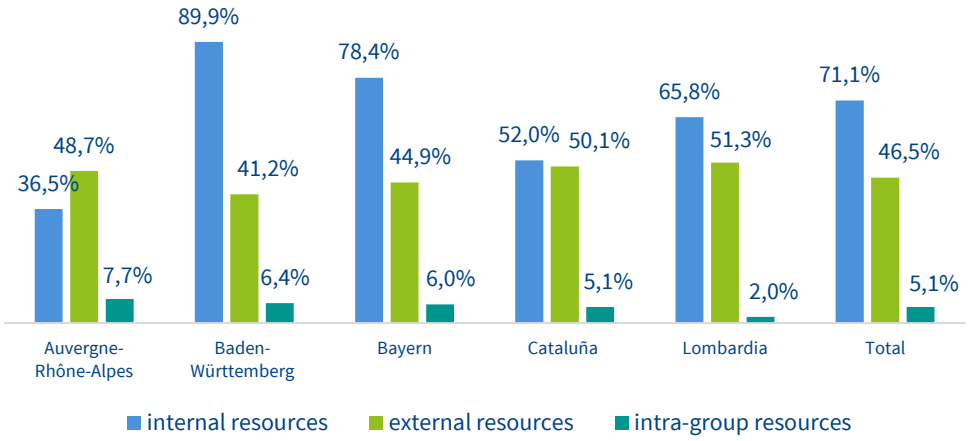
Figure 2.4 Average investment in ICT and equipment (% of turnover, 2015-2017)



Source: Assolombarda, Benchmark analysis

Over the years, firms have mostly relied on internal rather than external resources to finance their investment (71% vs 47% respectively) (Figure 2.5). Financing choices however differ across regions based on the dominant governance structure. As analysed in greater detail in Chapter 4, firms in Lombardia, Baden-Württemberg and Bayern see a dominant share of family-owned and family-run firms, which tend to be "self-reliant" when it comes to financing investments (66% of firms in Lombardia use internal resources, up to 90% in Baden-Württemberg). Firms in Rhône-Alpes and Cataluña are instead more used to recurring to the market due to relatively more open corporate settings.

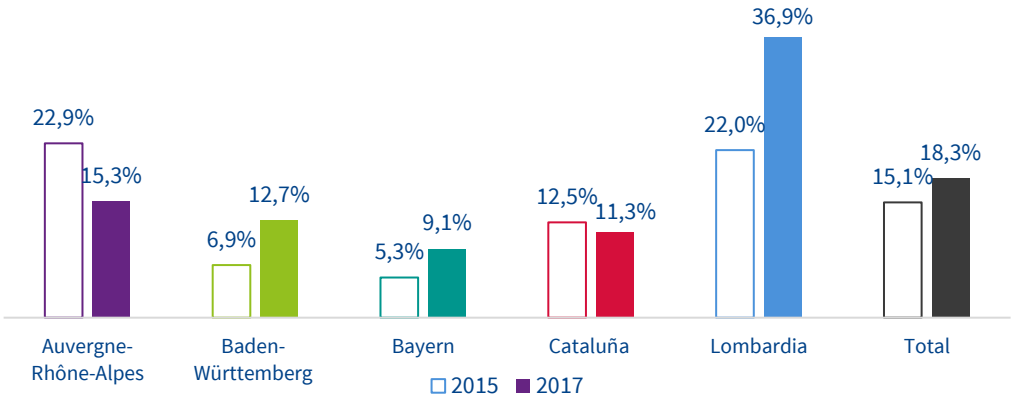
Figure 2.5 Sources of financing for investments (% of total firms)



Source: Assolombarda, Benchmark analysis

Firms in all regions anyway did not disdain fiscal incentives and tax cuts (Figure 2.6), the recurrence to which is largely consistent across waves, except from Lombardia with almost 40% of firms making use of incentives – up from 22% in 2015, likely reflecting the reach of the national industrial plan "Impresa 4.0".

Figure 2.6 Fiscal incentives and tax cuts (% of total firms, 2015 and 2017)

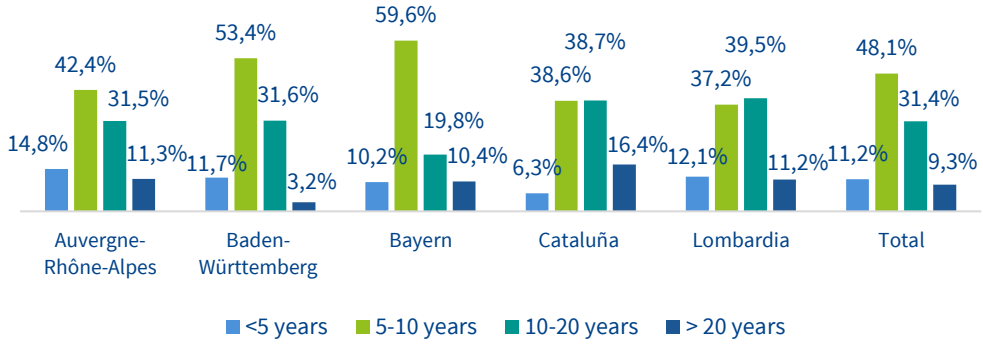


Source: Assolombarda, Benchmark analysis

Different investment attitudes arguably result into different levels of implementation and readiness to further developments of the 4.0 paradigm, with firms in Germany emerging at the forefront and their peers trying to catch up.

This is true starting from the distribution of firms based on the age of equipment (Figure 2.7). Almost 70% of firms in Germany have equipment less than 10 years old, compared to a sample average of 60% (Lombardia 49%).

Figure 2.7 Firms by age of equipment (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

2.3 Digital production

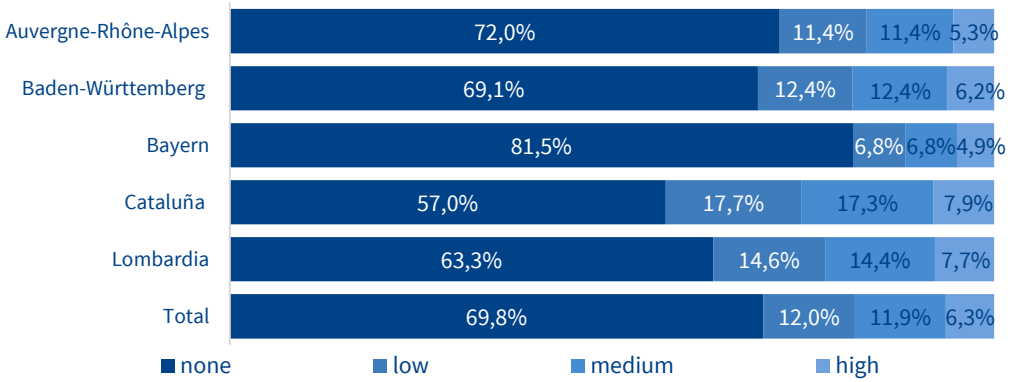
The progress in shifting towards a smart manufacturing system might also be inferred from data on the type of equipment used and its integration into production processes. In order to measure the level of smartness of firms using more than just single machines, an indicator was designed combining type of equipment, level of integration and use of 4.0 production technologies among industrial robots, 3D printing and RFID technology. Smart manufacturing is therefore split into four levels:

1) “none” if the firm has single machines and no smart manufacturing instrument;
2) “low” if the firm has either automatic loading systems, mechanically- or digitally-integrated equipment together with at least one among the 4.0 production technologies indicated;
3) “medium” if the firm has at least mechanically- or digitally-integrated equipment together with minimum one among the 4.0 production technologies indicated;
4) “high” if the firm has both mechanically- and digitally-integrated equipment and at least one among the 4.0 production technologies indicated.

The indicator thus depends on the availability of 4.0 equipment and increases according to the level of machine integration. “High smart manufacturing” should then capture those firms already at an advanced stage of understanding and implementation of the new production paradigm.

All in all, despite investments, there is still a relevant share of firms that have not started implementing the new paradigm yet, presumably acquiring some 4.0 equipment without integrating it into production processes. As Figure 2.8 shows, only 18.2% of firms in the sample qualify as medium or high smart manufacturers, with the share ranging from 25.2% of firms in Cataluña down to 11.7% in Bayern, and Lombardia achieving 22.1%. Perhaps counterintuitively, none of the German regions stands out. This result arguably suggests a partly different perception of smart manufacturing, especially equipment integration, across regions. Besides, when focusing on digital equipment integration only and selecting for firms which already have industrial robots, the picture slightly changes.

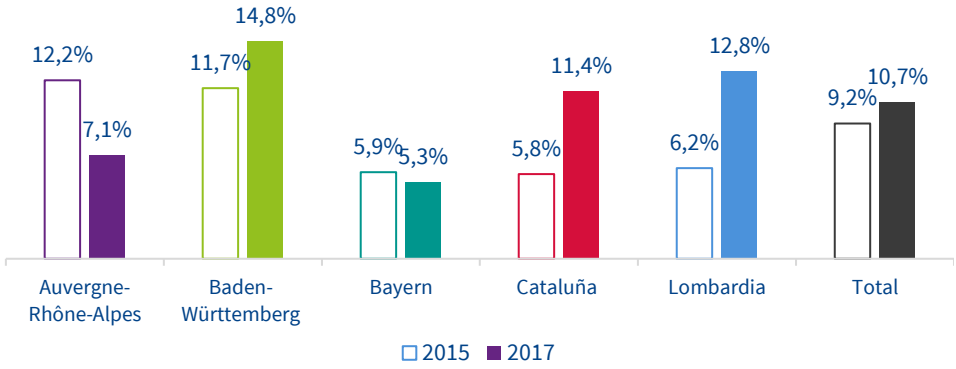
Figure 2.8 Smart manufacturing (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Figure 2.9 reports the share of firms with digitally-integrated machines and industrial robots that further add either sensors for equipment monitoring identification and integration (RFID technology) or mobile devices for production management and control (advanced human-machine interface). Compared to the previous edition, the figure increases in all regions (except from Rhône-Alpes and Bayern, where it slightly decreases). Baden-Württemberg is top performer (14.8%, + 4 p.p. compared to the sample average). Lombardia closely follows, having seen its share double from 6.2% in 2015 to 12.8% in 2017.

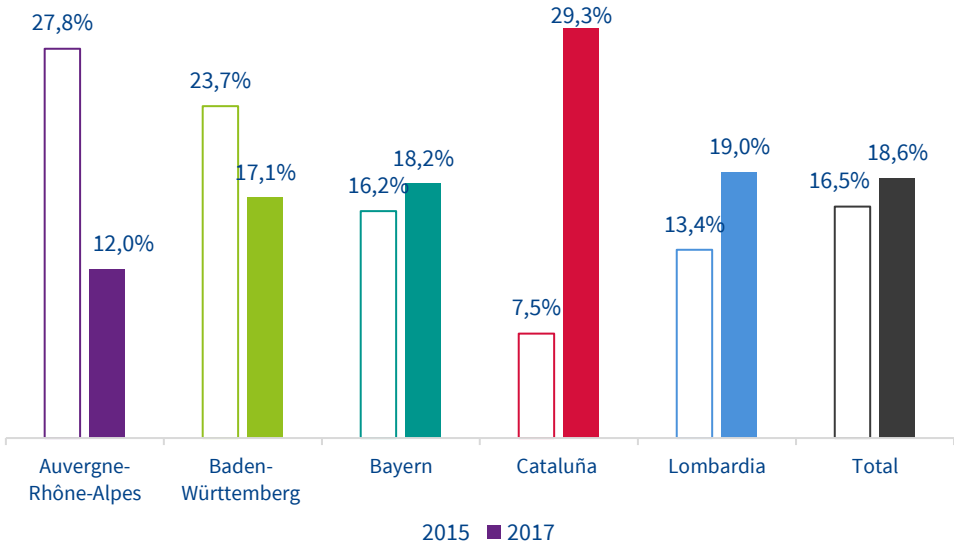
Figure 2.9 Firms integrating equipment with smart manufacturing instruments (% of firms with digitally-integrated equipment, 2015 and 2017)



Source: Assolombarda, Benchmark analysis

At the same time, firms with digitally-integrated machines expecting to further advance their smartness by getting 4.0 production and control technologies, i.e. industrial robots, RFID or mobile devices, near 20% of the total - with prospective 4.0 adopters remaining high in Germany and increasing particularly in Lombardia and Cataluña (Figure 2.10).

Figure 2.10 Firms expecting to integrate equipment with smart manufacturing instruments (% of firms with digitally-integrated equipment, 2015 and 2017)

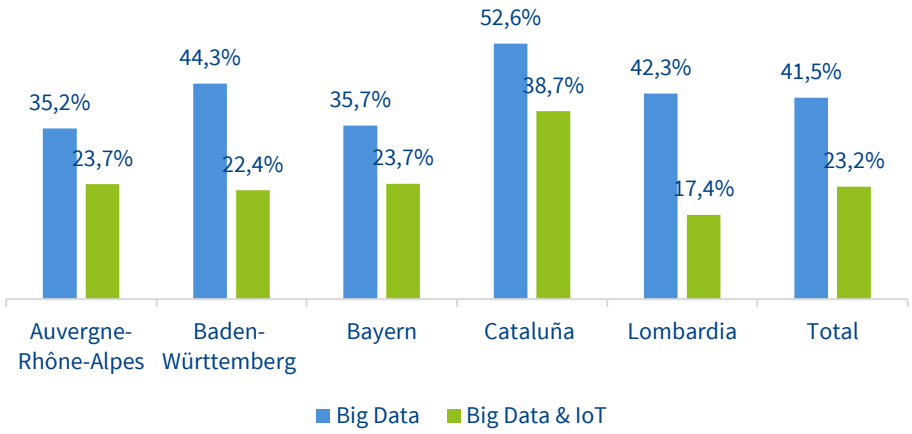


Source: Assolombarda, Benchmark analysis

Together with new production modes, firms in the sample also appear to be keen about Big Data collection and analysis (Figure 2.11). As many as 41.5% of firms in the sample claim to employ Big Data technologies, meaning they have an automatic data collection system and analyse the data collected. Over half these firms (23.2% of firms in the sample) even claim

to abide by Industrial IoT and cloud manufacturing standards, not only analysing the data collected but also sharing them across different business departments, if not along the entire value chain.

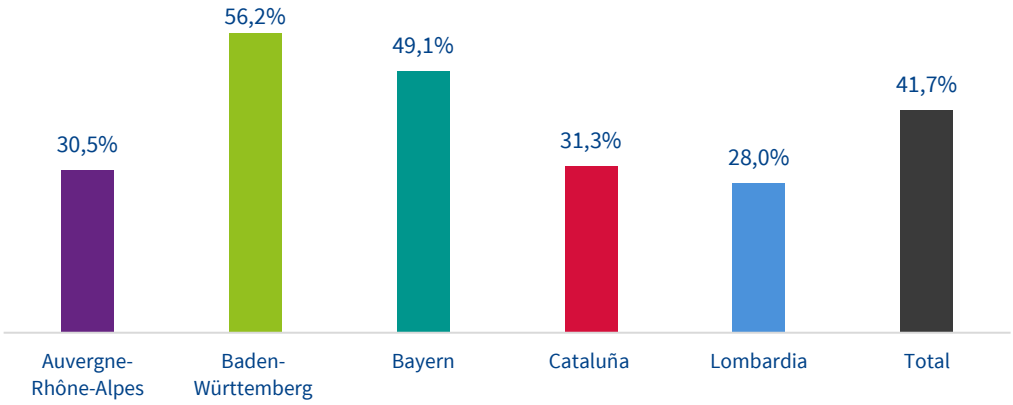
Figure 2.11 Big Data and Internet of Things (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

A boost to the transition towards smart manufacturing would ideally require the engagement of the top management or the Chief Operating Officer (COO), but could also benefit from the presence in the firm of a person in charge of digitalization at a more operative level. Firms in the sample are still struggling in this respect. Apart from Baden-Württemberg (56.2%), as few as 41.7% of firms have specifically delegated a person with the management of digitalization processes (Figure 2.12).

Figure 2.12 Firms with a person in charge of digitalization (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Internationalization

Exports are the preferred form of internationalization, compared to more sophisticated activities such as international outsourcing and offshoring. Around 14% of firms have a high participation in global value chains.
The analysis on unit labour costs (ULCs) confirms that the key determinant of the success on international markets is the quality of innovation rather than prices.

3.1 Introduction

"Internationalization" refers to all activities that put firms into a meaningful business relationship with a foreign partner, such as exports, imports, foreign direct investment (FDI - relocation or outsourcing), international subcontracting and international R&D cooperation.

Internationalization can be measured from two perspectives: «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»; «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.[11]
The two perspectives might be reconciled through the analysis of firm-level data such as those provided in this report: 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 active on international markets.

Moreover, by crossing firm-level data, tentative answers might be provided as to why firms should "go global", further building on the existing literature on the interlinks and spill overs between internationalization and competitiveness in terms of turnover and employment growth, R&D and innovation, productivity.

3.2 Exports and imports

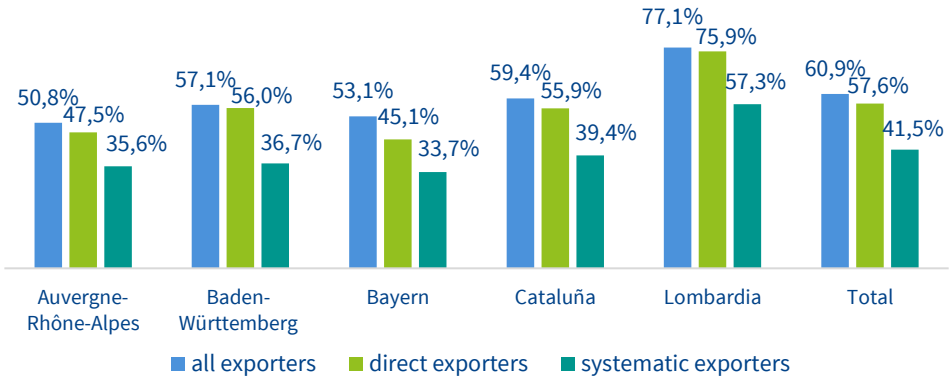
The results on commercial internationalization prove particularly consistent across waves. On average 61% of firms in the sample are internationally active (Figure 3.1). At the same time, 58% in the sample are direct exporters, meaning they directly sell from their home country to the foreign target market, without recurring to intermediaries or to branches in third countries. Firms that systematically export are also a good share (42%) of the sample. Though in all regions considered a fair portion of firms are exporters, in Lombardia almost

[11] *T. Mayer and G. I. P. Ottaviano,* The Happy Few: The internationalisation of European firms. New facts based on firm-level evidence*, Bruegel Blueprint Series, n. 3, 2007, p. 4.*

all firms have an international presence – 77% are active on international markets, 76% directly export and 57% systematically export.

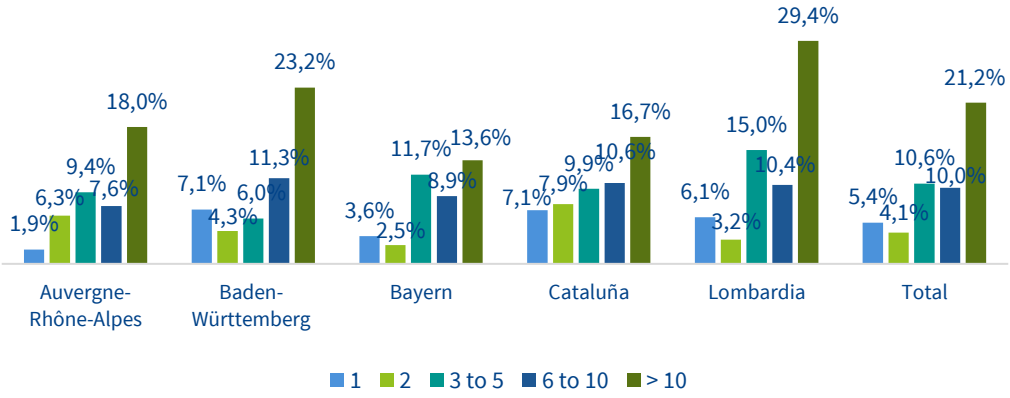
Compared to the rest of the sample, Lombardia stands out also in terms of geographic diversification. Not only it registers a significant share of firms exporting to non-EU countries (54% compared to a sample average of 41%). It also boasts the highest share of firms exporting to more than 10 countries (30% vs 21% in the sample) (Figure 3.2).

Figure 3.1 Exporters (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

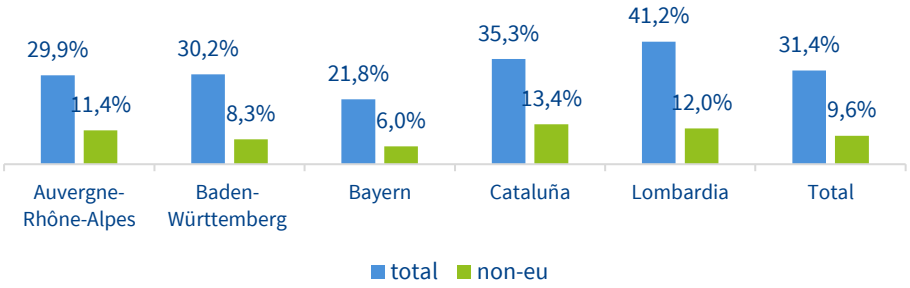
Figure 3.2 Firms by number of destination markets (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Together with the extensive margin (i.e. how many firms export) it is interesting to consider the intensive margin, i.e. the share of turnover from export activities. On average, for firms selling abroad one third (31%) of turnover stems from exports, of which 22% on EU markets and 9% on non-EU markets (Figure 3.3). In the case of Lombardia, the same figure peaks at 41% (29% on EU markets and 12% on non-EU markets).

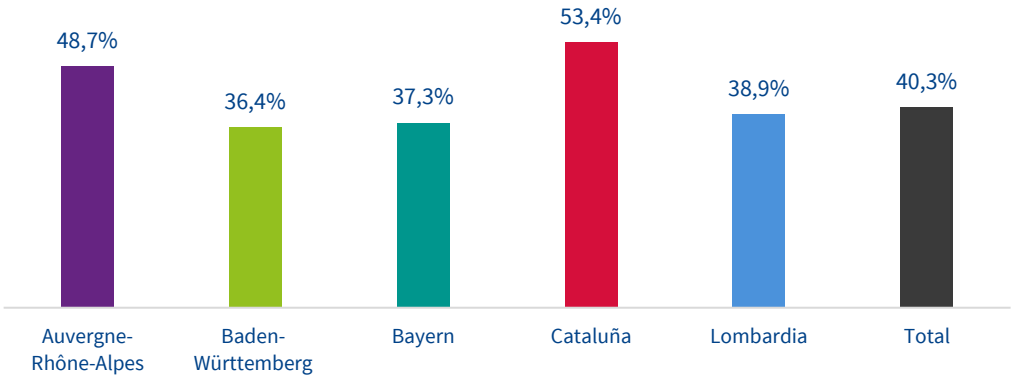
Figure 3.3 Turnover from exports (average % of total turnover, 2017)



Source: Assolombarda, Benchmark analysis

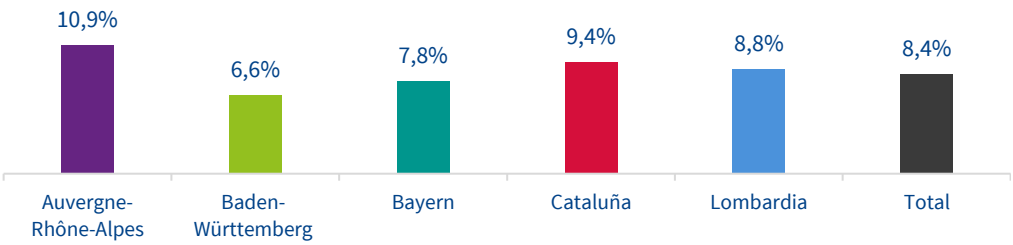
The international projection of firms in the sample is further confirmed considering import activities. As many as 40% of firms in the sample import goods and services for around 8% of their turnover (Figure 3.4 and Figure 3.5).

Figure 3.4 Importers (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Figure 3.5 Cost of imports (average % of total turnover, 2017)



Source: Assolombarda, Benchmark analysis

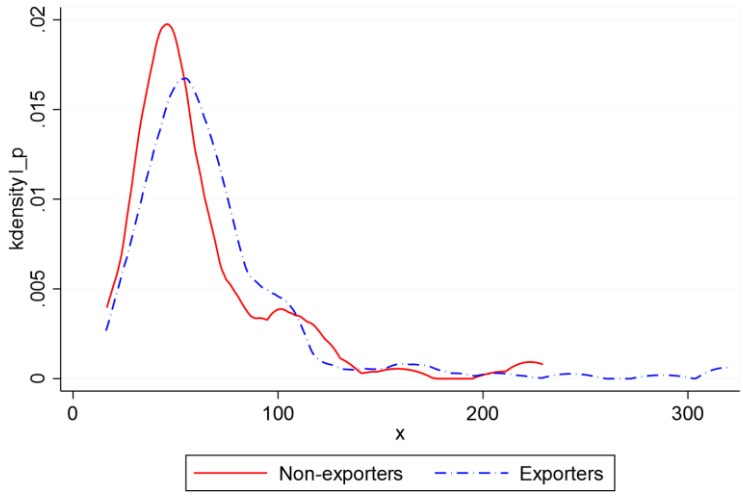
Commercial internationalization yields benefit in terms of turnover and productivity. Firms systematically selling to foreign markets are generally more competitive – and in 2017 especially record an average turnover roughly 3 times larger compared to domestic firms and occasional exporters (Table 3.1). In addition, in terms of productivity, there is a higher probability to draw an efficient firm from the pool of exporters rather than from the pool of domestic firms (Figure 3.6).

Table 3.1 Turnover: exporters vs domestic firms

	Average turnover of a systematic exporter (thousand €)			Average turnover of a domestic firm or an occasional exporter (thousand €)		
	2013	**2015**	**2017**	**2013**	**2015**	**2017**
Total	10,263.46	13,816.72	15,302.08	3,948.64	6,077.48	5,285.88
Lombardia	9,142.14	13,430.16	14,938.90	3,754.78	8,008.31	4,367.45

Source: Assolombarda, Benchmark analysis

Figure 3.6 Labour productivity: exporters vs non-exporters (k-density, total sample, 2017)



Source: Assolombarda, Benchmark analysis

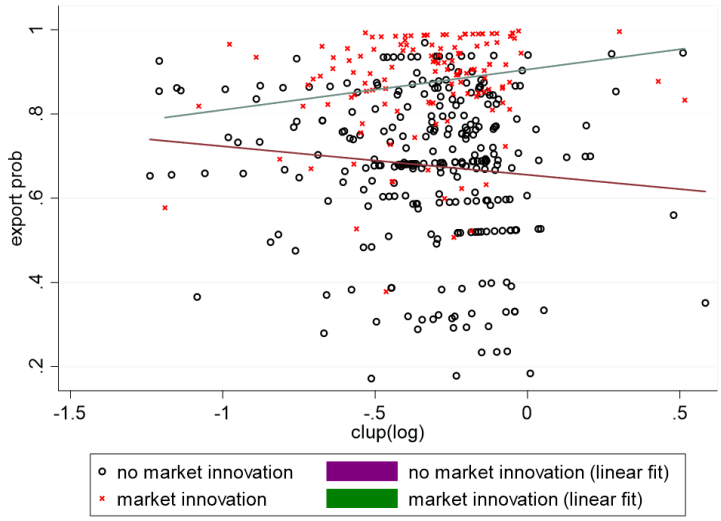
Since "going global" is associated with higher productivity and earnings, it is important to understand what drives international competitiveness. In this respect, the third edition of the survey confirms the nuances of the relationship between unit labour costs (ULCs, i.e. the average cost of labour per unit of output produced), innovation and international competitiveness found in the previous two editions.
Figure 3.7 graphs the relationship between the probability to export and quality-adjusted cost competitiveness for each wave of Benchmark analysis, 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).[12] The slope of the regression line quantifies by how much the probability to export varies as ULCs change, industry and region being equal. Across all

[12] *These results from rigorous statistical analysis. Specifically, a probit model regressing the export status on unit labour costs controlling for industry and region fixed effects.*

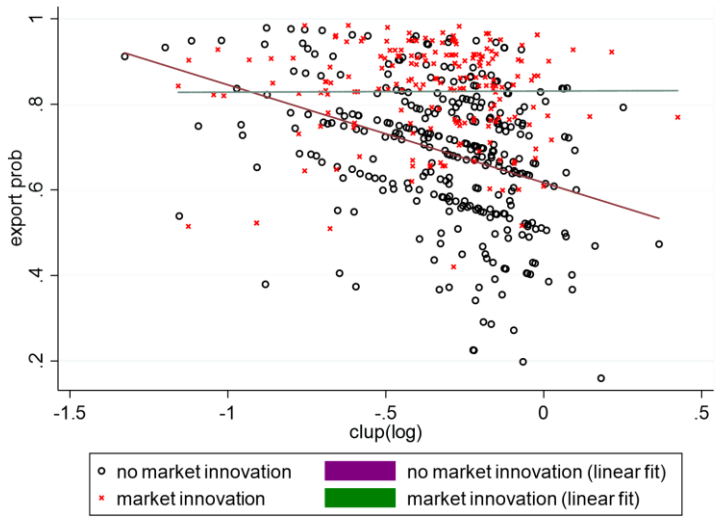
waves, data show that highly innovative firms manage to succeed internationally notwithstanding high ULCs: with reference to these firms, the key determinant of the success on international markets seems to be the quality of innovation rather than prices. Even more so as time goes by: if in 2013 a weak relationship was found between the probability to export and ULCs, in 2015 that relationship was almost non-existent (the regression line was basically flat) and in 2017 it results positive, suggesting that there is an increasing willingness to pay for a quality premium on international markets.
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 in the probability to export. 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 labour costs to a higher degree.

Figure 3.7 Probability to export, ULCs and innovation

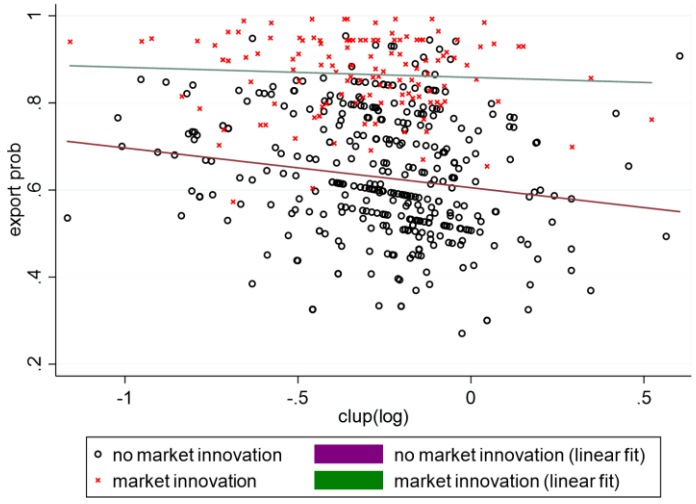
2017



2015



2013



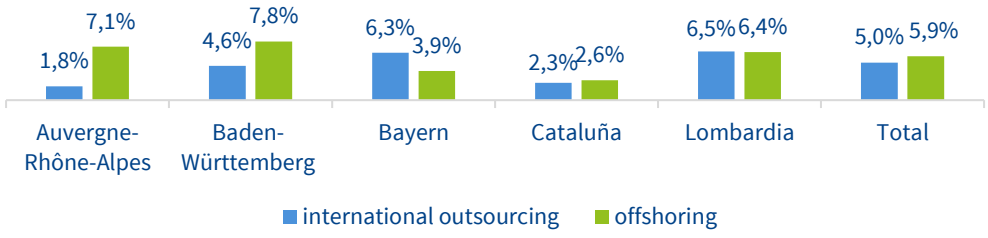
Source: Assolombarda, Benchmark analysis

3.3 Foreign direct investments

Firms in the sample are widely active on international markets in terms of commercial activities. When it comes to production though, their global presence is far less marked, an unfortunately consistent result through waves. Only 5.9% of firms outsource part of their production abroad (international outsourcing), and as few as 5.0% base some of their processes and services overseas (offshoring) (Figure 3.8). In Lombardia no strategy is neatly preferred to the other, as 6.5% of firms choose either one – the same happens in Cataluña, but the share of firms doing foreign direct investments is even smaller (2.5%). In Baden-Württemberg and Rhône-Alpes offshoring is instead the preferred choice.

In the case of Lombardia it is interesting to find that, while the share of firms doing international outsourcing (6.5%) is in line with the average of the past two periods surveyed (6.2%), there seems to be an upward trend in the share of firms offshoring part of their production (6.4% vs 3.4% on average in the previous periods).

Figure 3.8 Firms in part producing abroad through outsourcing or offshoring (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

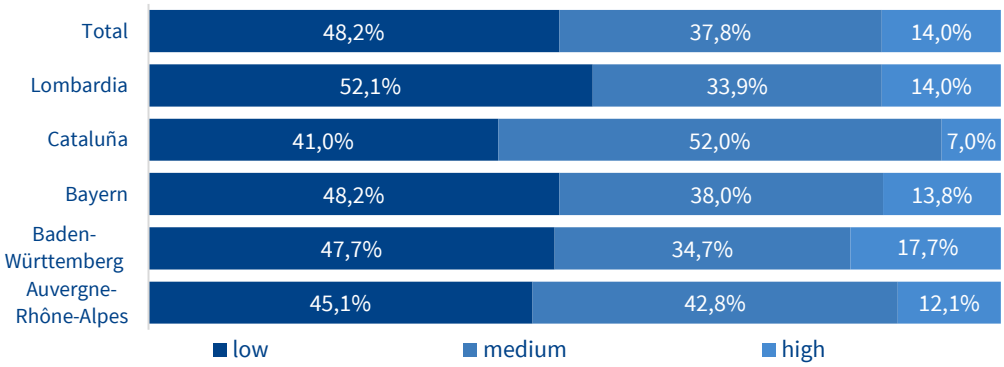
3.4 Global value chains

The complexity and combination of overseas activities (from imports and exports to offshoring) defines a firm's "global" status, with implications on the degree of participation in global value chains (GVCs). Here three degrees of GVC participation are defined: 1) *low*, if firms either export or import; 2) *medium*, if firms both import and export; 3) *high*, if firms either import or export and, at the same time, outsource or offshore.

Considering firms conducting some commercial or production activity abroad (around 70% of the sample), on average 48% have a low degree of GVC participation, 38% a medium one and 14% classify as highly integrated (Figure 3.9). Lombardia results in line with the sample average together with Bayern. Cataluña stands out for the concentration of firms in the medium GVC participation segment (52%; instead only 41% and 7% of firms in low and high participation segments respectively, both the lowest shares in the sample). Rhône-Alpes shows a rather similar distribution to Cataluña's. Baden-Württemberg boasts instead as many as 18% of firms with high GVC participation, the largest share in the sample.

As to the benefits of combining internationalization strategies, it is found once again that the higher the participation in GVCs arguably the larger and the more productive the firm (Table 3.2).

Figure 3.9 Participation in global value chains (% of internationally active firms, 2017)



Source: Assolombarda, Benchmark analysis

Table 3.2 Persons employed and labour productivity by GVC participation (2017)

		Participation in GVCs			
		None	Low	Medium	High
Persons employed	**mean**	28	29	54	98
	median	21	20	25	33
Labour productivity (€, thousand per person employed)	**mean**	61.0	69.8	67.0	75.3
	median	48.8	53.6	61.0	64.9

Source: Assolombarda, Benchmark analysis

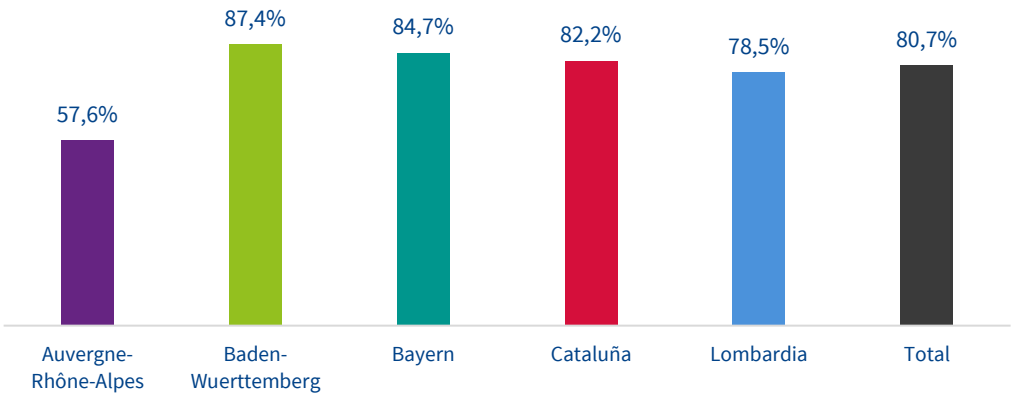
Firm structure and labour force

Family-owned and family-run businesses remain the dominant organizational model, but performance-based remuneration policies are spreading; though at a slower pace, managerial decentralization is also increasingly adopted.
Compared to rest of the sample, German firms hire more qualified human capital (the distribution of employees is consistently and markedly tilted towards qualified and managerial positions) and enjoy a consolidated position in the downstream segment of value chains.

4.1 Ownership and management

Among European manufacturing firms, the dominant ownership model is the family business, as 81% of firms in the sample are family-owned[13] (Figure 4.1). It is interesting to note the basically non-existent variation across regions, which undermines the assumption that family ownership is a distinctive feature of Italian firms. Consistently with the findings of the previous editions, Rhône-Alpes stands out as the exception, with only 58% of businesses being family-owned.

Figure 4.1 Family-owned businesses (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

A common structural feature remains also the role of CEO, often being the owner or a member of the owning (or controlling) family (Table 4.1).

[13] *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.*

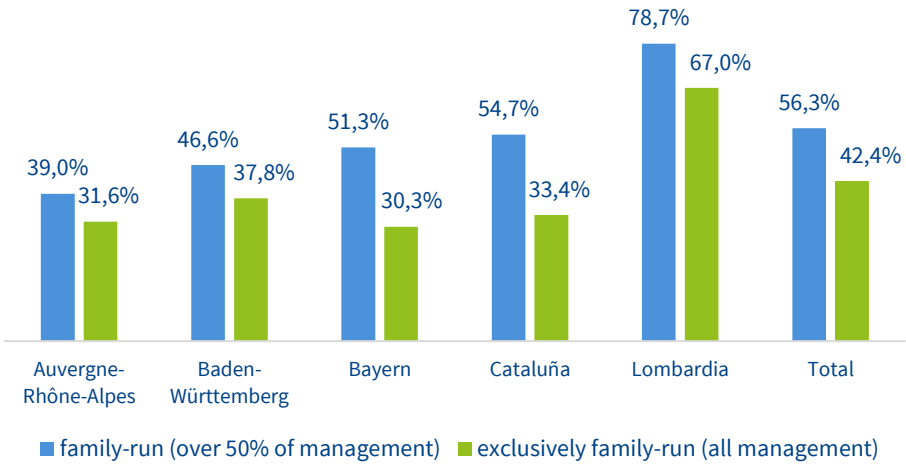
Table 4.1 CEO selection (% of family-owned firms, 2017)

	individual/family, owner or controlling	external manager	internal manager	other
Auvergne-Rhône-Alpes	86.1%	6.4%	7.5%	0.0%
Baden-Württemberg	87.8%	7.3%	2.8%	2.1%
Bayern	91.5%	7.3%	1.3%	0.0%
Cataluña	84.9%	2.2%	12.9%	0.0%
Lombardia	98.2%	1.2%	0.3%	0.0%
Total	91.0%	5.2%	3.1%	0.6%

Source: Assolombarda, Benchmark analysis

What sets regions apart is instead the management model (Figure 4.2). On average in the sample 56% of family-owned firms are also family-run, i.e. most managerial positions are assigned to family members (and 42% of firms in the sample assign all managerial positions to the owning family). In the case of Lombardia, the same figure peaks at 79%, compared to 39% in Rhône-Alpes and 49% in German regions. When focusing on firms fully in the hands of the owning family, Lombardia registers 67% of firms, compared to shares of around half as much in the other regions.

Figure 4.2 Family-run firms (% of family-owned firms, 2017)

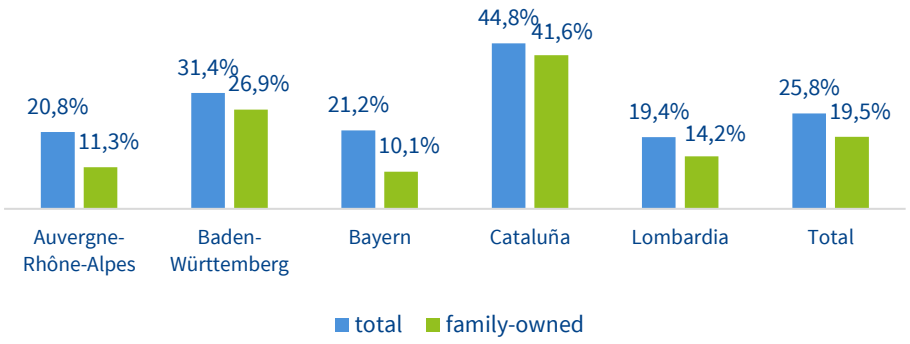


Source: Assolombarda, Benchmark analysis

4.2 Organizational model and remuneration policies

The popularity of a managerial setting centred around the firm's owners impacts on the organizational model chosen. Decentralized management, whereby the manager enjoys some degree of autonomy in decision-making, applies to 26% of firms only (20% considering family-owned firms) (Figure 4.3).

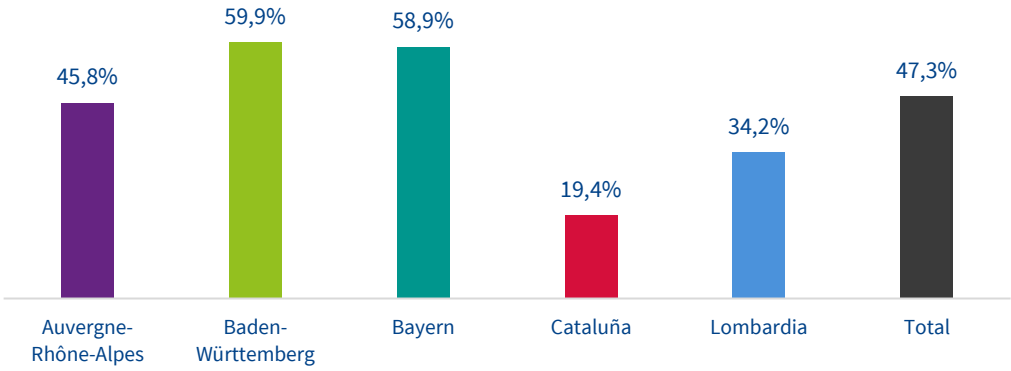
Figure 4.3 Decentralized management (% of total firms and % of family-owned firms, 2017)



Source: Assolombarda, Benchmark analysis

Performance-based remuneration policies are spreading at a faster pace: as of 2017 these are applied by 47% of firms compared to 38% in 2013 and 2015 (Figure 4.4). In Lombardia especially the trend is consistently positive: 34% of firms in 2017, vs 30% in 2015 and 20% in 2013.

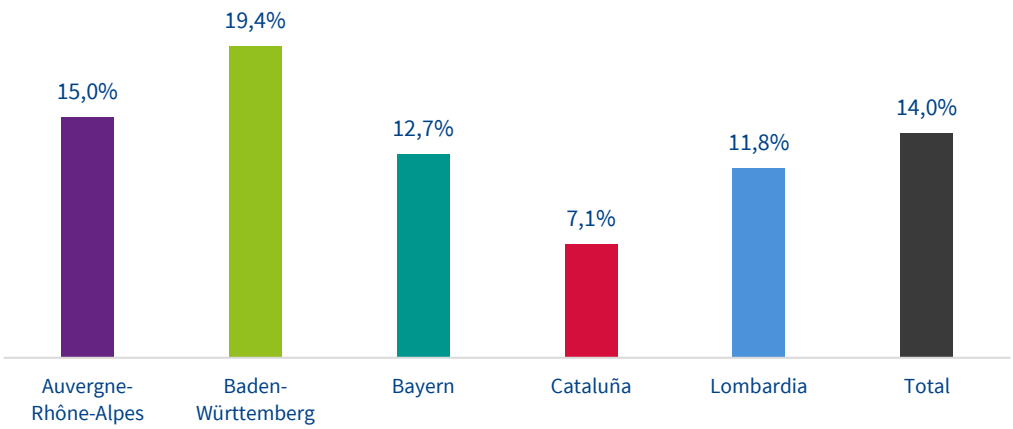
Figure 4.4 Performance-based remuneration policies (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

European manufacturing firms somehow appear oriented towards more decentralization as well (Figure 4.5): around 14% of the surveyed firms have increased the degree of autonomy conceded to their managers in 2017 (up from an average of 9% between 2013 and 2015). The share peaks at 19% in Baden-Württemberg. In Lombardia the same figure reaches 12%, which is double the average performed in the previous two periods. Based on this evidence, it might be concluded that, although the dominant organizational model across regions remains the family-owned and family-run business, a gradual shift towards decentralization and performance-based remuneration policies is taking place.

Figure 4.5 Increase in the degree of decentralization (% of total firms, 2017)

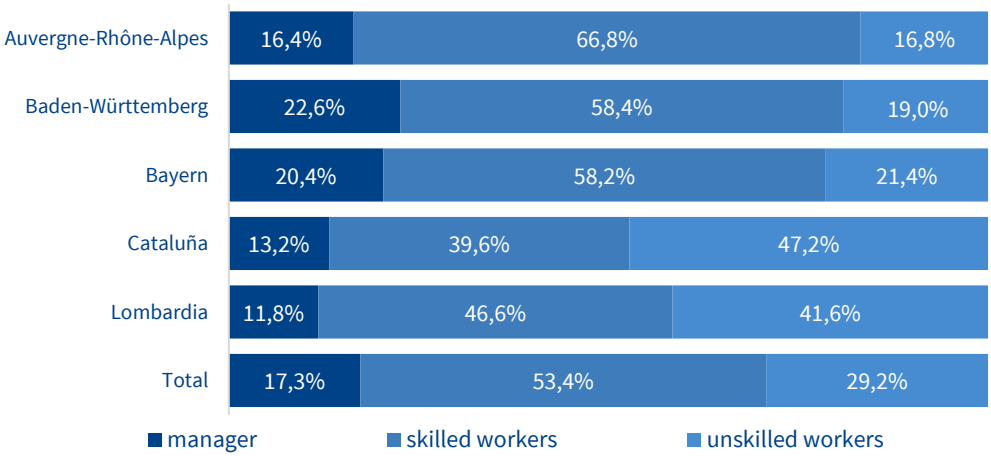


Source: Assolombarda, Benchmark analysis

4.3 Labour force composition, skills and trends

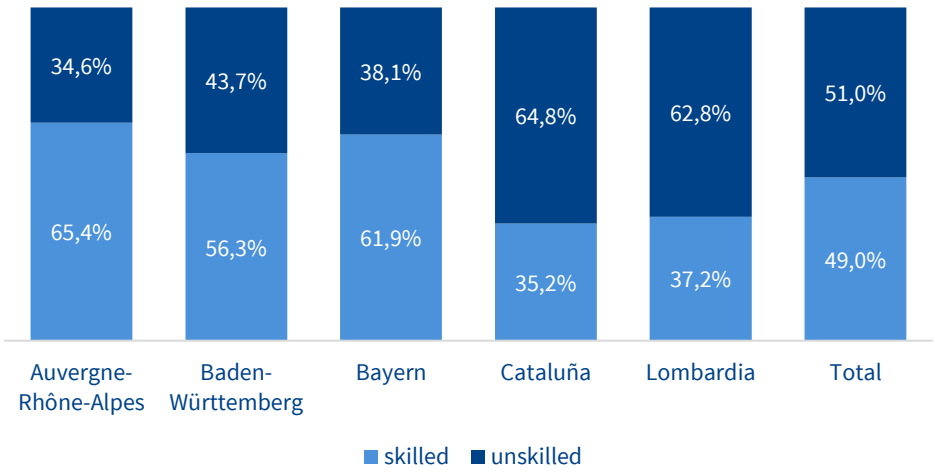
In general, around 17% of manufacturing firms' labour force are managers, 53% are skilled workers and 29% are unskilled workers (Figure 4.6). Compared to the sample average, in the case of German firms the distribution of employees is consistently and markedly tilted towards qualified and managerial positions.
Focusing on blue-collars (Figure 4.7), it is also confirmed that skilled workers are around 60% of the total in German firms, more than the sample average and almost double than those registered in Lombardia and Cataluña.

Figure 4.6 Labour force composition (%, 2017)



Source: Assolombarda, Benchmark analysis

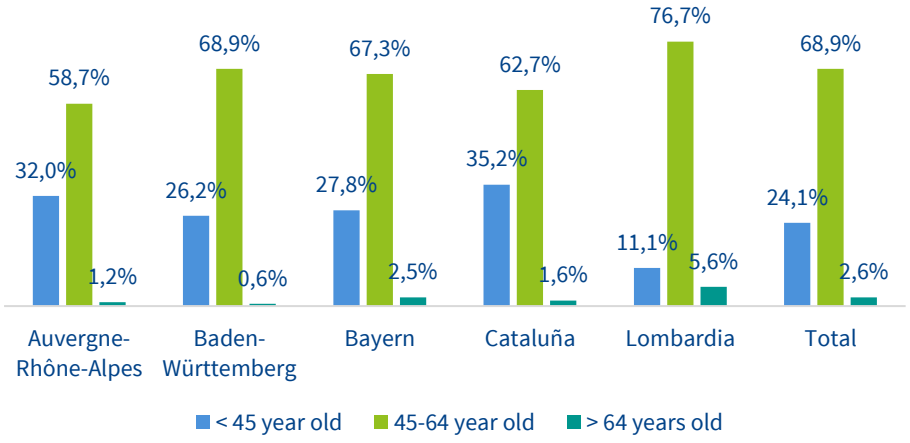
Figure 4.7 Skilled and unskilled workers (% of blue collar workers, 2017)



Source: Assolombarda, Benchmark analysis

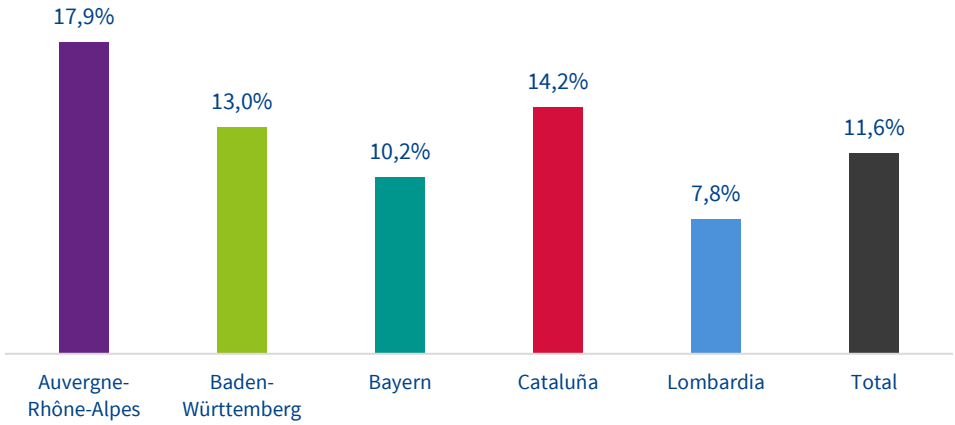
Focusing on managers, the youngest firms are confirmed to be those in Cataluña and Rhône-Alpes, while the oldest remain in Lombardia (Figure 4.8). Cataluña and Rhône-Alpes remain also the regions where graduates cover the largest share of the labour force (14% and 18% respectively, compared to 8% in Lombardia and 12% in German regions) (Figure 4.9).

Figure 4.8 Firms by manager average age (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

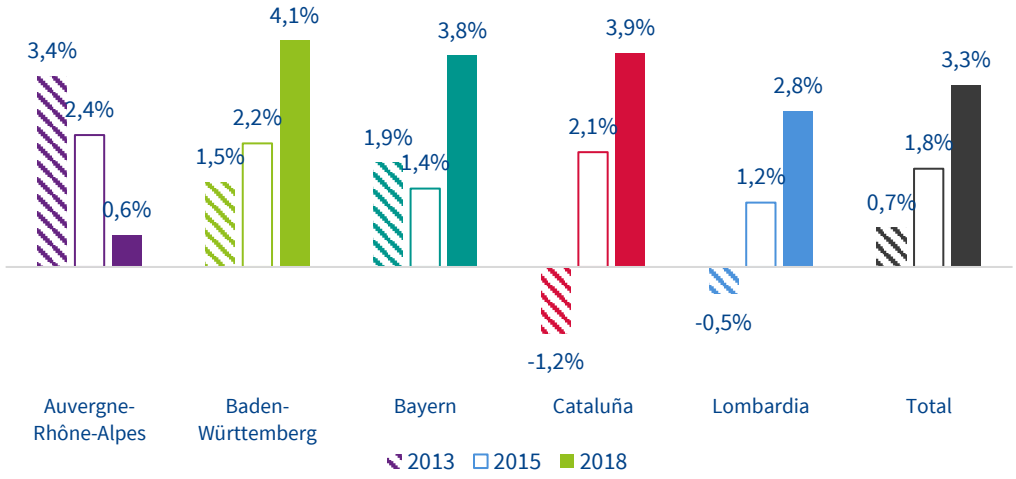
Figure 4.9 Graduates (average % of total labour force, 2017)



Source: Assolombarda, Benchmark analysis

While workforce composition and skills figures remain largely in line with what found in the previous edition, the evidence on the overall change in the labour force positively evolves to show that firms have exited the crisis – especially in Lombardia and Cataluña (Figure 4.10).

Figure 4.10 Labour force trends (average % change, 2017, 2015 and 2013)



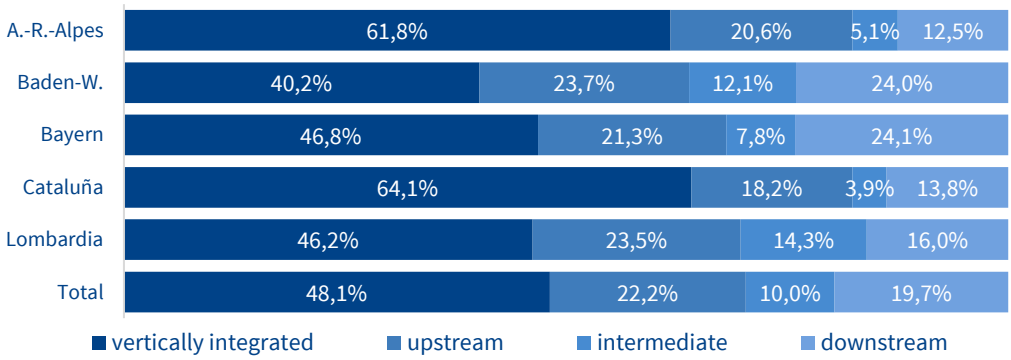
Source: Assolombarda, Benchmark analysis

4.4 Type of production and value chain involvement

Besides their internal organization, firms define the relationships with their peers. In this respect, the type of production and, subsequently, the positioning within value chains provides some insights. Overall in the sample, around half of firms are vertically integrated,

meaning they buy raw materials and produce finished goods for the final market (Figure 4.11). The other half is instead part of a value chain: 22% upstream (buying raw materials and producing semi-finished goods), 10% in the middle (buying and producing semi-finished goods) and 20% downstream (buying semi-finished goods and producing final goods). Consistently with findings from previous waves, Cataluña and Rhône-Alpes register the lowest share of firms participating to value chains, whereas in Lombardia the equivalent figure is below the sample average and in line with Bayern. German firms are once again those best positioned in the downstream segment (24% of the total), while their peers in Lombardia tend to concentrate in upstream and intermediate phases – a result essentially unchanged across waves.

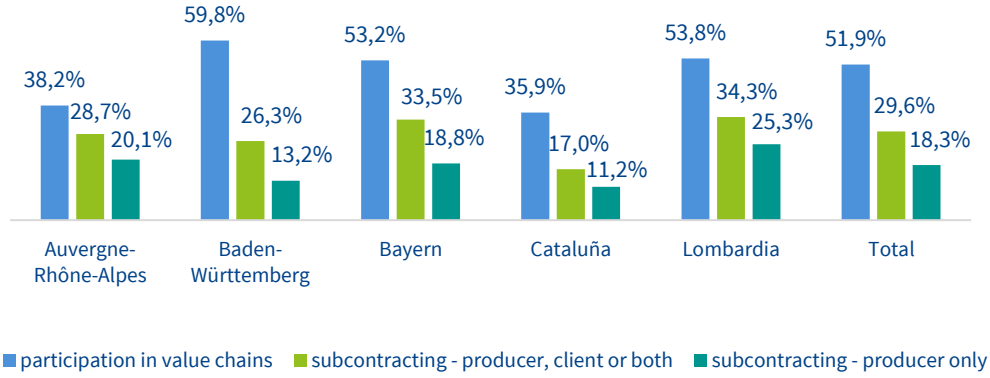
Figure 4.11 Type of participation in value chains (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Within value chains, a specific production mode is sub-contracting, where a contractor delegates to another firm (subcontractor) the partial execution or completion of a project or production phase according to specific guidelines. Such type of contract determines strong relationships among firms, sometimes lingering on dependence. As illustrated in Figure 4.12, on average a third (29%) of firms are the signatories of a subcontract, either as contractor or subcontractor. Compared to the rest of the sample, those firms exclusively producing as subcontractors – hence highly dependent on their clients – are mostly common in Lombardia (25% of firms vs an average of 18%).

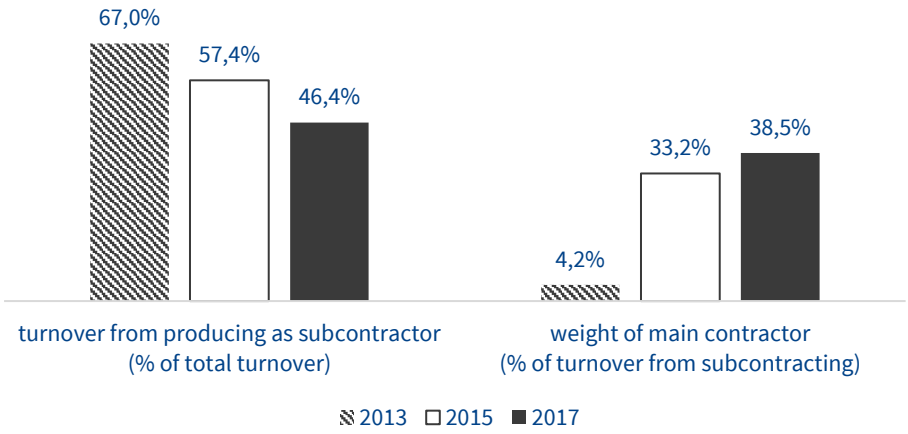
Figure 4.12 Subcontracting (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Across the sample the trend is towards less subcontracting but more dependence from a single contractor: the share of turnover from producing as subcontractors indeed generally diminishes, whereas the weight of the main contractor on the total turnover from subcontracting increases (Figure 4.12).

Figure 4.13 Subcontracting – turnover and weight of main contractor



Source: Assolombarda, Benchmark analysis

Finance and bureaucracy

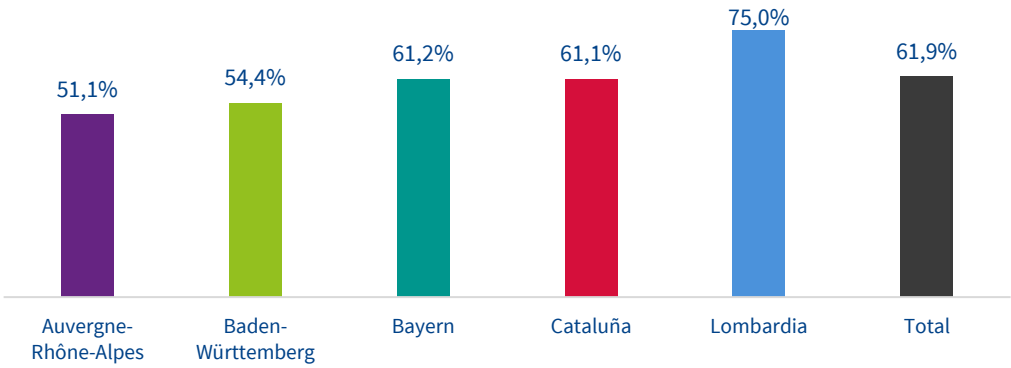
Bank credit is the preferred source of financing. The share of firms requesting bank credit grew to 47% in 2017 from 30% in 2013. Importantly, those firms obtaining the requested loan increased to almost reach 100% (97% in 2017 vs 82% in 2013), de facto eliminating the issue of credit constraints still present in 2013.

5.1 Financial structure

The considerations on the financial structure of firms are strongly consistent across waves. Starting with credit sources, most firms (62% of the sample) tend to recur to external sources of financing rather than relying on their own capital – a tendency particularly strong in Lombardia (Figure 5.1). Among the financial instruments available, bank credit is the preferred option (53% of firms if long-term, 31% if short-term), whereas capital markets (bonds, shares and private equity) are an option only in 2% of cases (Figure 5.2).

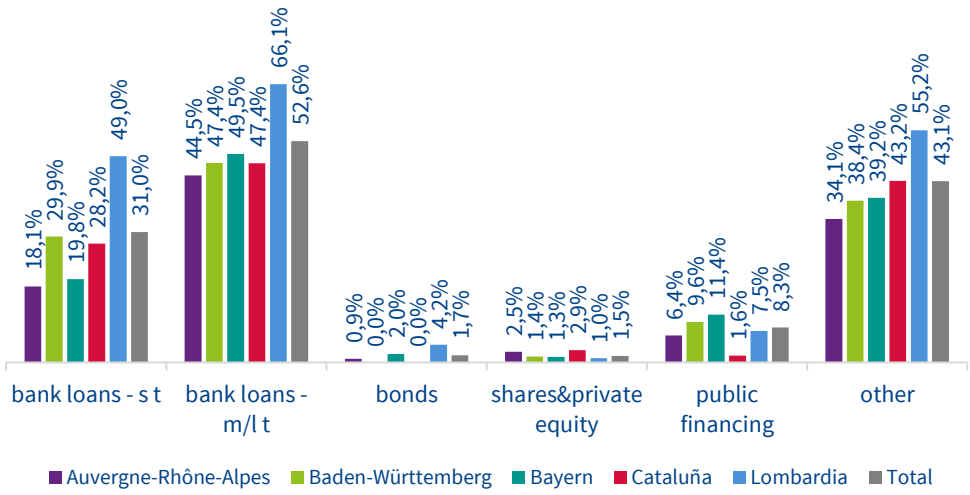
These behaviours are reflected in the debt structure (Figure 5.3). Bank loans cover the largest share of debt (18% short-term loans and 40% medium/long-term), followed by commercial debt (22%) and leasing (10%), while bonds are basically non-existent (0.4%).

Figure 5.1 Firms having recurred to external financing at least once (% of total firms, 2017)



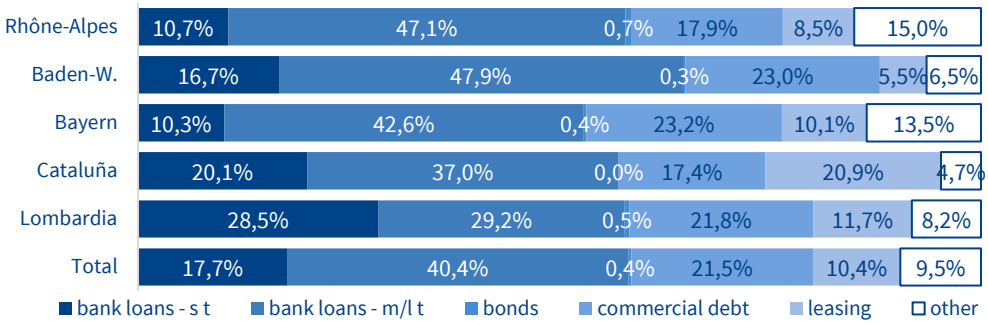
Source: Assolombarda, Benchmark analysis

Figure 5.2 Sources of external financing in 2015-2017 (% of total firms)



Source: Assolombarda, Benchmark analysis

Figure 5.3 Debt structure (%, 2017)

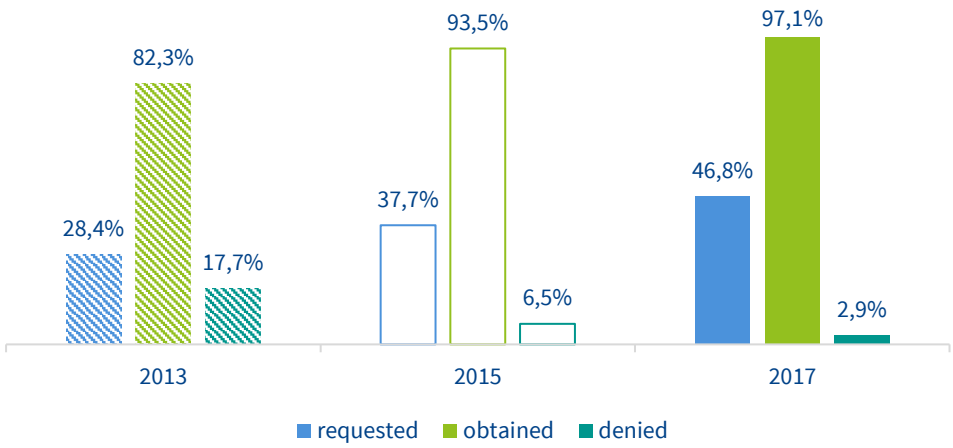


Source: Assolombarda, Benchmark analysis

5.2 Access to credit

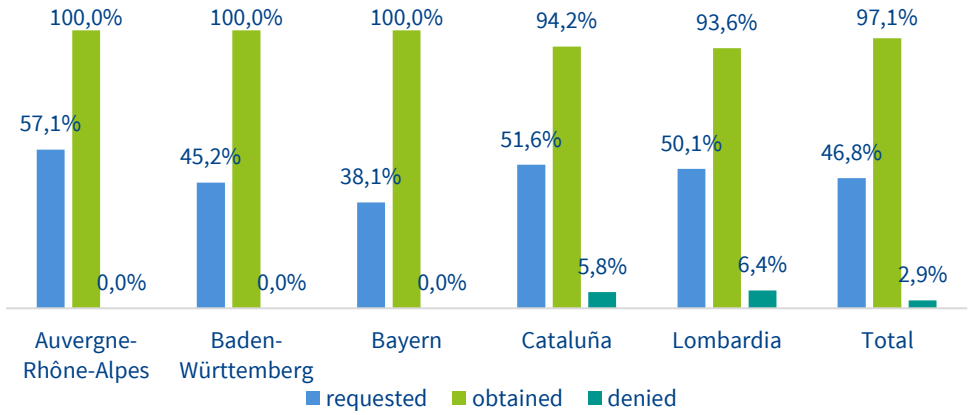
The share of firms requesting bank credit grew to 47% in 2017 from 30% in 2013 (Figure 5.4). Importantly, those firms obtaining the loan requested increased as well to almost reach 100% (97% in 2017 vs 82% in 2013), while those having their request denied dropped (3% in 2017 vs 18% in 2013). Importantly, the improvement concerns all regions, even Lombardia and Cataluña despite these two regions still report the largest share of credit denied (6%) (Figure 5.5).

Figure 5.4 Credit access (% of total firms and % of firms having requested credit, 2017, 2015 and 2013)



Source: Assolombarda, Benchmark analysis

Figure 5.5 Credit access (% of total firms and % of firms having requested credit, 2017)

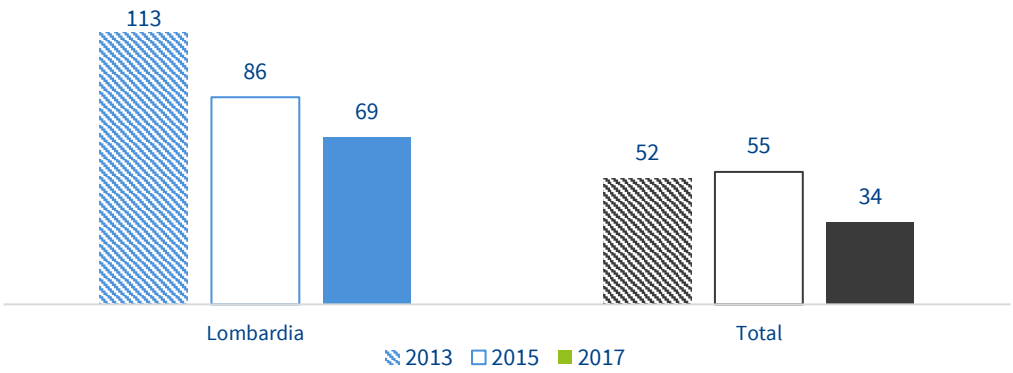


Source: Assolombarda, Benchmark analysis

5.3 Length of payment and bureaucratic costs

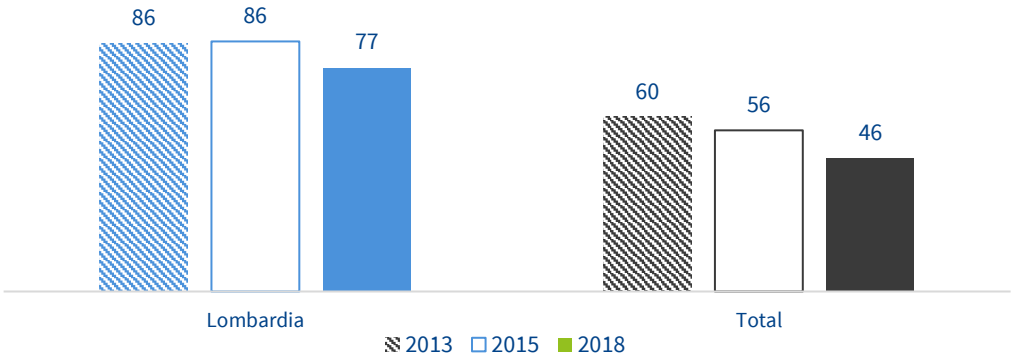
On average, the length of payment from the Public Administration is decreasing, yet in Lombardia is still double than in the rest of the sample (Figure 5.6). Similarly goes for the private sector, with firms in Lombardia having to wait longer to get repaid than their peers (Figure 5.7). Hence firms in Lombardia might incur into liquidity issues more easily than their peers elsewhere.

Figure 5.6 Public Administration: average length of payment (days, 2017, 2015, 2013)



Source: Assolombarda, Benchmark analysis

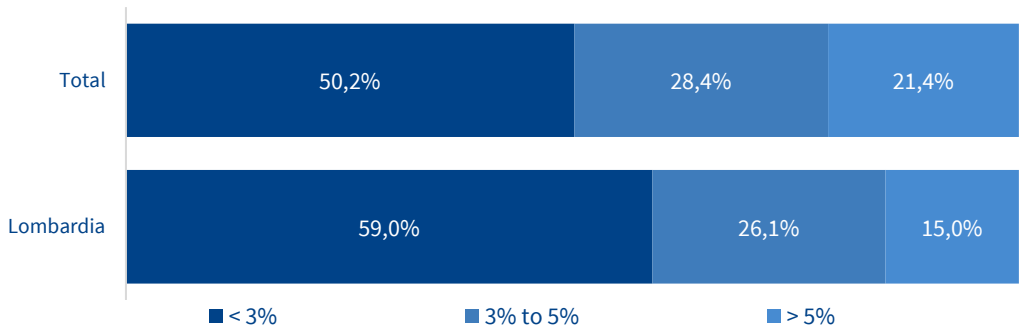
Figure 5.7 Private sector: average length of payment (days, 2017, 2015, 2013)



Source: Assolombarda, Benchmark analysis

Besides length of repayment, another factor hindering the competitiveness of firms are bureaucratic costs. 50% of firms in the sample estimate these costs at less than 3% of turnover, another 28% claim the cost is between 3% and 5% of turnover and 21% instead suffer a cost of over 5%. In the case of Lombardia, arguably the perceptions are more positive: most firms (60%) feel bureaucracy costs less than 3% of turnover and only 15% estimate to be paying more than 5% of turnover.

Figure 5.8 Bureaucratic costs on turnover (% of total firms, 2017)



Source: Assolombarda, Benchmark analysis

Focus: medium firms in Lombardia

Overall, compared to the rest of the regional manufacturing fabric, Lombardia's medium firms are particularly dynamic and innovative, with a stronger international presence and a better technological stance, and a greater adherence to managerial culture. Such distinctive features are still evident in the international comparison, but in line with the general evidence on manufacturing firms in Lombardia, critical issues remain technological transfer and the transition towards a managerial culture.

Lombardia concentrates one third of Italy's 3,500 medium firms – which altogether account for around 16% of manufacturing value added and exports at national level.[14] In light of the relevance of this industrial segment, the 2019 Benchmark analysis features a specific chapter on Lombardia and its medium firms[15].
Given that results are largely consistent across waves, for a greater statistical significance the evidence published in this chapter refers to the pooled sample (i.e. all firms surveyed considering the 2013, 2015 and 2017 waves together). Lombardia's medium firms are compared at the local level with the rest of the regional manufacturing system and at international level with their peers in the other benchmark regions.
The analysis is carried out on a set of key variables selected from the complete database which identify three growth drivers: innovation, internationalization and managerialization[16]. In fact, regardless of where they reside, firms investing on these growth levers tend to be more productive. The rest of the chapter hence focuses on such three fields of analysis.

6.1 Medium firms in Lombardia

R&D activities are more common among medium firms than in other manufacturing firms in Lombardia. Those are indeed conducted by more than two thirds of medium firms, +25 p.p. compared to the regional average (Figure 6.1). At the same time, around one fourth of medium firms use IPP instruments – twice as many as the rest of the sample (Figure 6.2).

Medium firms still perform above average when considering innovation and 4.0 levels. As to the innovation activities (Figure 6.3), the share of firms having introduced product or market innovation, process innovation and organizational innovation is 10 p.p. higher.

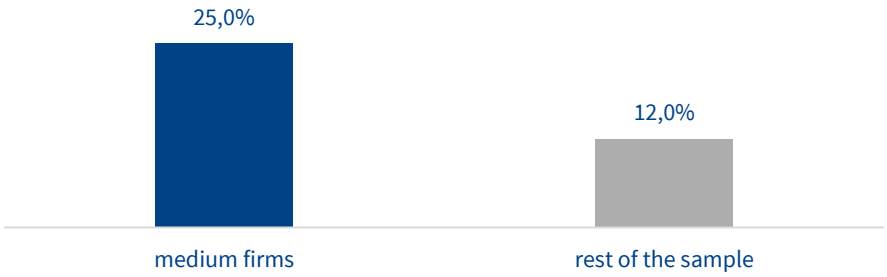
[14] *Mediobanca-Unioncamere, Medie imprese italiane 2019.*
[15] *In line with the criteria set by the European Commission, medium firms are those with 50 to 249 employees and a turnover between 11 and 50 million euro.*
[16] *The relevance of these drivers is underlined throughout the report and further analysed in the Appendix.*

As to the advancement towards Industry 4.0 (Figure 6.4), a high level of smart manufacturing[17] is almost four times more widespread among medium firms (15% of the total) than in the rest of the sample (4%).

Figure 6.1 Firms having conducted R&D over the past three years (% of total firms, average across the three-year periods 2011-2013, 2013-2015 and 2015-2017)

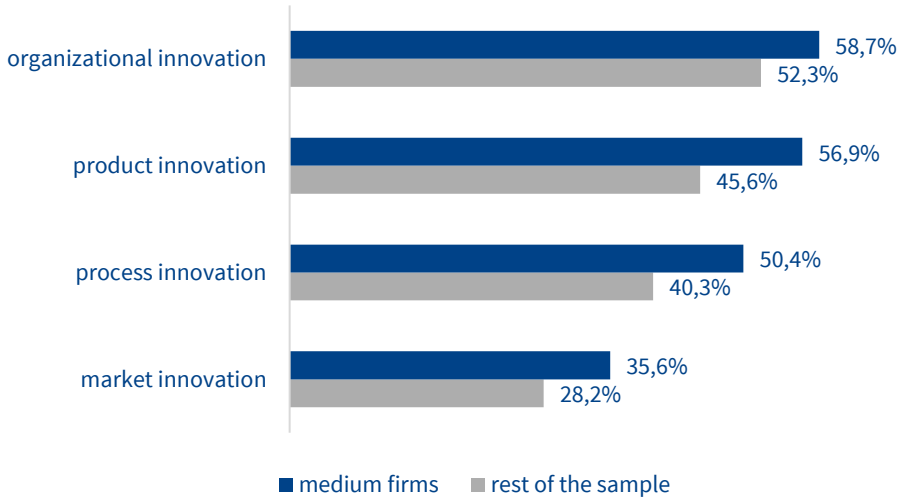
Source: Assolombarda, Benchmark analysis

Figure 6.2 Firms having used at least one IPP instrument over the past three years (% of total firms, average across the three-year periods 2011-2013, 2013-2015 and 2015-2017)



Source: Assolombarda, Benchmark analysis

Figure 6.3 Organizational, product, process and market innovation (% of total firms, average across the three-year periods 2011-2013, 2013-2015 and 2015-2017)



Source: Assolombarda, Benchmark analysis

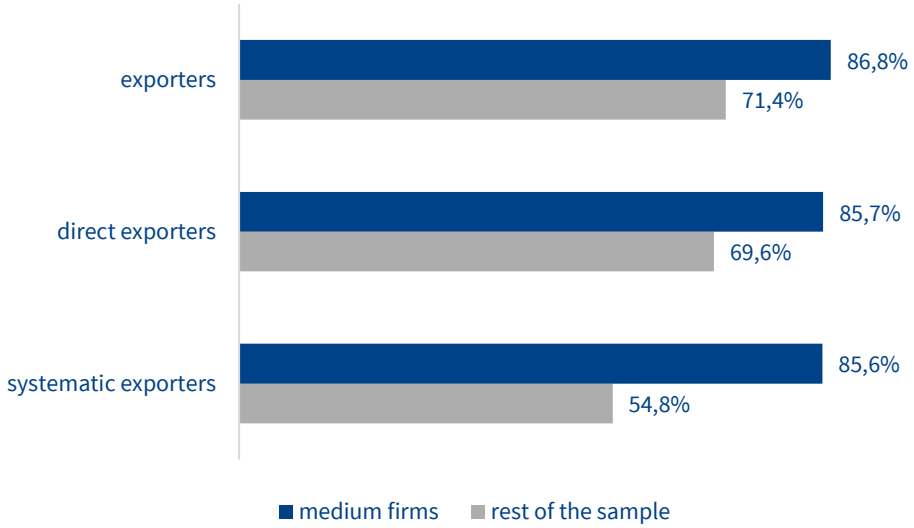
[17] *Defined as digital integration of equipment coupled with the deployment of industrial robots and either RFID technology or advanced human-machine interface.*

Figure 6.4 Advanced smart manufacturing (% of total firms, 2015 and 2017 average)

Source: Assolombarda, Benchmark Analysis

Other than for research and innovation, medium firms stand out in Lombardia for their international stance. Contrary to what registered in the rest of the sample, in the case of medium firms the share of exporters does not decrease as export complexity increases (from indirect and occasional to direct and systematic). This suggests that medium firms are better at serving culturally and geographically distant markets without the need of intermediaries – as also suggested by the percentage of firms that export to EU and non-EU markets (77% and 75% respectively for medium firms, 61% and 49% for the rest of the sample). Medium firms are arguably better than at maintaining a systematic and long-lasting relationship with foreign clients.

Figure 6.5 Exporters (% of total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

Besides exports, medium firms in Lombardia envisage and implement more complex internationalization strategies. A high degree of participation to global value chains[18] (Figure 6.6) concerns 15% of Lombardia's medium firms, almost double the equivalent share for all other firms (8%).

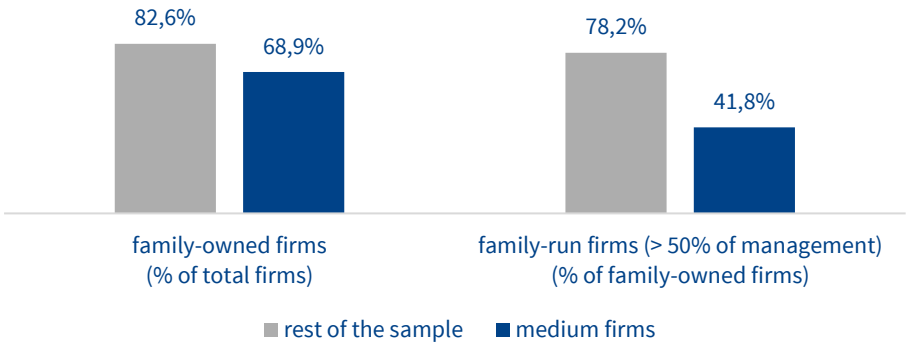
[18] Participation to global value chains is considered "high" if firms either import or export and, at the same time, outsource or offshore.

Figure 6.6 High level of participation in global value chains (% of total firms, 2013, 2015, 2017 average)

Source: Assolombarda, Benchmark analysis

As to firm ownership and management, in line with the rest of the sample, also in medium firms family ownership is the most common organizational structure (Figure 6.7). However, it only concerns 69% of medium firms, in contrast with an equivalent share of 83% in the case of other firms. Anyway, blunter is the evidence on managerialization: if in general in Lombardia 78% of family-owned firms are also family-run, i.e. most managerial positions are assigned to members of the owning family, the equivalent figure in the case of medium firms drops to 42%.

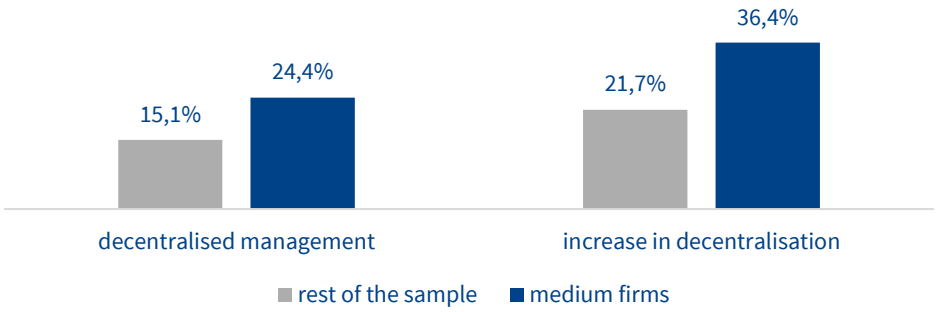
Figure 6.7 Family ownership and management (2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

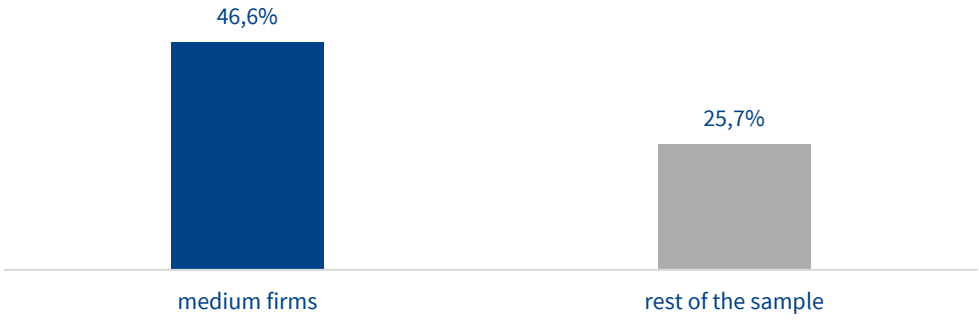
The larger openness in governance found in medium firms at least partly contributes to an easier transition to a managerial culture, intended as the concession of a greater degree of decisional autonomy to managers and as the adoption of performance-based remuneration policies. In fact, compared to the rest of the Lombard manufacturing fabric, decentralised management, or at least a process towards decentralisation, is most common in medium firms (respectively 24% and 36% of medium firms, compared to 15% and 22% of firms in the rest of the sample) (Figure 6.8). Moreover, the percentage of medium firms adopting performance-based remuneration policies (47%) is almost double that of the rest of the sample (26%) (Figure 6.9).

Figure 6.8 Decentralised management and increase in decentralisation (% of total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

Figure 6.9 Performance-based remuneration policies (% total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

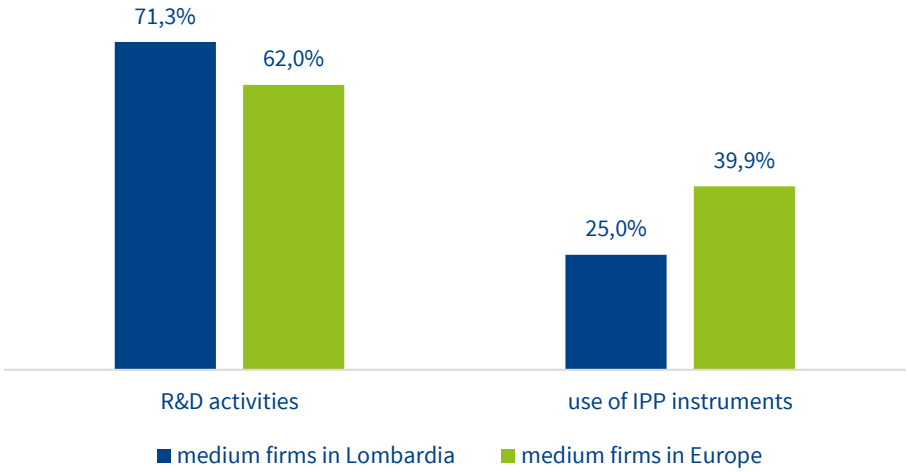
6.2 Lombardia's medium firms in the European comparison

The distinctive characteristics of medium firms in the regional comparison with the rest of the manufacturing fabric has been put to a test at the European level. How do medium manufacturing firms in Lombardia perform compared to their peers in the benchmark regions?

As to innovation, R&D activities are slightly more widespread among medium manufacturing firms in Lombardia than among their European peers (+9 p.p.) whereas technological transfer (-15 p.p.) proves once again to be one of Lombardia's critical issues[19] (Figure 6.10). When considering the spread of innovation, Lombardia's medium firms are largely in line with their European peers except for organizational innovation (-10 p.p.) (Figure 6.11).

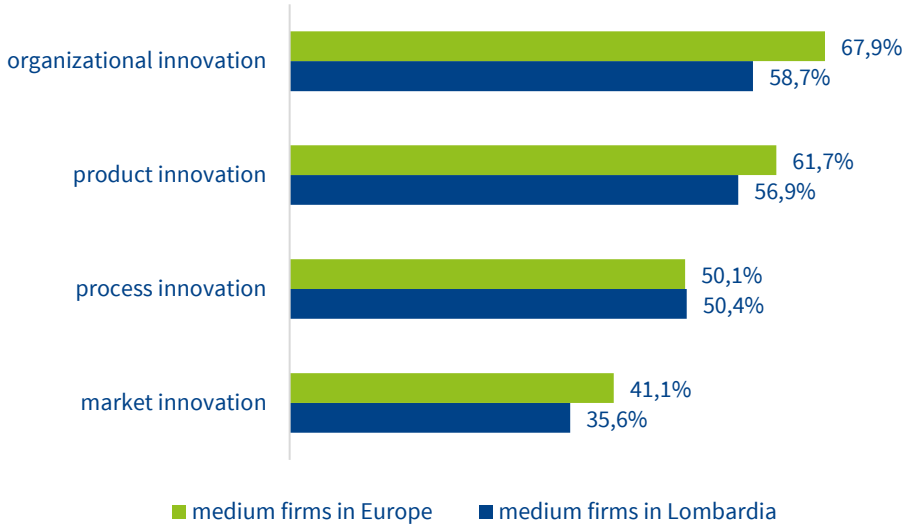
[19] *Please refer to chapter 1.*

Figure 6.10 R&D activities and use of IPP instruments (% of total firms, average across the three-year periods 2011-2013, 2013-2015 and 2015-2017)



Source: Assolombarda, Benchmark analysis

Figure 6.11 Organizational, product, process and market innovation (% of total firms, average across the three-year periods 2011-2013, 2013-2015 and 2015-2017)

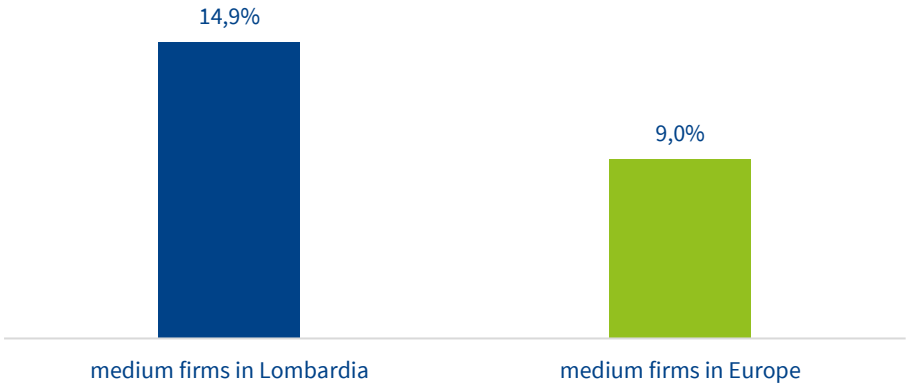


Source: Assolombarda, Benchmark analysis

Compared to European medium firms, it would appear that medium firms in Lombardia are more advanced in the 4.0 transition. Despite this positive evidence, it must be highlighted that it partly owes to differing considerations and perceptions regarding the level of advancement towards the 4.0 paradigm, as already underlined elsewhere in this report[20].

[20] *Please refer to chapter 2.*

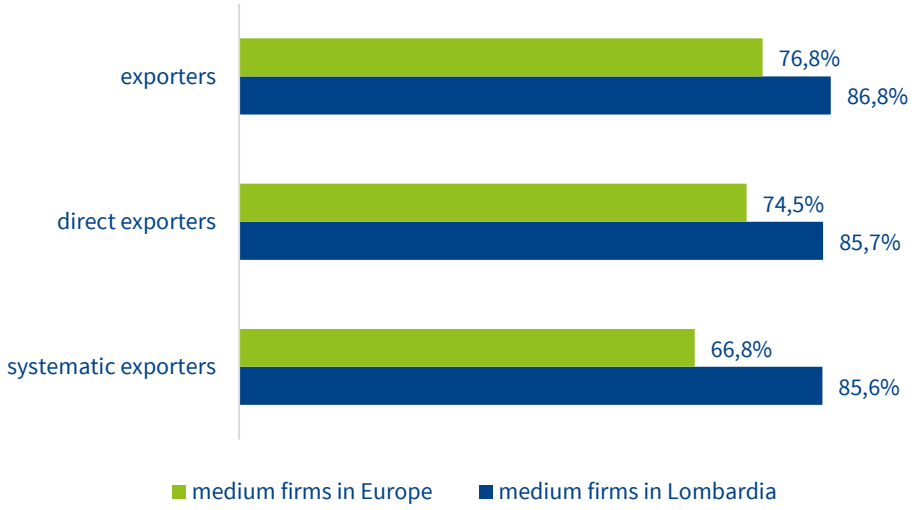
Figure 6.12 High level of smart manufacturing (% of total firms, 2015 and 2017 average)



Source: Assolombarda, Benchmark analysis

Regarding internationalization, in the European comparison medium firms from Lombardia confirm their international vocation (Figure 6.13). They are especially performant on direct and systematic exports compared to their European peers. In fact, exporters among medium firms cover a smaller share in European regions than in Lombardy as the modality and frequency of exports is factored in.

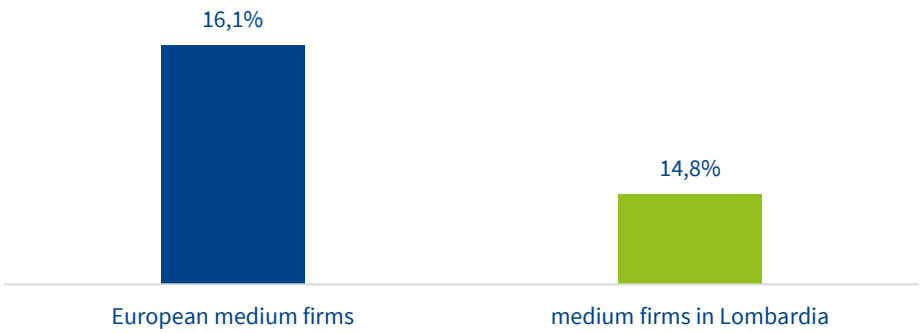
Figure 6.13 Exporters (% of total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

As to the complexity of internationalisation strategies, Lombardia's medium firms have nothing to envy their European peers for: a high degree of participation to global value chains is, in fact, equally widespread (Figure 6.14).

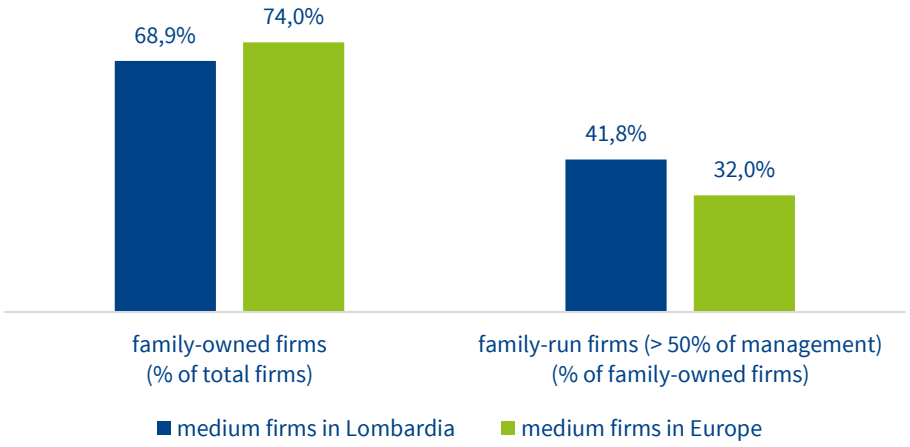
Figure 6.14 High level of participation in global value chains (% of total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

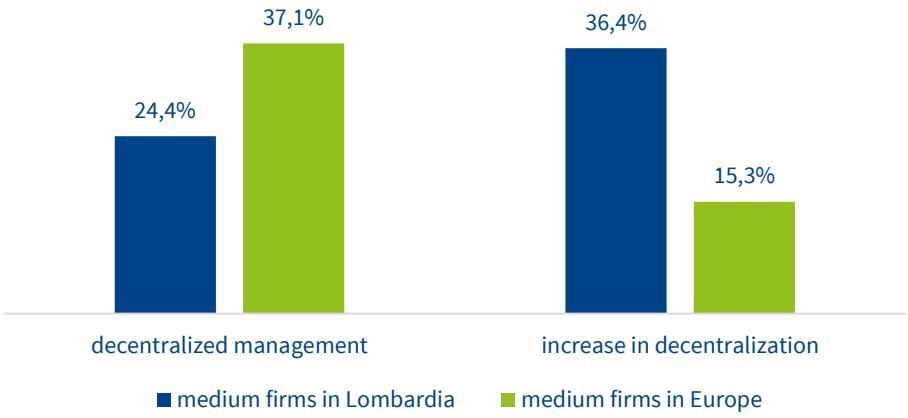
Finally, medium firms in Lombardia might have to improve towards a more managerial culture (Figure 6.16, Figure 6.16, Figure 6.17). Open governance is in fact less frequently adopted than in medium firms in Europe. In Lombardia 42% of family-owned medium firms have assigned over half of managerial positions to family members, compared to 32% in European benchmark regions (- 10 p.p.). The gap increases when considering decentralised management and performance-based remuneration policies (both at -13 p.p. from European peers). Hence arguably the larger share of medium firms in Lombardia increasing their degree of decentralization.

Figure 6.15 Family ownership and management (2013, 2015, 2017 average)



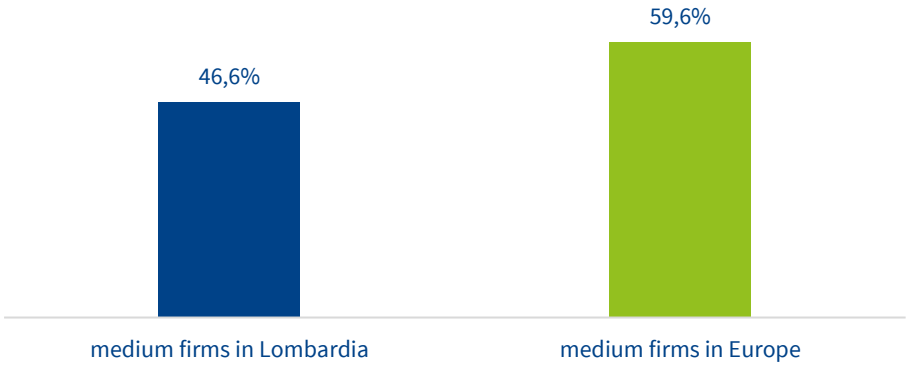
Source: Assolombarda, Benchmark analysis

Figure 6.16 Decentralised management and increase in decentralisation (% of total firms, 2013, 2015, 2017 average)



Source: Assolombarda, Benchmark analysis

Figure 6.17 Performance-based remuneration policies (% of total firms, average of 2013, 2015, 2017)



Source: Assolombarda, Benchmark analysis

Appendix 1. Regression analysis

Based on the survey results integrated with balance-sheet data, a rigorous statistical analysis was conducted to investigate the correlation between firms' performance and some key variables on innovation, smart manufacturing and internationalization. All regressions control for regional and structural (firm size and sector) fixed effects. Regression are run for each 2015 and 2017 wave, and for the pooled sample of firms surveyed in the three waves since 2013.

1. Innovation, smart manufacturing and productivity

The relation between innovation and business performance (measured in terms of labour productivity) **is mixed.** The evidence shows that innovating business processes is positively correlated with productivity, whereas organizational innovation does not seem to significantly influence performance (Regression 1.1). A medium and high degree of smart manufacturing is strongly correlated with higher productivity (Regression 1.3 and 1.7), but not with the probability to export (Regression 1.6 and 1.10). These results are consistent across waves. Also in line with evidence gathered in previous surveys, the presence of intellectual property instruments (anyone between patents, trademarks and industrial design) is instead consistently associated to higher productivity (Regression 1.2).

The correlation between innovation activities and smart manufacturing is instead neat and consistently significant across waves. No matter what level of smart manufacturing, there is a positive correlation with process innovation (Regression 1.4 and 1.8). Similar result, albeit slightly less robust, are obtained with organizational innovation (Regression 1.5 and 1.9). At the same time, innovation and smart manufacturing are associated to the presence within the firm of a person in charge of the digitalization of production (Regression 1.11).

Regression 1.1 Process innovation, organizational innovation and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Pooled (2013-2015-2017)*
Process innovation *(=1 yes)*	0.131**	0.0822	0.0991**
	(0.0626)	*(0.0672)*	*(0.0389)*
Organizational innovation *(=1 yes)*	-0.0969	0.117	0.113
	(0.119)	*(0.119)*	*(0.0719)*
Medium firms *(=1 yes)*	0.170**	0.0379	0.171***
	(0.0670)	*(0.0657)*	*(0.0491)*
Large firms *(=1 yes)*	-0.182	0.0391	0.0912
	(0.179)	*(0.123)*	*(0.0723)*
Year 2015			0.108**
			(0.0483)
Year 2017			0.0837*
			(0.0459)
Observations	*524*	*450*	*1,538*
R-squared	*0.228*	*0.225*	*0.163*

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

Regression 1.2 Technological transfer and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Pooled (2013-2015-2017)*
IPP *(=1 yes)*	0.226**	0.223**	0.209***
	(0.0929)	*(0.101)*	*(0.0585)*
Persons employed *(log)*	-0.0300	-0.0156	0.0116
	(0.0706)	*(0.0486)*	*(0.0311)*
Year 2015			0.110
			(0.0716)
Year 2017			0.0357
			(0.0648)
Observations	*276*	*232*	*763*
R-squared	*0.245*	*0.149*	*0.163*

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

Regression 1.3 Medium smart manufacturing and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Pooled (2015-2017)*
Medium smart manufacturing *(=1 yes)*	0.216**	0.270***	0.237***
	(0.0940)	*(0.0930)*	*(0.0721)*
Medium firms *(=1 yes)*	0.165***	0.0337	0.115**
	(0.0601)	*(0.0671)*	*(0.0495)*
Large firms *(=1 yes)*	-0.219	0.0134	-0.0416
	(0.184)	*(0.127)*	*(0.0979)*
Year 2017			-0.0406
			(0.0460)
Observations	*524*	*450*	*974*
R-squared	*0.234*	*0.238*	*0.209*

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

Regression 1.4 Medium smart manufacturing and process innovation

	Process innovation 2015	*Process innovation 2017*	*Pooled (2015-2017)*
Medium smart manufacturing *(=1 yes)*	0.358***	0.214***	0.292***
	(0.0566)	*(0.0824)*	*(0.0485)*
Medium firms *(=1 yes)*	0.164***	0.134**	0.146***
	(0.0587)	*(0.0683)*	*(0.0460)*
Large firms *(=1 yes)*	0.328***	0.199*	0.262***
	(0.0681)	*(0.110)*	*(0.0704)*
Year 2017			0.00706
			(0.0366)
Observations	*691*	*590*	*1,281*
R-squared	*0.138*	*0.073*	*0.092*

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

Regression 1.5 Medium smart manufacturing and organizational innovation

	Organizational innovation 2015	*Organizational innovation 2017*	*Pooled (2015-2017)*
Medium smart manufacturing *(=1 yes)*	0.129**	0.137*	0.113**
	(0.0603)	*(0.0801)*	*(0.0500)*
Medium firms *(=1 yes)*	0.187***	0.212***	0.199***
	(0.0621)	*(0.0601)*	*(0.0442)*
Large firms *(=1 yes)*	0.131	0.165	0.136*
	(0.108)	*(0.105)*	*(0.0782)*
Year 2017			0.0362
			(0.0376)
Observations	*691*	*590*	*1,281*
R-squared	*0.121*	*0.063*	*0.058*

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

Regression 1.6 Medium smart manufacturing and probability to export

	Direct exporter 2015	*Direct exporter 2017*	*Pooled (2015-2017)*
Medium smart manufacturing *(=1 yes)*	0.0157	0.0956	0.0453
	(0.0602)	*(0.0800)*	*(0.0497)*
Medium firms *(=1 yes)*	0.185***	0.186***	0.187***
	(0.0561)	*(0.0631)*	*(0.0435)*
Large firms *(=1 yes)*	0.441***	0.375***	0.402***
	(0.0473)	*(0.0491)*	*(0.0339)*
Year 2017			-0.0104
			(0.0372)
Observations	*691*	*590*	*1,281*
R-squared	*0.101*	*0.112*	*0.093*

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

Regression 1.7 High smart manufacturing and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Pooled (2015-2017)*
High smart manufacturing *(=1 yes)*	0.194	0.302**	0.231**
	(0.134)	*(0.132)*	*(0.106)*
Medium firms *(=1 yes)*	0.174***	0.0277	0.117**
	(0.0606)	*(0.0675)*	*(0.0492)*
Large firms *(=1 yes)*	-0.208	0.0228	-0.0335
	(0.187)	*(0.126)*	*(0.101)*
Year 2017			-0.0379
			(0.0464)
Observations	*524*	*450*	*974*
R-squared	*0.226*	*0.230*	*0.200*

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

Regression 1.8 High smart manufacturing and process innovation

	Process innovation 2015	*Process innovation 2017*	*Pooled (2015-2017)*
High smart manufacturing *(=1 yes)*	0.423***	0.319***	0.382***
	(0.0644)	*(0.105)*	*(0.0582)*
Medium firms *(=1 yes)*	0.159***	0.130*	0.140***
	(0.0583)	*(0.0696)*	*(0.0464)*
Large firms *(=1 yes)*	0.276***	0.193*	0.231***
	(0.0697)	*(0.110)*	*(0.0698)*
Year 2017			0.00623
			(0.0367)
Observations	*691*	*590*	*1,281*
R-squared	*0.128*	*0.079*	*0.092*

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

Regression 1.9 High smart manufacturing and organizational innovation

	Organizational innovation 2015	*Organizational innovation 2017*	*Pooled (2015-2017)*
High smart manufacturing *(=1 yes)*	0.181**	-0.0446	0.0620
	(0.0761)	*(0.111)*	*(0.0693)*
Medium firms *(=1 yes)*	0.182***	0.220***	0.204***
	(0.0607)	*(0.0600)*	*(0.0440)*
Large firms *(=1 yes)*	0.0992	0.187*	0.148*
	(0.111)	*(0.108)*	*(0.0782)*
Year 2017			0.0333
			(0.0377)
Observations	*691*	*590*	*1,281*
R-squared	*0.122*	*0.056*	*0.053*

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

Regression 1.10 High smart manufacturing and probability to export

	Direct exporter 2015	*Direct exporter 2017*	*Pooled (2015-2017)*
High smart manufacturing *(=1 yes)*	-0.00576	0.0885	0.0289
	(0.0753)	*(0.114)*	*(0.0646)*
Medium firms *(=1 yes)*	0.188***	0.187***	0.189***
	(0.0555)	*(0.0638)*	*(0.0435)*
Large firms *(=1 yes)*	0.450***	0.377***	0.406***
	(0.0514)	*(0.0490)*	*(0.0356)*
Year 2017			-0.0114
			(0.0371)
Observations	*691*	*590*	*1,281*
R-squared	*0.101*	*0.110*	*0.092*

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

Regression 1.11 Smart manufacturing and competences

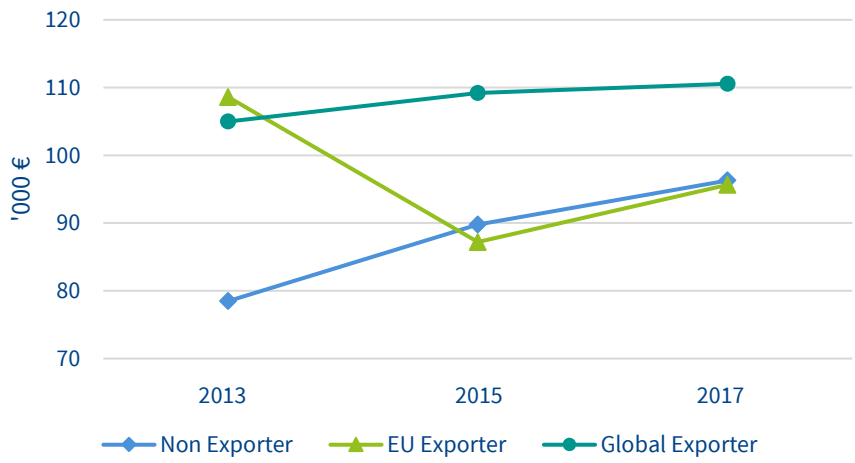
	Medium smart manufacturing 2015	*Medium smart manufacturing 2017*	*High smart manufacturing 2015*	*High smart manufacturing 2017*
Person in charge of digitalization *(=1 yes)*	0,0859**	0,0562*	0,0397	0,0698***
	(0,0369)	*(0,0124)*	*(0,0287)*	*(0,0100)*
Medium firms *(=1 yes)*	0,141***	0,0491	0,130***	0,0481
	(0,0611)	*(0,0150)*	*(0,0604)*	*(0,0117)*
Large firms *(=1 yes)*	0,400***	0,115	0,456***	0,0910
	(0,107)	*(0,0249)*	*(0,102)*	*(0,0211)*
Observations	*691*	*590*	*691*	*590*
R-squared	*0,087*	*0,037*	*0,094*	*0,037*

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

2. Internationalization premia

In analysing the variables on internationalization, it is interesting to look at the evolution of the export premium across waves. As illustrated in the graph below, in 2013 domestic firms had a lower productivity (around €80,000 per person employed) compared to exporting firms, in line with the idea of a self-selection of the most productive firms due to the presence of higher fixed costs in exporting. Moreover, in 2013 the productivity of exporters to EU markets and that of global exporters were essentially the same at around €100,000 per person employed. Since 2015 the productivity of exporters to EU countries has however become progressively aligned to that of domestic firms, while global exporters have remained the top performers. This finding suggests that the European Single Market effectively reduces the role of productivity in selecting those firms suited for international markets, via a reduction of the fixed costs necessary to operate in the internal EU market. **In other words, for firms in the sample the European Union seems today to be the equivalent of the domestic market**. The share of exporters – which has been growing through time and in 2017 equals 61% in the sample, 77% in Lombardia – might thus be expected to grow even further, as accessing European markets becomes less and less difficult even for smaller firms.

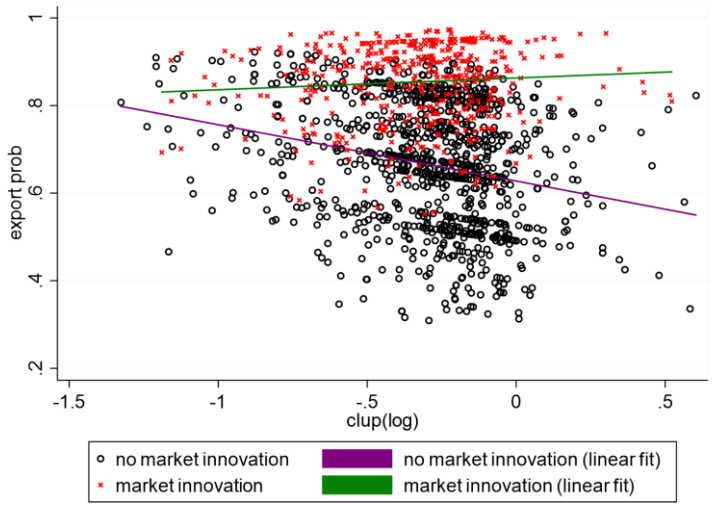
Average productivity (thousand euro) by exporters' reference market and wave



It is interesting to consider these findings together with the evidence on the relationship between unit labour costs (ULCs) and the probability to export reported in Chapter 3 (see pages 27-28). As already mentioned, the ability of firms to access international markets increasingly depends on innovation and quality rather than price factors. Survey results however point at the fact that, even for non-innovators, the (still negative) correlation between costs and probability to export slightly improves in 2017 compared to previous years. This outcome might be attributed in part to the European Single Market ability to shield and create opportunities even for less productive and less innovative firms, irrespective of pure cost consideration. The toughest selection process remains in the case of exports to global markets.

Besides trends across waves, the analysis on ULCs might be further deepened by pooling the Benchmark analysis over the three waves. Results, based on almost 2,000 observations, are extremely consistent: **highly innovative firms manage to succeed internationally even in the presence of high unit labour costs**.

Probability to export, ULCs and innovation (pooled results, 2013-2015-2017)



A further object of analysis is the relationship between the participation in global value chains[21] and productivity, controlling for innovation capability (R&D and Organizational innovation) and managerial setting (Bonus and Decentralization) (Regressions 2.1 to 2.3). In this case, since results are extremely consistent across waves, for the sake of simplicity we report only pooled regressions. As shown in the tables below, a significantly higher productivity is associated to firms participating in global value chains, with a particularly large premium for firms internationalizing both sales and part of production (Regression 2.3).

Regression 2.1 Low participation in global value chains, innovation and management (pooled results, 2013-2015-2017)

	Labour productivity	*Labour productivity*	*Labour productivity*
Low GVC participation *(=1 yes)*	0.228***	0.212***	0.208***
	(0.0532)	*(0.0553)*	*(0.0547)*
R&D *(=1 yes)*		0.0714	0.0528
		(0.0541)	*(0.0573)*
Bonus *(=1 yes)*		0.0255	0.0103
		(0.0584)	*(0.0586)*
Decentralized management *(=1 yes)*		0.0201	0.0164
		(0.0634)	*(0.0619)*
Organizational innovation *(=1 yes)*			0.166
			(0.103)
Year 2015	0.125*	0.119*	0.108
	(0.0665)	*(0.0686)*	*(0.0687)*
Year 2017	0.153**	0.143**	0.132**
	(0.0636)	*(0.0622)*	*(0.0624)*
Observations	*890*	*890*	*890*
R-squared	*0.186*	*0.190*	*0.194*

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

[21] *Three degrees of GVC participation are here defined: 1) low, if firms either export or import; 2) medium, if firms both import and export; 3) high, if firms either import or export and, at the same time, outsource or offshore.*

Regression 2.2 Medium participation in global value chains, innovation and management (pooled results, 2013-2015-2017)

	Labour productivity	*Labour productivity*	*Labour productivity*
Medium GVC participation *(=1 yes)*	0.200***	0.176***	0.176***
	(0.0599)	*(0.0579)*	*(0.0581)*
R&D *(=1 yes)*		0.0137	0.00569
		(0.0542)	*(0.0558)*
Bonus *(=1 yes)*		0.160**	0.151**
		(0.0635)	*(0.0653)*
Decentralized management *(=1 yes)*		0.0331	0.0282
		(0.0576)	*(0.0553)*
Organizational innovation *(=1 yes)*			0.0775
			(0.107)
Year 2015	0.111*	0.103	0.0986
	(0.0664)	*(0.0659)*	*(0.0653)*
Year 2017	0.0930	0.0840	0.0818
	(0.0571)	*(0.0562)*	*(0.0557)*
Observations	*776*	*776*	*776*
R-squared	*0.194*	*0.209*	*0.210*

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

Regression 2.3 High participation in global value chains, innovation and management (pooled results, 2013-2015-2017)

	Labour productivity	*Labour productivity*	*Labour productivity*
High GVC participation *(=1 yes)*	0.338***	0.338***	0.307***
	(0.0879)	*(0.0863)*	*(0.0888)*
R&D *(=1 yes)*		-0.0476	-0.0737
		(0.0794)	*(0.0817)*
Bonus *(=1 yes)*		0.0650	0.0465
		(0.0837)	*(0.0825)*
Decentralized management *(=1 yes)*		-0.0886	-0.0988
		(0.0838)	*(0.0817)*
Organizational innovation *(=1 yes)*			0.212
			(0.143)
Year 2015	0.161*	0.160*	0.151
	(0.0929)	*(0.0932)*	*(0.0917)*
Year 2017	0.180**	0.188**	0.190***
	(0.0752)	*(0.0730)*	*(0.0712)*
Observations	*472*	*472*	*472*
R-squared	*0.252*	*0.258*	*0.265*

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

3. Organizational models, size and performance

We now look at the governance of the firm, as a function of its size and by its impact on productivity. The larger the number of persons employed, the less likely it is to find a family-managed firm and, at the same time, the more common become decentralization and performance-remuneration policies (Regressions 3.1 to 3.4). These findings are extremely consistent across waves. As to productivity instead, the evidence is mixed. Decentralized management per se does not seem to have a statistically significant impact on productivity. It is however neat that a firm entirely family-run has a productivity disadvantage – especially considered that the lower the concentration of family members in management, the less negative the effect (Regression 3.5 and 3.6). Also, there is a positive correlation between performance-based remuneration policies and performance, independently from firm size.

Regression 3.1 Family management 100% and size

	Family management 100% 2015	*Family management 100% 2017*	*Family management 100% pooled*
Persons employed *(log)*	-0.171***	-0.203***	-0.185***
	(0.0348)	*(0.0284)*	*(0.0193)*
Year 2015			0.00958
			(0.0433)
Year 2017			-0.0452
			(0.0396)
Observations	*558*	*458*	*1,516*
R-squared	*0.125*	*0.197*	*0.148*

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

Regression 3.2 Family management 50% and size

	Family management 50% 2015	*Family management 50% 2017*	*Family management 50% pooled*
Persons employed *(log)*	-0.0896**	-0.145***	-0.127***
	(0.0418)	*(0.0344)*	*(0.0229)*
Year 2015			-0.0333
			(0.0438)
Year 2017			-0.0622
			(0.0390)
Observations	*558*	*458*	*1,516*
R-squared	*0.082*	*0.135*	*0.102*

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

Regression 3.3 Decentralized management and size

	Decentralization 2015	*Decentralization 2017*	*Decentralization pooled*
Persons employed *(log)*	0.0764***	0.0592**	0.0671***
	(0.0236)	*(0.0285)*	*(0.0152)*
Year 2015			-0.0291
			(0.0274)
Year 2017			0.0380
			(0.0302)
Observations	*687*	*589*	*1,908*
R-squared	*0.105*	*0.072*	*0.078*

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

Regression 3.4 Performance-based remuneration policies and size

	Bonus 2015	*Bonus 2017*	*Bonus pooled*
Persons employed *(log)*	0.0844***	0.0669**	0.0797***
	(0.0282)	*(0.0285)*	*(0.0166)*
Year 2015			0.00591
			(0.0339)
Year 2017			0.0651*
			(0.0352)
Observations	*687*	*589*	*1,908*
R-squared	*0.082*	*0.102*	*0.098*

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

Regression 3.5 Decentralized management and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Labour productivity pooled (2013-2015-2017)*
Decentralized management *(=1 yes)*	0.125	0.0154	0.0579
	(0.0824)	*(0.0711)*	*(0.0439)*
Persons employed *(log)*	-0.0320	-0.0348	-0.0108
	(0.0553)	*(0.0411)*	*(0.0252)*
Year 2015			0.154***
			(0.0508)
Year 2017			0.112**
			(0.0469)
Observations	*524*	*450*	*1,538*
R-squared	*0.210*	*0.216*	*0.140*

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

Regression 3.6 Family management 100% and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Labour productivity pooled (2013-2015-2017)*
Family management 100% *(=1 yes)*	-0.00278	-0.166**	-0.156***
	(0.0658)	*(0.0687)*	*(0.0477)*
Persons employed *(log)*	-0.0187	-0.0365	-0.0349
	(0.0549)	*(0.0453)*	*(0.0289)*
Year 2015			0.131**
			(0.0596)
Year 2017			0.110**
			(0.0531)
Observations	*403*	*336*	*1,176*
R-squared	*0.227*	*0.264*	*0.145*

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

Regression 3.7 Family management 50% and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Labour productivity pooled (2013-2015-2017)*
Family management 50% *(=1 yes)*	0.0150	-0.148**	-0.128***
	(0.0675)	*(0.0677)*	*(0.0457)*
Persons employed *(log)*	-0.0172	-0.0269	-0.0255
	(0.0549)	*(0.0454)*	*(0.0284)*
Year 2015			0.127**
			(0.0590)
Year 2017			0.109**
			(0.0534)
Observations	*403*	*336*	*1,176*
R-squared	*0.227*	*0.261*	*0.140*

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

Regression 3.8 Performance-based remuneration policies and productivity

	Labour productivity 2015	*Labour productivity 2017*	*Labour productivity pooled (2013-2015-2017)*
Bonus *(=1 yes)*	0.0850	0.170**	0.130***
	(0.0665)	*(0.0709)*	*(0.0417)*
Persons employed *(log)*	-0.0336	-0.0464	-0.0169
	(0.0562)	*(0.0399)*	*(0.0246)*
Year 2015			0.143***
			(0.0518)
Year 2017			0.105**
			(0.0470)
Observations	*524*	*450*	*1,538*
R-squared	*0.207*	*0.234*	*0.148*

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

Appendix 2. Method

1. Questionnaire

The questionnaire consists of around 70 questions grouped in six main fields:

1. Firm structure and market (control, organization, role played in value chains);
2. Workforce (persons employed, skills and training);
3. Investments, innovation, research and development, smart manufacturing;
4. Internationalization (trade and production);
5. Finance;
6. Bureaucracy.

The survey was conducted between December 2018 and February 2019 by GFK[22] using CATI (*Computer Based Telephone Interview*) methodology.

Firms to be interviewed were drawn exclusively from a pool of manufacturing firms employing at least 10 persons based on the information available in the database Orbis-Bureau van Dijk.

Questions generally refer to 2017. Sometimes though, questions concern the three-year period 2015-2017.

2. Sample

For the sake of statistical significance both in general and at regional level, the sample abides by two criteria:

1. it is sufficiently large for each region;
2. it is stratified based on
    a. technological intensity – i.e. Eurostat's 4 aggregates of the manufacturing industry related to high-technology, medium high-technology, medium low-technology and low-technology based on NACE Rev.2. (Table 2);
    b. enterprise size – i.e. the 3 categories defined by the European Commission as small enterprises (10-49 persons employed), medium-sized enterprises (50-249 persons employed) and large enterprises (250 or more persons employed) (Table 3).

As to the first criterion, the sample consists of 590 manufacturing firms, of which 190 in Lombardia and 100 in Baden-Württemberg, Bayern, Rhône-Alpes e Cataluña (Table 1).

[22] *Market research company active all over Europe.*

Table 1. Sample size by region (wave 2019)

	Number of firms
Auvergne-Rhône-Alpes	100
Baden-Württemberg	99
Bayern	101
Cataluña	100
Lombardia	190
Totale	**590**

Source: Benchmark analysis - Assolombarda

As to the second criterion, as shown in Table 3, in the representative distribution the number of large enterprises by sector falls short of guaranteeing the significance of survey results. A balance was given to the distribution of interviews by reducing the weight of small firms (10-49 persons employed) – the largest, so best represented, segment – and at the same time increasing that of medium-sized and large firms.

Table 2. Classification of manufacturing industries according to technological intensity

Technological intensity	NACE 2 digit	Manufacturing industry
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

Table 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

Auvergne-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

Lombardia	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**

Auvergne-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

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

Source: GFK on Eurostat data

Weights were computed based on the methodology illustrated in Box A.

Box A - The weighting system

In order to build sample weights, the sample distribution by sector and size of surveyed firms was re-balanced based on the equivalent distribution of the population of firms reported by Eurostat.

The sample distribution was built starting from absolute weights, in turn computed by splitting the sample in 72 cells based on the 24 manufacturing industries defined by Nace Rev. 2 2 digits and the 3 enterprise size classes (10-49 persons employed; 50-249 persons employed; 250 or more persons employed).

The sample weight for firms in sector *k* and size class *j* hence results from the following formula:

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

where

- $Nfirms_{kj}$ is the overall number of firms in sector *k* and size class *j* in a region;
- $Sfirms_{kj}$ is the number of firms in sector *k* and size class *j* in the sample;
- *Nfirms* and *Sfirms* are the total number of firms in the population and in the sample.

By construction, firms in the same sample cell (hence of the same sector/size combo) are attributed the same weight. Sample weights by region subsequently sum to the total number of firms in the reference population.

3. Comparability over time

The Benchmark analysis by Assolombarda, in its latest edition as in the previous two, takes after the country-level survey "European Firms in a Global Economy: Internal policies for external competitiveness" (EFIGE)[23]. The comparability with EFIGE and across waves, granted by the adoption of equivalent sampling stratification methods and questionnaire[24], allows to capture manufacturing firms' competitiveness dynamics in realms not included in balance-sheets – e.g. organization, innovation, internationalization – and draw relevant policy suggestions.

Table 4 sums persons employed and turnover data for firms sampled in EFIGE and the three waves of the Benchmark analysis.

[23] *EFIGE is an international research project run in 2010, coordinated by Bruegel (Brussels) and financed by the Seventh Framework Programme of the European Union. It is available at www.efige.org.*

[24] *EFIGE data were properly adjusted to match the territorial level of analysis chosen by Assolombarda.*

Table 4. Persons employed and turnover for firms in Benchmark analysis wave 2019 (on 2017 data), wave 2017 (on 2015 data) and wave 2016 (on 2013 data) and for firms in EFIGE 2010 (on 2009 data)

Wave 2019 (on 2017 data)

Region	Persons employed		Turnover
	mean	*median*	*(thousand €)*
Baden-Württemberg	43	23	8,002
Bayern	48	25	9,524
Auvergne-Rhône-Alpes	43	20	8,864
Cataluña	46	18	11,387
Lombardia	33	17	10,428
Total	**42**	**21**	**9,423**

Wave 2017 (on 2015 data)

Region	Persons employed		Turnover
	mean	*median*	*(thousand €)*
Baden-Württemberg	63	24	10,038
Bayern	63	25	8,211
Auvergne-Rhône-Alpes	35	22	7,521
Cataluña	35	25	8,974
Emilia-Romagna	34	20	6,981
Lombardia	31	17	10,738
Total	**36**	**20**	**8,949**

Wave 2016 (on 2013 data)

Region	Persons employed		Turnover
	mean	*median*	*(thousand €)*
Baden-Württemberg	66	26	8,419
Bayern	57	25	8,604
Auvergne-Rhône-Alpes	39	19	8,829
Cataluña	24	19	4,619
Lombardia	33	18	6,889
Total	**43**	**20**	**7,081**

EFIGE 2010 (on 2009 data)

Region	Persons employed		Turnover
	mean	*median*	*(thousand €)*
Baden-Württemberg	63	28	9,345
Bayern	62	27	8,685
Auvergne-Rhône-Alpes	43	18	6,719
Cataluña	39	20	7,772
Lombardia	43	20	7,570
Total	**51**	**23**	**8,046**

Source: Benchmark analysis – Assolombarda and Orbis – Bureau van Dijk

Appendix 3. Benchmarks

To best capture characteristics, constraints, challenges and strategies of the European manufacturing industry today, five regions similar by economic structure were selected as benchmarks: Baden-Württemberg and Bayern (Germany), Auvergne-Rhône-Alpes (France), Cataluña (Spain), Lombardia (Italy).

In their countries these regions account on average for a quarter of GDP and manufacturing value added (Table 5).

Table 5. Benchmark regions: GDP and manufacturing value added as % of national total

	GDP (2017)		**Manufacturing value added** (2018)	
	absolute value (current prices, million €)	*% of national total*	*absolute value (current prices, million €)*	*% of national total*
Auvergne-Rhône-Alpes	263,148.7	11.5%	34,924.7	15.2%
Baden-Württemberg	496,240.3	15.1%	144,161.8	21.6%
Bayern	597,818.0	18.2%	142,421.1	21.4%
Cataluña	223,987.9	19.2%	36,298.1	25.9%
Lombardia	380,955.2	22.1%	67,815.0	27.2%

Source: Assolombarda on Eurostat data

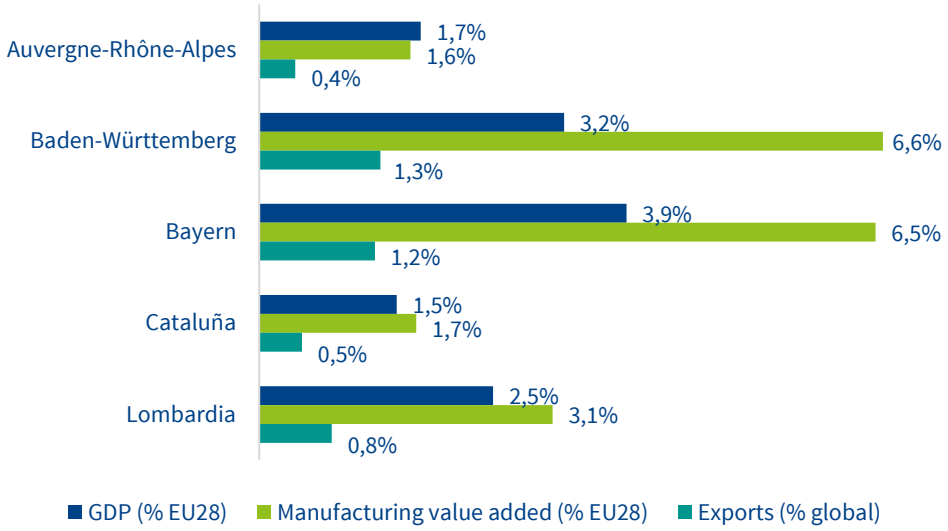
At European level, though covering only 5% of total land area and counting for 10% of total population (Table 6), these regions together represent 12.8% of GDP and 19.5% of manufacturing value added (shares that increase to 15.0% and 21.6% respectively considering the European Union without the UK) (Figure 1). Moreover, these regions export 4.1% of the global total.

Table 6. Benchmark regions: population and area (2018)

	Population on January 1st		**Area**	
	number	*% of EU28*	*sqkm*	*% of EU28*
Auvergne-Rhône-Alpes	7,992,341	1.6%	71,134	1.6%
Baden-Württemberg	11,023,425	2.2%	35,745	0.8%
Bayern	12,997,204	2.5%	70,543	1.6%
Cataluña	7,488,718	1.5%	32,110	0.7%
Lombardia	10,036,258	2.0%	23,864	0.5%

Source: Assolombarda on Eurostat data

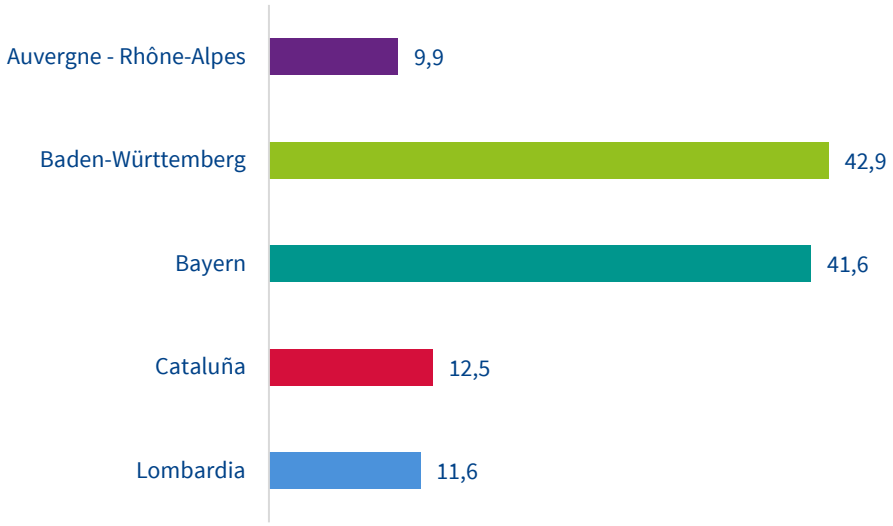
Figure 1. Benchmark regions: GDP (% of EU28, 2017), manufacturing value added (% of EU28, 2016) and exports (% of global, 2017)



Source: Assolombarda on Eurostat, WTO and regional statistics bureau data

Though comparable, regions differ in terms of GDP and manufacturing value added shares of European total, with German regions weighting around 3 times as much as the other regions. However, they differ the most in terms of manufacturing industry profile (Figure 2): on average manufacturing firms in Germany count 40 persons employed per local unit, in comparison with 10 in Auvergne-Rhône-Alpes, 13 in Cataluña and 12 in Lombardia – all regions characterized by a strong presence of micro and small firms.

Figure 2. Benchmark regions: average firm size (persons employed per local unit, 2016)



Source: Assolombarda on Eurostat data

In line with official statistics and previous waves, the Benchmark analysis 2019 sample shows a major role of small firms in all regions, with only Baden-Württemberg and Bayern highlighting a relatively large presence of firms with 250 or more persons employed (Table 7).

Table 7. Sample distribution by size class and average size (% of total firms and average number of persons employed, wave 2019)

	Firms by size class			Average size
	10-49	**50-249**	**>250**	
Baden-Württemberg	81.4%	17.0%	1.6%	43
Bayern	83.8%	13.4%	2.7%	48
Auvergne-Rhône-Alpes	84.6%	13.6%	1.8%	43
Cataluña	86.0%	9.3%	4.7%	46
Lombardia	89.3%	9.9%	0.8%	33
Total	**84.9%**	**13.1%**	**2.0%**	**42**

Source: Benchmark analysis - Assolombarda

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Other publications:

Elenco ricerche pubblicate:

– “Smart cities tra concetto e pratica” N° 01/2018
– “Analisi e prospettive delle geografie economiche del territorio lodigiano” N° 02/2018
– “Progetto C.E.R.C.A. Circular Economy come Risorsa Competitiva per le Aziende” N° 03/2018
– “Smart cities: casi studio” N° 04/2018
– “Fondimpresa: il Conto Formazione nel territorio milanese” N° 05/2018
– “Top 500+ Le eccellenze di Monza e Brianza” N° 06/2018
– “Top 200 Le eccellenze di Lodi” N° 07/2018
– “Platform economy: definizioni e prospettive” N° 08/2018
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