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Power dynamics in global supply networks at times of supply crisis

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ABSTRACT

This study investigates the shifting power dynamics within global supply networks amidst supply scarcity and the implications for supply security. It focuses on the impact of the semiconductor shortages on automotive original equipment manufacturers (OEMs) between 2020 and 2024, where traditional hierarchies of power shifted, and OEMs had to increasingly rely on their lower-tier suppliers for supply and innovation. Data are collected using a mix of participatory observations, interviews, and secondary sources from the focal OEM (and its holding group), its suppliers, its distributors, and market experts. Utilizing resource dependence theory as a framework, we explore how OEMs navigate these dependencies to secure their supply while facing scarcity. Through an analysis spanning micro (firm), *meso* (inter-firm and supply network), and macro (environment) levels, this study offers insights into the sources of power and dependencies in the network, strategies for mitigating vulnerabilities and ensuring continuity of supply vis-à-vis dependency. The key strategies identified include diversifying the supplier base, forming strategic alliances, and enhancing information sharing. Further, it reveals the importance of understanding and managing interdependencies within the macro and *meso* levels, in addition to the micro level, to maintain power balance and the continuous supply of critical components. This study contributes to the literature by advancing the understanding of power dynamics during supply crises and providing practical recommendations for managing interdependencies to maintain supply chain resilience.

1. Introduction

Power dynamics in buyer-supplier relationships are linked to the supply network's structures and relationships (Hingley et al., 2015; Johnsen & Lacoste, 2016; Makkonen et al., 2023). As the networks have grown in complexity, marked by interconnected supply chains, technological innovation, geopolitics, and resource efficiency needs (Möller et al., 2020), our understanding of power in this context also needs to be reevaluated. In the automotive industry, the traditional power position of original equipment manufacturers (OEMs), who once controlled an efficient supply flow through their tier 1 contracts (Choi & Linton, 2011), is now being challenged due to their heavy reliance on upstream suppliers' capabilities (Kalaitzi et al., 2019). Disruptions in the semiconductor market in 2020–2024 made this reliance evermore evident, triggering major shifts in the supply network, particularly with lower tier suppliers (Garcia et al., 2024). Investigating this context can advance our understanding of distribution of power, shifts, and influences in global supply networks.

This study draws on resource dependence theory (RDT). It conceptualizes power as mutual dependence between actors in a network, where the level of dependence indicates each partner's level of influence on the other (Emerson, 1962). In exchange relationships, such as in this study's context, this dependency arises from the need to access critical resources, including raw materials, components, or specialized knowledge (Pazirandeh & Norrman, 2014). Balanced or unbalanced relationships then create networks of power relationships for firms to navigate (Casciaro & Piskorski, 2005; Pfeffer & Salancik, 2003). Firms that are better at absorbing their power constraints or attempt to change them can be more successful in securing the supply needed (Pazirandeh & Norrman, 2014).

During the COVID-19 pandemic, the dramatic shifts in demand and supply particularly reshaped resource dependencies within supply networks (Craighead et al., 2020). For instance, countless news articles and policies highlighted the semiconductor crisis for automotive OEMs (Clark, 2021; Congress, 2022; European Commission, 2023). In such times of turbulence or disruptions, greater interdependencies are often thought as beneficial (Kalubanga & Gudergan, 2022). Increasingly over the decades prior to the pandemic, the automotive OEMs relied on the expertise and resources of the lower tier semiconductor suppliers for their development projects and to meet the evolving consumer demands

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(Garcia et al., 2024). Yet, contrary to their historic position in the supply chain, the dependence on the semiconductor suppliers was only from the OEMs' side during the crisis. Such high dependence on supplier innovation can become costly if access to the supply is denied (Arvidsson & Govik, 2025). Thus, understanding such redistributions of power/dependence has significant implications, especially during crises. While RDT has been widely applied to understand inter-organizational power, few empirical studies examine how power dynamics shift during crises.

Analyzing power/dependence dynamics in supply network relationships is a multidimensional task that can be approached from micro (intra-firm), *meso* (inter-firm and supply network), and macro (the external environment) levels (Möller et al., 2020; Siemieniako et al., 2023). Such a systems perspective allows for a more comprehensive view of how power is distributed and concentrated within industries, and how power shifts can reshape the long-standing industry paradigms, especially those as complex as global supply networks of automotive and semiconductors. At the micro level, a firm's purchasing and inventory management practices can influence its dependence on suppliers. For instance, limited supplier options or high minimum order quantities can increase a buyer's dependence (Pazirandeh & Norrman, 2014). The *meso* level focuses on buyer-supplier relationships within the network. RDT highlights the importance of both transactional (e.g., contracts and performance guarantees) and relational mechanisms (e.g., trust and cooperation) for managing these relationships. The optimal approach often involves a strategic combination of both (Hillman et al., 2009; Oliveira & Lumineau, 2019). Finally, the macro level considers the broader environment that shapes dependence dynamics. Factors such as industry regulations, geopolitical shifts, and global competition can influence a firm's bargaining power vis-à-vis its supply network (Tashman, 2021). Extant RDT studies often focus on dyadic relationships or firm-level strategies, overlooking the interplay between micro, meso, and macro forces.

Against this background, we explore the shifting power dynamics within global supply networks amidst supply scarcity and the implications for supply security. We address important research gaps by examining how power is redistributed due to a supply crisis and how firms respond across levels to secure supply. Specifically, in situations when firms are increasingly reliant on their lower-tier suppliers in their global supply networks, we aim to answer the following questions:

- How and why can the power distribution in supply networks shift during supply disruptions?
- How can firms leverage their position in the power shifts to shape the power dynamics, and influence their ability to mitigate supply disruptions and secure supply?

We investigate these questions using in-depth data from a single case study of an automotive OEM's supply network during the 2020–2024 semiconductor crisis and building on the antecedents of RDT. Moreover, our findings contribute to the literature on power/dependence within supply networks during supply crises (Kalubanga & Gudergan, 2022) by showing how and why it shifts, and how it can be leveraged. Further, by examining the strategies that firms use to influence these shifts, this study contributes to our understanding of how dependent firms in the supply network can maintain a more favorable position when needed (Pazirandeh & Norrman, 2014). Next, by analyzing the micro, *meso*, and macro levels, this study offers a multi system-levels perspective on power dynamics in global supply networks, and thus, contributes to the discourse on power dynamics, which has mainly focused within each level (e.g., Arvidsson & Melander, 2020; Siemieniako et al., 2023). The remainder of this article proceeds as follows. First, we review the theory on RDT in supply networks and related to supply security on the three system levels. Next, the methodological choices are summarized before presenting the empirical findings, analysis, and discussions.

2. Theoretical background

To frame our analysis, we begin by outlining the core tenets of RDT, followed by a review of how power is distributed across supply networks, and finally, how these power/dependence dynamics can be managed, including the implications during supply crises.

2.1. A resource dependency view of power in the supply network

Power has been conceptualized in different ways. It is context-related and multifaceted, often leading to misaligned strategies and opportunistic behaviors (Casciaro & Piskorski, 2005). RDT (Hillman et al., 2009; Pfeffer & Salancik, 2003; Wry et al., 2013), rooted in sociology (Emerson, 1962), offers a widely used framework to study power (Ozturk, 2021). In RDT conceptualizations, power is influenced by the firm's characteristics, its interactions with other firms, and the broader global economic context.

At the individual firm level (micro), factors like size, brand reputation, and expertise play a role in shaping power distribution. Firms with more resources, established brand recognition, and specialized capabilities often hold more power within the network (Kähkönen et al., 2015; Pfeffer & Salancik, 2003). Substitutability, demand share, and reputation are also important factors influencing power positions at the firm level (Pazirandeh & Norrman, 2014).

Moving to the dyadic and supply network level (*meso*), the focus shifts to the distribution of power among firms interacting within the network. Pfeffer and Salancik (2003) emphasize the importance of inter-firm relationships and dependencies in determining power imbalances. Factors such as control over critical information, negotiation skills, and supplier switching costs can significantly influence power distribution within a dyadic relationship (Pazirandeh & Norrman, 2014). Xiao et al. (2019) argue that buyers also depend on suppliers which possess, besides the aforementioned, large complex networks, and high technological capabilities. The firms and their network structures largely determine the sources of power. Marttinen and Kähkönen (2022) argue that supply network level sources of power significantly affect the reach of strategies to lower tier suppliers.

Finally, the global environment (macro) also influences power distribution within supply chains (Möller et al., 2020). Power relations are not static, and can be influenced by broader economic trends and shifts in the global market. Herlin and Pazirandeh (2012) find that purchasing regulations, such as public procurement or corporate strategy restrictions, influence power positions in a network. They contend that higher restrictions can limit the power of buyers. McNamara and Newman (2020) point towards the geopolitical and global disruption forces that reshape power distribution, such as the market shifts following the COVID-19 pandemic. Crucially, events such as the COVID-19 pandemic highlight the dependencies that can contribute to greater disruptions in global supply networks (Blessley & Mudambi, 2022; Hitt et al., 2020; Spieske et al., 2022).

Firms aim to manage their dependencies to gain control over their flows and survive depending on their effectiveness in managing the demands of partners on whom they depend. Firms can develop strategies to navigate the aforementioned uncertainties from these interdependencies and power imbalances. While implementing these strategies, new uncertainties rise due to a lack of direct control or precise predictions of resource flows (Pazirandeh & Norrman, 2014). Despite the widespread application of RDT, most studies focus on dyadic relationships or firm-level strategies. Few empirical studies examine how power dynamics evolve across multiple system levels. Even fewer focus on such dynamics during crises, despite resources across the supply network being important for firm survival and competitive advantage, which are especially relevant during disruptive events like the pandemic (Hitt et al., 2020).

2.2. RDT strategies for a better power position and their implications during supply crisis

Firm reliance on external entities for essential resources underscores the risks inherent in environmental interdependence and highlights the importance of managing interfirm relations to mitigate these risks (Hillman et al., 2009). The dependent partner in exchange relationships, in striving for better leverage, either reduces its dependence or increases its partner's dependence (e.g., Emerson, 1962). The most direct way to manage and control dependence is controlling and managing its source (Hillman et al., 2009; Pfeffer & Salancik, 2003).

Within the supply chain context, RDT has been used to understand how firms manage relationships with suppliers and customers to reduce uncertainty, and improve the stability of input and output flows (Bode et al., 2011). Many strategies suggested in the literature can be categorized based on Emerson's (1962) original four approaches for weaker parties in social settings: withdraw from the exchange; expand the network; increase their status; and form coalitions. More recent RDT studies suggest additional strategies, such as diversifying the resource base, forming strategic alliances, and engaging in political action to influence regulations and policies (Davis & Cobb, 2010). A recent literature review (Ozturk, 2021) also highlights the need for more empirical studies on RDT in different contexts, including our case with scarcity and crisis supply situations. These strategies can help firms improve their power positions by reducing vulnerabilities and enhancing their bargaining power within the network.

On a micro level, factors like production capacity, technological advancements, financial strength, and specialized expertise significantly influence a firm's bargaining power. Firm strategies often address the adaptation of their information systems, management and human relations, technology, products, values and norms, or definitions of the environment to cope with the uncertainties and constraints of the environment. Firms can gain power by substituting existing assets with new ones with higher critical value in the supply chain, similar to status improvement (Cox, 2003). Increasing attractiveness, or gaining supplier attention, are other potential ways to increase supplier dependence (Pulles et al., 2019). If the power imbalance is high, firms often do not undertake such efforts, as the dominant supplier will resist the attempt (Casciaro & Piskorski, 2005). However, later research (Pazirandeh & Norrman, 2014) finds many instances where firms successfully change their power position in such highly imbalanced relationships. Business diversification can increase resilience to industry-level shocks and economic disruptions. However, during global crises, it can increase vulnerability to severe circumstances (Xiao et al., 2024).

On a *meso* level, firms' ability to respond to extreme demand and supply shifts is constrained by their dependencies (Pfeffer & Salancik, 2003). For instance, during the COVID-19 pandemic, power imbalances were created as demand and supply shifted. When demand drops, downstream (upstream) parties rely less (more) on upstream (downstream) parties for inputs (orders). Conversely, when demand rises and supply becomes limited, downstream parties rely more on upstream parties for inputs, while upstream parties rely less on downstream parties for orders due to high demand (Jiang et al., 2023). Higher dependence on external resources increase firm vulnerability to disruptions like the pandemic. Business are often dependent on resources such as raw materials, cash, labor, and logistics (Craighead et al., 2020). Inter-firm relationships and dependencies play a crucial role in shaping these dynamics. This includes the structure of relationships, negotiation power within these relationships, and control over resources and information within the supply chain. Withdrawal by contracting with another party can reduce dependency levels (Pazirandeh, 2014). However, it can also decrease supply market visibility and knowledge. RDT advocates for cooperation and coordination among partners to generate mutual benefits (Dyer et al., 2018).

Finally, on a macro level, firms must navigate the broader environment that shapes the dependence dynamics. Factors like global economic trends (e.g., trade agreements and inflation rates), political and regulatory environments (e.g., government policies and environmental regulations), and technological advancements impacting the industry can all play a role in shifting the power distribution within the broader network. Governments are powerful entities that can significantly affect resource flows between buyers and suppliers, representing a source of risk (Darby et al., 2020). Governments exert indirect control over resource flows by regulating possession, allocation, and usage, which creates uncertainty for firms as access to critical resources can change with new policies and regulations (Pfeffer & Salancik, 2003). In some economies, the constant introduction of new policies and regulations means that managing policy risk and uncertainty is an ongoing challenge (Hillman et al., 2009). Government policies have differential effects on firms, with localized implementation and enforcement leading to varied effects within industries (Hassan et al., 2019). Firms also face different policy repercussions based on size and activities like lobbying and political connections (Hillman et al., 2009). Political ties can be resourceful but also complicate a firm's external environment, acting as a double-edged sword that necessitates cautious management. The benefits of political ties on firm performance heavily depend on the geopolitical context (Fan et al., 2024).

While extant research provides valuable insights into how firms manage power/dependencies, it has largely overlooked how these dynamics unfold during crises and how strategies interact across levels. Table 1 synthesizes the reviewed literature according to the three system levels considered in this study and organizes it into two panels: sources of power/dependence and strategies proposed in the literature. It presents a summary of i) the sources of power within the supply network that give rise to higher/lower power/dependence, ii) suggested strategies in the literature for managing dependencies to enhance the power position, and iii) implications of these strategies for power/dependence dynamics. Panel A summarizes constructs that shape power positions and their expected effects on concentration or diffusion of power/dependence, and panel B outlines the strategies suggested in the literature and their expected effects on the concentration or diffusion. We build on this classification and suggest effects in our study to examine power dynamics, positions and the specific implications of strategies during a supply crisis.

3. Methodology

We adopted a qualitative case study approach to investigate how power dynamics shift and are managed during supply crises. Case studies are particularly well-suited for exploring complex, context-dependent phenomena, and for building or elaborating theory (Eisenhardt & Graebner, 2007; Yin, 2009). Our study aligns with a theory-elaborating design (Ketokivi & Choi, 2014), as it builds on existing RDT concepts while extending them to a multi-level and crisis context. Given our focus on capturing critical events, decisions, and responses over time, we also take inspiration from Langley's (1999) process-oriented approach to case research, which emphasizes the importance of temporal sequencing and narrative structuring in understanding organizational dynamics.

3.1. Case selection

Our aim was to understand the phenomenon in its real-life context and in depth. Thus, we conducted a single case study (e.g., Eisenhardt, 2021), with the aim of capturing decisions, their motivations, and their context, via close interactions with respondents (Easton, 2010). Specifically, we adopted case research using interviews based on the study's purpose. A case study can help us in capturing critical events and activities, and the focal firm's responses to these events. We initially drew on established power concepts to guide the empirical study.

Our case used purposive sampling criteria to increase the external validity of our findings (Patton, 2002). We applied the following case

Table 1
RDT view of typical power/dependencies sources (Panel A) and strategies (Panel B).

	Construct (definition)	Expected effect on power and outcomes for the firms (↑) indicates concentration; (↓) indicates diffusion.	Example references mentioning constructs and effects
Panel A: Sources of power			
Micro	**Status** (*Visible assets and reputational capital that make a buyer attractive and increase its ability to elicit attention and preferential treatment.* E. g., *size, brand reputation, specialized expertise*)	↑ concentrates with the accumulation of status.	Kähkönen et al., 2015; Pfeffer & Salancik, 2003; Pazirandeh & Norrman, 2014; Pazirandeh, 2014
	Substitutability of supply (*Extent to which required inputs can be obtained from alternative sources or* via *alternative designs, supplier switching costs*)	↑ concentrates when substitutes are scarce; ↓ diffuses when alternatives open.	Pfeffer & Salancik, 2003; Pazirandeh & Norrman, 2014; Pazirandeh, 2014
	Demand share / Volume attractiveness (*Relative size/stability of the buyer's demand shaping allocation priority and attention*)	↑ concentrates in favor of high-volume buyers; ↓ diffuses for small/volatile demand.	Pfeffer & Salancik, 2003; Pazirandeh & Norrman, 2014; Pazirandeh, 2014
Meso	**Relationship quality** (*Trust, commitment, long-term relationship orientation, management engagement*)	↑ concentrates towards tight relational ties; ↓ diffuses with more equal relationships.	Pfeffer & Salancik, 2003; Pazirandeh & Norrman, 2014; Caniels & Gelderman, 2005
	Control of critical information (*who controls allocation/ technical knowledge in the dyad/network*)	↑ concentrates when information is controlled upstream; ↓ diffuses with transparency and joint monitoring.	Pazirandeh, 2014; Caniels & Gelderman, 2005
	Technological capability (*Specialized know-how that creates indispensability)*	↑ concentrates towards tech holders; ↓ diffuses with modular alternatives available in the market.	Pazirandeh, 2014; Xiao et al., 2019
	Supply-network position (*Centrality in the supply network*)	↑ concentrates towards upstream tech holders; ↓ diffuses with architectural/ modular alternatives.	Cox, 2003; Marttinen & Kähkönen, 2022
Macro	**Economic/market cycles & global competition** (*Shifts in demand/supply across industries that reallocate scarce capacity*)	↑ concentrates in favor of buoyant sectors; ↓ diffuses as cycles normalize.	Cox, 2003; Spieske et al., 2022
	Regulatory & policy environment (*Rules/ incentives that shape access, prioritization, and investment in capacity*)	↑ concentrates in highly regulated closed environments; may ↓ diffuse depending on policy design and local enforcement.	Pazirandeh & Norrman, 2014; Pazirandeh, 2014; Blessley & Mudambi, 2022
	Geopolitical shocks & disasters (*Events (trade wars, conflicts, pandemics, natural disasters) that disrupt global flows*)	↑ concentrates during crisis; ↓ diffuses with redundancy/ geographical diversification.	Möller et al., 2020; McNamara & Newman, 2020; Hitt et al., 2020
Panel B: Power/dependence strategies			
Micro	**Status improvement** (*Invest in/build/signal aspects such as size, brand, or unique abilities to increase attractiveness in the network*)	↑ concentrates in favor of the focal firm as it increases partner dependence or helps become a preferred partner, receive priorities and access to innovation and knowledge.	Emerson, 1962; Pazirandeh, 2014; Pulles et al., 2019
Meso	**Diversifying the resource base** (*Diversifying* e.g., *designs or portfolio of offerings. Create redundancy and design flexibility to lower switching costs and reduce single-source exposure*)	↓ diffuses buyer dependence on any single upstream node, lowering switching costs.	Cox, 2003; Pfeffer & Salancik, 2003
	Withdrawal (*Reduce/ exit commitment to an exchange. Rebalance exposure by reallocating volume or terminating disadvantageous ties*)	↓ diffuses dependence; may ↑ concentrates upstream if alternatives are scarce.	Emerson, 1962; Pazirandeh, 2014
	Network expansion / Supplier base diversification (*Add qualified sources; include spot/authorized distributors where appropriate)*	↓ diffuses dependence; increases outside options, lowering switching costs	Emerson, 1962; Pazirandeh, 2014; Pfeffer & Salancik, 2003
	Coalition formation (*Pulling resources horizontally with* e.g., *other buyers to increase* e. g., *volume through pooling to gain allocation priority and bargaining power in upstream markets*)	↑ concentrates bargaining power for the coalition with larger volumes, more knowledge and resources; may ↓ diffuse for individual smaller buyers and increase coordination cost	Emerson, 1962; Herlin & Pazirandeh, 2012; Pfeffer & Salancik, 2003
	Strategic alliances / Formalization / Socialization (*Creating stronger ties with partners/potential partners that can hedge the imbalances of the power relationship*)	↑ concentrates influence for well-connected buyers including greater control, predictability and stability, access to unique resources, mutual benefits, and becoming preferred partners; may ↓ diffuse if alternatives are better-connected.	Emerson, 1962; Pazirandeh, 2014; Pfeffer & Salancik, 2003; Dyer et al., 2018
Macro	**Engaging in political action / Policy shaping** (*Lobbying and collective representation to influence prioritization, incentives, and capacity investments*)	↑ concentrates for prioritized sectors/ regions and can mean preferential policies; can ↓ diffuse if policies broaden access and increased vulnerability in geopolitical situations.	Hillman et al., 2009; Fan et al., 2024

selection criteria to narrow down the case subject: i) experienced the impact of dependencies towards its suppliers, ii) experienced a supply crisis, iii) operated in a global supply network, and iv) was actively employing measures to secure supply. Accordingly, we focused on the case of an automotive OEM's supply network, which includes its Tier 1 suppliers, semiconductor suppliers, authorized distributors, and two other OEMs from the same holding group (see Fig. 1). Fig. 1 marks the borders of the three system levels of our study: micro, *meso*, and macro. For our data collection, we chose supply network actors that represent

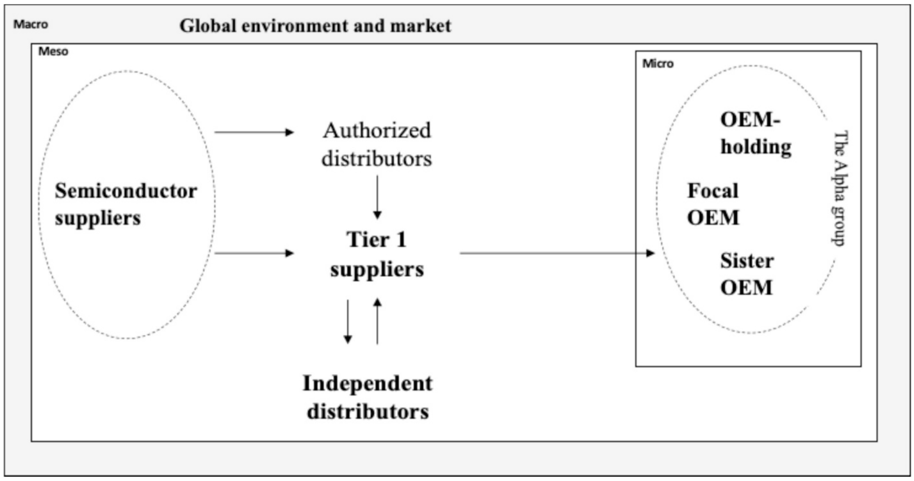

Fig. 1. A schematic view of the semiconductor supply network for the focal OEM in the three levels of this study (actors in Bold letters are interviewed in this study).

these three levels.

3.2. Case description

The focal OEM is a North European producer of large commercial and passenger vehicles. As depicted in Fig. 1, the focal OEM belongs to a business group, with OEM holding (which is the parent company) and sister OEM (a sister company) also included in this study. These firms represent the micro level. We focused on semiconductors and electronic control units (ECUs). ECUs are electronic devices programed to control a certain function of the vehicle based on the data received from the sensors. The Tier 1 s included here are all traditional suppliers to the major European automotive OEMs, including both pure automotive and mixed market suppliers. Some sampled suppliers supply to all automotive segments and some are focused on commercial vehicles. The independent distributors are companies that act in the spot market, engaging in buying and selling material. The network also includes authorized distributors who act as intermediaries (wholesalers) between the semiconductor producers and smaller customers, but do not have direct contact with the semiconductor producers. Tier 1 suppliers and distributors represent the *meso* level. The global environment represents the macro level, where we have collected data from market experts.

The focal OEM has been increasingly relying on electronic components due to the traditional outsourcing of development and production of electronics to Tier 1 suppliers. The components in question undergo three to four years of development, featuring detailed specifications and a high degree of customization. This extensive preparation positions the nominated and subsequently contracted supplier as the sole entity capable of meeting the product requirements. Tier 1 suppliers select and source subcomponents and often outsource manufacturing to electronics manufacturing services (EMS) companies and logistics to authorized distributors.

3.3. Data collection

Extensive data were collected from the firms and experts representing the micro, meso, and macro levels depicted in Fig. 1 through semi-structured interviews with 25 respondents, participatory observation, and firm documents during 2020–2024. Close and direct conversation was required with decision-makers to understand the context, supply measures, and the reasoning behind them (following suggestions by Easton, 2010). One of the authors had been part of the taskforce responding to the shortage crisis during 2020–2023. By being on the team, critical events and developments were observed as they evolved, as well as the responses and actions to counter them, and engagement in the supply network. We aimed to include all relevant firms in the semiconductor supply network for the focal OEM to understand the phenomenon. However, as depicted in Fig. 1, not all firms agreed to participate.

The interviewees were sampled based on their knowledge, experience, and engagement in the focal OEM's semiconductor supply network. Our sampling strategy also considered that respondents should represent the three levels of the study (micro, meso, and macro). The respondents included respondents from the focal OEM, the OEM holding and sister OEM, their Tier 1 suppliers, the focal OEM's independent distributors, the semiconductor suppliers, and semiconductor market experts (see Table 1). An interview guide (provided in the Appendix) with a semi-structured approach was used to both standardize responses and capture the situation as well as possible (suggested by Eisenhardt, 2021). The questions were designed to capture the buyer power, and supply measures undertaken at each level and/or by each firm. The motivations behind and impact of different strategies on the supply position were also examined. However, the aim was to capture the situation rather than to look at perceptions about the phenomenon. All interviews were recorded and transcribed.

Additional data were collected through participatory observation of one of the authors throughout the crisis and after it ended. This enabled the identification of and access to internal documents, contracts, and meetings (internal and with suppliers) in which changes in the supply network were discussed. These data sources, listed in the last row for each level in Table 2, provided a deeper picture of the semiconductor market and helped supplement the collected data from interviews. We applied triangulation in our data collection thought interviews, documents, and participatory observations. Further, all data relevant to the case was saved in a case database (Eisenhardt, 2021; Yin, 2009).

3.4. Data analysis

Our data analysis followed a process-oriented approach, aiming to capture the unfolding of the critical events, decisions, and responses over time (Langley, 1999), and pattern coding (Eisenhardt, 2021; Miles & Huberman, 1984). First, we familiarized ourselves with the case by developing the storyline of the case. Here, the timelines of critical events, activities, and responses were documented. Data were then analyzed to extend the theoretical discussions and gain an understanding of the concepts and interrelationships between them.

Pattern coding was used in a few tables for each source of power at the three different levels. Codes were developed iteratively and grouped into higher-order categories reflecting the sources of power, strategic responses, and their implications. This approach aligns with the theory-

Table 2
Descriptive info on the sources of data.

Level of analysis	Actor	Data source	
Micro (total respondents: 14)	The focal OEM	6 Commodity purchasers (CP1, CP2, CP3, CP4, CP5, CP6)	6 × 60–90 min
		2 Project purchasers (PP1, PP2)	2 × 60–90 min
		Business development manager (OEM-BDM1)	1 × 70 min
		2 R&D managers (OEM-R&D1, OEM-R&D2)	2 × 90 min
		Total: 4 documents -Invitation to trainings about semiconductors -Process description for spot market purchases -Presentation about semiconductor database -Communication on the creation of a purchasing team for semiconductors	
	OEM-holding (Parent firm of the focal OEMs)	2 Strategic purchasers (OEM-SP1, OEM-SP2)	2 × 60 min
	Sister OEM (same holding group)	Business development manager (OEM-BDM2)	1 × 60 min
Meso (total respondents: 8)	Suppliers A (Tier 1)	Sales director (T1-SD1)	1 × 40–60 min
	Supplier B (Tier 1)	Sales director (T1- SD2)	1 × 40–60 min
	Supplier C (Tier 1)	Sales director (T1- SD3)	1 × 60 min
	Independent distributor X	Purchasing manager (ID-PM) and Key Account Manager (ID-KAM1)	1 × 60 min
	Independent distributor Y	Key Account Manager (ID-KAM2)	1 × 70 min
	Semiconductor supplier	Senior Manager for OEM Business Development (SS-SM) and Key Account Manager (SS-KAM3)	1 × 60 min
	The focal OEM	Total: 7 documents -Tier 1 supplier contract -List of electronic components -List of Tier 1 suppliers -Tier 1's technical Product presentation -Common supplier meeting with sister brands -Presentation about OEM-holding escalation process -Request to Tier 1 suppliers for list of semiconductors -Process for extended forecasts -Letter to Tier 1 supplier about firm orders	
Macro (total respondents: 3)	Market expert I	Researcher on the topic (ME1)	1 × 90 min
	Market expert II	Previous experience in sales and procurement of semiconductors (ME2)	1 × 60 min
	Market expert III	Previous experience in procurement of semiconductors (ME3)	1 × 80 min
	The focal OEM	Total: 3 documents - Letter to the EU Commission - Presentation from meeting with Telecom OEM - Presentation on global market trend Exchange	

elaborating case study methodology (Eisenhardt & Graebner, 2007), where empirical insights are used to refine and extend existing theoretical constructs. The examples of these codes include "contracts", "regulations", "collaborations," and "competition". The data were coded by two individuals to mitigate the risks associated with individual bias or misinterpretation. The coded data from interviews, documents, and participatory observations were displayed in mega matrices (Miles & Huberman, 1984). We grouped similar codes into a smaller number of themes.

To structure the data, it was grouped into the three levels of micro, *meso*, and macro, as well as temporally into pre-crisis, during the crisis, and post crisis periods drawing on the suggestions of Langley (1999). The strategies were coded on each level based on the scope. For instance, improving status by increasing the volumes within the holding group was considered as a micro level strategy, while improving status in the global semiconductor market by being more present was coded as a macro level strategy. The quotes presented here are either representative quotes from the case or serve as a powerful illustrative quote. Finally, the analyses were sent to the case representatives for feedback and input, and to increase the validity of our findings.

4. Empirical findings

4.1. Pre-crisis supply dynamics and strategies of the focal OEM for semiconductors

Although the focal OEM practiced global sourcing, it typically selected suppliers predominantly from Europe. This preference stemmed from both technological capabilities and cultural/language barriers. Several European suppliers were also favored for their advanced technological competencies. For some buyers, the opportunity to validate technical solutions significantly influenced their supplier selection decisions. In the supplier selection process, only a small portion of bidding suppliers typically met the established requirements. For instance, in a given supplier selection process, only 4 out of 24 suppliers met the established technical requirements. In some cases, the Tier 1 suppliers have a dominant position as the only supplier able to meet quality and technical requirements. Hence, the OEM is hesitant about looking for alternative suppliers.

> "If the word came out that we wanted to challenge this supplier, and we weren't successful in finding anyone else, the supplier would raise the price"
>
> (CP4)

Often, once a supplier qualifies and is selected to supply an electronic part, a general agreement contract is signed, delineating the responsibilities of both parties. Given that technology rapidly evolves and electronic component prices generally decline annually, these contracts also require regular updates concerning pricing. The general contract outlines a long-term partnership, encompassing both development and supply phases, with renegotiation occurring post-development.

When a Tier 1 supplier is contracted, the focal OEM typically engages in single sourcing due to the supplier's considerable cost and involvement in product development (known as Early Supplier Involvement, or ESI), which fosters locked-in relationships. The ESI practice has been heavily emphasized due to the importance of time to market and because electronics strongly relies on technologies developed by Tier 1 suppliers that are adapted to the OEMs' needs, as illustrated in the case of an OEM purchaser in the quote below.

> "We were also discussing the intention to do insourcing in 2013, but there was no one in the company that was able to bring that (electronics development) competence in house. So, the decision was to have a (Tier 1) system supplier that is able to deliver this"
>
> (CP6)

However, we also observed the increasing dependence of Tier 1 suppliers on the innovations created by semiconductor suppliers and their limitations in keeping up with these innovations, as illustrated in the quote below from an OEM engineer. During the development phase, the focal OEM and its suppliers' R&D departments closely collaborate. However, as production commences, Tier 1 suppliers perceive that the relationship shifts to a more distanced dynamic between the focal OEM's purchasing department and supplier's sales team.

> "The tier 1s have problems to understand what they should do in the future, and when the complexity is coming more and more in the hardware, it's hard for them to really be in the situation to handle everything. They have to rely on what (the semiconductor suppliers) deliver."
>
> (OEM-R&D2)

4.2. *Measures initiated to secure the supply of semiconductors considering the shortages*

In 2020, with electronics demand and supply shifting between the automotive and consumer electronics in a short period of unplanned time, the world began facing a three-year semiconductor supply crisis that severely affected the focal company and its holding group. A summary of the measures initiated and undertaken within the OEM holding's business group to secure supply, together with the experiences related to these initiatives, is compiled in Table 3, sorted by the system level at which the practice was initiated.

On a micro level, the focal OEM's cooperation within the OEM holding featured the pooling of volumes and joint negotiations for components with similar specifications. Some suppliers perceived this strategy to be important for customer attractiveness due to the importance of volumes in the semiconductor industry, as expressed by a Tier 1 supplier sales manager in the quote below. Nevertheless, the suppliers were dissatisfied with this pooling approach as the technical specifications were not fully aligned. The focal OEM employed strategies to negotiate lower prices on already purchased products by sourcing multiple product types from the same supplier while also diversifying its supply base to mitigate dependence on single sources, striving for a balance between these strategies.

> "They [the focal OEM] could increase their attractiveness if they would source together [with its sister company]"
>
> (T1-SD3)

To address supply disruptions, the focal OEM also escalated and coordinated its most severe shortages to the OEM holding. This escalation was only used when their production was impacted and aimed to capture the supplier's attention, underscore the focal OEM's significance within the business group, and leverage the high-level communication facilitated by the OEM holding with Tier 1 suppliers and semiconductor producers. Such escalations led several Tier 1 suppliers to view them as punitive measures and created negative incentives, although the OEM's intention was to get closer to them. Still, other suppliers viewed the escalations as a way to obtain priority for the shortage within the supplier's organization:

> "If you add [the shortage case] to the [OEM holding] escalation meeting, that will help us get priority from our management internally"
>
> (Tier 1 key account manager, phone communication, February 2020)

The focal OEM also experienced a lack of knowledge on the semiconductors used in the electronic parts that it bought. This limited the focal OEM's ability to assess the impacts and risks of shortages, and its heavy reliance on its Tier 1 suppliers, as evident in the following emails sent by the OEM to purchasers of electronic parts just before the shortages became a global crisis:

> "Within (electronics) system we don't own the design and have no BOM list, so we don't know what components are mounted in the most cases."
>
> (OEM-Purchaser 1, email communication, January 2020)

> "If there is a semiconductor shortage in the world, I think that the less of the world problems are the automotive industry."
>
> (OEM-Purchaser 2, email communication, January 2020)

Consequently, OEMs in the holding group invested considerable effort into enhancing information sharing and visibility concerning product contents, as it was stated in internal strategic meetings at the beginning of the shortages:

> "We need to have a better monitoring of semiconductors in our vehicles to be able to read-out data in real-time"
>
> (OEM Procurement manager, internal presentation, January 2020)

Among the partners, the Tier 1 suppliers resisted sharing this information as it would have reduced their leverage. However, the semiconductor suppliers welcomed the initiative as it would get them closer to the source of demand.

> "Tier 1s fear that if OEMs have too much information, they will use it against them during price negotiations."
>
> (OEM-BDM2)

Additionally, one of the premium brand OEMs within the OEM holding, the sister OEM, saw the lack of technical knowledge regarding semiconductors and their contributions to sourced products as a barrier to securing supply during the crisis. Consequently, the OEM invested in increasing its knowledge of its purchasers in this respect. For instance, they created a strategic role for the purchasing of semiconductors to tackle this issue.

Additionally, for actors further away in supply chain, the OEMs wished that they would employ stockpiling based on the argument that for them, stockpiling "*is more expensive than earlier in the supply chain*" (OEM-BDM2). However, the suppliers on all tiers did not wish to stockpile due to the high cost of capital tied to component inventories. Independent of the focal firm, the independent distributors in the spot market cooperated horizontally. For instance, they actively bought back components from customers to secure stockpiles, thus enhancing their ability to manage supply disruptions and better meet demand. The focal OEM started sourcing from the spot market to find alternative sources and continue production. Here, the stockpiling by the distributors, who acted as the spot market, was helpful.

On a *meso* level, the lack of transparency and information asymmetry made the OEMs dependent on the Tier 1 suppliers, as also illustrated in the quote below. From the suppliers' side, the uncertainty in the OEMs' volume forecasts created limitations in securing semiconductor supply. Consequently, all parties felt the necessity to enhance transparency.

> "It has been a problem, not having the visibility, handing over every all the responsibility on the Tier 1, relying solely on the Tier 1"
>
> (CP5)

The practice around the allocation of semiconductors was unclear to the OEM. Under a shortage, allocation refers to how much supply each customer receives of a component. The OEM holding requested allocation information from the Tier1s. They did not want to share the information out of fear of losing their position in their supply network and since their other customers did "*not share the view of what is a fair allocation of semiconductors [with the OEM]*" (T1-SD2). Tier 1 suppliers especially saw this as an issue of sharing supply information from the contractual relationships between themselves and semiconductor suppliers. Thus, the focal OEM attempted to align information on demands and supply across the chain involving the Tier 1 and semiconductor suppliers, as motivated by the purchasing manager in the quote below:

Table 3
Measures initiated within the OEM business group to secure supply during the crisis.

	Measures initiated to secure supply	Firms involved	Power/dependence strategy (RDT code; see Table 1)	Motivation	Some experiences / outcomes
Micro	Pooling volumes and joint negotiations	The focal OEM, OEM-holding	Coalition formation Status improvement	• Gain more attractiveness through showcasing higher volumes	• Aligned volumes • Shared resources and knowledge • Misaligned technical specification did not fully explore synergies, from the supplier's view • Negative incentive from some suppliers' view
	Shortage escalation and coordination in the OEM-Holding	The focal OEM OEM-holding	Formalization	• Raise supplier attention • Emphasize the focal OEM's status • The most severe shortages at the Focal OEM (i.e., those posing imminent threats to vehicle production) were escalated to the OEM-Holding • Gain more communication with Tier 1 s and the semiconductor suppliers*	• Positive perception of some suppliers to increase priority within their organization • Closer contact with semiconductor suppliers • Not sufficient in the short-term, but increased visibility of the demand in the long term. The strategy was discontinued after the first years.
	Strategic role for purchasing of semis	OEMs, OEM-holding	Status improvement	• Understand a market of which the OEMs had low visibility	• All actors found this very important for securing supply both short and long term
	Obtain knowledge of semiconductors used in electronics parts	OEMs Tier 1 s Semiconductor suppliers	Status improvement	• Increasing transparency of semi content in electronic parts	• Tier 1 s resist the increased information sharing and visibility requests by OEM as they perceive it as leverage • Semiconductor suppliers welcome the increased info sharing as they are interested in the demand
	Geographical stockpiling	Independent distributors	Withdrawal	• Creation of buffer stocks due to export sanctions between the United States and China	• Not enough for the shortage experienced
	Spot market sourcing	OEMs Tier 1 s Independent distributors	Withdrawal	• Create access to an alternative source of semiconductors and mitigation impact of shortages from the original source (semiconductor suppliers).	• Reduced dependence on Tier 1 suppliers' spot market processes • Perceived benefit by the OEM in making swift spot purchase decisions
Meso	Aligning demand and supply info in the supply chain (e.g., 2-party and 3-party meetings)	OEMs** Tier 1 s semiconductor suppliers	Socialization	• Mitigate information asymmetry on OEM's demands and semiconductor supply	• Gathered several actors from the supply network in meetings to share information • Discontinued after the crisis
	Direct relationships with semiconductor suppliers	OEM-holding The focal OEM	Network expansion/ diversification of supplier base	• Direct information channels • Increase mutual knowledge and understanding	• Higher degree of knowledge on the product and semiconductor suppliers • Interest of the semiconductor suppliers in the automotive demand
	Annual semiconductor supplier-OEM meetings	OEMs semiconductor suppliers	Socialization	• For semiconductor suppliers to gain insight into OEM production plans	• Direct discussions on the planning needs • Discontinued once relationships to semiconductor suppliers were established and other meeting structures were adopted
	Increasing length and commitment of volume forecasts	OEMs** Tier 1 s	Formalization	• Align the OEM's volume forecasts with the planning horizons of semiconductor production	• Extending volume forecasts from 12 to 24 months • OEM's request for Tier 1 suppliers to place firm semiconductor orders • OEM's commitment to forecasts enables Tier 1 suppliers to place firm orders for semiconductors
Macro	Information exchange on the global market and global trends	OEMs Tier 1 s Semiconductor suppliers	Status improvement	• Increasing cross-network communication on trends in the external environment	• Market monitoring routines to obtain and share information on global trends within the OEMs • Established discussions with suppliers to share information and discuss implications of macro-economic developments
	Interaction with European transportation regulation authorities to delay the requirement for devices in shortage	International Road Transport Union (representing the focal OEM, other OEMs and Tier 1 suppliers)	Engaging in political actions	• Adjust the introduction of new EU requirements for tachographs to the availability of semiconductors in shortage	• Several OEMs and Tier 1 suppliers affected by the shortage of a • Cooperation between several OEMs and suppliers in the communication to the European Commission

(continued on next page)

Table 3 (*continued*)

Measures initiated to secure supply	Firms involved	Power/dependence strategy (RDT code; see Table 1)	Motivation	Some experiences / outcomes
Sharing knowledge with OEMs from other industries	The focal OEM Telecom OEM	(Horizontal) Socialization	• Cross-industry sharing of knowledge and practices on semiconductor management	• Learning from Telecom OEM's long experience in buying semiconductors • Telecom OEM interested in OEM's plans

* semi: Semiconductor; ** OEMs: OEMs in the same business group as OEM-holding.

> "In the in the old days, they (the semiconductor suppliers) had to rely on the information from the Tier 1. What they think about the market, what they think about what their customers, what the OEM's would like to have in the future. But if the semiconductor suppliers have a direct access to the OEMs, they will know for sure by themselves and then they come back with the right technology, building factories, creating a product portfolio, do all the stuff they have to do."
>
> (CP5)

The OEM holding explored the potential for direct relationships with semiconductor suppliers, identifying mutual interest stemming from the increased electronic content of vehicles within the automotive industry. The focal OEM actively participated in joint meetings, and shared technical knowledge and roadmaps with semiconductor suppliers to enhance their understanding of market dynamics and state-of-the-art developments. However, semiconductor procurement continued to flow through Tier 1 suppliers. The OEM recognized the need to establish relationships with semiconductor suppliers and strengthen existing relationships with Tier 1 suppliers. The close collaboration among OEMs within the business group facilitated volume alignment and fostered stronger connections with semiconductor suppliers. Initially, the direct relationships turned into annual semiconductor supplier-OEM meetings. Eventually, after the crisis, these evolved into direct relationships with key accounts on each side.

> "We should have good relationships with all these semiconductor suppliers, so whenever there is a really big problem, we have the possibility to call or send an email to the right person… Having a relationship, having the contact, helps us getting things improved in deliveries"
>
> (CP5)

A commitment to volumes was deemed critical for securing the supply of semiconductors. However, the automotive OEMs do not commit to volumes with their suppliers. During the crisis, the Tier 1 suppliers wished to have better information and commitment to secure the needed allocation from the semiconductor suppliers:

> "If we cannot give the right information [about our demand], we cannot get supply from our suppliers"
>
> (T1-SD1)

While vehicle producers provided forecasts for 12 months, Tier 1 suppliers needed to provide forecasts for 18 to 24 months to semiconductor suppliers, who in turn had 24 weeks' of production lead times. Semiconductor suppliers aggregate similar forecasts for their production planning and longer forecasts of up to 5 years for capacity investment planning. During the crisis, the OEMs extended the duration of their forecasts to 24 months with a higher level of commitment and asked the Tier 1 suppliers to place long-term binding orders for semiconductors.

Extensive effort on the macro level was dedicated to increasing the information shared within the global supply network both horizontally and vertically. The OEM and its holding group exchanged extensive information on the global market and global trends to stay on top of the global trends and macro-economic developments that shape the supply market (i.e., status improvement). They also engaged in discussions with the political actors including the European transportation regulation authorities to delay the requirement for devices in shortage, among other things. Finally, horizontally, they moved outside their sector to share knowledge with OEMs from other industries which were, say, more advanced in this segment (e.g., telecom).

4.3. *Shifts in the supply network dynamics triggered by the supply shortages*

During the crisis, some preferences in the focal OEM's supply network changed. Supply relationship trends changed in several major ways, including an inclination towards the information source (as in the direct links between the OEM and semiconductor suppliers), technological collaborations, non-coercive/opportunistic partnerships, and preference of cultural, language, and logistics similarities, as evident in the following quotes:

> "Producers in China do not want to communicate with European customers"
>
> (ID-PM)

The increased electronic content of vehicles had slowly increased the focal OEM's demand for semiconductors in the past decade. This increased OEMs' dependence on semiconductors but was not visible enough to the semiconductor suppliers. The focal OEM competes for its semiconductor needs with OEMs within and across industries. Further, even the semiconductor demands of the OEM holding (including several OEM brands) are relatively small compared to other industries. The existence of authorized distributors intermediating the small volume shipments between semiconductor suppliers and small Tier 1 suppliers added to the distance between the OEM and semiconductor suppliers. Although semiconductor suppliers had preferred using authorized distributors to intermediate relationships with smaller customers, this limited their understanding of where their products were used in the automotive industry.

This trend changed as the semiconductor crisis unfolded, and as the OEM holding and focal OEM initiated direct communication with these suppliers. The more the semiconductor suppliers learned about the OEM, the more they were willing to coordinate directly, as expressed by an engineer in the quote below.

> "The semiconductor suppliers learned that the best thing is, they show us the product and if we require this from the tier 1, they can sell it. If you like it, you can have daily meetings with some semiconductor suppliers showing you new products, the current product roadmap improvements. (OEM-R&D2)"

Today, OEMs and semiconductor suppliers have direct communication. However, the majority of contracts and physical flows still go through the Tier 1 suppliers. The focal OEM's technical status made it an attractive customer for its Tier 1 suppliers before the shortages and for the semiconductor suppliers during the crisis. Their margins were higher than passenger cars within the commercial vehicle segment, further contributing to their attractiveness. In addition, not exploiting their power in other categories also benefitted the focal OEM during the crisis, as partners did not perceive them negatively coercive or opportunistic.

According to several Tier 1 suppliers, this created greater willingness and priority to help the focal OEM during the crisis.

Another important shift has resulted from the improved and aligned understanding of demand and supply between the OEM and semiconductor suppliers. A lack of commitment to forecasts was a stressed barrier to securing supply, and was specifically problematic due to the distribution of power between the Tier 1 suppliers and their suppliers: *"we have no dominant role towards semiconductor producers"* (T1-SD2). To solve this, sharing forecasts could have been central for the Tier 1 suppliers to balance the need for technical developments and volumes. However, the OEM could not commit or share more accurate forecasts due to their own high demand fluctuations.

Still, upon recognizing the importance of forecast length and commitment during the crisis, the OEMs invested efforts into extending and increasing the commitment of their forecasts to Tier 1 suppliers. Instead of committing to volumes, the OEMs created links to the semiconductor suppliers aimed at increasing their understanding of the demand dynamics. As the understanding increased, the OEM-semiconductor supplier links have now created a new level of interdependence. However, commitment issues persist for Tier 1 suppliers, who arguably, and as perceived by other supply chain actors, have the least favorable power position perceived today (end of 2024).

> "The tier 1s have problems to understand what they should do in the future, and when the complexity is coming more and more in the hardware, it's hard for them to really be in the situation to handle everything. They have to rely on what (the semiconductor suppliers) deliver."
>
> (OEM-R&D2)

Additionally, cultural, language, and logistics similarities were an enabler for a successful partnership since before the crisis. Companies that shared similarities in this respect prioritized each other. This was largely due to simpler communications enabling more straightforward partnerships. This created strong interdependencies, which, especially due to their long-term character, persisted after the crisis. For instance, both the focal OEM, suppliers, and the independent distributors perceived that the semiconductor suppliers prefer their local business culture and language. We observed that these preferences were not affected by the supply shortage.

5. Analysis

Here, we analyze the empirical findings across the three system levels, focusing on the strategies employed during the crisis and the resulting shifts in power distribution.

5.1. Power/dependence strategies and supply security during the crisis

We summarize the findings on the three system levels in Table 4. The sources of power had power-dependence implications during the supply crisis. This triggered measures for securing supply by addressing these power implications, and in practice, had implications for securing supply vis-à-vis power. Demand share, technical sophistication of the component, transparency, and information exchange were the underlying factors in the power asymmetry. These became apparent during the semiconductor crisis and were largely driven by the lack of access to the electronic components. Choosing the right strategy to improve the power-dependence position in the network involved navigating the trade-offs and synergies across the three system levels.

At a micro level, OEMs depend on a limited number of suppliers for key components. This dependence is further amplified by high switching costs due to specialized knowledge and tooling required by the semiconductor supplier. This is also due to the existing transactional mechanisms, such as the contracts with the Tier 1 s. Here, relying heavily on a few key suppliers has made switching difficult. Consequently, there was a lack of visibility upstream and downstream, and some Tier 1 suppliers felt a lack of control and power during the crisis. Most common strategies used by the OEMs were to improve their status, internally formalize processes, and reduce their dependency by stockpiling (i.e., a form of withdrawal). The reduced dependency on external supply arguably reduced their dependency. However, the need for increasing interdependencies with semiconductor suppliers was higher.

At a *meso* level, long term (strategic) alliances with the Tier 1 s, while expected to theoretically contribute to better power positions, limited the focal OEM's visibility and access into the semiconductor supply

Table 4
Power/dependence sources and strategies for supply during the crisis.

	Micro	Meso	Macro
Sources of power	-Dependence on few key suppliers/ producers (market concentration) of critical components/ products - Concentration of specialized knowledge and production tools	- Strong transactional mechanisms (Tier 1 contracts with clear terms and penalties) limiting the shift from existing partnerships -High switching costs due to the specialized knowledge and development time - Long-term alliances with Tier 1 s - Lack of trust and information sharing	- Industry regulations (e.g. safety/quality standards that create barriers for new entrants) - Global/across-industry competition - Geopolitics - Vulnerability to major disasters
Power/ dependence implications during the crisis	- Lack of OEM visibility upstream and low supply market knowledge - High dependence and very limited bargaining power of Tier 1 s	- Low prioritization by semiconductor suppliers in allocations - Limited Tier 1 power position creating more mistrust towards partners	- Shift of targets (e.g., supply security over cost) - Need for geopolitically driven alliances and other type of collaborations (e. g., horizontal or cross industry)
Power/ dependence strategies taken for securing supply	-**Internal Formalization** within the firm by creating new routine and procedures -**Internal coalition** within the same holding group **- Status improvement** by increasing own knowledge and market knowledge of their demand -**Withdrawal** by stockpiling and finding potential substitutions	-**Socialization** with all in the network to increase joint understanding and planning -**External formalization/ socialization** of OEMs beyond the Tier 1 with other key players -**Network expansion/ diversification** by investing in new alternative partners	-**Status improvement** on a global scale by showing the automotive demand -**Engaging in political actions** -**Horizontal socialization** with actors outside of the immediate horizon
Implications for securing supply	-Reduced vulnerability to disruptions by efforts that increased the status of the firm, and reduced dependency on external supply	- Improved communication and transparency increasing the interdependence further up the chain and improving power position, early identification of potential problems, and being prioritized	- Reduced dependence on single geographical sources, reducing vulnerability to environmental disasters - Increased planning to market and regulatory changes, reducing vulnerability and dependencies

market. This created an unfavorable power position. We also observed a mutual distrust between the parties, information asymmetries, and a created distance from the semiconductor suppliers, who controlled the volumes and state-of-the-art knowledge. Tier 1 suppliers, who had traditionally been orchestrating supply, experienced limited bargaining power, lack of control over their supply network position, and increasingly felt distrust towards their OEM partners. The most common strategies at this level for the OEM were to socialize and formalize beyond the Tier 1 suppliers. While established OEM-Tier 1 contracts before the crisis created stability at that point, the potential contractual penalties for shifting partnerships limited flexibility and created vulnerabilities. The crisis made it necessary to change these contractual links. Meanwhile, the improved communication and transparency in the network created by the new relationships (OEM-semiconductor supplier) increased the interdependencies and improved the power position, which later contributed to the identification of upstream disruptions (e.g., 2023 Taiwan fab fires).

Finally, at the macro level, while firms can improve their position by increasing their global status and visibility of their demand, they are susceptible to external factors like geopolitical events and natural disasters which they need to prepare for. During the crisis, the targets in the industry and at the OEM changed, with supply security becoming the number one issue to solve. The crisis also highlighted the need for geopolitically driven alliances to secure supply in the long-term as the dependencies on component and material sources upstream became evident. Here, strategies were directed at expanding the network by finding new potential partnerships both horizontally and vertically and improving the attractiveness of automotive demand for the components. Much of the efforts were directed at reducing single geographical location dependencies and increasing regulatory alignments.

Table 5
Power distribution shifts throughout the supply disruption.

System level Supply disruption	Micro	Meso	Macro
Pre crisis (low levels of supply disruption)	- Hierarchical dependencies with OEM's control and perceived dominance -Tier 1 s acting as the orchestrators of supply and innovation	- Tier 1 centric supply network, with cascading outsources of supply management up the chain - Preference given to technical knowledge	- Stable supply, with the increased electronic content of vehicles increasing demand
During crisis (high levels of supply disruption)	- High dependence of the OEMs on semiconductor suppliers - Lack of visibility and access to the supply market increasing the dependence on semiconductor suppliers	- Increased links between all network actors - Preference given to culture, language, and ease of logistics	- Global shortages, higher pace of increased demand than expected, and not prioritized in allocations across industries
Post crisis (low levels of supply disruption)	- Increased status, demand volumes, and technical knowledge to improve power position - Move away from full reliance on Tier 1 s.	- Strong link between the focal OEM and the semiconductor suppliers, with the Tier 1 having a less pronounced role compared to before - Creating new contract and information sharing channels between OEM and semiconductor supplier - Higher degree of interdependence created with semiconductor suppliers - Preference given to long-term alliances	- Geopolitical instability with raw material criticality and concentrations, highlighting new dependencies and vulnerabilities - Knowledge on the electronic content of vehicles, and increased the visibility of automotive demand increasing their attractiveness

5.2. Shifts in the distribution of power

As summarized in Table 5, we also analyze the shifts in the distribution of power in this network that resulted from and in the measures and strategies on the three levels and pre-crisis, during the crisis, and post-crisis. In our case study, some power/dependency dynamics shifted from before to after the semiconductor crisis. A previously hierarchical structure in a stable supply network marked by perceived OEM dominance has shifted to an uncertain environment with new interdependencies created between the OEMs and semiconductor suppliers. The three-year crisis period created a highly unstable environment that highlighted the high-level dependencies for the OEMs, shifted preferences, and because of the measures taken to get closer to the upstream supply, reshaped the supply network dynamics.

6. Discussion

This study examined how and why power dynamics shift in global supply networks amidst supply scarcity, and the implications for supply security. Using the RDT lens (Hillman et al., 2009; Pfeffer & Salancik, 2003), we empirically investigated the phenomenon at the three systems levels of micro (firm), *meso* (supply network), and macro (the external environment).

We found that power asymmetry in supply networks is not inherently negative, as suggested in most RDT studies taking a firm perspective (e.g., Pfeffer and Salancik (2003). It can be a double-edged sword in a positive sense too. As suggested in some studies (Nyaga et al., 2013), asymmetric power structures can enhance efficiency in stable conditions (in our case pre-crisis), as dominant firms streamline processes, reduce redundancies, implement standardized practices, influence to invest in new technologies, and push to improve their capabilities. However, these same power asymmetries can result in the exploitation of other partners, leading to reduced margins and financial strains during supply shortages.

Simultaneously, firms overly dependent on powerful partners become increasingly vulnerable to changes in the dominant firm's strategy or market conditions (Pazirandeh & Norrman, 2014). Here, contrary to extant research suggesting that power imbalances can hinder information sharing or willingness to engage in joint initiatives (Pfeffer & Salancik, 2003), the concentration of power upstream pushed the OEMs to share more information and engage in joint initiatives to solve the supply shortage. Thus, while power asymmetry may suppress cooperation in some settings, it can also catalyze it under crisis conditions when mutual survival is at stake.

Our findings are summarized in the framework in Fig. 2, illustrating how firms' power shifts in their global supply networks during supply crises. The vertical axis represents the level of "supply network power/dependency concentration," which ranges from "high concentrations (unbalanced distribution)" at the bottom to "low concentrations (balanced distribution)" at the top. The horizontal axis represents the crisis phase (supply disruption level), moving from pre-crisis with low level disruptions, to acute crisis with high levels of disruption, and back to low levels of disruption post crisis. The crisis state increases the concentration of power, pushing the supply network into higher levels of unbalanced power distribution.

Different sources of power (left side of the figure) at the micro, *meso*,

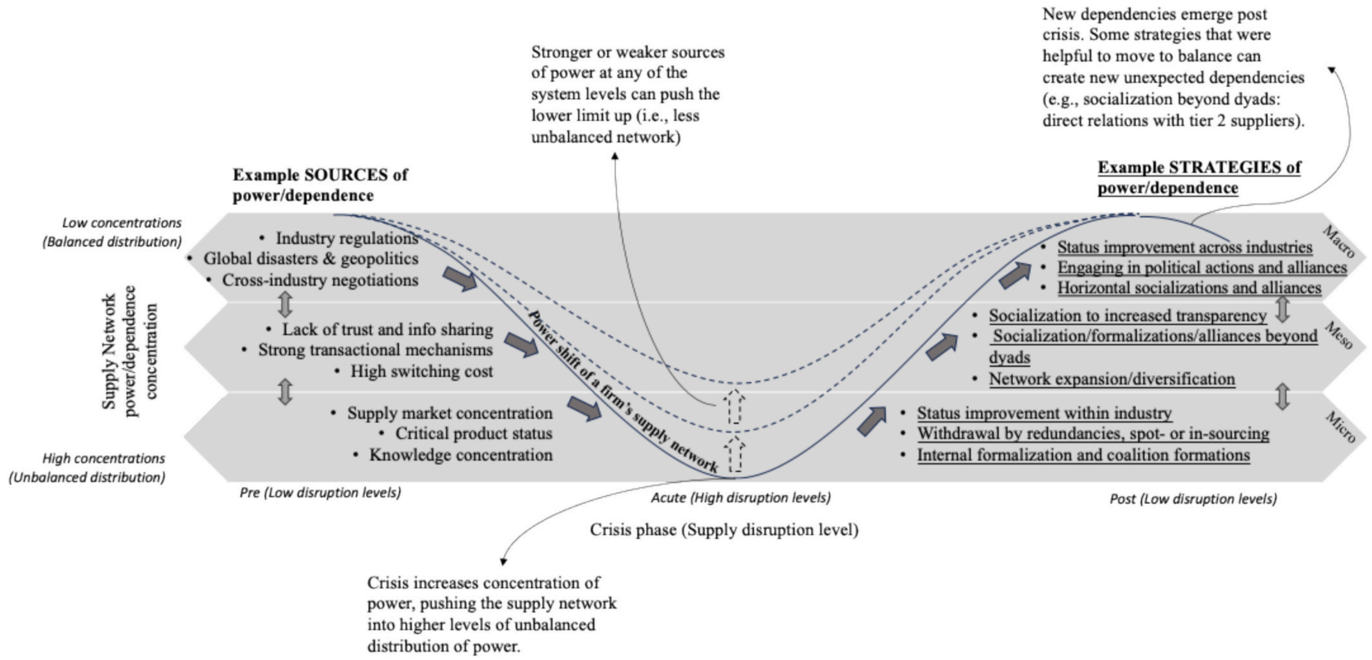

Fig. 2. A framework of power shifts at times of supply crisis for global supply networks.

and macro levels contribute to pushing a firm's supply network towards an unbalanced power state. Here, different power/dependence strategies (right side of the figure) can pull it towards a balanced state. Stronger or weaker sources of power at any of the system levels (e.g., better trust and information sharing in the supply network) can raise the lower limit in the acute phase (i.e., alleviating power imbalances and fostering a less unbalanced network). Our findings also suggest that new dependencies emerge post-crisis as the unexpected results of some strategies which were helpful for moving to a balanced state (e.g., socialization beyond dyads; direct relations with tier 2 suppliers). Future research can further explore theses dynamics. Next, we further elaborate on this framework, and discuss how our findings answer our research questions and how we make theoretical contributions.

6.1. Addressing research question 1: how and why the power distribution shifts during supply disruptions

Building on Fig. 2, this study contributes a dynamic, multi-level framework that explains how "power shifts in global supply networks during crises" are both shaped by and shape firms' strategic responses. We show that a given firm's power distribution within a supply network can shift when faced with a supply disruption due to constraints in access to the supply highlighting the supply dependencies (i.e., the sources of power at the micro, *meso*, and macro levels). For instance, in our study's context, the semiconductor crisis constrained the OEM's access to the critical component that highlighted their dependencies within this supply network. As depicted in Fig. 2, the different sources of power can push a firm's supply network into an unbalanced situation of high-power concentration. Here, power/dependence strategies can pull the firm into a balanced distribution.

Further, we extend RDT by conceptualizing power shifts as a dynamic process across three system levels—micro (firm), *meso* (network), and macro (environment)—rather than static dyadic dependencies in extant research. This multi-level lens reveals how strategies at one level (e.g., micro-level stockpiling) can have ripple effects across others (e.g., meso-level trust or macro-level visibility). While these findings are similar to previous research (e.g., Pazirandeh & Norrman, 2014), they extend previous research by emphasizing the interlinked nature of these sources and strategies at the three levels. The example sources of power that can lead to imbalance include geopolitics, global disasters, a lack of trust and information sharing, market concentration, market knowledge concentration, and high switching costs. While these sources have been identified in different studies (including in Marttinen & Kähkönen, 2022; McNamara & Newman, 2020), by considering the three system levels, we propose that changes in one level can affect the entire system. For instance, in a geopolitically constrained supply chain, firms with lower switching costs may experience a less unbalanced network (depicted by the dotted arrows in the figure).

RDT highlights how a firm's dependence on external resources controlled by others shapes its power within a network and global context, and how changes in this context shift these power distributions (Hillman et al., 2009; Pfeffer & Salancik, 2003). Our case study illustrated an OEM in a highly interdependent position towards its Tier 1 suppliers during a supply crisis, who in turn were situated in a highly dependent position towards their suppliers (i.e., the semiconductor producers). The cascading dependencies upstream in the supply chain resulted in low direct interdependence between the source of demand at the OEM and source of supply (at the Tier 2 and further up). This resulted in a lack of allocation for the semiconductor suppliers and lack of access for the OEMs. This emphasizes the importance of extending beyond the dyadic view of power when discussing supply management. This has also been stressed in other contexts such as Pazirandeh and Norrman (2014) in the global vaccine supply context.

Consequently, our findings contribute to the literature on power and dependence in the supply network, especially those from the RDT perspective (e.g., Hillman et al., 2009; Pfeffer & Salancik, 2003). The findings highlight that for higher supply security in global networks, understanding the power shifts at the macro and *meso* levels (i.e., decision making environment and supply network), in addition to the micro level, is important. While earlier RDT works emphasize the inter-firm aspects in determining power imbalances, later works highlight the embeddedness of dyadic relationships in their networks (Pazirandeh & Norrman, 2014; Xiao et al., 2019). Our study extends these discussions to include the macro decision-making environment, and shows the interrelationships between power shifts on micro, meso, and macro levels.

In the context of global supply networks, events such as disasters, regional and global regulations and reforms, and geopolitical situations further highlight the relevance of the macro level factors. This has also been highlighted by Möller et al. (2020), and McNamara and Newman (2020). Products deemed essential or critical can experience increased demand during a crisis. As observed in our study, this can shift power towards the suppliers of such products, giving them greater leverage in terms of pricing, delivery terms, and overall influence within the network. Implementing regulations, providing financial incentives, or even taking control of production and distribution channels during crises, building buffer stocks of critical materials and components (Bode et al., 2011), and having alternative production lines or backup manufacturing capabilities can reduce dependencies and contribute to a shift back to a more balanced power distribution. Hence, our findings contribute to the supply management literature focused on crises (Hitt et al., 2020). These findings are similar to what some extant studies have framed as buffering (creating safeguards) and bridging (managing dependencies) strategies (e.g., Bode et al., 2011; Kalaitzi et al., 2018; Spieske et al., 2022). However, going beyond these studies, we show how both these strategies can help manage dependencies (both increasing interdependencies and reducing dependencies) to increase the firm's ability to manage its supply.

Additionally, our study advances the understanding of the global power/dependence dynamics in the electronics and automotive networks (Jacobides et al., 2016; Kalaitzi et al., 2019). Automotive OEMs are impacted by their dependence on lower-tier suppliers, especially during supply disruptions (Kalaitzi et al., 2019) like semiconductor shortages. Our findings highlight the challenges of limited supplier options, long-term strategic alliances with Tier 1 suppliers, lack of transparency, and issues with commitment to forecasts. These factors contribute to vulnerabilities and power imbalances within the supply network, thereby affecting firms' abilities to secure critical components.

6.2. *Addressing research question 2: how firms can leverage their position during the power shifts to shape the power dynamics and affect their ability to mitigate supply disruptions and secure supply*

During supply disruptions, a firm's ability to secure supply and supply allocations weakens in an unbalanced network. We show that firms can address their power imbalances/dependencies that restrain their access to critical resources to increase their ability to secure supply in times of crisis at all three system levels (right hand side of Fig. 2). Thus, we extend the extant literature, which as only focused on the micro/firm level resources (Hitt et al., 2020). Status improvement and internal coalition on a micro level, socialization strategies on the *meso* level, and status improvement and socialization across industries on a macro level are effective in our study's context (see Fig. 2).

At a micro level, as depicted in Fig. 2, market and knowledge concentration, and critical product/component status are sources of power that create unbalanced power distributions. Meanwhile, improving the firm's status and introducing redundancies can contribute to a more balanced situation. When a small number of suppliers dominate a specific market, they hold significant power over pricing, availability, and terms (Pfeffer & Salancik, 2003), making it difficult for buyers to switch suppliers (Pazirandeh & Norrman, 2014). As observed in our data, this can exacerbate shortages during a crisis. Similarly, the concentration of specialized knowledge and expertise within a few individuals or organizations can create a vulnerability point in the balance of power in the network (Jin & Shao, 2022). If these key players are unavailable or their knowledge is lost, it can severely hinder the network's ability to adapt and recover. As seen in our case study, the knowledge is also concentrated with the semiconductor suppliers. When the focal OEMs lost their access to this knowledge, it reduced their ability to secure supply during the crisis. To counter these power imbalances, buying firms can leverage internal coalitions with other buying firms that share the same suppliers and invest in building internal knowledge that will reduce their dependence on suppliers' knowledge.

At the *meso* level, the lack of trust and information sharing, strong transactional mechanisms, and high switching costs create unbalanced positions in the supply network. Increased supply chain transparency and communications can improve the balance. Studies have shown that while a lack of transparency and trust can lead to information silos and inefficient resource allocation in the network (Jakobsen, 2020), this can be counterbalanced through secure transactional mechanisms (e.g., Jin & Shao, 2022) and improved information sharing throughout the entire supply network (c.f., Kalubanga & Gudergan, 2022). Our findings confirm that these strategies can minimize power imbalances, especially those addressing links with actors farther away from the firm. This can help empower all supply chain members to make informed decisions and pull the network into a balanced situation.

At the macro level, we observe that strategies address two main sets of power unbalances. First, regulations, cross-industry negotiations, and global events can create unbalances (Möller et al., 2020; Tashman, 2021). Our findings show that increasing the awareness of the demand for the global market, and engaging with and influencing regulations set by governments or industry bodies can help level the playing field. Specifically, it can ensure fair competition, prevent anti-trust practices, and promote collaboration within the supply network (Hassan et al., 2019; Hillman et al., 2009). This can help reduce the power of dominant players and create a more balanced distribution of power across the network. However, as seen in our case, they can also create imbalances by shifting priorities or limiting productions, as observed in previous studies (e.g., Fan et al., 2024). Second, when events such as trade wars, political instability, natural disasters, and pandemics disrupt production, transportation, and access to resources, cross-industry competition for the same components can also create or exacerbate unbalances in power distribution at the macro level. Here, by making the demand visible to the global market, the status, and thus, interest in the demand increases, thereby creating a more balanced situation (c.f., Pazirandeh & Norrman, 2014).

7. Conclusions

Drawing on RDT, this study investigates power/dependence during a supply crisis and highlights the importance of managing dependencies to maintain supply security. The results show that the concentration of power upstream, which was made evident during the semiconductor crisis, made supply security an issue for the automotive OEMs. They managed supply through a combination of strategies, especially cooperative, at all system levels (micro, *meso*, and macro), creating a more balanced network of interdependencies post-crisis.

This study makes several contributions. First, it contributes to our understanding of power by highlighting the importance of a multi-level systems perspective spanning micro, meso, and macro levels to fully understand power dynamics in globally stretched, multi-tiered supply chains (Hingley et al., 2015; Makkonen et al., 2023; Siemieniako et al., 2023). Moving beyond the extant literature, we show how strategies and dependencies interact across these system levels and how macro-level factors, such as geopolitical shifts and regulatory environments, shape network power. Indeed, in today's world, new dependencies many tiers away in the supply networks (e.g., dependencies on raw material) are reshaping power dynamics and strategies.

Second, this study also challenges the traditional RDT assumption that power asymmetry mostly suppresses cooperation (Pfeffer & Salancik, 2003). Our findings suggest that under crises, power asymmetry, often viewed negatively in RDT, can foster cooperation and network expansion. We introduce the notion of "crisis-induced interdependence," a condition where firms, despite initial power asymmetries, are compelled to collaborate and share information due to mutual survival needs.

Finally, we contribute to the understanding of automotive supply networks (Choi & Linton, 2011), which have shifted since the 2020–2024 semiconductor crisis (Garcia et al., 2024; Kalaitzi et al., 2019), and identify the new instances of cooperation created in the network. From the perspective of an automotive OEM's procurement, we propose that besides the OEM's own power position towards its Tier 1 supplier, a power imbalance between other tiers (e.g., Tier 1 and 2 suppliers) can also negatively impact the OEM. To leverage these power/dependence dynamics, we propose a typology of power-balancing strategies (e.g., status improvement, socialization, formalization, and withdrawal). Further, we show how their effectiveness varies depending on the level of disruption and system level at which they are applied. This typology, grounded in empirical data, offers a practical extension to Emerson's (1962) original propositions and the recent RDT strategy literature (e.g., Ozturk, 2021).

7.1. Managerial implications

Managing dependencies and power distribution is essential for maintaining a stable supply chain in an environment prone to disruptions. On a micro level, increasing the knowledge of purchased products that are regarded critical, if done before a crisis, can help a buying firm to reduce its dependence on external information flows. During a crisis, practitioners can resort to strengthening their status and attractiveness within the industry. On a meso level, managers should increase interdependence (e.g., cooperation) and diversification within the supply network during supply crises. While formalizing processes with key players can help manage dependencies before a crisis, finding new potential partners can reduce the dependency on single sources and increase availability during a crisis. However, managers should also enable their suppliers to be in a better power position towards their subsequent suppliers. Therewith, practitioners should assess the impact of their strategies on the power/dependence dynamics across the whole network. Finally, on a macro level, our findings show the importance of engaging in national and regional policy making for critical components (e.g., rare earth material) as a way to mitigate power imbalances in their related supply networks. Table 5 offers a matrix of actionable practices that firms can apply at the different phases of a crisis and at different system levels.

7.2. Limitations and future research directions

Our findings are limited to the scope of the supply network under power shifts during supply shortages. While we were able to include several actors in the supply network, suppliers and actors upstream in this supply chain can be included to show the meso and macro level interdependencies in such networks. While we highlight certain strategies (e.g., formalization and socialization) that were effective in the observed case, they may not be universally applicable or equally effective in different contexts or industries. Future studies can explore other situations of power shifts in the supply network. Power dynamics in supply networks are multifaceted and influenced by numerous factors. The study's focus on RDT may not capture all aspects of power relations, such as cultural or psychological factors. Future research can address this by using alternative theoretical lenses.

CRediT authorship contribution statement

Ala Arvidsson: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **José Augusto Campos Garcia:** Validation, Supervision, Investigation, Funding acquisition, Data curation, Conceptualization. **Lisa Govik:** Writing – review & editing, Validation, Investigation.

Appendix A. Interview guide

OEM focused:

Background information on the company, role and responsibilities, semiconductor scope, supplier responsibilities, and internal organization.

Background info on reputation, substitutability of supply, interconnectedness, information asymmetry, and other power dynamics in the supply network.

The importance of the purchase and exchange.

Internal stakeholders, and supply and design organization.

Relationships within the supply chain.

Control, influence, and visibility of the supply.

Experience, impact, and response to the shortages.

Information sharing back and from in the supply network.

Supplier focused (in addition to above):

Prioritization, customer attractiveness, and allocations.

Experience, and perceptions and emotions towards the customer.

Collaborations.

Dependencies.

Other:

What, in your point of view, is important to secure supply in a longer perspective?

What is your strategy to deal with semiconductors in the future?

Data availability

Data will be made available on request.

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