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Organizational adaptiveness during COVID-19: The role of absorptive capacity and management practices

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The role of absorptive capacity and management practices

Groenewegen, J.T., Hardeman, S. & Stam, E.

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Abstract
COVID-19 forced many businesses to rapidly adapt to new circumstances. While firms could not foresee this shock, some were better able to adapt than others. This required firms to quickly and efficiently process new information from both external and internal sources. To what extent and how are absorptive capacity and quality of management practices important in this setting? We expect a high level of absorptive capacity to enable firms to efficiently gather and process external information, whereas good management practices helps them to deal with internal information. To test these hypotheses, we run a large scale survey among companies in the Netherlands to assess their level of absorptive capacity and the quality of their management practices. We relate this to their level of adaptiveness, measured in terms of firms' pivot toward online revenue sources during COVID-19. We find that firms with greater absorptive capacity and greater quality of management practices earned a higher share of their revenues online. This suggests that absorptive capacity and management practices enable firms to adapt successfully in response to the COVID-19 shock.

Keywords: Management practices, absorptive capacity, COVID-19

JEL classification: D22, L22, M20, O32

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1. Introduction

Every so often businesses are exposed to events that cannot be fully anticipated, but for which they need to be prepared. A recent example is the COVID-19 pandemic. The pandemic presented firms with huge challenges: government-imposed lockdowns, supply chain disruptions, large changes in consumer preferences, and a sudden shift to working from home for large parts of the workforce (Sadun et al, 2020; Barrero et al, 2021; Grashuis et al, 2020; Juergensen et al, 2020). A major question is which firms are better capable of adapting to such inadvertent shocks than others. The aim of this paper is to uncover determinants of organizational adaptiveness during the COVID-19 pandemic. Organizational adaptiveness relates to necessary changes in how firms create, deliver and capture value (Teece, 2010; 2018): how do firms alter their business models in the face of rapidly changing business circumstances?

Firms can generally be viewed as information gathering and processing units, where firm outcomes are determined by their efficiency and aptitude at dealing with information (Galbraith, 1974; Tushman & Nadler, 1978). That information may come from outside sources, relating for instance to market opportunities and threats, but it could also relate to internal metrics, as captured by KPIs for example. In the case of COVID-19, gathering and processing external information could involve identifying supply chain bottlenecks during lockdowns and finding alternatives. Successful use of internal information could be monitoring employee satisfaction while working from home and improving working-from-home protocols in response. To capture firm's aptitude at gathering and processing both external and internal information, we make use of two established concepts. One, absorptive capacity, is from the strategic management literature and the other, quality of management practices, originates in the organizational economics literature. Absorptive capacity focuses on how firms absorb and learn from outside information (Cohen and Levinthal, 1990). Quality of management practices relates to collecting and processing internal information (Bloom and Van Reenen, 2007). We combine these concepts in one empirical study. This allows us to gauge their relative importance in determining organizational adaptiveness. The main research question in this paper is: to what extent and how do management practices and absorptive capacity affect organizational adaptiveness during the COVID-19 pandemic?

To answer the main research question, we collect data on firm-level characteristics and outcomes of around 1,200 firms in the manufacturing, retail and hospitality industries in the Netherlands. We measure both firms' absorptive capacity and the quality of their management practices. We measure the acquisition and exploitation side of absorptive capacity (Zahra and George, 2002), and use a methodology developed by Bloom et al. (2019) for measuring the quality of a firm's management practices. We model both as determinants of organizational adaptiveness. We proxy successful organizational adaptiveness with increases in online revenue; i.e. how much have firms digitalized their business model in response to COVID-19? This has been one of the primary routes through which firms could adapt their operations to the pandemic (Amankwah-Amoah et al, 2021). Our main finding is that both absorptive capacity and management practices contribute to firms' adaptiveness through digitalization. This findings holds even whilst controlling for other firm-level characteristics, including firm size, age, ownership and industry.

Our paper builds upon and adds to various strands of the existing literature on management and organization in times of changing business circumstances. One is about the role played by absorptive capacity in driving the organizational adaptiveness of firms. Cohen and Levinthal (1990) define absorptive capacity as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends". Such an ability is presumably highly valued in

circumstances such as the current pandemic, yet research on the role that absorptive capacity has played in absorbing the COVID-19 shock at the firm level is scarce.

Another strand of literature we contribute to concerns the role of management practices in times of crisis. Formal management practices and centralization are sometimes seen as possible barriers to organizational adaptiveness. They might impede flexibility and rapid decision-making (Aghion et al, 2021; Tushman and Nadler, 1978). Yet, recent papers have identified quality of management practices as an important driving factor for increases in sales, preventing firm closures and for adjustments to employment and operations during COVID-19 (Grover and Karplus, 2021; Lamorgese et al, 2021), and an important determinant of changing production as a response to COVID-19 (Krammer, 2022), and an important condition of COVID-19 state support for business (Groenewegen et al, 2021). Our study is distinct from and adds to these earlier papers in that we focus not so much on firm performance per se, but on firms' ability to deal with suddenly changing business circumstances.

A final strand of literature we seek to contribute to concerns the distinction between ordinary and dynamic capabilities (Teece, 2014). Firms' ability to adapt to changing circumstances has often been conceived of as a dynamic capability, defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997). Indeed, firms' absorptive capacity has often been conceived of as a particular expression of firms' dynamic capabilities (Patterson and Ambrosini, 2015). In contrast, management practices have sometimes been portrayed as ordinary instead of dynamic capabilities (Teece, 2014), suggesting that such practices do not contribute to a firm's ability to deal with changing business circumstances. Likewise Porter (1980) suggests that such practices are easy to imitate and hence do not contribute to sustained competitive advantage. At the same token, however, it is at least remarkable that despite their alleged imitability, huge differences exist across firms in the adoption of good management practices (Bloom and Van Reenen, 2007; Bloom et al., 2019); practices whose beneficiary effects on firm performance have been shown time and again (e.g. Iacovone et al., 2022). A major question is therefore whether management practices are best conceived of as dynamic capabilities, ordinary capabilities or a mix of these two. By including both absorptive capacity and quality of management practices in our study, we provide new insights into the relative importance of both concepts in explaining adaptiveness (see Figure 1).

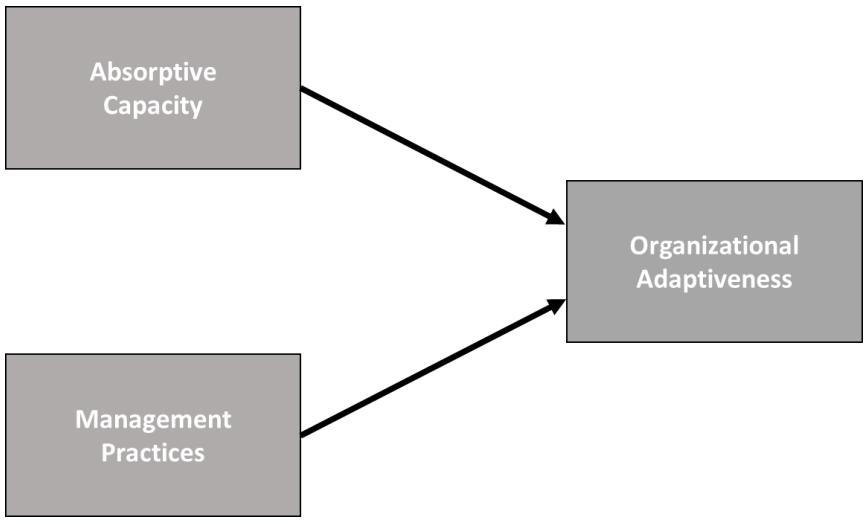

Figure 1. Management practices, absorptive capacity and organizational adaptiveness

We proceed as follows. In section 2 we further expand on the model from Figure 1: we discuss the relevant literature from the absorptive capacity and management practices literature. In section 3 we show how we designed our survey and what the data look like. Section 4 contains both an overview of our methodological approach and the results. In section 5 we discuss our findings and their implications.

2. Literature

In Figure 1 above we presented the simple theoretical framework underlying this paper. Before we move on to the description of our data, the operationalization of our variables and the presentation of our results, we discuss some of the relevant literature surrounding the concepts of absorptive capacity and management practices.

2.1. Absorptive Capacity

Absorptive capacity is rooted in the theory of dynamic capabilities, where dynamic capabilities refer to firms' ability to sense and seize opportunities in their operating environment (Teece et al, 1997). Absorptive capacity is then a particular type or subset of dynamic capability (Zahra & George, 2002). Specifically, it is defined as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1989); it is about successfully "absorbing" outside knowledge and is crucial for firm-level innovation and learning (Cohen & Levinthal, 1990).

Subsequent theoretical work on absorptive capacity has further developed the concept. Researchers have come up with more specific conceptualizations of absorptive capacity. This has led to a plethora of definitions of absorptive capacity, which have also sometimes become somewhat detached from the original meaning of the concept and assumptions behind it (Lane et al, 2006). Among empirical studies on absorptive capacity, meanwhile, a common problem is that of tautologies, with researchers using the same measure for the dependent and independent variables in their models.

Despite some of the shortcomings in the literature on absorptive capacity, the consensus is that absorptive capacity is one of the key constructs in organizational research. There are recent papers showing a positive direct effect of absorptive capacity on innovation and an indirect effect on financial performance, while hewing both closely to the original definition of absorptive capacity and sidestepping the tautology issue (e.g. Kostopoulos et al, 2011).
For this paper we have to choose a operationalization of absorptive capacity from the wide range of prior applications by other researchers. We delve into that further in section 3.

2.2. Management Practices

The importance of good management practices for firm performance has long been acknowledged by economists. In fact, in 1881, Francis Walker, then-President of the American Economic Association (AEA), said that "..in works controlled by men who have a high power of administration and a marked degree of execution (..) there is much less nervous and muscular wear and tear than in works under inferior management" (Walker, 1887, p. 275). But until recently, few economists actually studied the issue empirically. According to Chad Syverson "no potential driver of productivity differences has seen a higher ratio of speculation to actual empirical study" (Syverson, 2011, p. 336).

This has changed recently. Bloom and Van Reenen (2007) set up a large-scale research project for systematically and consistently measuring the quality of management practices, first within broadly defined industries across countries and later also across industries (Bloom et al., 2014).

This initiative is now almost 20 years old and their methodology has been widely adopted (Scur et al, 2021)

A consistent set of stylized facts emerge from this literature: first, there is considerable variation in quality of management practices across firms, implying that implementation of good management practices is not trivial. Second, a high quality of management practices generally correlates with various measures of firm performance, such as turnover, profit, survival and stock market returns.

The methodology by Bloom and Van Reenen (2007) was originally based on face-to-face interviews, but can also be conducted via a written survey (Bloom et al, 2019). We further discuss our choice of measurement for quality of management practices in section 3.

3. Data

3.1. Survey design

In the midst of the second wave of COVID-19 infections in the Netherlands (October 22th 2020 – November 9th 2020), we sent out a survey to 18,352 firms in manufacturing, retail and the hospitality industries. Of these firms, 1,151 firms responded (response rate of 6.3 percent).[1] Appendix A1 contains an overview of our survey. The sample was composed of commercial clients of Rabobank, one of three large banks in the Netherlands. Appendix A2 offers an overview of our sample by industry, size, ownership type, and location, also in comparison to the population of firms in the Netherlands. Our sample is not entirely representative of the universe of Dutch firms. That is partly by design, i.e. we only sample firms from three industries, and partly due to response biases, e.g. larger firms are more likely to take time to respond to our survey. Nevertheless, we cover a wide range of firm types in terms of size, location and ownership.

3.2. Organizational adaptiveness

We focus our analyses on organizational adaptiveness. In this paper, we measure this with a firm's capacity to deal with the COVID-19 shock by shifting their sales from on-site to online. Note that our measure of adaptiveness is not so much about agile (project) management (see e.g. Annosi et al., 2020), but about the ability of firms to shift their production activities into directions that are in line with current requirements. Our measure is also more fine-grained than another recent paper on the effects of quality of management practices and R&D expenditures on organizational adaptiveness to COVID-19, operationalized with the survey item "Has this establishment adjusted or converted, partially or fully, its production or the services it offers in response to the COVID-19 outbreak?" (Krammer (2022). Also note that, although we focus on commercial enterprises, non-profit organizations might have also adapted their operations during COVID-19. Take for example social care organizations that adopted e-health technology (Kateb et al, 2022). Our measure of adaptiveness concerns the extent to which firm turnover has become more dependent on online activity. COVID-19 has made firms' online business proposition more important: consumers buy more online than before. Also, in the business-to-business domain firms can no longer easily rely on, for example, trade fairs to acquire new costumers.

To construct our measure we ask respondents to fill in their firms' percentage of online turnover both before the crisis set in (March 2020) and at the time the survey was conducted (November-

[1] We sent out an invitation e-mail with a link to our online survey environment, and sent out two reminder e-mails, spaced approximately two weeks apart.

December 2020). We subtract these numbers to arrive at the change in online revenue in percentage points.[2] This number can range from negative 100, in case a firm sold everything online before the COVID-19 crisis but no longer sells anything online now, to positive 100, when the reverse is true and a firm sells all of its goods online now, but operated completely offline before. Figure 2 contains a histogram displaying the change in revenue from online activities for our sample, proxying for organizational adaptiveness during COVID-19.

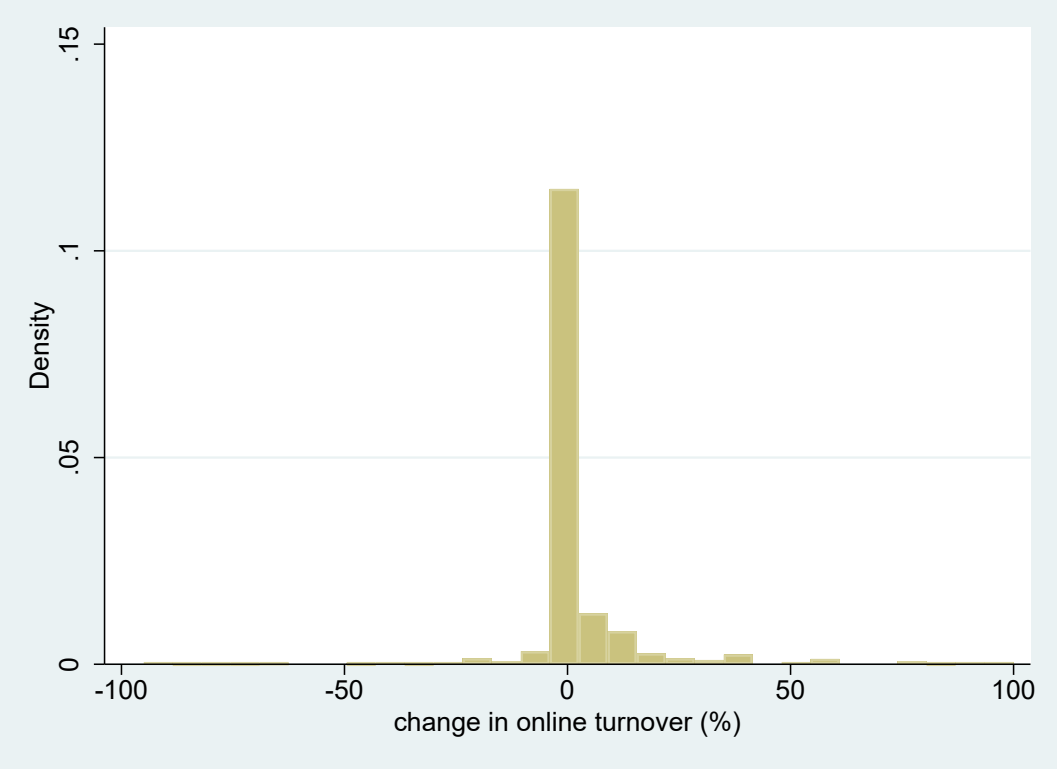

Figure 2. Change in online turnover

We can also make a binary distinction between firms with a positive change in online sales and firms with no change or a negative change in online sales. Then we can see if these two groups have certain distinctive characteristics. Around a quarter of firms has experienced a positive change in online sales (Table 1). This fraction is not the same across different categories. More manufacturing firms seem to have made the transition toward increased online revenues as compared to retail and hospitality firms; the same holds for the larger firms and for family firms as compared to non-family firms. Testing this more specifically, it turns out that there is no significant difference between industries or firm types. Size, however, does correlate with the likelihood of having generated more revenue online ($p < 0.01$).

Table 1. Percentage of firms generating more turnover online: overall and per firm type

	Percentage of firms generating more revenue online
Overall	25.3%
Manufacturing	27.9%
Retail	23.5%

[2] A change in online turnover as a percentage of total revenue may also (partially) be the result of total revenue changing (denominator effect). During COVID-19 offline revenue may have decreased, for example due to lockdowns, while online revenue stayed the same. According to our measure, this would imply that a firm is adapting to external circumstances, while this is not necessarily the case.

Hospitality	25.8%
<10 employees	23.5%
10-50 employees	25.1%
50-250 employees	36.2%
250+ employees	37.5%
Family firm	25.9%
Non-family firm	22.3%

3.3. Absorptive capacity

Based on the literature on absorptive capacity (Cohen and Levinthal, 1990; Jaworski and Kohli, 1993; Jansen et al., 2005), we formulate three survey questions to measure the extent to which firms are capable of acquiring external information. The first two questions are directly from Jansen et al. (2005), and the third question is based on a more general reading of the literature.

- To what extent do your employees regularly approach third parties such as accountants, consultants or tax consultants?
- To what extent do you collect industry information through informal means (e.g. lunch with industry friends, talks with trade partners)?
- How difficult is it to attain information relevant for the continuity of your business?

Respondents are asked to answer these questions on a scale from 1 to 7, where a 1 indicates "not difficult" and a 7 "very difficult" for the question on information availability , and a 1 indicates "not at all" and 7 "very much" for the questions on employee relations and informal networks. We then invert the answer to the question on information availability, so that a high score on that question also implies a significant capability of acquiring external information. We then conduct principal component analysis to construct a single measure of the information acquisition dimension of absorptive capacity from these questions. We plot a histogram of this measure in Figure 3.

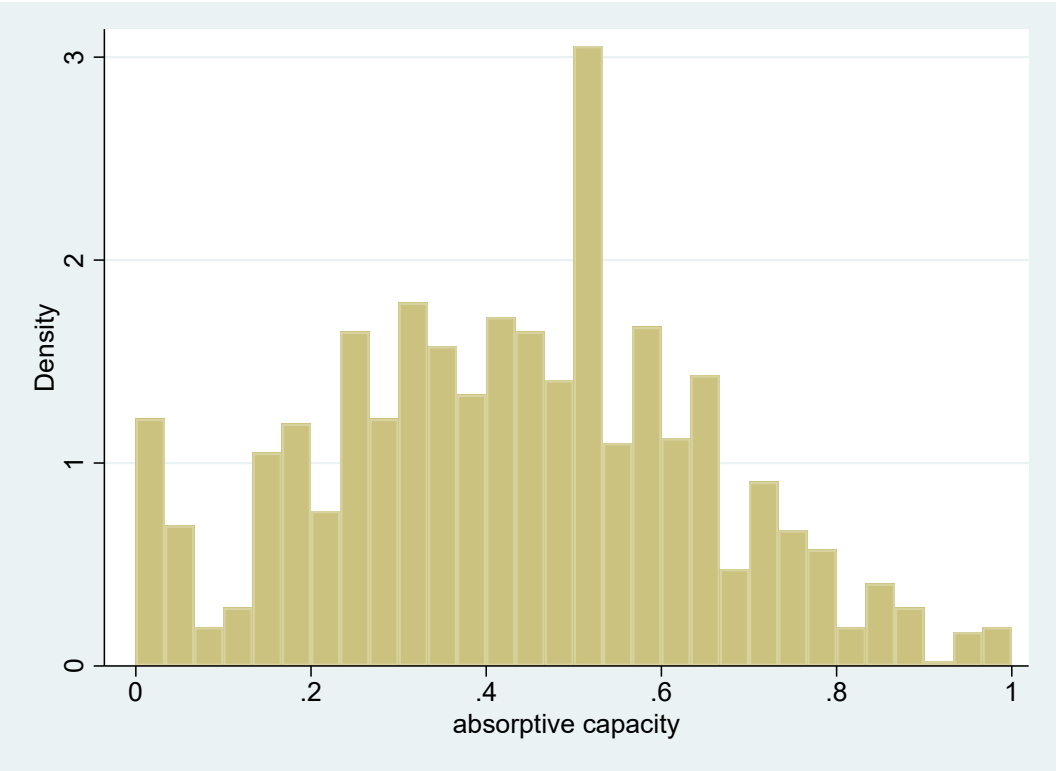

Figure 3. The information acquisition dimension of absorptive capacity

The other dimension of absorptive capacity that we measure, is the information exploitation capability of firms. Successful exploitation of external information leads to the successful introduction of new products and services. We therefore ask respondents how much of their turnover at the time of filling in the survey stems from products or services firms newly introduced since the COVID-19 crisis. This number can range from zero, when firms have not earned any revenue from new products since COVID-19, to 100, when firms are now earning all of their revenue from new products. Figure 4 shows how the histogram of the share of revenue earned from new products and services. Around 35 percent of the firms in our sample earn at least some part of their revenues from new products and services, with several outliers now earning a majority or even all their revenues from new products and services.

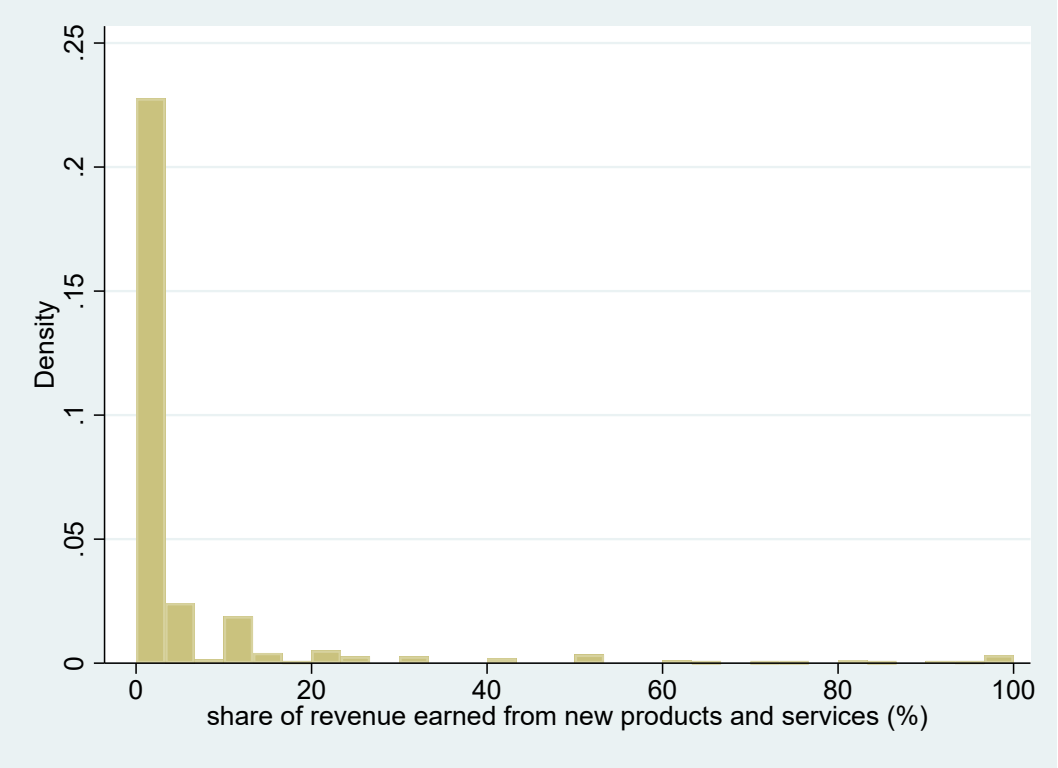

Figure 4. The information exploitation dimension of absorptive capacity

We rely on these survey-based measures of absorptive capacity rather than R&D expenditures or R&D intensity (cf. Krammer, 2022), because small- and medium sized companies, which comprise a large part of our sample, often lack an official R&D budget. This does not, however, imply that these firms do not innovate (Muscio, 2007).

3.4. Management practices

Our second main independent variable of interest is quality of management practices. We use seven questions from the Management and Organizational Practices Survey to measure the quality of management practices within firms (Bloom et al., 2019). As can be seen below, these deal with how information is gathered within the firm and then used:

1. How many key performance indicators (KPIs) are monitored at your business?
2. How frequently are KPIs typically reviewed at your business?
3. What did you do when a service or production problem arises in your business?
4. What describes the time frame of your service/production targets?
5. How easy or difficult is it to achieve service, or production targets?
6. What are the primary ways employees are promoted in your business?
7. When is an under-performing employee reassigned or dismissed?

These seven questions cover three areas of management: monitoring (question 1, 2 and 3), targets (question 4 and 5), and HR (question 6 and 7). The answers to these questions are multiple-choice. Depending on the answer, the respondent is assigned a score between 0 and 1 for a particular question, where the most structured management practice is normalized to 1 and the least structured management practice is normalized to 0 (see Appendix A1 for answering

options). The final management score is the unweighted score of all questions.[3] Many stylized facts discussed in the management literature are also visible in our data (see e.g. Scur et al., 2021). Most importantly, our management data show a considerable dispersion across firms (Figure 5). Good management practices are not easy to implement, and only a handful of firms come close to implementing the full set of practices completely.

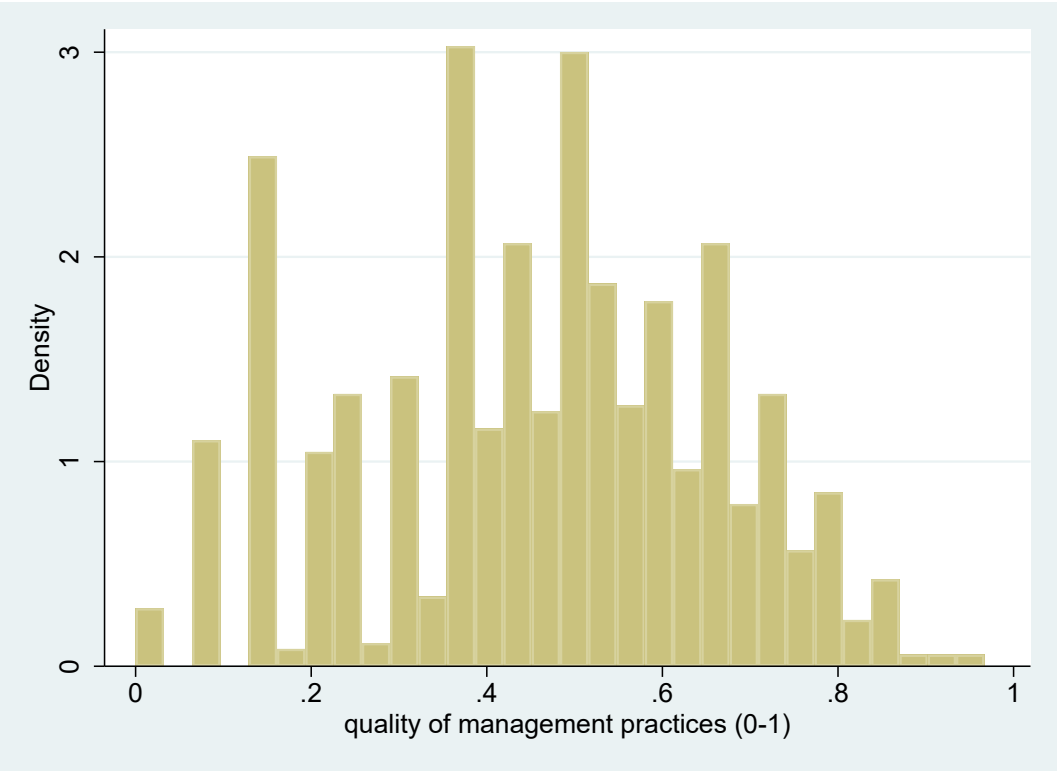

Figure 5. Quality of management practices

3.5. Control variables

We also include several other firm-level characteristics in our estimations. For example, we include firm size. Larger firms may have more internal resources to change course in the face of an outside shock, while keeping their main operations running. The effect could also run in the opposite direction, with larger firms being less nimble.

We also control for the industry that firms operate in. COVID-19 has hit the service sector especially hard. In response to lockdowns and out of fear for infections, consumers have made many more online purchases than before. It is important to include industry controls, as retail and hospitality firms are likely to do more online business regardless of their ability to pivot. Finally, we include firm age and family ownership as control variables, although we do not report on these variables specifically in our results, as they are not our main variables of interest.

Following Bloom and Van Reenen (2007), and subsequent papers making use of management data collected using surveys, we elicit respondent level information concerning the age, gender, role within the firm (owner/director, manager, employee), and amount of time spent on the

[3] It is good to note that a number of firms in our sample have little personnel (i.e. < 10), and the HR questions might therefore not be equally applicable to them. In our empirical model we test whether using a management score which excludes these 2 questions yields different results. That is not the case. Hence we stick to our measure based on all 7 questions.

survey by the respondent. We provide descriptive statistics of our main dependent and independent variables of interest, and correlations between them in Appendix A3 and Appendix A4.

4. Results

To estimate the impact of the quality of management practices and of absorptive capacity on different forms of organizational adaptiveness, we perform regression analysis, controlling for both firm-level and respondent-level factors.
We estimate the following regression specification:

$$Y_i = \beta_0 + \beta_M M_i + \beta_{A1} A1_i + \beta_{A2} A2_i + \beta_X X_i + \epsilon_i$$

where Y_i represents the change in online revenue for firm i, or the percentage of revenue from new products; M is the total firm-specific management score; A1 is a firm-specific absorptive capacity score relating to information acquisition; A2 is a firm-specific absorptive capacity score relating to information exploitation; X is a vector of firm characteristics (firm size, sector, family ownership, age) and respondent characteristics (respondent age, gender, function within the firm, time spent filling in the survey); and ϵ_i is a firm-specific error term.

As we did in the data section, we can reduce the data for the dependent variable to a binary format and split up the sample into firms that have experienced a positive online revenue change since COVID-19 and those that have not. We then conduct a logit regression, using the same specification as above, except that we use different dependent variables. To measure the determinants of organizational adaptiveness, we estimate OLS and logit regressions. Table 3 contains the OLS results.

Table 3. OLS results, change in revenue from online sources

	1	2	3	4
Management practices		6.637**		6.150**
		(3.204)		(3.123)
Absorptive capacity - share			0.331***	0.338***
revenue from new products			(0.063)	(0.067)
Absorptive capacity - external			-3.770	-4.316
information acquisition			(2.508)	(2.795)
Employees (ln)	-0.187	-0.780	-0.267	-0.924*
	(0.357)	(0.499)	(0.342)	(0.484)
Firm controls	Y	Y	Y	Y
Respondent controls	Y	Y	Y	Y
Observations	1,026	881	1,019	875
R-squared	0.014	0.026	0.132	0.141

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We first estimate a model with only control variables (column 1). Then we estimate a model with management (column 2), with both dimensions of absorptive capacity (columns 3) and with all variables together (column 4). Our key findings are as follows.

First, management matters for the change in online revenue. That is, firms with high quality management practices are more likely to have increased the share of online sales in the face of COVID. Second, absorptive capacity matters, but only the exploitation dimension of absorptive capacity. Third, firm size starts to matter in the full specification, but negatively. That is, smaller firms experience a large change in revenue from online sources, suggesting that smaller firms have a certain agility not captured by the other variables. In Table 4 below we switch to logit models for the binary version of our dependent variable where we add our independent variables of interest in the same way as above.

The results from our logit regressions are broadly similar to our results from the OLS regressions, except that firm size now matters positively in all models, and the information acquisition dimension of absorptive capacity also matters in the model without management practices. A finding that we cannot easily explain is that firm size has opposite effects in the OLS and logit specifications. In the OLS specifications the size effect is not significant or negative at the 10 percent level (model 4). In the logit specifications the size effect is consistently positive and highly significant. Given the high significance and the theoretical underpinnings of a positive size effect on adaptability (i.e. resource availability), we put more weight on the logit findings for this variable.

Table 4. Logit results, change in revenue from online sources

	1	2	3	4
Management practices		1.096**		0.981**
		(0.456)		(0.473)
Absorptive capacity - share			0.025***	0.026***
revenue from new products			(0.005)	(0.006)
Absorptive capacity - external			0.739**	0.635
information acquisition			(0.363)	(0.395)
Employees (ln)	0.253***	0.140*	0.257***	0.143*
	(0.055)	(0.074)	(0.057)	(0.077)
Firm controls	Y	Y	Y	Y
Respondent controls	Y	Y	Y	Y
Observations	1,026	879	1,019	873
Pseudo R-squared	0.0388	0.0376	0.0734	0.0706

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5. Discussion

In this paper we aimed to uncover the determinants of organizational adaptiveness during the COVID-19 pandemic. Our main research question was: to what extent and how do management practices and absorptive capacity affect organizational adaptiveness during the COVID-19 pandemic? Our study shows that the quality of management practices positively relates to changes in online revenue. The relationship between adaptiveness and absorptive capacity is less straightforward, with one dimension of absorptive capacity, namely the information exploitation dimension, being more robustly correlated than the information acquisition dimension.

In general, our findings suggest that management practices and absorptive capacity enable organizational adaptiveness. We already knew that these factors mattered for firm performance in normal times, but they also seem to matter in times of crisis. An important question then is why not all firms invest in management practices and absorptive capacity, given their importance for digitalization and innovation: figures 3, 4 and 5 show that the dispersion in management and absorptive capacity is large.

Bloom et al (2014) list a number of possible impediments to such investments in organizational improvement. Firms are not always aware of their limitations in these areas, perceiving themselves as better than they actually are. They might not know what to do about their limitations, as they lack information on how to improve. The incentives to act on their shortcomings might in some cases not be strong enough, due to weak competition. Finally, persuading the different stakeholders inside a firm to change the organization and established ways of working is sometimes hard to do, as change creates both winners and losers. From a policy perspective, removing these barriers should be a priority, given the effect of good management and high absorptive capacity on outcomes, and the volatile and uncertain business

environment that many firms operate in. Options include removing barriers to competition, increasing general education levels, and promoting management and entrepreneurial training.

Based on our findings, several avenues for future research are possible. Our measure for absorptive capacity can be improved. One option would be to further consider its robustness, and perhaps use other measures for this construct that have been tested more widely (e.g. Jiménez-Barrionuevo et al, 2011). Another addition would be to include a measure of R&D expenditures, similar to Krammer (2022), in spite of its limitations when applied to our sample, alongside our measure of absorptive capacity.
Also, our approach and data do not allow us to show full causality. Either a natural experiment, or a designed experiment in the shape of a randomized control trial should be conducted to get a better understanding both of causality and of the underlying mechanisms that link management and absorptive capacity with firm outcomes.

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Appendix A1. Survey outline

Questions	**Answering options**
Firm characteristics	
Who owns the firm?	Founder; family of the founder; different shareholders (non-founder/non-family); private equity; other
When was the firm founded?	Less than three years ago; between 3 and 10 years ago; between 10 and 50 years ago; more than 50 years ago
How many employees does the firm have?	[interval]
Management	
How many key performance indicators (KPIs) are monitored at your business?	None; 1 or 2; 3 to 9; 10 or more
How frequently are KPIs typically reviewed at your business?	Never; annually; every quarter; monthly; weekly; daily; multiple times per day
What did you do when a service or production problem arises in your business?	No action is taken; the problem is solved, but no further action is taken; the problem is solved and further action is taken so that the problem does not arise again; the problem is solved, further action is taken so that the problem does not arise again and a continuous improvement process is implemented
What describes the time frame of your service/production targets?	Emphasis is on short term targets (less than 1 year); emphasis is on long term targets (more than 1 year); emphasis is on a combination of short term and long term targets; there are no targets
How easy or difficult is it to achieve service, or production targets?	With little effort; with some effort; with normal effort; with much effort; only with extraordinary effort
Absorptive capacity - external information acquisition	
How difficult is it to attain information relevant for the continuity of your business?	[1-7 scale]
To what extent do your employees regularly approach third parties such as accountants, consultants or tax consultants?	[1-7 scale]
To what extent do you collect industry information through informal means (e.g. lunch with industry friends, talks with trade partners)?	[1-7 scale]
Absorptive capacity - external information exploitation	
What percentage of your revenue do you currently derive from products that you did not offer before COVID?	[interval]
Adaptiveness	

What percentage of your revenue have you earned from online activities since COVID (March 2020-November 2020)	[interval]
Uncertainty	
How would you rank the uncertainty your firm is facing?	Very low, revenue for the next 12 months can be forecast very accurately; low; neither low, nor high; high; very high; don't know
Respondent characteristics	
What is your role in the firm?	Owner, CEO or board member; manager; employee
What is your age?	[interval]
What is your gender?	Male; female; do not want to say

Appendix A2. Sample characteristics in comparison to the population of Dutch firms

	Percentage in sample	Percentage in population
Manufacturing sector	19.0%	3.7%
Retail sector	57.8%	13.2%
Hospitality sector	23.2%	3.3%
<10 employees	52.3%	96.6%
10-50 employees	35.7%	2.6%
50-250 employees	10.6%	0.6%
250+ employees	1.4%	0.2%
Family or founder-owned firm	84.8%	n/a
Non-family firm	16.2%	n/a
Northern Netherlands	10.4%	8.7%
Eastern Netherlands	22.4%	19.5%
Western Netherlands	49.2%	51.9%
Southern Netherlands	19.0%	19.9%

Sources: Rabobank, Statistics Netherlands. Note: we could not find statistics on founder-owned firms in the Netherlands

Appendix A3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Change in online revenue	1076	2.6	15.1	-95	100
Management score	992	.45	.21	0	.95
Information acquisition	1151	.02	1.18	-2.4	3.16
Information exploitation (revenue from new products)	1134	5.3	15.6	0	100
Firm size pre-COVID	1138	33.74	191.1	1	5042

Appendix A4. Pairwise correlations

Variables	Change in online revenue	Management score	Information acquisition	Information exploitation	Firm size pre-COVID
Change in online revenue	1.000				
Management score	**0.0569**	1.000			
	(0.0834)				
Information acquisition	-0.0213	0.0468	1.000		
	(0.4862)	(0.1410)			
Information exploitation	**0.3343**	**0.0627**	**0.1005**	1.000	
	(0.0000)	**(0.050)**	**(0.0007)**		
Firm size pre-COVID	-0.0007	**0.1277**	0.0125	-0.0192	1.000
	(0.9827)	**(0.0001)**	(0.6734)	(0.5204)	