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Power Dynamics and Financial Flexibility: Insights from Chinese Supply Chain Dyads

Ying Xu
School of Economics & Management,
University of Science and Technology Anhui, Huainan, China
Email: 2024112@aust.edu.cn

Liukai Wang (correspondence author)
School of Economics & Management,
University of Science and Technology Beijing, Beijing, China
Email: wangliukai1@ustb.edu.cn

Jason X. Wang
Department of Sustainable Supply Chain Management,
Sheffield University Management School, UK
Email: jason.x.wang@sheffield.ac.uk

Xiangrui Meng
School of Economics and Management,
Anhui University of Science and Technology, Huainan, China
Email: xrmeng@aust.edu.cn

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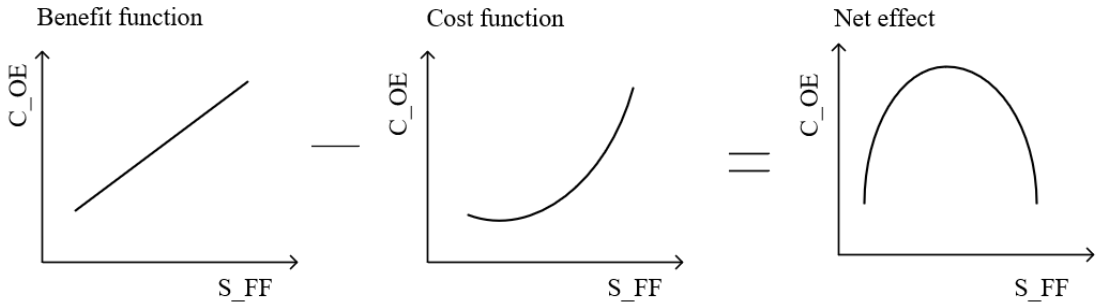
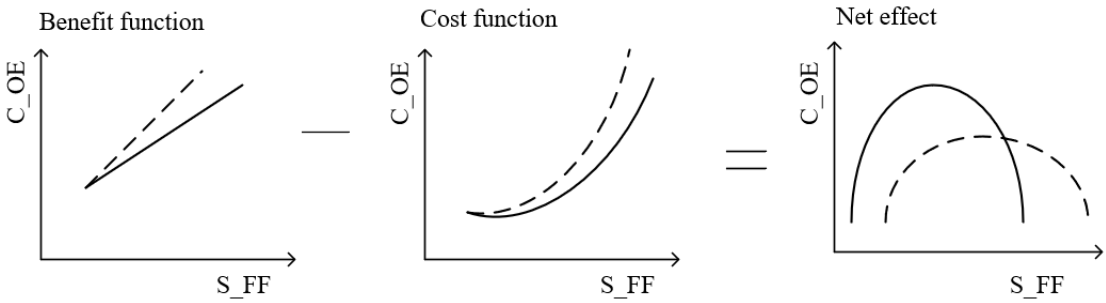
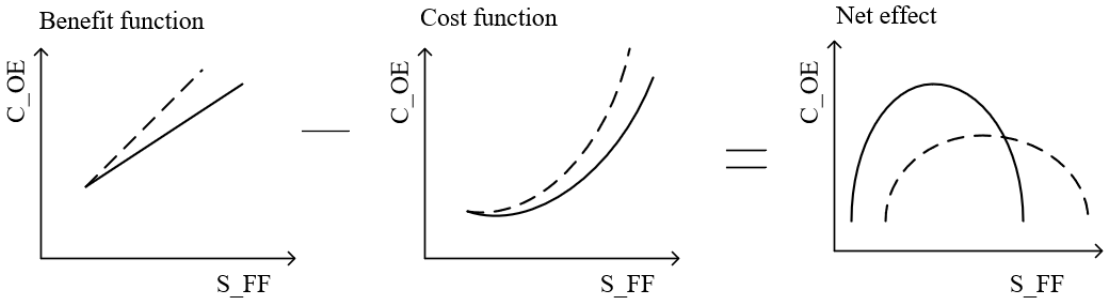


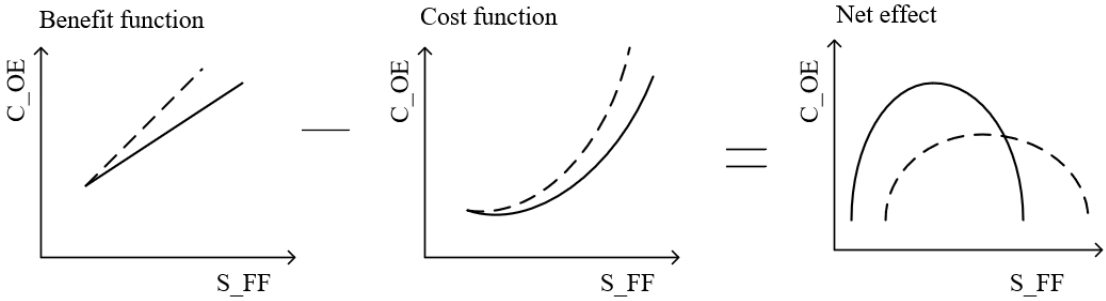
(a) Subtracting costs from benefits results in an inverted U-shaped relationship



(b) Turning point shift right and flattening: the age of supplier-customer relationship both increases the benefit function and cost function



(c) Turning point shift right and flattening: the supplier dependence both increases the benefit function and cost function



(d) Turning point shift right and flattening: the uncertain environment increases the benefit function and cost function

Figure 1 Latent mechanism of the inverted U-shaped relationship and moderators

Note: C_OE: the customer's operational efficiency; S_FF: supplier's financial flexibility.

Table 1 Industry description of our sample

Supplier	Number (% of total)	Customer	Number (% of total)
Agriculture, forestry, animal husbandry and fishery	10 (1.28%)	Agriculture, forestry, animal husbandry and fishery	8 (1.03%)
Mining industry	72 (9.23%)	Mining industry	81 (10.38%)
Manufacturing industry	548 (70.26%)	Manufacturing industry	538 (68.97%)
Electricity, heat, gas and water production and supply industries	22 (2.82%)	Electricity, heat, gas and water production and supply industries	25 (3.21%)
Transportation, warehousing and postal services	44 (5.64%)	Transportation, warehousing and postal services	47 (6.03%)
Information transmission, software and information technology services	66 (8.46%)	Information transmission, software and information technology services	63 (8.08%)
Real estate	18 (2.31%)	Real estate	18 (2.31%)
Total	780 (100%)	Total	780 (100%)

Table 2 Variable description and measurement

Variable	Description	Measurement	Reference
Dependent variable			
C_OE	Customer's operational efficiency	Stochastic Frontier Estimation	Liu et al. (2021)
Independent variable			
S_FF	Supplier's financial flexibility	Cash flexibility + Debt flexibility	Arslan *et al*. (2014)
Moderating variable			
S_AGE	The age of the relationship between supplier and customer	The number of years of transactions between suppliers and customer during the sample period	Gligor *et al*. (2018)
S_SD	The share of business the supplier has with its customer	The logarithm of ratio of supplier's sales to customer over its total sales	Gligor *et al*. (2018)
S_EU	The supplier's external environment fluctuation in sales	The logarithm of coefficient of variation of sales	Ghosh and Olsen (2009)
Control variable			
C_AGE	Customer's number of listing years	The natural log of age	Kim and Henderson (2015)
C_LEV	Customer's total amount of debt relative to assets	Total Debt/Total Assets	Kim and Henderson (2015)
C_TANG	Customer's tangibility	Noncurrent Assets/Total Assets	Wetzel and Hofmann (2019)
C_SIZE	The ratio of the customer's total operational revenues with adjustments to gross sales	The natural log of sales	Kim and Henderson (2015)

Table 3 Pearson correlation matrix and descriptive statistics

	1	2	3	4	5	6	7	8	9
C_OE	1								
S_FF	-0.215*	1							
S_AGE	0.433*	-0.134	1						
S_SD	0.135**	-0.136	0.567	1					
S_EU	-0.263	0.120*	-0.043	-0.09	1				
C_LEV	0.221	-0.073*	-0.027	-0.168	0.113	1			
C_SIZE	0.567**	-0.273	0.032*	-0.115	0.265	0.221*	1		
C_AGE	0.118**	-0.041	-0.003	0.087	0.123	0.010*	0.141	1	
C_TANG	0.094	-0.862	-0.096	0.202	0.156	0.010*	-0.060	0.132	1
Mean	2.161	1.301	2.318	-2.555	-1.579	0.491	13.482	2.817	0.475
S.D.	1.027	0.368	0.823	0.928	0.628	0.194	1.930	0.152	0.226

Notes: ***, **, * represent significance at the 0.01, 0.05, and 0.1 levels (two-tailed tests), respectively. Numbers 1-9 in the first row represent the variables in the first column.

Table 4 Results of the regression models

	Model 1	Model 2(a)	Model 2(b)	Model (3)
S_FF	2.809*** (0.488)	0.120 (0.180)	0.343* (0.189)	9.528** (1.287)
S_FF^2	-1.161*** (0.802)	-0.055* (0.036)	-0.154* (0.080)	-4.752** (0.521)
S_AGE		0.042 (0.038)		
S_SD			-0.185 (0.201)	
S_EU				3.045*** (0.407)
S_FF*S_AGE		0.165 (0.067)		
S_FF*S_ SD			0.174* (0.080)	
S_FF*S_EU				-6.735*** (0.681)
S_FF^2*S_AGE		-0.031 (0.028)		
S_FF^2*S_SD			0.084* (0.019)	
S_FF^2*S_EU				3.400*** (0.279)
C_LEV	0.400* (0.180)	0.013 (0.035)	-0.005 (0.073)	0.525* (0.154)
C_SIZE	0.219*** (0.020)	0.013*** (0.004)	0.023** (0.007)	0.174*** (0.017)
C_AGE	-0.585*** (0.064)	0.019* (0.010)	0.038* (0.021)	-0.568** (0.054)
C_TANG	0.042 (0.145)	-0.091* (0.051)	-0.026 (0.104)	0.098 (0.124)

Notes: ***, **, * represent significance at the 0.01, 0.05, and 0.1 levels (two-tailed tests), respectively.

Table 5 Summary of hypotheses testing results

Hypothesis	Statement	Supported?	Explanation
H1	The effect of suppliers' financial flexibility on the customer's operational efficiency is an inverted U-shaped relationship.	Yes	Both the independent variable and its quadratic term are statistically significant, therefore, the hypothesis is supported.
H2(a)	The age of the supplier- customer relationship moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.	No	The independent variable, the moderating variable, and their interaction term are all not statistically significant, therefore, the hypothesis is not supported.
H2(b)	The supplier dependence moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.	Partly yes	Although the main effect of the moderator is not significant, the interaction terms are significant, indicating that the supplier dependence influences the relationship between supplier's financial flexibility and customer's operational efficiency. Therefore, the hypothesis is partly supported.
H3	The uncertain environment of supplier moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.	Yes	The independent variable, the moderator, and their interaction term are all statistically significant, therefore, the hypothesis is supported.

Table 6 The results of the endogeneity test

		(1)	(2)	(3)	(4)
	Stage 1	Stage 2			
QR	0.089* (0.043)				
S_FF		0.843* (1.195)	0.220 (0.200)	0.349* (0.189)	0.582* (0.529)
S_FF^2		-0.284* (0.660)	-0.109** (0.098)	-0.194* (0.104)	-0.187* (0.180)
S_AGE			0.104 (0.102)		
S_SD				-0.153 (0.181)	
S_EU					1.966 (1.585)
S_FF*S_AGE			0.143 (0.057)		
S_FF*S_SD				0.179 (0.199)	
S_FF*S_EU					-2.783* (2.581)
S_FF^2*S_AGE			-0.101 (0.121)		
S_FF^2*S_SD				0.075 (0.174)	
S_FF^2*S_EU					0.996* (1.033)
C_LEV	-0.622*** (0.183)	0.192 (0.790)	0.012 (0.030)	-0.012 (0.052)	-0.754 (1.459)
C_SIZE	0.028 (0.018)	0.357*** (0.058)	0.015** (0.004)	0.023** (0.006)	0.517*** (0.105)
C_AGE	-0.001 (0.005)	0.332** (0.011)	0.019* (0.011)	0.039* (0.021)	0.027* (0.015)
C_TANG	1.190** (0.146)	0.012 (1.358)	-0.087* (0.047)	-0.035 (0.074)	0.710 (2.583)

Notes: ***, **, * represent significance at the 0.01, 0.05, and 0.1 levels (two-tailed tests), respectively.

Table 7 Robustness results with alternative measure

	(1)	(2)	(3)	(4)
S_FF	0.356*	0.120	0.275	0.529**
	(0.191)	(0.180)	(0.329)	(0.227)
S_FF2	-0.143*	0.055*	-0.131*	-0.230*
	(0.081)	(0.076)	(0.129)	(0.097)
S_AGE		0.042		
		(0.038)		
S_SD			-0.440	
			(1.328)	
S_EU				0.652
				(0.586)
S_FF*S_AGE		0.065		
		(0.067)		
S_FF*S_SD			0.602*	
			(2.306)	
S_FF*S_EU				-1.493*
				(1.103)
S_FF2*S_AGE		-0.031		
		(0.028)		
S_FF2*S_SD			0.096*	
			(0.029)	
S_FF2*S_EU				0.650
				(0.495)
C_LEV	0.008	0.013	-0.015	-0.005
	(0.073)	(0.035)	(0.074)	(0.072)
C_SIZE	0.027***	0.013***	0.024**	0.025***
	(0.007)	(0.004)	(0.007)	(0.007)
C_AGE	0.038*	0.018*	0.039*	0.043*
	(0.021)	(0.010)	(0.022)	(0.020)
C_TANG	-0.021	-0.091*	-0.036	-0.031
	(0.105)	(0.051)	(0.107)	(0.104)

Notes: ***, **, * represent significance at the 0.01, 0.05, and 0.1 levels (two-tailed tests), respectively.

Table 8 Robustness results with lag prolongation

	(1)	(2)	(3)	(4)
S_FF	3.349***	0.151	0.553**	5.297**
	(0.480)	(0.506)	(0.265)	(1.378)
S_FF2	-1.419***	0.334**	-0.407**	-2.889**
	(0.195)	(0.195)	(0.184)	(0.558)
S_AGE		0.231		
		(0.744)		
S_SD			0.153	
			(0.513)	
S_EU				2.116**
				(0.435)
S_FF*S_AGE		0.065		
		(0.067)		
S_FF*S_SD			0.466**	
			(0.275)	
S_FF*S_EU				-4.697**
				(0.729)
S_FF2*S_AGE		-0.765*		
		(0.455)		
S_FF2*S_SD			0.812**	
			(0.250)	
S_FF2*S_EU				2.387**
				(0.299)
C_LEV	0.261	-0.063	-0.276*	0.349*
	(0.177)	(0.114)	(0.113)	(0.164)
C_SIZE	0.224***	0.047***	0.074**	0.190***
	(0.019)	(0.014)	(0.013)	(0.182)
C_AGE	-0.592***	-0.139***	-0.145***	-0.581***
	(0.062)	(0.043)	(0.042)	(0.058)
C_TANG	-0.051	0.079	-0.064	-0.016
	(0.143)	(0.093)	(0.091)	(0.133)

Notes: ***, **, * represent significance at the 0.01, 0.05, and 0.1 levels (two-tailed tests), respectively.

Power Dynamics and Financial Flexibility: Insights from Supply Chain Dyads

Abstract: Grounded in Resource Dependence Theory and Bargaining Power Theory, this study investigates how power asymmetries in supplier–customer relationships affect customer operational efficiency, with a particular focus on the supplier's strategic use of financial flexibility. We collected 974 paired dyadic data from the China Stock Market and Accounting Research Database in 2016–2023 and used panel-data regression analysis. Surprisingly, we discovered an inverted U-shaped relationship between the supplier's financial flexibility and the customer's efficiency. This suggests the power effect of financial flexibility on performance in a supply chain dyad is not quickly realized until a certain threshold is reached in our context. We also investigated contextual factors of power dynamics, focusing on relationship strength and environmental uncertainty. We found that higher supplier dependence reduces the threshold for the impact of the supplier's financial flexibility on customer efficiency, as does high market uncertainty. Our study contributes to the literature by highlighting the challenges of utilizing financial flexibility to readjust power dynamics in Chinese supply chain dyads. However, our findings suggest to the supplier managers that the effective use of this approach relies heavily on the dependence factor and market uncertainty.

Keywords financial flexibility; dyads structure; uncertain environment; bargaining power theory; resource dependence theory

Article classification: Research paper

1 Introduction

The ongoing uncertainty driven by external macro-environmental factors, such as geopolitical conflicts and supply chain disruptions, has placed significant pressure on firms' daily financial management. In this challenging environment, small suppliers with limited financial flexibility often fail to expand their production capacity in a timely manner, creating bottlenecks in manufacturers. Conversely, financially robust suppliers tend to prioritize higher-profit customers, such as high-end car manufacturers or electronic equipment producers, thereby squeezing the market share of small and medium-sized manufacturers. For example, during the global semiconductor shortage (2020–2022), financially constrained suppliers struggled to expand production due to limited cash flow and investment capacity. This led major semiconductor manufacturers, such as Taiwan Semiconductor Manufacturing Company (TSMC) and Samsung, to prioritize high-margin clients like Apple, Nvidia, and high-end electric vehicle (EV) manufacturers such as Tesla (Mohammad et al., 2022). In contrast, other automakers—including even large firms like Ford and General Motors—faced severe chip shortages and were forced to temporarily halt production at multiple plants due to their lower priority in chip allocation[1]. In dyadic supply chains, this highlights the critical role of a supplier's financial flexibility in shaping customer operations (Medina *et al.*, 2023). Suppliers with insufficient financial flexibility risk disrupting their customers' production schedules by failing to meet demand, while those with excessive financial power can exert undue influence, favoring lucrative partnerships and sidelining smaller players. These disparities underscore the importance of understanding the impact of suppliers' financial flexibility on customer outcomes to better manage risks and optimize their supply chain strategies.

Existing literature highlights the critical role of financial flexibility in enabling firms to navigate uncertainties (Fahlenbrach *et al.*, 2021; Hunjra *et al.*, 2024), capitalize on growth opportunities (Mura and Marchica, 2010; Georgios and Emmanouil, 2021), and sustain operational resilience (Lee *et al.*, 2022). Financial flexibility, often defined

[1] https://www.ft.com/content/27d11095-72cd-4f92-bb00-60df48e5fb73

as the ability to access and efficiently allocate financial resources (Bonaimé *et al.*, 2014; Byoun, 2021), has been linked to improved risk management (Ang and Smedema, 2011; Bonaimé *et al.*, 2014; Alice *et al.*, 2016), and the attainment of competitive advantage (Dreyer and Grønhaug, 2004). In the context of a globalized and interconnected business environment, a supplier's financial flexibility is crucial for maintaining stability, as disruptions in it can create ripple effects that adversely impact a customer's operations (Wuttke *et al.*, 2013). For example, financial distress faced by a key supplier may hinder its ability to deliver goods or services consistently and on time, potentially causing production delays and increased costs for the customer (Oliveira *et al.*, 2017). Despite the evident importance of this dyadic relationship, there is a lack of empirical research focusing on the direct impact of a supplier's financial flexibility on a customer's operational efficiency. Addressing this gap is essential to better understand the dynamics of supplier-customer relationships and their implications for supply chain performance.

Financial flexibility, a pivotal financial decision, pertains to a company's capacity to adapt to shifts in the economic landscape (Arslan *et al.*, 2014; Ma *et al.*, 2022; Rapp *et al.*, 2014). Suppliers endowed with high financial flexibility are better positioned to respond to customer demands, maintain consistent delivery, and support customers in navigating disruptions, thereby contributing to improved customer operational efficiency (Hendricks and Singhal, 2005). Nevertheless, dissenting perspectives exist. For example, Eskandari and Zamanian (2022) posit that maintaining high cash reserves may lead to ineffective investment and squandering of financial resources. In the field of supply chain context, customers increasingly rely on suppliers to manage their operating affairs (e.g., delivery) (Gligor, 2016). This supplier-customer dyad is a basic supply chain relationship bedstone, in which the supplier's financial decision is important, because it extends the scope of optimizing cash flow beyond a single firm (Wuttke *et al.*, 2013), and its practice is crucial in enabling firms to gain competitive advantage (Bodendorf *et al.*, 2022). The juxtaposition of these perspectives suggests that the effect of a supplier's financial flexibility on a customer's operational efficiency

may be a "double-edged sword", potentially reshaping the power dynamics within their relationship.

To address this under-researched issue, we adopt Resource Dependence Theory (RDT) and Bargaining Power Theory (BPT) as the theoretical foundation for our framework. RDT emphasizes that firms are dependent on external partners for critical resources and seek to manage these dependencies and reduce uncertainty by aligning with resource-controlling partners (Pfeffer and Salancik, 1978; Drees and Heugens, 2013). This perspective suggests that a supplier's financial flexibility may play a critical role in shaping the dynamics of buyer-supplier relationships, raising important questions about whether different levels of financial flexibility differentially affect a customer's ability to secure stable and responsive support. BPT focuses on how power asymmetries in dyadic relationships influence decision-making and outcomes. When a supplier holds a stronger financial position, it may gain bargaining advantages and leverage its power to secure more favorable terms—such as pricing or contract conditions—from its customers (Schelling, 1956; Muthoo, 1999). This theory underscores the importance of understanding and managing power dynamics to optimize relationship performance. Together, RDT and BPT provide a comprehensive lens for analyzing the dual impact of supplier financial flexibility on customer operational efficiency, capturing both the resource-based benefits and the potential power-induced constraints.

To strengthen our framework, we include relationship strength and environmental uncertainty as key moderating variables, as both are theoretically grounded in RDT and BPT. The relationship strength between a supplier and a customer encompasses both the duration of their partnership and the supplier's dependence on the buyer, reflecting the depth of their ties and the underlying power dynamics (Gligor, 2018; Gligor *et al.*, 2021). Within the framework of RDT, this relationship strength plays a critical role in shaping supplier strategic behavior. When the relationship is strong, suppliers are more inclined to maintain collaboration and, even with substantial financial flexibility, are less likely to leverage their power opportunistically—thereby enhancing customer efficiency. In contrast, weaker relationships may lead suppliers to prioritize self-interest,

undermining cooperative efforts (Casciaro & Piskorski, 2005). BPT further suggests that dependence shapes the distribution of bargaining power, thereby influencing how financial flexibility affects relationship outcomes (Gligor, 2018; Roldán *et al.*, 2023). Thus, relationship strength serves as a key moderating variable in explaining the nonlinear relationship between financial flexibility and customer performance. RDT also posits that environmental uncertainty heightens resource acquisition challenges, making firms more reliant on stable and capable partners (Drees and Heugens, 2013). In such contexts, suppliers with moderate financial flexibility are better positioned to provide consistent support, enhancing customer efficiency (Wong *et al.*, 2011). Meanwhile, BPT emphasizes that environmental uncertainty alters the power dynamics and negotiation behavior between parties (Kokshagina, 2021). Under high uncertainty, risk-averse suppliers may prioritize self-protection over collaboration, weakening their positive contributions (Laguir *et al.*, 2022). Therefore, environmental uncertainty defines the boundary conditions under which financial flexibility influences outcomes, making it a critical moderating factor in understanding the observed relationship.

In light of the aforementioned context within our study, our research aims to address the following key questions:

RQ1: Following the argument of RDT and BPT, how does the financial flexibility of suppliers affect their customer' s operational efficiency in the supply chain dyads?

RQ2: How do relationship strength and uncertain environment, as a power-related factors, affect the relationship between suppliers' financial flexibility and their customer's operational efficiency?

To address these questions, we collected dyadic data (i.e., suppliers and their paired customers), drawing manually on public reports that disclose firms' main suppliers/ customer in the China Stock Market and Accounting Research (CSMAR) database. Each paired observation includes a supplier and its customer. We defined that the customer firm is the one on trading with the supplier. Our sample contains 974 customer-supplier pairs with their transactional data from 2016 to 2023. We then drew

on financial data from the CSMAR database to estimate the variables of interest. We then employed panel data regressions in our analysis.

Our study makes three important contributions to the literature. First, this study applies RDT and BPT to supply chain management, exploring how suppliers' financial flexibility functions as a bargaining tool to reshape power dynamics in supplier–customer relationships. By revealing the threshold effect of financial flexibility on the power–performance relationship, the study extends BPT and, through the lens of RDT, emphasizes the role of resource dependence in shaping the effectiveness of such strategies. Second, we contribute to the literature by identifying supplier dependence and environmental uncertainty as key contingencies that moderate the strategic use of financial flexibility in supply chains. These findings align with and extend RDT by illustrating how external dependence and contextual volatility shape the effectiveness of financial strategies in power rebalancing. In doing so, we refine the boundary conditions under which RDT and BPT operate and offer practical insights for managers navigating asymmetric and dynamic supplier–customer relationships. Third, this study provides a new perspective for the practice of supply chain management, reveals the influence mechanism of suppliers' external dependence and power dynamics on customer performance through financial flexibility, and helps enterprises to formulate more strategic financial management and negotiation strategies in power relations, thus optimizing supply chain performance and reducing operational risks.

The remainder of this paper is organized as follows. Section 2 reviews previous studies and proposes the hypotheses. Section 3 describes the variables, methods, and sample used in our study. Section 4 describes the empirical results, and Section 5 discusses the implications. Section 6 describes the limitations, including suggestions for future directions.

2 Theoretical development and hypotheses

2.1 Theory foundations

2.1.1 Resource dependence theory

RDT provides a relevant and robust theoretical foundation for exploring the relationship between a supplier's financial flexibility and a customer's efficiency. RDT posits that organizations are not self-contained entities but are embedded within a broader environment where they depend on external actors for access to critical resources such as capital, labor, information, and technology. This dependence creates vulnerabilities, as the external environment is often uncertain and beyond the organization's direct control. To manage these dependencies and reduce associated risks, organizations engage in various strategic behaviors, such as forming alliances, negotiating power relationships, diversifying resource channels, or attempting to control or influence resource-providing entities (Pfeffer and Salancik, 1978).

In our study, we conceptualize the supplier's financial flexibility as a critical strategic resource that reshapes power dynamics within supplier–customer relationships (Drees and Heugens, 2013). Our findings show that when financial flexibility is at a moderate level, suppliers can leverage it to stabilize operations, provide favorable terms, and signal reliability, thereby enhancing customer efficiency (Li *et al.*, 2025). By interpreting these results through the lens of RDT, we demonstrate how financial flexibility functions as a resource-driven power mechanism. This framing not only clarifies the dual performance implications of resource asymmetry in supplier–customer dyads but also extends RDT by revealing that financial flexibility can simultaneously enable collaboration and generate power imbalances that constrain efficiency (Jia *et al.*, 2025).

2.1.2 Bargaining power theory

BPT is a foundational concept in economics and management that provides a deep understanding of the power dynamics and negotiation capabilities inherent in business relationships (Schelling, 1956). Rooted in the fundamental principles of economic transactions, BPT investigates how the relative strength of parties engaged in these

transactions influences the outcomes of negotiations. It acknowledges the existence of power imbalances, which are shaped by factors including market conditions, ownership of resources, and the degree of interdependence among parties (Crook and Combs, 2007). Parties with varying levels of bargaining power employ a range of negotiation strategies to maximize their respective interests, ultimately influencing critical aspects such as pricing and contractual terms (Ahern, 2012; Fabbr and Klapper, 2016). This theoretical framework sheds light on the intricate mechanisms at play in business negotiations, offering valuable insights for effective strategic decision-making and relationship management in the economic landscape.

In the context of supply chain relationships, Bargaining Power Theory (BPT) provides a valuable lens for interpreting the dynamic interplay between suppliers and buyers. Our study shows that suppliers, when facing customer pressures for favorable terms, often deploy adaptive strategies to preserve or strengthen their bargaining position (Haitao *et al.*, 2007). BPT highlights how negotiation outcomes are shaped not only by mutual benefit and trust but also by the strategic evaluation of counterparties' strengths and weaknesses (Oliveira *et al.*, 2017). Building on this perspective, we demonstrate that a supplier's financial flexibility serves as a crucial source of bargaining leverage, influencing both operational efficiency and the balance of power in supplier–customer dyads. Moreover, by integrating external market conditions and internal resource allocation into the analysis, we extend BPT to show how relative power asymmetries can simultaneously enable cooperation and impose constraints, particularly under volatile environments (Parviziomran *et al.*, 2023). Thus, BPT provides the theoretical foundation for our study's insights into how financial flexibility reshapes negotiation strategies and, ultimately, supply chain performance.

2.2 Financial flexibility and operational efficiency

Financial flexibility refers to the ability of a company or an individual to manage its financial resources in a way that allows it to adapt to changing circumstances and take advantage of opportunities (Bonaimé *et al.*, 2014; Byoun, 2021). It involves having the capacity to respond to unexpected events, market fluctuations, or strategic needs

without jeopardizing the overall financial health of the entity (Denis, 2011; Mahmood *et al.*, 2021). Financial flexibility involves key elements like maintaining liquidity for quick access to funds and managing debt wisely—avoiding excessive burdens while ensuring enough leverage for growth. This balance helps adapt to financial needs and opportunities (Rapp *et al.*, 2014). Flexibility in cost management involves adjusting operating expenses in response to changing revenue or economic conditions (Liu et al., 2021). A well-designed capital structure, considering the mix of equity and debt, strikes a balance between financial stability and potential for future growth (Ma *et al.*, 2022). Diversification of revenue streams and investments reduces dependence on a single income source or market segment, contributing to enhanced financial flexibility (Mura and Marchica, 2010). Finally, effective risk management practices play a vital role in mitigating the impact of adverse events and bolstering overall financial resilience (Georgios and Emmanouil, 2021).

Referring to Haans et al. (2016), we explain the financial flexibility-- operational efficiency in a dyadic supply chain relationship from two opposing sides; that is, the benefit function and the cost function. The benefit function demonstrates that a supplier's financial flexibility can enhance a customer's operational efficiency—though this relationship may not be strictly linear. From the perspective of RDT, financially flexible suppliers are better able to provide stable, high-quality inputs and responsive services, which reduces the uncertainty and dependency risks customers face in volatile environments (Pfeffer and Salancik, 1978). This stability enables customers to streamline operations, avoid costly disruptions, and improve performance. Furthermore, suppliers with stronger financial positions are more likely to invest in innovation and process upgrades (Mura and Marchica, 2010; Chortareas and Noikokyris, 2021), thereby increasing the adaptive capacity of the supply chain and contributing to customer efficiency. Such suppliers are better equipped to navigate economic uncertainties and allocate resources to research and development, contributing to greater stability and operational efficiency for their customers (Rapp *et al.*, 2014). By driving innovation and reinforcing supply chain resilience, financially

flexible suppliers create a symbiotic relationship that fosters mutual success and operational excellence in a rapidly changing business environment.

In the context of the cost function, while supplier financial flexibility is generally considered beneficial in supporting downstream operations, excessively high levels of financial flexibility may lead to strategic behaviors that negatively affect certain customers. According to BPT, suppliers with greater financial strength often possess enhanced bargaining power, which can shift the balance of the supplier–customer relationship. In such cases, highly flexible suppliers may prioritize high-margin or strategically significant customers—such as large or influential buyers—when allocating resources or scheduling production (Zhao *et al.*, 2020). As a result, less powerful customers may face unfavorable contract terms, reduced service responsiveness, or even supply delays. Moreover, financial flexibility does not operate in isolation. It is part of a broader strategic flexibility framework that includes operational and structural capabilities (Bamel U., and Bamel N., 2018). When financial flexibility increases disproportionately without corresponding improvements in other forms of flexibility—such as production agility or coordination capacity—it may create internal misalignment. This imbalance can weaken the supplier's ability to efficiently coordinate with diverse downstream partners, leading to inconsistencies in supply performance (Wang and Webster, 2022). Customers that lack bargaining leverage are particularly vulnerable to such disruptions, as they may not have the power to demand prioritized service or renegotiate terms. Consequently, despite having abundant financial resources, a supplier with unbalanced flexibility may fail to support customer needs effectively, ultimately harming the customer's operational efficiency. This explains why overly high levels of supplier financial flexibility can become counterproductive in a supply chain context.

As viewed through the lens of RDT and BPT, the relationship between a supplier's financial flexibility and a customer's operational efficiency exhibits nuanced, non-linear dynamics. At low levels of financial flexibility, any improvement allows the supplier to better secure critical operations and reduce resource-related disruptions. This enhances reliability for the customer, who depends on the supplier for stable input

flows, thereby improving the customer's operational efficiency by lowering uncertainty and coordination costs (Itzkowitz, 2013; Wuttke *et al.*, 2013; Kim and Henderson, 2015), which accords to RDT. However, when financial flexibility becomes excessive, suppliers may leverage their strong cash positions and low debt dependence to strengthen their bargaining power, prioritize high-margin clients, or impose stricter terms on less powerful customers, ultimately undermining customer operational efficiency (Fabbri and Klapper, 2016; Veronica *et al.*, 2011). BPT emphasizes how shifts in financial posture can reshape power dynamics and strategic behaviors, leading to diminishing returns (Crook and Combs, 2007). Thus, while a moderate level of supplier financial flexibility can improve customer outcomes, its benefits diminish at higher levels, and negative consequences—such as reduced responsiveness or coordination frictions—begin to outweigh the gains. This balance between positive and negative effects gives rise to an inverted U-shaped relationship between supplier financial flexibility and customer operational efficiency. Accordingly, we propose the following hypothesis:

H1: The effect of suppliers' financial flexibility on customers' operational efficiency follows an inverted U-shaped relationship.

2.3 The moderating role of relationship strength

The robustness of the supplier–customer relationship plays a critical moderating role in shaping how factors such as supplier–customer flexibility fit affect partner performance (Gligor, 2018; Kim and Henderson, 2015). To further advance this understanding, our study investigates the moderating effect of relationship strength on the link between the supplier' financial flexibility and a customer's operational efficiency. The balance of power in supply chain relationships is shaped by key dimensions such as the "age of the supplier-customer relationship" and "supplier dependence" (Gligor, 2018; Gligor *et al.*, 2021). The "age of the supplier-customer relationship" reflects the duration of transactions, with longer relationships potentially fostering trust and collaboration (Gligor, 2018; Gligor *et al.*, 2021). "Supplier dependence" refers specifically to the extent to which a supplier's business is reliant on a particular buyer, measured as the

proportion of its revenue derived from that buyer. While this differs from the traditional buyer-centric interpretation, this supplier-focused definition is adopted to better reflect the power dynamics examined in our research context (Kim and Henderson, 2015). Excessive dependence may lead to undesirable behaviors, including opportunism (Yang *et al*., 2021) and complacency (Veronica *et al*., 2011). From RDT and BPT lens, these dimensions influence negotiation dynamics, with stronger relationships potentially mitigating power imbalances and fostering mutual benefits (Kim *et al.*, 2005). Consequently, we conceptualize relationship strength as a combination of the "age of the supplier-customer relationship" and "supplier dependence" to explore its moderating role in supplier-customer interactions.

Building on this conceptualization, it is essential to examine how suppliers' financial flexibility and the age of the supplier–customer relationship jointly shape the dynamics of their interaction. According to BPT, financial flexibility enhances a supplier's bargaining position by enabling them to offer more favorable terms, such as reliable delivery, customization, and joint innovation, which can improve the customer's operational efficiency (Kim and Wemmerlov, 2015; Laeequddin and Sardana, 2010). However, as the relationship matures, the power balance may shift. Long-term relationships may create switching costs or mutual dependence that reduce the urgency for performance improvements, leading to complacency or inefficiencies. Moreover, according to RDT, the longer a relationship lasts, the more deeply embedded the dependencies between the supplier and customer become. While such dependence can initially foster collaboration and resource sharing, over time, it may constrain the supplier's strategic flexibility and increase coordination costs (Canils and Gelderman, 2010). These accumulated costs can erode the benefits of financial flexibility.

Moreover, building on the role of relationship strength in shaping supplier–customer dynamics, it is crucial to explore how financial flexibility interacts with shifts in bargaining power and dependency. According to BPT, when suppliers possess greater financial flexibility, they are less reliant on exerting bargaining power in negotiations, allowing them to focus on delivering higher service levels, better quality, and more reliable performance (Civelek and Emberci, 2020; Li *et al.*, 2023). However,

as a supplier becomes increasingly dependent on a specific customer—often reflected in a high business share—the power dynamics shift in favor of the customer. This shift enables the customer to extract more favorable terms, such as lower prices or extended payment periods, potentially reducing the supplier's profitability and limiting the strategic use of their financial flexibility (Kumar *et al.*, 2015). From the perspective of RDT, a supplier's growing dependence on a dominant customer reduces its autonomy and increases its vulnerability to external control. This dependency can restrict the supplier's ability to leverage its financial resources effectively and may introduce additional operational costs, coordination burdens, or pressures to conform to the customer's demands. As a result, while financial flexibility initially enhances the customer's operational efficiency, increasing dependence may offset these benefits over time by raising hidden costs or reducing the supplier's strategic responsiveness. Therefore, we extend H1 and hypothesize the following:

H2a: The age of the supplier- customer relationship moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.

H2b: The supplier dependence moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.

2.4 The moderating role of uncertain environment

Uncertainty is often attributed to the lack of accurate information at the individual level (Haarhaus and Liening, 2020). Scholars have extended this concept to the organizational environment, exemplified by Ghosh and Olsen (2009), who characterize environment uncertainty as the rate of change in an individual's external environment. This broader perspective encompasses critical factors such as customers, competitors, government regulations, and trade unions. Haarhaus and Liening (2020) offer an additional dimension to the understanding of environment uncertainty, defining it as the incapacity or ambiguity arising from managers' limited rationality to comprehensively gather and interpret information about the organization's

surroundings. In this view, uncertainty arises not only from the external environment itself but also from the cognitive limitations of organizational decision-makers. Adding to the discourse, Laguir *et al*. (2022) define environment uncertainty as the occurrence of swift and unpredictable changes affecting a firm's production, customer demand, and market competition. This uncertainty manifests when there is insufficient information about future events, such as shifts in customer requirements, alterations in the behavior of competitors and suppliers, or advancements in technology. This definition emphasizes the dynamic and multifaceted nature of uncertainty, capturing its essence in the context of business operations and strategic decision-making.

According to the principles of RDT and BPT, uncertainties significantly influence the financial flexibility and bargaining dynamics of suppliers. RDT posits that firms are interdependent and must manage their reliance on external parties for critical resources (Drees and Heugens, 2013). In low-uncertainty environments, suppliers with high financial flexibility can reduce their dependence on specific customers by maintaining stable operations, absorbing shocks, and pursuing strategic investments. This resource autonomy enhances their bargaining position, consistent with BPT, and enables them to negotiate more favorable contract terms—thereby contributing positively to the customer's operational efficiency (Kokshagina, 2021). However, under high environmental uncertainty, RDT suggests that suppliers become more dependent on key customers for financial stability and order continuity. At the same time, BPT highlights that increased operating costs—stemming from volatile demand, raw material price fluctuations, and logistical disruptions—reduce suppliers' ability to leverage financial flexibility for strategic advantage. Instead, suppliers may prioritize short-term liquidity over long-term positioning, weakening their bargaining power (Sreedevi & Saranga, 2017; Gernert *et al.*, 2023). Thus, the combined effect of rising dependency (RDT) and diminishing leverage (BPT) under high uncertainty flattens the strategic benefit curve of financial flexibility and shifts its turning point, weakening its positive effect on customer operational outcomes. Based on the analysis, we propose the following hypothesis:

H3: The uncertain environment of supplier moderates the relationship between suppliers' financial flexibility and the customer's operational efficiency by shifting turning point to the right and flattening the curve.

The hypotheses developed are presented in Figure 1.

[Insert Figure 1 in here]

3 Methodology

3.1 Data collection and sample selection

3.1.1 Data collection

Our study encompasses data gathered from Chinese listed companies over the 2016–2023 period, focusing on entities meeting specific criteria. The inclusion criteria mandate that these companies maintain significant relationships with at least one major supplier or customer. To ensure a comprehensive dataset, listed companies are required to disclose details about their top five suppliers and customers based on trading volume. The scope of the study is limited to companies listed on prominent Chinese stock exchanges such as the Shenzhen Stock Exchange and the Shanghai Stock Exchange. The names of major suppliers or customers were sourced from the reputable CSMAR databases[2]. Notably, these databases not only provide the identities of major suppliers and customers but also furnish specific transaction amounts between these entities. This meticulous data collection approach, combining stringent inclusion criteria and reliable sources, establishes a robust foundation for our research, enabling an in-depth analysis of the financial dynamics between suppliers and customers in the Chinese listed company context during the specified timeframe.

There are three reasons for defining the research boundaries of the supply chain. First, annual reports do not disclose the relationship between suppliers for low transaction volumes. Second, limiting the research to several important suppliers can reduce the complexity of the analysis. Third, if the supplier's proportion of the customer's purchase/sales volume is low, its correlation with the customer is weak.

[2] accessible at http://www.gtarsc.com/

3.1.2 Sample selection

Our sample selection process involved two key steps. Initially, we identify listed companies using the CSMAR databases. These companies meet specific criteria: (1) they disclose the names of specific suppliers/customers in their annual reports, and (2) they are not classified as ST (special treatment) companies. The inclusion of ST companies is excluded to ensure a more robust sample. Samples are drawn from diverse industries, considering that large-scale listed companies often engage in a variety of business activities, making it challenging to categorize their supply chain composition within a specific industry. The interconnectedness of suppliers and customers, often being affiliated, led to an unavoidable overlap in industry classifications. Consequently, we operate on the assumption that industry-specific impacts are weak or even negligible within the supply chain. This assumption aligns with research findings suggesting that, under certain circumstances, industry assignments may not significantly influence outcomes, even when examined from a single-firm perspective (Hendricks and Singhal, 2005).

Then, following the initial sample selection, we applied further filtering criteria to enhance the quality and reliability of our dataset. This involved excluding: (1) listed companies operating in the finance or insurance industry, (2) companies with missing data, and (3) observations identified as outliers. After this refinement process, we identify and retain a total of 974 representative supplier-customer dyads. These firms are chosen based on their significance and relevance within the context of our study. The meticulous screening process ensures that our analysis is conducted on a refined and representative subset of the initial sample, providing a robust foundation for our research findings. Table 1 describes our sample of industries according to *Industrial Classification for National Economic Activities*.

[Insert Table 1 in here]

3.2 Variable measure

3.2.1 Independent variable

Financial flexibility. Following Arslan *et al*. (2014), we have measured the supplier's financial flexibility (S_FF) based on the financial data of listed companies with two indicators, calculated as the sum of cash flexibility and debt flexibility, which has both theoretical and practical value.

$$\begin{aligned} S\_FF &= Cash\ flexibility + Debt\ flexibility \\ &= \frac{Cash + Cash\ Equivalents}{Total\ Assets} + \frac{Total\ Debt}{Total\ Assets} \end{aligned} \tag{1}$$

Here, *Cash flexibility* refers to a firm's ability to use internal funds and *Debt flexibility* refers to its ability to obtain external funds. To reduce the non-normality of the distribution, the heteroscedasticity of the residuals, and the collinearity between the direct and quadratic terms, we convert S_FF into its natural logarithm. Then, we centered S_FF by subtracting the sample average to reduce multicollinearity between its direct and quadratic terms further.

3.2.2 Dependent variable

Following Liu *et al.* (2021), we have chosen Stochastic Frontier Estimation (SFE) to measure the customer's operational efficiency (C_OE). Compared with the traditional measurement of operational efficiency using a single financial indicator (e.g. returns of assets, returns of sales), SFE provides a more comprehensive measurement of the overall operational efficiency of firms. First, a stochastic production function is constructed:

$$\begin{aligned} \ln Operational\ Income = \beta_0 + \beta_1 \ln Number\ of\ Employees \\ + \beta_2 \ln \mathrm{Cos}t\ of\ Goods\ Solds + \varepsilon + \eta \end{aligned} \tag{2}$$

Here, ε is the stochastic random error term; η is the operational inefficiency of a firm, and its range is 0 to 1. Then, we calculate the firm's operational efficiency as follows:

$$Operational\ efficiency = 1 - \eta \tag{3}$$

3.2.3 Moderating variable

Relationship strength. Listed companies are asked to indicate the age of the relationship with the supplier/ customer, the number of products/services exchanged with the supplier/ customer, and the total amount of purchases for the year. This allows us to calculate the percentage of business shared by the supplier-customer duality. Here, we measure relationship strength between supplier and customer from two dimensions: age of the relationship and supplier dependence.

1) *Age of the relationship.* Following Gligor (2018), we have used the number of years of transactions between suppliers and the customer during the sample period as the measurement of age between the supplier and the customer (S_AGE).
2) *Supplier dependence.* Referring Gligor (2018), we measure the shared business volume by calculating the proportion of a supplier's sales to a specific customer in relation to its overall sales, then take logarithm of the proportion (S_SD).

Uncertain environment. To focus on the external environment rather than the management's reactions, we exclusively examine the firm's market characteristics, specifically the fluctuation in sales. Following the approach outlined by Ghosh and Olsen (2009), we measure the coefficient of variation (CV) with a firm year's sales. This CV is then transformed by taking the logarithm, resulting in the metric known as environmental uncertainty (S_EU):

$$CV = \sqrt{\sum_{t=1}^{5} \frac{(Z_i - \overline{Z})^2}{5}} \Big/ \overline{Z} \tag{4}$$

Where is, Z_i indicates the sales of firm i of the year, $\bar{Z}$ indicates the average of five year's sales.

3.2.4 Control variable

Extraneous effects are controlled by some variables related to the company. To control for other potential impacts on a company's operational efficiency, we have included

four control variables based on the characteristics of companies. These are (1) the customer's listing age (C_AGE) is measured as the natural logarithm of the number of years since its listing date, representing the firm's maturity and stability, which may impact its operational efficiency and ability to manage supplier relationships effectively (Kim and Henderson, 2015). (2) the customer's financial leverage (C_LEV) is measured as the ratio of total debt to total assets (see Equation 5), reflecting the firm's financial risk and resource constraints, which may influence its operational decisions and interactions with suppliers (Kim and Henderson, 2015).

$$C\_LEV = \frac{Total\ Debt}{Total\ Assets} \tag{5}$$

Besides, (3) the customer's size (C_SIZE) is measured as the natural logarithm of sales, which may impact its operational efficiency and bargaining power in supplier relationships (Wetzel and Hofmann, 2019). (4) referring to Kim and Henderson, 2015, the customer's tangibility (C_TANG) is estimated, as it can affect the firm's borrowing capacity and investment decisions, ultimately influencing its operational efficiency (see Equation 6).

$$C\_TANG = \frac{Noncurrent\ Assets}{Total\ Assets} \tag{6}$$

[Insert Table 2 in here]

3.3 Regression models

To explore our hypotheses, tailored to varying effects across individual entities rather than time, we employ panel data regressions with fixed effects models. This approach allows us to delve into the nuances of our proposed hypotheses in a dynamic context. Model 1 is first developed to investigate the impact of the financial flexibility of supplier on the operational efficiency of a customer. We define Model 1 as follows:

$$\begin{aligned} C\_OE_{i,t} = {} & \beta_0 + \beta_1 S\_FF_{i,t} + \beta_2 S\_FF_{i,t}{}^2 + \beta_3 C\_AGE_{i,t} + \beta_4 C\_LEV_{i,t} \\ & + \beta_5 C\_TANG_{i,t} + \beta_6 C\_SIZE_{i,t} + Dyad_i + Year_t + \varepsilon \end{aligned} \tag{7}$$

We extend Model 1 by introducing the relationship strength between supplier and customer, and uncertain environment of the supplier as moderators. Our study builds

regression models (Models 2 and 3) to test H2 and H3, respectively:

$$\begin{aligned} C\_OE_{i,t} = {} & \beta_0 + \beta_1 S\_FF_{i,t} + \beta_2 S\_FF_{i,t}{}^2 + \beta_3 M_{i,t} + \beta_4 S\_FF_{i,t} * M_{i,t} \\ & + \beta_5 S\_FF_{i,t}{}^2 * M_{i,t} + \beta_6 C\_AGE_{i,t} + \beta_7 C\_LEV_{i,t} \\ & + \beta_8 C\_TANG_{i,t} + \beta_9 C\_SIZE_{i,t} + Dyad_i + Year_t + \varepsilon \end{aligned} \tag{8}$$

Where is, $C\_OE_{i,t}$ denotes the customer's operational efficiency; $S\_FF_{i,t}$ denotes the supplier's financial flexibility of dyad i in year t; $M_{i,t}$ denotes the moderating variables including the relationship strength between supplier and customer (in terms of the age of supplier-customer relationship and supplier dependence), and uncertain environment of the dyad i in year t; $C\_AGE_{i,t}$, $C\_LEV_{i,t}$, $C\_TANG_{i,t}$, $C\_SIZE_{i,t}$ are control variables, and denote the characteristics of dyad i in year t; $Dyad_i$ is dummy variable, when the sample is the dyad i, $Dyad_i$ is 1, otherwise is 0; $Year_t$ is dummy variable, when the sample is in the year t, $Year_t$ is 1, otherwise is 0; ε denotes the random disturbance term.

4 Empirical analyses

4.2 Description of variables

Before proceeding with regression analysis, we implemented specific data preprocessing steps to ensure the robustness of our results. Initially, we apply a winsorization technique, limiting extreme values to 1% of the distribution. This adjustment is made to mitigate potential distortions caused by outliers. Subsequently, we conduct a multicollinearity test to assess the interdependence of independent variables and avoid redundancy. The results reveal a variance inflation factor (VIF) consistently below 5, indicating acceptable levels of multicollinearity among the independent variables. Table 3 provides a comprehensive overview of the Pearson correlation coefficients and descriptive statistical results for each variable. Notably, the distributions of these variables appear relatively uniform, contributing to the reliability of our analyses. These meticulous preprocessing steps ensure that our regression analysis is conducted on a dataset that is both robust and free from undue influence from extreme values or collinearity issues among independent variables.

[Insert Table 3 in here]

4.3 Analysis of the empirical results

We employed panel data regressions to address our models. Model 1 tests the effects proposed in H1. Following Lind and Mehlum (2010), we take three steps to test the regression result. First, coefficient of S_FF^2 is negative and significant ($\beta_{S\_FF^2} = -1.161,\ \rho < 0.05$). Second, the slope at the minimum of S_FF, which is $\beta_{S\_FF} + 2 * \beta_{S\_FF^2} * S\_FF_{\min} = 2.684$, is positive and significant, and the slope at its maximum, which is $\beta_{S\_FF} + 2 * \beta_{S\_FF^2} * S\_FF_{\max} = -1.342$, is negative and significant. Third, the turning point, which is $-\beta_{S\_FF} / 2\beta_{S\_FF^2} = 1.210$, is within the data range. These conclusions indicate that when a supplier's financial flexibility is within a certain range, it promotes improvement in the customer's operational efficiency; however, supplier's financial flexibility beyond the critical boundary leads to deterioration in the customer's operational efficiency. Hence, H1 is verified.

The regression result of Model 2(a) corresponds to Table 4's third column. The insignificance of the coefficients of S_FF ($\beta_{S\_FF} = 0.120,\ \rho < 0.10$), S_FF*S_AGE ($\beta_{S\_FF*S\_AGE} = 0.065,\ \rho > 0.10$), and S_FF^2*S_AGE ($\beta_{S\_FF^2*S\_AGE} = -0.031,\ \rho > 0.10$) is insufficient to prove that the age of the relationship moderated the potential relationship between the supplier's financial flexibility and customer's operational efficiency. However, the positive coefficient of S_FF*S_AGE and the negative coefficient of S_FF^2*S_AGE indicate to a certain extent that S_ AGE plays a promoting role in the relationship between S_FF and C_OE. These findings can't verify our H2(a), which indicates that the age of relationship does not always bring about higher trust or resource coordination effects, but may instead weaken the positive impact of financial flexibility on customer efficiency due to path dependence.

The fourth column of Table 4 corresponds to the estimated results from Model 2(b). It shows that the coefficient of S_FF is significantly positive ($\beta_{S\_FF} = 0.343,\ \rho < 0.10$) and the coefficient of S_FF^2 is significantly negative ($\beta_{S\_FF^2} = -0.154,\ \rho < 0.10$), which proves the existence of the postulated inverted U-shapes relationship. Moreover, the coefficient of S_FF^2*S_SD ($\beta_{S\_FF^2*S\_SD} = 0.084,\ \rho < 0.10$) is positive and statistically significant, indicating that

the inverted U-shape flips to a U-shaped curve as S_SD moderates the relationship we postulate. We determined the exact value of S_SD at which the shape-flip occurs, $S\_SD^* = -\beta_{S\_FF^2} / \beta_{S\_FF^2*S\_SD} = 1.833$, but it is beyond the data ranges of S_SD. This finding in reality indicates that S_SD weakens the main effect of S_FF on C_OE by improving both benefits and costs of inverted U-shaped curve. Although the main effect of the moderator is not significant, both the interaction terms of S_FF*S_SD and S_FF^2*S_SD are significant, indicating that the supplier dependence influences the relationship between supplier's financial flexibility and customer's operational efficiency. Therefore, H2(b) is partly supported.

The last column of Table 4 shows that the coefficient of S_FF is positive and significant ($\beta_{S\_FF} = 9.528,\ \rho < 0.05$); the coefficient of S_FF^2 is negative and significant ($\beta_{S\_FF^2} = -4.752,\ \rho < 0.05$), verifying the presence of the original inverted U-shaped curve. Additionally, the coefficient for the interaction S_FF*S_EU is negative and statistically significant ($\beta_{S\_FF*S\_EU} = -6.735,\ \rho < 0.01$) and the coefficient of S_FF^2*S_EU is significantly positive ($\beta_{S\_FF^2*S\_EU} = 3.400,\ \rho < 0.01$). Following Haans et al. (2016), $\beta_{S\_FF} * \beta_{S\_FF^2*S\_EU} - \beta_{S\_FF^2} * \beta_{S\_FF*S\_EU} = 0.390 > 0$, so the turning point of this curve moves to the right as S_EU increases. $\beta_{S\_FF^2*S\_EU} > 0$ indicates that a flattening occurs for our inverted U-shaped relationship, and the inverted U-shape flips to a U-shaped curve as S_EU moderates the relationship between supplier's financial flexibility and customer's operational efficiency. We determined the exact value of S_EU at which the shape-flip occurs, $S\_EU^* = -\beta_{S\_FF^2} / \beta_{S\_FF^2*S\_EU} = 1.398$, and it is not within the data ranges of S_EU. This implies that in an uncertain environment, further improvement in supplier financial flexibility may have a positive impact on customer operational efficiency, but will not reverse the diminishing returns observed in a more stable environment. Therefore, H3 is supported.

Finally, the four control variables exhibit the expected directionality, but not all are statistically significant across the four models. Table 5 shows our testing results.

[Insert Table 4 in here]

[Insert Table 5 in here]

4.4 Robustness

4.4.1 Endogeneity

The endogeneity issue primarily arises from the reverse causality between financial flexibility and operational efficiency. Companies exhibiting strong operational efficiency are likely to attract suppliers with enhanced financial flexibility, who can provide essential resources. Additionally, operational efficiency is influenced by both the financial flexibility of suppliers and firm-specific characteristics. It is also conceivable that we may have omitted variables, such as the quick ratio (QR), which could impact financial flexibility (Chen *et al.*, 2023). To address this endogeneity concern, we employ the two-stage least squares method. This approach allows us to disentangle the reciprocal relationship between supplier's financial flexibility and customer's operational efficiency, providing a more robust and unbiased estimation of their causal linkages in the context of our analysis.

We use the ratio of quick assets to current liabilities as an instrumental variable. In the first stage, we estimated financial flexibility of supplier with control variables and fixed industry and year effects. In the second stage, we explain operational efficiency of customer with fitted values of financial flexibility of supplier. The results in the first column of Table 6 shows that the instrumental variable and operational efficiency are significantly correlated. Table 6 reports the second-stage regression results, which provides evidence for supporting our hypotheses and our models.

[Insert Table 6 in here]

4.4.2 Alternative measure

In order to enhance the robustness of our findings, we conducted a rigorous robustness test using an alternative dependent variable, specifically return on assets (ROA) as defined by Hendricks and Singhal (2005). ROA is measured as the ratio of net income to total assets, as indicated by Kim and Henderson (2015). This alternative measure allows us to scrutinize the reliability and consistency of the regression results derived from our models. The outcomes of the robustness test, as presented in Table 7,

demonstrated a general alignment with our original conclusions. Overall, these test results lend additional support to our hypotheses and contribute valuable insights into the potential relationships among the variables under investigation. They serve to affirm our initial expectation that the association between the supplier's financial flexibility and the customer's operational efficiency follows an inverted U-shaped relationship.

[Insert Table 7 in here]

4.4.3 Lag prolongation

Financial flexibility and its effects may not be immediate. Using lagged variables helps establish a temporal sequence, ensuring that the observed effects on operational efficiency follow changes in financial flexibility, thereby supporting a causal relationship. Additionally, changes in financial flexibility might take time to influence operational efficiency. Lagged variables capture these delayed effects, offering a more accurate picture of how financial flexibility impacts performance over time. In this context, all explanatory variables were re-evaluated with a one-period lag. We find that the main variables remain largely consistent with previous results, with no significant changes in coefficient signs or significance levels (shown in Table 8).

[Insert Table 8 in here]

5. Discussion

5.1 Theoretical implications

Our study makes several theoretical implications. First, this study extends RDT and BPT by examining how a supplier's financial flexibility—a key strategic resource—shapes power dynamics and performance outcomes in supplier–customer relationships. From the perspective of RDT, financial flexibility reflects a firm's ability to manage resource dependence and uncertainty, thereby influencing its control over interorganizational exchanges. From the BPT perspective, it serves as a source of bargaining leverage that can shift the balance of power in negotiations. The study contributes theoretically by showing that financial flexibility functions not only as a firm-level capability but also as a relational power mechanism that affects the

customer's operational efficiency. Notably, the identification of an inverted U-shaped relationship challenges the assumption of linear benefits, suggesting that excessive resource-based power may reduce collaboration benefits—thus expanding the boundary conditions of both theories (Choi and Wu, 2009; Fabbri and Klapper, 2016; Gligor, 2018). This nuanced finding enhances our understanding of how financial resources can both facilitate and constrain interfirm cooperation, offering new insights into power balance and negotiation strategy in supply chain contexts.

Second, by incorporating the moderating role of relationship strength—measured by relationship age and supplier dependence—this study deepens the application of RDT and BPT in the context of supplier–customer dynamics. We find that supplier dependence strengthens both the positive and negative effects in the inverted U-shaped relationship, highlighting its dual role in enhancing cooperation and intensifying power pressure. In contrast, relationship age shows no significant moderating effect. These results challenge the conventional view (Kim and Henderson, 2015) that stronger supplier–customer ties uniformly enhance operational efficiency. Instead, our findings suggest that the influence of supplier relationships is conditional, especially under customer financial distress. While long-term relationships may promote trust and stability, they do not necessarily shift power dynamics or mitigate financial constraints—thus offering a more nuanced perspective on relational governance in supply chains.

Third, we examined how the supplier's environmental uncertainty moderates the inverted U-shaped relationship between financial flexibility and customer operational efficiency, focusing on its influence on both benefit and cost effects (Ma *et al.*, 2022). The results show that uncertainty amplifies the benefits of financial flexibility while reducing its drawbacks, positioning it as a key risk management tool in unstable environments. From the perspectives of RDT and BPT, this study extends existing theory by showing that power dynamics are not solely shaped by financial or relational factors, but are also contingent on external environmental conditions. Environmental uncertainty acts as a boundary condition that alters how suppliers exercise power and influence outcomes. These findings highlight the contextual and dynamic nature of

bargaining power and resource dependence in supply chains, offering a more nuanced understanding of interfirm interactions under uncertainty.

5.2 Practical implications

Our study offers some practical implications. First, recognizing the inverted U-shaped relationship suggests that there is an optimal level of financial flexibility that maximizes the positive impact on customer operational efficiency. Businesses should aim to strike a balance, ensuring sufficient financial flexibility without reaching levels that could potentially lead to diminishing returns. In addition, when evaluating and selecting suppliers, businesses can use the understanding of the inverted U-shaped relationship to guide their decisions. Prioritizing suppliers with an appropriate level of financial flexibility aligns with the goal of optimizing operational efficiency without experiencing diminishing returns or potential negative effects. Furthermore, supply chain practitioners should not only utilize financial flexibility efficiently to find profitable investment opportunities and improve operational efficiency, but also prevent resource wastage caused by excessive financial flexibility (Gligor, 2018).

Second, understanding the moderation effect of supplier dependence allows businesses to strategically optimize collaboration strategies with suppliers. Firms can tailor their collaboration approaches to leverage the positive impact of financial flexibility while managing potential negative consequences, ensuring a balanced and mutually beneficial relationship. Practical implications extend to negotiation and contracting practices. Businesses can use insights from this finding to inform negotiations with suppliers, considering the level of supplier dependence. Contractual agreements can be structured to align with the optimal point on the inverted U-shaped curve, fostering cooperation and managing potential risks associated with extreme financial flexibility. In addition, when selecting and evaluating suppliers, businesses can incorporate considerations of supplier dependence as a key factor. This insight provides a basis for informed decision-making in supplier relationships, ensuring compatibility in terms of financial flexibility that aligns with the operational efficiency goals of the customer (Lin *et al.,* 2017; Verghese *et al.,* 2022).

Third, in light of the moderating effect of the uncertain environment, businesses can strategically select suppliers based on their ability to navigate uncertainty. Firms should assess not only the financial flexibility of suppliers but also their adaptability and resilience in uncertain conditions. This ensures a more reliable and stable supply chain, mitigating potential disruptions. Moreover, firms should regularly assess the supplier's environment and adapt strategies accordingly. This may involve revisiting contracts, revising risk mitigation plans, and adjusting operational strategies to align with changing supplier conditions. Proactive investment in supplier relationship management practices is crucial. Building strong and transparent relationships with suppliers fosters open communication and collaboration, enabling both parties to navigate uncertainties effectively and contribute to each other's operational resilience.

6. Conclusion

Our study investigated the effect of a supplier's financial flexibility on a customer's operational efficiency, as moderated by relationship strength between supplier and customer in terms of relationship's age and supplier dependence, and uncertain environment of the supplier, and documented several interesting results. First, we find that the relationship between a supplier's financial flexibility and a customer's operational efficiency presents an inverted U-shape. Second, we find that relationship strength between supplier and customer in terms of supplier dependence moderates the inverted U-shaped relationship by improving both the positive effect and the negative effect of supplier's financial flexibility, however, there is not sufficient evidence to prove relationship strength between supplier and customer in terms of relationship's age moderate the inverted U-shaped curve. Third, the moderating role of a supplier's uncertain environment flattens the inverted U-shape and moves the turning point right, indicating that the supplier's uncertain environment moderates the inverted U-shaped relationship by improving the positive effect and the negative effect of financial flexibility.

Our study has some limitations. First, the data source is limited to Chinese listed company, which restricts the generalizability of the results. Future research could

address these limitations by expanding the sample size and validating the model's applicability across different industries or regions. Second, our study focuses on the supplier's financial flexibility and its impact on dyadic supply chain relationships, without examining the customer's financial flexibility. Customers may strategically present limited financial flexibility to influence negotiations and gain advantages, shaping supply chain dynamics. Future research could explore how customer financial flexibility impacts power balance and operational decisions, offering a more holistic view of these interdependent relationships.

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