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Digital retailing practices for triggering physical retailers' bounce-back and bounce-forward performance against a great shock: evidence from the COVID-19 pandemic

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This paper explores the mapping from specific digitalization practices to specific resilient performance against a great shock. Based on an adapted structure-conduct-performance framework, this paper hypothesizes by theoretically analyzing how the pre-shock establishment of digital retailing practices could trigger physical retailers' bounce-back and bounce-forward performance against the COVID-19 crisis. Using a difference-in-differences strategy, the hypotheses are examined with a sample including 549 observations of 50 Chinese listed retailers from the first quarter of 2018 to the third quarter of 2020. The empirical results mainly indicate the following binary findings. First, regardless of the differences in triggering bounce-back performance, different digital retailing practices are found to be effective in triggering physical retailers' bounce-forward performance against the COVID-19 crisis. This somewhat addresses the concern about the temporality of digitalization-enabled resilience by revealing the generality across digital retailing practices in the sense of triggering resilient performance. Second, it is shown that physical retailers' bounce-back performance at a specific stage of the COVID-19 crisis could only be triggered by digital retailing practices that coincidentally apply to the shock-induced market structure changes at the stage. The results emphasize each digitalization practice's individuality in triggering resilient performance. This justifies the non-negligibility of the direct mapping from specific digitalization practices to specific resilient performance in digitalization-enabled resilience evaluation.

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Introduction

In today's precarious world, physical retailers must adapt to an uncertain operational environment (Biggs et al., 2023; Verschueren et al., 2021). Natural disasters and human-caused accidents can induce a variety of external changes, which may signify both threats and opportunities for physical retailers (Olsen and Porter, 2011). To cope with this type of shock, digital transformation has been leveraged by a large number of physical retailers to build the capabilities of absorbing shock-induced losses, adapting to shock-driven disruption, and transforming to anticipate future shocks (Boh et al., 2023; Torres and Augusto, 2019).

Regarding common uncertain events, a lot of literature suggests that the aforementioned capabilities (i.e., *digital resilience capabilities*) are helpful for firms to sustain operations (e.g., Dubey et al., 2022; Gu et al., 2021; Leoni et al., 2022; Nakandala et al., 2022; Papanagnou et al., 2022). However, possessing the capabilities does not imply that digitalization can trigger physical retailers' resilient performance (i.e., a type of operational achievement that can be directly observed via financial indices or objective traces in operations) against every shock (Boh et al., 2023; Parast, 2022).¹ Compared with regular business disturbances, *great shocks* like the COVID-19 pandemic strikingly pose more unpredictable changes and a stronger impact prolongation (Ge et al., 2022; Kim, 2020). The presence of these characteristics emphasizes the individuality of each shock rather than the generality across uncertainties (Ge et al., 2022; Parast, 2022). In this context, the evaluation of whether physical retailers can leverage digitalization to be resilient should not be confined to assessing digital resilience capabilities (e.g., Birkel and Hartmann, 2020; Dennehy et al., 2020; Ignatiadis and Nandhakumar, 2007). Instead, researchers need to investigate how digitalization-empowered physical retailers perform exactly against individual shocks and specify what form(s) of resilient performance reflects more long-term potential rather than temporary shock-specific success (Boh et al., 2023).

In addition to the concern about the temporality of digital resilience capabilities, the ignorance of the gap between composite digitalization and specific digitalization practices may be another problem in evaluating digitalization-enabled resilience (Arvidsson and Holmström, 2017). When a composite digitalization strategy/capability shows effectiveness in building resilience for physical retailers, it is actually difficult to judge whether a digitalization practice covered by the composite strategy/capability has the same effect. For example, there is a popular view that e-commerce adoption (i.e., a composite digitalization strategy) can contribute to physical retailers' resilience, but evidence shows that some e-commerce adoption practices were not successful during the COVID-19 pandemic (e.g., Li et al., 2023). In the face of problems like this, many researchers urge that the evaluation of digitalization-enabled resilience should be boiled down to the mapping from digitalization practices to resilience (Arvidsson and Holmström, 2017; Ge et al., 2022).

This paper aims to address the above concerns together by examining how physical retailers' digital retailing practices play out in the sense of triggering resilient performance against a great shock. Figure 1 illustrates the gap targeted by this paper. Instead of contemplating the mapping from composite digitalization to resilience capabilities in different environments (e.g., Alvarenga et al., 2023; Bag et al., 2022; Balakrishnan and Ramanathan, 2021; Bianco et al., 2023; Herold et al., 2021; Zhao et al., 2023), this paper directly connects digitalization practices and physical retailers' resilient performance against a great shock. Going further than the literature that focuses on shock-specific digitalization practices (e.g., Ge et al., 2022), this paper pays particular attention to the effect of unintended digitalization practices.

To provide grounds for the hypothesizing, this paper first analyzes the features of a great shock (Darkow, 2019; Manyena et al., 2011) and constructs two types of resilient performance that should be tracked. *Bounce-back performance* summarizes how well a firm can contain unpredictable crises *during* a great shock (e.g., the success of maintaining demand under a demand shock). *Bounce-forward performance* captures how well a firm can quickly sense the market trend(s) embodied in a great shock and responsively reconfigure operations *during and after* the shock to achieve new normalcy (e.g., the success of adapting fixed assets management to the long-term marketplace shaped by a great shock) (see Fig. 2 for an illustration of the concepts). With the resilient performance constructs, an adapted *structure-conduct-performance* (S-C-P) framework (cf., Bain, 1959; Tirole, 1988) is established to directly connect a digitalization practice and a type of resilient performance. Under this framework, there are two logics underlying the hypothesizing: (1) a digital retailing practice can trigger firms' bounce-back performance against a great shock if the digital retailing practice itself coincidentally meets the temporary market structure changes induced by the shock and (2) a digital retailing practice can trigger firms' bounce-forward performance against a great shock if it can enable firms to reconcile their overall operations with the long-term market structure evolution shaped by the shock.

Based on the theory development, this paper specifically studies how well physical retailers' pre-shock establishment of digital retailing practices triggered their bounce-back and bounce-forward performance within the COVID context. The digital retailing practices of concern revolve around *online-to-offline food delivery services* (O2OFDS) and *social media marketing services* (SMMS), which were highlighted by many practitioners as promising resilience triggers at the beginning of the pandemic (Cheng et al., 2020; Kang, 2020). Given the difference between the services supplied via *third-party large platforms* (TP) and *proprietary platforms* (PP) (Dannenberg et al., 2020; Li et al., 2023), this paper finally involves four digital retailing practices: O2OFDS-PP, SMMS-PP, O2OFDS-TP, and SMMS-TP. Under the adapted S-C-P framework, the hypotheses are developed by matching the digital retailing practices with the market structure changes induced by the *first wave of the COVID-19 pandemic* (abbreviation, the COVID-19 crisis).

Empirically, this paper collects a retailer-quarter panel including 350 observations of 50 listed general merchandise retailers in China from the first quarter of 2019 to the third quarter of 2020 (i.e., an extension of the sample employed in Li et al. (2023)). With the sample, the hypotheses are tested using a difference-in-differences (DID) strategy that is similar to the method for identifying the effectiveness in a vaccine clinical trial.

The results mainly uncover three findings. First, the pre-shock establishment of O2OFDS-PP and SMMS-PP (i.e., the digital retailing practices operated based on physical retailers' proprietary platforms) did not trigger physical retailers' bounce-back performance against the COVID-19 crisis. This may result from the mismatching between physical retailers' proprietary platforms and the dominant during-shock preferences of the consumers forced to purchase online. Second, the pre-shock establishment of O2OFDS-TP triggered physical retailers' bounce-back performance during the whole COVID-19 crisis, while the pre-shock establishment of SMMS-TP triggered physical retailers' bounce-back performance during the second stage of the shock (i.e., after the shock-induced panic calmed down). Third, the pre-shock establishment of different digital retailing practices triggered physical retailers' bounce-forward performance against the COVID-19 crisis. Digital retailing, in general, may enable physical retailers to quickly sense and continuously adjust their operations toward the long-term market trends shaped by the shock.

Contributor(s)	Digitalization		Resilience		Effect(s) of concern
	Business practice	Strategy/Capability	Capability	Shock-specific performance	
Ignatiadis and Nandhakumar (2007)	No	Enterprise systems adoption	Yes	No	Composite digitalization strategies/capabilities → Resilience capability
Birkel and Hartmann (2020)	No	Internet of things (IoT)	Yes	No	
Gu et al. (2021)	No	Information technology usage	Yes	No	
Dennehy et al. (2021)	No	Big data analytics	Yes	No	
Leoni et al. (2022)	No	Artificial intelligence (AI)	Yes	No	
Dubey et al. (2022)	No	AI-driven big data analytics	Yes	No	
Papanagnou et al. (2022)	No	Data-driven digital transformation	Yes	No	
Nakandala et al. (2023)	No	Industry 4.0 technology	Yes	No	
Lin et al. (2023)	No	Digital-driven business capabilities	Yes	No	Composite digitalization strategies/capabilities → Resilience capability → Resilient performance (scenario-specific)
Bag et al. (2022)	No	Big data and predictive analytics	No	Yes (Partly)	
Zhao et al. (2023)	No	Supply chain digitalization	Yes	Yes (Partly)	Composite digitalization strategies/capabilities → Resilience capability → Resilient performance (shock-specific)
Balakrishnan and Ramanathan (2021)	No	Digital supply chain technologies	Yes	Yes	
Herold et al. (2021)	No	Digitalization and data management	Yes	Yes	
Munir et al. (2022)	No	Data analytics	Yes	Yes	
Alvarenga et al. (2023)	No	Digital technologies usage	Yes	Yes	
Bianco et al. (2023)	No	Industry 4.0 technologies	Yes	Yes	
Gap: Digitalization practices → Composite digitalization strategies/capabilities → Resilience capability → Resilient performance (shock-specific)					
Ge et al. (2023)	Working from home	No	No	Yes	Digitalization practices (shock-specific) → Composite digitalization strategies/capabilities → Resilience capability → Resilient performance (shock-specific)
Ours	Digital retailing practices	No	No	Yes	Digitalization practices (unintended) → Composite digitalization strategies/capabilities → Resilience capability → Resilient performance (shock-specific)

Fig. 1 Summary of the empirical research on firms’ digitalization-enabled resilience (in the leading IS and OM journals). The journals include Decision Support Systems, European Journal of Information Systems, Information & Management, Information and Organization, Information Systems Journal, Information Systems Research, Journal of the Association for Information Systems, Journal of Information Technology, Journal of Management Information Systems, Journal of Strategic Information Systems, MIS Quarterly, Journal of Operations Management, Management Science, International Journal of Operations & Production Management, Journal of Supply Chain Management, Production & Operations Management, Decision Sciences, International Journal of Production Economics, Journal of Business Logistics, Manufacturing & Service Operations Management, Journal of Purchasing & Supply Management, and Supply Chain Management: An International Journal.

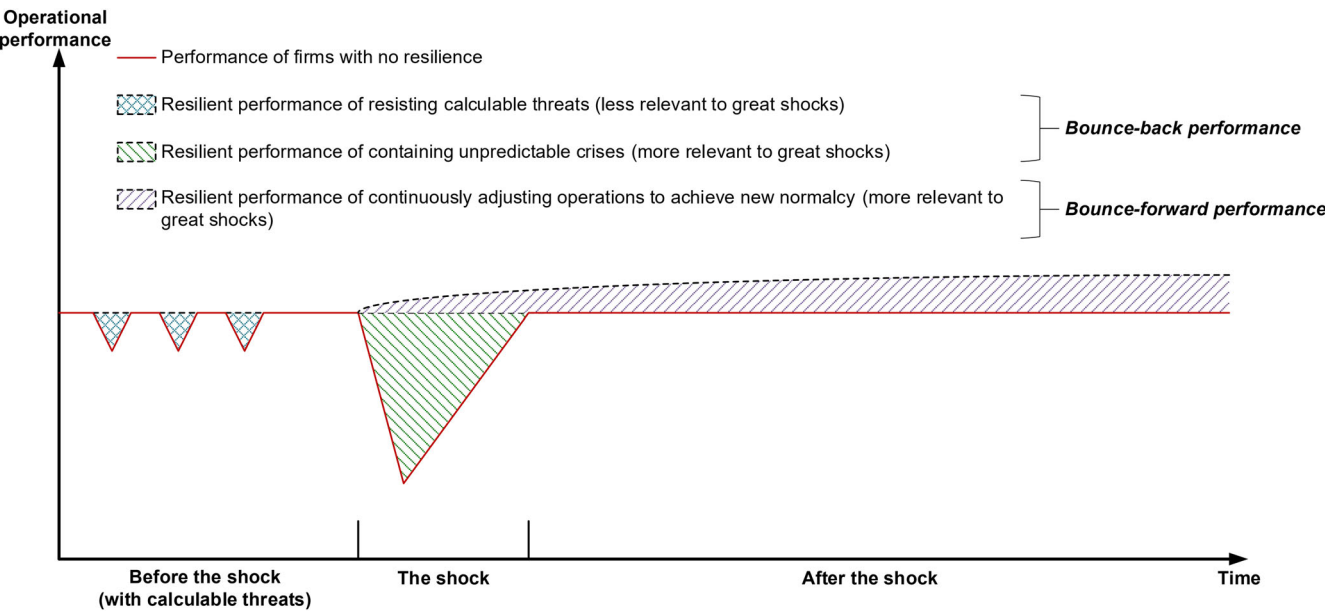


Fig. 2 Constructs of the resilient performance against a great shock.

This paper mainly contributes to the information systems (IS) and operations management (OM) research in two aspects. First, it looks further than digital resilience capabilities in general and specifies the resilient performance constructs that should draw researchers’ attention in the context of a great shock. The evidence shows that the different digital retailing practices mostly triggered physical retailers’ bounce-forward performance against the COVID-19 crisis. The finding implies that digitalization’s

contribution to physical retailers’ quick sensing and responsive reconfiguration may apply to different shocks. This somewhat addresses the concern about the temporality of digitalization-enabled resilience (Boh et al., 2023). Second, the paper investigates the connections between digital retailing practices and physical retailers’ bounce-back performance against the COVID-19 crisis. The empirical results indicate that only the digital retailing practices that coincidentally met the temporary demand shift in the COVID-19 crisis triggered physical retailers’ bounce-back performance. The finding justifies the necessity of studying the direct effect of specific digitalization practices on specific resilient performance, rather than the mapping from composite digitalization to resilience capabilities when evaluating digitalization-enabled resilience (Ge et al., 2022; Li et al., 2023).

Theory development and hypothesizing

Bounce-back and bounce-forward performance against a great shock. The concept of resilience originated from ecological research (Holling, 1973). It was introduced into the organization and OM research to describe an organization’s or a system’s ability to absorb disturbance and bounce back after damage (Home and Orr, 1997; Pettit et al., 2010).² Recently, the concept of resilience was extended to include the capabilities of adapting operations to long-term changes and transforming operations to cope with future opportunities and threats (Darkow, 2019). Researchers have proposed several sets of resilience capability constructs (Conz and Magnani, 2020), such as absorptive, adaptive, and transformative resilience (Boh et al., 2023) or engineering, ecological, and social–ecological resilience (Lin et al., 2023).

When proposing the above constructs, researchers have already taken the presence of great shocks into consideration. However, the constructs still revolve around the capabilities in general. They contribute little to clarifying the visible resilient performance that can be regarded as the ultimate goal of building resilience. Hence, it is necessary to specify the resilient performance constructs that should be tracked before building the direct mapping from specific digitalization practices to physical retailers’ resilient performance.

To plug this gap, this paper integrates Darkow’s definitions (Darkow, 2019) with the classical terms “bounce back” and “bounce forward” (Manyena et al., 2011) to characterize two types of great-shock-specific resilient performance. As illustrated in Fig. 2, this paper uses bounce-back performance to represent the resilient performance of containing unpredictable crises during a great shock and uses bounce-forward performance to denote the resilient performance of continuously adjusting operations during and after a great shock to achieve new normalcy. Compared with the resilience capability constructs, these two resilient performance constructs literally depict the

objective phenomena that can be tracked by observing from firms’ (final) operational outcomes.

Given the lack of a well-established theory (Castillo, 2023), this paper does not specify the relations between resilient performance and resilience capability constructs in detail. Rather, it pays particular attention to the direct links between digitalization practices and physical retailers’ resilient performance. According to Boh et al.’s (2023) constructs, it is roughly feasible to regard bounce-back performance as a realization of absorptive resilience capability and consider bounce-forward performance as a realization of adaptive or transformative resilience capability.

Four types of digital retailing practices in the COVID-19 era. O2OFDS and SMMS are two types of phenomenal digital retailing practices adopted in the COVID-19 era. A lot of practitioners regarded them as promising ways to help physical retailers recover from the disruption in the COVID-19 era, but it is still under-explored whether they can enable physical retailers to be resilient across contingencies (Cheng et al., 2020; Kang, 2020).

As shown in Table 1, O2OFDS mainly serves to assist busy people who place food orders online and expect rapid offline delivery (Shah et al., 2021). SMMS helps retailers visibly and interactively present products and salespersons’ identities to dynamic communities and individuals (Roberts and Kraynak, 2008). The two types of digital retailing practices must be operated based on an e-commerce platform. Hence, with respect to the difference between physical retailers’ adoptions of proprietary platforms (PP) and large third-party platforms (TP) (Dannenberg et al., 2020; Li et al., 2023), O2OFDS can be further divided into O2OFDS-PP and O2OFDS-TP, whilst SMMS can be further divided into SMMS-PP and SMMS-TP.

The (mutually exclusive) advantages of the digital retailing practices are discussed in the next subsection to develop the hypotheses. Devoted to investigating whether unintended digitalization preparations can trigger physical retailers’ resilient performance against the COVID-19 crisis, this paper does not take account of any during-shock adoption of the digital retailing practices.

Mapping from the digital retailing practices to physical retailers’ resilient performance against the COVID-19 crisis

Adapted S–C–P framework for linking resilient performance with digitalization practices. An adapted S–C–P framework is developed to link resilient performance with specific digitalization practices in theoretical analysis. As a classical tool, the S–C–P paradigm was established by the Harvard School (Bain, 1959) for static industrial organization analysis. According to the Harvard School paradigm, the (short-term) performance of a firm’s certain conduct (e.g., a strategy or business practice) depends on the

Table 1 Four types of digital retailing practices investigated in this paper.				
Digital retailing practice	Online-to-offline food delivery services (O2OFDS)		Social media marketing services (SMMS)	
Product focus	Necessary consumables (examples: vegetables, fruits, meats, semi-finished dishes, and seafood for daily eating)		Durables and high-added-value consumables (examples: Apparel, cosmetics, electronics, and unconventional food)	
Consumers’ expectation of hedonic value	Normal or low hedonic value		High hedonic value	
Consumers’ expectation of time commitment	Limited time commitment		Intensive time commitment	
Example	Based on proprietary platforms (O2OFDS-PP) Online Sam’s Club	Based on large third-party platforms (O2OFDS-TP) Carrefour China on JD Daojia	Based on proprietary platforms (SMMS-PP) BAILIAN’s advertising in WeChat communities	Based on large third-party platforms (SMMS-TP) Wangfujing’s live-streaming advertising on Tmall.com

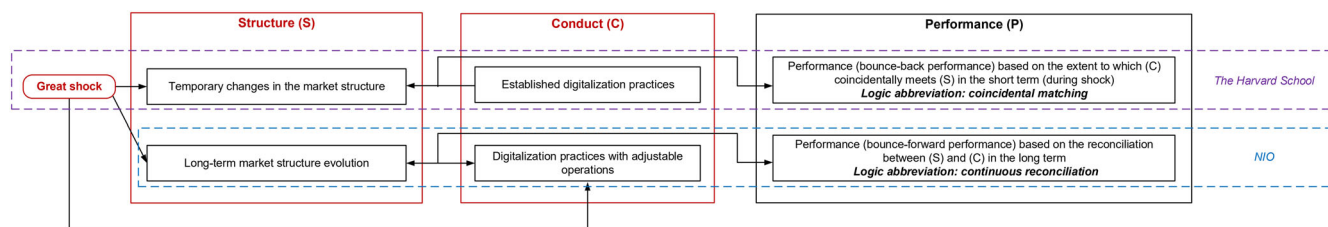


Fig. 3 Adapted S-C-P framework for linking great-shock-specific resilient performance with digitalization practices.

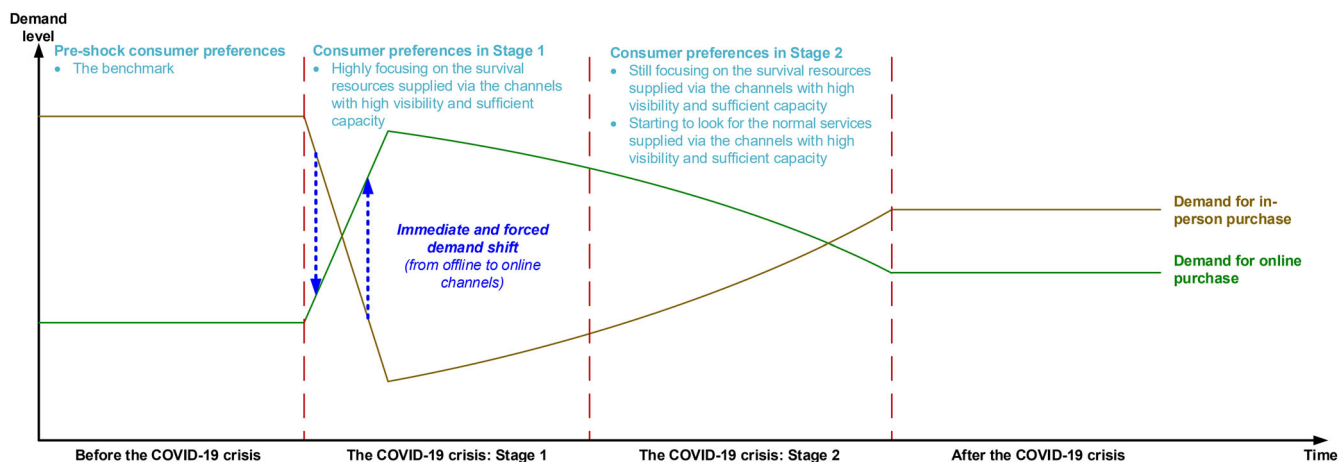


Fig. 4 Market structure changes at the different stages of the COVID-19 crisis.

extent to which the conduct coincidentally meets the market structure that is exogenously given in the short term. The New Industrial Organization (NIO) scholars criticized the Harvard School for its strong assumption that the market environment is exogenously given (Tirole, 1988). They contended that the S-C-P paradigm should be used from a dynamic view. That is to say, the (long-term) performance of a firm's certain conduct is determined by how well the firm can reconcile the conduct with the long-term market structure evolution.

As illustrated in Fig. 3, the mapping from specific digitalization practices to firms' resilient performance against a great shock requires both of the paradigms. On the one hand, firms' bounce-back performance is specific to the temporary during-shock market environment where firms do not have enough time to change their operations responsively. In this sense, the Harvard School paradigm can work for specifying what digitalization practices can trigger firms' bounce-back performance. A digitalization practice is proposed as effective for triggering firms' bounce-back performance if it passively and coincidentally meets the shock-induced temporary market structure. On the other hand, firms' bounce-forward performance is specific to the shock-shaped long-term market environment where firms have the freedom to adjust their operations. Hence, the NIO paradigm can be applied to analyzing what digitalization practices can trigger firms' bounce-forward performance. Accordingly, a digitalization practice is proposed as effective for triggering firms' bounce-forward performance if it can enable firms to reconcile their operations with the shock-shaped long-term market structure evolution. In summary, firms' bounce-back performance against a great shock is only triggered by dedicated digitalization practices, while firms' bounce-forward performance against a great shock can be triggered by a larger range of digitalization practices.

This paper constructs the research model following the adapted S-C-P framework. Specifically, the market structure changes

induced by the COVID-19 crisis and the advantages of digital retailing practices are characterized at first. Then, the specific hypotheses are separately developed by matching the digital retailing practices with the market structure changes.

Digital retailing practices for the shock-specific temporary market structure changes. As shown in Fig. 4, for physical retailers, the COVID-19 crisis mainly caused an online demand boom relative to the decrease in face-to-face demand during the shock (Verschuere et al., 2021). The highly infectious coronavirus and the sweeping anti-infection measures forced a huge number of consumers who mainly purchased goods in person before the pandemic to immediately shift from offline to online shopping (Li et al., 2023). This demand shift implied two aspects of temporary market structure changes. The four digital retailing practices' might have different effects on physical retailers' operations against the market structure changes.

Matching the platform adoptions with the shifted consumers' channel preferences: As most of the shifted consumers were new users of online shopping, they first needed to choose a channel (Valentini et al., 2011). At the beginning of the pandemic, the danger of the coronavirus and the limited time to find a new shopping place caused panic and information overload to the shifted consumers. In this context, they might homogeneously prefer channels with high visibility and sufficient capacity because they could easily reach these channels and get their demand satisfied via them (Roggeveen and Sethuraman, 2020; Sheth, 2020). This channel preference might remain unchanged throughout the pandemic. Of course, the shifted consumers might no longer attach importance to a channel's high visibility and sufficient capacity after tiring of the anti-pandemic measures and getting used to online shopping (Keane and Neal, 2021). Nevertheless, there was no extra shock to lead them to

shed their dependence and change their channel choice (Goldfarb, 2006).

When focusing on homogeneous products and services, it is evident that a large platform rather than a small platform can attract consumers more easily because the large platform's greater user scale implies stronger cross-side externalities for consumers on the platform (i.e., consumers can benefit more from reaching more sellers) (Rochet and Tirole, 2006). Hence, the adoption of large third-party platforms may enable physical retailers to present their online services to a great number of consumers. Nevertheless, physical retailers that present online services on third-party platforms may also bear the risk that consumers on these platforms fail to notice a specific seller due to the presence of too many choices (Du et al., 2023; Zhen et al., 2022).

In comparison with the adoption of large third-party platforms, the adoption of proprietary platforms enables physical retailers to track customers' customs and provide customized online services to their loyal customers. This may help them cultivate their own brands and exploit demand (Du et al., 2023; Wang et al., 2023). However, proprietary platforms have relatively small scales, as well as low scale efficiency. By adopting proprietary platforms, physical retailers can only gain relatively low exposure to new consumers but need to bear relatively high operating costs (Cennamo, 2018).

As aforementioned, during the COVID-19 crisis, the shifted consumers displayed homogeneous needs for goods and preferred channels with high visibility and sufficient capacity under the shock. Hence, large third-party platforms might dominantly attract the shifted consumers because the platforms' scale-based visibility advantages coincidentally met the aforementioned channel preferences. Conversely, physical retailers' proprietary platforms and the services offered on the platforms might be hardly noticed by the shifted consumers (Dannenberg et al., 2020; Li et al., 2023). Furthermore, the shifted consumers might crowd onto large third-party platforms in a short period of time and even overload the capacity of all the suppliers on the platforms (Dannenberg et al., 2020). In this case, physical retailers' digital retailing practices operating based on the platforms could gain saturated exposure and somewhat escape from the risk that consumers on the platforms fail to notice a specific seller. Hence, Hypothesis 1 can be proposed as follows:

H1: Physical retailers' pre-shock establishment of the digital retailing practices operated based on proprietary platforms did not trigger their bounce-back performance against the COVID-19 crisis, while the pre-shock establishment of the digital retailing practices operated based on large third-party platforms offered the opportunity to trigger their bounce-back performance against the COVID-19 crisis.

Matching the digital retailing practices with the shifted consumers' needs for goods: In addition to channel preference, the shifted consumers' needs for specific goods might vary with the evolution of people's perceptions toward the pandemic. In the first stage of the COVID-19 crisis, the imminent danger and the pandemic-driven panic impelled people to focus on their survival (Keane and Neal, 2021; Yuen et al., 2021). At the same time, people were worried about their personal incomes declining in the future, and there was a common cost of shifting from offline shopping to online shopping (Saunders, 2020). As a well-known response to a negative income shock, consumers might find it necessary to stop purchasing goods with high price elasticity and keep purchasing goods with low price elasticity (i.e., necessities) (Roggeveen and Sethuraman, 2020). Therefore, the shifted consumers might concentrate on necessities for daily living in the first stage of the COVID-19 crisis (Eger et al., 2021). In the second stage of the COVID-19 crisis, consumers became

accustomed to the situation because they received more information about the disease, and the infection seemed to be under control (Keane and Neal, 2021). Under this condition, while still attaching importance to the necessity of their purchase, the shifted consumers started to pursue services to achieve a normal shopping experience (China Consumers Association, 2020).

In terms of the advantages of satisfying consumers' needs for goods, O2OFDS may equip physical retailers with the advantages of providing necessary consumables with limited hedonic value to consumers who expect to expend a limited amount of time when shopping (Roh and Park, 2019; Shah et al., 2021). This advantage could meet the shifted consumers' preference for daily necessities during the first stage and, to some extent, the second stage of the COVID-19 crisis (Chang and Meyerhoefer, 2021). In contrast, SMMS typically helps physical retailers promote the selling of durables and high-added-value consumables to consumers who want to spend their time acquiring hedonic value from shopping or engaging with salespersons (Barefoot and Szabo, 2009; Lin et al., 2017; Wongkitrungrueng and Assarut, 2020). This advantage could only meet the shifted consumers' need to achieve a normal shopping experience during the second stage of the COVID-19 crisis (Keane and Neal, 2021; Sim et al., 2022). Considering the effectiveness of the platform adoptions together, Hypotheses 2 and 3 can be proposed as follows:

H2: Physical retailers' pre-shock establishment of O2OFDS-TP triggered their bounce-back performance against the COVID-19 crisis during the whole shock.

H3: Physical retailers' pre-shock establishment of SMMS-TP triggered their bounce-back performance against the COVID-19 crisis at the second stage of the shock.

No particular attention is attached to the simultaneous pre-shock establishment of O2OFDS-TP and SMMS-TP. With their incompatible advantages, it is difficult for physical retailers to yield extra advantages by integrating O2OFDS and SMMS. In other words, the advantages of the sum of the digital retailing practices are equivalent to the sum of the advantages of each digital retailing practice. Although some surveys mentioned that food is also an important product category concern for SMMS (e.g., China Consumers Association, 2020), the popular food products supplied in the context of SMMS (e.g., junk food and unconventional food) are usually different from those sold within the O2OFDS context (e.g., daily food products) (Lee and Wan, 2023).

Digital retailing practices for the shock-induced long-term market structure evolution. As also shown in Fig. 4, the COVID-19 crisis also reshaped the demand for digital retailing in the long term beyond the temporary during-shock changes. The wide-range and long-lasting social distancing measures rapidly shrank the share of purely offline consumers in the market (Roggeveen and Sethuraman, 2020). After the pandemic, the shifted consumers who realized the advantages of online shopping might further engage in digital retailing and hope to pursue "real life" in the digital world (Donthu and Gustafsson, 2020). The shifted consumers who went back to offline channels might also form certain attitudes toward online shopping (e.g., their preferences within the online shopping context and the feelings that motivated them not to keep purchasing online) (Sharma and Jhamb, 2020). These nearly irreversible trends in consumers' perceptions of online shopping might signify opportunities for retailers' omnichannel operations in the future (Gupta et al., 2023; Verhoef, 2021).

To trigger physical retailers' bounce-forward performance against the COVID-19 crisis, the coincidental matching between the digital retailing practice and the during-shock market structure may be unnecessary (Yrjölä et al., 2018). The COVID-19 crisis shaped the perceptions of a great number of previously

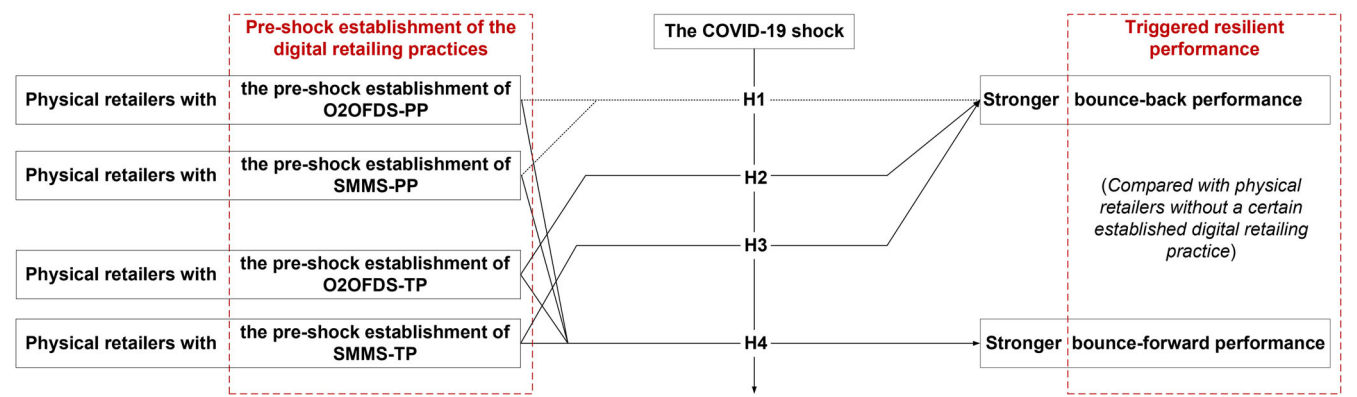


Fig. 5 Research model for the empirical analysis.

Table 2 The links between resilient performance and shock-specific financial performance.		
Resilient performance	Shock-specific financial performance	Mechanism
Bounce-back performance	Temporary increase in sales Temporary decrease in current assets	Improvement derived from coincidentally meeting the demand shift from offline to online shopping
Bounce-forward performance	Stable decrease in illiquid assets	Improvement derived from transforming toward an asset-lite operation model
Overall resilient performance	Increase in asset turnover	Improvement in final operational outcome

offline consumers toward online shopping. This might provide fruitful information and signify opportunities for physical retailers’ omnichannel operations in the future (Gupta et al., 2023; Verhoef, 2021). Although it is possible that physical retailers with the four types of digital retailing practices did not use them intensively before the COVID-19 crisis, the general engagement in digital retailing might equip physical retailers with the capabilities of quickly sensing the shock-shaped market trends and reconfiguring operations according to the information (Boh et al., 2023; Munir et al., 2022). It is reasonable to propose that physical retailers with these capabilities could responsively reallocate their operational infrastructures toward the shock-induced opportunities for omnichannel operations and benefit from the gradually achieved reconciliation. Hence, Hypothesis 4 is formed as follows:

H4: The pre-shock establishment of the four types of digital retailing practices triggered physical retailers’ bounce-forward performance against the COVID-19 crisis.

Based on the hypotheses, the research model is presented in Fig. 5. It is illustrated in a way that is aligned with the identification conducted in the empirical analysis.

Methodology
Quantitative identification

Data sources and description. The sample employed in the empirical analysis is drawn from Chinese-listed general merchandise retailers. Specifically, the original sample includes 53 listed firms in the China Securities Index (CSI) Department Stores industry, CSI Hypermarkets and Super Centers industry, and CSI General Merchandise Stores industry. After removing the one firm controlled by another listed retailer and the two listed e-commerce retailers, a retailer-quarter panel including 549 qualified observations (obs.) of 50 retailers from the first quarter of 2018 (abbreviated, 2018Q1) to the third quarter of 2020 (abbreviated, 2020Q3) remains as the final sample.³ The time span is set to avoid the disturbance from the modification to the accounting standard at the end of 2020 and to include enough

pre-shock period for a parallel trends test (Lechner, 2011). These retailers have very similar properties in terms of their operations and financial measures. In particular, all of them focused on brick-and-mortar businesses before the COVID-19 crisis, while some of them established different digital retailing practices at the very preliminary stage before the shock. Supplementary Table S1 reports the descriptive statistics of the variables involved.

Outcome variables: The micro-level data on the financial indices of retailers come from the Choice SSE and SZSE Stock Database, which records the financial data of all Chinese-listed firms from their regular reports. According to the research model and the measurement framework shown in Table 2, financial indices that represent retailers’ operational performance (Subramanyam, 2014; Xia and Zhang, 2010) are tracked as the outcome variables in the empirical analysis. The variables include asset turnover (AT) and its components—sales (SalesG), current assets (CAG), and illiquid assets (FAG). For these components to be commensurable, all of them are measured on a growth rate basis.

Treatment and placebo treatment variables: Collecting information from the annual reports and official websites of the sample retailers, this paper forms four treatment variables and five placebo treatment variables, as shown in Table 3. To examine the hypotheses, assignment statuses regarding whether a retailer had established the four types of digital retailing practices before the COVID-19 crisis are tracked. To further ensure the validity of the main impact analysis, assignment statuses regarding whether a retailer had been equipped with the five possibly overlapped business practices (Keane and Neal, 2021; Laato et al., 2020) before the COVID-19 crisis were also taken into account.

Control variables: Some firm-level factors and regional variations that may relate to physical retailers’ operational performance are controlled to avoid the omitted variable bias (Subramanyam, 2014; Xia and Zhang, 2010). At the firm level, variables, including total assets and total inventory, are collected from the aforementioned database. At the regional level, the quarterly gross

domestic products and the quarterly business volume of express services are collected from statistics authorities. The region-level data are matched to each retailer based on the retailer's business area(s).

Identification strategy. In the sense of econometric identification, the effectiveness of the pre-shock establishment of a certain digital retailing practice in triggering physical retailers' resilient performance against the COVID-19 crisis is similar to the effectiveness of an ex-ante vaccination in triggering people's immune responses to the exposure to a virus. Hence, for the identification strategy, this paper employs a DID strategy in line with the method for identifying a vaccine's immune effect (Wooldridge, 2010).⁴ Specifically, with respect to the pre-shock establishment of each digital retailing practice, heterogeneous physical retailers' responses in operational performance to the COVID-19 crisis are compared to identify the contribution of the pre-shock establishment to resilient performance (cf., Díaz et al., 2022; Konings and Vandenbussche, 2008). The corresponding econometric model is given by Eq. (1):

$$\begin{aligned} Outcome_{it} = & \alpha + \beta_1 (O2OFDS_PP_i \times Post_t) + \beta_2 (SMSS_PP_i \times Post_t) + \\ & \beta_3 (O2OFDS_TP_i \times Post_t) + \beta_4 (SMSS_TP_i \times Post_t) + \\ & \delta^T (Placebos_i \times Post_t) + \\ & (\tau^T Placebos_i + \theta^T Treat_i + \gamma Post_t) + \pi^T X_{it} + c_t + \mu_i + \varepsilon_{it}. \end{aligned} \quad (1)$$

In Eq. (1), $Outcome_{it}$ is a proxy for one of the outcome variables of retailer i in quarter t . The outcome variables include AT_{it} and its components, $SalesG_{it}$, CAG_{it} , and FAG_{it} , requiring four separate regressions using Eq. (1). $Post_t$ is an intervention indicator variable that takes a value of 1 after 2019Q4. Column vector $Treat_i$ represents the treatment variables; column vector $Placebos_i$ represents the placebo treatment variables; column vector X_{it} denotes the control variables. c_t denotes the quarter fixed effects; μ_i denotes the firm fixed effects. The involvement of these fixed effects can control for the unobservable disturbances from the factors that are invariant across firms or constant over time.

The interaction terms of $Post_t$ and each treatment variable are at the core of the identification. The estimators of their coefficients can capture the resilient performance triggered by the pre-shock establishment of the digital retailing practices against the COVID-19 crisis (i.e., the average treatment effects on the treated, ATTs). At the same time, the interaction terms of $Post_t$ and each placebo treatment variable are also included in the model to control for the confounding effects of the pre-shock establishment of possibly overlapped business practices (cf., the immune effects triggered by the ingredients besides the intended active ingredients within a vaccine).

Taking the ATT concerning the pre-shock establishment of O2OFDS-PP as an example, Fig. 6 illustrates how the above model works and why the estimators of β_1 through β_4 can capture the effects of concern. As illustrated, when focusing on one of the digital retailing practices, all other treatment and placebo treatment interaction terms enter the model together to control for the potential omitted variable bias (Imbens and Rubin, 2015; Rosenbaum, 1987). According to the digital retailing practices' mutually exclusive advantages (see Table 3), the model does not involve any triple difference term (e.g., $SMSS_PP_i \times O2OFDS_PP_i \times Post_t$) in the identification. The resilient performance triggered by the pre-shock establishment of two digital retailing practices together can be identified by taking the sum of the resilient performance triggered by the two digital retailing practices separately. The term $(\tau^T Placebos_i + \theta^T Treat_i + \gamma Post_t)$

is actually omitted in the regressions because of its collinearity with the fixed effects (cf., Beck et al., 2010).

To ensure the validity of estimating the ATTs, the corresponding treatment assignments must have no significant correlation with the outcome variables unless the sample retailers have been exposed to the COVID-19 crisis. That is to say, the treatment and control groups should have stable parallel trends in the outcome variables before being exposed to the shock (Wooldridge, 2010; Lechner, 2011). The test for this issue is presented in the dynamics analysis.

Qualitative interview. Some qualitative materials are derived to further confirm and explain the findings indicated by the quantitative analysis. Specifically, six executives from six different retailers have been purposively selected as empirical cases (Johnston et al., 1999; Yin, 2009). Of the retailers, three (i.e., #1, #3, and #5 in the appendix) had businesses related to O2OFDS-PP and/or O2OFDS-TP during the COVID-19 crisis, whilst five (i.e., #2, #3, #4, #5, and #6 in the appendix) had businesses related to SMMS-PP and/or SMMS-TP during the COVID-19 crisis. The executives' attitudes toward O2OFDS and SMMS within the COVID-19 context have been explored by semi-structured interviews. Due to the small size of the sample, only the information drawn from no less than two interviewees is adopted as supplementary evidence in explaining the quantitative analysis results (Punch, 2013).⁵

Empirical results

Main impact analysis. The estimators of the ATTs of concern are presented in Table 4. Columns (1) through (4) report the results of regressions with the four outcome variables (viz., $SalesG_{it}$, CAG_{it} , FAG_{it} , and AT_{it}) respectively. In Column (1), in terms of the impacts of the pre-shock establishment of O2OFDS-PP and SMMS-PP on the treated retailers' sales (growth) against the COVID-19 crisis, all the estimators are insignificant. Conversely, as a response to the shock, the sample retailers that had established O2OFDS-TP before the shock exhibited 31.028 ($p < 0.01$) higher sales (growth) on average compared with those without the pre-shock establishment; the sample retailers that had established SMMS-TP before the shock exhibited 17.140 ($p > 0.10$) higher sales (growth) on average compared with those without the pre-shock establishment. In Column (2), as the outcome variable turns to current assets (growth), all the ATT estimators are not strongly significant. These results coincide with the evidence reported in previous studies (e.g., Li et al., 2023) and some executives' opinions (e.g., Issue I #1 and #3 in the appendix).

Roughly, the results show that the pre-shock establishment of the digital retailing practices operated based on proprietary platforms did not significantly trigger retailers' bounce-back performance against the COVID-19 crisis, while the pre-shock establishment of the digital retailing practices operated based on large third-party platforms possibly triggered physical retailers' bounce-back performance against the COVID-19 crisis. This somewhat lends credit to Hypothesis 1, while the dynamics analysis is required to further confirm this hypothesis and check Hypotheses 2 and 3.

In Column (3), the sample retailers that had established O2OFDS-PP before the shock exhibited 86.475 ($p < 0.01$) lower illiquid assets (growth) on average against the COVID-19 crisis compared with those without the pre-shock establishment. The sample retailers that had established SMMS-PP before the shock exhibited 117.647 ($p < 0.01$) higher illiquid assets (growth) on average against the COVID-19 crisis compared with those without the pre-shock establishment. The sample retailers that

Table 3 Treatment and placebo treatment assignments used in the empirical analysis.

Variable	Treatment group (treatment assignment status = 1)		Control group (treatment assignment status = 0)	
	Criteria	Obs.	Criteria	Obs.
<i>Treatment assignments</i>				
O2OFDS_PP	A retailer had established O2OFDS-PP before 2020	105 (15 retailers)	A retailer had not established O2OFDS-PP before 2020	444 (35 retailers)
SMMS_PP	A retailer had established SMMS-PP before 2020	56 (8 retailers)	A retailer had not established SMMS-PP before 2020	493 (42 retailers)
O2OFDS_TP	A retailer had established O2OFDS-TP before 2020	63 (9 retailers)	A retailer had not established O2OFDS-TP before 2020	486 (41 retailers)
SMMS_TP	A retailer had established SMMS-TP before 2020	21 (3 retailers)	A retailer had not established SMMS-TP before 2020	528 (47 retailers)
<i>Placebo treatment assignments</i>				
PP	A retailer had proprietary platforms before 2020	154 (22 retailers)	A retailer had not owned a proprietary platform before 2020	395 (28 retailers)
TP	A retailer had participated in large third-party platforms before 2020	112 (16 retailers)	A retailer had not participated in large third-party platforms before 2020	437 (34 retailers)
PD	A retailer had used proprietary delivery for its online retail before 2020	56 (8 retailers)	A retailer had not used proprietary delivery for its online retail before 2020	493 (42 retailers)
SuperM	A retailer had engaged in a supermarket business as its main business before 2020	56 (8 retailers)	A retailer had not engaged in a supermarket business as its main business before 2020	493 (42 retailers)
Diversified	A retailer was a diversified company at the beginning of 2020	21 (3 retailers)	A retailer was not a diversified company at the beginning of 2020	528 (47 retailers)

This table is just about treatment assignment information, which is constant over time. A business is regarded as a firm's main business if the business accounts for more than 50% of the firm's total revenues at the end of 2019. A (comprehensive) retailer is regarded as a diversified company if it has a retailing-irrelevant business (e.g., medical manufacturing) that singly accounts for 20% of the retailer's total revenues or gross profits at the end of 2019. Of the 8 sample retailers that had established SMMS-PP before 2020, 6 had established O2OFDS-PP before 2020. None of the sample retailers had established both O2OFDS-TP and SMMS-TP before 2020. 27 sample retailers had not established each of the digital retailing practices before 2020.

had established O2OFDS-TP before the shock exhibited 113.993 ($p < 0.10$) lower illiquid assets (growth) on average against the COVID-19 crisis compared with those without the pre-shock establishment. The sample retailers that had established SMMS-TP before the shock exhibited 153.175 ($p < 0.05$) lower illiquid assets (growth) on average against the COVID-19 crisis compared with those without the pre-shock establishment.

As indicated by the above results, the pre-shock establishment of SMMS-TP enabled physical retailers to satisfy the shifted consumers' during-shock demand, but the effect is weaker compared with that of the pre-shock establishment of O2OFDS-TP. Nevertheless, the pre-shock establishment of SMMS-TP strongly facilitated physical retailers to reconfigure their long-term investments (e.g., their plans for retail branch distribution and expansion). At the same time, the pre-shock establishment of O2OFDS-PP and SMMS-PP also seemed effective in enabling physical retailers to redispense their long-term investments. Physical retailers, with the pre-shock establishment of SMMS-PP, would like to leverage the digital retailing practice to adjust their operational infrastructures in response to the COVID-19 crisis. However, such an adjustment might require further investments by retailers in order to upgrade their proprietary offline and online facilities (Lo and Lam, 2015). This implies a type of temporary cost rather than improvement. In general, the above results give Hypothesis 4 some support.

In Column (4), the impacts of the pre-shock establishment of O2OFDS-PP and SMMS-PP on the treated retailers' asset turnover against the COVID-19 crisis are not significantly positive, while the impacts of the pre-shock establishment of O2OFDS-TP and SMMS-TP on the treated retailers' asset turnover against the shock are significantly positive. The results indicate that the coincidental matching with the temporary demand shift should be a prerequisite for the pre-shock establishment of a digital retailing practice to trigger retailers' overall resilient performance against the COVID-19 crisis. This does not depend on whether or not there was any bounce-forward performance triggered. Actually, illiquid assets are

usually a minor part of retailers' asset structure, and retailers' overall operational performance in a short period mainly depends on their efficiency in selling activities (Subramanyam, 2014).

Dynamics analysis

Extended identification specifications. To test the parallel trends assumption and further examine the hypotheses, the dynamics of the main impacts are decomposed using the following event study approach (ESA) models:

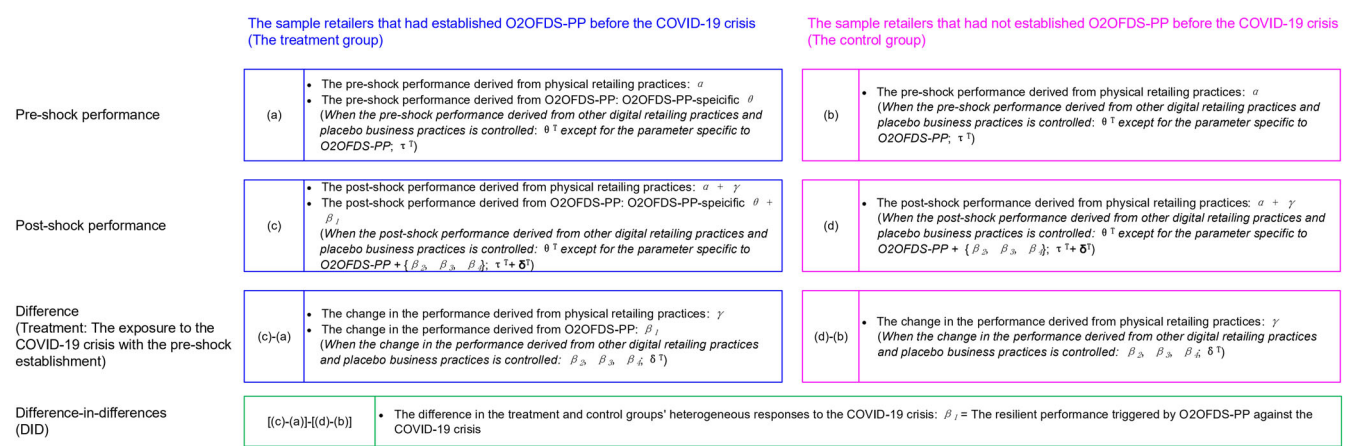
$$Outcome_{it} = \alpha + \sum_Q \beta_{1Q} (O2OFDS_PP_i \times Q_t) + \beta_2 (SMMS_PP_i \times Post_t) + \beta_3 (O2OFDS_TP_i \times Post_t) + \beta_4 (SMMS_TP_i \times Post_t) + \delta^T (Placebos_i \times Post_t) + \pi^T X_{it} + c_i + \mu_i + \varepsilon_{it}. \quad (2)$$

$$Outcome_{it} = \alpha + \beta_1 (O2OFDS_PP_i \times Post_t) + \sum_Q \beta_{2Q} (SMMS_PP_i \times Q_t) + \beta_3 (O2OFDS_TP_i \times Post_t) + \beta_4 (SMMS_TP_i \times Post_t) + \delta^T (Placebos_i \times Post_t) + \pi^T X_{it} + c_i + \mu_i + \varepsilon_{it}. \quad (3)$$

$$Outcome_{it} = \alpha + \beta_1 (O2OFDS_PP_i \times Post_t) + \beta_2 (SMMS_PP_i \times Post_t) + \sum_Q \beta_{3Q} (O2OFDS_TP_i \times Q_t) + \beta_4 (SMMS_TP_i \times Post_t) + \delta^T (Placebos_i \times Post_t) + \pi^T X_{it} + c_i + \mu_i + \varepsilon_{it}. \quad (4)$$

$$Outcome_{it} = \alpha + \beta_1 (O2OFDS_PP_i \times Post_t) + \beta_2 (SMMS_PP_i \times Post_t) + \beta_3 (O2OFDS_TP_i \times Post_t) + \sum_Q \beta_{4Q} (SMMS_TP_i \times Q_t) + \delta^T (Placebos_i \times Post_t) + \pi^T X_{it} + c_i + \mu_i + \varepsilon_{it}. \quad (5)$$

In Eqs. (2) through (5), $Q \in \{2018Q2, 2018Q3, 2018Q4, 2019Q1, \dots, 2020Q3\}$, and Q_t is a dummy designated 1 when $Q = t$. The dynamics of a certain ATT, coded n , can be derived from a series of β_{nQ} with respect to Q .⁶ For each outcome variable (i.e., Sales G_{it} , CAG $_{it}$, or FAG $_{it}$), Eqs. (2) through (5) are



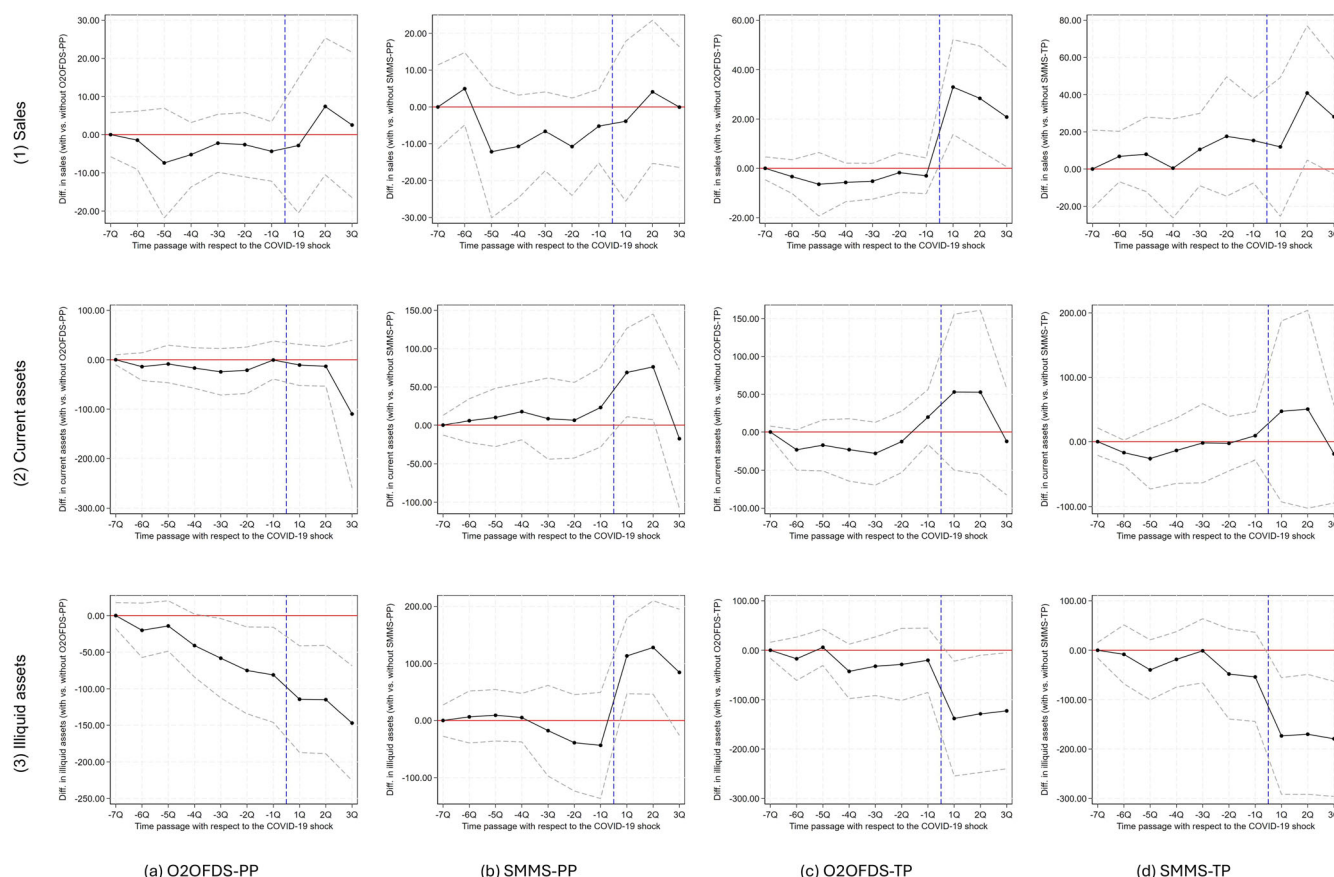


Fig. 7 The dynamics of the ATTs of concern. **a1** The dynamics of the ATT regarding the outcome variable sales (growth) and the treatment assignment O2OFDS-PP. **b1** The dynamics of the ATT regarding the outcome variable sales (growth) and the treatment assignment SMMS-PP. **c1** The dynamics of the ATT regarding the outcome variable sales (growth) and the treatment assignment O2OFDS-TP. **d1** The dynamics of the ATT regarding the outcome variable sales (growth) and the treatment assignment SMMS-TP. **a2** The dynamics of the ATT regarding the outcome variable current assets (growth) and the treatment assignment O2OFDS-PP. **b2** The dynamics of the ATT regarding the outcome variable current assets (growth) and the treatment assignment SMMS-PP. **c2** The dynamics of the ATT regarding the outcome variable current assets (growth) and the treatment assignment O2OFDS-TP. **d2** The dynamics of the ATT regarding the outcome variable current assets (growth) and the treatment assignment SMMS-TP. **a3** The dynamics of the ATT regarding the outcome variable illiquid assets (growth) and the treatment assignment O2OFDS-PP. **b3** The dynamics of the ATT regarding the outcome variable illiquid assets (growth) and the treatment assignment SMMS-PP. **c3** The dynamics of the ATT regarding the outcome variable illiquid assets (growth) and the treatment assignment O2OFDS-TP. **d3** The dynamics of the ATT regarding the outcome variable illiquid assets (growth) and the treatment assignment SMMS-TP.

the pre-shock establishment, but there is also no evidence that the COVID-19 crisis disrupted the pre-existing trend. Figure 7b2 and Fig. 7b3 indicate that the pre-shock establishment of SMMS-PP led to short-term jumps in the treated retailers' current assets and illiquid assets during the COVID-19 crisis. As aforementioned, leveraging established SMMS-PP to reconfigure operations might induce extra operational costs to supplement resources in the short term. As shown in the appendix, "to provide customers with a good experience, we [a physical retailer] need to invest a lot in live-streaming infrastructures and professionals, so we cannot derive too many profits from this business [in the short term]" (see Issue 6 #6 for the original material and #3 for a similar opinion).

Figure 7c3 and Fig. 7d3 show that the pre-shock establishment of both O2OFDS-TP and SMMS-TP facilitated the sample retailers in slowing down illiquid assets expansion in response to the COVID-19 crisis. In particular, the negative ATTs occurred immediately after the COVID-19 outbreak and remained stable over time. In general, Hypothesis 4 can be partly supported by the above results. On the one hand, the contributions of O2OFDS-PP and SMMS-PP to physical retailers' bounce-forward performance are not very solid. On the other hand, the results generally imply that the pre-shock establishment of different digital retailing

practices triggered physical retailers' bounce-forward performance against the COVID-19 crisis regardless of the differences in triggering bounce-back performance.

Further mechanism analysis. To further understand the triggered bounce-forward performance, this paper collects the data of the sample retailers' newly established branches in 2019 and 2020, and checks whether the digital retailing practices operated based on large third-party platforms caused a slow-down in physical retailers' branch expansion as a response to the COVID-19 crisis. The expected difference (i.e., the difference conditional on the control variables involved in Eq. (1)) in the shock-reactive changes of branch expansion with respect to the treatment variable TP_i is estimated and reported in Supplementary Fig. S1. The specific types of digital retailing practices are not involved here. As the data are only available by year, involving too many treatment statuses in the estimation may lead to serious collinearity problems and small-sample biases.

As shown in Supplementary Fig. S1, the sample retailers that had established digital retailing practices based on large third-party e-commerce platforms before the COVID-19 crisis contracted their plans for branch expansion against the pandemic

more significantly compared with those without the pre-shock establishment. As indicated in Supplementary Table S2, the exposure to the COVID-19 crisis did not change the situation that differences in total assets with respect to the treatment assignments are insignificant. This implies that physical retailers' reconfiguration of their plans for branch expansion is more likely intended activities rather than forced give-up with losses. In other words, the pre-shock establishment of O2OFDS-TP and SMMS-TP triggered retailers' bounce-forward performance against the COVID-19 crisis by enabling them to responsively reconfigure their long-term investments toward the shock-shaped market trends.

Discussion and conclusion

Theoretical implications

Addressing the concern about temporality of digitalization-enabled resilience. This paper somewhat addresses the concern about the temporality of digitalization-enabled resilience (Boh et al., 2023) by revealing that different non-dedicated digitalization practices can trigger physical retailers' resilient performance against a great shock.

In the past, researchers mostly focused on digital resilience capabilities when evaluating digitalization-enabled resilience, but it is actually difficult to confirm whether such organizational capabilities can take effect across different shocks (Ge et al., 2022; Kim, 2020). This paper investigates the contribution of digitalization to specific resilient performance under great shock. As shown in Table 5, Hypothesis 4 is partly supported by the empirical results. Specifically, the pre-shock establishment of both O2OFDS-TP and SMMS-TP triggered physical retailers' bounce-forward performance against the COVID-19 crisis; the pre-shock establishment of O2OFDS-PP and SMMS-PP possibly enabled physical retailers to reconfigure their long-term investments toward the market trends shaped by the COVID-19 crisis.

These findings imply a type of generality across different digitalization practices in the sense of triggering resilient performance. As indicated, regardless of the differences in triggering bounce-back performance, the different digital retailing practices can contribute to a single type of resilient performance against the COVID-19 crisis. The triggered bounce-forward performance may be a concrete image of the digital resilience capabilities of quick sensing and responsive reconfiguration (Boh et al., 2023; Munir et al., 2022). It shows that the capabilities are

not subject to the coincidental matching between digitalization practices and shock-induced market structure changes.

Linking specific digitalization practices with specific resilient performance. As one of the first that directly links specific digitalization practices with specific resilient performance, this paper justifies the non-negligibility of the direct mapping in the research on digitalization-enabled resilience evaluation.

The hypothesis testing results (see also Table 5) show that (1) the pre-shock establishment of O2OFDS-PP and SMMS-PP did not trigger physical retailers' bounce-back performance against the COVID-19 crisis, because the platform adoption (i.e., physical retailers' proprietary platforms) did not meet the shifted consumers' channel preferences; (2) the pre-shock establishment of O2OFDS-TP triggered physical retailers' bounce-back performance during the whole COVID-19 crisis because O2OFDS-TP's advantage might coincidentally meet the shifted consumers' preference for daily necessities throughout the shock; and (3) the pre-shock establishment of SMMS-TP triggered physical retailers' bounce-back performance during the second stage of the shock, because SMMS-TP's advantage might coincidentally meet the shifted consumers' need to achieve a normal shopping experience at the second stage of the COVID-19 crisis.

The contribution of the coincidentally matched digital retailing practices to physical retailers' bounce-back performance against the COVID-19 crisis may be a realization of (digitalization-based) operational redundancy's effect on firms' absorptive resilience capability (Sahebjamnia et al., 2015; Wang et al., 2010). The findings emphasize that the condition for this generalized effect to be specifically realized is very strict. Even a slight deviation from a coincidental matching condition should not be allowed for a digitalization practice to trigger physical retailers' bounce-back performance against a great shock. Hence, researchers should pay more attention to specific digitalization practices rather than composite digitalization in evaluating digitalization-enabled resilience.

Managerial implications

Emphasizing the risk of leveraging digital retailing to trigger bounce-back performance. This paper unveils a dilemma concerning leveraging digital retailing to build resilience to great shocks. That is, digital retailing practices that are effective for helping physical retailers thrive after a great shock may not help

Table 5 Summary of hypothesis testing results.			
Hypothesis	Overall testing result	Specific propositions	Testing result
H1	Supported	Physical retailers' pre-shock establishment of digital retailing practices operated based on proprietary platforms did not trigger their bounce-back performance against the COVID-19 crisis.	Supported
		Physical retailers' pre-shock establishment of digital retailing practices operated based on large third-party platforms offered the opportunity to trigger their bounce-back performance against the COVID-19 crisis.	Supported
H2	Supported	Physical retailers' pre-shock establishment of O2OFDS-TP triggered their bounce-back performance against the COVID-19 crisis during the whole shock.	Supported
H3	Supported	Physical retailers' pre-shock establishment of SMMS-TP triggered their bounce-back performance against the COVID-19 crisis at the second stage of the shock.	Supported
H4	Partly supported	Physical retailers' pre-shock establishment of O2OFDS-PP triggered their bounce-forward performance against the COVID-19 crisis.	Questionable
		Physical retailers' pre-shock establishment of SMMS-PP triggered their bounce-forward performance against the COVID-19 crisis.	Questionable
		Physical retailers' pre-shock establishment of O2OFDS-TP triggered their bounce-forward performance against the COVID-19 crisis.	Supported
		Physical retailers' pre-shock establishment of SMMS-TP triggered their bounce-forward performance against the COVID-19 crisis.	Supported

them survive during the shock. As shown in the interviews, some physical retailers are forced to adopt digital retailing without grasping the advantages of different digital retailing practices in detail (e.g., Issue I #5 and #6 in the appendix). These thoughtless physical retailers may suffer from a cost-effectiveness risk (Dormady et al., 2022), given the individuality of digitalization-triggered bounce-back performance and the high fixed cost of digitalizing physical retail operations (Durand and Baud, 2024).

With this risk, it is unwise to suggest that physical retailers pin their hopes on catching the coincidentally matched digital retailing practices under a great shock. For triggering bounce-back performance under a specific great shock, a better choice for physical retailers may be a temporary action based on their advantages in physical retail operations. For example, Sam's Club resurged quickly from the lockdown in Shanghai in April 2024. Digitalization contributed little to this resurgence. Instead, the retailer benefited a lot from exploiting its advantages of stably supplying big-box goods through offline warehouse stores (Chen, 2022; Ding, 2022).

Clarifying the prospect of leveraging digital retailing to trigger bounce-forward performance. This paper reveals the generality of digital retailing practices in the sense of triggering bounce-forward performance against great shocks. Participation in digital retailing generally empowers physical retailers with the necessary resources (e.g., digital supply chain technologies and customer data) to improve their capabilities of quickly sensing market environment changes. Accordingly, they may be able to grasp opportunities and avoid threats more easily under great shocks. In this sense, even if physical retailers get involved in digital retailing passively, they can still benefit from digital retailing practices in terms of building resilience.

However, although the above implication somewhat reassures retail executives' worry about achieving temporary resilience at the expense of costly digital transformation, it does not imply that every digital retailing practice can work efficiently. For example, Yonghui Superstores adopted O2OFDS very early, but most related businesses were operated within an independent business segment that contributed little to digitalizing other offline retail businesses. In this case, the digital retailing practice barely helped the whole company adapt to the post-pandemic marketplace (Chen, 2023). To properly exploit the potential of digital retailing in triggering bounce-forward performance, executives of physical retailers should learn from digital retailing consciously and refresh the entire operation systems based on the resources acquired from digital retailing.

Conclusions. This paper investigates the effects of the pre-shock establishment of O2OFDS-PP, SMMS-PP, O2OFDS-TP, and SMMS-TP on triggering physical retailers' bounce-back and bouncer-forward performance against the COVID-19 crisis. On the one hand, the empirical analysis indicates that different digital retailing practices can trigger physical retailers' bounce-forward performance against the COVID-19 crisis. This contributes to addressing the concern about the temporality of digitalization-enabled resilience by revealing the generality of digital retailing practices in the sense of triggering bounce-forward performance. On the other hand, the empirical analysis shows that physical retailers' bounce-back performance at a specific stage of the COVID-19 crisis can only be triggered by digital retailing practices that coincidentally apply to the shock-induced market structure changes at the stage. This highlights the individuality of each digitalization practice and justifies the necessity of studying the direct effect of specific digitalization practices on specific

resilient performance when evaluating digitalization-enabled resilience.

Although several lessons can be learned from this paper, there are still some limits in the empirical analysis, and some important issues may deserve further exploration. First, in the DID identification, to keep the units of measurement similar to each other in terms of operations, this paper employs Chinese-listed general merchandise retailers as a sample. The industry uniqueness and country uniqueness may limit the practical implications of the findings. Second, this paper only provides a non-exclusive explanation for the impact of the pre-shock establishment of SMMS-PP on physical retailers' resilient performance against the COVID-19 crisis. Given the popularity of the digital retailing practice in today's retail market, it may be informative to further collect data and clarify the above issue in detail. Third, it would be interesting to review other great shocks and investigate whether different digitalization practices can generally trigger physical retailers' bounce-forward performance. An affirmative result may further support the generality of digitalization practices in the sense of triggering bounce-forward performance.

Data availability

The interview materials are presented in the Appendix, which has been uploaded as a supplementary file. The datasets analyzed in the study are also available online as a supplementary material.

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Notes

- 1 In this paper, digitalization-enabled resilience is used to summarize the resilience outcomes resulting from digitalization, including digital resilience capabilities and digitalization-triggered resilient performance. Roughly, in the sense of building resilience, digitalization-triggered resilient performance can be regarded as the final product, while digital resilience capabilities are similar to the intermediate products.
- 2 This paper does not distinguish between organizational resilience and operation system/supply chain resilience. When taking a firm as a whole and focusing on its (final) operational outcomes, the above two concepts are equivalent to each other.
- 3 The data of Gansu Guofang Industry & Trade Group in 2018Q1 are omitted because they are not recorded by the Shanghai Stock Exchange's public database.
- 4 To some extent, the pre-shock establishment of each digital retailing practice is similar to the pre-exposure vaccination in a vaccine clinical trial, which should have no immediate effect on the treated units in terms of the outcome of concern.
- 5 It should be noted that all the qualitative materials can only provide supplementary evidence. They are not independently convincing because the case selection has not achieved information richness.
- 6 The initial period is omitted due to collinearity.

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Author contributions

Sirui Li and Ying Liu proposed the research idea. Jing Su, Xianwei Shi, and Jie Wang also contributed to the formulation of the research. Sirui Li performed the quantitative analysis. Ying Liu performed the qualitative study, including organizing the interviews and analyzing the materials. Sirui Li and Jing Su wrote the original manuscript, with the contribution of Jie Wang and Michael Lepech to edits and revisions. Sirui Li, Ying Liu, Jing Su, and Xianwei Shi took the analysis and writing tasks in the revision phase. Ying Liu (principal), Xianwei Shi, and Sirui Li jointly supervised the research. Resources needed for conducting the research were provided by Ying Liu.

Competing interests

The authors declare no competing interests.

Ethical approval

The interview materials were performed in line with the principles of the Declaration of Helsinki. Approval was obtained from the ethics committee of the Research Center for Cyber-Economy and Knowledge Management, University of Chinese Academy of Sciences (Beijing Municipal Open Lab of Cyber Economy and Knowledge Management at Zhongguancun) on July 11, 2022 (File no. 2022CEKM061001). The rest part of this article does not contain any studies with human participants.

Informed consent

Informed consent was obtained from the interviewees included in the study. With the interviewees' approval, some anonymity policies were employed when presenting the interview materials to avoid the disclosure of personal identifiers.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-024-03927-0>.

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