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Supply Chain Disruptions and Corporate Liquidity: Lessons from the COVID-19 Crisis, a Review of Cash Preservation, Supplier Continuity, and Emergency Financing

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Abstract

The COVID-19 crisis of 2020 combined a supply shock, as factory closures in China halted the flow of intermediate goods, with a demand shock, as lockdowns spread across the world. For many firms these disruptions turned into a liquidity crisis within weeks, as revenues fell faster than costs could be cut and payment relationships along supply chains came under strain. This paper reviews how firms responded, organised around three pillars of corporate liquidity management: cash preservation, supplier continuity, and emergency financing. Firms that entered the crisis with larger cash holdings, less short-term debt, and committed credit lines were markedly more resilient. Access to emergency funding through credit line drawdowns and bond issuance was concentrated among larger and higher-rated firms, while smaller firms depended heavily on government programmes that reached them unevenly. Supplier continuity depended on visibility beyond first-tier suppliers and on buyers' willingness to protect the working capital of weaker suppliers. Process discipline, data visibility, and payment controls shaped how well firms could use the liquidity they had. The paper proposes an integrated framework that links pre-crisis preparation, in-crisis actions, and their trade-offs across the three pillars, and identifies implications for managers and policymakers together with directions for future research.

Keywords: COVID-19; supply chain disruption; corporate liquidity; cash holdings; credit lines; trade credit; working capital; emergency financing; supply chain resilience; emerging economies

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1. Introduction

Supply chains and corporate finance are usually studied in separate literatures. Operations scholars examine how disruptions propagate through networks of suppliers and customers (Dolgui et al., 2018; Jüttner et al., 2003; Kleindorfer & Saad, 2005; Tang, 2006), while finance scholars examine how firms choose cash holdings, credit lines, and debt maturities to manage the risk of running short of money (Almeida et al., 2014; Denis, 2011; Lins et al., 2010; Opler et al., 1999). The COVID-19 crisis of 2020 made the connection between the two fields impossible to ignore. When Chinese manufacturing output fell sharply in February 2020, firms across the world that depended on Chinese components faced production stoppages (Meier & Pinto, 2020). When governments imposed lockdowns from March, demand for everything from air travel to apparel collapsed (del Rio-Chanona et al., 2020; Guerrieri et al., 2020). A firm that cannot obtain inputs cannot produce and sell, and a firm that cannot sell cannot generate the cash needed to pay its suppliers, employees, and lenders. For most firms, supply chain disruption was ultimately experienced as a liquidity problem.

The speed of transmission was striking. Within weeks of the first lockdowns, stock prices of firms more exposed to China and to global value chains had fallen further than those of comparable firms (Baker et al., 2020; Gormsen & Koijen, 2020; Ramelli & Wagner, 2020; Zhang et al., 2020). Corporate bond spreads widened to levels last seen in the 2008 global financial crisis, and firms drew down unprecedented amounts from their bank credit lines (Acharya & Steffen, 2020; International Monetary Fund, 2020; Li et al., 2020). Surveys of small businesses in the United States found that the median firm with monthly expenses above ten thousand dollars held only about two weeks of cash (Bartik et al., 2020). The question facing managers was not whether their supply chains would be disrupted but whether their balance sheets could survive the disruption.

This paper reviews what was learned during 2020 about the interaction between supply chain disruption and corporate liquidity. It asks three questions. First, how did firms preserve cash once revenues began to fall, and which pre-crisis characteristics made cash preservation easier? Second,

how did firms keep their supply chains functioning when suppliers were themselves under financial and operational stress? Third, how did firms obtain emergency financing, and what roles did banks, capital markets, central banks, and governments play? Early reviews of the pandemic tended to treat these questions separately, with supply chain reviews focusing on operational resilience (Golan et al., 2020; Ivanov & Das, 2020; Pournader et al., 2020) and finance reviews focusing on markets and funding (Goodell, 2020). This paper brings the two together and adds a third strand that is seldom connected to either: applied research from emerging economies on procurement, operations, industrial safety, and digital governance. That combination shows that the capacity to preserve cash, protect suppliers, and use emergency funds well rested not only on balance sheet strength but also on process discipline, data visibility, and controls that firms built before the crisis.

The remainder of the paper proceeds as follows. Section 2 describes the methodology. Section 3 synthesises the literature, covering the theoretical foundations, the 2020 shock, and the evidence on cash preservation, supplier continuity, emergency financing, and the capabilities that supported them. Section 4 presents a conceptual model and a set of propositions. Section 5 discusses the findings, Section 6 sets out implications for managers, policymakers, and researchers, Sections 7 and 8 address limitations and future research, and Section 9 concludes.

2. Methodology

2.1 Review design

This paper adopts a structured narrative review rather than a statistical meta-analysis, because the relevant evidence spans disciplines with different methods and reporting conventions and because much of the evidence on 2020 was still appearing as the crisis unfolded. Sources were drawn from four groups: (i) empirical studies of corporate financial behaviour during the crisis, many circulated as working papers during 2020; (ii) operations and supply chain studies of pandemic disruption, together with the pre-crisis literature on supply chain risk and resilience (Golan et al., 2020; Pournader et al., 2020); (iii) publications by central banks and international bodies describing corporate liquidity conditions and policy responses (Banerjee et al., 2020; Cavallino & De Fiore, 2020; International Monetary Fund, 2020; OECD, 2020b); and (iv) conceptual and

applied frameworks on procurement, operations, industrial safety, and digital governance developed largely in emerging economies. The fourth group was included deliberately because the evidence base on COVID-19 corporate finance is heavily centred on listed firms in the United States and Europe.

2.2 Search strategy and selection criteria

Sources were identified through keyword searches of bibliographic databases and working paper repositories, including Google Scholar, Crossref, SSRN, and the National Bureau of Economic Research, together with the publications of central banks and international organisations, and were supplemented by backward citation tracking from key studies. Search terms combined disruption terms (supply chain disruption, supply chain risk, resilience, COVID-19, pandemic, lockdown) with liquidity and financing terms (cash holdings, liquidity, credit lines, trade credit, working capital, supply chain finance, emergency financing, government support). The search covered work available up to the end of 2020. Foundational studies published before the pandemic were included where they provide the theoretical basis for interpreting the crisis evidence, and applied frameworks from emerging economies were included where they address procurement, operations, safety, or governance mechanisms relevant to the three pillars.

Sources were retained if they addressed at least one of the three pillars of the review or the capabilities that support them. Findings were coded into three themes: cash preservation (actions that reduce cash outflows or accelerate inflows), supplier continuity (actions that keep critical inputs flowing, including financial support for suppliers), and emergency financing (new external funds raised during the crisis). A fourth theme, enabling capabilities, captured process, data, and control factors that cut across the pillars. Working papers from 2020 are treated as preliminary evidence, and conceptual frameworks are treated as sources of mechanisms and propositions rather than as empirical evidence.

2.3 Analysis and synthesis

The synthesis proceeded in three steps. First, evidence was organised by pillar to establish what was known about each type of response. Second, the evidence was examined for mechanisms that link the pillars, such as the transfer of liquidity pressure between buyers and suppliers or the dependence of supplier support on access to emergency funds. Third, these mechanisms were

abstracted into a conceptual model with testable propositions, presented in Section 4. Throughout, empirical findings were distinguished from conceptual arguments, and findings from different settings were compared rather than pooled.

3. Literature Synthesis

This section synthesises the literature in four parts. Sections 3.1 to 3.3 set out the theoretical foundations linking supply chains, liquidity, and trade credit. Section 3.4 describes how the 2020 shock unfolded. Sections 3.5 to 3.7 review the evidence on the three pillars of cash preservation, supplier continuity, and emergency financing, and Section 3.8 examines the organisational and digital capabilities that supported them.

3.1 Supply chains, disruption risk, and the operating cash cycle

The link between supply chains and liquidity runs through the operating cash cycle: the time between paying suppliers for inputs and collecting cash from customers for outputs, usually measured as days inventory outstanding plus days sales outstanding minus days payables outstanding (Farris & Hutchison, 2002; Hofmann & Kotzab, 2010). Shorter cycles are associated with higher profitability (Deloof, 2003), and the cycle can be managed across the chain rather than firm by firm (Randall & Farris, 2009). A disruption alters every component at once. Inventory may build up if demand collapses, or be depleted if inputs stop arriving. Receivables may lengthen as customers delay payment. Payables may shorten if suppliers demand cash in advance because they no longer trust the buyer's creditworthiness, or lengthen if the buyer unilaterally stretches payments. Each movement can drain cash at precisely the moment when operating income is falling.

The supply chain management literature has long recognised that disruptions carry financial consequences. Hendricks and Singhal (2003) showed that announcements of supply chain glitches were associated with substantial losses in shareholder value, and Hendricks and Singhal documented lasting deterioration in operating performance (Hendricks & Singhal, 2005a) and in returns and equity risk (Hendricks & Singhal, 2005b) after disruptions. Financial distress also travels along the chain: suppliers and customers of distressed firms experience negative wealth

effects (Hertzel et al., 2008), and stock markets penalised firms whose supply chains were disrupted by the 2011 Japanese earthquake (Hendricks et al., 2020). Supply risk has been defined in terms of the probability and consequences of inbound failures (Zsidisin, 2003), and Chopra and Sodhi (2004), Kleindorfer and Saad (2005), and Tang (2006) classified its sources and argued that mitigation strategies such as buffer inventory, redundant suppliers, and flexible capacity carry costs that must be weighed against expected disruption losses, a trade-off that Tomlin (2006) formalised. Empirical work shows that supply chain performance is affected by several distinct dimensions of risk (Wagner & Bode, 2008), and that confidence and visibility across the chain reduce vulnerability (Christopher & Lee, 2004).

The resilience literature framed the capacity to recover through redundancy, flexibility, collaboration, and visibility (Christopher & Peck, 2004; Pettit et al., 2010; Ponomarov & Holcomb, 2009; Sheffi, 2005; Tukamuhabwa et al., 2015). Empirical studies link resilience to collaboration (Scholten & Schilder, 2015), to resource-based capabilities such as visibility and flexibility (Brandon-Jones et al., 2014), to firm-level resilience capabilities (Ambulkar et al., 2015), and to the network structure of the supply base (Kim et al., 2015). Studies of the 2008 crisis showed how financial shocks tested supply chain resilience (Jüttner & Maklan, 2011), and studies of global sourcing identified the enablers of supply resiliency (Blackhurst et al., 2011). Network studies of the 2011 Tohoku earthquake showed that shocks to a single supplier propagate downstream, particularly when inputs are specific and hard to substitute (Barrot & Sauvagnat, 2016; Boehm et al., 2019; Carvalho et al., 2016), a pattern the operations literature describes as the ripple effect (Dolgui et al., 2018; Ivanov et al., 2017), and quantitative methods for analysing such resilience were reviewed shortly before the pandemic (Hosseini et al., 2019).

Research from emerging economies adds a project and asset perspective that is directly relevant to 2020. In energy and gas processing projects, supply chain failures translate into schedule delays and cost overruns that strain project cash flows (Agbabiaka et al., 2019). Procurement and inventory frameworks developed for oil and gas operations treat the availability of critical items, rather than total stock, as the driver of operational uptime (Okonkwo et al., 2018a, 2018b), and contract negotiation and vendor governance are presented as levers for sustained cost reduction (Okonkwo et al., 2019). Studies of port logistics show how demurrage and clearance delays add avoidable costs and lengthen the cash cycle (Okonkwo et al., 2020).

3.2 Precautionary liquidity and financial flexibility

The corporate finance literature explains why firms hold liquid assets despite the cost of doing so. The precautionary motive holds that firms facing uncertain cash flows and costly external finance hold cash to avoid forgoing valuable investments or defaulting in bad times (Opler et al., 1999). Financially constrained firms save a larger share of their cash flows as cash (Almeida et al., 2004), cash holdings of US firms rose substantially as cash flow volatility increased (Bates et al., 2009), and firms facing refinancing risk from short-maturity debt hold more cash (Harford et al., 2014). Bank credit lines offer an alternative form of liquidity insurance, but they carry covenants and are more readily available to profitable firms (Demiroglu & James, 2011; Jiménez et al., 2009; Sufi, 2009). Survey evidence shows that firms use cash to insure against bad states and credit lines to fund opportunities in good states (Lins et al., 2010), and firms with more exposure to aggregate risk rely more on cash because banks may not honour credit lines when many firms draw at once (Acharya et al., 2013). Banks can provide such liquidity insurance because deposit inflows tend to rise when credit line demand rises (Kashyap et al., 2002), although banks with more unused commitments cut other lending in 2008 (Cornett et al., 2011). At the level of the economy, private liquidity provision can fail in aggregate shocks, which creates a role for public liquidity (Holmström & Tirole, 1998). Denis (2011) and Almeida et al. (2014) summarise this work under the heading of financial flexibility: the ability to respond to unexpected shocks and opportunities at low cost.

Evidence from the 2008 financial crisis showed that constrained firms cut investment and employment more sharply (Campello et al., 2010), relied heavily on credit lines when markets froze (Campello et al., 2011; Ivashina & Scharfstein, 2010), and that firms with more internal liquidity before the crisis reduced investment less (Duchin et al., 2010). Kahle and Stulz (2013) found that the investment decline in 2008 was not limited to bank-dependent firms, suggesting that demand and uncertainty mattered as well as credit supply, and firms with high social capital fared better during that crisis (Lins et al., 2017). Small firms are structurally more exposed: access to finance is a binding growth constraint for small and medium enterprises (Beck et al., 2005; Beck & Demirgüç-Kunt, 2006), and their financing depends on a mix of lending technologies and relationships that can break down under stress (Berger & Udell, 2006). These findings set the expectations against which the 2020 experience can be judged.

3.3 The financial supply chain and trade credit

Trade credit links the two literatures. Suppliers finance customers by allowing deferred payment, and trade credit provision tends to rise when bank credit is scarce, at least for suppliers with access to financing (Petersen & Rajan, 1997). Firms in countries with weaker financial institutions rely more on trade credit (Fisman & Love, 2003), and trade credit terms depend on the nature of the goods supplied (Giannetti et al., 2011). Suppliers can act as liquidity insurers because the threat of cutting off supply gives them enforcement power (Cuñat, 2007), firms pass liquidity shocks down the chain by defaulting on their own suppliers (Boissay & Gropp, 2013), and in 2008 cash-rich suppliers increased trade credit to customers who lost access to bank funding (Garcia-Appendini & Montoriol-Garriga, 2013). Yet trade credit can also transmit distress. Provision contracted after earlier emerging market crises as suppliers' own liquidity deteriorated (Love et al., 2007), trade credit amplified sectoral shocks (Raddatz, 2010), firms with greater financial frictions cut back trade credit and output during 2008-09 (Coulibaly et al., 2013), and credit conditions shaped the collapse of international trade in that crisis (Chor & Manova, 2012). The failure of a customer raises the probability that its suppliers will fail (Jacobson & von Schedvin, 2015), and Costello (2020) showed that firms hit by a credit supply shock passed the shock to their suppliers by reducing trade credit. Large buyers also use extended payment terms as a source of financing at their suppliers' expense (Murfin & Njoroge, 2015).

Financial supply chain management and supply chain finance attempt to coordinate these flows across the network. Reverse factoring and related programmes let suppliers receive early payment on invoices approved by a creditworthy buyer, priced on the buyer's credit (Gelsomino et al., 2016; Klapper, 2006; Wuttke et al., 2013), and the buyer's intermediation can lower total financing costs for the chain (Tunca & Zhu, 2018). For small suppliers in particular, reverse factoring can release working capital at lower cost than their own borrowing (Lekkakos & Serrano, 2016). The 2020 crisis tested these arrangements at scale.

3.4 The 2020 shock: From disrupted supply chains to a liquidity crisis

The crisis unfolded in two overlapping phases. The first was a supply shock originating in China. Extended factory closures after the Lunar New Year holiday interrupted the production of components used in electronics, automobiles, pharmaceuticals, and consumer goods worldwide (Meier & Pinto, 2020). Simulation work showed that the timing of facility closures and reopenings

at different tiers of a supply chain, rather than the duration of any single closure, was a key determinant of downstream impact (Ivanov & Das, 2020; Ivanov, 2020b), echoing earlier work on how disruptions and vulnerabilities reinforce one another along a chain (Ivanov, 2020a). Network simulations for Japan showed that a lockdown of one large city could reduce output far beyond its borders through supplier and customer links (Inoue & Todo, 2020), and production network models showed that such nonlinear propagation could magnify aggregate losses (Baqaee & Farhi, 2020). NASDAQ 100 firms discussed supply chain decisions extensively in their public communications as the disruption spread (Sharma et al., 2020).

The second phase, from March, was a demand shock as lockdowns spread. Sectors such as airlines, hospitality, and non-essential retail saw revenues fall almost to zero, while grocery, medical supplies, and e-commerce faced surges in demand that their supply chains struggled to meet (Aday & Aday, 2020; del Rio-Chanona et al., 2020; Hobbs, 2020). The medical supplies case exposed how concentrated global value chains had become (Gereffi, 2020), food security risks rose in poorer countries as incomes and logistics were disrupted (Laborde et al., 2020), and macroeconomic analysis showed how a negative supply shock in some sectors could cause demand shortages in others (Guerrieri et al., 2020). Scenario analysis anticipated large global output losses (McKibbin & Fernando, 2020), and international forecasts in mid-2020 projected the deepest global recession in decades (World Bank, 2020). Model-based evidence suggests that global supply chains transmitted part of the GDP decline across countries, but that renationalising production would not have made economies more resilient (Bonadio et al., 2020; Javorcik, 2020; Miroudot, 2020). High-frequency data showed sharp, uneven falls in consumer spending and small business revenue (Chetty et al., 2020), and the crisis also triggered reallocation of demand and labour across firms (Barrero et al., 2020). Telecommunications and digital services saw demand climb as work and commerce moved online, putting pressure on network rollout plans and equipment supply in emerging markets (Sanni et al., 2020c). In health systems, the pandemic placed sudden demands on diagnostic and laboratory infrastructure (Aminu-Ibrahim et al., 2018, 2020).

Both phases placed pressure on liquidity. Firms facing input shortages carried fixed costs without the revenue to cover them. Firms facing demand collapse held inventory ordered before the crisis and still owed suppliers for it. Text analysis of earnings calls shows that firms' early concerns

centred on supply chain disruption and collapsing demand, and that liquidity concerns rose rapidly as the crisis progressed (Hassan et al., 2020). The Bank for International Settlements estimated that a large proportion of firms across advanced and emerging economies did not hold enough cash to cover debt service and operating costs under a severe revenue decline lasting through 2020 (Banerjee et al., 2020), and global firm-level estimates suggested that many firms would exhaust their cash buffers within months under a severe sales shock (De Vito & Gomez, 2020). OECD analysis pointed in the same direction (OECD, 2020b), and evidence from Italy showed both large liquidity needs (Schivardi & Romano, 2020) and equity shortfalls concentrated among small and medium enterprises (Carletti et al., 2020).

Table 1. Key events in the 2020 supply chain and liquidity shock

Period	Supply chain and operating developments	Liquidity and financing developments
Jan to Feb 2020	Factory closures in Hubei and wider China extend beyond the Lunar New Year; shortages of components emerge in electronics, autos and pharmaceuticals.	Firms with China exposure underperform in equity markets; early warnings in earnings calls about supply interruptions.
Early to mid Mar 2020	Lockdowns spread to Europe and North America; demand collapses in travel, hospitality and discretionary retail; panic buying strains grocery and medical supply chains.	Corporate bond spreads widen sharply; commercial paper market comes under stress; firms rush to draw down bank credit lines.
Mid to late Mar 2020	Many manufacturing plants close temporarily; logistics capacity becomes volatile as passenger flights (which carry belly cargo) are grounded.	Central banks cut rates and launch large asset purchase and lending facilities; US CARES Act enacted on 27 March; UK Covid Corporate Financing Facility announced.
Apr to Jun 2020	Gradual reopening in China; staggered restarts across Europe and the Americas; firms work to restart multi-tier supply networks.	Record investment grade bond issuance; government guaranteed loan and grant programmes disbursed at scale; credit line balances begin to be repaid by stronger firms.

Period	Supply chain and operating developments	Liquidity and financing developments
Jul to Dec 2020	Recovery uneven by sector; shipping container and semiconductor capacity tightens as demand for goods rebounds.	Liquidity conditions ease for larger firms; concerns shift toward solvency, leverage, and the durability of small and medium enterprises.

Source: Author's compilation from the studies and official announcements cited in the text.

3.5 Cash preservation

3.5.1 The value of pre-crisis liquidity

The clearest finding is that the liquidity a firm held before the crisis mattered greatly once the crisis began. Fahlenbrach et al. (2020) found that US firms with more cash and less short-term debt and long-term debt maturing within the year experienced significantly smaller stock price declines in February and March 2020, with the effect strongest in the most exposed industries. Using data from more than fifty countries, Ding et al. (2020) found that more cash, less debt, and less exposure to global supply chains and affected customer locations were associated with milder stock price reactions. Firms more resilient to social distancing experienced smaller price declines (Pagano et al., 2020), and firms with high environmental and social ratings experienced higher returns and lower volatility during the market collapse (Albuquerque et al., 2020), consistent with evidence from 2008 that trust and social capital pay off in crises (Lins et al., 2017).

These results imply that the true test of a cash policy is its performance in an extreme scenario rather than its cost in normal years. Holding cash is expensive in normal times, but the option value of that cash rose sharply in 2020 when operating cash flows and external markets became unreliable at the same time. Estimates for small and medium enterprises suggested that, absent government support, failure rates would have risen substantially because many such firms entered the crisis with thin buffers (Gourinchas et al., 2020; OECD, 2020a).

3.5.2 Working capital levers

Once revenues fell, the fastest internal source of cash was usually working capital. On the inventory side, firms cancelled or deferred purchase orders, reduced production runs, and in some cases liquidated stock at a discount. On the receivables side, they tightened credit terms, intensified collection efforts, and sold receivables through factoring arrangements (Klapper, 2006). Digital

payment channels helped keep collections flowing when offices and branches closed; Agyei et al. (2019) find that trust, cost, and ease of use determine how quickly businesses and customers in Sub-Saharan Africa adopt web-based payment portals, so firms that had already built such channels were better able to collect cash during lockdowns. On the payables side, some firms extended payment terms to suppliers, either through negotiation or unilaterally. Logistics frictions also locked up cash, and demurrage charges and port delays intensified in 2020 as port and shipping capacity became volatile (Okonkwo et al., 2020). Logistics innovations that brought services closer to customers' homes helped some firms keep revenue flowing during lockdowns (Choi, 2020).

These levers carry trade-offs that interact directly with supply chain health. Cancelling orders protects the buyer's cash but transfers the inventory and cash shock upstream, and extending payables conserves the buyer's cash at the expense of suppliers who may have less access to finance (Costello, 2020; Murfin & Njoroge, 2015). Evidence on working capital management suggests that shortening the cash cycle can improve profitability (Deloof, 2003), but when every firm in a chain attempts to do so at once the result is a contest over who bears the liquidity shortfall. Several large firms publicly committed instead to accelerate payments to small suppliers, recognising that their own continuity depended on supplier survival.

3.5.3 Cost reduction, capital expenditure, and payouts

Beyond working capital, firms preserved cash by deferring discretionary capital expenditure, freezing hiring, furloughing staff (often with government wage support), negotiating rent deferrals, and reducing or suspending dividends and share repurchases. Dividend futures implied large expected cuts in payouts, particularly in Europe (Cejnek et al., 2020), and in several jurisdictions regulators or the terms of government support schemes restricted payouts. Capital expenditure cuts preserved cash quickly but risked weakening the firm's position in the recovery. Phased delivery models for high-risk capital projects allow commitments to be staged in line with available funding rather than abandoned outright (Aminu-Ibrahim et al., 2019), and choices about materials and energy efficiency in facilities affect operating costs over the life of an asset (Ogbete et al., 2020).

Procurement offered a less damaging source of savings than indiscriminate cuts. Strategic sourcing, contract renegotiation, and disciplined vendor governance can lower costs without

disrupting operations (Okonkwo et al., 2019, 2018a), and automation and process redesign can reduce operating expenses on a lasting basis (Agboada et al., 2018). Marketing budgets were another early target. Sanni et al. (2020a) note that the difficulty of measuring marketing return on investment makes such spending easy to cut, yet indiscriminate cuts can weaken the customer relationships a firm needs in the recovery. Evidence that integrated marketing communications can sustain subscriber growth (Agyei et al., 2018), and that data-driven brand positioning helps firms differentiate in regulated markets (Sanni et al., 2020b), suggests that targeted rather than across-the-board cuts better protect future revenue.

3.5.4 Who was able to preserve cash

The capacity to preserve cash was unevenly distributed. Large firms had more bargaining power with suppliers and landlords, more flexible cost structures, and greater access to external liquidity. Small businesses were far more vulnerable. Many expected to close if the crisis lasted several months, and their survival expectations depended heavily on access to government support (Bartik et al., 2020). The number of active business owners in the United States fell sharply in the first months of the pandemic (Fairlie, 2020), and evidence from Oakland showed that small firms' capacity to survive depended on their cash reserves and the fit of policy support (Bartlett & Morse, 2020). In the United Kingdom, smaller firms with lower cash reserves before the crisis were more likely to need external finance (Cowling et al., 2020). Start-ups faced acute liquidity stress (Kuckertz et al., 2020), and in China the pandemic reduced firm performance most in hard-hit regions and industries (Shen et al., 2020). The pandemic also highlighted how entrepreneurial and supply chain capabilities interact in small firms (Ketchen & Craighead, 2020).

Firm capabilities mattered too. Limited access to finance constrains the growth of rural agribusiness enterprises (Michael & Ogunsola, 2019a), a structural weakness that left many small suppliers in food and agricultural value chains with little capacity to absorb the 2020 shock, while firms with stronger management and entrepreneurial capabilities were better placed to adapt (Michael & Ogunsola, 2019b). Firms in essential sectors faced a different problem: surging demand required additional working capital to finance inventory and receivables, so that even growing firms could experience cash strain. Expanding diagnostic access, for example, depends on infrastructure, equipment, and consumable supply chains that all required up-front funding when testing needs surged (Aminu-Ibrahim et al., 2018, 2020).

3.6 Supplier continuity

3.6.1 Visibility beyond the first tier

A recurring lesson of 2020 was that many firms lacked visibility beyond their direct suppliers. A firm might know that its first-tier supplier was located outside China while being unaware that the supplier depended on Chinese sub-components. Ivanov and Dolgui (2020) argued that the pandemic required a shift from thinking about the resilience of individual supply chains to the viability of intertwined supply networks able to survive prolonged disruption. Firms that had previously mapped their multi-tier networks were able to identify exposures and secure alternative sources more quickly, and research on supply network structure suggests that the position of key suppliers in the network shapes how far a disruption spreads (Kim et al., 2015). Mapping is a liquidity tool as well as an operational one: knowing where shortages will occur allows a firm to anticipate revenue gaps and plan financing earlier.

Digital tools make such mapping more practical. Quantitative and simulation models of supply chain resilience allow firms to test disruptions and recovery paths (Hosseini et al., 2019; Ivanov et al., 2017). GIS-enabled ERP procurement links suppliers to their locations and spatial risks (Ahiaeke Patrick et al., 2020), and agile supply chain digital transformation with embedded IT risk and compliance controls extends the same logic to the wider information architecture (Mbonu, Iwuanyanwu, et al., 2020b). Remote monitoring technologies also let firms watch physical assets when travel was restricted. Unmanned aerial vehicles can inspect pipelines and infrastructure corridors without sending crews to site (Dagodzo & Ahiaeke Patrick, 2020), and their use in power grid and transmission line inspection (Dagodzo, 2018a, 2018b) shows how routine asset checks can continue with fewer people in the field.

3.6.2 Supplier financial health

Operational continuity depended on the financial survival of suppliers. Many suppliers, particularly small and medium enterprises, held thin cash buffers and faced the same combination of falling orders and fixed costs as their customers. Purchasing teams in 2020 increasingly monitored supplier financial health, using credit ratings, payment behaviour, and direct dialogue to identify suppliers at risk (van Hoek, 2020). The logic resembles near-miss reporting in industrial safety, where small warning signals are collected and analysed before they become serious incidents (Arumosoye & Obriki, 2019). In a supply chain, late deliveries, requests for early

payment, and slipping quality are the equivalent signals. Supplier audits adapted from internal quality, health, safety and environment audit systems (Obogo et al., 2020a), and governance models for overseeing many contractors at once (Arumosoye & Obriki, 2020; Obogo, Ozobu, et al., 2019b), give buyers structured ways to act on them.

Where a critical supplier was at risk, buyers had several options: accelerating payment, making advance payments, guaranteeing supplier borrowings, extending supply chain finance programmes, or in extreme cases acquiring or directly financing the supplier. Each option uses the buyer's own liquidity, so support had to be prioritised by the criticality and substitutability of the input. Evidence from earlier crises suggests that suppliers with strong liquidity positions act as liquidity providers to their customers (Garcia-Appendini & Montoriol-Garriga, 2013), that liquidity shocks pass down the chain through payment defaults (Boissay & Gropp, 2013), and that the failure of one firm can propagate through trade credit links (Hertzel et al., 2008; Jacobson & von Schedvin, 2015). Supporting a critical supplier is therefore an investment in the buyer's own continuity.

3.6.3 Trade credit and supply chain finance

Supply chain finance offered a way to inject liquidity into the supply base without consuming the buyer's cash immediately (Gelsomino et al., 2016; Lekkakos & Serrano, 2016; Tunca & Zhu, 2018). However, the crisis also exposed its risks. Because these programmes let buyers extend payment terms while suppliers are paid early, they can disguise what is economically buyer borrowing, and their availability depends on the continued willingness of finance providers to fund them. A programme withdrawn in a crisis can leave both buyer and suppliers suddenly short of liquidity. Supply chain finance is a useful tool for supplier continuity, but buyers should treat it transparently, measure its effect on the cash cycle of the whole chain (Randall & Farris, 2009), and understand its dependence on funding providers (Wuttke et al., 2013).

3.6.4 Inventory buffers, dual sourcing, and the efficiency trade-off

The disruptions of 2020 renewed debate about whether lean, just-in-time supply chains had been optimised for efficiency at the expense of resilience (Handfield et al., 2020; Kano & Oh, 2020; Sarkis et al., 2020; Shih, 2020). Firms that held buffer stocks of critical components or had qualified alternative suppliers in different regions were better able to maintain production. Yet

buffer stocks tie up cash, and in a demand collapse excess inventory becomes a liquidity burden rather than a protection. McKinsey Global Institute (2020) estimated that prolonged supply chain disruptions could erase a substantial share of a year's profits over a decade for companies in many industries. The appropriate response is not a wholesale abandonment of lean practices but a targeted one: identifying the inputs whose loss would halt production and for which substitutes are scarce, and holding buffers or redundancy for those inputs specifically (Craighead et al., 2007; Pettit et al., 2013; Tomlin, 2006). Studies of energy facilities illustrate this logic, showing that the availability of critical spares, rather than total inventory volume, determines plant uptime (Okonkwo et al., 2018b), and supply chain risk models for complex projects make the same point (Agbabiaka et al., 2019). More accurate demand forecasting reduces the buffer stock needed to protect a given service level, which eases the trade-off between resilience and cash (Aifuwa et al., 2020).

3.6.5 Operating continuity under health restrictions

Supplier continuity in 2020 depended not only on finance but also on whether plants, warehouses, and sites could keep operating under health restrictions. Firms in essential industries had to balance output against worker protection, a tension the industrial safety literature has long addressed. Nwangwu et al. (2018) frame operational integrity as a balance between productivity and safety compliance, and Obriki and Arumosoye (2018) show how data-driven risk control can focus attention on the hazards that matter most. Structured hazard identification and risk control (Obogo, Uduokhai, et al., 2019), and safety management systems for maintenance projects (Obogo et al., 2020c), provide templates for assessing new risks before sites reopen. Protective measures can create risks of their own: protective equipment worn in hot environments adds to heat stress (Arumosoye & Obriki, 2018), and fatigue and disrupted routines raise the likelihood of human error (Obriki & Arumosoye, 2020). High-risk activities such as heavy lifting require planning that accounts for reduced crews and changed supervision (Obogo et al., 2020b). Financial service providers faced the same continuity test in 2020, and their business continuity and disaster recovery preparedness bore directly on whether the payment and credit services that supply chains depend on remained available (Fadero et al., 2020).

Leadership and supervision shape whether such measures hold. Leadership-driven safety culture (Obogo, Ozobu, et al., 2019a) and visible management walkthroughs (Obriki & Arumosoye, 2019)

are associated with stronger compliance, and standard operating procedures helped embed changes quickly and consistently across sites (Agboada et al., 2019). Applied to the pandemic, these principles supported distancing, shift restructuring, and screening protocols that allowed critical facilities to stay open rather than close entirely. For liquidity, the payoff was direct: every week a facility stayed open was a week of revenue that did not have to be replaced with borrowing. In health care, laboratory spatial planning that improves safety and throughput (Ogbete et al., 2018) and regulatory-compliant design of molecular and pathology laboratories (Ogbete et al., 2019) bear directly on how fast testing capacity could be expanded.

3.7 Emergency financing

3.7.1 Bank credit lines: the first line of defence

When the scale of the crisis became apparent in March 2020, firms turned first to their banks. Li et al. (2020) documented that US firms drew down existing credit lines at an unprecedented rate, causing commercial and industrial lending to grow by hundreds of billions of dollars within weeks. Banks accommodated these drawdowns partly because they entered the crisis with strong capital and liquidity positions and because deposits flowed into the banking system at the same time, as theory predicts (Kashyap et al., 2002). Acharya and Steffen (2020) characterised this behaviour as a dash for cash, especially pronounced among lower-rated investment grade firms facing the risk of downgrade to speculative grade. Drawdowns supported spending by the firms that drew them (Greenwald et al., 2020), and firms that later issued bonds used the proceeds partly to repay bank lines (Darmouni & Siani, 2020). The benefits were uneven. Small firms had shorter-maturity credit lines, more collateral requirements, and more covenant restrictions, and they drew down far less than large firms despite their greater need (Chodorow-Reich et al., 2020). The evidence underlines the value of committed facilities negotiated in good times, and the importance of covenants that do not restrict drawdowns precisely when they are most needed (Acharya et al., 2013; Sufi, 2009).

3.7.2 Bond markets and central bank backstops

Corporate bond markets were severely disrupted in mid-March 2020. Spreads widened sharply, investment grade bonds became surprisingly illiquid, and even investment grade issuance briefly stalled (Haddad et al., 2020; Kargar et al., 2020; O'Hara & Zhou, 2020). Redemptions from bond mutual funds amplified the selling pressure (Falato et al., 2020). The turning point came with

central bank intervention. On 23 March 2020 the Federal Reserve announced its Primary and Secondary Market Corporate Credit Facilities, committing for the first time to purchase corporate bonds. The European Central Bank launched its Pandemic Emergency Purchase Programme, and the Bank of England and HM Treasury created the Covid Corporate Financing Facility to purchase commercial paper (Cavallino & De Fiore, 2020).

The announcement effect was powerful: spreads narrowed and market liquidity improved well before the facilities bought significant quantities of bonds (Boyarchenko et al., 2020; Gilchrist et al., 2020; Haddad et al., 2020). Investment grade issuance rebounded rapidly and reached record levels. Bond issuance was concentrated among larger and higher-rated firms, while issuance by riskier firms recovered more slowly and on less favourable terms (Halling et al., 2020). The interventions restored market access for many firms but did not equalise it.

3.7.3 Government support programmes

For small and medium enterprises, government programmes were the main source of emergency financing. These took several forms: government guaranteed bank loans, forgivable loans and grants, wage subsidies and furlough schemes, and tax deferrals (OECD, 2020a). Policy design mattered for whether firms in hibernation could survive without accumulating unsustainable debt (Didier et al., 2020), and for whether credit programmes reached viable firms without subsidising those that would fail anyway (Elenev et al., 2020; Hanson et al., 2020). In the United States, the Paycheck Protection Program provided forgivable loans to small businesses conditional on maintaining employment. Funds were disbursed very quickly, but their distribution did not closely track the severity of the economic shock (Granja et al., 2020), information frictions limited take-up among the smallest firms (Humphries et al., 2020), and early evaluation using payroll data found modest employment effects relative to programme cost (Autor et al., 2020). The Main Street Lending Program faced design challenges in reaching mid-sized firms (English & Liang, 2020). State guaranteed loan schemes in the United Kingdom, Germany, France, and other economies channelled large volumes of credit through commercial banks (OECD, 2020b).

Table 2. Illustrative emergency financing channels used by firms in 2020

Channel	Main users	Strengths in the crisis	Limitations
Committed bank credit lines	Large and mid-sized firms with pre-existing facilities	Immediate access; no need for new credit approval	Covenants may restrict access; smaller firms often lack committed lines
Investment grade bond issuance	Large, highly rated firms	Large volumes at long maturities once central banks intervened	Market briefly closed in March; access weaker for lower-rated firms
Central bank corporate facilities (e.g. Fed PMCCF/SMCCF, BoE CCFF, ECB PEPP)	Investment grade and large issuers, directly or indirectly	Restored market confidence; announcement effect lowered spreads	Direct eligibility limited; benefits concentrated among larger firms
Government guaranteed and forgivable loans (e.g. US PPP, national guarantee schemes)	Small and medium enterprises	Broad reach; low or zero cost; partial or full forgiveness	Allocation frictions; dependence on bank relationships; added leverage
Equity and hybrid capital	Listed firms in severely affected sectors	Strengthens solvency rather than adding debt	Dilutive; costly when share prices are depressed
Supply chain finance and trade credit	Suppliers of large creditworthy buyers	Moves liquidity to suppliers using buyer's credit	Dependent on funders; can obscure buyer leverage

Source: Author's synthesis of the literature reviewed in Sections 3.5 to 3.7.

3.7.4 Equity and the shift from liquidity to solvency

Emergency borrowing solved immediate liquidity problems but increased leverage. As 2020 progressed, attention shifted from whether firms could pay their bills in the next few weeks to whether they could carry enlarged debt loads through a prolonged recovery. Estimates for Italy

showed that a large share of firms would face equity shortfalls even after liquidity support (Carletti et al., 2020), and OECD analysis noted that liquidity measures alone could not prevent solvency problems for firms with persistent revenue losses (OECD, 2020b). Corporate debt overhang threatened to depress investment in the recovery (Brunnermeier & Krishnamurthy, 2020), and analysis of restructuring capacity suggested that courts and out-of-court processes would face heavy demand (Greenwood et al., 2020). Some firms in severely affected sectors raised equity or hybrid capital despite depressed share prices, and several governments recapitalised strategically important firms. Debt can bridge a temporary gap, but if revenues remain impaired for an extended period, firms need loss-absorbing capital rather than additional borrowing.

3.8 Digital and organisational enablers

3.8.1 Process discipline and governance

The ability to act on the three pillars depended on decision makers seeing their cash and supply positions clearly and being able to change processes quickly. Digital transformation in operations management, through automation, analytics, and process redesign (Agboada et al., 2018), provides the information base for rolling cash forecasts and supplier risk reviews. Crisis responses require rapid process change, which is easier where processes are already documented and governed: standard operating procedures act as infrastructure for change (Agboada et al., 2019), and coordinating business processes across multiple stakeholders depends on clearly aligned roles and decision rights (Eyetsemitan et al., 2020), a point that applies equally to treasury, procurement, and operations teams working together in a crisis. Procurement processes that are data-driven and integrated with ERP systems (Ahiaeke Patrick et al., 2020; Okonkwo et al., 2018a) allow purchasing to remain both fast and controlled when suppliers and prices change rapidly.

3.8.2 Controls, cyber security, and data governance

The speed of the 2020 response created control risks. Relaxed verification, remote approvals, and large volumes of new payments created opportunities for fraud and error, so that crisis liquidity had to be protected as well as raised. The move to remote working shifted treasury, procurement, and payment approvals onto cloud systems. Identity and access controls in hybrid and multi-cloud environments (Mbonu, Aliliele, et al., 2020), governance of infrastructure as code for secure cloud deployments (Mbonu, Iwuanyanwu, et al., 2020a), and incident response capabilities that can

detect fraudulent payment requests and supplier impersonation (Mbonu, Iwuanyanwu, et al., 2019) became part of protecting liquidity. Legal and ethical risk modelling for data protection (Mbonu et al., 2018) and comparative analysis of data protection rules across jurisdictions (Mbonu, Aliliele, et al., 2019) address the risks that arise when financial and supplier data flow between more systems, partners, and countries than before. Internal audit systems (Obogo et al., 2020a) provide the assurance that such controls are working.

4. Conceptual Model

The synthesis points to a set of relationships that can be expressed as a conceptual model (Figure 1). The model treats a supply chain disruption as a combined supply and demand shock that tests the firm's liquidity. Three groups of pre-crisis capabilities, namely financial flexibility, supply network visibility, and process, data, and control capabilities, shape the effectiveness of three crisis responses: cash preservation, supplier continuity, and emergency financing. The three responses are interdependent rather than separable, and their combined effect determines liquidity resilience in the short run and solvency and recovery in the longer run. Firm size, credit quality, sector exposure, and access to public support moderate these relationships.

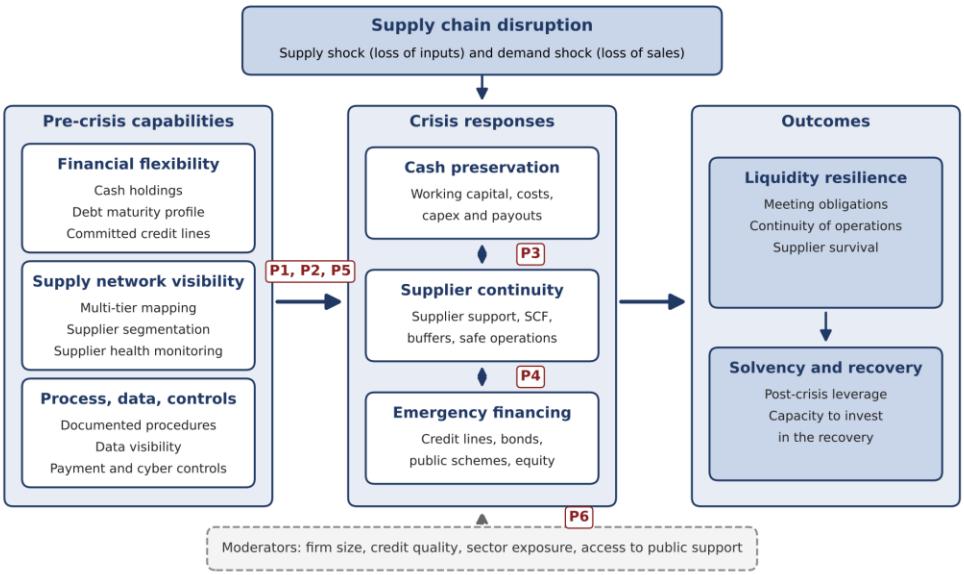


Figure 1. Conceptual model of liquidity resilience under supply chain disruption

Source: Author's synthesis. P1 to P6 refer to the propositions in Section 4.

The model yields six propositions that summarise the evidence and can guide empirical testing.

Proposition 1. Pre-crisis financial flexibility, in the form of cash holdings, longer debt maturities, and committed credit lines, is positively associated with a firm's ability both to preserve cash and to obtain emergency financing during a supply chain shock (Acharya & Steffen, 2020; Ding et al., 2020; Fahlenbrach et al., 2020; Li et al., 2020).

Proposition 2. Multi-tier supply network visibility and supplier segmentation strengthen supplier continuity and reduce the cash cost of disruption, because they allow buyers to target buffers and support at critical inputs rather than spreading them across the supply base (Ivanov & Dolgui, 2020; Kim et al., 2015; Tomlin, 2006).

Proposition 3. Cash preservation actions that shift liquidity pressure onto suppliers, such as extending payables or cancelling orders, weaken supplier continuity, and this effect is stronger when suppliers are financially constrained (Boissay & Gropp, 2013; Costello, 2020; Murfin & Njoroge, 2015).

Proposition 4. Emergency financing increases a buyer's capacity to support critical suppliers, but it also raises leverage and therefore solvency risk if the disruption persists (Brunnermeier & Krishnamurthy, 2020; Carletti et al., 2020).

Proposition 5. Process discipline, data visibility, and payment and cyber controls moderate the effectiveness of all three responses, so that firms with similar balance sheets achieve different liquidity outcomes depending on these capabilities (Agboada et al., 2019; Eyetsemitan et al., 2020; Mbonu, Iwuanyanwu, et al., 2019).

Proposition 6. Firm size, credit quality, and access to public support moderate the relationship between financial flexibility and emergency financing, with smaller and lower-rated firms obtaining less funding for a given level of need (Chodorow-Reich et al., 2020; Granja et al., 2020; Halling et al., 2020).

Table 3 translates the model into practice by setting out, for each pillar and for the enabling capabilities, the preparation required before a crisis, the actions available during one, and the main trade-offs.

Table 3. Integrated framework for liquidity resilience under supply chain disruption

Pillar	Pre-crisis preparation	In-crisis actions	Key trade-offs
Cash preservation	Hold precautionary cash calibrated to stress scenarios; lengthen debt maturities; build a 13-week cash forecasting capability	Cut discretionary spending and capex; suspend payouts; manage inventory and receivables tightly	Cost of carry in normal times versus survival in extreme scenarios; short-term cuts versus recovery capacity
Supplier continuity	Map multi-tier networks; segment inputs by criticality; qualify alternative suppliers; monitor supplier financial health	Prioritise support for critical suppliers through early payment, advances or supply chain finance; coordinate restarts across tiers	Buffers and redundancy consume cash; supporting suppliers draws on buyer liquidity
Emergency financing	Negotiate committed credit lines with resilient covenants; maintain diverse lender relationships and market access; protect credit rating headroom	Draw on committed lines early; issue debt when markets reopen; use public programmes; raise equity if losses threaten solvency	Speed of access versus cost; added leverage versus solvency; reliance on public support
Enablers and governance	Document procedures; build data visibility; maintain payment controls and cyber safeguards; create joint treasury, procurement and operations risk forums	Establish a crisis cash committee with authority over payments, orders and financing; tighten controls over new payees and approvals	Central control versus local responsiveness; speed versus verification

Source: Author's synthesis.

5. Discussion

The evidence suggests that cash preservation, supplier continuity, and emergency financing should not be treated as separate functions managed by separate departments. Treasury decisions about

payment terms affect supplier survival; procurement decisions about inventory buffers affect cash needs; and financing decisions determine how much room the firm has to support its suppliers. The pandemic supply chain literature reached a similar conclusion from the operations side (Craighead et al., 2020; Ketchen & Craighead, 2020; van Hoek, 2020), and the corporate finance literature from the funding side (Almeida et al., 2014; Denis, 2011).

Five overarching lessons emerge. First, liquidity planning should be scenario-based and should incorporate supply chain disruption explicitly. Traditional stress tests often modelled a fall in demand but not the simultaneous loss of inputs or the tightening of supplier payment terms. Second, committed and diversified sources of liquidity are worth paying for, because uncommitted or market-dependent sources can disappear exactly when they are needed. Third, a firm's resilience depends on the resilience of its suppliers, so buyer liquidity should be viewed in part as a resource for the whole supply network (Boissay & Gropp, 2013; Costello, 2020). Fourth, operational resilience measures such as inventory buffers and dual sourcing must be designed with their cash costs in mind and targeted at the inputs whose loss would be most damaging. Fifth, emergency financing addresses liquidity but not necessarily solvency; plans should anticipate how added debt will be serviced or replaced by equity if the disruption is prolonged.

Two tensions run through the evidence. The first is between firm-level and network-level liquidity. Actions that are rational for an individual buyer, such as stretching payables or cancelling orders, transfer the shock to suppliers and can weaken the network on which the buyer depends (Costello, 2020; Jacobson & von Schedvin, 2015; Murfin & Njoroge, 2015). The second is between speed and control. The fastest responses, whether drawing on credit lines, approving new suppliers, or disbursing public loans, are also the most exposed to error, fraud, and misallocation (Granja et al., 2020; Humphries et al., 2020). The applied frameworks from emerging economies reviewed here suggest that both tensions are easier to manage where firms have already invested in procurement governance, documented procedures, and data visibility (Agboada et al., 2019; Eyetsemitan et al., 2020; Okonkwo et al., 2019, 2018a), which helps explain why firms with similar balance sheets responded with very different effectiveness.

The evidence also qualifies the debate about lean supply chains. The 2020 experience does not show that efficiency-oriented supply chains failed in general, but that their weaknesses were concentrated where inputs were critical, hard to substitute, and sourced from a single region

(Miroudot, 2020; Shih, 2020). Because buffers and redundancy consume the same liquidity that firms needed to survive the demand collapse, resilience investments compete with cash preservation. The appropriate response is therefore a targeted combination of financial and operational buffers rather than a general retreat from lean practice.

6. Implications

6.1 Managerial implications

For managers, the central implication is to plan liquidity and supply chain risk together. Stress tests should model the loss of inputs and the tightening of supplier payment terms as well as the loss of sales. Committed funding should be negotiated before it is needed, with covenants that do not restrict drawdowns in a downturn. Procurement teams should identify the suppliers whose failure would halt operations, monitor their financial health, and agree in advance what support the firm could offer them. Firms should also decide in advance who has authority over payments, orders, and financing in a crisis, and maintain the controls that protect cash when processes are changed at speed.

6.2 Policy implications

The 2020 experience also carries lessons for policymakers. The speed and scale of central bank and fiscal intervention were critical in preventing a liquidity crisis from becoming a wave of insolvencies (Cavallino & De Fiore, 2020; Gourinchas et al., 2020), but the benefits flowed disproportionately to larger and higher-rated firms with existing market access and bank relationships (Chodorow-Reich et al., 2020; Halling et al., 2020). Small and medium enterprises, which form much of the supplier base of large firms, depended on programmes whose design and delivery shaped who received support (Hanson et al., 2020; OECD, 2020a). Because supply chains link small suppliers to large buyers, support for small firms is also, indirectly, support for the production capacity of larger firms.

6.3 Implications for research

For researchers, the review suggests that the corporate finance and supply chain management literatures would benefit from shared constructs and data. Measures of liquidity resilience should incorporate supply-side exposure, and measures of supply chain resilience should incorporate the

financial capacity of the firm and its suppliers. The propositions in Section 4 offer a starting point for integrated empirical work that treats cash, suppliers, and financing as parts of a single system (Craighead et al., 2020; Ketchen & Craighead, 2020).

7. Limitations

This review has several limitations. Much of the evidence on 2020 comes from working papers and early studies that may be revised as more data become available, and it is heavily weighted toward listed firms in the United States and Europe. Evidence on private firms and on emerging and developing economies, where access to emergency finance and public support was often more limited, remains comparatively thin. The emerging economy frameworks included here are largely conceptual and identify mechanisms rather than measure effects. Stock market reactions are an imperfect measure of resilience, and survival and long-run performance will provide a more complete test. Finally, the extraordinary policy response makes it difficult to isolate what firms would have experienced in its absence.

8. Future Research

Several directions for future research follow from this review. Researchers could examine how liquidity shocks propagated through supplier and customer networks using firm-to-firm transaction or payment data, extending work on the propagation of supply shocks (Carvalho et al., 2016; Inoue & Todo, 2020) to financial channels (Costello, 2020). A second agenda concerns the long-run consequences of the 2020 financing choices: whether firms that hoarded liquidity invested more in the recovery, and whether debt raised during the crisis constrains them later (Brunnermeier & Krishnamurthy, 2020). A third concerns supply chain finance and trade credit, including how buyer payment practices affected supplier survival. A fourth concerns whether firms will permanently change their cash policies, credit line structures, inventory strategies, and sourcing geography, or whether the lessons will fade as conditions normalise (Javorcik, 2020; Sarkis et al., 2020; van Hoek, 2020). A fifth concerns emerging economies: empirical tests of the procurement, process, and control frameworks reviewed here would show whether firms that had adopted them fared better in 2020. Finally, comparative work across countries could clarify which policy designs

delivered emergency finance most efficiently to the firms and supply networks that needed it (Didier et al., 2020; Goodell, 2020).

The propositions in Section 4 also suggest specific empirical tests. Proposition 3 could be tested by comparing supplier outcomes across buyers that extended payment terms in 2020 and those that accelerated payments. Propositions 1 and 6 could be tested by relating pre-crisis liquidity and credit quality to the amount and cost of emergency funding obtained. Propositions 2 and 5 call for data on supply network mapping, procurement processes, and internal controls, which could be gathered through surveys and case studies of firms in both advanced and emerging economies.

9. Conclusion

The COVID-19 crisis of 2020 showed that supply chain disruption is, for most firms, ultimately a liquidity event. Factory closures, shipping interruptions, and collapsing demand all ended up as gaps between cash going out and cash coming in. Firms that entered the crisis with ample cash, manageable short-term debt, and committed credit lines were better able to absorb the shock, keep their supply relationships intact, and wait for markets and public support to stabilise. Firms without these buffers, especially smaller firms deep in supply networks, depended on the speed and reach of government intervention.

Cash preservation, supplier continuity, and emergency financing are interdependent. Squeezing suppliers to protect a buyer's cash can weaken the supply base on which recovery depends; holding inventory to protect supply can drain the cash needed to survive a collapse in demand; and emergency debt can solve an immediate liquidity problem while creating a later solvency problem. The quality of a firm's processes, data, and controls also determined how well it could use whatever liquidity it had. Firms that manage the three pillars as one system, supported by scenario planning that joins operational and financial risk, will be better prepared for the next large disruption, whatever its source.

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