

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

Stefano Costa ¹, Stefano De Santis ¹, Giovanni Dosi ²,
Roberto Monducci ³, Angelica Sbardella⁴, Maria Enrica Virgillito ^{2 5}

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.

1 Italian National Institute of Statistics - Istat (scosta@istat.it; sdesantis@istat.it).

2 Institute of Economics and MbeDS, Sant'Anna, School of Advanced Studies - Pisa, Italy (gdosi@santannapisa.it).

3 Institute of Economics, Sant'Anna, School of Advanced Studies - Pisa, Italy (rmonducci@gmail.com).

4 Centro Ricerche Enrico Fermi, Roma, Italy and Institute of Economics and MbeDS, Sant'Anna, School of Advanced Studies - Pisa, Italy (angelica.sbardella@cref.it).

5 Department of Economic Policy, Università Cattolica del Sacro Cuore, Milano, Italy (mariaenrica.virgillito@santannapisa.it).

The views and opinions expressed are those of the authors and do not necessarily reflect the official policy or position of the Italian National Institute of Statistics - Istat.

The authors would like to thank the anonymous reviewers for their comments and suggestions, which enhanced the quality of this article.

1. Introduction

Italy is growing like never before!, many commentators have been recently declaring. Macroeconomic statistics initially 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 latter 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 IMCPI⁶. 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 six 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%)

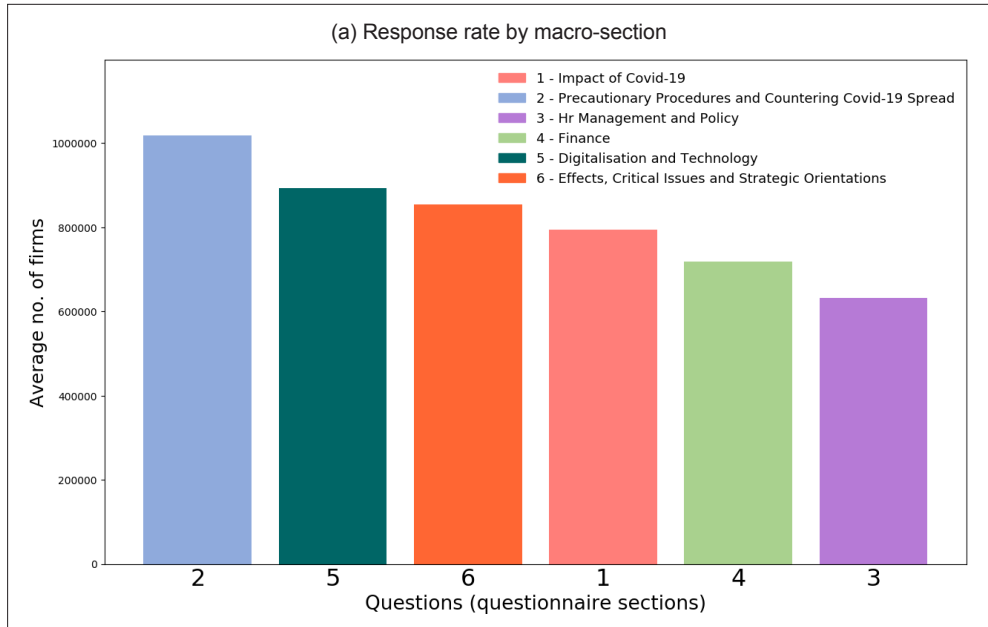
6 The two surveys share the same two-phase sample design. In particular, in the first phase sample (the IMCPI survey) the strata were defined according to the combination of the modalities of the structural variables defining the study domains. In the second phase sample (the SPIESC-19 survey), the sample 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 3.1⁷.

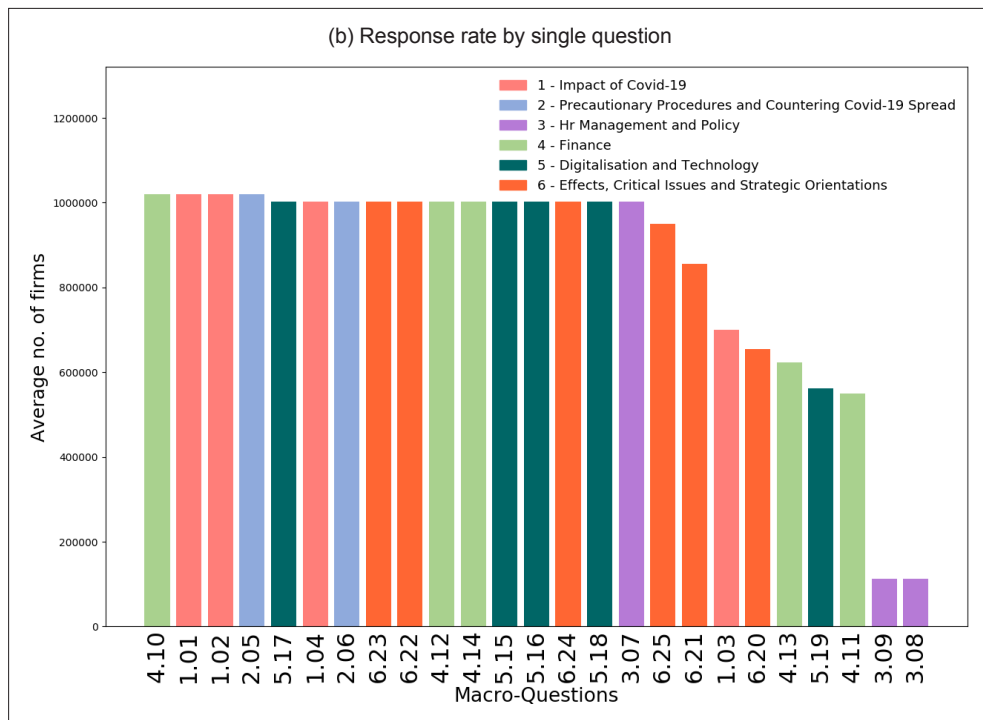
Figure 3.1a - Response rate to the SPIESC-19 questionnaire



Source: Authors' elaboration

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

Figure 3.1b - 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
<p>3.7. From June 2020 to date, what human resource management measures has the firm taken as a result of the COVID-19 emergency?</p>	<p>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</p>
<p>4.10. From June 2020 to date, what instruments has the firm used to meet the liquidity needs caused by the COVID-19 emergency?</p>	<p>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</p>
<p>6.20. What effects do you expect the COVID-19 emergency to have on the firm up until June 2021?</p>	<p>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</p>

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 4.0) 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
Cl 1 Essential	14.2	69.8	62.5
Cl 1 Managerial	25.6	75.5	64.5
Cl 3 Interdependent	36.3	73.1	64.3
Cl 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.

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.

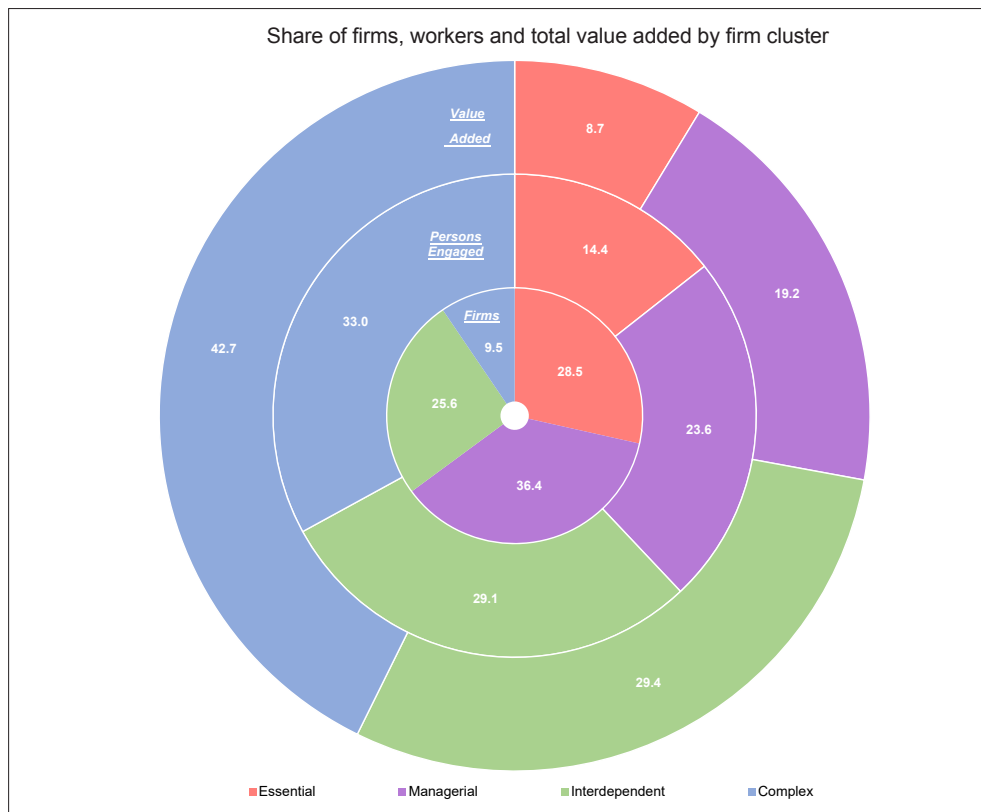
Table 4.2 - Characteristics of firm clusters (units with at least 10 employees), *Indagine Multiscopo del Censimento Permanente delle Imprese* data-set carried out by Istat in 2019

Cluster	Firm		Number of Workers		Average	Value Added		Productivity		Profitability (MoI/ Revenues)		Average salary (Cost per employee)	
	Number	%	Number	%		Total (Euros Mln.)	% Average	Cfc of (Euros) Variation	Average Cfc of (%) Variation	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 4.1a complements the picture, showing the share of firms, employees and total value added by cluster.

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

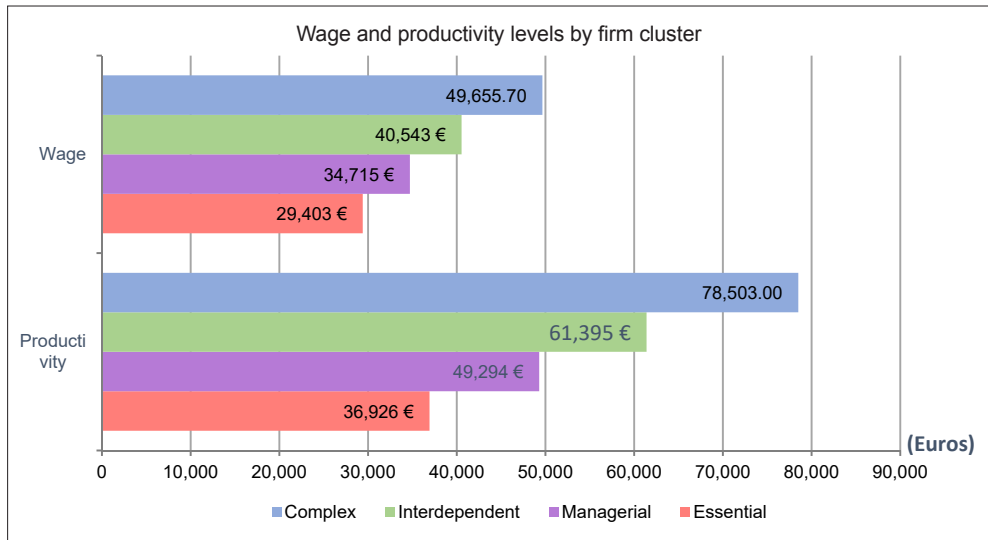


Source: Authors' elaboration

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 4.1b).

Figure 4.1b - 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.

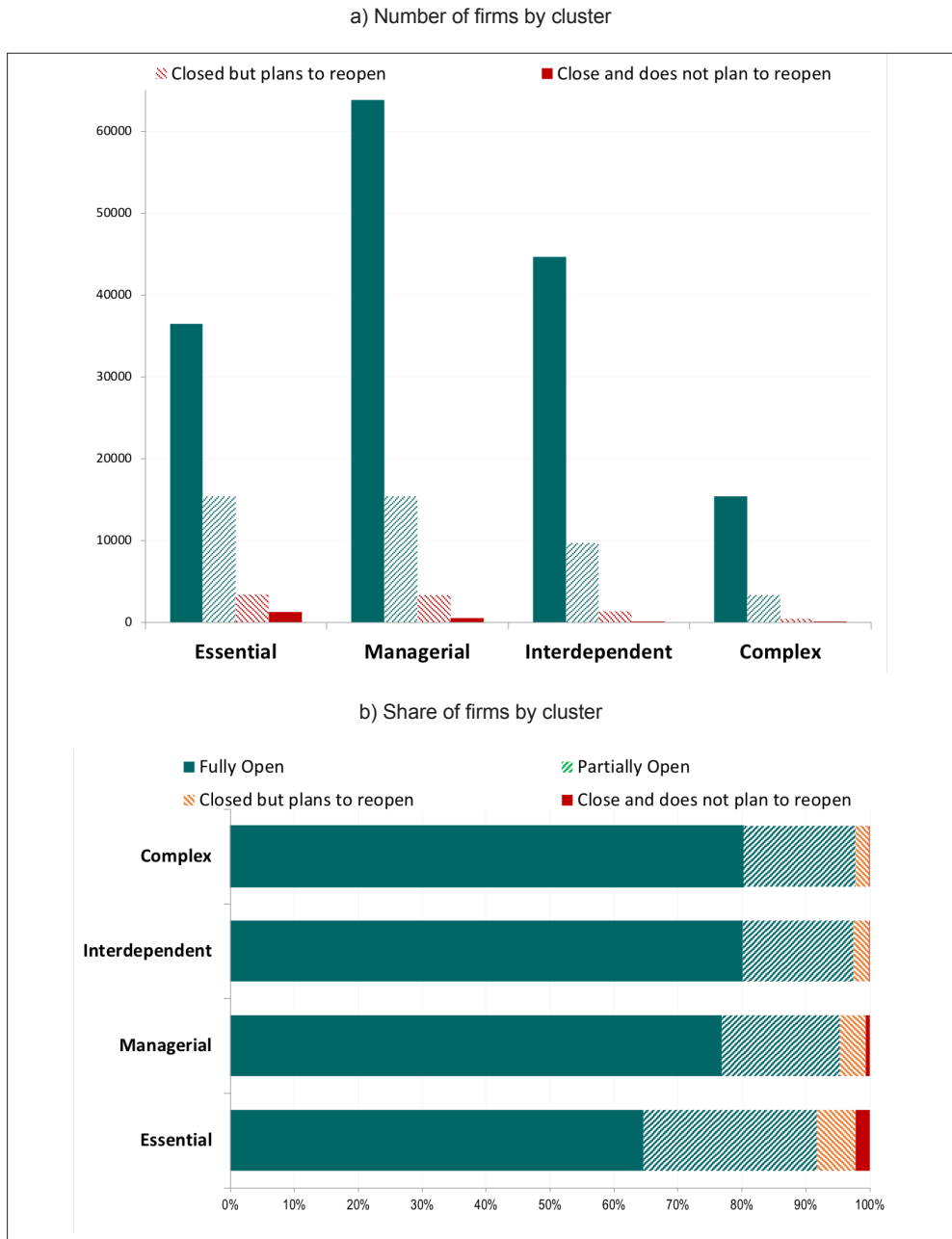
We found that the diversification of strategies increases as the organisational complexity of the clusters increases: whereby Essential firms display a fundamental lack of any systematic organisational structure and strategic plans, *i.e.* few significant characteristics in almost every macro-area of 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)



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 cluster⁹.

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 4.3a), the outbreak of the pandemic strongly disoriented such firms, who were actually unable to plan, define or even think of any countermeasure.

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

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 4.3b). 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 4.3c), 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 4.3d).

Moving now to the two upper clusters, the Interdependent firms (Figure 4.3e) 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 4.3f). 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 4.3g). 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.

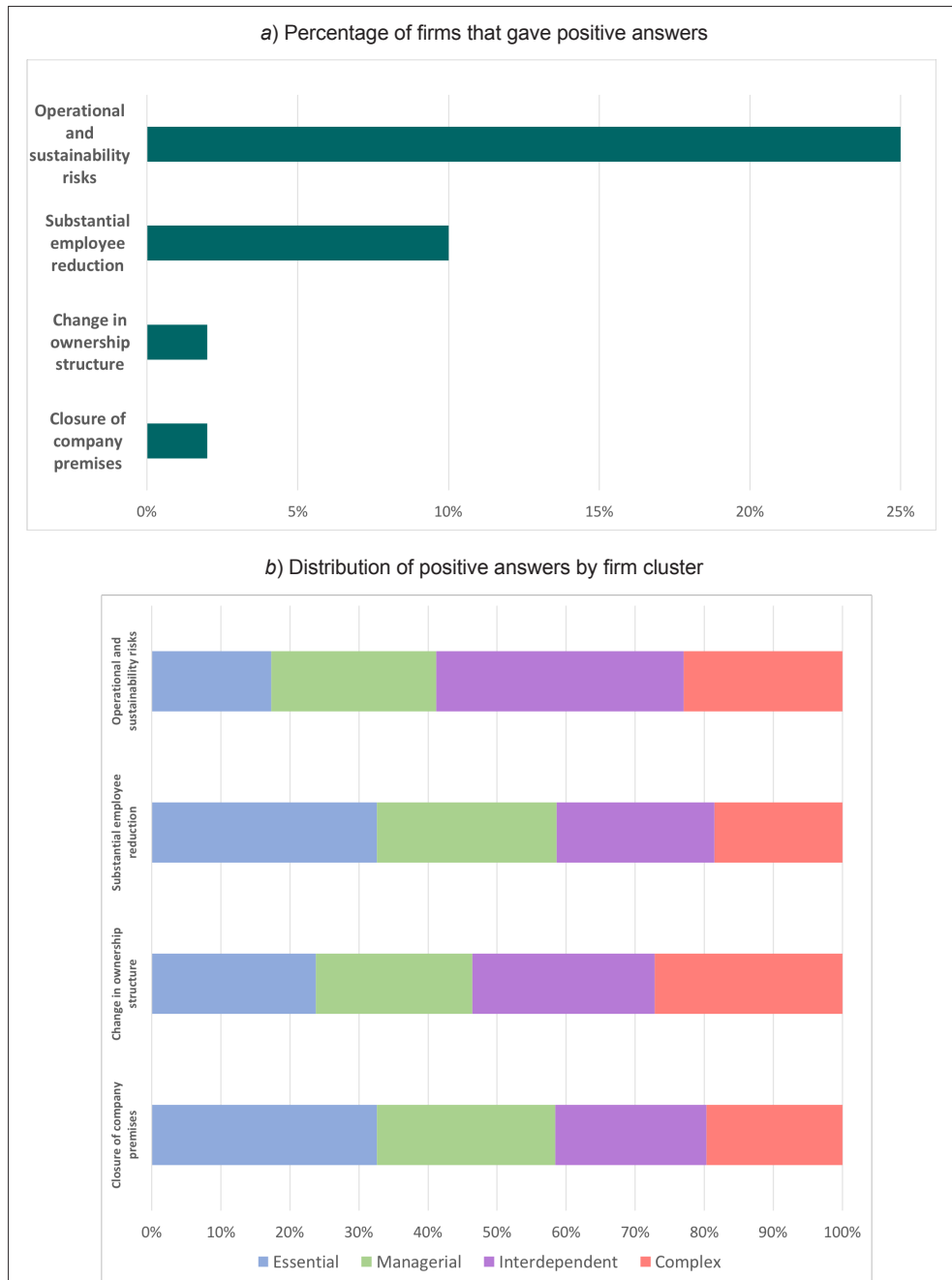
5. COVID-19 and corporate crises

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*

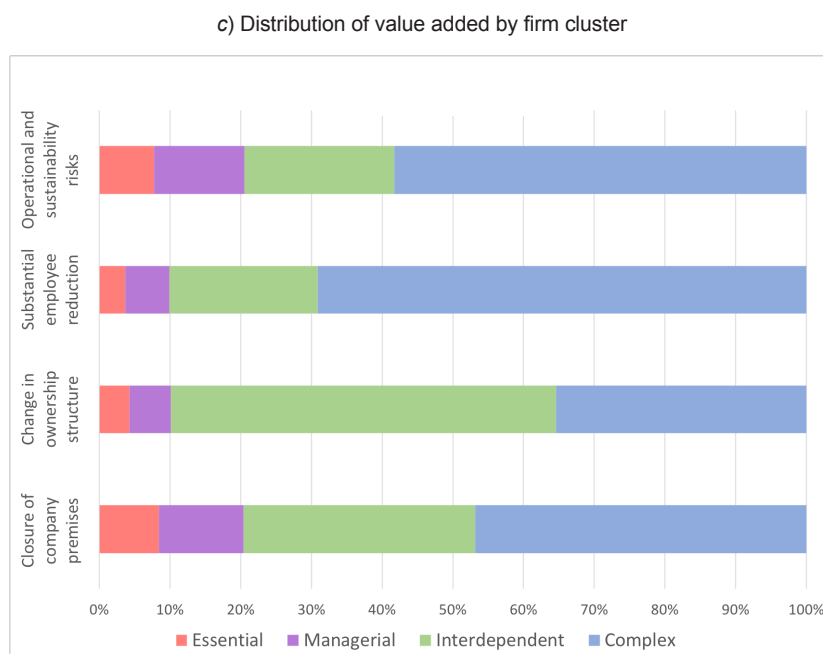
Such questions are clearly characterised by a different degree of pervasiveness and commonality across firms. In addition, they also report different degrees of riskiness about the status of the company, from more to less burdensome ones, as shown by the response rates in Figure 5.1a. Indeed, while firms 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 5.1b). 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 5.1c). 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)



Source: Authors' elaboration

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



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

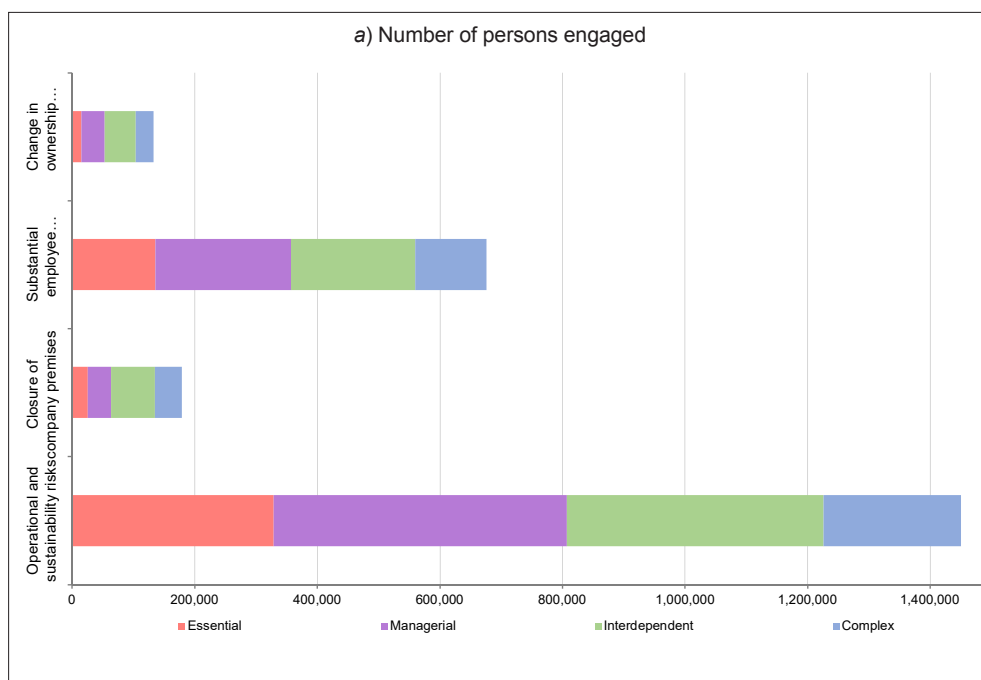
Source: Authors' elaboration

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 5.2a 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*).

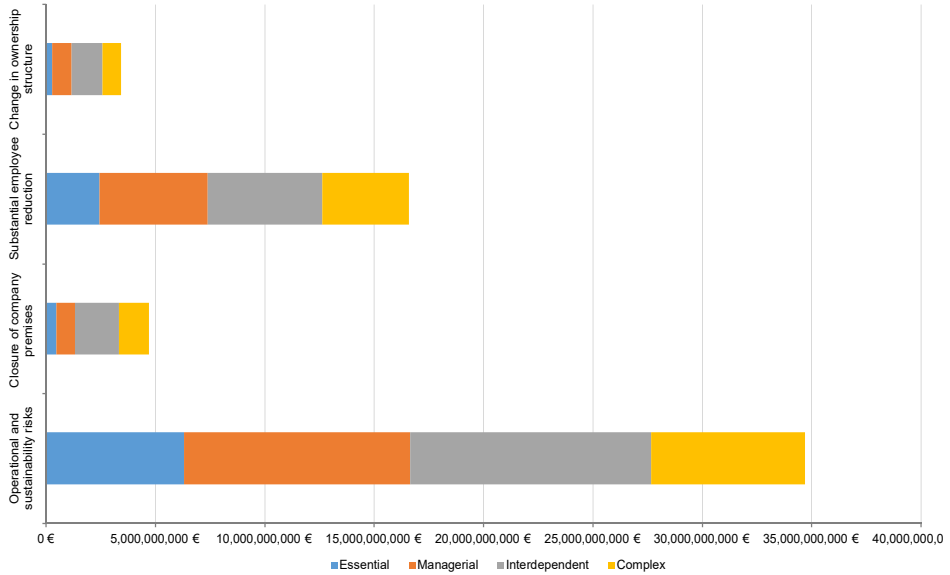
Figure 5.2 - Characteristics of the firms reporting risks of corporate crises by firm cluster (units with at least 10 employees)



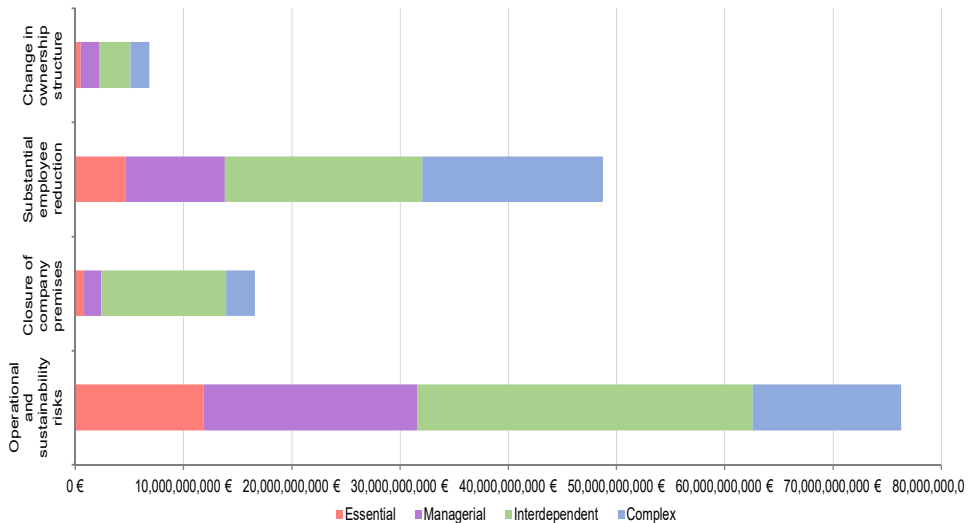
Source: Authors' elaboration

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

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 design) 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 quantitative 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.

References

Adalet McGowan, M., D. Andrews, V. Millot, and T. Beck. 2018. “The walking dead? Zombie firms and productivity performance in OECD countries”. *Economic Policy*, Volume 33, Issue 96: 685-736.

Adams-Prassl, A., T. Boneva, M. Golin, and C. Rauh. 2020. “Inequality in the impact of the coronavirus shock: Evidence from real time surveys”. *Journal of Public Economics*, Volume 189, Article 104245.

Aguiar, M., G. Dosi, D.A. Knopoff, and M.E. Virgillito. 2021. “A multiscale network-based model of contagion dynamics: heterogeneity, spatial distancing and vaccination”. *Mathematical Models and Methods in Applied Sciences*, Volume 31, N. 12: 2425-2454.

Baldwin, R., and R. Freeman. 2021. “Risks and global supply chains: What we know and what we need to know”. *NBER Working Paper Series*, N. 29444. Cambridge, MA, U.S.: National Bureau of Economic Research - NBER.

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.

Bellomo, N., R. Bingham, M.A. Chaplain, G. Dosi, G. Forni, D.A. Knopoff, J. Lowengrub, R. Twarock, and M.E. Virgillito. 2020. “A multiscale model of virus pandemic: Heterogeneous interactive entities in a globally connected world”. *Mathematical Models and Methods in Applied Sciences*, Volume 30, N. 08: 1591-1651.

Benzécri, J.P., M.O. Lebeaux, and M. Jambu. 1980. “Aides a l’interprétation en classification automatique”. *Cahiers de l’Analyse des Données*, Tome 5, N. 1: 101-123.

Bloom, N., R.S. Fletcher, and E. Yeh. 2021. “The impact of COVID-19 on US firms”. *NBER Working Paper Series*, N. 28314. Cambridge, MA, U.S.: National Bureau of Economic Research - NBER.

Buchheim, L., J. Dovern, C. Krolage, and S. Link. 2020. “Firm-Level Expectations and Behavior in Response to the COVID-19 Crisis”. *CESifo Working Paper*, N. 8304. Munich, Germany: CESifo.

Caracciolo, G., F. Cingano, V. Ercolani, G. Ferrero, F. Hassan, A. Papetti, and P. Tommasino. 2020. "COVID-19 and Economic Analysis: a Review of the Debate". *Literature Review*, Issue N. 3. Roma, Italy: Banca d'Italia.

Cerra, V., A. Fatas, and S.C. Saxena. 2021. "Fighting the scarring effects of COVID-19". *Industrial and Corporate Change*, Volume 30, Issue 2: 459-466.

Cetrulo, A., D. Guarascio, and M.E. Virgillito. 2022. "Working from home and the explosion of enduring divides: income, employment and safety risks". *Economia Politica*: 1-58.

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., S. De Santis, and R. Monducci 2022. "Reacting to the COVID-19 crisis: state, strategies and perspectives of Italian firms". In this issue of the *Rivista di statistica ufficiale*, N. 1/2022. Roma, Italy: Istat.

Delaporte, I., J. Escobar, and W. Peña. 2021. "The Distributional Consequences of Social Distancing on Poverty and Labour Income Inequality in Latin America and the Caribbean". *Journal of Population Economics*, Volume 34, N. 4: 1385-1443.

Dosi, G., and M. Egidi. 1991. "Substantive and Procedural Uncertainty: An Exploration of Economic Behaviours in Changing Environments". *Journal of Evolutionary Economics*, Volume 1, Issue 2: 145-168.

Dosi, G., L. Fanti, and M.E. Virgillito. 2020. "Unequal societies in usual times, unjust societies in pandemic ones". *Journal of Industrial and Business Economics*, Volume 47, Issue 3: 371-389.

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, organisational capabilities, and productivity distributions". *Small Business Economics*, Volume 57, Issue 1: 167-189.

Dosi, G., M. Piva, M.E. Virgillito, and M. Vivarelli. 2021. “Embodied and disembodied technological change: the sectoral patterns of job-creation and job-destruction”. *Research Policy*, Volume 50, Issue 4: 104199.

Dosi, G., M.E. Virgillito, and X. Yu. 2020. “The wage-productivity nexus in the world factory economy”. *World Development*, Volume 129, 104875.

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.

Gottlieb, C., J. Grobovs̃ek, M. Poschke, and F. Saltiel. 2021. “Working from home in developing countries”. *European Economic Review*, Volume 133, 103679.

Gower, J.C, and G.J.S. Ross G. 1969. “Minimum Spanning Trees and Single Linkage Cluster Analysis”. *Journal of the Royal Statistical Society, Series C (Applied Statistics)*, Volume 18, N. 1: 54-64.

Helfat, C.E., and S.G. Winter. 2011. “Untangling Dynamic and Operational Capabilities: Strategy for the (N)ever-Changing World”. *Strategic Management Journal*, Volume 32, Issue 11: 1243-1250.

International Monetary Fund - IMF. 2021. *World Economic Outlook. Recovery During a Pandemic. Health Concerns, Supply Disruptions and Price Pressures*. Washington, DC, U.S.: IMF.

Montenovo, L., X. Jiang, F.L. Rojas, I.M. Schmutte, K.I. Simon, B.A. Weinberg, and C. Wing. 2020. “Determinants of Disparities in COVID-19 Job Losses”. *NBER Working Paper Series*, N. 27132. Cambridge, MA, U.S.: National Bureau of Economic Research - NBER.

Morineau, A., and L. Lebart. 1986. “Specific Clustering Algorithms for Large Data Sets and Implementation in SPAD Software, in Classification as a Tool of Research”. In Gaul, W., and M. Schader (Eds.). *Classification as a tool of research: proceedings of the 9th Annual Meeting of the Classification Society (F.R.G.)*: 321-329. University of Karlsruhe, F.R.G., 26-28 June 1985.

Sharma, D., J.-P. Bouchaud, S. Gualdi, M. Tarzia, and F. Zamponi. 2021.

“V-, U-, L- or W-shaped economic recovery after COVID-19: Insights from an Agent Based Model”. *PloS ONE* (Published by Public Library of Science), Volume 16, N. 3, e0247823.

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

Winter, S.G. 2000. “The Satisficing Principle in Capability Learning”. *Strategic Management Journal*, Volume 21, N. 10/11 (Special Issue: “The Evolution of Firm Capabilities”): 981-996.

Zamarro, G., and M.J. Prados. 2021. “Gender differences in couples’ division of childcare, work and mental health during COVID-19”. *Review of Economics of the Household*, Volume 19, Issue 1: 11-40.

Zoller-Rydzek, B., and F. Keller. 2020. “COVID-19: guaranteed Loans and Zombie Firms”. *CESifo Economic Studies*, Volume 66, Issue 4: 322-364.

