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Editorial Preface

The first 2022 issue of the *Rivista di statistica ufficiale/Review of official statistics* is monothematic and focusses on the Italian business system in terms of competitiveness, propensity to grow and resilience to shocks.

This represents a core topic of great relevance, also in the light of the persistent turbulence still affecting economic systems on a global scale.

The results illustrated derive from a joint research project carried out by the Italian National Institute of Statistics – Istat and the Institute of Economics of the Sant'Anna School of Advanced Studies (Pisa, Italy). This synergy is based on a highly coordinated research strategy, a common methodological approach to the use of different data sources, as well as an intense use of firm-level analyses combining qualitative and quantitative statistical information.

In more detail, this research project deals with "*Links between performance and organisational-strategic choices of firms: measurement and analysis*" and aims at deepening the links between business performance (primarily in terms of labour productivity and size growth) and organisational and strategic configurations, thus adopting a multidimensional perspective.

Special attention is paid to control structure; belonging to groups of firms; internal organisation of work and recruitment; degree of technological development; innovation and internationalisation.

The related activities are organised into four research lines: *i*) Anatomy of the Italian production structure: organisational skills and business performance; *ii*) Relationship between productivity and business growth; *iii*) Selection and dispersion of productivity; *iv*) Technology, globalisation and the labour market.

The three scientific articles published in this issue of the *Rivista di statistica ufficiale/Review of official statistics* refer mainly to the first research line.

In the first article, Stefano De Santis, Jelena Reljic and Federico Tamagni define the characteristics of the underlying context of the Italian production development. The general picture emerging from the analysis is that within-firm learning prevails over between-firm reallocation in shaping aggregate productivity dynamics over the reference period (2011-2018). In addition,

allocative efficiency is generally stable and rather weak, although slightly stronger in manufacturing than in services. This is in line with other studies illustrating the emergence of a *neo-dualism* in the Italian business system, featuring the co-existence of a small group of high-productivity and technologically advanced leading firms, whose traction on the economy is hampered by a large group of small, low-productivity and non-innovative laggard firms.

The following two papers focus on the relationship between structural and behavioural characteristics of companies and their ability to react to shocks, in particular to the crisis caused by the COVID-19 pandemic.

More specifically, Stefano Costa, Stefano De Santis, Giovanni Dosi, Roberto Monducci, Angelica Sbardella, and Maria Enrica Virgillito address both the status and strategic profile of Italian firms in the wake of the most severe crisis that economies have been facing since World War II, assessing whether and how these characteristics affected firms' ability to react to this particularly critical situation. Applying a multidimensional data analytics approach, two main findings are evident: *i*) firm responses are highly path-dependent on their pre-crisis organisational capabilities; *ii*) this crisis related to COVID-19 might turn out in being more pervasive than expected, producing widespread restructuring processes rather than creativeness. A strong adaptive persistence between firms' behavioural attitudes is also detected, thus highlighting that both their knowledge and organisation in their business-as-usual mode exert remarkable impacts on their ability to react to unforeseen events.

In the final article, Stefano Costa, Stefano De Santis and Roberto Monducci, despite the cross-cutting nature of the recession, illustrate how a former higher dynamism contributes to addressing the new emergence. Thus favouring a divergence of firms' paths of growth, even though for some previously static segments the crisis also produced an innovative stimulus effect and not just a defensive one. In a global context increasingly characterised by exogenous shocks of great impact, these analyses indicate that firms presenting development paths oriented towards innovation, digital transformation and human capital improvement during the pre-crisis period show a greater capacity to develop articulated reaction strategies.

From a structural point of view, these analyses highlight that when facing such far-reaching, exogenous crises, business size eventually plays an important role in shaping the resilience to shocks and a company's readiness to undertake proactive strategies. The overall picture illustrated in this monothematic issue of the *Rivista di statistica ufficiale/Review of official statistics* stands as an enhancement of the ability to read the characteristics of the Italian production system and its growth potential, with significant policy implications.

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Patrizia Cacioli   Nadia Mignolli
Editor   *Coordinator of the Editorial board*

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In memory of Professor Jean-Paul Fitoussi, R.I.P.

The *Rivista di statistica ufficiale/Review of official statistics* shares with deep sorrow the news of the recent death of Professor Jean-Paul Fitoussi (19th August 1942 – 15th April 2022).

He was one of the best-known French economists in the world, who went far beyond the borders of his country, making significant contributions to a number of organisations, with a clear international reputation. He was an eminent figure in his discipline, holding strategic roles and very often counselling govern representatives together with policy-makers. One of his greatest commitments and merits has been to put the rigour of scientific research and study at the service of economic policy and, above all, of citizens, thus fostering the promotion, development and enhancement of the economic culture.

Jean-Paul Fitoussi had a special relationship with Italy as well, because of both his academic teaching experiences (first at the European University Institute in Fiesole, Firenze, later at Luiss Guido Carli in Roma) and his involvement with the Italian National Institute of Statistics - Istat.

His scientific contributions during the coordination of the "*Commission on the Measuring of Economic Performance and Social Progress*" (co-chaired by Joseph Stiglitz and Amartya Sen) in the years 2008-2009 were relevant also for Istat's "*Scientific Commission for the Measurement of Well-being*", which was established in 2011 and of which Jean-Paul Fitoussi was a member and actively co-operated with.

For several years, Jean-Paul Fitoussi has participated as a member in the Scientific Committee of this *Rivista di statistica ufficiale/Review of official statistics* with constant, brilliant and proactive suggestions, thus conveying his vision and opening fruitful and positive debates.

He was also an author of the *Rivista*, with an article on political economy published in issue N. 2/2021 and titled "*Putting People First: Beyond COVID-19*" (https://www.istat.it/it/archivio/262320). Its content deals with the global pandemic situation, strongly supporting that the beneficiaries and the disadvantaged concerning the State actions have to become an essential part of the social dialogue and policy-making.

Jean-Paul Fitoussi's constant commitment, his ideas, his enthusiastic planning role, his direct and always effective communication will always remain and be missed.

Productivity dynamics in Italy: learning and selection

Stefano De Santis [1], Jelena Reljic [2], Federico Tamagni [2]

Abstract

This paper investigates the sources of labour productivity dynamics in Italy between 2011 and 2018. Exploiting the FRAME-SBS dataset maintained by Istat, we apply productivity decomposition methods to assess the relative contribution of within-firm productivity ("learning" effect) and reallocation of market shares across firms ("market selection" effect) to aggregate productivity. While we cannot measure entry/exit dynamics and thus focus on incumbents, the comprehensive coverage of the Italian economy offered by the data enables us to perform a disaggregated analysis at the level of very narrowly defined industries (at 5-digit level, NACE Rev.2). This provides a significant contribution to the literature, as previous studies looked at aggregate economy or aggregate macro-sectors (e.g. total manufacturing). The general picture emerging from the analysis is that within-firm "learning" prevails over between-firm reallocation and allocative efficiency effects in shaping aggregate productivity dynamics. This finding is robust over time and across both manufacturing and service industries. In addition, allocative efficiency is generally stable and rather weak over the reference period, although somewhat stronger in manufacturing than in services.

Keywords: Productivity, decomposition, learning, reallocation.

JEL classification: D22, J24, L25, O47.

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1. Introduction

The slowdown in productivity dynamics observed in advanced countries (Syverson, 2017) has recently revived the interest in productivity analysis and its drivers. Economic analysis of the micro-level sources of productivity typically follows two complementary research lines. On the one hand, one tries to identify the enhancing or hampering effect of firm-specific characteristics and capabilities, such as firm size, ownership type, managerial profiles and strategies, technological and innovation patterns, as well as their interplay with contextual or policy-related factors, such as product/labour market regulation, the role of credit and financial markets, innovation and industrial policies. On the other hand, the second strand of research seeks to explain aggregate (sector-wide or economy-wide) productivity patterns by looking at the relative contribution of learning effects due to within-firm productivity dynamics, vis-à-vis market selection or between-firms effects, arising from reallocation of market shares across heterogeneously productive firms.

A large number of studies have evaluated patterns and relative contribution of reallocation dynamics, using different methods to decompose productivity into within and between effects in various countries and time periods. Recent works, most notably from the US, provide suggestive evidence that they do play a role in the recent slowdown. To mention just a few, Foster *et al.* (2016) compare the 2008 financial crisis with earlier downturns and find that strength of productivity-enhancing reallocation fell rather than increase in the US, which is at odds with the "cleansing" hypothesis. Similarly, Decker *et al.* (2017) claim that productivity slowdown in the US can be partly explained by declining allocative efficiency.

This article examines learning *vs.* selection forces underlying the patterns of productivity in Italy between 2011 and 2018. The issue is the subject of long-lasting debate in the Italian case, as Italy has been underperforming in terms of aggregate productivity growth since the mid-nineties (Bugamelli *et al.*, 2020). Concerning the period under study, two studies provide a number of interesting empirical findings on Italy, both exploiting the Melitz and Polanec (2015) decomposition framework. First, Linarello and Petrella (2017) document an increase in allocative efficiency over the period 2005-2013 – occurring through productivity-enhancing reallocation from low-productivity to high-productivity firms as well as from the net entry effect –, coupled with

a negative unweighted average firm-level productivity growth component. This adverse contribution of unweighted average productivities may reflect a polarised structure of the Italian economy (Costa *et al.*, 2020; Dosi *et al.* 2012), where a large number of micro/small low-productivity and innovation-laggards firms coexist with a small set of high-productivity firms featuring high technological and organisational capabilities. The second reference study for Italy, by Bugamelli *et al.* (2020), documents that the contribution of unweighted average productivity growth was negative for both aggregate manufacturing and aggregate services over the period 2007-2016. Instead, reallocation and net entry effects contributed positively to the aggregate productivity growth. Besides, they also find that less productive firms were downsizing during the period.

This paper adds to these existing studies by providing two main contributions. The first distinct feature of our work is that we perform decomposition analysis at a very narrow level of sectoral aggregation (at the 5-digit level, NACE Rev.2). This represents an important improvement not only vis-à-vis reference studies on Italy but vis-à-vis the literature on productivity decomposition more generally. In fact, as discussed in Bottazzi *et al.* (2010) and in Dosi *et al.* (2015), the higher level of sectoral aggregation employed in previous studies (from the aggregate economy to macro-sectors like services *vs.* manufacturing, or even more disaggregated by 2- or 3-digit industries) is likely mixing selection/reallocation effects occurring across firms active in quite diverse sub-markets, not actually competing among each other for market shares. The finer level of disaggregation we examine here, conversely, allows us to capture learning and selection effects across firms that are genuinely competing in the same product market. Put differently, as discussed for instance in Bugamelli *et al.* (2020), the components of the productivity decompositions summarise the average tendency in the sample over which those components are measured: within component represents the productivity increases or decreases of the average incumbent firm, while between component and allocative efficiency emerge as the balancing out of movements of market shares across differently productive incumbents, where shares are measured against all firms in the sample. If the reference sample is – say – aggregate manufacturing, patterns observed in average incumbent and market shares movements at this level surely do not adequately represent the underlying patterns occurring at more disaggregated levels, like in the 5-digit

industries we focus on. It may well be that in disaggregated industries the within components increase (decrease), while the same component measured via the average incumbent in total manufacturing decreases (increases). As we shall see, our analysis of the components obtained separately for each 5-digit sector reveals substantial heterogeneity underlying the aggregate patterns, casting doubt that aggregate analysis is genuinely informative of the patterns unfolding in the country.

The second point of departure from the literature is more technical but nonetheless important. Since, as it is well known, different decompositions proposed in the literature entail alternative definitions of the components, in turn implying different measures and interpretations of the within *vs.* between/reallocation components (see Melitz and Polanec, 2015, for a detailed discussion), we want to test that our main conclusions are not driven by selecting one specific decomposition methodology. Therefore, while previous studies, in particular the abovementioned works on Italy, tend to focus on just one decomposition, we combine insights from three different decomposition methods proposed in the literature. In particular, we compare the relative weight of within vis-à-vis between and/or cross components from the dynamic decompositions developed by Griliches and Regev (1995) and by Foster, Haltiwanger and Krizan (2001), and also examine the relative weight of the covariance term from the static productivity decomposition proposed in Olley and Pakes (1996). This combination of techniques, besides testing the robustness of the results across methods, also allows us to provide evidence on both dynamic and static patterns of learning *vs.* reallocation.

The empirical analysis, and in particular its highly disaggregated level, takes advantage of access to a unique source of information on the Italian industrial system, the FRAME-SBS dataset, offering a comprehensive coverage of the population of Italian firms. Over the last couple of decades, the demand for high-quality firm-level micro-data has increased significantly, both for the purpose of measurement of economic phenomena and for policy reasons. In order to meet such demand, European statistical offices have accelerated the design and production of new datasets able to accurately capture heterogeneity and changes within productive systems, as well as factors underlying, *e.g.* the competitiveness and resilience of firms, competitive and backward segments, and profiles of growing or declining firms. In this context, Istat has undertaken

a strategy of designing and implementing a new generation of micro-founded statistics, in which the microeconomic component plays a central role. This new approach has been based on the implementation of a twofold integrated strategy in statistical production, combining (*i*) massive use of administrative data for the construction of multidimensional statistical registers, with extensive possibilities to link individual data to additional administrative sources and direct surveys; and (*ii*) direct statistical surveys focussed on economic units with multi-purpose modules able to measure their organisational structures, behaviours and strategies, not detectable when using administrative sources only. The resulting new system of integrated data also guarantees consistency between the micro and macroeconomic perspectives lends solidity to micro-founded analyses of heterogeneity within various universes (*e.g.* economic units) in different dimensions (*e.g.* performance, geographical positioning, workforce utilisation, international openness, remunerations). The FRAME-SBS data, consisting in the annual replication of the Register System collecting information on firm balance sheets, is central in the new system and makes multi-level dynamic analyses possible.

For this work, we had access to FRAME-SBS data for the period 2011-2018. Our results document that, despite substantial variability across industries in terms of the relative weight of within *vs.* between/reallocation effects, the contribution of within-firm "learning" prevails over between-firm reallocation in shaping aggregate productivity dynamics over the reference period. Moreover, and notwithstanding large variability across 5-digit industries, static allocative efficiency is rather stable over time and in most industries is quite weak, although somewhat stronger across manufacturing sectors than across service industries.

Exploiting access to FRAME-SBS over the period 2011-2018, we document that, irrespectively of the decomposition method, within-firm "learning" prevails over between-firm reallocation in shaping aggregate productivity dynamics over the reference period. Moreover, efficient reallocation is stable over time and quite weak, although somewhat stronger across manufacturing sectors than across service industries.

The paper is organised as follows. In Section 2, we present the decomposition methods. Section 3 describes the data. We present and discuss our main findings in Section 4. Final remarks are drawn in the concluding Section 5.

2. Review of productivity decomposition methods

Various approaches have been put forward to break down aggregate productivity. All decompositions start with a common definition of aggregate productivity to be decomposed, defined as a weighted average of the productivity of all firms active in the same sector, in our case defined at the 5-digit level. Formally, indicating with t the year and j the sector, aggregate productivity is defined as:

$$\Pi_{j,t} = \sum_{i \in j} \omega_{i,t}\, \pi_{i,t} \tag{2.1.1}$$

where Π represents sectoral productivity, while π denotes firm-level productivity, and ω is the market share of each firm in industry j.

Needless to say, productivity can be measured in several ways. Studies typically adopt either single-factor or multi-factor indicators. We opt for labour productivity since total factor productivity necessitates strong assumptions about the undifferentiated nature of technology. Accordingly, we use employment shares as weights ω instead of output shares (Foster *et al.*, 2001).

Lacking information on "true" entry and exit, we focus on decomposing the contribution of incumbent firms. In general, the latter can be decomposed into (*i*) a 'learning component' or 'within-firm' effect, resulting solely from heterogeneity in individual firms' productivity, measured statically in a given year, or dynamically, as firms become more or less efficient over time; and (*ii*) one or more components capturing 'between-firm' or 'reallocation/selection' effects, resulting from the static or dynamic allocation of market shares among differently productive firms. We employ three productivity decompositions widely used in the literature, the two dynamic decompositions by Griliches and Regev (1995) and Foster, Haltiwanger and Krizan (2001), and the static decomposition by Olley and Pakes (1996).

Griliches and Regev (1995) method, hereafter GR, breaks down sectoral productivity growth of incumbent firms between two consecutive years, $\Delta\Pi_{j,t}$, into the following two components:

$$\Delta\Pi_{j,t}^{GR} = \underbrace{\sum_{i \in j} \overline{\omega}_i\big(\pi_{i,t} - \pi_{i,t-1}\big)}_{\text{within}} + \underbrace{\sum_{i \in j} \big(\omega_{i,t} - \omega_{i,t-1}\big)\big(\overline{\pi}_i - \overline{\Pi}_j\big)}_{\text{between}} \tag{2.1.2}$$

where a bar over a variable indicates the simple average of the variable over two consecutive periods (*e.g.* (ωit+ωit−1)/2; (πit+πit−1)/2; (Πjt+ Πjt−1)/2).

The first term on the left-hand side of Equation 2.1.2 is the within-firm component, summing all the changes in firm-level productivities at constant market shares (equal to firms' average employment shares over the initial and final year). The within-component is therefore productivity-enhancing if individual firms increase their efficiency (learn, in evolutionary terms), keeping their input shares "fixed". The 'between-firm effect' in the second term on the right-hand side, instead, reflects over time changes in the distribution of employment shares among firms. It is productivity-enhancing if labour inputs tend to increase more in relatively more productive firms than in relatively less productive firms.

Foster, Haltiwanger, and Krizan (2001) decomposition, hereafter FHK, can be written formally as follows:

$$\Delta\Pi_{j,t}^{FHK} = \underbrace{\sum_{i\in j} \omega_{i,t-1}\left(\pi_{i,t} - \pi_{i,t-1}\right)}_{\text{within}} + \underbrace{\sum_{i\in j}\left(\omega_{i,t} - \omega_{i,t-1}\right)\left(\pi_{i,t-1} - \Pi_{j,t-1}\right)}_{\text{between}}$$
$$+ \underbrace{\sum_{i\in j}\left(\omega_{i,t} - \omega_{i,t-1}\right)\left(\pi_{i,t} - \pi_{i,t-1}\right)}_{\text{cross}} \qquad (2.1.3)$$

The within and between components in this framework are similar to the components of the GR decomposition, but they rely on different reference measures. Instead of taking averages of key variables (*i.e.* productivity and labour shares) over time, FHK take values in the initial period. Hence, the within-effect reflects changes in firm-level productivity, weighted by initial employment shares. The between-component accounts for changes in employment shares, weighted by the deviation of a firm's productivity from the average sectoral productivity in the initial year t-1. This leads to an additional third component that reflects simultaneous changes in employment shares and in productivity. This is usually referred to as a "cross" or covariance term, and it is productivity-enhancing (reducing) if firms increasing their employment shares are at the same time becoming more (less) efficient.

The Olley and Pakes (1996) decomposition is, instead, a static decomposition, which breaks down aggregate productivity in a given year t, without following productivity or market share changes over time. The OP decomposition is

conceptually different from the abovementioned methods, meaning that their respective components are not easily comparable. Formally, one has

$$\Pi_{j,t}^{OP} = \overline{\Pi}_j + \underbrace{\sum_{i \in j} (\omega_{i,t} - \overline{\Omega}_j)(\pi_{i,t} - \overline{\Pi}_j)}_{\text{covariance term}} \qquad (2.1.4)$$

where $\overline{\Pi}$ and $\overline{\Omega}_j$ are average productivity and average market share in sector j, respectively.

The first term is simply unweighted average productivity, and it thus reflects the hypothetical productivity level of sector j if all firms in the sector had the same employment shares. This is interpreted as a reference situation in the absence of market selection forces delivering reallocation of shares across firms. In this view, the deviation between such a benchmark and weighted productivity, given in the second term on the right-hand side of the equation, delivers a measure of allocative efficiency. Market selection/reallocation forces are efficient (inefficient) if this term is positive (negative), as this implies that more (less) productive firms have larger than average market shares. In other words, the higher the covariance term, and the more efficiently market forces operate in sector j.

3. Data

As mentioned, the empirical analysis takes advantage of the Italian microdata from the FRAME-SBS database maintained by Istat, reporting rich firm-level information on firms operating in non-agricultural and non-financial sectors between 2011 and 2018.

We run separate analyses by 5-digit sectors based on the NACE Rev. 2 classification of economic activities. Similarly to Linarello and Petrella (2017), we exclude from the analysis manufacturing of coke and petroleum products, construction, utilities, and services overlapping with the public sector. In addition, to ensure that a minimum number of firms is present in each 5-digit industry, which is essential to run meaningful statistical analysis, we restrict the analysis to the 5-digit sectors with more than twenty firms. We are left with more than 2.4 million firms operating annually in 613 industries – 280 within manufacturing and 333 within service.

The variables of our interest are employment figures and labour productivity. Employment is reported in FRAME-SBS as the number of full-time equivalent employees, while we compute labour productivity as the ratio between value added and employment. To avoid misleading comparisons over time, we compute real value added at constant 2015 prices, deflating firm-level nominal value added by the 2-digit sectoral production price indexes provided by Istat.

Table 3.1 reports some descriptive statistics of our sample. The total number of firms in the Italian economy has been increasing between 2013 to 2018. This growth has been concentrated in service sectors while a contrasting pattern emerges in manufacturing industries, where the number of firms has been steadily diminishing over the reference period. Namely, in 2018 there were 42,571 more firms in services and 29,305 firms less in manufacturing than in 2012. Moreover, we also observe a notable difference between manufacturing and services in terms of the average 5-digit NACE sectoral labour productivity levels. While the latter increased on average between 2012 and 2018 in both macro sectors, productivity levels have been relatively higher in manufacturing industries.

Table 3.1 - Descriptive statistics (a)

YEAR	Total			Manufacturing			Services		
	N	n		N	n		N	n	
2012	613	2,484,833	34,789.35	280	339,216	43,163.42	333	2,145,617	29,019.20
2013	613	2,418,302	35,441.69	280	323,969	44,714.48	333	2,094,333	29,150.45
2014	613	2,418,418	36,778.78	280	323,536	47,389.56	333	2,094,882	29,718.90
2015	613	2,430,713	38,642.65	280	320,346	50,397.88	333	2,110,367	30,908.64
2016	613	2,440,266	40,303.70	280	315,680	53,146.72	333	2,124,586	31,939.88
2017	613	2,482,292	41,604.49	280	317,857	54,495.13	333	2,164,435	33,157.28
2018	613	2,498,099	43,379.99	280	309,911	56,559.45	333	2,188,188	34,706.54

Source: Authors' elaboration
(a) "N" stands for the number of sectors, while "n" for the number of firms. Level of labour productivity is calculated as a ratio between value added at constant 2015 prices and the number of employees.

4. Decomposition results

Decomposition analysis was run separately by year and 5-digit sector. We report a descriptive summary of results, primarily focussing on the extent of selection/efficient allocation. Accordingly, we focus on two main exercises. First, we compare within *vs.* between and/or cross components from the GR and FHK decompositions, allowing us to assess whether selection effects prevail over learning. Second, we study the covariance component of the OP decomposition to assess the strength of allocative efficiency. We highlight the main patterns emerging over time and across manufacturing *vs.* services.

Dynamic decompositions

We first summarise the empirical results of the GR and FHK decompositions. All reported values are expressed as percentage shares of the components in aggregate productivity changes, allowing us to assess their relative weight in productivity dynamics.

Figure 4.1 reports boxplots of the distribution of the relative weight of each component from the GR and the FHK decompositions, computed across the 5-digit sectors, pooled over time. Despite considerable cross-sectional variability, it turns out that both decomposition methods point to a relatively dominant role of the within-effect vis-à-vis the between-effect in shaping productivity dynamics in Italy. Indeed, the entire white box – spanning values between the 25th and the 75th percentile of the within-term components – is positioned above the boxes representing the distribution of the other components. This clearly suggests a relatively weak role of market selection forces.

Figure 4.1 - Distribution of relative importance of components from the GR and FHK decompositions, computed by 5-digit industries and year, reported pooling across industries and time
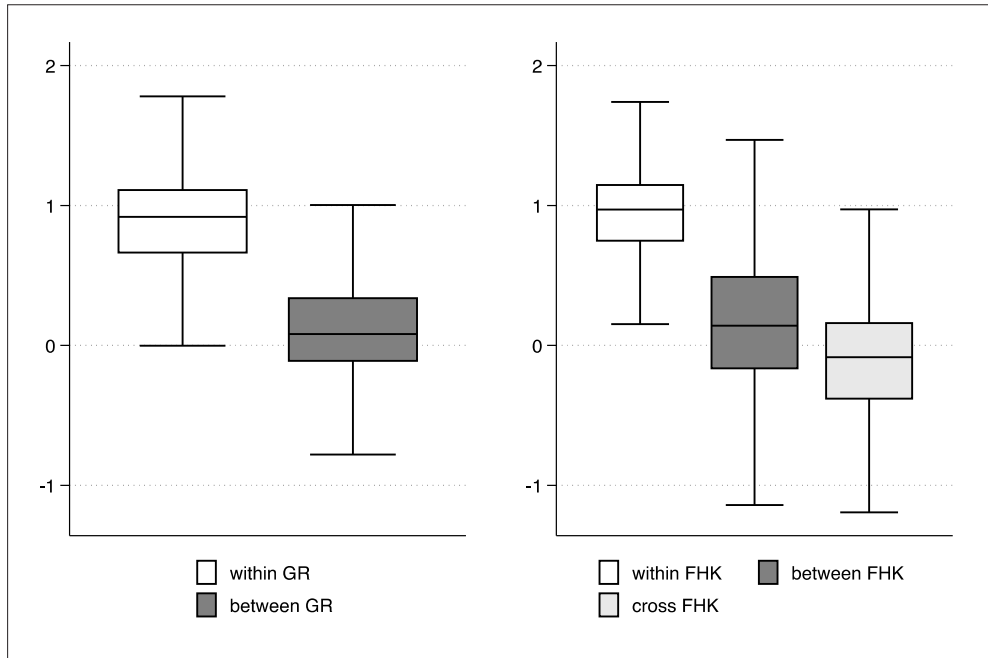
Source: Authors' elaboration

As patterns observed in Figure 4.1 may hinder some underlying time-related or business-cycle effect, we replicate the analysis splitting results by year. In particular, this allows us to capture whether the results presented above are characterised by significant changes in the pace of allocative efficiency over the reference period. Figure 4.2a reports the GR components. Both the within and the between components display notable stability over time, despite some variability between 2011 and 2013, which is marked by a slight increase in the strength of reallocation. This increase could be related to the sovereign debt crisis, which might have induced some downsizing among less productive firms. It is, in any case, marginal compared to the main pattern observed during the entire period. Results of the FHK decomposition, reported in Figure 4.2b, deliver a consistent picture. Again, the contribution of within-firm learning is larger than the contribution of the other components capturing reallocation of shares across firms in all years.

Figure 4.2*a* - Relative importance of components from the GR decomposition method, computed by 5-digit industries and year, break-down by year

Source: Authors' elaboration

Figure 4.2*b* - Relative importance of components from the FHK decomposition, computed by 5-digit industry and year, break-down by year
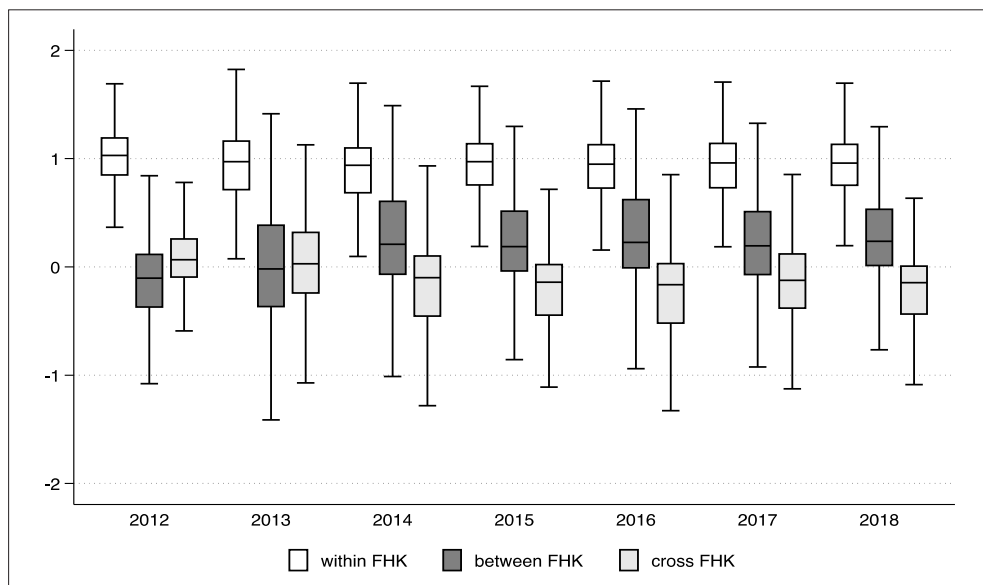
Source: Authors' elaboration

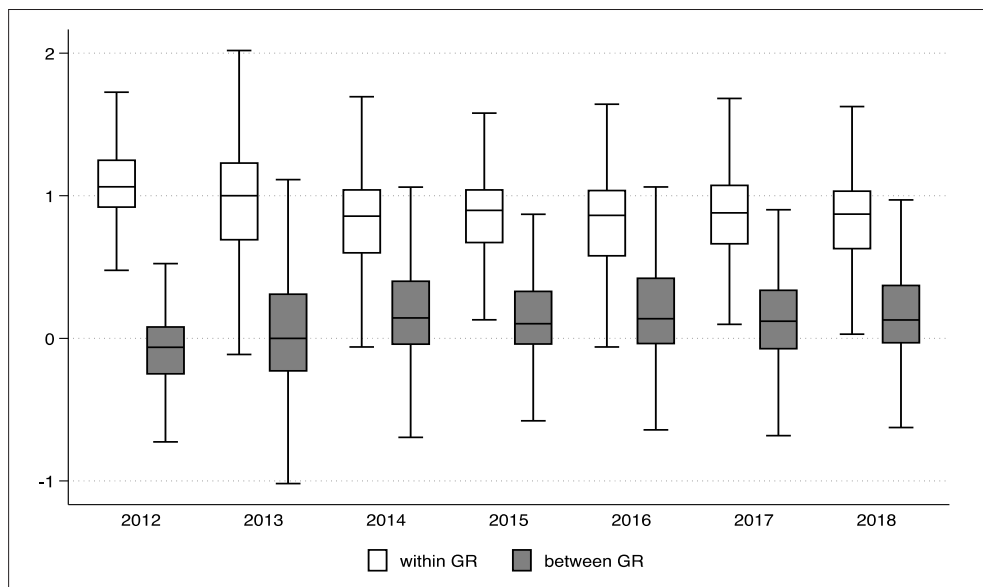**Figure 4.3 - Relative importance of components from GR and FHK decompositions, computed by 5-digit industry and year, break-down of Manufacturing *vs.* Services**
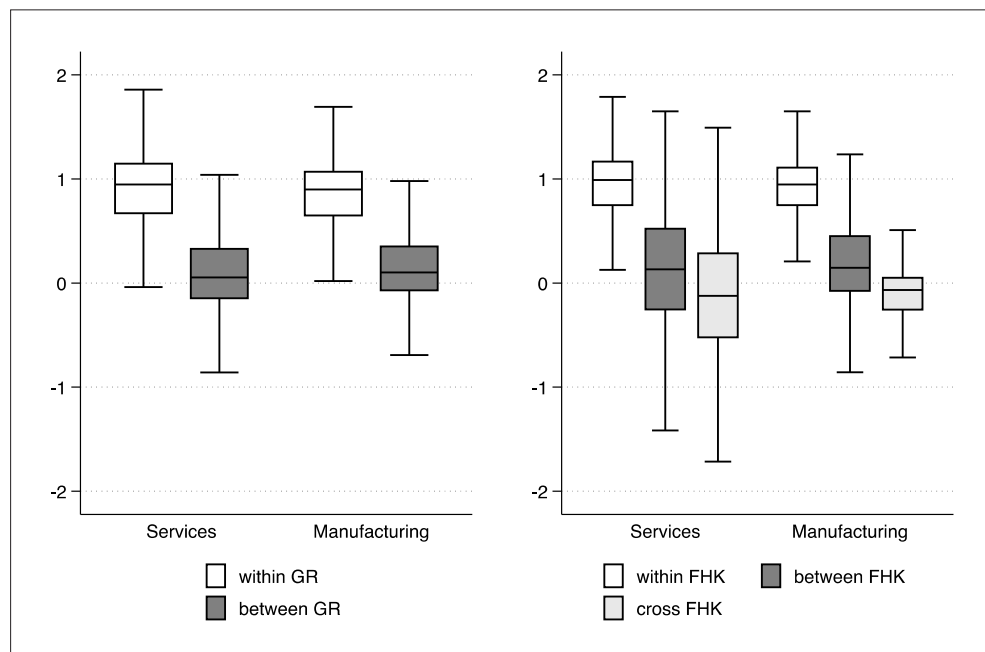
Source: Authors' elaboration

Next, we examine whether previous results hold when we break down the analysis by macro sector. Figure 4.3 reports the distribution of the relative contribution of the components, pooling across 5-digit industries in manufacturing and 5-digit industries in services. Results clearly reveal that our main findings do not stem from compositional effects across sectors. Indeed, the median value of the within-component is centred around 1 (*i.e.* 100%) for both manufacturing and services, once again corroborating that learning processes measured by changes in individual productivities account for a considerably greater percentage contribution to productivity growth than selection/reallocation effects. Moreover, the box plots referring to the other components are always positioned below the box plot of the within-term. Overall, we do not find support in data that market selection forces operate differently in manufacturing than in services. Interestingly, services are characterised by a higher degree of cross-sectoral heterogeneity in performance.

As a final exercise, exploiting all the industry-year observations allowed for by the data, we explore the relationship between productivity growth and the different components. Figures 4.4a and 4.4b report the results for the GR and the FHK decomposition, respectively. Two distinct patterns emerge. First, we observe a positive (and essentially linear) relationship between productivity growth and the within-firm components in the left-hand side graphs of both Figures. This suggests that sectors experiencing stronger and positive productivity growth are sectors where productivity growth is almost entirely driven by within-firm learning. Correspondingly, low or negative productivity growth is clearly related to a strong contribution of negative learning (de-learning) effects.

A second common pattern is that the between components display a much weaker association with productivity growth. In the right-hand side plots, indeed, although a linear fit of the data suggests a positively sloping relationship, we observe considerable cross-sectoral heterogeneity, quite more scattered data points and a very low explanatory power revealed by low R^2.

Figure 4.4*a* - Labour productivity growth *vs.* within and between components of the GR decomposition
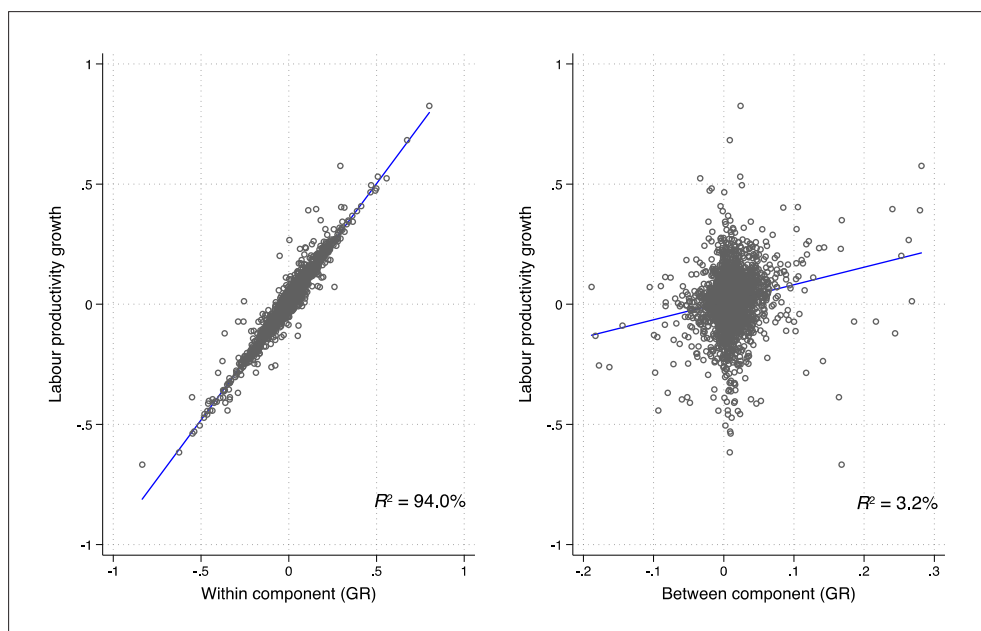
Source: Authors' elaboration

Figure 4.4*b* - Labour productivity growth *vs.* within and between component of the FHK decomposition
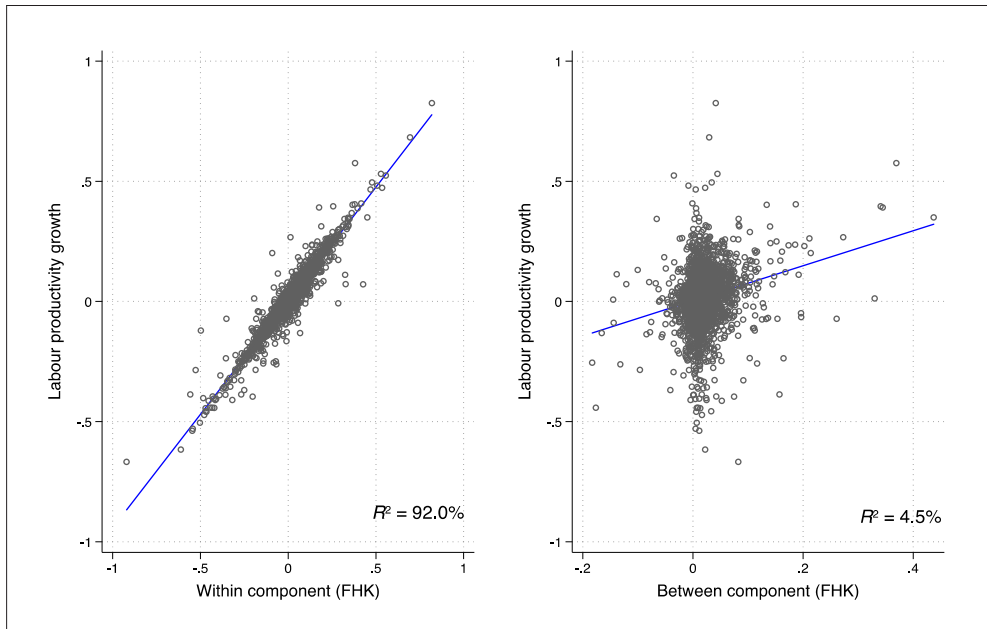
Source: Authors' elaboration

In summary, the general picture emerging from dynamic decomposition analysis is that within-firm learning prevails over between-firm reallocation in shaping aggregate productivity dynamics of Italian firms over the reference period. This overall confirms earlier findings at more aggregated levels of sectoral analysis. What we add here is perhaps that considerable heterogeneity across 5-digit sectors is hindered by aggregate results: the general tendency is that learning prevails, but sectoral specificities may matter.

The static OP decomposition

We now turn to the results of the OP decomposition. Figure 4.5 shows box plots of the distribution of the relative weight of the covariance measured across 5-digit industries, pooling by year. We find that allocative efficiency is productivity-enhancing for most of the 5-digit sectors, suggesting that more productive firms do generally enjoy higher than average employment shares. Nevertheless, market forces appear as quite weak. Indeed, the relative weight

of the covariance term is quite low: median values are about 0.04 and even the largest values do not exceed 0.1. Moreover, these results are remarkably stable over time, both in the median and in distribution. This picture resonates with the minor role of reallocation in Europe documented in De Loecker and Eeckhout (2018) within a different literature stream examining markups instead of productivity. Instead, our findings are in contrast with productivity decomposition analysis for Italy by Linarello and Petrella (2017) and Bugamelli *et al.* (2020), who document some stronger role of allocative efficiency in fostering productivity that has been increasing over time. Our explanation for this discrepancy is that, as suggested above, disaggregating by 5-digit industries allows for a more detailed and precise characterisation of the components, avoiding mismeasuring the two reference benchmarks that are crucial in the definition of the components (unweighted productivity of the average incumbent and the average market shares). Differences in results vis-à-vis Linarello and Petrella (2017) may also, at least partly, reflect the more recent time period of our analysis (2011-2018 here *vs.* 2005-2013 in their paper). Of course, our results only apply to incumbents' productivity dynamics, as we cannot account for entry/exit as the other Italian studies do. However, this does not bias our conclusions: we decompose incumbents' productivity and judge allocative efficiency among them, while entry/exit data would allow us to benchmark incumbents against entrant and exiting firms.

Figure 4.5 - Distribution of the relative weight of the OP covariance term, computed by 5-digit industry and year, break down by year
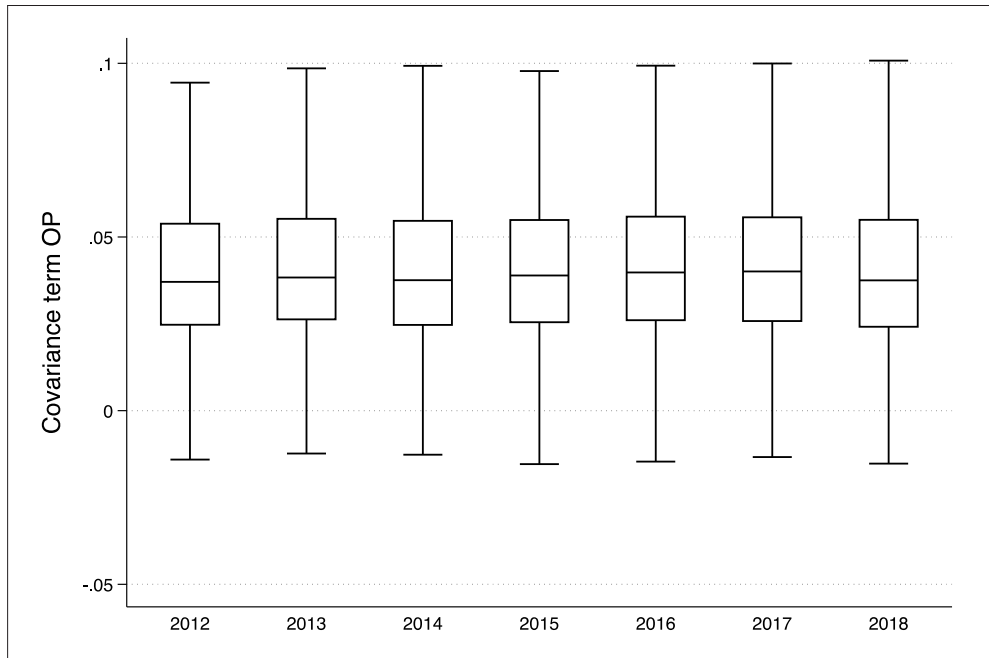
Source: Authors' elaboration

In Figure 4.6, we break down the analysis by macro sectors of activity, pooling together 5-digit industries within manufacturing and within services. The results reveal some dissimilarity across sectors. The covariance term displays stability between 2012 and 2018 in both macro-sectors, but manufacturing sectors feature relatively higher allocative efficiency than services. This is apparent by looking at median values, but also, more generally, by considering the lower positioning of the boxes referring to the central part (between the 25th and the 75th percentile) of the distribution of the covariance components in services.

To mention some paradigmatic examples of sectoral patterns, "Manufacturing of beer" (NACE 11050), "Rental and leasing of cars and light motor vehicles" (NACE 77110) and "Manufacture of plaster products for construction purposes" (23620), exhibit among the highest relative weights of allocative efficiency productivity over the reference period. Namely, in these

5-digit industries, aggregate productivity is around 13% higher than what it would have been if employment shares were evenly distributed across firms. On the other extreme, "Service activities incidental to land transportation" (NACE 52214) and "Security systems service activities" (NACE 80200) are both characterised by strongly negative allocative efficiency. Their actual productivity level is around 3% lower than what it would have been if employment shares were equally distributed among firms.

Figure 4.6 - Relative weight of the OP covariance term, computed by 5-digit industry and year, break-down of manufacturing *vs.* services
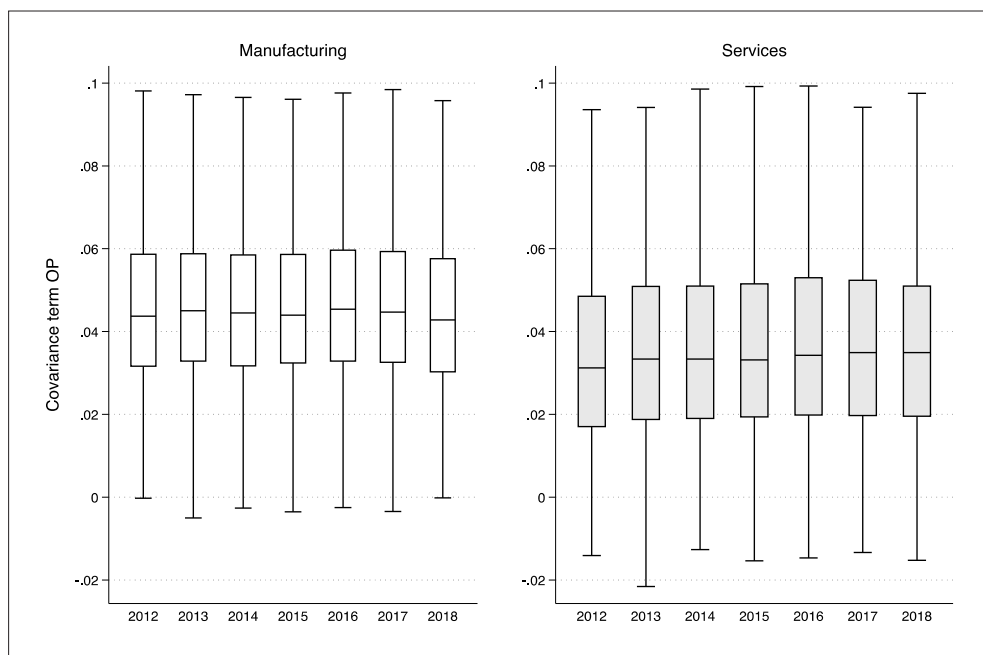
Source: Authors' elaboration

Figure 4.7 - Labour productivity *vs.* covariance term from the OP decomposition
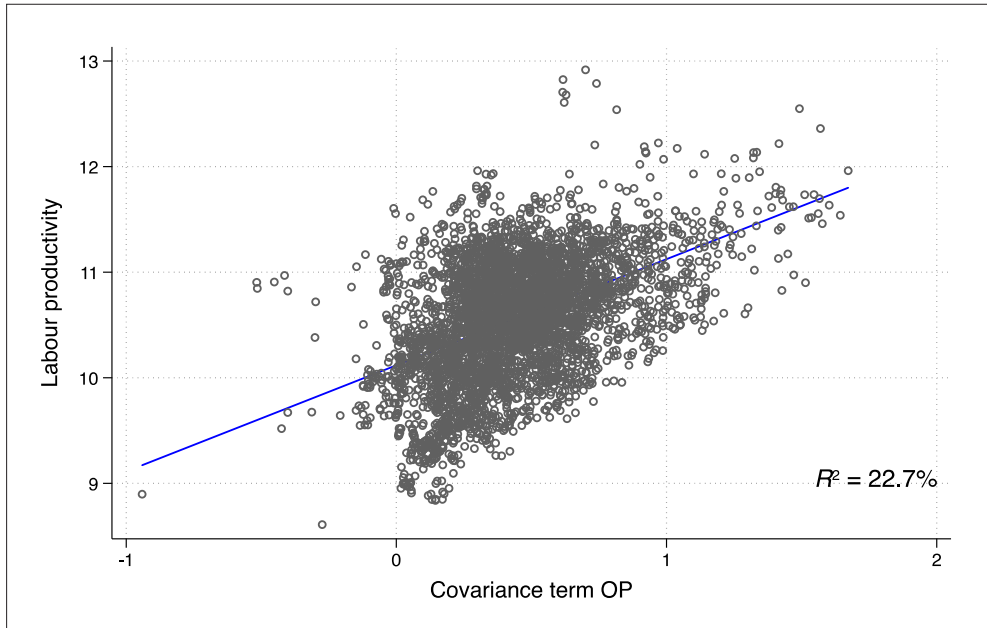
Finally, we examine the simple correlation between sectoral productivity and the covariance term, addressing to what extent higher allocative efficiency is in fact positively associated with higher productivity. In Figure 4.7, we plot this relationship, exploiting all the sector-year observations in our data. The linear fit indicates that, as one could expect, there is a positive association between the two. However, the relationship does not appear as strong as the one observed in the previous section relating productivity growth and within-effects. Moreover, the R^2 suggests that the covariance term explains only about 23% of labour productivity total variance.

Final remarks

By exploiting access to the Istat FRAME-SBS data covering more than 2.4 million Italian firms operating in manufacturing and services, we examined the relative importance of learning vis-à-vis efficiency of reallocation/market selection processes underlying productivity dynamics over the period 2011-18. Taking together results from static and dynamic decompositions of productivity by disaggregated 5-digit sectors, we find robust evidence that within-firm learning plays a predominant role. Instead, selection forces appear as generally weak, considering that reallocation of labour inputs across firms contribute relatively little to aggregate productivity performance. This picture is consistent across sectors and rather stable over time.

As we cannot account for entry/exit effects, our main findings signal that Italy has not been able to improve its allocative efficiency across incumbents over the last decade. Notwithstanding two decades of "structural" labour market reforms towards more flexibilisation (see Cirillo *et al.*, 2017 for a review), which promised to achieve greater productivity-enhancing allocative efficiency, the relative magnitude of the reallocation of labour inputs from less to more productive firms is low and continues to play a minor role. One interpretation could be that labour market deregulation and stagnant wages allowed a number of relatively low-productivity firms to survive in the market via cost factors by reducing incentives toward much-needed investments in new technologies, organisational capabilities and labour skills (see Kleinknecht, 2020 for a critical review). This is in line with studies documenting the emergence of a dichotomy between "the best" *vs.* "the rest" in many OECD countries (Andrews *et al.*, 2016). In the Italian case, our findings resonate the emergence of a "neo-dualism" in the Italian productive system (Dosi *et al.* 2012; Dosi *et al.* 2019; Costa *et al.*, 2020), featuring the co-existence of a small group of high-productivity and technologically advanced leading firms whose traction on the economy is hampered severely by a large group of small, low-productivity and non-innovative laggard firms.

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Firm responses to the COVID-19 crisis: sticky capabilities and widespread restructuring

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Abstract

This paper addresses the status and strategic profile of the Italian firms in the wake of the most severe crisis economies are facing since WWII, and assesses whether, and how, these characteristics affected firms' ability to react to the crisis. In order to accomplish the task we use two high quality firm-level dataset reporting information about firm behavioural traits: the first includes information on organisational capabilities, practices, attitudes toward innovation, business models and strategies during the period 2016-2018, i.e. in "usual times". The second dataset provides information on firm responses to the COVID-19 crisis in the period June - October 2020. Applying a multidimensional data analytics approach, two main results emerge: firstly, firm responses are highly path-dependent on their pre-crisis organisational capabilities; secondly, the COVID-19 crisis might turn out be more pervasive than expected, producing widespread, rather than creative, restructuring processes.

Keywords: Organisational capabilities, Italian productive structure, COVID-19 crisis.

JEL classification: D21, D22, D83, J24, J53.

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1. Introduction

Italy is growing like never before!, many commentators have been recently declaring. Macroeconomic statistics intially told a story of a V-shaped and fast recovery from the COVID-19 crisis (Sharma *et al.*, 2021). However, the crisis represents a turning point in terms of the organisation of the economic and productive system. Although the expectations of a V-shaped recovery at the macroeconomic level are prevalent (see *e.g.* Caracciolo *et al.*, 2020), potential long-lasting impacts on the industrial system are still hidden, mainly due to the absence of firm-level evidence in terms of economic performance, exits and closures.

The literature has partially addressed firm-level effects of the COVID-19 making use of *ad hoc* surveys, mainly conducted in real-time to monitor the status of the business systems. Other evidence relies on sectoral level dynamics, such as the dynamics of vacancies and employment rates. However, a systematic picture about how firms behaved during the COVID-19 crisis and their future prospects is still absent.

This paper aims to fill this gap with reference to the Italian economy. How did Italian firms react to the COVID-19 crisis? What actions and responses did they put in place? What reorganisational and strategic choices did they adopt? How did their pre-existing capabilities structure affect their responses to the crisis? To address the latter questions we build on Costa *et al.* (2021), which, making use of the *Indagine Multiscopo del Censimento Permanente delle Imprese* (IMCPI) carried out by the Italian National Institute of Statistics - Istat in 2019, developed a comprehensive four-class taxonomy of Italian firms with at least 3 workers in the pre-crisis period, according to their organisation and strategic framework (namely "Essential", "Managerial", "Interdependent" and "Complex").

On such bases, to assess the firms' responses to the COVID-19 crisis, we take advantage of a new comprehensive survey launched by Istat in November 2020, *Situazione e Prospettive delle Imprese nell'Emergenza Sanitaria COVID-19* (SPIESC-19), collecting specific information on behaviours, practices, effects and strategies put in place during the pandemic. This survey, while conducted on a smaller sample with respect to the IMCPI, shares with it the same sample design and is representative of

the same reference universe of over 1 million firms with at least 3 persons employed.

Analysing the capability taxonomy before and after the COVID-19 crisis to study actions and responses in "normal" and pandemic times, strong stickiness and persistence emerge in Italian firms' behavioural traits. The first result of our paper is the confirmation of a "neodualistic" structure in the Italian business system (Dosi *et al.*, 2021), where the majority of firms (which includes the two low-capabilities classes of our taxonomy, *i.e.* the so-called "Essential" and "Managerial firms") put in place minimalistic responses, in terms of reorganisational choices, technological adoption, human resource management, investment planning, credit and liquidity channels, opening of new markets. By contrast, a relatively small fraction of firms (which includes the two high-capabilities classes of the taxonomy, *i.e.* "Interdependent" and "Complex") show a remarkable ability to react to the crisis, accelerating digitalisation strategies, adopting reorganisation of the workplace, investing in new business plans, and notably reorganising supply chains to circumvent possible shortages.

We then move to explore diverse types of corporate difficulties such as general perceptions of operational risks, plans to reduce the labour force, change in the ownership structure, closing down the operating activity and the site. Those risks, different in their distributional patterns and incidence across firms, are however quite revealing of some specific findings. First, whenever firms are affected by such corporate crises, the neodualistic divide tends to disappear and such risks are almost widespread affecting all four classes of taxonomy, independently from their attributes. Second, the amounts of persons employed, value added and paid wages involved in such corporate difficulties are all but negligible. Our findings warn against considerable potential social costs given that COVID-19 crisis does not exclusively impinge on less productive, small firms, although the latters are primarily more exposed.

Overall, our empirical evidence suggests that the COVID-19-induced crisis might have potential hysteresis effects in the medium run (Cerra *et al.*, 2021). Rather than being a cleansing, productivity-enhancing crisis, only affecting small unproductive zombie firms (Adalet McGowan *et al.*, 2018), it might turn out to be a strong reorganisational crisis affecting also the

most productive and advanced segment, leading to a deep reconfiguration of the Italian industrial system in terms of firms capabilities, and related of sectoral composition.

The rest of the paper is organised as follows: Section 2 presents the context and motivation; Section 3 describes the data; Section 4 discusses the empirical methodology; while Section 5 digs inside corporate crises; Section 6 discusses results and concludes.

2. Context and motivation

Since its inception, the COVID-19-induced crisis has been extensively studied, with many works trying to address its effects on countries' economic structures (see Bellomo *et al.*, 2020; Aguiar *et al.*, 2021, among others) and labour market, particularly in terms of inequality, socio-economic risk stratification, gender and racial divides (Montenovo *et al.*, 2020; Delaporte *et al.*, 2021; Adams-Prassl *et al.*, 2020; Zamarro and Prados, 2021; Gottlieb *et al.*, 2021; Cetrulo *et al.*, 2022). Supply chains disruption, increasing delivery time, recombination of intermediate inputs, China's potential role of world factory economy (Dosi *et al.*, 2020) have been addressed as well (Baldwin and Freeman, 2021; IMF, 2021).

The literature on firm-level effects of COVID-19 is still limited due to lack of data. It generally relies on survey-based information regarding small samples of units. Moreover, such surveys are often directed to assess managerial expectations on future outcomes and track sales dynamics during the crisis. This is the case, for example, for the US firms studied in Bartik *et al.* (2020), who surveyed 5,800 small units between March and April 2020 asking them about closures, and in Bloom *et al.* (2021), who surveyed approximately 2,500 firms using the Study of Internet Entrepreneurship, an ongoing, optin quarterly survey that began in early 2019. According to their study, which reports sales drop of 30% over the 2nd and 3rd quarters of 2020, impacts have been heterogeneous across firms, with big and online firms proving to be more resilient to compulsory closures, in some cases even increasing their sales, while the opposite occurred especially to black- and female-owned enterprises, often small, which experienced the most severe losses.

Financial fragility and bank loans are central to the analysis in Zoller-Rydzek and Keller (2020), who conducted an online survey among managers of Swiss firms (205 managers in total), inquiring about their current and future expectations about the pandemic induced crisis. Weak evidence in support of prior good economic performance correlated with less adverse expectations about the future is provided. Representative sampling strategies are adopted in the survey run by Ifo (Buchheim *et al.*, 2020) targeting a panel of about 6,000 German firms. The survey assesses how pre-crisis attributes affected both business outlook and response strategies to face the pandemic. In general, bad pre-crisis conditions negatively influenced business outlook, but also

their responses, which were quite diverse in intensity and also diversification, ranging from access to telework, firing and postponement of investments.

This stream of literature was mainly interested in monitoring real time firm responses, perception of uncertainty and potential changes in employment and investment strategies, also to understand the impact of the lock-down measures. Although forms of stickiness in the response and resilience of firms have been generally identified, and there is general consensus in literature on fiercer effects upon most vulnerable and fragile units already in the pre-pandemic phase, an analysis on firms organisational capabilities in usual and in pandemic times is still missing.

Closer to our approach are the results in the Industrial Development Report (2022) which describes the results of the *UNIDO COVID-19 firm-level survey*, conducted in the period November 2020 - June 2021, targeting 3,700 firms in 26 countries across Asia, Africa and Latin America and including questions about observed and expected impacts on some economic variables (*e.g.* employment, investment), but also strategies to cope with the crisis, together with some firm characteristics. Three types of reactions to the COVID-19-related crisis have been identified, according to firm responses: *a) robustness*, *i.e.* the capability to not only survive but even profit from the crisis; *b) readiness*, *i.e.* the capability of proactively react albeit with strong difficulties; *c) vulnerability* representing conservative and non-reactive strategies. In addition, *industrial capabilities* - defined as a set of organisational routines, collective knowledge, procedures and shared behaviours to operate production processes - have been considered as a crucial element to positively respond to the crisis. Country-level industrial capabilities are measured by a synthetic indicator, the UNIDO's Competitive Industrial Performance (CIP) Index, which synthesises nation-wide competitiveness as the result of: (*i*) the capacity to produce and export manufactured goods; (*ii*) technological deepening and upgrading; (*iii*) world impact.

The Industrial Development Report (2022) further deepens the role of industrial capabilities extending the analysis to both manufacturing and service firms. The report indeed echoes the notion of *organisational capabilities* (Helfat and Winter, 2011), adopted and operationalised in Costa *et al.* (2021) to detect the so-called "quasi-genetic" traits of Italian firms in usual, non-pandemic times.

The capability-based theory of the firm, as we will see in the following pages, proves to be quite revealing in understanding the stickiness of crisis responses with respect to firms also, as we will see in the following pages, pre-pandemic behavioural traits. Indeed, the coherence between ex-ante and ex-post behaviours in conducting the business activities confirms about the correct identification of the organisational and behavioural attributes characterising the Italian business system.

3. Data and descriptive statistics

Over the last two decades, the demand for high-quality firm-level micro-data has significantly increased, both for the purpose of measuring economic phenomena and for policy-related reasons. In order to meet such demand, European statistical offices have accelerated the design and production of new datasets able to accurately capture heterogeneities and changes within business systems, as well as other factors such as firms' competitiveness and resilience, the characteristics of most and least competitive business segments, and the profiles of growing or declining firms.

In this context, in last decade Istat undertook a new approach to the production of structural business statistics. This new approach is based on the implementation of a twofold integrated strategy in statistical production:

a) massive use of administrative data for the construction of statistical registers, with extensive possibilities to link individual data to additional administrative sources and direct surveys;

b) direct statistical surveys focussed on economic units with multi-purpose modules able to measure their organisational structures, behaviours and strategies, not detectable when using administrative sources only.

This new system guarantees also a high level of accuracy of aggregate estimates that can be largely derived from the direct aggregation of individual data. Furthermore, the consistency between the micro and macroeconomic perspectives lends solidity to micro-founded analyses of heterogeneity within various universes (*e.g.* economic units) in different dimensions (*e.g.* performance, geographical positioning, workforce utilisation, international openness, remunerations).

The first wave of the *Indagine Multiscopo del Censimento Permanente delle Imprese* (IMCPI) was carried out by Istat in 2019. The survey involved a designed sample of about 280,000 firms representative of the universe of over 1 million units with 3 or more persons employed operating in industry and services sectors, and accounting for 24.0% of total Italian firms, 84.4% of national value added, 76.7% of workers (12.7 millions) and 91.3% of employees.

The questionnaire is structured in nine sections: 1) Ownership, control, management; 2) Human resources; 3) Relations between companies and other organisations; 4) Market; 5) Technology, digitalisation and new professions; 6) Finance; 7) Production internationalisation; 8) New trajectories of development; 9) Environmental sustainability, social responsibility and workplace security. The integration between the qualitative information derived from the survey and the register system (Frame-Sbs) enables to carry out in-depth analysis of the structure, behaviour and performance of Italian firms, and it is particularly useful in the study of productivity dynamics.

The second survey here considered, labelled *Situazione e Prospettive delle Imprese nell'Emergenza Sanitaria COVID-19* (SPIESC-19), was carried out by Istat in November 2020. In Italy, like in most European countries, this was when the second wave of the COVID-19 pandemic reached its peak, and the feeling (which was gained in the summer months) that the crisis was already over was definitively waved away, leaving room to a new phase of uncertainty both for firms and individuals. The survey is based on a sub-sample of the IMCPI including more than 90,000 firms, representative of the same reference universe as for IMCPI[6]. It provides information about the effects of the COVID-19 crisis on firms' performance and strategies (*e.g.* demand dynamics, turnover, employment, investments, technologies, *etc.*) and about what type of reaction, if any, enterprises opposed to the shock (*e.g.* reorganisation of production processes, downsizing, digital transformation, management of suppliers and clients, *etc.*) during the period June 2020 - October 2020. More in detail, the survey SPIESC-19 questionnaire includes sixth macro sections and 25 demands on: 1) Impact of COVID-19; 2) Precautionary procedures and countering COVID-19 spread; 3) Human Resources management and policies; 4) Finance; 5) Digitalisation and Technology; 6) Effects, critical issues and strategic orientations.

We focus on firms with at least 10 persons employed, *i.e.* on the segment of Italian business system with a firm-organisational structure. In such a way we obtain a sample of more than 109 thousand units, representative of a universe of about 215 thousand firms, with 9 million workers (54.7% of the total), 8.8 million employees (74.7%), 2,300 billion euros revenues (75.3%)

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6   The two surveys share the same two-phase sample design. In particular, in the first phase sample (the IMCPI survey) the strata were defined according to the combination of the modalities of the structural variables defining the study domains. In the second phase sample (the SPIESC-19 survey), the sample weights are defined as a function of the non-response bias observed within the sample first phase.

and 557 billion euros of value added (71.4%). Within this segment, there are approximately 3,700 large firms (250+ workers), accounting for 38.5% and 44.8% of total employment and value added respectively.

Figure 3.1 presents the response rate, referred to the universe of over 1 million firms, aggregated at the section level (top panel) and demand-level (bottom panel). The response rate is quite homogenous across the six sections, differently from the IMCPI where heterogeneity across sections was more pronounced (see Costa *et al.*, 2021). When disaggregating by demand-level, a high response rate emerges, except for the HR, technology and finance sections, reporting lower levels.

Among the 25 questions, we focus on a subset in order to better highlight (*i*) the practices put in place to manage workplace adjustments and labour force; (*ii*) liquidity instruments used to counteract the crisis; (*iii*) expected effects and reasons; (*iv*) adopted and planned strategies. More in detail, the selected questions are presented in Table 3.1[7].

Figure 3.1*a* - Response rate to the SPIESC-19 questionnaire
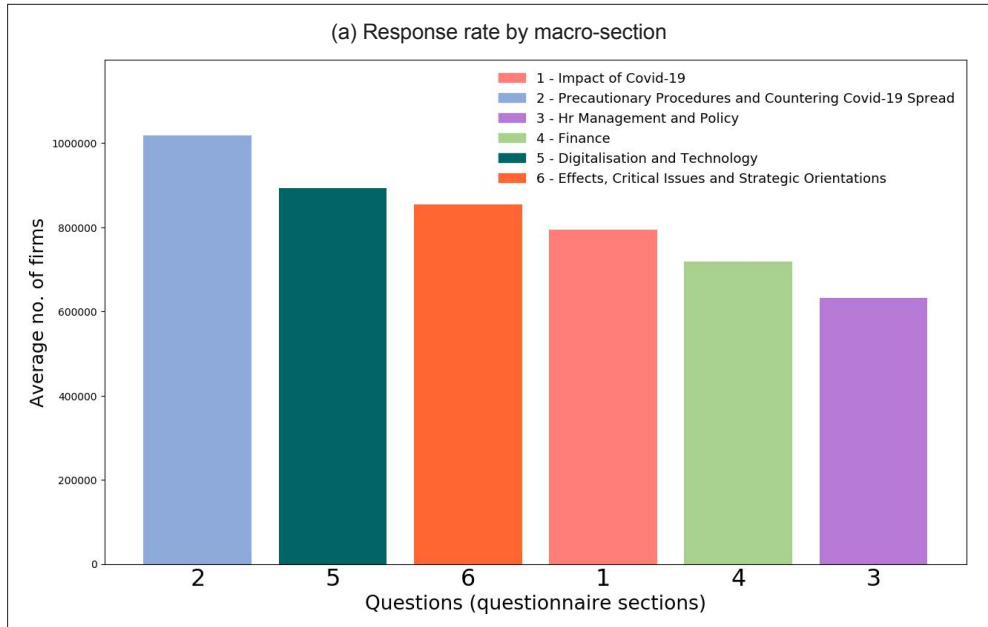
Source: Authors' elaboration

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7   Note that multiple answers to the questions displayed in Table 3.1 were possible.

Figure 3.1*b* - Response rate to the SPIESC-19 questionnaire
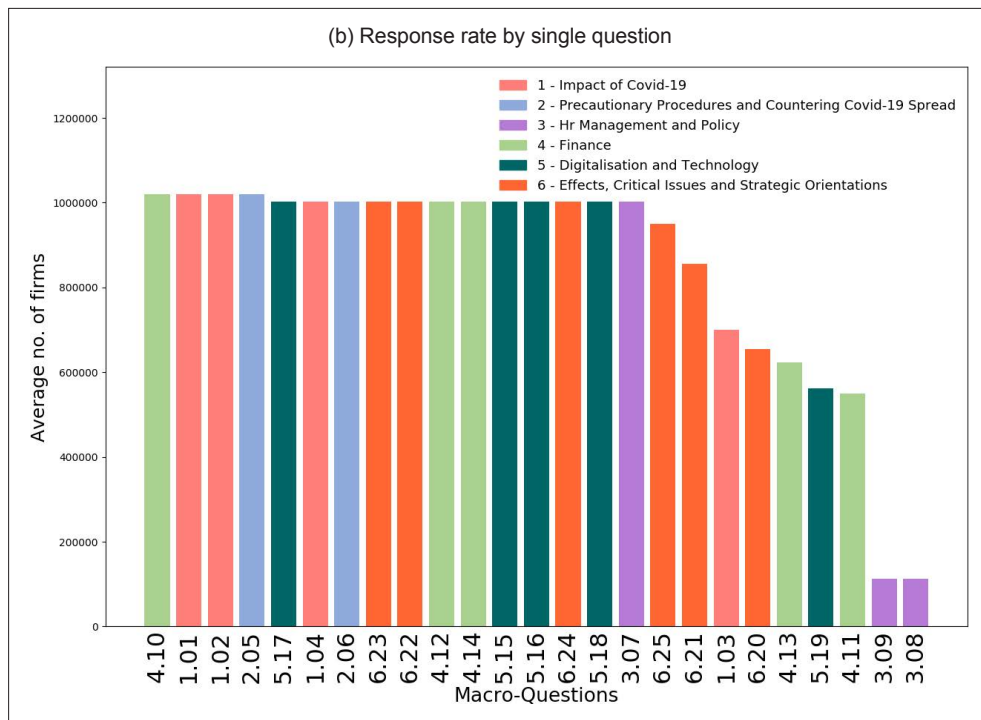
Source: Authors' elaboration

The results allows to detect the paths and actions that firms have taken during the crisis. In addition to this selection, in order to portray the status of the overall system, we also consider the first opening question, namely whether the firms' premises, at the time of the survey, were open, partially open, or alternatively, closed with or without reopening plans.

Table 3.1 - Selection of questions from the SPIESC-19 questionnaire carried out by Istat in November 2020

QUESTION	MODALITY
3.7. From June 2020 to date, what human resource management measures has the firm taken as a result of the COVID-19 emergency?	0 - Remote working, smart working or teleworking for the whole or part of the staff 1 - Reduction in working hours or shifts 2 - Increase in working hours or shifts 3 - Rearrangement of working days 4 - Use of the Cassa Integrazione Guadagni (redundancy fund) or similar instruments (Fondo Integrazione Salariale, Fondo Solidarietà Bilaterale Artigianato, *etc.*) 5 - Compulsory holiday leave or other temporary cost-cutting measures 6 - Reduction in fixed-term staff or external collaborators (no extension of contracts) 7 - Reduction of permanent staff (redundancies) 8 - Deferral of planned hires 9 - No use of outsourced workers 10 - Hiring 11 - Additional staff training 12 - No measures 13 - Other measures
4.10. From June 2020 to date, what instruments has the firm used to meet the liquidity needs caused by the COVID-19 emergency?	0 - Use of liquid assets on the balance sheet (*e.g.* bank deposits) 1 - Disposal of non-liquid assets on the balance sheet (*e.g.* sale of real estate or capital goods) 2 - Use of available margins on credit lines 3 - Change in payment terms and conditions with customers 4 - Change in payment terms and conditions with suppliers 5 - Deferment of debt repayments (*e.g.* use of a moratorium) 6 - Renegotiation of lease contracts 7 - Taking out new bank debt (*e.g.* state-guaranteed debt) 8 - Use of financing instruments other than bank debt (*e.g.* bonds, crowdfunding, P2P lending platforms) 9 - Capital increases by the ownership (entrepreneur, shareholders) 10 - Capital increases by external financiers (*e.g.* holdings, new shareholders) 11 - Other instruments 12 - No instruments used
6.20. What effects do you expect the COVID-19 emergency to have on the firm up until June 2021?	a. There are serious operational and business sustainability risks b. There will be a reduction in the desirability of goods or services due to the inability to attend, or the cancellation or postponement of trade shows or promotional events c. Demand will be reduced as a result of restrictions due to the implementation of health protocols (*e.g.* distancing, restrictions on customer access to the business premises, *etc.*) d. Domestic demand for goods or services (including tourist demand) will be reduced e. Foreign demand for the goods or services will be reduced (including tourist demand) f. There will be more difficulties in exporting/importing goods due to increased transport and logistics costs g. The supply of raw materials, semi-finished goods or intermediate inputs will be reduced or interrupted h. Prices of raw materials, semi-finished products or intermediate inputs will increase i. Serious liquidity problems will arise j. Closure of company offices/premises in Italy or abroad k. No particular effects on the undertaking, which will continue its business as usual. l. Will increase the level of activity of the enterprise m. Other effect

Source: Authors' elaboration

Table 3.1 cont. **- Selection of questions from the SPIESC-19 questionnaire carried out by Istat in November 2020**

QUESTION	MODALITY
6.20.1 For which of the following reasons?	0 - Increase in domestic demand for goods or services (including tourist demand) 1 - Increase in demand from abroad for the goods or services (including tourism demand) 2 - Reduction in transport and logistics costs 3 - Reduction in prices of raw materials, semi-finished products or intermediate inputs 4 - Growth induced by public incentive measures (*e.g.* Eco-bonus) 5 - Development of e-commerce activity 6 - Other reason
6.21. What strategies has the company already adopted or is considering to adopt up to June 2021?	0 - Production of new goods, provision of new services or introduction of new production processes (*e.g.* production of masks, respirators, *etc.*) while remaining within the scope of one's own economic activity 1 - Production of new goods, provision of new services or introduction of new production processes while remaining within its own economic activity 2 - Radical change in the type of activity compared with previous activities 3 - Changing or expanding sales channels or methods of supplying/delivering goods or services (*e.g.* moving to online services, e-commerce and multi-channel distribution models) 4 - Change and diversification of the modes of transport used for export/import of goods 5 - Change or expansion of exported goods 6 - Change or extension of export destination countries in the EU area 7 - Change or extension of export destination countries in the non-EU area 8 - Acceleration of the digital transition and greater use of internal and external virtual connections 9 - Reorganisation of processes and work or commercial spaces 10 - Search for new industrial and business models based on innovative technologies (Industry 40) 11 - Changing the quantity of orders for input factors (*e.g.* raw materials, *etc.*) 12 - Intensification of existing relationships or creation of partnerships with other domestic or foreign companies 13 - Substantial reduction in the number of employees 14 - Change in ownership structure 15 - Other strategy 16 - No strategy
6.21.1 What are the reasons for which the firm has not adopted or is not considering adopting any strategy?	0 - Difficulty in defining/planning a strategy 1 - Difficulty in reorganising premises and production processes 2 - Difficulty in finding/managing the necessary expertise 3 - Difficulty in raising the necessary financial resources 4 - Other reasons 5 - The company's activity is not negatively affected by the COVID-19 emergency

Source: Authors' elaboration

4. Methodology

Both the IMCPI and the SPIESC-19 surveys, for their process-centred features, are particularly adequate to study the structure of the Italian business system through the lens of the capability-based theory of the firm (where the latter is intended as a behavioural entity). Indeed, the survey design allows to compare the so-called *quasi-genetic traits* of the firms in pre-pandemic years with their responses during the COVID-19 crisis.

In the following, we start by recalling how, in Costa *et al.* (2021), we identified the emergence of four clusters characterising the Italian business structure according to firms' strategies, making use of the IMPCI questionnaire (Subsections 4.1, 4.2, 4.3). Then we analyse actions and responses cluster by cluster, comparing the IMCPI and the SPIESC-19 evidence (Subsection 4.4).

4.1 Step 1: Factor analysis on the IMCPI

In order to classify Italian firms according to their capabilities, in our previous work (Costa *et al.*, 2021) we adopted a data-driven, multi-step approach. First, we selected a subset of items covered by the questionnaire consistent with the capability-based theory, *i.e.* those that are supposed to cover the most distinctive operational attributes of firms.

More in detail, we focussed on subsections of the survey belonging to the seven macro-areas: *Ownership, control and management*; *Human resources*; *Relations between firms and other entities*; *Market*; *Technology, digitalisation and new professions*; *New trajectories of development*; *Environmental sustainability, social responsibility and safety*.

As a second step, given the high dimensionality of the information, we carried out an analysis of multiple correspondences on the selected variables, and extracted seven latent factors that summarised the informative content of each of the seven subsections taken into consideration. Then, we performed a further factor analysis on these seven factors, thus obtaining three latent factors that accounted for 69% of total variance. The sampling adequacy, which yielded a KMO (Kaiser-Meyer-Olkin) test of 86% (thus above the 80% required threshold) confirmed the robustness of the factorisation.

Three factors were identified, referring to different sets of capabilities. The first one is associable to work organisation, employees training processes, the presence of recruitment mechanisms, technological-organisational skills (mainly linked to investments in digitalisation), the use of management software and platforms. The second factor concerns managerial strategies, in terms of both past and future targets, pricing and investment plans. The third factor relates to the propensity to activate and manage external (productive) relations with other firms – in terms of contracts or supplies – and to the management of internal relations with workers.

4.2 Step 2: Cluster analysis - IMPCI and Frame-Sbs

The next step of our analysis consisted in defining the "genetic" traits and the strategic orientations of firms.

Table 4.1 - Firm clusters and organisational-strategic profiles (units with at least 10 workers)

	Cluster	Relations		
		Organisational-strategic profiles	Technological-organisational capabilities	Managerial strategies
CI 1	Essential	14.2	69.8	62.5
CI 1	Managerial	25.6	75.5	64.5
CI 3	Interdependent	36.3	73.1	64.3
CI 4	Complex	49.4	65.8	61.5
	Total	**27.4**	**72.4**	**63.6**

Source: Authors' elaboration

In doing so, using the database IMCPI-Frame-Sbs mentioned above, we performed a K-means clusterisation on the first factor (with a total explained variance of 88%)[8]. This enabled us to identify four clusters of firms.

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8   Many authors have insisted upon the complementarity between principal axes techniques and classification, which concerns the comprehension of the data structure as well as the interpretation of the results (Gower and Ross, 1969; Benzecri *et al.*, 1980). From a purely computational point of view, when dealing with very large data sets such as those provided by survey data files, it may prove efficient to perform a classification using a limited number of factors obtained by a factor analysis to increase the performances of the techniques (Morineau and Lebart., 1986). Furthermore, it is particularly effective to describe the obtained groups by using a barycentric analysis on an interpreted factorial plane. However, performing a classification on a limited number of factors is equivalent on the original data matrix, as long as selected factors represent an adequate portion of the vectors norm in the original space.

The first factor captures the complexity of *technological-organisational capabilities* inasmuch it covers practices aimed at fostering the diffusion of knowledge inside workplaces, problem-solving and learning regimes, and it is linked to the technological dimension embodied in digital technologies and management software. The weight of this technological organisational factor is very low in the first cluster of firms and gradually increases in the other clusters (Table 4.1). On the basis of such weights, we defined as *Essential* the firms belonging to the first cluster (with a 14.2 weight) and, at the opposite, as *Complex* those ones belonging to the fourth cluster (weight 49.4). The two intermediate clusters have a very high weight in both managerial (second factor) and relational strategies (third factor). We label firms in the second cluster as *Managerial*, since they show the highest value of the factor that incorporates managerial strategies (75.5), while we label *Interdependent* the firms belonging to the third cluster, as they feature a very high relational factor (64.3) and present the second most relevant contribution in the technological-organisational factor (36.3), which suggests that these firms might be suppliers and having relationship with more complex firms.

Table 4.2 presents some descriptive statistics regarding the four clusters. About two thirds of Italian firms with at least 10 employees are Essential or Managerial, even though they contribute to less than one third of total value added. By contrast, the group of Complex firms in the fourth cluster, accounting for only 9% of the total, contributes for 42% of value added.

Table 4.2 - Characteristics of firm clusters (units with at least 10 employees), *Indagine Multiscopo del Censimento Permanente delle Imprese* data-set carried out by Istat in 2019

Cluster	Firm		Number of Workers			Value Added		Productivity		Profitability (Mol/ Revenues)		Average salary (Cost per employee)	
	Number	%	Number	%	Average	Total (Euros Mln.)	%	Average (Euros)	Cfc of Variation	Average (%)	Cfc of Varia- tion	Average (Euros)	Cfc of Variation
Cl 1 Essential	60,380	28.5	1,282,830	14.4	21.2	47,370.0	8.7	36,926	2.1	7.0	149.9	29,403.3	0.7
Cl 1 Managerial	77,040	36.4	2,106,065	23.6	27.3	103,816.5	19.2	49,294	1.1	7.4	60.9	34,714.9	0.5
Cl 3 Interdependent	54,267	25.6	2,595,343	29.1	47.8	159,340.2	29.4	61,395	1.3	7.9	3.5	40,543.2	0.4
Cl 4 Complex	20,070	9.5	2,947,326	33.0	146.9	231,373.3	42.7	78,503	1.4	10.1	35.8	49,655.7	0.5
Total	**211,757**	**100.0**	**8,931,563**	**100.0**	**42.2**	**541,900.0**	**100.0**	**60,672**	**1.2**	**8.7**	**73.0**	**40,434.8**	**0.5**

Source: Authors' elaboration

Figure 4.1*a* complements the picture, showing the share of firms, employees and total value added by cluster.

Figure 4.1*a* - Cluster characteristics. Units with at least 10 employees

Share of firms, workers and total value added by firm cluster

- Essential
- Managerial
- Interdependent
- Complex
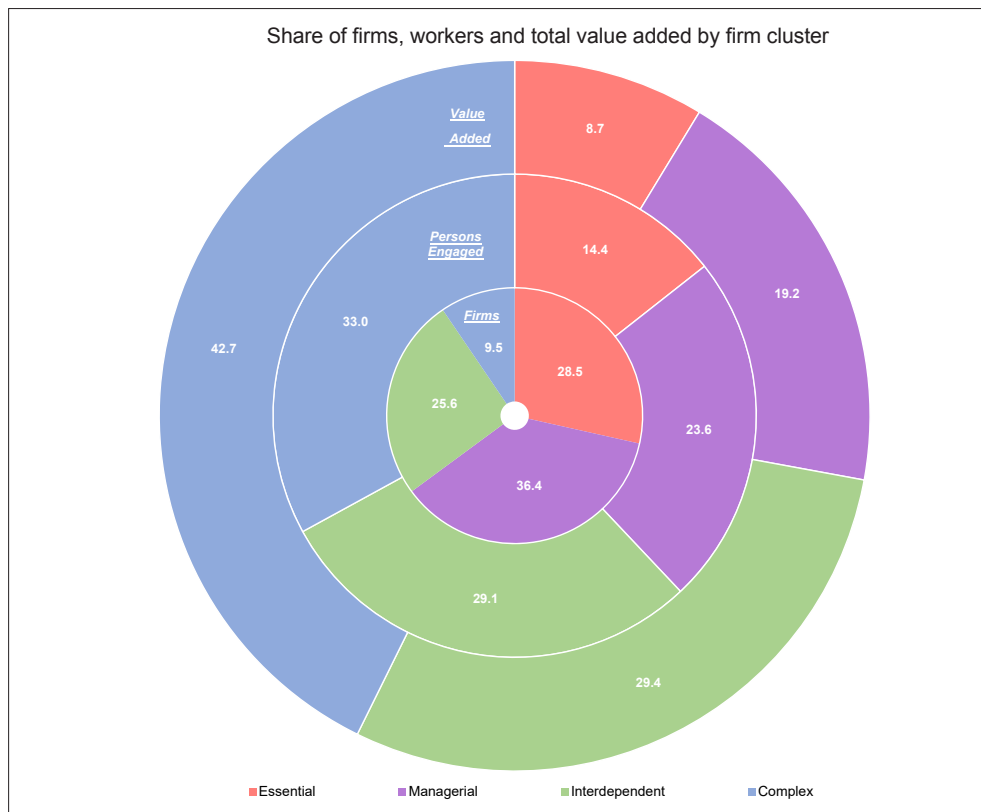
Source: Authors' elaboration

From a macro-sectoral perspective, in manufacturing Complex firms are 12.8% of the total and account for 46.7% of value added; in market services the ratio decreases to 7.8% of total firms and 39.4% of value added. Therefore, first we observe distinct differences among clusters in terms of size (21.2 workers on average for Essential firms, 146.9 for Complex ones), and, second, remarkable macro-sectoral ones, whereby advanced manufacturing firms, even if they are a small portion of the total, have a prominent role and contribute heavily to the overall value added.

Indeed, by looking at the average productivity of each cluster (expressed in terms of value added per worker), we observe that Complex firms are twice as productive as Essential firms (78 thousand and 36 thousand euros, respectively). Moreover, the variance is higher within the latter group, with a coefficient of variation of 2.1 compared to a value of 1.4 in the former group. In other words, the firms in the most productive Complex cluster not only do perform better, but are also more homogeneous than Essential ones. Additionally, we find a wide gap in average wages that increases progressively as we move from Essential firms to the Complex ones (Figure 4.1*b*).

Figure 4.1*b* - Cluster characteristics. Units with at least 10 employees
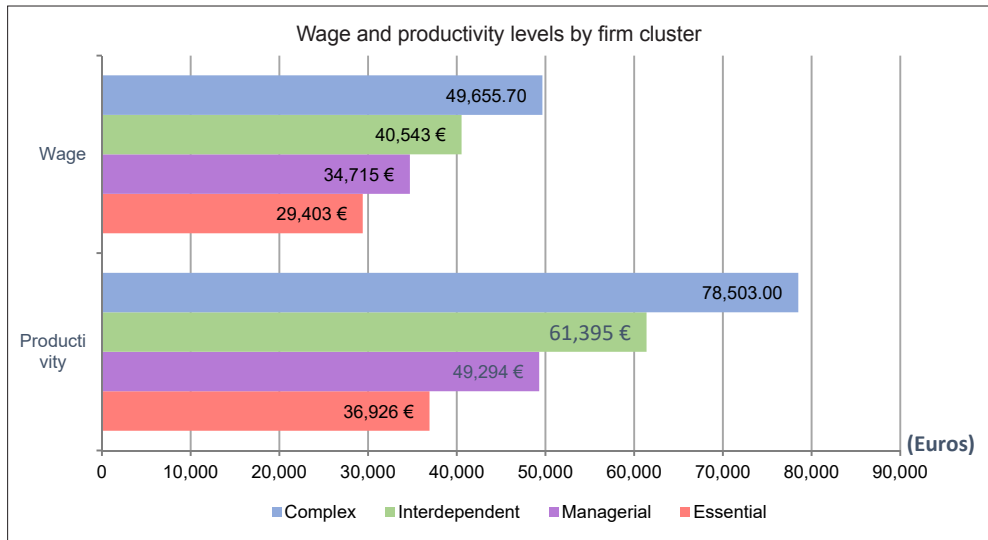
Source: Authors' elaboration

4.3 Step 3: Analysis of co-occurrences in pre-pandemic phase (2019)

To further characterise firm clusters, we also looked at the association between clusters and dominant co-occurring practices. In this respect, we analysed the co-occurrences in the answers within each cluster. By treating the answers as independent events, for each firm cluster and each question, the positive or negative response frequency of the firms in the cluster were considered, by and the answers were selected using a χ^2 test. The simultaneous

significance of two or more answers thus determined the co-occurrence of questions.

We found that the diversification of strategies increases as the organisational complexity of the clusters increases: whereby Essential firms display a fundamental lack of any systematic organisational structure and strategic plans, *i.e.* few significant characteristics in almost every macro-area of the survey, with particular emphasis on the absence of current and future strategic objectives (*e.g.* no investments in R&D and human resources, defensive strategies in local markets), Complex firms appear to be characterised by the co-occurrence of the majority of practices aimed at achieving technological and skills upgrading (4th Industrial Revolution, upskilling).

4.4 Step 4: Italian productive structure in pandemic times

Which was the condition of the Italian business system in the COVID-19 crisis? Below we start presenting some evidence of the status of the firms: (*i*) open, (*ii*) partially open, (*iii*) closed with intentions to reopen, (*iv*) closed without intentions to reopen.

Figure 4.2 presents the firms' status by cluster in the period June - October 2020. Again, we focus on firms with at least 10 persons employed. From 60% to 80% of firms reports to be fully open. Weaker and more vulnerable firms, which are only partially open or closed with intentions to reopen, are approximately 20% in the Complex and Interdependent clusters, while the share increases in the Managerial cluster and peaks in the Essential one, reaching almost 35% of business units. A positive share of closed firms without intentions to reopen is present as well. At this stage, the first signal from the SPIESC-19 is that least advanced clusters are also more severely hit by closures.

Figure 4.2 - Distribution by firm cluster and closure/openness status (units with at least 10 employees)

a) Number of firms by cluster
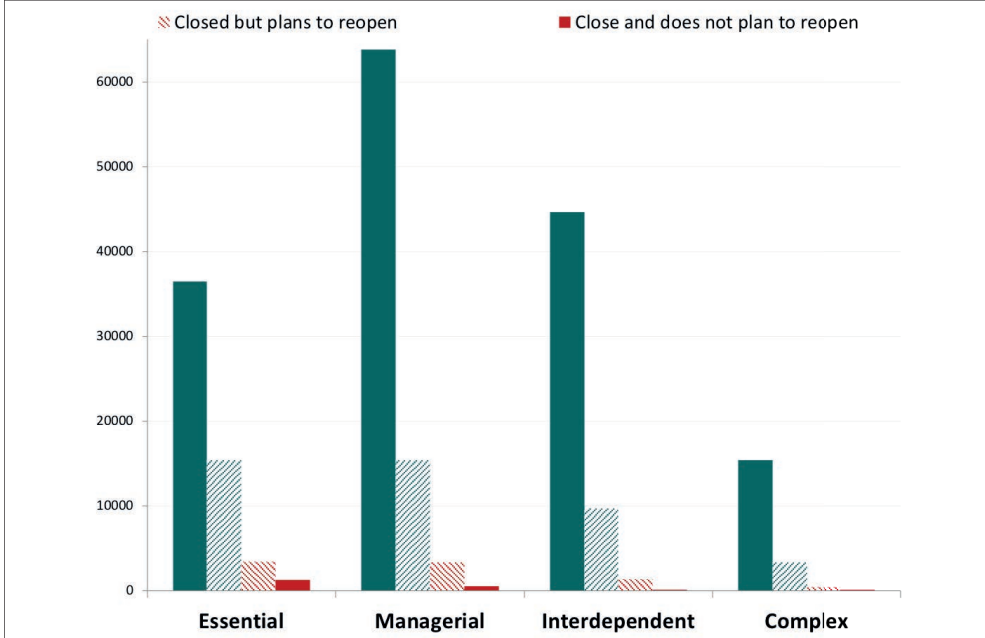
b) Share of firms by cluster
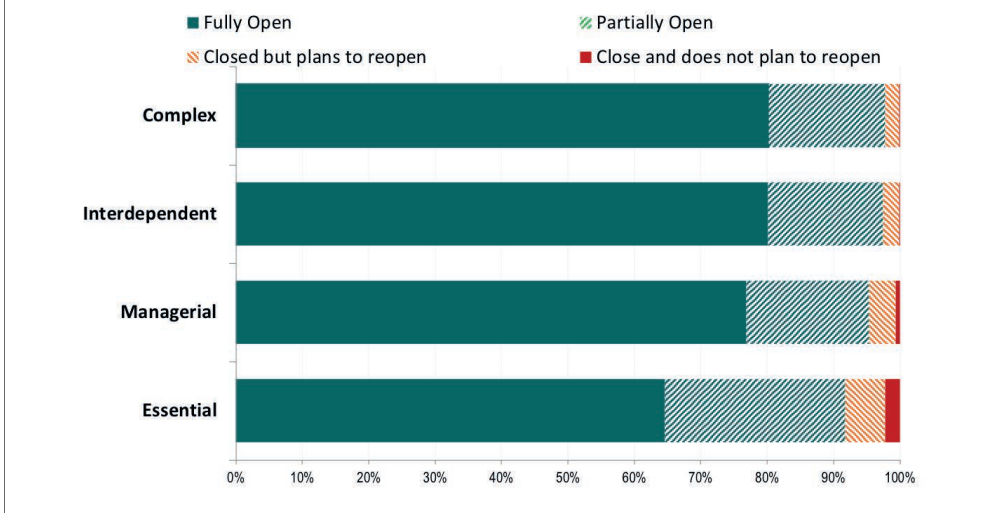
Source: Authors' elaboration

We now turn to replicate the analysis of co-occurrences, already conducted on the IMCPI, on the SPIESC-19 questionnaire. The analysis allows us to compare the attributes of firms in the pre-pandemic phase – their "quasi-genetic traits" – with the type of responses emerged during the COVID-19 crisis. As discussed before, our attention is devoted to practices put in place to manage both the workforce and financial issues, expected impacts and foreseen strategies. With this objective in mind, Figure 4 shows firm attributes as elicited from the IMCPI before the pandemic (left column), and firm responses as elicited from the SPIESC-19 during the pandemic period (right column), cluster by cluster. It is important to bear in mind that the analysis of co-occurrences is aimed at detecting the attributes more distinctive of the response rate by cluster, having as benchmark a theoretical χ^2 distribution, compared with the empirical one. Therefore, whenever a specific strategy – *e.g.* internationalisation investments – appears referred to a given cluster, this does not necessarily imply that firms in that cluster are the only ones to implement the strategy; it rather implies that the strategy characterises that cluster to a larger extent with respect to the others.

As can be observed in the text clouds in Figure 4.3, the number of strategies and text size of each strategy differ: such difference, completely endogenous, reflects the presence of more or less proactive attitudes of firms. In some clusters a multi-dimensional strategy approach prevails, while in others only few behavioural responses were put in place (Costa *et al.*, 2022). In addition, few detected actions mean that there are few specific behavioural traits of the cluster, and firms tend to behave somehow independently within the cluster. The text size of the strategy reflects its relevance in characterising the specific cluster[9].

As for the Essential cluster, in the pre-pandemic phase it was mostly characterised by low investment rates, no attention to design safety policy processes, higher inclination to invest in cybersecurity, data and network security, low propensity to operate on international markets (Figure 4.3*a*), the outbreak of the pandemic strongly disoriented such firms, who were actually unable to plan, define or even think of any countermeasure.

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9   The figure was realised using a word cloud visualisation tool. The size of the words varies according to the distance of the chi-square statistics: the higher the values, the greater the contribution of the word in defining the characteristics of each group.

Figure 4.3 - Co-occurrences of firms' strategies within each of the four firm cluster, the set of textual clouds on the left (a, c, f, h) refers to the practices recorded in the *Indagine Multiscopo del Censimento Permanente delle Imprese* data-set, carried out by Istat in 2019, while textual clouds on the right (b, d, g, e) reports the strategies (and lack of) undertaken by firms facing the COVID-19 crisis recorded in the *Situazione e prospettive delle imprese nell'emergenza sanitaria COVID-19* questionnaire carried out by Istat in November 2020

a) Essential in pre-pandemic times   *b*) Essential in pandemic times

c) Managerial in pre-pandemic times   *d*) Managerial in pandemic times

Source: Authors' elaboration

Figure 4.3 cont. **- Co-occurrences of firms' strategies within each of the four firm cluster, the set of textual clouds on the left (a, c, f, h) refers to the practices recorded in the *Indagine Multiscopo del Censimento Permanente delle Imprese* data-set, carried out by Istat in 2019, while textual clouds on the right (b, d, g, e) reports the strategies (and lack of) undertaken by firms facing the COVID-19 crisis recorded in the *Situazione e prospettive delle imprese nell'emergenza sanitaria COVID-19* questionnaire carried out by Istat in November 2020**

e) Interdependent in pre-pandemic times   *f*) Interdependent in pandemic times

g) Complex in pre-pandemic times   *h*) Complex in pandemic times

Source: Authors' elaboration

In many cases, the business activities were not even affected, according to respondents, exactly because of the absence of any strategy and change in behaviour put in place to counteract the crisis (Figure 4.3*b*). Firing, substantial employee reduction, in-depth reorganisation of production processes and unclear measures are all hallmarks of such Essential firms. A similar picture characterises Managerial firms (Figure 4.3*c*), which in pre-pandemic times were mainly interested in pursuing defensive strategies (mainly oriented to domestic markets) and had not planned investment in human capital, R&D or recruitment. Such attributes would be reflected in a quite conservative reaction to the pandemic inasmuch no human-resource management practice was put in place, neither current nor future strategies were envisaged (Figure 4.3*d*).

Moving now to the two upper clusters, the Interdependent firms (Figure 4.3*e*) in the pre-pandemic phase showed a strong inclination to invest in intramuros R&D, develop digital skills, demand professional services, and to invest in internationalisation, marketing, sales and post-sales activities, all this coupled with human-resource retraining and work organisation. Such type of firm behavioural attributes have been quite important to address the COVID-19 crisis. In fact, this cluster of firms, confirming its interdependent nature, was able to reorganise the direction of market destinations, increasing exports both toward EU and non-EU countries. Indeed, in a period characterised by strong value chain disruptions, reorienting the acquisition of the inputs of production became a crucial factor for highly interconnected firms. In addition, such units tended to accelerate Industry 4.0 solutions, relied on new business models, changed the ownership structure and reinforced strategic partnerships (Figure 4.3*f*). This behaviour portrays a proactive business attitude, able to counteract and more or less promptly address the pandemic storm. Finally, Complex firms represent the most advanced and dynamic layer of the industrial structure. In the period 2016-2018 these firms were already planning to enter the 4th Industrial Revolution, promoting processes of upskilling, investing in augmented reality and big-data analytics, and strongly activating R&D partnerships, but also ICT provision, with emphasis toward a Smart Factory (Figure 4.3*g*). Such pre-pandemic attributes conflate in a completely different set of responses *vis-à-vis* Essential and Managerial firms and were instead more similar to those of Inter-dependent firms. In addition, not only were Complex firms able to reorganise their business models and accelerate the digital transformation toward Industry 4.0; they were also capable to device

some specific interventions, such as improving the logistic performance, changing the bundle of acquired inputs, changing sales channels. Together with the reorganisation of the workspace, providing additional training and smart-working, such firms were able to raise capital from external financiers, hiring and renegotiate client payments terms and conditions (Figure 4.3*h*).

Comparing all clusters, two results appear quite robust: first, firm responses to the pandemic crisis have been strongly related to their pre-crisis attributes, showing a remarkable degree of stickiness and adaptive persistence in firms' behavioural attributes, defined as quasi-genetic traits. Second, if the emergence of a neodualistic structure was already identified in the pre-crisis period (Costa *et al.*, 2021), a similar behaviour between the two lower and the two upper clusters highlights the presence of a neodualistic pattern also with respect to crisis responses.

5. COVID-19 and corporate crises

Considering the heterogeneous and different strategies put in place by firms, and the potential asymmetric impacts of the crisis across the four clusters as well, we now turn to analyse a specific set of questions concerning some alternative forms of corporate crises, from less to more severe. In particular, we consider the SPIESC-19 dataset (referred to 2020) and focus on four questions about:

- *Operational and sustainability risks*

- *Substantial employee reduction*

- *Change in ownership structure*

- *Closure of company premises*

Such questions are clearly characterised by a different degree of pervasiveness and commonality across firms. In addition, they also report different degrees of riskiness about the status of the company, from more to less burdensome ones, as shown by the response rates in Figure 5.1*a*. Indeed, while firms reporting operational and sustainability risks are approximately 25% of respondents, substantial employment reduction affects 10% of respondents, while more radical actions, such as change in ownership structure and closure of the company premises, regard 2.5% of the respondents respectively. If in total approximately 40% of respondents report some form of corporate crisis, more or less irreversible, the distribution across clusters is not as asymmetric as the heterogeneous behaviours in terms of strategies might have entailed. Although different shares in the response rate by cluster do emerge, they are not so distinctive as to characterise only specific clusters (Figure 5.1*b*). Even the upper Interdependent and Complex ones, that account for the lion share of employment and value added, report a minimum of 40% up to a maximum of 60% of positive replies across the four questions. Indeed, the share of value added which is affected by some form of corporate crisis, which might go from more manageable operating risks up to closure of company premises, largely (80%-90%) originates from Interdependent and Complex firms (Figure 5.1*c*). Even though the particular circumstances in which the SPIESC-19 survey has been carried out are to be bear in mind in interpreting these results, this still signals a potential destruction in capabilities of a chunk of quite "good" firms.

Figure 5.1 - Firms reporting risks of corporate crises (units with at least 10 employees)

a) Percentage of firms that gave positive answers

b) Distribution of positive answers by firm cluster
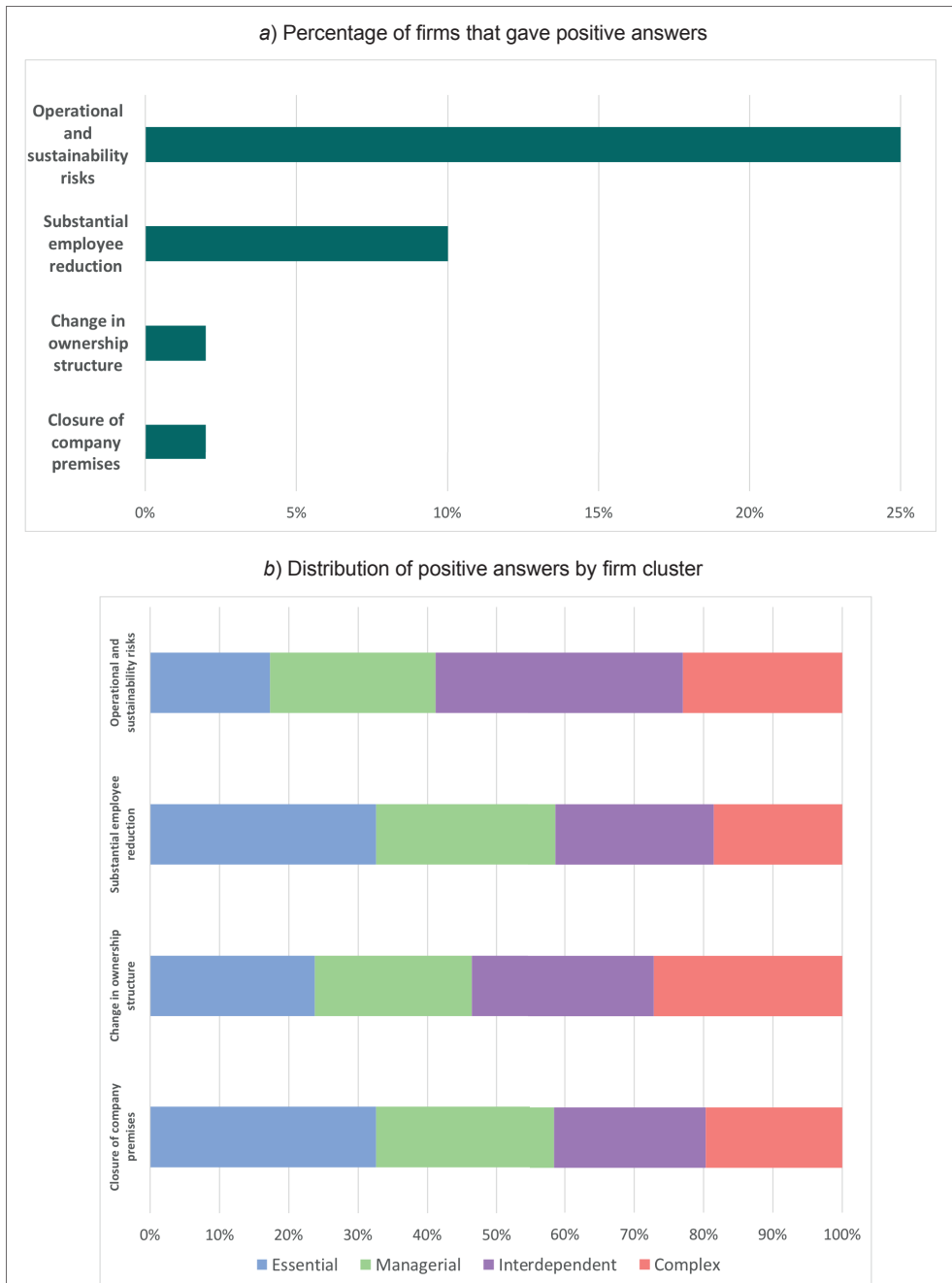
Source: Authors' elaboration

Figure 5.1 cont. **- Firms reporting risks of corporate crises (units with at least 10 employees)**

c) Distribution of value added by firm cluster
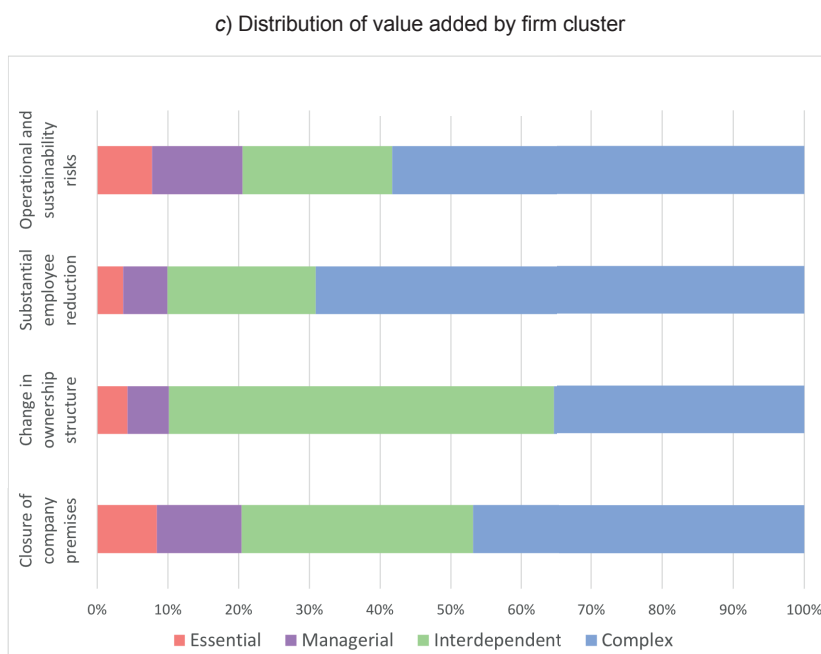
Source: Authors' elaboration

According to Table 5.1, approximately one fourth of those positively replying about sustainability risks reported the intention to fire workers. More reassuring is instead the co-occurrence between the change in ownership structure and the intention to close the company, which stands at less than 10%.

Table 5.1 - Co-occurrences of replies on corporate crises

	Operational and sustainability risks	Closure of company premises	Substantial emp. reduction	Change in ownership structure
Operational and sustainability risks	53,734	2,584	14,297	1,781
Closure of company premises	2,584	4,094	1,283	372
Substantial emp. reduction	14,297	1,283	22,493	1,349
Change in ownership structure	1,781	372	1,349	4,829

Source: Authors' elaboration

In order to have a tentative understanding of the amount of jobs, wages and value added possibly lost, *i.e.* the entailed "social costs", Figure 5.2*a* shows the number of persons employed which would be affected by such processes

of corporate restructuring: it ranges from the 150 thousand persons involved in change in ownership structure, to the 200 thousands involved in direct company closures, the more than 600 thousand workers in firms affected by forms of employee reduction, up to the 1.4 million persons in firms affected by operational and sustainability risks. Clearly, these numbers are not to be read as an estimation, but rather a range of the potential expected job losses, which might end-up affecting 1 million workers.

These jobs are obviously remunerated. When coming to the total amount of wages, quite huge figures emerge, up to 30 billions of euros when considering firms reporting sustainability risks (Figure 5.2*b*). Finally, the possible value added lost is all but nil, ranging from 15 billions of euros when destroyed in case of company closures to which one should sum-up the eventual reduction in value added of those firms expecting to fire workers, which produce a total value added of more than 40 billion euros (Figure 5.2*c*).

Figure 5.2 - Characteristics of the firms reporting risks of corporate crises by firm cluster (units with at least 10 employees)
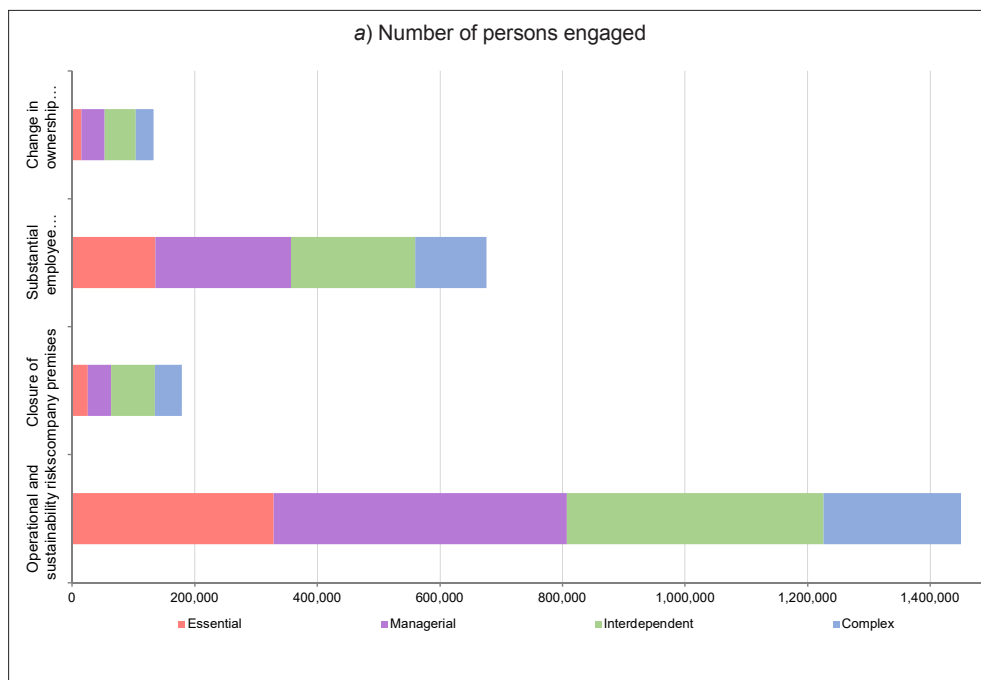
Source: Authors' elaboration

Figure 5.2 cont. **- Characteristics of the firms reporting risks of corporate crises by firm cluster (units with at least 10 employees)**

b) Total wages
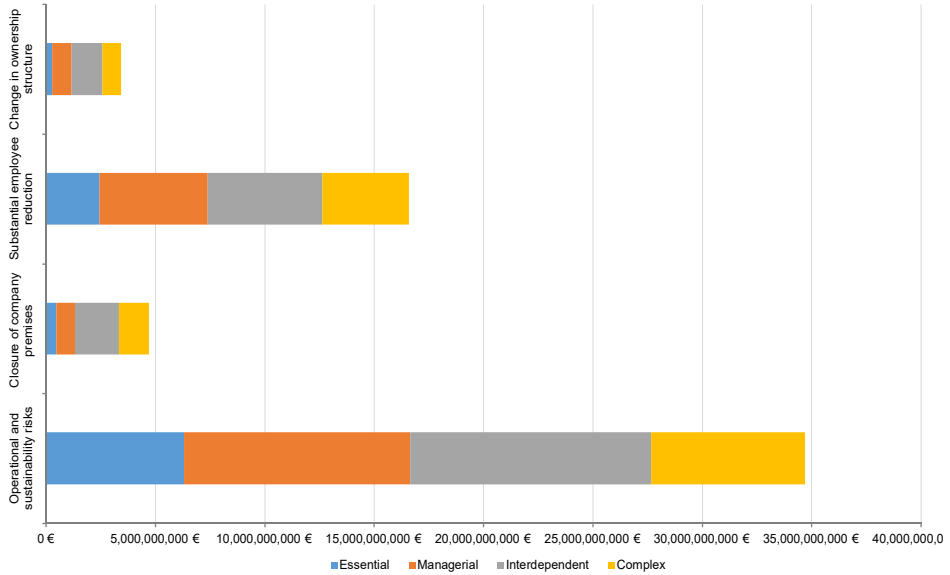
c) Total value added
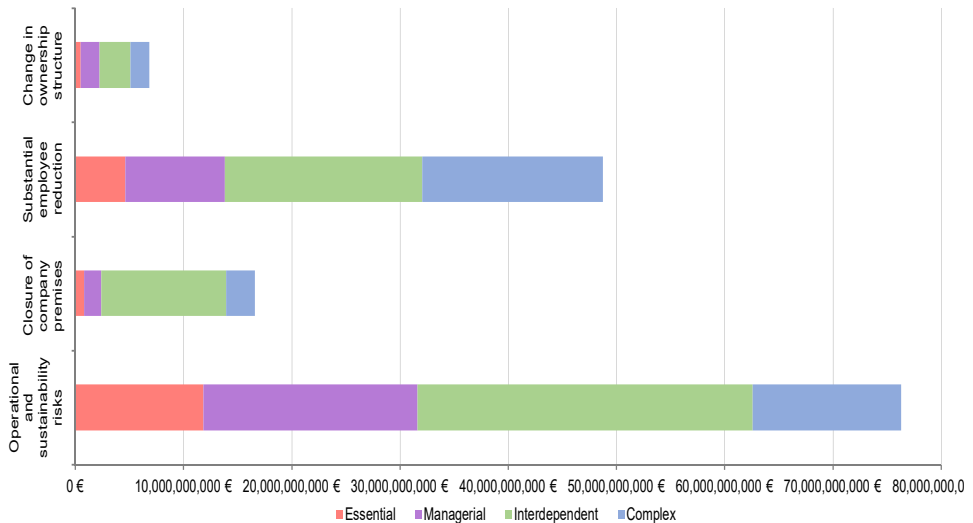
Source: Authors' elaboration

Considering that the impact is also likely to be asymmetric across sectors, we move toward a breakdown at 2-digit NACE industry classification, both for manufacturing and service. The sectoral analysis is restricted to two aspects, namely substantial employee reduction and corporate closure, due to the similarity in results of the two remaining questions. Figure 5.3 depicts a quite polarised picture for standard manufacturing activities like Apparel, Food, Other manufacturing, Rubber and plastics, appearing as the top-five most exposed sectors and accounting for more than forty percent of overall corporate closures. Among the top-exposed sectors to substantial employee reduction we find also Leather and Machinery. When coming to services, Catering and Lodging account for the lion share, not surprisingly. Other affected sectors are Building and Landscape, Land transport, and more surprisingly Software and consultancy, Advertising and Other professional services.

Figure 5.3 - Incidence of corporate crises: closure of company premises and substantial employee reduction, by manufacturing and service NACE industry at 2-digit aggregation level

Source: Authors' elaboration

Figure 5.3 cont. **- Incidence of corporate crises: closure of company premises and substantial employee reduction, by manufacturing and service NACE industry at 2-digit aggregation level**

Source: Authors' elaboration

Overall, a higher resilience to the crisis of more advanced sectors *vis-à-vis* standard ones appears to be confirmed. The so-called "Pavitt downstream sectors" (Dosi *et al.*, 2021), as those belonging to the Supplier Dominated class characterised by low learning regimes and poor technological opportunities, are the most exposed to different forms of vulnerability. However, also more advanced sectors belonging to the upstream Specialised Supplier class in the Pavitt Taxonomy are affected by risk exposure, although with a different incidence (*e.g.* Machinery). To sum-up, the evidence here presented warns against a potential widespread restructuring process: the COVID-19 crisis, rather than being a cleansing mechanism directed toward the least productive firms, is impinging also on more advanced and structured business activities, belonging to the Interdependent and Complex clusters. If the pandemic-induced crisis is not only targeting low-value added Essential and Managerial firms but also the most advanced layers of the productive system, this may somewhat hinder the possibility of a fast recovery.

6. Discussion and conclusions

This paper addresses the status and strategic profile of the Italian firms in the wake of the most severe crisis economies are facing since WWII, and assesses whether, and how, these characteristics affected firms' ability to react to the crisis. In order to accomplish the task we rely on two high-quality datasets (originating from the same sample desing) realised by Istat and reporting information about firms' behavioural traits: the first one, the IMCPI (2019), collected information on organisational capabilities, practices, attitudes toward innovation, business models and strategies during the period 2016-2018 (*i.e.* in "ordinary" times). The second dataset, the SPIESC-19 (2020), reports firm responses to the COVID-19 crisis, collecting information in the period June - October 2020. The SPIESC-19 is among the most detailed, representative, wide coverage surveys currently available on the effects of, and reaction to the current crisis, also compared to the information available for other advanced countries.

To analyse the link between the Italian firms' capabilities and their strategical responses to the COVID-19 crisis, we build on Costa *et al.* (2021) where, by applying a data analytics approach to the IMCPI dataset, we identified four-class taxonomy of firms according to their strategical framework and orientation. This taxonomy is used in the present paper to assess the behavioural responses of firms during the COVID-19 crisis. The analysis was conducted by first identifying a series of informative variables, in terms of practices put in place to manage the crisis, effects, expectations and strategies. Then such responses were studied through the lens of the taxonomy. Furthermore, we assessed the status of the Italian business system in the middle of the crisis, looking both at direct closures, but also at more long-term and underground perspectives of possible crises.

Two fundamental findings complementing the results of Costa et al. (2022) emerge from our analysis. First, there is strong stickiness and (adaptive) persistence between the behavioural attitudes of the firms in their "business as usual" and "emergency" status, meaning that what they know and how they are organised in the business-as-usual mode exert remarkable impacts on how they are able to react to unforeseen crises. This first result supports and strengthens the capability-based theory of the firms, and the overall understanding of firms as complex, behavioural entities as opposed to maximising units, performing

operational research calculus to optimise inputs of production in uncertain environments. Whenever an unforeseen event occurs, the safest response is to rely on previous knowledge and experience to adjust and cope with the new environment, mostly applying a heuristic-based behavioural approach (Dosi and Egidi, 1991; Winter, 2000).

The second result regards the nature of this crisis. Crises have been, since the Schumpeterian notion of creative restructuring, considered as a potential source of market-cleansing from unproductive, poorly innovative firms. Crises are also often seen as an *opportunity*. However, the most recent experience of the Great Recession taught us that such market-based mechanism may suffer from poor functioning (Dosi *et al.*, 2012; Foster *et al.*, 2016). The COVID-19-induced crisis will hardly represent an opportunity to reshape the business structure toward a high-productivity path: as we have seen, diverse risks are in place for Italian firms, ranging from more to less intense forms and targeting not only low-productivity, low-complex firms (in our taxonomy: Essential firms), but also many productive and structured units, responsible for a considerable share of Italian value added, employment and wages.

The power of the microlevel analysis here conducted, combining qualitative and quantita-tive information, is indeed both the possibility of having a gauge of the status of the economy, and to operate with selective and targeted policy interventions, for example impeding closures and delocalisations of important components of the overall Italian production chain. As such, we prompt the policy intervention to advance as fast and selectively as possible along two directions, namely (*i*) providing guarantees and safety instruments to protect the firms belonging to highly productive clusters (Interdependent and Complex), preventing their closure and providing finance resources but also policy guidance; (*ii*) creating public instruments able to foster integration of small, often disoriented Essential and Managerial firms toward a reconversion of production able to face the challenges of digitisation and greening of the economy. Vertical and selective industrial policies, addressing firm clusters rather than sheer sectors of activity, beyond the non-selective fiscal incentives, are crucial to cope with a crisis that may otherwise produce long-lasting hysteresis effects (Dosi *et al.*, 2020).

A limitation of our study is that it might be partially biased by survey respondents; moreover, actual causality effects between firms' pre-pandemic

capabilities and their reactions to the COVID-19 crisis are not explicitly measured.

With the aim of addressing these limitations, we are planning to work on an extension of the present study that will entail the analysis of quantitative measures of firm responses, starting with the hiring and firing flows during the pandemic, to tackle both a quite effective estimate of firms' behaviour in response to the crisis and the ensuing impacts on their internal labour markets.

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Reacting to the COVID-19 crisis: state, strategies and perspectives of Italian firms

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Abstract

This paper analyses how firms' pre-COVID strategic orientations influence their ability to react to the COVID-19 pandemic. Applying data analytics to the results of Istat permanent business census and the "COVID-19 survey", we firstly classify the enterprises according to their pre-crisis degree of "dynamism"; secondly, we identify five types of firm reactivity to the 2020 crisis (also considering the effects they suffered) and estimate how the two kinds of firm orientation interacted. We find that despite the cross-cutting nature of the recession, a former higher dynamism does help better face the new emergence, favouring a divergence of firm growth paths, even though the crisis also produced an innovative stimulus effect (not just a defensive one) for some previously static segments.

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1. Introduction

COVID-19 pandemic severely affected economies worldwide, but the economic consequences were heterogeneous both across countries and firms, depending on a number of factors which range from the different intensity of anti-contagion measures – *e.g.* the choice about what activities to lock down –, to the structural peculiarities of sectors and firms – such as concentration, vertical integration, connection ability, size, *etc.* With refer to the Italian case, the study of such aspects is of great importance in order to assess the possibilities for the business system to recover from the third recession in twelve years.

This article analyses how Italian firms' pre-COVID strategic orientation condition their ability to react to the pandemic. The issue is today a particularly debated one: since the outbreak of the pandemic in 2020, a growing amount of literature has been trying to measure its impact on countries, industries, firms and workers, also investigating what structural characteristics and strategic choices helped economic actors to cope with the new emergency.

Adopting a firm-level perspective, two far-reaching works by OECD (2021) and UNIDO (2021) show that business dynamics, financial solidity, innovation and digital technology are important determinants of firm resilience with respect to the COVID-19 shock, while pre-crisis structural weakness in these areas tend to undermine firms' ability to cope with the economic effects of the crisis. In this respect, Bajgar *et al.* (2019) find that in pre-crisis years a productivity gap had been widening between "leader" and "laggard" firms, resulting in an increasing industry concentration. Moreover, Calvino *et al.* (2020) show that also the lack of capabilities and incentives for younger and smaller firms to innovate and adopt new technologies is responsible for the increasing concentration dynamics. Also the role of financial solidity has been investigated, for instance pointing out that SMEs and young firms tend to suffer from financial constraints, so that they may lack financial cushions to survive a prolonged recession (OECD, 2020; Bartik *et al.*, 2020; WTO, 2021).

With regard to the role of advanced technologies, it has been argued that digitalisation tends to support firms' response capacity to the pandemic shock in a number of ways (UNIDO, 2021): for example, digital competences

facilitate the shift to remote work; the application of the Internet of Things (IoT) or virtual reality facilitates the reorganisation of production processes; additive manufacturing solutions can help cope with the shortage of specific inputs. However, it has also been recalled that in pre-pandemic years substantial divergences between firms had been increasing in the technology adoption and digital transformation processes (Andrews *et al.*, 2016), mostly to the detriment of small and young firms. In this vein, Costa *et al.* (2022) show that adequate organisational capabilities – *i.e.* the ability to design and implement a complex range of strategies and to adapt to a complex environment – supported Italian firms' performance in pre-crisis period and, above all, did help them successfully react to the economic consequences of pandemic, in some cases allowing them to growth and increase employment.

Firm internationalisation, in turn, has been found to play more a controversial role in offering a shelter against the COVID-19 effects. On the one hand, the direct relationship between firm productivity, performance and capacity to compete on international markets is a well-established result in literature[3], so that internationalised firms may be more able to react to the crisis; on the other hand, the very peculiarities of the current crisis – first of all the lockdown measures adopted worldwide – could have disruptive effects on supply chains and GVCs. Using World Bank data, Giglioli *et al.* (2021) find that actually GVCs proved to be more resilient than expected, Italian firms operating in sectors more involved in GVCs and with higher export intensity tended to suffer less, and – also depending on firm ex-ante characteristics – internationalised firms tended to react faster and to adopt new strategies to remain in the market. Similar results are drawn also by Istat (2021), and Monducci (2021*a* and 2021*b*), according to whom the enterprises that in the pre-COVID phase had driven Italian export and economic performance reacted more brilliantly to the pandemic crisis, and so especially did those belonging to multinational groups (notably foreign ones). More in general, Borino *et al.* (2021) find that internationalised firms were hit harder by the pandemic compared to domestic firms, because of their exposure to international markets. However, they also find that these firms proved to be more resilient to the COVID-19 crisis than domestic firms, less likely to lay off workers and file for bankruptcy, and more likely to adopt countermeasures to continue producing, such as telework.

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3   See Wagner (2007 and 2012) for two comprehensive surveys.

The evolution of all these aspects may affect the future development of the Italian business system, for example accentuating the strong heterogeneity already existing in firms' growth dynamics, with a further divergence among their performance. On the other hand, a number of works repeatedly showed the existence of very competitive business segments with performances of outstanding levels, generally relying on significant firm size but also, sometimes even small and medium-sized enterprises, relying on substantial organisational capabilities (Costa *et al.*, 2021), on the ability to invest in innovation and worker skills (*e.g.* Bugamelli *et al.*, 2012; Romano, 2019), in digital transformation (Andrews *et al.*, 2016) in internationalisation (Costa *et al.*, 2017; Bugamelli *et al.*, 2018) and more in general in complementary intangible assets such as skills and organisational capital (Romano, 2019; Corrado *et al.*, 2021). This "neo-dualism" in the Italian business structure (Dosi *et al.*, 2012 and 2019) reflects a substantial divergence in firms' performance and growth paths which ends up significantly conditioning the shape of the system after a recession (Bartoloni *et al.*, 2021).

Based on such premises, this work aims at evaluating on an empirical ground how the pre-crisis strategic orientation of Italian firms conditioned their ability to react to the pandemic emergence.

In the context of the works cited, we adopt a microfounded and multidimensional analytical approach, based on the construction of firm profiles both in terms of strategies, objectives and corporate configuration prevailing in the phase preceding the pandemic, and in terms of the corporate behaviours and dynamics adopted in the acute phase of the crisis generated by COVID-19. This methodological framework makes the evidence presented here significantly innovative and original in the context of the debate on the effects of the crisis on the Italian business system. In doing so, we make use of three recent Istat microdata sources: *a)* the multipurpose survey of the Permanent business census, which with refer to 2016-2018 reports qualitative information on a wide range of firm characteristics, concerning both routines (*e.g.* hiring practices and human resource management, price setting rules) and strategies (*e.g.* investment in digitalisation, advanced technologies, internationalisation, innovation); *b)* the business register Frame-Sbs, which on an annual basis reports quantitative information on firms' structure (*e.g.* size, sector, location, membership of groups, labour costs) and economic

results (*e.g.* income statement, international operations); *c)* the *ad hoc* "COVID-19" survey carried out in November 2020 which reports information about the impact of the pandemic on firms' activity (*e.g.* on turnover, demand, supply) and about their reaction to the crisis (*e.g.* choices on operating scale, employment, digitalisation, finance).

Focussing on enterprises with at least 10 persons employed (the most relevant business segment from a competitiveness point of view) we firstly analyse the firms' strategies in the 2016-2018 period, identifying five classes of "dynamism" on the basis of the extent and complexity of firm investment in a number of domains (internal organisation, human capital, digitalisation, internationalisation, *etc.*)[4]. Then we study the consequences of the COVID-19 recession on the Italian business system and how firms reacted in the short term (until end-2020), distinguishing also in this case five profiles of response. Finally, we examine the interaction between the pre-crisis dynamism and the response profiles, in order to assess how past strategic orientation affected the resilience during the pandemic.

The measurement and analysis of such aspects may be grounded on the extensive literature focussing on the role of firm dynamic capabilities in explaining business dynamics[5]. In particular, it appears promising the possibility of linking firms' actions to their dynamic capabilities, in particular to their ability to react to pressures for change (Teece, 2007). This latter is induced by external and/or internal factors, on the basis of evidence or perceptions of risks or opportunities, which may require organisational, process, allocative transformations (Easterby-Smith *et al.*, 2009). Further developments emphasise the innovative processes as representative of dynamic capabilities and crucial for the possibility of transforming competitive potential into market results (Wang and Ahmed, 2007)[6].

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4   It needs to be noted that our notion of firms' dynamism differs from other measures considered in economic literature, such as the "business dynamism" proposed by Decker *et al.* (2020), and is somehow complementary to them: while the latter basically refers to the aggregate of the business system, and is used to explain the productivity dynamics on the basis of its "allocative" component (*i.e.* related to business demography or resources reallocation across sectors), our notion of dynamism refers to the within-firm component, that is the number, the type and the complexity of strategies adopted by firms to compete or react to the COVID-19 crisis.

5   Dynamic capabilities refer to "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments [...] *dynamic capabilities* thus reflect an organisation's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions" (Teece *et al.*, 1997: 516).

6   "Conceptually, we reckon that adaptive capability, absorptive capability and innovative capability are the most important component factors of *dynamic capabilities* and underpin a firm's ability to integrate, reconfigure, renew and recreate its resources and capabilities in line with external changes. […] Innovative capability effectively links a firm's

Our main research questions can be posed as follows: *1)* to what extent did the pandemic affect the growth path of Italian business system that took place in the previous three years? *2)* in a global context increasingly characterised by exogenous shocks of great impact and difficult to predict, what are the firm structural and behavioural characteristics ensuring a higher capacity to react to shocks?

The rest of the paper is structured as follows. Section 2 describes the information sources and the database; Section 3 presents a taxonomy of companies with at least 10 employees based on an indicator of firm dynamism; Section 4 classifies enterprises again, this time according to the consequences of the health emergency and their ability to react to the crisis. Section 5 analyses the interaction between firms' pre-crisis strategic orientation and their ability to react to COVID-19 crisis, also evaluating a possible divarication in Italian firms' growth paths. Section 6 concludes.

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inherent innovativeness to marketplace-based advantage in terms of new products and/or markets. Innovative capability effectively links a firm's inherent innovativeness to marketplace-based advantage in terms of new products and/or markets. Thus, innovative capability explains the linkages between a firm's resources and capabilities with its product market" (Wang and Ahmed, 2007: 39).

2. The data

We focus on industrial and service firms operating in Italy with at least 10 workers (a universe of approximately 215,000 units, with 9 million persons employed (54.7% of the total) and 8.8 million employees (74.7%), which generate about 2,300 billion of turnover (75.3%) and 557 billion of value added (71.4% of the total).

In particular, we use a set of microdata sources which are part of a unified approach to the production of business statistics developed by Istat in the last decade; an approach that now ensure a highly granular information on economic units, covering a broad range of themes and consistent with macroeconomic aggregates[7].

In this work, the following microdata sources are used:

1. Permanent Business Census (2019). It is a large multi-purpose survey (sample of over 200,000 enterprises with at least 3 persons employed, representative of a universe of over 1 million firms) that provides mostly qualitative information about firms' strategies in the following fields:

   - Governance (ownership, control, management, group membership);

   - Human capital (hiring, training, *etc.*);

   - Inter-enterprises relationships (clients, subcontractors, partnerships, joint ventures, *etc.*);

   - Competitive levers (price, quality, innovation, location, distribution network, *etc.*);

   - Technology (investments/use of ICT, I4.0, platforms, *etc.*);

   - Finance (sources, typology and conditions of the relationships bank-enterprise, *etc.*);

   - Internationalisation (international outsourcing, via offshoring or agreements, type of partners, *etc.*).

2. The second survey on "Situation and prospects of Italian enterprises in the health emergency". Carried out by Istat on November 2020 (Istat, 2020d), this survey is based on the same sample design as the

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7   For details, see Luzi and Monducci, 2016; Monducci and Costa, 2016.

Istat Permanent Business Census; it covers a sample of over 90,000 companies with at least 3 persons employed, providing information about the effects of the COVID-19 crisis on firms' performance and strategies (*e.g.* demand dynamics, turnover, employment, investments, technologies, *etc.*) and about what type of reaction, if any, enterprises opposed to the shock (*e.g.* in terms of reorganisation, downsizing, digital transformation, management of suppliers and clients, *etc.*) during the period June 2020-October 2020.

3. Frame-Sbs Register. For each of the 4.3 million firms active in Italy, this dataset provides information on structure (number of workers, business sector, location, age, belonging to a multinational group) and performance (production, turnover, value added, labour cost).

The database resulting from the integration of these three sources consists of over 40,600 companies with at least three persons employed, employing 3.1 million people and generating 216.7 billion of value added[8].

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8   We ruled out from our analysis the sectors of Mining and Tobacco.

3. The "dynamism" of Italian firms in pre-crisis years (2016-2018)

The resilience of Italian firms in the medium-long term also depends on their previous choices in terms of organisation, productive inputs and strategic orientation. Adopting a more complex organisation, possibly with an endowment of human capital able to manage a wide-ranging set of strategies is often found to be associated to better performance and more robust dynamics[9]. In other words, it is necessary to assess whether the COVID-19 emergency has led firms to accentuate such previous orientations – thus further increasing their "dynamism" – or has induced them to abandon them.

The competitiveness and growth of companies depend on the combination of productive, organisational, technological and market choices. In order to grasp the complexity of these aspects, a synthetic indicator of the degree of "dynamism" has recently been constructed taking advantage of the results of the permanent census on business units (Istat, 2020*a*). The indicator measures the firm propensity to innovate, to invest in technology, digitalisation and personnel training (especially in ICT), to modernise organisation and production processes, also paying attention to sustainability issues. Furthermore, the construction of the indicator is also based on a wide range of information capable of measuring the company's aptitudes to undertake dynamism-oriented strategies, in terms of growth objectives, propensity for change, attention to the emergence of new opportunities and risks.

Focussing on firms' behavioural – rather than structural – characteristics is an important task in such a fragmented economy as the Italian one, because it implies to investigate on a very granular basis some important aspects of the business system that even a firm-level analysis carried out on business registers or firm balance sheets may end up overlooking. Among the most significant examples, it has been recently pointed out (Istat, 2021) that during last decades adopting advanced, complex strategies – in our terms: having a high degree of dynamism – substantially supported small firms' performance, with increases in turnover, value added and productivity, and it allowed SMEs to attain levels of labour productivity comparable to (and often even higher than) those of large, less dynamic firms. This sort of "accessible dynamism"

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9   See for example Bartoloni *et al.* (2021), Bugamelli *et al.* (2012) and Costa *et al.* (2021) for the Italian case; Andrews *et al.* (2016) for an international comparison.

would therefore help overcome, at least partially, the size-related limits of many Italian enterprises.

In this vein, with reference to firms with at least 10 employees, in this paper we applied a multi-stage methodology to the study of firms' dynamism[10]. First of all, a factor analysis was carried out on the relevant variables of the multi-purpose survey, in order to identify the determinant of heterogeneity. The variables considered, all referred to the 2016-2018 period, are related to the firms' governance (presence of managers), the presence of investment in R&D, staff training (additional to the mandatory one), innovation, social responsibility, the choices about the business development paths (*e.g.* in terms of productive differentiation, technological modernisation, introduction of products that are really new to the market), their competition levers (price, quality, location of the company, quality of human capital, productive flexibility). Subsequently, through a clustering procedure, the companies were classified according to how these factors combine with each other.

As a result, the five classes of dynamism shown in Table 3.1 were identified.

Table 3.1 - Strategies of firms with at least 10 persons employed, by classes of dynamism - Year 2018

DEGREE OF DYNAMISM	Main strategies
Low	Substantial lack of investment and strategy; self-financing.
Medium-low	Defensive strategies (market share defense), mostly oriented to the national market; (modest) investment in staff training (digital literacy, problem solving) and Ict (not advanced ones); limited (but present) contracts and subcontracting relationships; limited innovative activity; financing with bank credit.
Medium	Expansive strategies (access to new markets) also with international activity; investments in digitalisation and R&D, staff training (especially digital), machinery for innovation, internationalisation, environmental responsibility and process safety; intense use of bank and (especially) commercial credit.
Medium-high	Structured business entities; intense investment in R&D, advanced digitalisation (Big Data Analytics, Cyber-security, robotics and intelligent systems, simulation between interconnected machines; 3D printing), specific staff training, internationalisation, social and environmental responsibility; diversification of financial sources (equity, intra-group loans, *etc.*) with a decreasing use of bank credit.
High	Large investments in R&D (intramuros and acquired), innovation (of product, process, organisational, marketing), advanced digitalisation (*e.g.* I4.0, cloud), internationalisation (commercial and production), targeted staff training, social and environmental responsibility; maximum complexity of internal and external financial sources (self-financing, equity, intra-group loans, bank and commercial credit, Project finance, crowfunding)

Source: Authors' calculation on Istat data

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10   For details of the methodology, see the Methodological appendix.

The differences between the classes provide insights on the investments necessary to move towards higher degrees of dynamism.

Transition from low to medium-low dynamism - This is probably the most challenging transition, not so much for the number of units involved, but for the nature of the changes needed: the first step towards higher dynamism requires a real "business vision" and, consequently, a proactive propensity for growth. In order of importance, investments, albeit not huge, need to appear in staff training (*e.g.* for digital literacy), digitalisation (even of least advanced type, far from the Industry 4.0 technologies), organisation (*e.g.* safety of production processes, reduction of environmental impact, activation of productive collaboration relationships with other companies, in the form of orders or subcontracting). However, this also implies a change in the financial structure, which must go (and be able to go) beyond mere self-financing, opening up to external sources, although unsophisticated, such as bank and commercial credit.

Transition from medium-low to medium dynamism - This transition, which also marks the entry into the field of truly dynamic behaviours, is characterised by a stronger orientation towards innovation, the modernisation of production processes, and internationalisation. Investments in R&D (in house or purchased from third parties), in machinery for product and process innovation, in advanced software (*e.g.* data analytics) become essential. At the same time, investments in human capital are crucial too, if only in order to train personnel on the new technologies adopted. Finally, the attainment of a "medium" level of dynamism is accompanied by more attention to sustainability issues, in particular those related to the safety of production processes and environmental protection.

Transition from medium to medium-high dynamism - This transition characterises the transition towards fully structured and internationalised units, and requires a higher degree of process digitalisation, with the adoption of 4.0 enabling technologies (*e.g.* cyber-security; automation advanced, robotics, 3D printing) and specific staff training. Investments in R&D and internationalisation become significant. Furthermore, the possibility of diversifying the sources of financing towards more sophisticated forms of credit (such as equity, intra-group loans, *etc.*) is also fundamental. Entry into more dynamic classes must therefore be accompanied by the possibility

of finding different economic resources, to finance activities with different degrees of risk.

Transition from medium-high to high dynamism - Moving to the highest degree of dynamism requires substantial investments in internationalisation (of both commercial and productive type), advanced digitalisation (such as automation, intelligent systems, augmented reality, Internet of Things, cyber-security, use of services cloud for the remote management of data and business processes) and training of human capital (*e.g.* on the innovations adopted and/or planned), a high propensity to innovation (through R&D, acquisition of licenses and patents, tools for data analytics, network and telecommunications equipment), the use of sophisticated funding sources.

The characteristics of each class of dynamism are reported in Table 3.2. A noticeable structural heterogeneity emerges: over 15% of companies (about 34 thousand units) have "low" dynamism, with a relatively limited weight in terms of employees (8.5% of the total, about 781 thousand individuals) and even more of value added (5.7%). 39% (over 83 thousand units, with 2.1 million persons employed and generating 17.6% of total value added) have a "medium-low" degree of dynamism, and over a quarter (28.9%, over 61 thousand companies, with 2.6 million persons employed and producing 26.2% of the total value added) have "medium" dynamism. In other words, the great majority of Italian companies with at least 10 employees (68%) have a medium or medium-low dynamic profile. The number of units with high dynamism (less than 4%, almost 8 thousand companies) or medium-high dynamism (12.6%, about 27 thousand companies) is therefore small, even if these groups account for approximately 18 and 22% of the employment of the system respectively (approximately 3.6 million employees in total, more or less equally divided between the two groups) and 25.6 and 24.8% of the value added. These are also the classes of units with a labour productivity higher than the overall average and – together with the one with medium dynamism – they are the most active on international markets.

The firm dynamism has an evident size dimension (Figure 3.1): over 60% of very small enterprises (10-19 p.e.) display a low or medium-low degree of dynamism, and this share decreases as the firm size increases, so that over half of large firms' dynamism is high of medium-high.

Table 3.2 - Structural characteristics of firms with at least 10 persons employed, by classes of dynamism - Year 2018

DEGREE OF DYNAMISM	Firms		Persons employed			Value added		Productivity	Export		Export propensity (export/ turnover; %)
	No.	%	No.	%	Avg.	Million €	%	(Val. Add./ P.e.; Avg.; €)	Million €	%	
Low	33,684	15.8	781,215	8.5	23.2	34,654.2	5.7	44,359.3	10,630.7	2.6	9.1
Medium-low	83,168	39.0	2,104,604	23.0	25.3	106,646.1	17.6	50,672.8	31,185.2	7.7	7.4
Medium	61,629	28.9	2,596,501	28.4	42.1	158,588.7	26.2	61,077.9	106,013.1	26.1	16.0
Medium-high	26,893	12.6	1,984,071	21.7	73.8	149,670.7	24.8	75,436.2	109,724.9	27.0	17.3
High	7,698	3.6	1,671,207	18.3	217.1	154,811.1	25.6	92,634.3	149,075.6	36,7	24.0
Total	**213,071**	**100.0**	**9,137,596**	**100.0**	**42.9**	**604,370.8**	**100.0**	**66,141.1**	**406,629.5**	**100.0**	**16.5**

Source: Authors' calculation on Istat data

Figure 3.1 - Firms' dynamism, by size class - Year 2018 (percentage values)
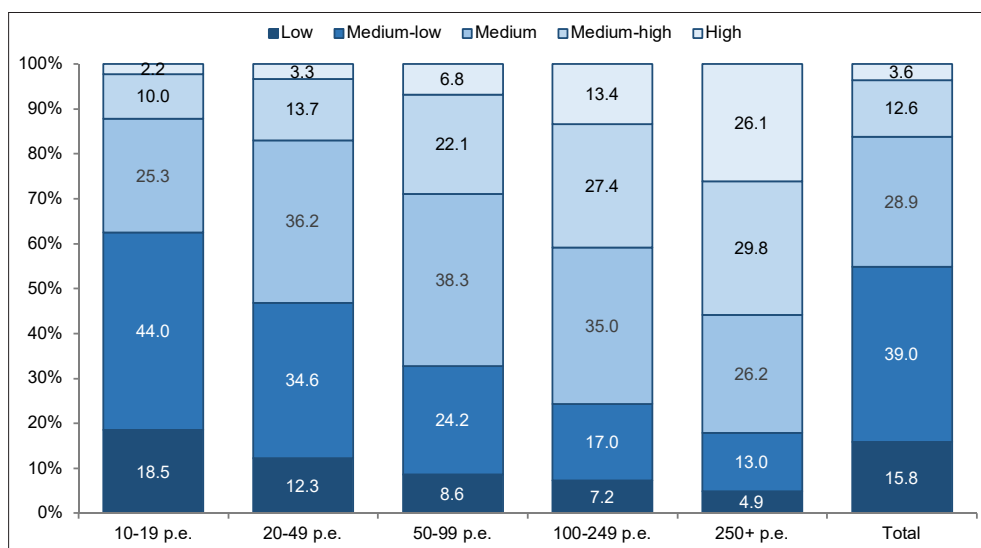
Source: Authors' calculation on Istat data

However, a noteworthy aspect is that many highly dynamic companies are small-sized, and also in this case the attainment of an adequate degree of dynamism allowed thousands of small firms to have a good performance in terms of turnover, value added and productivity levels and dynamics, opening up significant growth opportunities to them.

This is mostly important as far as labour productivity is concerned, because its stagnation is one of the critical issues most frequently evoked in the debate on Italy's growth prospects. Figure 3.2 shows that, although in all size classes

the labour productivity increases as the degree of firm dynamism increases, small and medium-sized units with a high or medium-high degree of dynamism have levels of productivity higher than those of large companies (or companies belonging to larger size classes) with a low or medium degree of dynamism. Furthermore, the performance gap in favour of the more dynamic profiles emerges in almost all industrial and tertiary activities: in industry, enterprises with at least "average" dynamism display labour productivity levels higher – in most sectors by an amount between 20 and 80% – than those of "low" dynamic firms; in business services the heterogeneity still holds, albeit less pronounced.

Figure 3.2 - Labour productivity, by degree of dynamism and size class - 2018 (firms with at least 10 persons employed; value added per person employed; €)
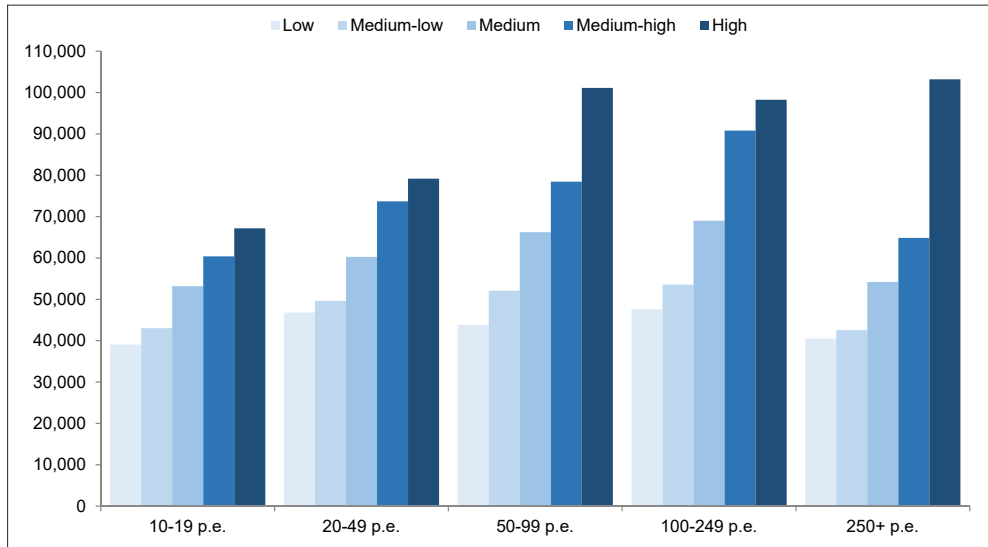
Source: Istat, 2021

Moreover, these findings do not seem to be conditioned by possible sector-related bias: analysing the distribution of firms within "cells" obtained by crossing 5 size classes and 270 sectors of economic activity, it emerges that, in all size classes, the of firms whose productivity is in the fourth quartile (25% of firms with the highest productivity) increases significantly in moving from less dynamic clusters to the most dynamic ones.

For example, for firms with 10-19 employees the incidence of high-productivity companies ranges from 20.9% for firms belonging to the low-dynamism cluster to 35.6% for the high-dynamism ones; in the class of 20-49 workers the incidence is respectively 17.3% and 35.8%; in the class of 50-99 workers it ranges from 17.1% to 36.8%, in 100- 249 workers class from 14.2% to 33.4%; among largest firms it ranges from 15.1% to 30%.

A higher dynamism also supported productivity in the three-year period 2016-2018 (Figure 3.3): across all size classes, one out of two of the high dynamism firms had substantial average annual labour productivity gains. A dynamic profile made the difference especially in the performance of small and medium-sized firms, for which productivity increased (on median) even in correspondence of medium dynamism units. In the case of medium-sized and (above all) large companies, on the other hand, productivity growth has implied a high degree of dynamism.

Figure 3.3 - Labour productivity dynamics, by degree of dynamism and size class – 2016-2018 (firms with at least 10 persons employed; average annual growth rate, value added per person employed; %)
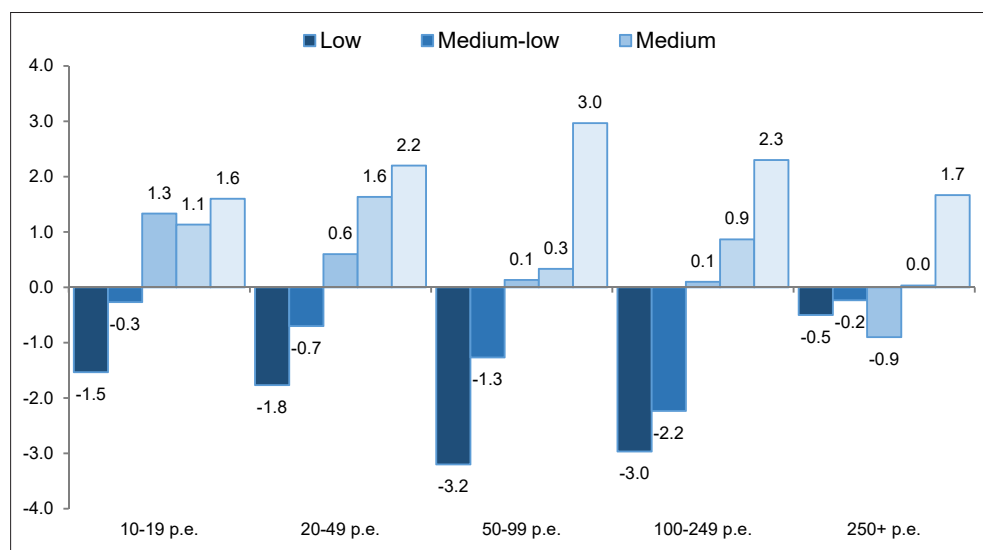
Source: Authors' calculation on Istat data

4. The response strategies to the COVID-19 crisis

The COVID-19 shock occurred in this framework. The experience of past crises shows that these were not neutral, and produced profound and differentiated effects, differently affecting different business segments and playing an important role in increasing existing inequalities[11]. The availability of firm-level, multidimensional data makes it possible to take into account such differences going beyond structural aspects (*e.g.* size- and sector-related ones), so as to identify "virtuous" behaviours and best practices and to support the development of more targeted (and therefore potentially more effective) public policies.

To this end, a new factor analysis was carried out on the variables of the dataset regarding the effects of the crisis and the strategies chosen by businesses to react to the COVID-19 crisis, in order to isolate the determinants of the behavioural heterogeneity. In particular, with reference to the economic consequences of the pandemic, information was considered on the impact on turnover (in 2020 and in the first half of 2021), costs of containing the contagion (for sanitisation, shifts, training, *etc.*), demand (local, national, foreign), supplies (in terms of price and quantity), investment plans (*e.g.* increase, reduction, postponement). As for response strategies, information was considered with regard to personnel management (*e.g.* use of smart working, changes in working hours, mandatory vacations, *etc.*), liquidity (*e.g.* debt renegotiations, use of bank credit, capital increases, *etc.*), digital transformation (*e.g.* investments in connection, communication, cloud, e-commerce, platforms, *etc.*), product and service offerings (in terms of expansion, contraction or conversion), range of markets served (in terms of change, enhancement or reduction).

Subsequently, applying a further clustering procedure, it is possible to obtain a new business taxonomy which, on the basis of the combination of these factors, classifies the Italian firms with at least 10 persons employed according to how they reacted to the economic consequences of the COVID-19 crisis. In this way, the five profiles of reaction to the crisis shown in Table 4.1 are identified.

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11   See, for example, Bartoloni *et al.*, 2021; Foster, 2016.

Table 4.1 – Profiles of reaction to the COVID-19 crisis - Year 2020 (firms with at least 10 persons employed)

	Type of firm	Crisis effects	Response strategies
1	Static in crisis	very negative	None
2	Static resilient	Very mild	None
3	Proactive in distress	Highly negative	Limited
4	Proactive resilient	Mild	No specific response, but same orientation as before the crisis
5	Proactive advanced	Varied	Wide and varied, with more investment

Source: Authors' calculation on Istat data

The sudden recession had heterogeneous consequences on these classes of firms, which reacted very differently from one another. Overall, two groups include units that did not implemented specific response strategies (the "Static" firms), while three groups include those who have implemented actions to cope with the emergency (the "Proactive" ones). In turn, the Static firms differ according to the extent of the effects suffered: for the "Static in crisis" the consequences were severe, thus suggesting that this group was somehow caught off-guard by the outbreak of the pandemic and the subsequent recession. In the case of "Static resilient", however, the absence of response strategies may stem from the fact that there was no real need for them to react, since they were affected by the crisis to an extremely limited extent.

As regards the profiles of proactive firms, the differences concern not only the effects of the pandemic but also the different types of countermeasures adopted. The "Proactive in distress" implemented a limited set of actions even though they suffered from severe damages, thus representing a group of reactive units still in serious trouble. In turn, the "Proactive resilient", like the "Static resilient", were marginally affected by the crisis and did not need to design specific response strategies to the crisis; however this firms are proactive in that they pursue expansive strategies, basically following their pre-pandemic investment plans. Finally, the "Proactive advanced" are somehow a mixed group: on the one hand, differently from the "Proactive resilient", a not negligible amount of such enterprises did suffer from the crisis, in some cases in a severe way (although the incidence of these cases is much lower than among the "Proactive in distress"); on the other hand, in 2016-2018 these units displayed a high dynamism, adopting wide and complex sets of strategies, which helped virtually all of them put in place a wide and varied set of countermeasures against the COVID-19 crisis, occasionally even going beyond the pre-crisis investment plans.

The characteristics of each group of firms are reported in Table 4.2.

Table 4.2 - Firms' response to the COVID-19 crisis - Year 2020 (firms with at least 10 persons employed)

	Firms		Persons employed			Value added		Productivity	Export		Export propensity (export/turnover; %)	Sectors with highest incidence
	No.	%	No.	%	Avg.	Million €	%	(Val. Add./P.e.; Avg.; €)	Million €	%		
Static in crisis	36,941	17.3	755803	8,3	20,5	30537,6	5,1	40404,2	5767,1	1,4	5,9	Gambling/Betting; Food/Beverage serv.; Sport; Other pers. serv.; Accommodation; Printing, Textiles
Static resilient	58,042	27.2	1672739	18,3	28,8	95589,0	15,8	57145,2	37820,4	9,3	10,9	Serv. to building/Landscape.; Res. care; legal/accounting; Energy; Waste; Wood
Proactive in distress	26,201	12.3	827010	9,1	31,6	40199,6	6,7	48608,4	18817,3	4,6	14,4	Travel agency; Accommodation; Water transp.; Food/Beverage serv.
Proactive resilient	65,604	30.8	3361922	36,8	51,2	261319,1	43,2	77729,1	186087,4	45,8	16,0	Finnace/Insur.; R&D; Pharmaceutics; Computer programming/consul.; Tlc
Proactive advanced	26,283	12.3	2520123	27,6	95,9	176725,5	29,2	70125,7	158137,4	38,9	22,0	Publishing; Pharmaceutics; Air transp.; Beverage; Education
Total	**213,071**	**100.0**	**9,137,596**	**100.0**	**42.9**	**604,370.8**	**100.0**	**6,6141.1**	**406,629.5**	**100.0**	**16.5**	**-**

Source: Authors' calculation on Istat data

Figure 4.1 - Composition of 5 classes of response to the crisis, by sector; Industry - Year 2020 (firms with at least 10 persons employed; %)
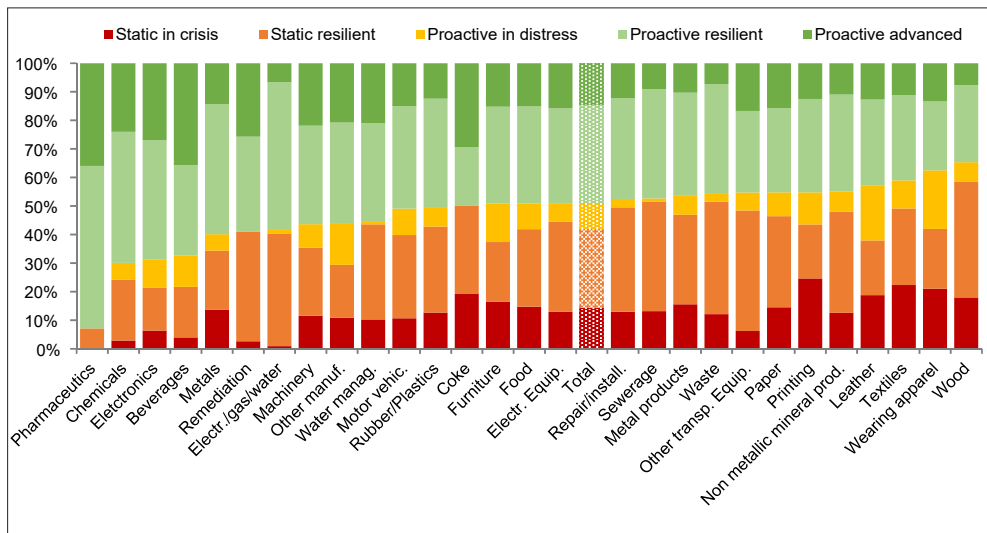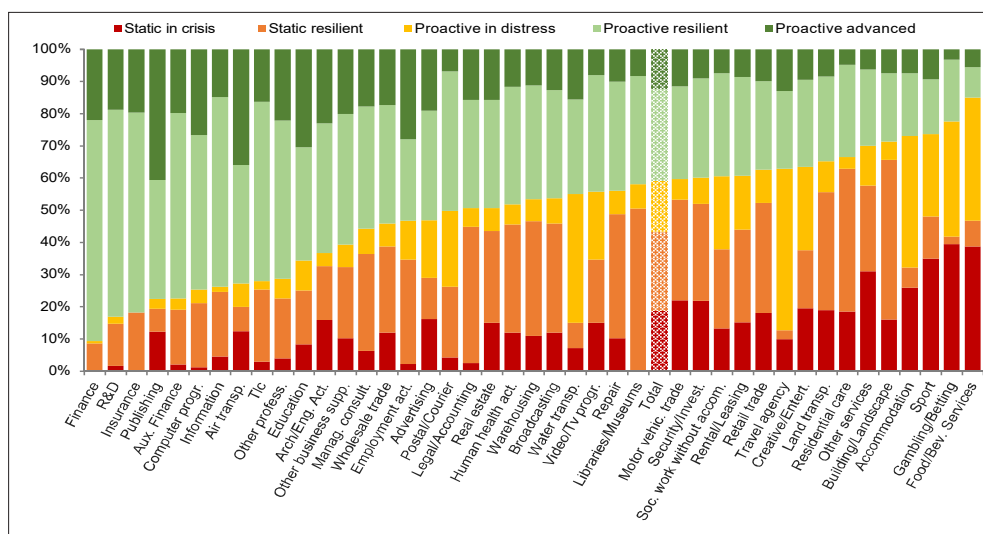

Source: Authors' calculation on Istat data.

With reference to the industrial sectors, Figure 4.1 shows that the incidence of firms most reactive to the crisis ("Proactive resilient" and "Proactive

advanced") is higher in the infrastructural activities spared by lockdown measures – such as energy and water supplies – or in those activities necessary to contain the emergency, such as chemicals, pharmaceuticals, electronics. On the other hand, difficulties emerge in traditional manufacturing: in textiles, wearing apparel, leather and non-metallic mineral products, more than half of the companies are static or in serious distress.

In services (Figure 4.2) there is a higher heterogeneity, and it seems important to look at the interaction between effects and ability to react. In this respect, some of these activities exhibit a strong reactivity even in the presence of negative effects: the share of "Proactive advanced" appears high in Publishing, Air Transport, Education. On the other hand, the ability to undertake structured countermeasures and seize opportunities, in the presence of limited effects, stands out in sectors relatively spared by administrative closure measures, also in relation to their centrality to the economic and social life: the share of "Proactive resilient", in fact, is significant in finance, insurance, R&D, IT and telecommunications. Finally, situations of distress and difficulty ("Proactive in distress") characterise those services most directly affected by the anti-contagion policies: travel agencies, maritime transport, accommodation, food and beverage services.

Figure 4.2 - Composition of 5 classes of response to the crisis, by sector; Services - Year 2020 (firms with at least 10 persons employed; %)
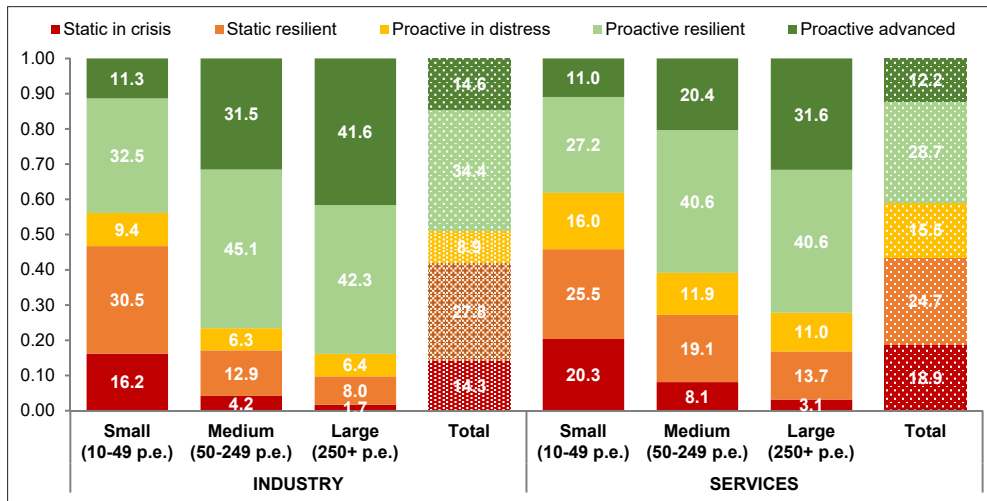

Source: Authors' calculation on Istat data

An equally important feature of the COVID-19 crisis is a noticeable difference in the impact on the firm size classes. The two "COVID surveys" carried out by Istat in May and November 2020 (Istat, 2020c) pointed out that in all macro-sectors the share of firms whose turnover sharply declined, as well as that of firms facing operational risk, decreases as the firms size increases: at the end of 2020 on average 26.8% of small firms (10-49 persons employed) deemed their operations to be at serious risk; the same share was between 10 and 15% among medium and large units (at least 50 persons employed), and dropped to 8% among large industrial firms (250+ p.e.).

Remarkable differences also characterise the firms' (declared) ability to react (Figure 4.3). In both industry and services, six months after the pandemic outburst more than half of the small firms lacked a reaction plan or were in trouble (respectively 56.1% in industry and 61.8% in services), while among large firms this percentage was around 16% in industry and 27% in services. In other words, the business segment of largest enterprises appeared basically solid and able to react to the emergency.

Figure 4.3 - Composition of 5 classes of response to the crisis, by firm size classes -Year 2020 (firms with at least 10 persons employed; %)
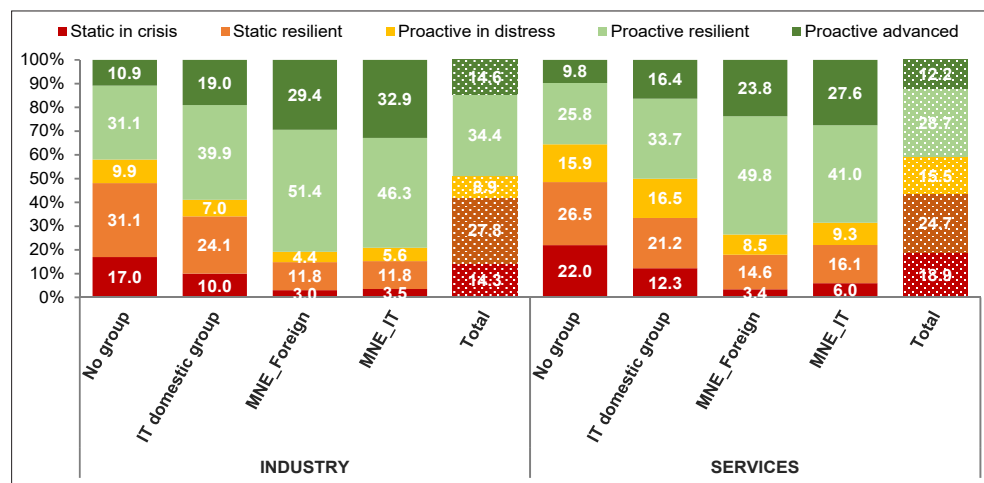

Source: Authors' calculation on Istat data

The corporate governance also plays a role (Figure 4.4): with regards to the belonging to a business group, 69% of industrial companies operating

in an Italian domestic group and over half of those of services belonging to the same type of group are included in the classes of "Proactive resilient" or "Proactive advanced", with percentages that reach or exceed 80% in the case of industrial companies belonging to foreign or Italian multinational groups (the corresponding shares for service companies are around 70%). In other words, corporate linkages, in particular the international ones, were at the same time an element of protection against the most negative consequences of the crisis and a factor of greater reactivity to it, also thanks to the possibilities of managing intra-group commercial and financial flows.

Figure 4.4 - Composition of 5 classes of response to the crisis, by type of business group - Year 2020 (firms with at least 10 persons employed; %)

Source: Authors' calculation on Istat data

5. Firm dynamism and response to the COVID-19 crisis

Beside the structural aspects, also the organisational-strategic factors played a role in determining how the Italian business system went through the first phase of the crisis.

As mentioned before, the adoption of "advanced" strategies allowed companies to overcome some structural limits, starting with the dimensional ones. With reference to the capacity to react to the current emergency, having taken dynamic paths before the crisis seems to have contributed to shelter Italian

firms (Figure 5.1): the "Proactive resilient" and the "Proactive advanced" represent 80% of the highly dynamic units, almost two thirds of those with medium-high dynamism and over 60% of those with medium dynamism. At the same time, a persistence of the condition of "static" concerns 66% of low-dynamism firms and 55% of low-medium dynamism ones.

Figure 5.1 - Composition of 5 classes of response to the crisis, by type of business group - Year 2020 (firms with at least 10 persons employed; %)
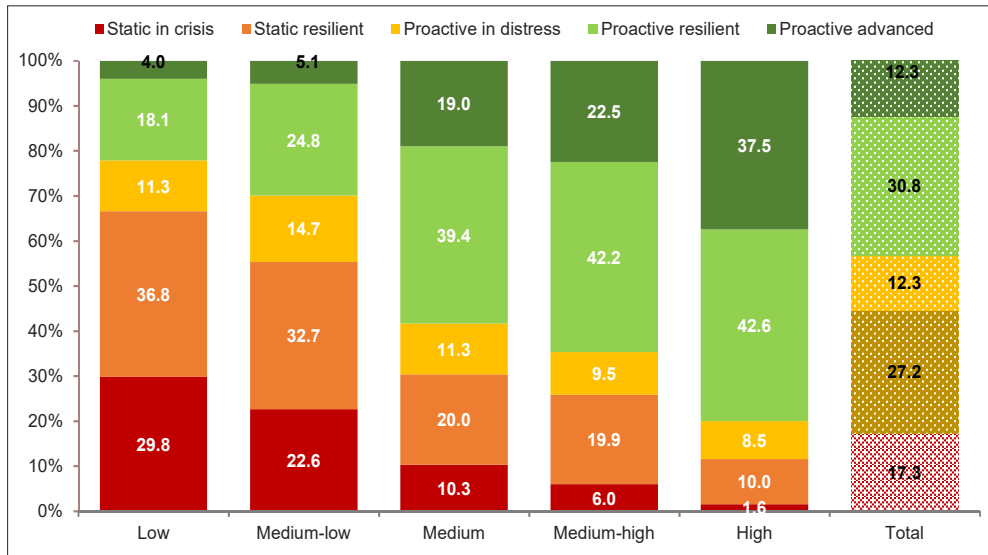

Source: Authors' calculation on Istat data

However, this may indicate an evolution of the general economic context which may prove to be relevant for the medium- and long-term growth prospects of the Italian business system: to the extent that already dynamic companies are also those able to better seize the opportunities for recovery, a polarisation of development paths between firms (and sectors) could emerge, with significant consequences for industrial and employment policy.

To further investigate these aspects, it is possible to estimate the role played by the firm dynamism to the probability of belonging to one of the five profiles of response to crisis described above.

In this regard, since the belonging of each firm to the different profiles is expressed through a qualitative variable that has a finite number of modalities

without an evident ordering (nominal polytomous variable), we estimate a multinomial logit model[12], which in our case takes the following specification[13]:

$$\text{Prob}\left(Y_{i,2020} = j \mid \boldsymbol{X}_{i,2016-18}, \boldsymbol{D}_{i,2018}\right) = \frac{\exp\left(\alpha_{ij} + \boldsymbol{X}_{i,2016-18}\boldsymbol{\beta}_{ij} + \boldsymbol{D}_{i,2018}\boldsymbol{\gamma}_{ij}\right)}{1 + \sum_{m=2}^{J} \exp\left(\alpha_{im} + \boldsymbol{X}_{i,2016-18}\boldsymbol{\beta}_{im} + \boldsymbol{D}_{i,2018}\boldsymbol{\gamma}_{im}\right)} \,,$$

where:

- is a categorical variable related to firm i's profile of response to the crisis in 2020, taking value 1 for "Static in crisis", 2 for "Static resilient", 3 for "Proactive in distress", 4 for "Proactive resilient", 5 for "Proactive advanced";

- is a vector of dummy variables which refer to firm i's class of dynamism in 2016-2018, taking value 1 (0) depending on whether the firm has (does not have) a low, medium-low, medium, medium-high, high degree of dynamism or not;

- is a vector of dummy variables which refer to firm i's characteristics in 2018. In particular, the variables take value 1 (0) when firm i has (does not have) the following characteristics:

  - it has a high labour productivity level (*i.e.* its level of value added per person employed is higher than the median of its sector and size-class combination;

  - it has high labour costs (proxy for a high level of human capital);

  - it belongs to a group (distinguishing between domestic group, Italian multinational group or Foreign multinational group);

  - it is an exporter;

  - it belongs to a specific class of employees (10-49, 50-249, 250 and more);

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12 This type of models allows to estimate the effect of a vector of explanatory variables of interest (x) on the probability of observing each outcome, , j = 2, …, J. Since the sum of the probabilities is unitary, it follows that is known once the probabilities for the remaining modes (j = 2,…,J - 1) are known. Letting j = 1 be the reference category, the probability of j=i is therefore given by , where is a vector of explanatory variables and βm is the vector of parameters for the type m (m = 2,..., J).

13 In our exercise, the choice of the multinomial model is supported by empirical evidence for the hypothesis of parallel regressions (Independence from Irrelevant Alternatives, IIA). IIA is verified by data. Furthermore, the Wald test allows us to reject the null hypothesis of joint non-significance of the parameters associated with each explanatory variable. Finally, the test on combinations of modes of the dependent variable rejects the null hypothesis about the existence of pairs of categories that are not significantly different from the explanatory variables of the model.

- it belongs to a specific sector (NACE Rev.2 - 2-digit);

- it belongs to a specific area (North-West, North-East, Centre, South and Islands).

5.1. The results

The contribution of each class of dynamism to the probability of having implemented a given type of response to the COVID-19 crisis, represented by the marginal effects of the respective dummies and expressed as a differential with respect to a condition of low dynamism is reported in Table 5.1 (Industry) and Table 5.2 (Services).

With regard to the industrial sector, in line with the aforementioned descriptive evidence it emerges how previous investments in innovation, technology, digitalisation and staff training (especially in ICT field), or having modernised firm organisation and production processes increase the probability of successfully reacting to the crisis: as the degree of dynamism increases, the probability of belonging to the "static" classes decreases (with respect to the low dynamism firms, the gap of the medium-high and high dynamism firms reaches about 25 percentage points of difference in correspondence of "Static resilient"). Symmetrically, the same investments increase the probability of belonging to the "proactive" business classes, especially "Proactive resilient" and "Proactive advanced". The effect is more visible from a degree of dynamism at least "medium", consistently with the results obtained in other analyses (Istat, 2020b). The impression of a gap in growth paths is also confirmed: for firms that were more dynamic in the pre-crisis period, the probability of reacting to the emergency by adopting a wide range of strategies is over 20 percentage points higher than that of the units that were already in a condition of low dynamism.

Moreover, the role of productivity (value added per employee) in favouring firms' response to the recession stands out. In particular, having reached, in the three-year period 2016-2018, levels of productivity higher than the median of firms in the same sector and with similar size increases the probability of belonging to clusters that managed to design countermeasures to the emergency. At the same time, it helps reduce the probability of belonging to

static classes. This is a relevant point, as it does not imply that the company has not suffered the recessive effects of lockdown closures (as we have mentioned, many of the Proactives have been affected to a large extent), but a previous high productivity ensures that the company itself is able to activate an articulated and coherent set of countermeasures, with an overall amount of investments even higher than that of the pre-crisis years, and much more solid prospects for recovery.

Table 5.1 – Strategic dynamism and response to crisis - Industry (a)

	Profiles of response to crisis									
	Static in crisis		Static resilient		Proactive in distress		Proactive resilient		Proactive advanced	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Medium-low dynamism	-0.026***	0.005	-0.112***	0.007	-0.027***	0.003	0.097***	0.006	0.014***	0.003
Medium dynamism	-0.100***	0.005	-0.266***	0.006	0.055***	0.003	0.181***	0.006	0.130***	0.004
Medium-high dynamism	-0.131***	0.006	-0.245***	0.008	0.050***	0.004	0.168***	0.007	0.158***	0.005
High dynamism	-0.188***	0.006	-0.262***	0.010	0.036***	0.007	0.160***	0.010	0.254***	0.008
High labour productivity	-0.037***	0.003	0.083***	0.004	-0.053***	0.003	0.031***	0.004	0.025***	0.003
High labour cost	-0.019***	-0.015	-0.011***	-0.005	-0.009***	-0.004	0.004	0.004	0.036***	0.002
exporter	-0.083***	0.003	-0.051***	0.003	0.013***	0.002	0.038***	0.004	0.083***	0.003
Group: domestic	-0.010**	0.004	-0.048***	0.005	-0.011***	0.003	0.041***	0.005	0.027***	0.004
Group: multinational_FOR	-0.043***	0.012	-0.107***	0.011	-0.023**	0.008	0.159***	0.013	0.015**	0.007
Group: multinational_IT	-0.057***	0.006	-0.119***	0.006	-0.010**	0.005	0.124***	0.008	0.063***	0.005
Medium size (50-249 p.e.)	-0.054***	0.005	-0.056***	0.006	-0.025***	0.003	0.068***	0.006	0.067***	0.004
Large size (250+ p.e.)	-0.065***	0.015	-0.067***	0.017	0.01	0.01	0.037**	0.016	0.085***	0.009
Sectoral controls (Nace Rev. 2 - 2 digit)	Yes									
Geographical controls (NUTS 1)					Yes					
N. observation					8,395					
Pseudo R-squared					0.115					

Source: Authors' calculation on Istat data
(a) Multinomial logit (marginal effects) for weighted sample; (robust) standard error in italics; Dep. Var: response profiles at 2020; Dynamism: 2016-2018; Other covariates: 2018; Benchmark: low dynamism; High productivity: (value added / persons employed) > median of sector*size; high labour cost: (personnel costs / persons employed) > median of sector*size. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Furthermore, the presence of a human capital higher than the sector/size median, here approximated by the cost of labour per employee, is associated with a higher probability of being included among "Proactive advanced" (with an even higher marginal effect than that of the highly productive units), while the presence on international markets, identified by the condition of exporter, is accompanied by a greater capacity to react, with a positive and significant contribution to the probability of being "Proactive" (regardless of the consequences suffered) and a negative one to the probability of being "Static".

Finally, the support of belonging to groups for firm competitiveness is also confirmed: it increases the probability of reacting and reduces that of not being able to implement countermeasures to the crisis; but above all, the amount of this contribution is growing as we move from belonging to Italian domestic groups to more complex groups, such as foreign multinationals and Italian multinationals.

As for services (Table 5.2), there emerges the role of an adequate pre-crisis dynamism in sheltering firms from the damages of COVID-19 recession: also for these activities, more severely affected by the crisis with respect to industry, having attained at least a "medium" level of dynamism in 2016-2018 is associated to a more marked ability to react (*i.e.* to a proactive status) during the pandemic years, with a gap of probability with respect to the low-dynamism units which is over 20 percentage points for the high-dynamic firms. Once again, in services, where the recession due to the administrative closures was much less selective, the effect just described is present but less pronounced, and the differential is smaller. The damages of the crisis among service sectors also seems to explain the fact that a pre-crisis high productivity increases the likelihood of being "Static resilient" rather than "Proactive".

Table 5.2 – Contributions to the probability of reacting to the crisis - Services (a)

	Profiles of response to crisis									
	Static in crisis		Static resilient		Proactive in distress		Proactive resilient		Proactive advanced	
	coeff.	std. Err.	coeff.	std. Err.	coeff.	std. Err.	coeff.	std. Err.	coeff.	std. Err.
Medium-low dynamism	-0.067***	0.003	-0.081***	0.004	0.058***	0.002	0.070***	0.003	0.020***	0.002
Medium dynamism	-0.154***	0.003	-0.193***	0.004	0.057***	0.003	0.133***	0.004	0.158***	0.003
Medium-high dynamism	-0.157***	0.004	-0.127***	0.005	0.039***	0.004	0.123***	0.005	0.122***	0.003
High dynamism	-0.214***	0.006	-0.261***	0.006	0.107***	0.008	0.152***	0.008	0.216***	0.007
High labour productivity	-0.011***	0.003	0.038***	0.003	-0.021***	0.002	-0.005	0.003	-0.002	0.002
High labour cost	-0.042***	0.003	-0.043***	0.003	0.019***	0.002	0.054***	0.003	0.011***	0.002
exporter	-0.050***	0.005	-0.046***	0.004	0.009**	0.004	0.043***	0.004	0.044***	0.003
Group: domestic	-0.046***	0.003	-0.036***	0.003	0.026***	0.003	0.024***	0.003	0.032***	0.002
Group: multinational_FOR	-0.105***	0.008	-0.058***	0.008	0.001	0.008	0.111***	0.009	0.051***	0.006
Group: multinational_IT	-0.062***	0.007	-0.060***	0.006	-0.004	0.006	0.051***	0.007	0.075***	0.005
Medium size (50-249 p.e.)	-0.059***	0.004	-0.038***	0.004	-0.003	0.037	0.065***	0.005	0.035***	0.003
Large size (250+ p.e.)	-0.105***	0.01	-0.073***	0.009	0.004***	0.01	0.059***	0.01	0.082***	0.008
Sectoral controls (Nace Rev. 2 - 2 digit)					Yes					
Geographical controls (NUTS 1)					Yes					
N. observation					11,195					
Pseudo R-squared					0.155					

Source: Authors' calculation on Istat data

(a) Multinomial logit (marginal effects) for weighted sample; (robust) standard error in italics; Dep. Var: response profiles at 2020; Dynamism: 2016-2018; Other covariates: 2018; Benchmark: low dynamism; High productivity: (value added / persons employed) > median of sector*size; high labour cost: (personnel costs / persons employed) > median of sector*size. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

6. Conclusions

In this article we analyse how firms' pre-COVID strategic orientation conditioned their ability to react to the pandemic. The integration of different microdata sources allows to grasp the complexity and multidimensionality of firm behaviour, and makes it possible to provide new interpretations to the recent dynamics of Italian business system and to assess the ability of Italian firms to react and adapt to exogenous shocks, such as that generated by the COVID-19 pandemic.

The outbreak of the pandemic in 2020 affected the business system to a very heterogeneous extent. On the one hand, it has hit some sectors more directly (in particular some tertiary activities, such as those related to tourism and hospitality), sparing others considered essential for the economic and social survival of the system (such as energy and infrastructural) or needed in order to cope with the epidemic (food or chemical-pharmaceuticals). Equally evident is the size dimension of the crisis: the sudden, violent and exogenous recession hit the smaller companies with greater severity, which had less differentiated activities and markets and fewer tools to deal with the inevitable depletion of liquidity following the administrative closure measures.

In this context, we analysed to what extent the crisis has affected the growth path that Italian firms undertook in the previous three years. More in detail, the integration between the Istat survey on the state and perspectives of Italian firms before and during the COVID-19 crisis, and the Istat Frame-Sbs business register permits to obtain two classifications of enterprises according to 1) their strategic profile in "ordinary times" and 2) their responses to the pandemic in the second half of 2020.

The interaction of the two taxonomies shows that the firms that, in the pre-crisis period, presented development paths oriented towards innovation, digital transformation, improvement of human capital show a greater capacity to develop articulated reaction strategies (here defined as "Proactive resilient" and "Proactive advanced"). The attainment of an "adequate" degree of dynamism in the pre-COVID period plays a role even more important than past performance (*e.g.* productivity) in increasing the probability of react in a proactive way to the crisis, confirming the competitiveness and adaptability of the highly dynamic firms. On the other hand, our twofold interpretative key

also allows to identify cases in which COVID-19 has produced an innovative stimulus effect (not just a defensive one), for some previously static segments of Italian business system.

In other terms, our evidence highlights the persistence, even during the COVID-19 crisis, of evident propensity for change and growth by the business segments which were more dynamic in the pre-crisis phase. The risk factors, although existing (and sometimes remarkable), do not seem to have substantially altered the forces driving such firms. On a more general level, this points out that in a global context that is increasingly characterised by exogenous shocks of great impact and difficult to predict, the possibility of relying on a previous, solid development paths oriented towards innovation, digital transformation, improvement of human capital ensures a greater capacity to develop articulated (and mostly effective) reaction strategies.

Finally, from a more structural point of view, our analysis shows that a) business size plays an important role in determining a high degree of resilience to shocks and a firm's readiness to undertake proactive strategies; b) the firm's operations in a highly relational context, measured by belonging to groups of companies, increases the probability of reacting and reduces the risk of not being able to implement countermeasures to the crisis.

In conclusion, the relationship between firms' capabilities and the severity of the crisis may produce new challenges, such as a divergence in the development paths of different segments of the business system. The further gap between the more competitive and dynamic companies and the less reactive ones prefigures, on the one hand, positive expectations on their ability to intercept the recovery both on the domestic and foreign markets, and, on the other hand, the need to adopt, selectively, interventions conditioned by temporary support to situations of greater risk.

Methodological appendix

The objective is represented by the study of the relationships existing between the variables, or in deriving behavioural models that allow a general representativeness of the phenomenon examined. Methodologically, the methodology consists of a so-called "Tandem Approach", a sequential approach of data analysis techniques that carry out sorting and classification, both of which are multidimensional. The former correspond to factorial models and methods that allow information to be read according to new points of view, the latter to automatic (unsupervised) classification methods that reconstruct optimal types or groups according to a chosen objective function.

The first step was the study of relationships through an analysis of multiple correspondences, a multivariate statistical analysis technique of an exploratory nature aimed at analysing the existence of association patterns between qualitative variables, through the identification of an "optimal" space, small size, synthesis of the structural information contained in the original data. In particular, this technique is applied whenever one is interested in extracting useful information from the data, in terms of similarity between the elements belonging to each of the two sets of rows and columns. This similarity is observed through the factorial representation of the configuration or shape of the point clouds associated with these sets. The pattern is made up of the set of distances reproduced on a factorial plane and provides, at the same time, a synthetic and global vision of the relationships between the points (aimed at understanding the structural relationships present in the phenomenon) and an analytical reading on the particular aspects of these relationships (aimed at describing each structural relationship).

The analysis of the complex phenomenon therefore takes place in producing dimensions (factors) through which to simplify, synthesize and represent the phenomenon. The more the latter must be redefined or expressed through new global (no longer elementary) and undetectable (*i.e.* not directly detectable) measures, the more the results will be satisfactory and useful both as final processing and as a basis for further treatments. In fact, the "tandem approach" takes the form of the use of dimensional scaling carried out by the factor analysis (low-dimensional solution) to identify a significant allocation of observations in similar groups, not with respect to the starting variables,

but rather to the transformed data, with significant advantages in terms of computational and data understanding.

There is a strong commonality in the data used in this paper: the first factor alone explains 77% of the linear variability of the complex phenomenon; the second factor, which explains just over 5% of the trace of the eigenvalue matrix, could already be excluded on the basis of the very strong variance drop. However, the second factor was equally considered because it is a second degree function of the first factor, thus incorporating non-linear effects[14].

The second step consists of a clustering strategy represented by: 1. identification of the data matrix and standardisation of the variables; 2. choice of classification criteria to be applied to the data (agglomerative/splitting) 3. evaluation of the result obtained, consolidation of the partitions and interpretation of the taxonomy obtained. On point 1 we have already said in the previous lines. Point 2 was preceded by an exploratory phase, carried out by means of a series of k-means, with a number of groups ranging from 9 to 2, each of which optimised with a series of random starts (in the ratio of 100). The optimal partition was made up of 5 groups, which were preliminarily evaluated to study the existence of data partitions of the aforementioned elements in specific multidimensional "equivalence classes". In order to limit the effects of the preliminary choices and the constraints that both hierarchical and non-hierarchical procedures impose on the result of an automatic classification, a "mixed" classification technique was opted, carried out by: a) production of a fine classification with a large number of provisional classes (unit / nucleus ratio 1: 100), obtained by means of a non-hierarchical algorithm (k-means - Euclidean distance); b) definition of the final taxonomy by applying a hierarchical method (ward distance) by conveniently evaluating the optimal jump (criterion of the minimum jump) in order to obtain the minimum number of groups with maximum internal homogeneity; the examination of the dendrogram allows in fact to know the similarity between the nuclei of the fine classification, obtained in the previous phase; c) consolidation of the final taxonomy.

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14 The cloud of points highlights a paraboloid shape corresponding to the so-called "Guttman effect", a structure in the data matrix with the appearance of the typical diagonal, which reveals the arrangement of the row and column elements along a single continuum. This form reveals the existence of a relationship between the variables and of a first dominant factor, as well as of successive axes, which are its higher order functions (the second factor is a second-degree function, the third of the 3rd degree *etc.*).

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