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

Stefano Costa[1], Stefano De Santis[1], Roberto Monducci[2]

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.

Keywords: Firm strategies, COVID-19 crisis, factorial analysis, cluster analysis.

JEL classification: C38, D22, L11, L25.

1   Italian National Institute of Statistics - Istat (scosta@istat.it; sdesantis@istat.it).
2   Institute of Economics, Sant'Anna, School of Advanced Studies - Pisa, Italy (rmonducci@gmail.com).

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.

---

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].

---

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.

---

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

---

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].

---

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"

---

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

---

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)
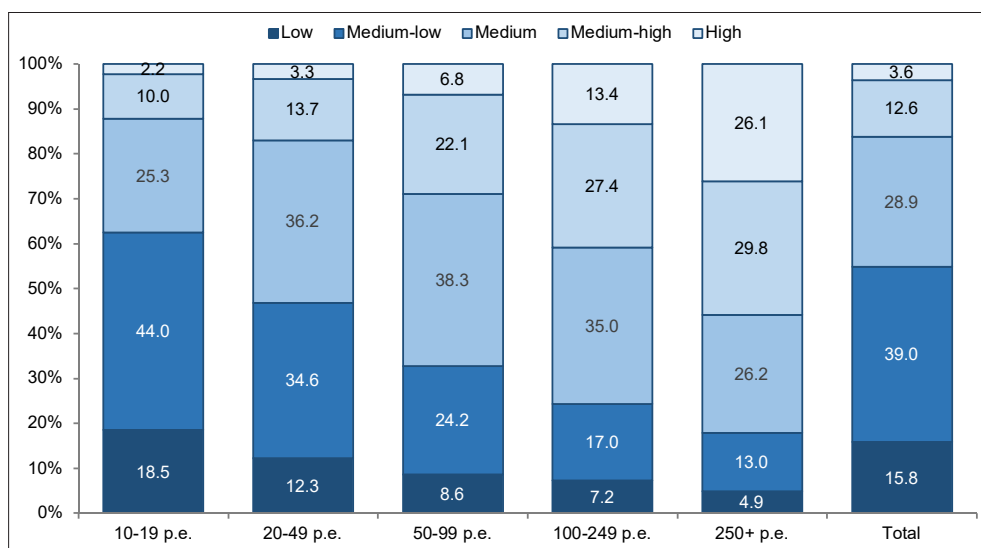

Source: Authors' calculation on Istat data

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; €)
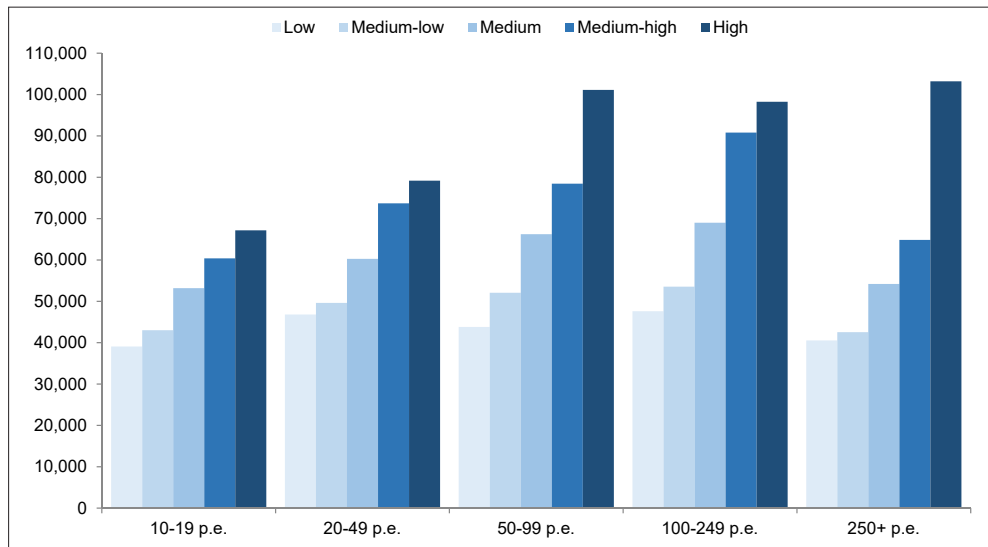

Source: Istat, 2021

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; %)
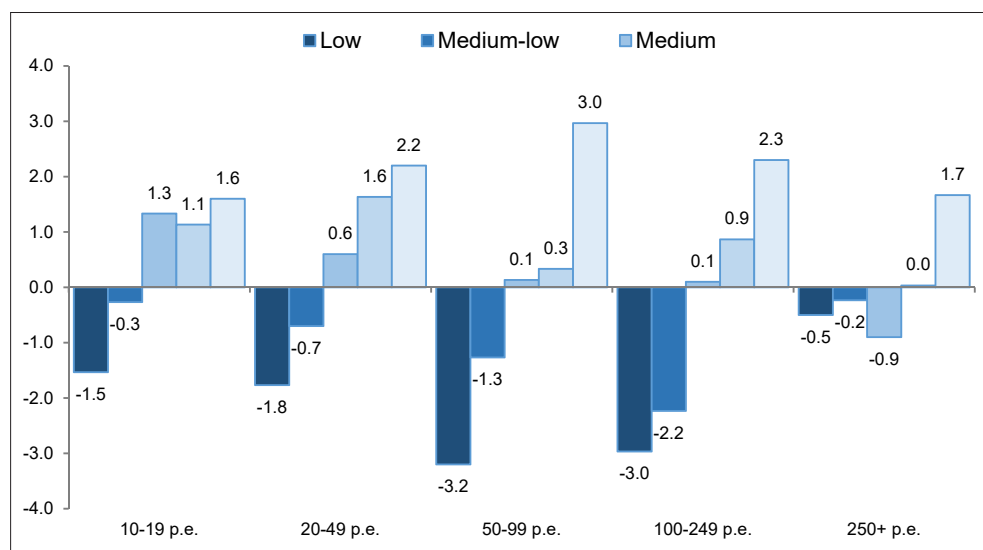
Source: Authors' calculation on Istat data

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.

---

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; %)
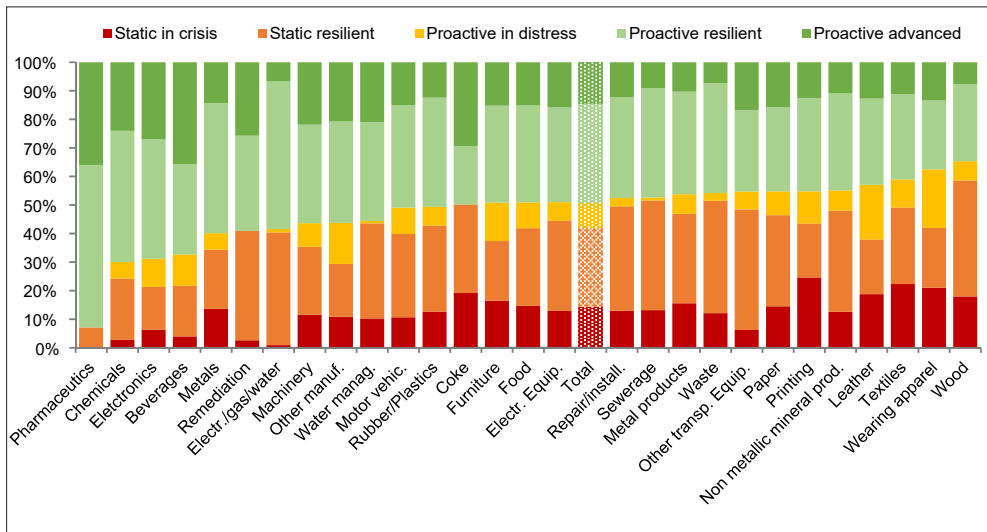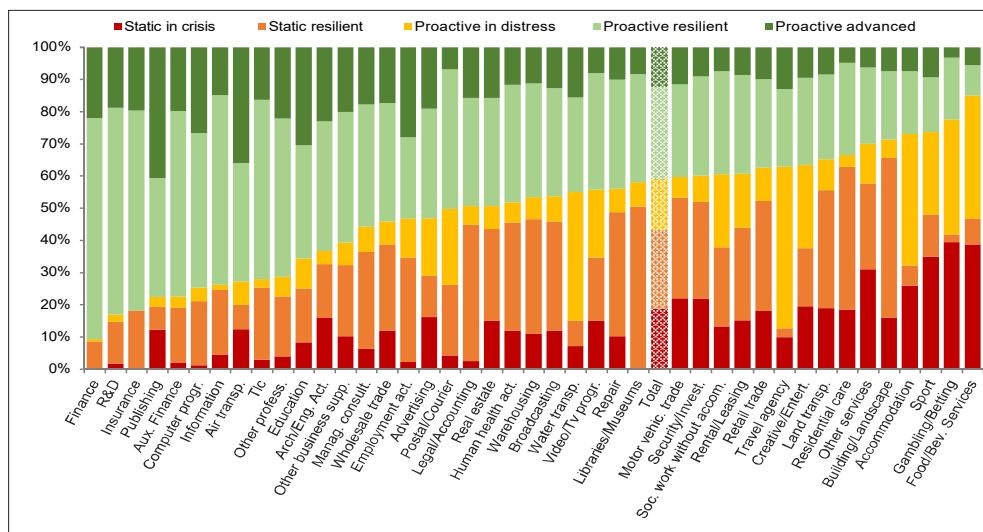

Source: Authors' calculation on Istat data.

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; %)
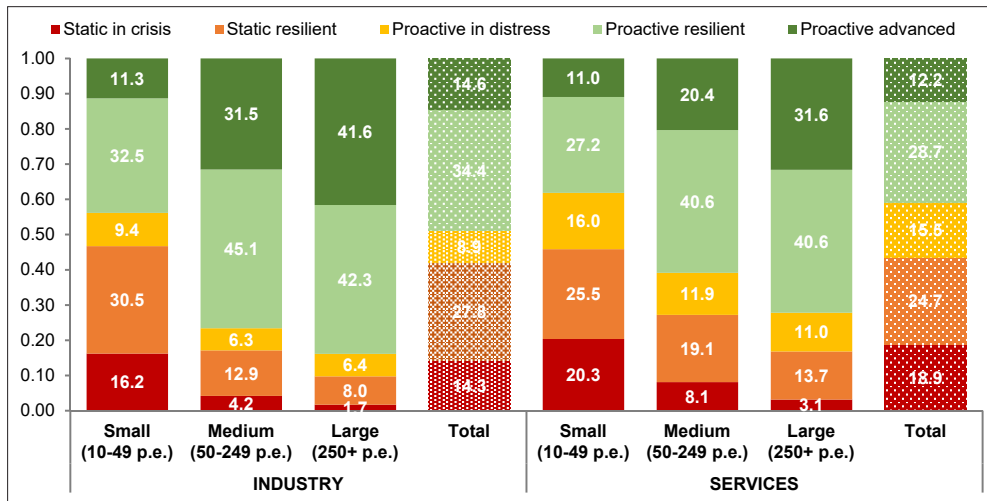

Source: Authors' calculation on Istat data

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; %)
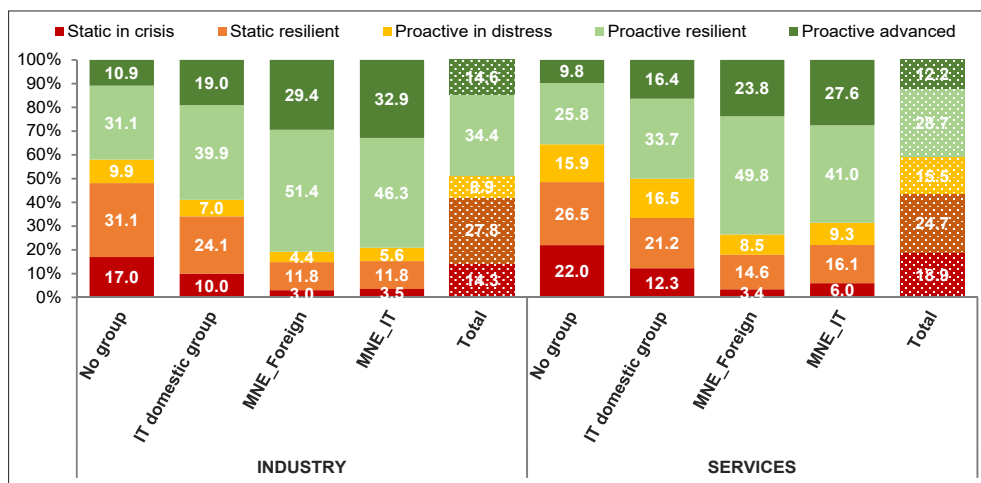

Source: Authors' calculation on Istat data

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; %)
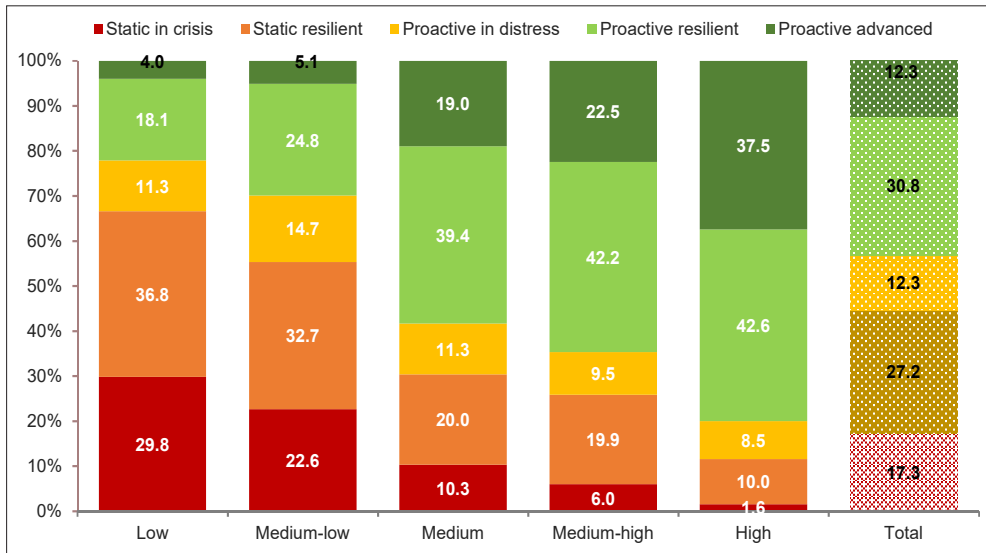

Source: Authors' calculation on Istat data

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]:

$$\text{Prob}\left(Y_{i,2020} = j \mid X_{i,2016-18}, D_{i,2018}\right) = \frac{\exp\left(\alpha_{ij} + X_{i,2016-18}\beta_{ij} + D_{i,2018}\gamma_{ij}\right)}{1 + \sum_{m=2}^{J} \exp\left(\alpha_{im} + X_{i,2016-18}\beta_{im} + D_{i,2018}\gamma_{im}\right)},$$

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);

---

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.

---

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.*).

References

Andrews, D., C. Criscuolo, and P.N. Gal. 2016. "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy". *OECD Productivity Working Papers N. 5*. Paris, France: OECD Publishing.

Bartik, A.W., M. Bertrand, Z. Cullen, E.L. Glaeser, M. Luca, and C. Stanton. 2020. "The impact of COVID-19 on small business outcomes and expectations". *Proceedings of the National Academy of Sciences*, Volume 117, Issue 30: 17656-17666.

Bartoloni, E., A. Arrighetti, and F. Landini. 2021. "Recession and firm survival: is selection based on cleansing or skill accumulation?". *Small Business Economics*, Volume 57, N. 4:1893-1914.

Borino, F., E. Carlson, V. Rollo, and O. Solleder. 2021. "International firms and Covid-19: evidence from a global survey". *COVID Economics, Vetted and Real-Time Papers*, Issue 75: 30-45. London, UK: Centre for Economic Policy Research - CEPR Press.

Bugamelli, M., L. Cannari, F. Lotti, and S. Magri. 2012. "The Innovation Gap of Italy's Production System: Roots and Possible Solutions". *Bank of Italy Occasional Papers*, N. 121.

Bugamelli, M., S. Fabiani, S. Federico, A. Felettigh, C. Giordano, and A. Linarello. 2018. "Back on track? A macro–micro narrative of Italian exports". *Italian Economic Journal*, Volume 4, Issue 1: 1-31.

Corrado, C., C. Criscuolo, J. Haskel, A. Himbert, and C. Jona-Lasinio. 2021. "New evidence on intangibles, diffusion and productivity". *OECD Science, Technology and Industry Working Papers*, N. 2021/10. Paris, France: OECD Publishing.

Costa, S., S. De Santis, G. Dosi, R. Monducci, A. Sbardella, and M.E. Virgillito. 2022. "Firm responses to the COVID-19 crisis: sticky capabilities and widespread restructuring". In this issue of the *Rivista di statistica ufficiale/ Review of official statistics*, N. 1/2022. Roma, Italy: Istat.

Costa, S., S. De Santis, G. Dosi, R. Monducci, A. Sbardella, and M.E. Virgillito. 2021. "From organizational capabilities to corporate performances:

at the roots of productivity slowdown". *LEM Paper Series*, N. 2021/21. Pisa, Italy: Laboratory of Economics and Management - LEM, Sant'Anna School of Advanced Studies.

Costa, S., C. Pappalardo, and C. Vicarelli. 2017. "Internationalization choices and Italian firm performance during the crisis". *Small Business Economics*, Volume 48, N. 3: 753-769.

Decker, R.A., J. Haltiwanger, R.S. Jarmin, and J. Miranda. 2020. "Changing Business Dynamism and Productivity: Shocks versus Responsiveness". *American Economic Review*, Volume 110, N. 12: 3952-3990.

Dosi, G., M. Grazzi, C. Tomasi, and A. Zeli. 2012. "Turbulence underneath the Big Calm? The Micro-Evidence behind Italian Productivity *Dynamics"*. *Small Business Economics*, Volume 39, N. 4: 1043-1067.

Dosi, G., D. Guarascio, A. Ricci, and M. E. Virgillito. 2021. "Neodualism in the Italian business firms: training, organizational capabilities, and productivity distributions". *Small Business Economics*, Volume 57, N. 1: 167-189.

Easterby-Smith, M., M.A. Lyles, and M.A. Peteraf. 2009. "Dynamic Capabilities: Current Debates and Future Directions". *British Journal of Management*, Volume 20, Issue S1: S1-S8.

Foster, L., C. Grim, and J.C. Haltiwanger. 2016. "Reallocation in the Great Recession: Cleansing or Not?". *Journal of Labor Economics*, Volume 34, N. S1, Part 2: 293-331.

Giglioli, S., G. Giovannetti, E. Marvasi, and A. Vivoli. 2021. "The Resilience of Global Value Chains during the Covid-19 pandemic: the case of Italy". *Working Papers – Economics*, N. 7/2021. Firenze, Italy: Università degli Studi di Firenze, Dipartimento di Scienze per l'Economia e l'Impresa - DISEI.

Istituto Nazionale di Statistica – Istat. 2022. "Situazione e prospettive delle imprese dopo l'emergenza sanitaria COVID-19". *Statistiche Report*. Roma, Italy: Istat. https://www.istat.it/it/archivio/266078.

Istituto Nazionale di Statistica – Istat. 2021. "Rapporto sulla competitività dei settori produttivi. Edizione 2021". *Letture Statistiche – Temi*. Roma, Italy: Istat. https://www.istat.it/it/archivio/255558.

Istituto Nazionale di Statistica – Istat. 2020a. "Censimento permanente delle imprese 2019: i primi risultati". *Censimenti Permanenti – Imprese*. Roma, Italy: Istat.

https://www.istat.it/it/archivio/238337.

Istituto Nazionale di Statistica – Istat. 2020b. "Rapporto sulla competitività dei settori produttivi. Edizione 2020". Letture Statistiche – Temi. Roma, Italy: Istat. https://www.istat.it/it/archivio/240112.

Istituto Nazionale di Statistica – Istat. 2020c. "Individuazione delle priorità di utilizzo del Recovery Fund. Elementi conoscitivi a supporto di politiche rivolte a settori e imprese". *Audizione presso la Camera dei Deputati*, V Commissione "Bilancio, tesoro e programmazione". Roma, Italy: Istat. https://www.istat.it/it/archivio/246875.

Istituto Nazionale di Statistica – Istat. 2020d. "Situazione e prospettive delle imprese nell'emergenza sanitaria COVID-19". *Statistiche Report*. Roma, Italy: Istat. https://www.istat.it/it/archivio/251618.

Luzi, O., and R. Monducci. 2016. "The new statistical register "Frame SBS": overview and perspectives". *Rivista di Statistica Ufficiale/Review of official statistics*, N. 1/2016: 5-14. Roma, Italy: Istat. https://www.istat.it/it/archivio/192775.

Monducci, R. 2021a. "Effetti del COVID-19 e strategie di reazione delle imprese esportatrici". *Quaderni tematici del Rapporto ICE 2020-2021*. Roma, Italy: ICE.

Monducci, R. 2021b. "Le imprese a controllo estero nella pandemia: rischi e strategie di reazione". Presentazione al Convegno Luiss-Confindustria, *Le imprese estere in Italia al tempo del Covid: spunti di resilienza*, Roma 5 maggio 2021.

Monducci, R., and S. Costa. 2016. "A multidimensional approach for the measurement of competitiveness and economic resilience: the design, production and exploitation of integrated micro level data". *Rivista di statistica ufficiale/Review of official statistics*, N. 2/2016: 5-32. Roma, Italy: Istat. https://www.istat.it/it/archivio/221024.

Organisation for Economic Co-operation and Development - OECD. 2021. *Strengthening economic resilience following the COVID-19 crisis. A firm and industry perspective*. Paris, France: OECD Publishing.

Organisation for Economic Co-operation and Development - OECD. 2020. "Coronavirus (COVID-19): SME policy responses". *OECD Policy Responses to Coronavirus (COVID-19)*. Paris, France: OECD Publishing.

Romano, L. 2019. "Explaining growth differences across firms: The interplay between innovation and management practices". *Structural Change and Economic Dynamics*, Volume 49, Issue C: 130-145.

Teece, D.J. 2007. "Explicating dynamic capabilities: the nature and micro-foundations of sustainable enterprise performance". *Strategic Management Journal*, Volume 28, Issue 13: 1319-1350.

Teece, D.J., G. Pisano, and A. Shuen. 1997. "Dynamic capabilities and strategic management". *Strategic Management Journal*, Volume 18, N. 7: 509-533.

United Nations Industrial Development Organization - UNIDO. 2021. *Industrial Development Report 2022. The Future of Industrialization in a Post-Pandemic World*. Vienna, Austria: UNIDO.

Wagner, J. 2012. "International trade and firm performance: a survey of empirical studies since 2006". *Review of World Economics*, Volume 148, Issue 2: 235-267.

Wagner, J. 2007. "Exports and Productivity: A Survey of the Evidence from Firm-level Data". *The World Economy*, Volume 30, Issue 1: 60-82.

Wang, C.L., and P.K. Ahmed. 2007. "Dynamic capabilities: A review and research agenda". *International Journal of Management Reviews*, Volume 9, Issue 1: 31-51.

World Trade Organization – WTO. 2021. *World Trade Report 2021. Economic Resilience and Trade*. Geneva, Switzerland: WTO.