The effect of customer and supplier concentration on firm resilience during the COVID-19 pandemic: Resource dependence and power balancing

Abstract

The COVID-19 pandemic has created significant disruptions in both demand and supply. Our study makes use of such dramatic changes in demand and supply during the pandemic to examine resource dependence and power balancing/unbalancing issues in buyer–supplier relationships. Specifically, we investigate the effect of customer and supplier concentrations on firm resilience during the pandemic. Drawing on resource dependence theory (RDT), we theorize that shifts in demand and supply in different pandemic stages influence the effect of customer and supplier concentrations on firm resilience by altering the power dynamics between focal firms and their concentrated customers and suppliers. Central to our theorizing is that the worsening power imbalance is more detrimental. Measuring firm resilience by loss and recovery (i.e., change) in productivity, our analysis of 23,440 Chinese listed firms' quarter observations from 2019 to 2020 shows that customer concentration is negatively related to firm resilience in the disruption stage but has no effect in the restoration stage. Supplier concentration is positively related to firm resilience in the disruption stage but undermines firm resilience in the restoration stage. These findings largely confirm our theoretical propositions. We discuss the theoretical and managerial implications.

KEYWORDS: customer concentration; supplier concentration; COVID-19; resilience; resource dependence

1 | INTRODUCTION

The ongoing COVID-19 pandemic has been considered one of the biggest challenges since World War II (Pantano et al., 2020; Saiah et al., 2022). It not only threatens human health but also significantly cripples the global economy. One major economic manifestation is unprecedented disruptions and shifts in demand and supply (Craighead et al., 2020; Ivanov, 2020). Lockdown orders stifle demand for most goods and block the supply and movement of materials (Lee et al., 2020a). The resumption of work and production sharply boosts demand but overwhelms supply lines (Lynch, 2021). These tumultuous disruptions in both the demand and supply ends have brought to the fore the importance of supply chain management more than ever before and have left managers wondering which supply chain characteristics can help firms combat and navigate the pandemic.

Firms with particular supply chain characteristics can operate well during a stable economy, but they may become weak and vulnerable in the case of a crisis or major disruption, costing them all the wealth they have accumulated for years and threatening their survival directly. In this study, we focus on one of the most controversial supply chain characteristics—customer and supplier concentrations (Kim, 2017; Korcan Ak & Patatoukas, 2016), and investigate how they impact firm resilience—the opposite of vulnerability of a firm in case of a major crisis (van der Vegt et al., 2015).

Advocates of building a concentrated customer/supplier base claim that reducing the number of supply chain partners enables firms to focus their resources and energy on a few major customers/suppliers, increasing the likelihood of building strong relationships with major customers/suppliers and facilitating collaboration and mutual help (Saboo et al., 2017). This may help firms maintain resilience during a crisis (Bode et al., 2011). As a case in point, JD.com, a major customer of many manufacturers, initiated a number of measures during the pandemic to help manufacturers overcome the difficulties (Shen & Sun, 2021). Nevertheless, a concentrated customer/supplier base indicates fewer outside choices and higher dependencies on major customers/suppliers (Kim & Zhu, 2018; Schwieterman et al., 2018), increasing partner-level uncertainties and risks that firms may face during a crisis (Dong et al., 2021; Lee et al., 2020b; Leung & Sun, 2021). For instance, when major apparel brands canceled orders

to reduce their own losses during the pandemic, upstream manufacturers were devastated.[1] These conflicting views, together with the mixed findings reported in previous studies (e.g., Kim, 2017; Saboo et al., 2017; Schwieterman et al., 2018), suggest the possibility that customer/supplier concentration is a double-edged sword: it may yield both favorable and unfavorable outcomes. This theoretical tension poses a more intriguing question: Why and when is customer/supplier concentration more beneficial or detrimental?

To bring clarity to this important question, our study makes use of the dramatic changes in supply and demand during COVID-19 and investigates how such dramatic changes intertwine with customer/supplier concentration to influence firm resilience. We draw on resource dependence theory (RDT) to understand the underlying mechanisms. RDT posits that firms depend on external entities for resources (Pfeffer & Salancik, 1978). Such dependent relationships vary considerably in terms of the level of relative dependence and the resultant power imbalance (Lumineau & Malhotra, 2011). When a party possesses more critical and scarce resources, it has more power over its counterparts, and power imbalance occurs (Emerson, 1962). Power-unbalanced relationships are more likely to trigger opportunistic and exploitative behaviors and a focus on self-interest (Casciaro & Piskorski, 2005; Cheng et al., 2021; Karanovic et al., 2021), whereas power-balanced relationships are more likely to lead to collaborative interactions and a focus on mutual interests (Kumar et al., 1998). We postulate that the dramatic shifts in demand and supply during the pandemic reshape resource dependence within supply chains (Craighead et al., 2020), alleviating or worsening the power imbalance issues between firms and their concentrated partners and thus shaping the effect of customer and supplier concentrations on firm resilience.

Specifically, considering the divergent patterns of demand and supply shifts in different stages of the pandemic, our study focuses on both the disruption and restoration stages. During the disruption stage, when the demand for most products drops, the downstream parties reduce their dependence on upstream parties for inputs, whereas the upstream parties increase their dependence on downstream parties for orders and revenues. As a result, the power relationship

[1] https://www.business-humanrights.org/en/latest-news/major-apparel-brands-delay-cancel-orders-in-response-to-pandemic-risking-livelihoods-of-millions-of-garment-workers-in-their-supply-chains/

between focal firms and their concentrated customers is more unbalanced, and that with concentrated suppliers is more balanced. During the restoration stage, when demand soars and supply becomes the bottleneck, the downstream parties increase their dependence on upstream parties for inputs, whereas the upstream parties are overwhelmed with demand and less dependent on downstream parties for orders. Consequently, the power relationship between focal firms and their concentrated customers is more balanced, and that with concentrated suppliers is more unbalanced. Accordingly, we postulate that customer concentration is detrimental in the disruption stage and becomes beneficial in the restoration stage; supplier concentration is beneficial in the disruption stage but becomes detrimental in the restoration stage.

We first collected qualitative data through interviews with 24 managers from 24 different firms to develop our hypotheses and provide qualitative evidence for our theorization. Then, based on 2,990 Chinese listed firms (medical-related industries excluded) and 23,440 firm-quarter observations, we use ordinary least squares (OLS) models with industry fixed effect to test our hypotheses. Firm resilience is measured by the change in productivity—the difference between the current and previous periods. The results largely support our conjectures and are consistent under alternative variable measurements. To provide further evidence of the power unbalancing mechanism, we examine the dyadic relationship between a focal firm and one of its major customers or suppliers and elucidate how size asymmetry, another indicator of an unbalanced power relationship, affects firm resilience. The results corroborate our theorization.

Our study makes two major contributions to the operations management literature. First, our study advances the literature on customer and supplier concentrations by uncovering and testing the mechanisms of their effects during crises. We demonstrate that the worsening power imbalance due to dramatic supply and demand shifts is the primary mechanism by which customer and supplier concentrations are detrimental to firm resilience. Second, our study contributes to the disruption and resilience literature by highlighting the importance of taking a closer look at the characteristics of each stage of a crisis. We reveal a novel path of how the macro environmental characteristics of the crisis influence the efficacy of resilience strategies by reshaping micro supply chain relationships.

The remainder of the manuscript is structured as follows: Section 2 presents the literature review and theoretical background, followed by Section 3, in which we draw on findings from the interviews and theoretical works to develop our hypotheses. In Section 4, we describe the data sources and measures of the constructs and model specifications. Section 5 presents the empirical results, followed by the theoretical and managerial discussions in Section 6.

2 | LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1 | Resilience

The high occurrence of disasters and crises in recent decades has spurred research on resilience across different disciplines (van der Vegt et al., 2015). Typically, resilience is treated as a companion concept to "disruptions" (Scholten & Schilder, 2015), more precisely as the ability to respond to disruptions (Bhamra et al., 2011). Due to its dynamic and multidimensional nature (DesJardine et al., 2019; Dormady et al., 2019), scholars define and understand resilience in different ways (Ge et al., 2022). In the operations management literature, Kim et al. (2015) emphasize resilience as the ability of a firm to mitigate the negative effects of a supply disruption. Ambulkar et al. (2015) describe resilience as the ability of a firm to alert, accommodate, and rapidly react to shocks and disruptions. Wieland and Durach (2021) state that "resilience does not just relate to the ability of a system to 'bounce back' after an impending event, but also to the capacity to adapt and transform" (p.315). Ge et al. (2022) describe resilience as a firm's capability to withstand disruptions and recover quickly. Taking these perspectives together, we define firm resilience as the ability of an organization to cushion itself against damage and recover rapidly from a disruption (Essuman et al., 2020). Consistent with previous research (Davis et al., 2020; Ge et al., 2022; Melnyk et al., 2014), our understanding of resilience also highlights two dynamic components: minimizing losses in the disruption stage (the resistance component) and striving to bounce back in the recovery stage (the recovery component).

Another ambiguity of resilience lies in its inconsistent operationalizations. As a latent construct, resilience cannot be directly measured or observed (DesJardine et al., 2019). Some studies have used survey instruments to assess respondents' perceptions of firm resilience (e.g.,

Ambulkar et al., 2015; Essuman et al., 2020). This approach falls short of objectivity. One common objective way to measure resilience is to assess the changes that resilience evokes in other performance outcomes (DesJardine et al., 2019). For example, scholars have used changes in stock price (DesJardine et al., 2019; Sajko et al., 2021), profitability (Dimitriadis, 2021; Lin et al., 2021; Ortiz-de-Mandojana & Bansal, 2016), operating avenue (Ge et al., 2022; Li et al., 2022), and inventory (Lin et al., 2021) to measure a firm's resilience in the face of a crisis. An emerging stream of literature has begun to measure resilience from the perspective of production function (Dohale et al., 2022; Dormady et al., 2019), which depicts the efficiency and effectiveness of firms' efforts to configure the combination of inputs to obtain production targets or maximize profits (Rose, 2004). The COVID-19 pandemic affects almost every aspect of a firm's production, including the inputs of labor, capital, and materials (Shen & Sun, 2021), rendering the change in production and productivity a more precise indicator of firm resilience during the pandemic.

In this study, adaptively applying the canonical resilience path model (Barker et al., 2016; Holling, 1973; Zobel, 2011), which is shown in Figure 1, we examine productivity changes in different stages. In Figure 1, *A* is the average productivity level before an event, while *B* is the productivity level immediately after a disaster. The relation B–A thus measures firms' productivity loss in the disruption stage. *C* is the productivity level after recovery. Thus, C–B thus measures firms' productivity recovery (Dormady et al., 2019). In this way, our analysis incorporates the resistance and recovery components of resilience.

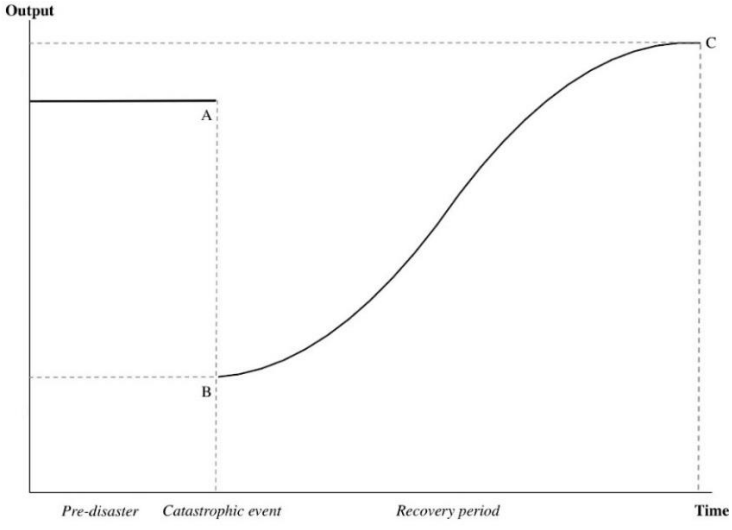

Figure 1. Firm resilience after a catastrophic event

2.2 | Resource dependence theory

RDT posits that a firm cannot possess all the resources it needs for survival; it has to depend on other external entities for access to critical resources (Pfeffer & Salancik, 1978). Such dependence can help firms buffer against uncertain environments, maintain stability of inputs and outputs, and enhance the chances of survival (Crook & Combs, 2007). However, it also adds uncertainty to and may disrupt firms' operations due to potential power imbalance problems (Hillman et al., 2009). Power, as the inverse of dependence (Emerson, 1962), is amassed when a party possesses a large volume of heavily demanded resources that are less available elsewhere (Lumineau & Malhotra, 2011). When the dependence levels between two parties are not equivalent, power imbalance arises (Casciaro & Piskorski, 2005; Emerson, 1962). Ample evidence suggests that the ramification of exchange relationships is influenced by the level of relative power (Gulati & Sytch, 2007; Lumineau & Malhotra, 2011).

Power imbalance can trigger opportunistic and exploitative behaviors (Villena & Craighead, 2017). In power-unbalanced relationships, the power-advantaged party, being less dependent on others, is more concerned with its own gains and pays less attention to those of others (McEvily et al., 2017). In the meantime, it has less to lose and is thus less afraid of retaliation (Kumar et al., 1998). As such, the power-advantaged party is more likely to wield its power to exploit the weaker parties, who are more locked in the relationships and have less leverage to resist (Huo et al., 2017; Jap & Ganesan, 2000). Consequently, adversarial tactics and uncooperative behaviors are common in power-unbalanced relationships (Hoehn-Weiss et al., 2017; Lawler & Bacharach, 1987), hurting the value of power-disadvantaged parties (Emerson, 1962; Pfeffer & Salancik, 1978).

On the contrary, power balance may deter adversarial tactics and foster collaborations (Kumar et al., 1998). In power-balanced relationships, both parties lack the overwhelming power to coerce obedience (Kim et al., 2016) and both are afraid of loss and retaliation (Kumar et al., 1998). As a result, they are more likely to make compromises and seek solutions in favor of common interests (Kim et al., 2016). This further fosters a higher level of mutual trust and

lays the foundation for close collaboration (Gulati & Sytch, 2007). Consequently, cooperative behaviors, such as information and resource exchange and joint activities, are common in power-balanced relationships (Gulati & Sytch, 2007; Uzzi, 1997), potentially benefiting both parties.

2.3 | Customer and supplier concentrations

Customer concentration refers to the extent to which a firm's sales revenue comes from a few major customers (Schwieterman et al., 2018). Supplier concentration refers to the extent to which firms' purchasing spending goes to a few major suppliers (Schwieterman et al., 2018). These two important concepts have been studied in diverse scholarships and from different perspectives. Transaction cost theory underpins the efficiency benefits of customer/supplier concentration by positing its importance in reducing supply chain complexity and coordination costs (Lanier et al., 2010). The embeddedness view highlights its importance in facilitating strong relationships with supply chain partners by focusing resources on a few major partners (Brandon-Jones et al., 2015; Choi & Krause, 2006; Giannoccaro et al., 2018; Kim, 2017; Saboo et al., 2017; Steven et al., 2014). The diversification literature consider customer and supplier concentrations as a detriment due to the risk of "putting all eggs in one basket" (Lin et al., 2021). RDT is another lens for understanding the detrimental effects of customer and supplier concentrations, and it brings forth the power imbalance, a more fundamental issue of high concentration on customers and suppliers (Kim & Zhu, 2018; Korcan Ak & Patatoukas, 2016).

All these theoretical lenses have offered valuable insights into understanding the complex effects of customer and supplier concentrations. Nonetheless, RDT represents a more appropriate theoretical lens for understanding the effects of customer and supplier concentrations during the pandemic. One major challenge brought about by the pandemic is shifts in demand and supply (Ivanov, 2020). Such shifts alter resource dependence within supply chains and introduce power dynamics into supply chain relationships (Craighead et al., 2020). Drawing on RDT in the pandemic context allows us to explore how resource dependence and power dynamics unfold and intertwine with customer and supplier concentrations to influence firm resilience in different stages of the pandemic, uncovering the

power balancing/unbalancing mechanisms.

3 | RESEARCH HYPOTHESES

Research on resilience has distinguished between two stages of a shock or crisis: the disruption stage and the recovery stage (Dormady et al., 2019; Melnyk et al., 2014). Our study focuses on the pandemic in China in 2020. During the early outbreak period of the pandemic, to save human lives and control the spread of the disease, the Chinese government issued national lockdown and stay-at-home orders. Most businesses (except for those in the healthcare sector) shut down, and supply chains were disrupted in the first quarter of 2020, which can be viewed as the disruption stage. Starting in March 2020, the pandemic was alleviated, with major decreases in the number of daily confirmed infections. On April 7, the lockdown in Wuhan was lifted, and the first wave of the pandemic in China was considered to be controlled (World Health Organization, 2020), with zero newly confirmed cases for several consecutive days. Production began to resume, and supply chains were restarted in the second quarter. Thus, we set the second quarter of 2020 as the restoration stage. Overall, although there have been occasional outbreaks of the pandemic, countrywide disruptions in China occurred in the first quarter of 2020, and life and production gradually returned to normal in the second quarter of the year, making it an appropriate time window to investigate the effect of customer and supplier concentrations on firm resilience in different stages of the pandemic. Such a classification of the stages of the pandemic is consistent with previous studies on operations management during the COVID-19 pandemic in China (Han et al., 2022; Lin et al., 2021).

To develop a deep understanding of how resource dependence changes within supply chains at different stages of the pandemic and how such changes alter the power relationships between firms and their major customers and suppliers, we collected interview data from Chinese firms. Following the principle of theoretical sampling (Eisenhardt & Graebner, 2007), we purposely selected firms that enabled us to have maximum access to data and that were critical in developing theoretical insights (Rahman, 2021). Firms that were affected by the pandemic were our targeted sample firms, and managers or executives who were in charge of supply chains and were knowledgeable of their supply chain partners' behaviors and conditions

during the pandemic were our targeted interviewees. Referrals were used to recruit interviewees (Mun & Jung, 2018).

We conducted interviews in two waves. In the first wave from April to May 2022, we conducted five interviews at different (focal) firms. In the second wave from October to November 2022, we interviewed another four firms, and using these contacts, we also interviewed some of their customers and suppliers. This allowed us to triangulate the insights obtained from the perspective of the focal firms. In total, we conducted twenty-four interviews, seven from customer firms, eight from supplier firms, and nine from different focal firms. We stopped conducting new interviews when we reached "theoretical saturation," wherein no insights were provided by the interviews (Locke, 2001). Information about the sampled firms and interviewees is shown in Appendix A. These firms covered a wide range of industries, were of different sizes, and had different levels of customer/supplier concentration (for focal firms).

All interviews were conducted using telephones or online meetings (e.g., VooV Meeting). Each lasted around forty minutes and was recorded and transcribed verbatim. A semi-structured interview protocol was used to guide the interviews. We asked questions about the demand and supply conditions in their supply chains, customers' and suppliers' attitudes and behaviors toward the focal firms, and each firm's difficulties in the disruption and restoration stages, respectively. We used an inductive approach to analyze the data. Details of the analysis are shown in Appendix B. We employed the insights obtained from the interviews to develop our hypotheses.

3.1 | Concentration and resilience: The disruption stage

In the disruption stage, due to lockdown and stay-at-home orders, the demand for most products drops significantly. Two pieces of evidence strongly support this statement. According to data from the China National Bureau of Statistics, in the first quarter of 2020, total retail sales of consumer goods dropped by 19% compared to the year before.[2] A recent study, based on data from Alibaba, the largest e-commerce platform in China, also reports that during the Wuhan

[2] https://baijiahao.baidu.com/s?id=1664423629126603378&wfr=spider&for=pc

shutdown (January 23–April 7, 2020), e-commerce sales declined by over 22% (Han et al., 2022). Such a disturbance on the consumer side propagates along supply chains, decreasing customers' dependence on focal firms for materials. All our interviews also supported this demand plunge phenomenon. For example, one manager stated, "*We have both domestic and international customers. During the lockdown, many domestic customers postponed their orders. But many international customers directly canceled the orders because they did not want to wait and because they could obtain supplies elsewhere*." Facing a demand plunge, focal firms are more dependent on orders from customers to maintain their sales and revenues. Therefore, according to RDT (Pfeffer & Salancik, 1978), the shift in demand in the disruption stage shifts power relationships between focal firms and their customers in favor of customers.

Under these circumstances, a high level of customer concentration leads to a worsened power-unbalanced relationship. Major and concentrated customers who already have overwhelming power over focal firms become more powerful. As a result, they may be more concerned with self-interest (McEvily et al., 2017) and have less fear of retaliation (Kumar et al., 1998). Facing the unforeseeable losses in the disruption stage, major customers are thus more likely to "exploit control mechanisms to reduce their own uncertainty" (Brito & Miguel, 2017, p. 83) and pass risks to their less powerful upstream counterparts (Kim et al., 2010; Leung & Sun, 2021). Consequently, focal firms face more opportunism and exploitation (Villena & Craighead, 2017). Several of our interviews supported this view. In addition to canceling orders without considering the upfront costs of focal firms, major customers tend to have other demanding requirements. For example, "*Our major customers required far more trade credit and longer terms. Besides, they refused to pay a deposit for their orders. Hence, we faced a big cash flow crunch at that time.*" On the contrary, minor customers, although they decrease their dependence on focal firms, do not have sufficient power to negotiate positive terms. One manager from a customer firm said, "*As a minor customer, we do not have much bargaining power to require the GZ company to do favors for us. We just hoped that they would consider our benefits and at least be fair.*"

Therefore, a high level of customer concentration evokes more uncertainties and exerts more constraints on firms. This further constrains firms' ability to maintain resilience in the

disruption stage. For example, the postponement of payments and the cancelation of orders may raise severe liquidity issues (e.g., cash flow shortages), limiting firms' ability to acquire sufficient resources, such as materials or labor, to maintain the continuity of operations, and to resist productivity loss. In fact, in the disruption stage, the Chinese government only allowed firms that met the epidemic prevention requirements to resume production. Therefore, if focal firms do not have enough capital to purchase epidemic protection materials, their production would be fully halted, and productivity loss would be heavy. In summary, high customer concentration reduces firm resilience in the disruption stage in a way that depletes or limits firms' resources and capacities to absorb disruptions and resist losses. Therefore, we propose the following:

Hypothesis 1a: Customer concentration is negatively related to firm resilience in the disruption stage of the pandemic.

As stated above, because of the demand plunge in the disruption stage, focal firms reduce their dependence on suppliers for inputs. Nonetheless, this renders suppliers more dependent on focal firms for orders. Our interviews with managers from supplier firms confirmed this phenomenon. "*Supply greatly exceeded demand for the whole market. Our bargaining power dropped significantly because it was difficult to get even one order. … We really needed orders from our custome*rs." In fact, as capital becomes more critical to survival during the disruption stage (Priya, 2020), suppliers are more dependent on focal firms for orders and revenues. One manager said, "*There were no sales at that time. Our inventory was piled up. We wished we could transfer every piece of the inventory into capital*." Therefore, according to RDT (Pfeffer & Salancik, 1978), the shift in demand in the disruption stage shifts power relationships between focal firms and their suppliers in favor of focal firms.

Under these circumstances, if firms have a high level of supplier concentration, the original power-unbalanced relationships between firms and their major and concentrated suppliers will be more balanced. Thus, the latter no longer has overwhelming power and advantage to exploit focal firms (Emerson, 1962; Pfeffer & Salancik, 1978). On the contrary, a more balanced relationship lays the groundwork for collaboration and the achievement of

mutual interest (Kim et al., 2016). At the very least, because both are afraid of loss and retaliation, they are more likely to make compromises (Kumar et al., 1998). For example, one manager from a focal firm said, "*Our major supplier asked us to purchase its products preferentially. As a return, they promised to offer us financial support, masks, and other epidemic prevention materials.*" However, this is not the case when the level of supplier concentration is low. With low supplier concentration, focal firms are more powerful in the disruption stage. Such power imbalance does not lay the foundation for minor suppliers to closely collaborate with focal firms (Gulati & Sytch, 2007).

Therefore, high supplier concentration during the disruption stage enables firms to build more favorable cooperative relationships with major and concentrated suppliers. This enhances firms' ability to remain resilient. Cooperation in difficult times is more likely to nurture a sense of "in it together". As a result, both parties are more frequently engaged in joint problem-solving and fine-grained information exchange (Gulati & Sytch, 2007; Uzzi, 1997), enabling focal firms to better deal with supply chain fluctuations and operational frictions. From this perspective, high supplier concentration offers firms more resources and capacities to resist productivity loss and remain resilient during the disruption stage. Therefore, we propose the following:

Hypothesis 1b: Supplier concentration is positively related to firm resilience in the disruption stage of the pandemic.

3.2 | Concentration and resilience: The restoration stage

In the restoration stage, when the lockdown has been lifted, life returns to normal. The pent-up demand accumulated in the disruption stage is released, leading to a surge in demand (Kirk & Rifkin, 2020). However, the recovery of supply is not as quick as that of demand. Our interviews suggest that many firms operate under capacity due to a shortage of labor and materials in the restoration stage. One manager said, "*The biggest challenge we faced after the resumption of production was the soaring orders. We could hardly meet the demand even though our capacity had been used 100 percent… The workers had to work three shifts a day at that time. But we were happy that our sales hit a new high.*" Another manager said, "*Our*

major customer asked us to meet the supply requirements. The thing is, they not only placed rush orders but also required quick delivery. This in turn gave us some leverage to negotiate in the transaction." Therefore, according to RDT (Pfeffer & Salancik, 1978), the shift in demand in the restoration stage shifts power relationships between focal firms and their customers in favor of focal firms.

Under these circumstances, if firms have a high level of customer concentration, the original power-unbalanced relationships between focal firms and their major and concentrated customers are weakened by a shift in demand. Thus, major customers do not have the dominant power to coerce obedience (Kim et al., 2016). On the contrary, balanced-power shifts the mindset of major customers from coercion to collaboration to avoid retaliation (Dwyer & Walker, 1981). For example, to ensure sufficient supply, instead of using negative tactics, major customers may offer help. Several managers from both the focal and customer firms stated that major customers helped the focal firms build digital capabilities to improve their ability to deal with uncertainties. Balanced-power also leads to compromises (Kim et al., 2016). One manager from a customer firm said, "*We needed to work together with our suppliers to cope with the pressure. To elicit more cooperation, we stopped punishing them for their mistakes but offered to help fix the problems.*" All these are beneficial to focal firms. Yet, when the level of customer concentration is low, power is in favor of focal firms (power imbalance), lacking the ground for cooperation (Gulati & Sytch, 2007).

Therefore, a high level of customer concentration in the restoration stage facilitates collaboration with major customers. This enables firms to gain extra support to recover quickly from disruptions. In fact, in the restoration stage, demand shifts not only in terms of quantity but also in terms of consumer spending pattern (Ketchen & Craighead, 2020). For example, due to the pandemic, Philips witnessed a demand shift from traditional consumer products to professional-level imaging and ventilator products (Hughes et al., 2020). It meets this demand by closely collaborating with its suppliers (Hughes et al., 2020). Our interviews also confirmed that major customers are more eager to collaborate with focal firms to seize market opportunities. One manager said, "*Major customers' demand was more diversified in the*

restoration stage. They wanted us to engage in their new big projects, so they offered to help us improve our research & development capabilities." Therefore, by closely collaborating with major customers, firms' own capabilities to better arrange production, adjust operations, and innovate products are improved. As a result, firms' productivity is more likely to bounce back. Therefore, high customer concentration offers firms valuable resources to recover production and maintain resilience in the restoration stage. Therefore, we propose the following:

> *Hypothesis 2a: Customer concentration is positively related to firm resilience in the restoration stage of the pandemic.*

The surge in demand and the shortage in supply in the restoration stage offer upstream suppliers abundant opportunities for new customers, decreasing their dependence on current ones. For example, one purchasing manager told us, "*When production began to resume, there was a bottleneck in the supply of materials. One of our major suppliers chose to supply to our competitor over us because that competitor ranks high in the industry.*" Another manager from a supplier firm said, "*After the lockdown, orders soared, which was a good thing. However, we were short-staffed. Meanwhile, we had to deal with uncertainties in our supply chain. Thus, not all orders could be fulfilled in a timely manner.*" According to RDT (Pfeffer & Salancik, 1978), such a shift in demand and supply in the restoration stage shifts power relationships between focal firms and their suppliers in favor of suppliers.

Under these circumstances, a high level of supplier concentration indicates a worsened power-unbalanced relationship between focal firms and their major and concentrated suppliers. Thus, the latter has more power to exploit focal firms in the restoration stage (Kumar et al., 1998). In fact, the surge in demand also places a financial burden on suppliers, as they have to increase capacity. Powerful suppliers are more likely to transfer such costs to weaker focal firms. For example, one manager from an automaker company said, "*We are a leading company in the industry. After the resumption of production, the supply of materials was sufficient and timely. However, the major suppliers significantly raised their prices. This became one of the challenges we had to face.*" In addition, when facing capacity constraints, major suppliers must decide whose orders to fulfill first. It is unlikely that focal firms' interests

would be considered preferentially because of the high power imbalance (Dwyer & Walker, 1981). As a result, focal firms' orders may be canceled or delayed. With few sources of alternative suppliers, focal firms thus face more idiosyncratic risks (Leung & Sun, 2021). Their production may be severely disturbed, significantly undermining their ability to recover from disruptions. This would not be a problem with low supplier concentration. Minor suppliers do not have the dominant power to cut supplies to focal firms, as they can be easily replaced. Furthermore, a high power imbalance also impedes fair collaboration (Kumar et al., 1998) between focal firms and major suppliers, thus limiting firms' ability to adjust production and operations to meet the diversifying demand in the restoration stage. Taken together, high supplier concentration hurts firm resilience in terms of recovery ability. Therefore, we propose the following:

Hypothesis 2b: Supplier concentration is negatively related to firm resilience in the restoration stage of the pandemic.

4 | METHODOLOGY

This section describes the empirical methodology used to test the above hypotheses. The measures of our main variables and the identification strategy are described.

4.1 | Data

We focus on the first wave of the COVID-19 pandemic in China. We draw samples from Chinese-listed firms to test our hypotheses. We exclude medical-related industries, since these industries have experienced a sharp increase in demand during the pandemic and are facing a different situation from other industries.[3] We obtain firm-level information (e.g., top five major customers, top five major suppliers, total sales, total assets, financial information, number of employees, ownership information, year of establishment, and cash payments for raw materials and service) and other accounting information from CSMAR, a database of Chinese listed firms. Our observation window is from the first quarter of 2019 to the fourth quarter of 2020. After deleting samples with missing values, we obtained a total of 2,990 unique firms and

[3] https://baijiahao.baidu.com/s?id=1664423629126603378&wfr=spider&for=pc

23,440 firm-quarter observations.

4.2 | Measures

Resilience. Following Dormady et al. (2019), we use the production function to measure firm-level resilience during the pandemic. The production function is about how firms operate, and it offers insight into the configuration of inputs and the related productivity level and specifies how the input–output relationships vary according to scale. The production function includes intermediate inputs, labor inputs, and capital investment. Following Nagle (2019) and Giannetti et al. (2015), we use the standard method of estimation, namely the classic Cobb–Douglas production function:

$$\ln(VA_{it}) = \alpha \ln K_{it} + \beta \ln L_{it} + \gamma \ln M_{it} + \delta + \epsilon_{it} \quad (1)$$

where VA_{it} is the total sales revenue of firm i in a particular quarter t, K_{it} refers to the logarithm of the total assets of firm i in a particular quarter t, L_{it} refers to the logarithm of the total number of employees of firm i in a particular quarter t, and M_{it} refers to the logarithm of the expense for materials and other inputs of firm i in a particular quarter t. Considering the quarter effect, we also add δ (season dummies) as control variables in the above model. The coefficients of each factor are equivalent to a firm's output elasticity for a given input. The coefficients represent the percentage change in VA_{it} for a 1% change in the value of the given input. We calculate firm *i*'s total factor productivity (TFP) in quarter *t* as the residual (TFP_{it}), ϵ_{it} of the firm-level regression. All these specifications assume that the price of each input reveals its value in production. Then, we use the change in productivity as the measure of resilience. The degree of change in the productivity of the current period relative to the productivity of the previous period can be a good proxy for resilience (Ambulkar et al., 2015).

$$Resilience_{it} = TFP_{it} - TFP_{it-1} \quad (2)$$

In line with the literature (Han et al., 2022), we define the first quarter of 2020 as the disruption stage during which the lockdown orders were issued and the resumption of work and production was difficult, and the second quarter of 2020 as the restoration stage during which Wuhan reopened and China had fully resumed work and production.

Customer and supplier concentrations. Following previous studies (Banerjee et al., 2008;

Campello & Gao, 2017; Kim & Henderson, 2015), we measure customer concentration by the ratio of the total sales of the top five customers to the total annual sales in each year. We measure supplier concentration by the proportion of the total purchases of the top five suppliers to the total purchase amount in each year.[4]

$$Customer\ concentration_{it} = \sum_1^5 Sales_{ist}/Sales_{it} \quad (3)$$

$$Supplier\ concentration_{it} = \sum_1^5 Purchases_{ist}/Purchases_{it} \quad (4)$$

where $Sales_{ist}$ refers to firm i's sales to major customer s in year t, $Sales_{it}$ refers to the total sales of firm i in year t, $Purchases_{ist}$ represents firm $i's$ purchases from major supplier s in year t, and $Purchases_{it}$ is the total purchases of firm i in year t. The listed firms in the Chinese stock market are only required to disclose sales or purchases from the top five customers and suppliers in the annual reports.

Control variables. To eliminate confounding effects, we include a series of factors that might impact resilience as control variables. Specifically, we control for firm size, firm age, leverage, R&D intensity (R&D), tangibleness, and state-owned enterprises (SOE). Larger firms have more financial and managerial resources than smaller ones to buffer the shock of COVID-19 and adjust production processes (Tafti et al., 2013). Thus, we control for firm size, which is measured by the logarithm of total assets. Firm age is related to production experience and established routines, which are predictors of resilience (Tsikriktsis et al., 2004). Older firms may also be less risk-taking than younger firms. Therefore, we control for firm age by calculating the number of years since the establishment of the firm. The availability of financial resources may affect cash flow and firms' resilience in crisis (Wiengarten et al. 2017). Thus, we include leverage as a control variable, which is measured by the ratio of total debts to total assets. Some companies have more intangible assets and may be more flexible in responding to the pandemic. We control for tangibleness, measured as the proportion of intangible assets

[4] The "Guidelines for the Content and Format of Information Disclosure by Companies Offering Securities to the Public" revised in 2016 require Chinese A-share companies to disclose the information of major customers and major suppliers (e.g., the percent of the sales of top five customers to total sales, the percent of the purchases of top five suppliers to total purchases) and encourage the disclosure of relevant identities.

to total assets (Lo et al., 2014).

Since high-tech firms have stronger innovation capabilities to innovate their processes and products to adapt to the uncertain environment (Yiu et al., 2020), we control for R&D intensity, which is measured by the ratio of R&D expenditures to total assets. Following Chen and Ho (2019), we set its R&D expenditure to zero if a firm's R&D expenditure is missing. In China, state-owned enterprises (SOE) have formal political connections and are more likely to conform to government goals (Tihanyi et al., 2019; Lu et al., 2020). We control for state ownership using a dummy (SOE), which is set to one if a firm is controlled by the local or central government. We also include industry dummies to control for unobserved factors across industries that may cause contemporaneous changes in the supply chain and resilience. We summarize the definition of the variables in Appendix C.

4.3 | Model specification

Table 1 shows the basic descriptive and statistical information about the variables. Our identification utilizes the lockdown induced by the COVID-19 outbreak as an exogenous shock. The premise of our method lies in the assumption that the pandemic is exogenous to all firms and their supply chain partners and that anticipated responses are unlikely. In reality, COVID-19 was initially regarded as a low-risk common flu, and no significant actions were taken until late January 2020 (Fang et al., 2020). It rapidly developed into a global pandemic, and the Chinese government then implemented a strict lockdown policy. Residents were strictly isolated, traffic was completely blocked, and almost all supply chains were disrupted.

TABLE 1. Descriptive statistics and correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Resilience	1.000										
(2) CC	0.013	1.000									
(3) SC	0.007	0.260	1.000								
(4) Disruption	-0.673	-0.003	-0.012	1.000							
(5) Restoration	0.341	0.008	-0.002	-0.141	1.000						
(6) Firm size	-0.010	-0.135	-0.141	0.019	0.006	1.000					
(7) Firm age	-0.048	-0.108	-0.041	0.044	-0.000	0.380	1.000				
(8) Leverage	-0.014	-0.050	-0.158	0.016	-0.001	0.354	0.274	1.000			
(9) Tangibleness	-0.007	0.008	0.102	0.000	-0.007	0.621	0.140	0.076	1.000		
(10) R&D	-0.004	-0.065	-0.052	0.001	-0.004	0.129	0.068	0.062	0.050	1.000	
(11) SOE	-0.010	0.009	-0.021	0.010	0.000	0.336	0.472	0.218	0.157	0.072	1.000
Mean	0.04	0.332	0.334	0.12	0.128	20.416	2.228	0.43	0.207	0.046	0.302
SD	0.981	0.223	0.19	0.325	0.334	1.719	0.741	0.195	0.148	0.053	0.459

Note: CC and SC refer to customer concentration and supplier concentration, respectively.

We estimate ordinary least squares (OLS) models with industry fixed effect to identify

how customer concentration and supplier concentration influence firm resilience in different stages of the pandemic. Our specification compares firms with different levels of customer/supplier concentration across the pre-crisis and post-crisis periods. Our post-crisis period is further divided into two periods—the disruption and restoration periods. The interactions between customer/supplier concentration and the two stages allow us to estimate how the shocks in different stages of the pandemic intertwine with customer and supplier concentrations to influence firm resilience during COVID-19. We use the following model specification with firm-quarter level panel data:

$$Resilience_{it} = F(CC_{it}, SC_{it}, SIZE_{it}, AGE_{it}, TAN_{it}, LEV_{it}, R\&D_{it}, SOE_{it}, I) \quad (5)$$

where F (·) is the OLS function, i denotes firm, t denotes the quarter, and $Resilience_{it}$ represents the change of TFP for firm i from quarter t to quarter $t-1$. I is the industry fixed effect that captures the time-invariance characteristics of the industry.

5 | EMPIRICAL RESULTS

In this section, we present the estimates of customer and supplier concentrations on resilience (productivity change) during the disruption and restoration periods. Further, we replace concentration with size asymmetry using paired data between a firm and one of its major customer/suppliers to test the underlying mechanisms of the effect of customer and supplier concentrations on resilience. Lastly, we conduct a series of robustness checks.

5.1 | Main Results

The results in Table 2 show that the coefficient of interaction between customer concentration and the disruption stage is significantly negative (b = ‐ 0.1063, p < 0.05), whereas the coefficient of interaction between customer concentration and the restoration stage is insignificant (b = 0.0042, p > 0.1). This indicates that customer concentration is negatively related to firm resilience at the disruption stage and has no relationship with resilience at the restoration stage. The interaction between supplier concentration and the disruption stage is significantly positive (b = 0.1676, p < 0.01), and that between supplier concentration and the restoration stage is negative and statistically significant (b = ‐ 0.2047, p < 0.01). This indicates that supplier concentration increases resilience at the disruption stage, but its effect becomes

negative at the restoration stage. In Columns (3)–(4), we add industry fixed effects, and the results are consistent.

TABLE 2. Baseline results

	Dependent variable: Firm resilience			
	(1)	(2)	(3)	(4)
Customer concentration * Disruption	**-0.1063****		**-0.1055****	
	(0.0476)		**(0.0476)**	
Supplier concentration * Disruption	**0.1676*****		**0.1697*****	
	(0.0548)		**(0.0549)**	
Customer concentration * Restoration		0.0042		0.0053
		(0.0335)		(0.0334)
Supplier concentration * Restoration		**-0.2047*****		**-0.2050*****
		(0.0345)		**(0.0345)**
Disruption	-2.0713***		-2.0728***	
	(0.0228)		(0.0229)	
Restoration		1.0671***		1.0668***
		(0.0143)		(0.0143)
Customer concentration	0.0839***	0.0329***	0.0849***	0.0413***
	(0.0118)	(0.0106)	(0.0134)	(0.0117)
Supplier concentration	-0.0306**	0.0467***	-0.0193	0.0501***
	(0.0146)	(0.0120)	(0.0160)	(0.0127)
Firm size	0.0118***	0.0013	0.0117***	0.0009
	(0.0018)	(0.0016)	(0.0020)	(0.0017)
Firm age	-0.0317***	-0.0726***	-0.0295***	-0.0762***
	(0.0036)	(0.0095)	(0.0079)	(0.0098)
Leverage	-0.0193	-0.0144	-0.0165	-0.0238
	(0.0133)	(0.0344)	(0.0294)	(0.0366)
Tangibleness	-0.1302***	-0.0047	-0.1473***	0.0043
	(0.0173)	(0.0145)	(0.0212)	(0.0175)
R&D	-0.0957***	-0.0019	-0.1294***	0.0028
	(0.0353)	(0.0306)	(0.0441)	(0.0353)
SOE	0.0035	0.0278*	0.0049	0.0262
	(0.0046)	(0.0156)	(0.0130)	(0.0166)
cons	0.0432	-0.0858	0.0380	0.0014
	(0.0318)	(0.0953)	(0.1089)	(0.1345)
Industry fixed	No	No	Yes	Yes
N	23440	23440	23440	23440
R^2	0.450	0.114	0.464	0.114

Note. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The robust standard in parentheses is clustered by industry.

5.2 | Mechanism test: Evidence from focal firm-major customer/supplier pairs

Our main theoretical argument is that the worsening power imbalance due to dramatic supply and demand shifts and high customer and supplier concentrations is the underlying mechanism that makes focal firms less resilient in a crisis. If this power unbalancing argument is correct, the results will hold with other indicators of power balance/imbalance. To provide further evidence of this mechanism, we replace customer and supplier concentrations with the relative size of focal firms and their major customers and suppliers, namely, size asymmetry, which is

widely agreed to be an indicator of power imbalance issues in buyer–supplier relationships (Villena & Craighead, 2017).

Size asymmetry makes more sense for paired data. Thus, the mechanism test is based on the sample of the focal firm–major customer and focal firm–major supplier pairs. First, we provide the sample construction approach. Next, we estimate the effect of size asymmetry on productivity changes in the disruption and restoration stages when the major customer and supplier have a larger size than the focal firm.

Table 3 presents the specific steps of the sample construction. To begin with, we obtain the names of the major customers and suppliers of each firm from CSMAR. However, only a small portion of the firms revealed the names of their supply chain partners. We thus further use an online crawler technique to search major customers and suppliers' financial information from the Qiachacha website (http://qcc.com). We then manually check whether the crawled companies match the names of major customers and suppliers and supplement the financial information of these customers and suppliers from multiple sources. Our final data set includes 323 unique focal firm–customer pairs with 1292 pair-year observations and 293 unique focal firm–supplier pairs with 1272 pair-year observations. Size asymmetry is measured by the firm size (the log form of total assets) difference between a major customer/supplier and a focal firm as follows:

$$\text{Size asymmetry} = \text{Size of major customer (supplier)} - \text{Size of focal firm} \quad (6)$$

TABLE 3. Name-matching procedure for sample construction.

Steps	Results
The initial listed firms from CSMAR	3777 focal firms with 5508 major suppliers and 6012 major customers
Delete the major customers and suppliers that do not have names	2034 major customers and 2420 major suppliers
Delete the major customers and major suppliers without the financial information from Qichacha	250 major customers and 230 major suppliers
Merge with the firm information from CSMAR to get the focal firm-supplier/customer pairs	323 unique focal firm–customer pairs with 1292 pair-year observations. 293 unique focal firm–supplier pairs with 1272 pair-year observations

Note: Some major customers and suppliers are matched with multiple focal firms.

Table 4 presents the results. Column (1) shows that, during the disruption stage when power imbalance is in favor of customers, the size asymmetry of customers (Major customer

> Focal firm) has a negative impact on firm resilience (b = ‐ 0.0440, p < 0.01). Column (4) shows that during the restoration stage, when power unbalancing is in favor of suppliers, the size asymmetry of suppliers (Major supplier > Focal firm) has a negative impact on firm resilience (b = ‐ 0.0296, p < 0.05). These results support our worsening power imbalance of power-unbalanced relationships during the pandemic. In addition, Columns (2) and (3) show that the effect of size asymmetry of customers (Major customer > Focal firm) in the restoration stage and that of size asymmetry of suppliers (Major supplier > Focal firm) in the disruption stage are insignificant. These results are consistent with our theory. That is, in the disruption stage, the power relationship between focal firms and major customers changes from unbalanced to more balanced, so that major customers do not have a negative impact on resilience. Similarly, in the restoration stage, the power relationship between focal firms and major suppliers changes from unbalanced to more balanced. Therefore, major suppliers will not squeeze the focal firms. These results further establish that a diminishing power imbalance (i.e., a greater power balance) is not harmful to firm resilience.

TABLE 4. The effect of size asymmetry

	Dependent variable: Firm resilience			
	(1)	(2)	(3)	(4)
	Customer side		***Supply side***	
Size asymmetry (Major customer > Focal firm) × disruption	**-0.0440***** **(0.0143)**			
Size asymmetry (Major customer > Focal firm) × restoration		0.0054 (0.0103)		
Size asymmetry (Major supplier > Focal firm) × disruption			-0.0068 (0.0240)	
Size asymmetry (Major supplier > Focal firm) × restoration				**-0.0296**** **(0.0149)**
Size asymmetry (Major customer > Focal firm)	0.0103*** (0.0029)	0.0046 (0.0099)		
Size asymmetry (Major supplier > Focal firm)			0.0005 (0.0048)	0.0052 (0.0159)
Disruption	-2.2683*** (0.0497)		-2.3970*** (0.0730)	
Restoration		0.8031*** (0.0434)		0.8909*** (0.0537)
Cons	Included	Included	Included	Included
Control	Included	Included	Included	Included
Industry fixed	Included	Included	Included	Included
R^2	0.218	0.234	0.217	0.214

N	1292	1292	1172	1172

Note. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The robust standard in parentheses is clustered by industry.

5.3 | Robustness check

Considering the province effect. Firms located in different provinces may be affected differently by the pandemic. To examine whether our results are robust to firms' exposure to the pandemic, we further include province dummies in our model. We repeat the OLS regression and present the results in Table 5. The results presented in Columns (1) and (2) of Table 5 show consistency with our main analysis.

Alternative measure for concentration. We use the dummy indicator of concentration as an alternative measure to repeat our main analysis. We divide our observations into a high customer (supplier) concentration group and a low customer (supplier) concentration group, according to whether the value of customer (supplier) concentration is above or below the median of customer (supplier) concentration during our period (2019-2020). The customer concentration dummy (CC) is set to one if firm i in quarter t is above the median value of customer concentration (27.79%). The supplier concentration dummy (SC) is set to one if firm i in quarter t is above the median value of supplier concentration (29.55%). The results shown in Columns (3) and (4) are consistent with our main analysis.

TABLE 5. The province effect and alternative measures of concentration

	Dependent variable: Firm resilience			
	(1)	(2)	(3)	(4)
	Considering province effect		***Concentration dummy***	
Customer concentration * Disruption	**-0.1022**** **(0.0487)**		**-0.0462**** **(0.0197)**	
Supplier concentration * Disruption	**0.1672***** **(0.0557)**		**0.0439**** **(0.0199)**	
Customer concentration * Restoration		0.0031 (0.0438)		0.0104 (0.0127)
Supplier concentration * Restoration		**-0.2142***** **(0.0475)**		**-0.0637***** **(0.0128)**
Disruption	-2.0700*** (0.0234)		-2.0492*** (0.0159)	
Restoration		1.0695*** (0.0201)		1.0246*** (0.0097)
Cons	Included	Included	Included	Included
Control	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes
Province fixed	Yes	Yes	No	No
N	23440	23440	23440	23440
R2	0.450	0.114	0.464	0.114

Note: The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The robust

standard in parentheses is clustered by industry.

***Alternative measure for size asymmetry*.** We further use the size ratio between the focal firm and major supplier/customer as the alternative measures of size asymmetry to test the robustness of our mechanism. Specifically, the size asymmetry is computed as Equation (7):

Size asymmetry = Size of major customer (supplier) / Size of focal firm (7)

The results shown in Table 6 suggest that our findings are not sensitive to the measure of size asymmetry, which further supports our argument that the worsening power imbalance between supply chain partners exerts a negative impact on firm resilience.

TABLE 6. The results with the alternative size asymmetry measure

	Dependent variable: Firm resilience			
	(1)	(2)	(3)	(4)
	Customer side		***Supply side***	
Size asymmetry (Major customer > Focal firm) × disruption	**-0.8081***** **(0.2656)**			
Size asymmetry (Major customer > Focal firm) × restoration		0.0315 (0.2034)		
Size asymmetry (Major supplier > Focal firm) × disruption			-0.1360 (0.4511)	
Size asymmetry (Major supplier > Focal firm) × restoration				**-0.6216**** **(0.2878)**
Size asymmetry (Major customer > Focal firm)	0.1973*** (0.0574)	0.1136 (0.1924)		
Size asymmetry (Major supplier > Focal firm)			0.0008 (0.0988)	0.1369 (0.2989)
Disruption	-1.4665*** (0.2991)		-2.2607*** (0.5028)	
Restoration		**0.7837***** **(0.2348)**		**1.5180***** **(0.3244)**
Cons	Included	Included	Included	Included
Control	Included	Included	Included	Included
Industry fixed	Included	Included	Included	Included
R^2	0.321	0.321	0.321	0.321
N	1292	1292	1172	1172

Note: The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The robust standard in parentheses is clustered by industry.

6 | DISCUSSION

Using a sample of 2,990 Chinese public listed firms, we draw on RDT to explicate how and why customer and supplier concentrations influence firm resilience during the COVID-19 pandemic. Our findings indicate that the impact of customer and supplier concentrations varies

across different stages of the pandemic. Higher customer concentration is detrimental to firm resilience during the disruption stage, but it has no effect in the restoration stage. Higher supplier concentration is positively related to firm resilience in the disruption stage, but it becomes an impediment to the focal firms' restoration process. Our mechanism test supports the notion that the worsening power imbalance is the mechanism that explains why concentration imposes a negative impact on firm resilience. Our study has important theoretical contributions and managerial implications.

6.1 | Theoretical contributions

First, our study advances the customer and supplier concentration literature by uncovering and testing the power unbalancing mechanism from the perspective of RDT. Previous studies have employed different theoretical lenses to understand the divergent findings of customer and supplier concentrations (Kim & Zhu, 2018; Lanier et al., 2010; Saboo et al., 2017). For example, transaction cost theory and the embeddedness view are used to underpin the efficiency and relationship merits of concentration, and the bargaining power view is employed to illustrate its adverse outcomes due to being exploited by major partners (Kim & Zhu, 2018; Korcan Ak & Patatoukas, 2016; Saboo et al., 2017; Zhu et al., 2021). In the operations management community, the supply chain complexity literature commends concentration because it reduces complexity (Bode & Wagner, 2015; Lu & Shang, 2017), whereas the diversification literature devalues it because it cannot diversify risks (Lin et al., 2021). All these theoretical perspectives and literatures shed important light on the mechanisms of how customer and supplier concentrations influence firm outcomes. However, few studies have endeavored to test these underlying mechanisms. As what customer/supplier concentration really measures is the extent to which focal firms depend on a few major customers/suppliers for sales/purchases, our study explores its mechanisms from the perspective of RDT. In particular, departing from previous studies that hold a static view of the power and dependence relationships between focal firms and their major customers and suppliers (e.g., Kim & Zhu, 2018), our study introduces a power dynamics perspective. By investigating the effects of customer and supplier concentrations at different stages of the pandemic, our study theoretically explicates and empirically verifies that the worsening power imbalance is the

underlying mechanism for the negative effect of customer and supplier concentrations during the pandemic. Similarly, the threat of concentrating on major customers and suppliers is diminished when power dynamics are shifted in favor of focal firms (diminishing power imbalance). From this perspective, our study offers a situational understanding of the complex effects of customer and supplier concentrations from a dynamic power and dependence perspective.

Second, our study contributes to the disruption and resilience literature by highlighting the importance of taking a closer look at the characteristics of the different stages of a crisis or disruption. Although scholars have recognized that resilience includes two important components—the resistance component in the disruption stage and the recovery component in the recovery stage (Melnyk et al., 2014)—few studies have examined firm resilience in these two stages (e.g., Anokhin et al., 2021) or have merely treated environments in different stages as static backgrounds (e.g., DesJardine et al., 2019; Lin et al., 2021; Sajko et al., 2021). Our research extends these studies by capturing the key characteristics of each stage of a crisis. In particular, we provide qualitative evidence that shifts in the macro supply–demand relationship in different stages of the pandemic can alter the micro buyer–supplier relationships and shape their roles in influencing firm resilience. From this perspective, our study highlights a novel research avenue, which is to investigate how the macro environmental characteristics of a crisis influence the efficacy of strategies for resilience by reshaping micro inter-firm-level factors. In addition, we find that the efficacy of a resilience strategy does not hold across the whole course of a crisis. Supplier concentration enhances firm resilience in the disruption stage, but it becomes detrimental in the restoration stage; customer concentration is an inhibitor of resilience in the disruption stage, and its role is insignificant in the restoration stage. This not only suggests the necessity of dividing a crisis into stages and exploring the fit between resilience strategies and the crisis stages but also raises the concern of the potential dark side of some supply chain characteristics during major crises. For example, supplier concentration is found to function well in a stable context (Bode & Wagner, 2015; Steven et al., 2014), but it can be very dangerous for firms during a crisis context. Therefore, it is necessary to reexamine how some seemingly positive characteristics and activities of supply chains affect firm

resilience in major crises.

While the research context between our paper and Lin et al. (2021) is quite similar, we are different from this paper in terms of major objectives and theoretical angles. Specifically, unlike Lin et al. (2021), the objective of our paper is not simply to examine the impact of customer/supplier concentration (or diversification in Lin et al.'s (2021) term) during COVID-19. Instead, in this study, we make use of dramatic changes in supply and demand during COVID-19 to examine power balancing/unbalancing issues in buyer–supplier relationships. The COVID-19 pandemic provides a perfect setting for us to examine the situation (a crisis) when the demand and supply relationship shifts drastically, making power unbalancing issues more salient and leading to a less productive buyer–supplier relationship, which hurts firms' resilience during a crisis. Accordingly, the objectives of the two papers are completely different, in that our paper is theory-driven research using the pandemic as a setting to study the power unbalancing issue. Further, whereas Lin et al. (2021) examined how customer/supplier diversifications provide potential advantages to reduce risks and enhance resilience, we examine this problem from a completely different angle. We examine how resource dependence and power balance/imbalance issues of buyer–supplier relationships affect firm resilience and empirically verify the worsening power unbalancing mechanism of customer and supplier concentrations due to supply and demand shifts (as a result of the COVID-19 crisis).

6.2 | Managerial implications

The COVID-19 pandemic has significantly disrupted global supply chains. Some view it as a rare event, while others anticipate that such a pandemic will recur in the future. Either way, our findings are valuable to supply chain managers. First, our study informs supply chain managers regarding how to benefit from a concentrated customer and supplier base. We suggest that the key is to balance the relationships, shifting the power in favor of the focal firms. Although our study only finds that power can be shifted by macro supply–demand relationships, which cannot be changed by individual firms, the power balancing/unbalancing mechanism we uncover is informative. According to the power-dependence perspective, firms can shift power in favor of them by cultivating and accumulating resources and capabilities that are attractive

to major customers and suppliers. For example, they can try to improve their market share and develop their R&D capacity. A basic tenet is that when firms have unique leverage to balance dependence and power, a concentrated customer or supplier base can be beneficial.

Second, our study informs managers of how to maintain resilience through the configuration of supply chains. Our study finds that customer and supplier concentrations could affect firm resilience, and they have distinctive effects at different stages of the crisis. However, decisions regarding customer and supplier concentrations are not immediate ones that can be readily changed according to the stage of the crisis. Therefore, managers should be aware of the overall risks of having a high level of customer and supplier concentration during a crisis. Our study suggests that high customer concentration is generally more detrimental during a market downturn, whereas high supplier concentration becomes detrimental when supply becomes a bottleneck. Therefore, it is safer to build a diversified customer base. For supplier concentration, managers have to embrace its two opposite effects and make decisions according to their expectations of the macro demand and supply relationship. Relatedly, supply chain managers should understand that when there is a shift in demand and supply due to a crisis, buyer–supplier relationships might be altered, influencing their ability to maintain resilience. From this perspective, our study suggests a novel perspective for managers to reexamine their buyer–supplier relationships during a crisis.

6.3 | Limitations and future research

Our study is subject to some limitations that may provide directions for future research. First, RDT and the power balancing/unbalancing view suggest one possible explanation for the complex effect of concentration. Future studies may consider integrating this view with other theoretical perspectives, such as TCE and relational ties, to dig deeper into the underlying mechanisms of concentration. Second, although it is obvious that the pandemic changes macro demand and supply and can change the dependence and power relationships between firms and their supply chain partners, we do not directly measure the power dynamics. Future research could measure it or provide more evidence about how macro demand and supply change micro power relationships in supply chains. Third, our study considers only the role of customer and supplier concentrations in a public health crisis (COVID-19). Nevertheless, different crises

(e.g., man-made crises, such as trade wars, and natural disasters, such as floods and droughts) may have different characteristics and cause different damages to supply chains. Focusing on only one kind of crisis limits the generalizability of the research conclusions. Thus, subsequent studies could focus on the role of concentration in different crises. Finally, a multitude of factors may influence the relationship between concentration and productivity changes, such as firms' slack resources, political ties, and supply chain network centrality. Future research could consider the contingent effects of these factors while examining the effects of customer and supplier concentrations.

Appendix A. Information about interviewees and sampling firms in the qualitative research

Number of interviewees	24
Number of focal firms	9
Number of customer firms	7
Number of supplier firms	8
Interviewees' title	
Chief /general manager	6
Supply chain/purchasing/operations/marketing managers	18
Interviewees' mean position experience in years	6.5
Firms' industry	
Automobile (parts) manufacturing	4
Machinery manufacturing	4
Equipment manufacturing	3
Chip manufacturing	1
Home appliances	3
Metal Materials	3
Technology support	2
Automotive sales	2
E-commence platform	1
Medical technology*	1
Focal firms' Level of customer concentration	
Sales to major customers (First wave)	30%–95%
Sales to the biggest customer (Second wave)	15%–40%
Focal firms' Level of supplier concentration	
Purchases from major suppliers (First wave)	24%–80%
Purchases from the biggest supplier (Second wave)	8%–17%
Firms' size (Number of employees)	50–10000
Firms' age (Years)	6–31

Note. *We interviewed one manager from a medical industry to confirm the different patterns of shifts in demand and supply from other industries. We excluded medical-related industries from our quantitative analysis.

Appendix B. Illustrations of resource dependence and power dynamics from qualitative research

Themes		Illustrative quotes
In the disruption stage when demand collapses,		
Resource dependence	Customers reduce dependence on focal firms	"*We have both domestic and international customers. During the lockdown, many domestic customers postponed their orders. But many international customers directly canceled the orders because they did not want to wait and because they could obtain supplies elsewhere*" (F). "*Some major customers were shut down. They did not need orders from us at that time*" (F).
	Suppliers increase dependence on focal firms	"*Supply greatly exceeded demand for the whole market. Our bargaining power dropped significantly because it was difficult to get even one*

		order. … We really needed orders from our customers" (S). "*There were no sales at that time. Our inventory was piled up. We wished we could transfer every piece of the inventory into capital*" (S).
Power dynamics	Power unbalancing with concentrated customers, leading to exploitation.	"*Our major customers required far more trade credit and longer terms. Besides, they refused to pay a deposit for their orders. Hence, we faced a big cash flow crunch at that time*" (F).
	Power balancing with concentrated suppliers, leading to collaboration.	"*Our major supplier asked us to purchase its products preferentially. As a return, they promised to offer us financial support, masks, and other epidemic prevention materials*" (F).
In the restoration stage when demand soars,		
Resource dependence	Customers increase dependence on focal firms	"*Our major customer asked us to meet the supply requirements. The thing is they not only placed rush orders, but also required quick delivery. This in turn gave us some leverage to negotiate in the transaction*" (F).
	Suppliers decrease dependence on focal firms	"*After the lockdown, orders soared, which was a good thing. However, we were short-staffed. Meanwhile, we had to deal with uncertainties in our supply chain. Thus, not all orders could be timely fulfilled*" (S).
Power dynamics	Power balancing with concentrated customers, leading to collaboration.	"*We needed to work together with our suppliers to cope with the pressure. To elicit more cooperation, we stopped punishing them for their mistakes but offered to help fix the problems*" (C). "*Major customers' demand was more diversified in the restoration stage. They wanted us to engage in their new big projects, so they helped us to improve our research & development capabilities*" (F).
	Power unbalancing with concentrated suppliers, leading to exploitation.	"*When production began to resume, there was a bottleneck in the supply of materials. One of our major suppliers chose to supply to our competitor over us because that competitor ranks high in the industry*" (F). "*We are a leading company in the industry. After the resumption of production, the supply of materials was sufficient and timely. However, the major suppliers significantly raised their prices. This became one of the challenges we had to face*" (F).

Note： F/C/S means that quotes are obtained from focal/customer/supplier firms.

Appendix C. Definition of variables

Variables	Definition
Resilience	The changes in productivity of each firm between the current period and the previous period. For all firms in an industry quarter, we regress the logarithm of total sales revenues on the logarithm of total fixed assets, the logarithm of the total number of employees, and the logarithm of cash payments for raw materials and services. The TFP of each firm is calculated as the residual of this regression.
Customer concentration	Continuous measure for the ratio of sales from top five largest customers to the total sales.
Supplier concentration	Continuous measure for the ratio of purchases from top five largest suppliers to the total purchases.
Firm size	The logarithm of total assets.
Firm age	The years since the establishment of the firm.
Leverage	The ratio of total debts to total assets.
Tangibleness	The ratio of the tangible assets to total assets.
R&D intensity	The ratio of R&D expenditures to total assets. The missing values are replaced by zero.
SOE	State-owned enterprise: dummy set to one for the firm controlled by the government.

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