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Abstract

This paper examines the relationship between supply chain diversification (SCD) and the persistence of micro, small, and medium-sized enterprises (MSMEs) in Iran, with a focus on the moderating role of external finance. Using a Probit regression analysis and marginal effect estimations on a sample of 480 firms, the study reveals that SCD positively influences the persistence of firms with full access to external finance. However, for firms lacking external finance or relying solely on internal finance, SCD reduces their probability of persistence. These findings underscore the essential role of external finance in enabling MSMEs to leverage SCD as a resilience strategy. The paper provides policy recommendations to enhance MSMEs' access to external finance, especially in regions affected by sanctions.

Keywords: Supply chain diversification, MSMEs, Iranian economy, Access to finance, Firm persistence.

JEL Classifications: L2.

ملخص

تتناول هذه الورقة العلاقة بين تنوع سلسلة التوريد (SCD) واستمرار المؤسسات الصغيرة والمتوسطة الحجم (MSMEs) في إيران، مع التركيز على الدور المعتدل للتمويل الخارجي. وباستخدام تحليل انحدار Probit وتقديرات التأثير الهامشي- على عينة مكونة من 480 شركة، تكشف الدراسة أن SCD يؤثر بشكل إيجابي على استمرار الشركات التي تتمتع بإمكانية الوصول الكامل إلى التمويل الخارجي. ومع ذلك، بالنسبة للشركات التي تفتقر إلى التمويل الخارجي أو تعتمد فقط على التمويل الداخلي، فإن SCD يقلل من احتمالية استمرارها. تؤكد هذه النتائج على الدور الأساسي للتمويل الخارجي في تمكين المشروعات متناهية الصغر والصغيرة والمتوسطة من الاستفادة من التنمية المستدامة كاستراتيجية للمرونة. وتقدم الورقة توصيات سياسية لتعزيز وصول المشروعات متناهية الصغر والصغيرة والمتوسطة إلى التمويل الخارجي، وخاصة في المناطق المتضررة من العقوبات.

1. Introduction

Amid growing global economic and political instability, micro, small, and medium-sized enterprises (MSMEs) in emerging markets face increasing uncertainty. The Iranian economy, in particular, has been severely impacted by sanctions and global isolation, with the manufacturing sector most affected (Azadi et al., 2022). This situation forces MSMEs to navigate supply chain disruptions, financial constraints, and market volatility while striving to maintain economic viability.

As global supply chains face unprecedented pressures from trade wars, sanctions, and instability, the resilience of SMEs is severely tested. The literature on supply chain risk management primarily focuses on large multinationals, leaving a gap in understanding the challenges that SMEs face in volatile environments (Chopra and Sodhi, 2014; Ho et al., 2015). Economic instability and political volatility in regions such as the Middle East, Africa, and Latin America highlight the urgent need for research addressing SMEs' vulnerabilities (Shumetie and Watabaji, 2019; Nawaz et al., 2021). This paper aims to bridge this gap by exploring the intricacies of supply chain management among SMEs operating in emerging markets impacted by economic and political uncertainty.

Supply chain diversification (SCD) can benefit SMEs significantly by expanding supplier options, fostering innovation, and improving product quality (Babich, 2007). This is especially important for SMEs in developing countries, as SCD can enhance their global competitiveness (Humphrey, 2003). When integrated into a firm's strategy, SCD can also provide a competitive advantage (Adobor and McMullen, 2007). Moreover, SCD is a key risk mitigation strategy that expands suppliers, markets, and channels (Bode et al., 2011; Brandon-Jones et al., 2014). This approach can enhance resilience by reducing dependencies and balancing costs. However, the role of financial access in enabling SCD for SMEs in volatile developing economies remains understudied.

This study examines the moderating role of finance in the relationship between SCD and the persistence of Iranian MSMEs, with particular attention to the source of financing. Iran's recent economic challenges—including geopolitical tensions, sanctions, and the COVID-19 pandemic—provide relevant context (Najafi et al., 2024; Farzanegan and Batmanghelidj, 2023). Micro-level evidence on how Iranian MSMEs leverage financial resources to mitigate supply chain vulnerabilities, however, remains limited. These challenges have significantly impacted Iran's trade and business environment, particularly due to the sanctions imposed after the US withdrawal from the Iran nuclear deal in 2018 (Azadi et al., 2022).

Our study emphasizes the critical role of finance in mitigating supply chain risks. However, our findings indicate that SCD can actually reduce firm persistence. SMEs often lack resources, making diversification risky without sufficient financial support. Diversification is effective only

when firms have full access to external financial resources, which enhances their chances of persistence. A lack of such access can threaten their viability. Small enterprises should pursue diversification only if they have full access to external finance; otherwise, their persistence could be at risk. These insights offer valuable guidance for firms operating in similar geopolitical contexts.

The rest of the paper proceeds as follows. Section 2 reviews the literature on supply chain risk and diversification, while section 3 outlines the dataset and the methodology. Section 4 reports the results, and section 5 concludes with implications.

2. Theory and evidence

In today's global economy, SCD is essential for business resilience and growth. This strategy mitigates risks associated with disruptions caused by natural disasters, geopolitical tensions, and economic upheavals (Christopher and Peck, 2004; Tang, 2006; Choi et al., 2020). By diversifying their supply bases, organizations can strengthen their resilience to external shocks and adapt quickly to changing market dynamics. Moreover, SCD serves as a protective mechanism against uncertainty, enabling firms to adjust swiftly to changing market conditions (Wieland and Wallenburg, 2012). The COVID-19 pandemic highlighted the vulnerabilities of highly concentrated supply chains, emphasizing the importance of diversification for firms operating in volatile environments (Ivanov and Dolgui, 2020).

Firms are increasingly adopting SCD strategies to ensure their competitive resilience. According to the Resource-Based View, diversification equips firms with unique capabilities that provide a competitive advantage. By utilizing diverse resource inputs, fostering innovation, and mitigating risks associated with supply chain concentration, firms can gain a competitive edge (Barney, 1991). Empirical studies support the assertion that diversified supply chains enhance organizational resilience. For example, firms with diversified supply networks performed better during the 2008 financial crisis than those with concentrated supply chains (Wagner and Bode, 2008). Additionally, global analyses reveal a strong correlation between SCD and operational performance, bolstering firms' ability to adapt to market volatility (Chopra and Sodhi, 2004).

Recent studies have explored the relationship between SCD and resilience, especially during disruptions like the COVID-19 pandemic. Findings suggest that digital transformation plays a crucial role in strengthening resilience, particularly when combined with effective sourcing and geographic diversification strategies (Xu et al., 2024). For SMEs, foreign market scanning is essential to leverage the advantages of foreign diversification for resilience in highly disruptive environments (Essuman et al., 2023). In the agrifood sector, horizontal diversification enhances resilience, whereas vertical diversification may result in diminishing returns (Stevens and Teal, 2024). Additionally, configuration analysis has identified three strategic pathways to achieve

substantial supply chain resilience: digital transformation, diversification initiatives, and a strategic combination of supplier centralization with customer base diversification (Yin and Ran, 2022).

Although the benefits of SCD are well-documented for large enterprises, SMEs encounter unique challenges in adopting this strategy (Beck et al., 2006). Their limited resources, narrower product lines, and restricted R&D budgets hinder their capacity to invest in and manage multiple supply sources (Atkinson, 2017). In addition, their reliance on larger firms for supply chain governance often restricts their autonomy and capacity for innovation. These financial and structural constraints make it challenging for SMEs to effectively navigate the complexities of global supply chains (Loury-Okoumba and Mafini, 2021). As a result, SMEs often face heightened operational costs and administrative burdens, leading to inefficiencies and an elevated risk of business failure (Santarelli and Tran, 2013). These financial constraints hinder their capacity to absorb the costs of managing diverse suppliers and navigating complex global networks (Grossman et al., 2023; Kuppuswamy and Villalonga, 2016; Beck et al., 2006). Conversely, full access to external finance strengthens firm persistence by funding operational optimization, innovation, and risk management (Cheratian et al., 2024; Kumar et al., 2023). This enables MSMEs to efficiently manage supplier diversity, enhancing competitiveness. Thus, while financial barriers exacerbate SCD challenges, adequate financing unlocks its potential, emphasizing the pivotal role of financial accessibility in sustaining long-term resilience.

Apart from financial constraints, labor management also plays a crucial role in firm persistence. Previous studies have found that hiring new employees positively affects firm persistence rates, particularly in uncertain environments (Thomas and Douglas, 2021; Varum and Rocha, 2014). Moreover, focusing on niche markets with specialized products adds complexity to diversification efforts (Coad and Tamvada, 2012). Increased diversification may also heighten operational complexity and management challenges, imposing particularly stringent burdens on resource-constrained SMEs (Stevens and Teal, 2024; Colombo et al., 2014). Managing multi-regional suppliers often leads to inefficiencies, delays, and strained customer relations. Misallocated resources toward coordination reduce innovation capacity, while over-diversification compromises quality control. Vulnerability to disruptions like pandemics or sanctions is paradoxically amplified, as limited bargaining power forces unfavorable supplier terms. These factors collectively weaken resilience, hinder growth, and threaten long-term viability unless strategic alignment with firm capacity is achieved (Kanyepe et al., 2025; Fernando et al., 2024).

The limited financial resources and inherent conservatism of SMEs, especially in high-risk environments, significantly hinder their ability to diversify supply chains. This risk aversion, rooted in the need to minimize potential financial losses, often leads to a preference for short-term financial stability over long-term strategic investments (Beck, 2007). Consequently, SMEs often adopt conservative supply chain strategies that prioritize stability over growth opportunities

(Harrison and Wicks, 2013). Furthermore, while diversified supply chains can expose SMEs to a broader range of market and product risks, these firms often lack the necessary capacity to manage these complexities effectively (Markides and Williamson, 1994; Park and Jang, 2012).

SMEs often struggle to implement the costly systems and processes essential for sustainable business practices. Despite their significant contributions to the economy, SMEs often lack the resources to invest in areas such as environmental management systems and advanced product costing methodologies (Gerrans and Hutchinson, 2004; Brierley, 2011). SMEs are less likely than larger firms to allocate overhead costs or adopt activity-based costing (Brierley, 2011). Collaboration and clustering can help SMEs overcome these limitations by sharing expertise, reducing costs, and boosting productivity (Navickas and Malakauskaitė, 2009). Partnerships with larger firms can also provide SMEs with access to resources and expertise that may be lacking internally (Rothwell, 1991).

Access to financial resources is essential for SMEs to implement effective SCD. Sufficient funding allows firms to absorb the costs and risks associated with diversification, as demonstrated by Carpenter and Petersen (2002) and Beck (2007). Adequate access to finance enables entrepreneurs to invest in the infrastructure, technology, and expertise required for efficient supply chain management. This investment helps mitigate diversification-related risks, particularly for firms with lower supply chain concentrations (Xu et al., 2023; Beck et al., 2008). The source of financial resources is critical, as internal financing often presents greater control over strategic decisions, while external financing provides essential capital for diversification, albeit with added risks (Xu et al., 2023; Bui, 2020). For firms relying on self-financing, SCD may not enhance persistence due to limited adaptability and constrained resource allocation, reducing resilience despite the autonomy offered by internal funds (Li et al., 2023). The dynamic interplay between internal and external funding sources is especially significant across different economic contexts and industries, particularly for capital-constrained SMEs looking to expand their operations (Beck et al., 2008; Brown et al., 2012).

Empirical evidence underscores the importance of external financing during economic downturns. For instance, Cowling et al. (2012) indicate that government-backed loans were essential for SMEs during the 2008 financial crisis, while Ferrando and Ruggieri (2015) show that limited access to external capital can significantly impair productivity in innovative sectors. Furthermore, Beck et al. (2008) highlight that international external funding is crucial for fostering growth and stability in developing nations. These insights suggest that a balanced financing strategy that carefully considers both internal and external resources is essential for aligning with a firm's growth objectives and risk profile, highlighting the need to understand their interplay for effective financial planning and strategic decision-making.

In high-risk environments, such as Iran, SMEs face complex decisions regarding SCD. In these conditions, SCD may be viewed as a potential threat rather than a safeguard, particularly if the firm lacks the financial resources to manage the associated risks effectively. The increased complexity and costs of a diversified supply chain can lead to operational inefficiencies and, in extreme cases, business closure (Chopra and Sodhi, 2004; Christopher and Peck, 2004). However, with sufficient financial resources, the negative impact of SCD on firm persistence can be reduced. Government-backed loans, subsidies, and other forms of financial support could provide SMEs with the stability needed to pursue diversification strategies while managing the associated risks (Cheratian and Goltabar, 2023; Cheratian et al., 2023; Smit and Watkins, 2012).

3. Data and methodology

3.1. Survey data

This study investigates MSMEs in Iran, specifically focusing on firms with one to 50 employees. We rely on a survey conducted by the Academic Center for Education, Culture, and Research (ACECR) among 500 firms; however, 20 questionnaires were excluded due to missing data, resulting in a final sample of 480.⁴ To ensure representativeness and capture regional diversity, a simple random sampling technique was used. Five Iranian provinces were selected for the study: Tehran, Khorasan Razavi, Kerman, Mazandaran, and Ilam. These provinces represent diverse geographical locations and differing levels of economic development. The provincial context is as follows: Tehran Province, located in central Iran, is the country's economic powerhouse and commercial hub.⁵ Tehran's dominant role is evident in its significant contribution of 25.5 percent to the national non-oil GDP.⁶ Khorasan Razavi, the second most populous province, exhibits notable industrial and economic maturity, contributing 5.8 percent to the non-oil GDP.⁷ The Mazandaran and Kerman provinces hold moderate positions in economic development, contributing 3.7 percent and 4.1 percent to the non-oil GDP, respectively. Ilam Province, one of Iran's least populated regions, faces significant challenges. With a comparatively low share of 0.6 percent of the non-oil GDP, this province struggles with underdeveloped financial markets and inadequate infrastructure, which hinders its economic growth potential. Including this diverse range of provinces enables a comprehensive examination of Iran's economic landscape,

⁴ Based on Cochran's formula, the minimum sample size was calculated for an estimated population of 12,000 firms across the five selected provinces. Sample firms were proportionally chosen from each province to reflect the total number of businesses within that region.

⁵ According to the 2016 National Statistics Portal of Iran, Tehran Province boasts the largest population in the country, exceeding 13 million residents. Khorasan Razavi follows closely behind as the second most populous province, with a population of approximately 6.4 million. Available from: <https://www.amar.org.ir/english>.

⁶ Non-oil GDP data obtained from the regional accounts of the Statistical Center of Iran: <https://www.amar.org.ir/english>

⁷ Population data retrieved from the National Statistics Portal of Iran: <https://www.amar.org.ir/english>

encompassing aspects such as business evolution, financial markets, tourism development, and regional disparities.

The survey was conducted from December 2019 to September 2020.⁸ Face-to-face interviews were conducted with the owners or senior managers of the sampled firms. The firms were proportionally selected based on the total number of businesses in each province. The definitions of variables and their descriptive statistics can be found in Table 1.

Table 1. Descriptive statistics

Variables	Mean	S.D.	Min	Max	Explanation
Firm Persistence (FP)	0.35	0.48	0	1	1= if firm had not been exposed to bankruptcy at least once during the sanctions period; 0= otherwise
Supply Chain Diversification (SCD)	0.64	0.48	0	1	1= if firm aims to foster supply chain diversification; 0= otherwise
Full Access to External Finance (FAXF)	0.05	0.23	0	1	1= if the firm had access to external finance entirely in the past 12 months; 0= otherwise
Non-Access to External Finance (NAXF)	0.09	0.30	0	1	1= if the firm had no access to external finance and its request for financing has been rejected in the past 12 months; 0= otherwise
Highly Dependent to Self-finance (HDSF)	0.72	0.45	0	1	1= if the firm has relied on its own sources for financing during the last 12 months, 0= otherwise
Export Oriented	0.03	0.18	0	1	1= if over 50 percent of the firm's manufactured goods have been exported within the last 12 months; 0= otherwise
Age	13.74	10.42	1	70	Firm's age by year
Size	17.48	14.31	1	50	Number of firm employees
Access to Technology	0.66	0.48	0	1	1= if firm access to required technology; 0= otherwise
Hiring New Labor	0.67	0.47	0	1	1= if the firm employed new labor in the past 12 months; 0= otherwise
Dismissal of the Workforce	0.52	0.50	0	1	1= if the firm had a dismissal of workforce in the past 12 months; 0= otherwise
Profitability	0.13	0.34	0	1	1= if firm has profit growth in the past 12 months; 0= otherwise

3.2. Variables measurements

3.2.1. Dependent variable

A well-established body of research suggests that economic downturns and unfavorable financial market conditions significantly impact firm persistence and performance (Cowling et al., 2012). Notably, smaller firms appear more vulnerable to economic cycles and fluctuations compared to their larger counterparts (Fort et al., 2013; Siemer, 2014). The survey revealed that 171 out of the 480 responding businesses (35 percent) reported avoiding bankruptcy at least once in the past year, likely due to imposed sanctions. A binary variable was used to capture this data, with a value of 1 indicating no exposure to bankruptcy in the past 12 months as a proxy for firm persistence, and a value of 0 indicating otherwise.

⁸ For further information on this project, visit the ACECR website (in Persian): <http://ergtm.acecr.ac.ir/fa/news/41121>

3.2.2. *Variables of interest*

The survey examined respondents' perspectives on diversifying their supply chains and identifying new business partners. In this context, the study used a binary scale variable to quantify the degree of SCD. This variable was assigned a value of 1 if the firm aimed to foster diversification within its supply chain, and a value of 0 if it did not. The average response was approximately 0.64, suggesting that most surveyed firms were engaged in efforts to diversify their supply chain networks.

3.2.3. *Moderator variables*

The survey also investigated the financing strategies used by the firms over the past 12 months. In this context, the study uses three binary-scale variables, adapted from Cowling et al. (2018) and Lopez-Garcia and Puente (2012), to measure access to finance. The 'access to finance' variable is assigned a value of 1 if a firm's demand for bank loans over the past 12 months was fully funded. If the demand was not met, the variable is assigned a value of 0. The 'non-access to finance' variable is assigned a value of 1 if a firm's demand for bank loans over the past 12 months was entirely unfunded; otherwise, it is assigned a value of 0. Additionally, respondents were asked whether they relied on their own financial resources or sought external financing. The 'depended on self-finance' variable was coded as a binary measure, where 1 represented firms that used self-financing, and 0 denoted firms that relied on external financing sources. This information, combined with data on access to financial resources, provided a comprehensive understanding of financing dynamics within the sample. Notably, five percent of respondents reported access to finance, nine percent reported non-access to finance, and 72 percent relied on self-finance.

3.2.4. *Control variables*

Apart from the variables of interest and moderators, our estimation models consider other crucial determinants of firm persistence. However, it is important to note that our explanatory variables are limited to the survey data available. In our model, some control variables are considered interactive, including export, age, size, access to technology, hiring new labor, workforce dismissal, profitability, location, and industry classification dummies.

Engaging in international markets and exporting activities allows MSMEs to access larger customer bases and diversify their revenue streams, which can be crucial for long-term sustainability and persistence. These activities not only enhance the financial stability of MSMEs but also allow them to diversify their supply chains and reduce reliance on domestic markets (Martínez and Poveda, 2022; Safari and Saleh, 2020; Love and Roper, 2015).

Recent studies (e.g., Coad et al., 2013; Haltiwanger et al., 2013) emphasize the importance of considering a firm's age when assessing performance. In this study, firm age is measured as a nominal variable, representing the actual age of the firm. The analysis showed that the average age

of surveyed firms was approximately 13 years. Since Gibrat's seminal work (1931), substantial empirical research has explored whether a firm's growth rate depends on its size (e.g., Bentzen et al., 2012; Cowling et al., 2018). This concept has significant implications for market competition dynamics and small enterprises' potential to compete with larger counterparts. In this study, firm size is measured as a nominal variable, representing the number of employees. The average number of employees among surveyed firms was 17.

Furthermore, the Solow (1956) model emphasizes the acquisition of technology—such as new equipment, innovation, and R&D—as an essential element of firm-level growth (e.g., Tsai and Wang, 2008; Koellinger, 2008; Che and Zhang, 2018). Access to external technologies can provide firms with various benefits, including cost reduction, decreased development time, and reduced environmental risks, ultimately leading to improved output performance (Henderson and Cockburn, 1996; Chatterji, 1996; Sakas et al., 2014). The survey findings indicate that approximately 66 percent of the respondent businesses had access to the required technology.

Resource-based theory suggests that differences in firm performance can be attributed to the uneven allocation of valuable resources (including human capital) across organizations (Crook et al., 2011). Accordingly, a series of studies emphasizes human capital as a crucial element of sustainable competitive advantage and superior performance for businesses. Regarding hiring new labor (Panayotopoulou et al., 2010) and workforce dismissal (Qiu, 2019), the survey asked respondents about their recruitment of new employees during the past year, and 67 percent reported having hired new employees. Concerning workforce dismissal, respondents reported a 52 percent reduction in their workforce during the past year.

Ultimately, the relationship between profitability and firm persistence warrants further investigation (Coad, 2010). The notion of profitability is central, as it provides feedback on how well the firm responds to competitive pressures and market demands. Profitable firms are more likely to survive, as they can generate the necessary positive cash flow and begin accumulating slack resources (George, 2005). Increasing profitability also demonstrates the operational effectiveness of the firm, as the alignment between cost structures and market-accepted prices reflects a suitable fit. As such, firms with increasing profitability are less likely to be forced to exit for financial reasons. Consequently, increases in profitability enhance the likelihood of firm persistence (Delmar et al., 2013). The survey findings indicate that approximately 13 percent of the respondent MSMEs accrued profits.

3.3. Model specification

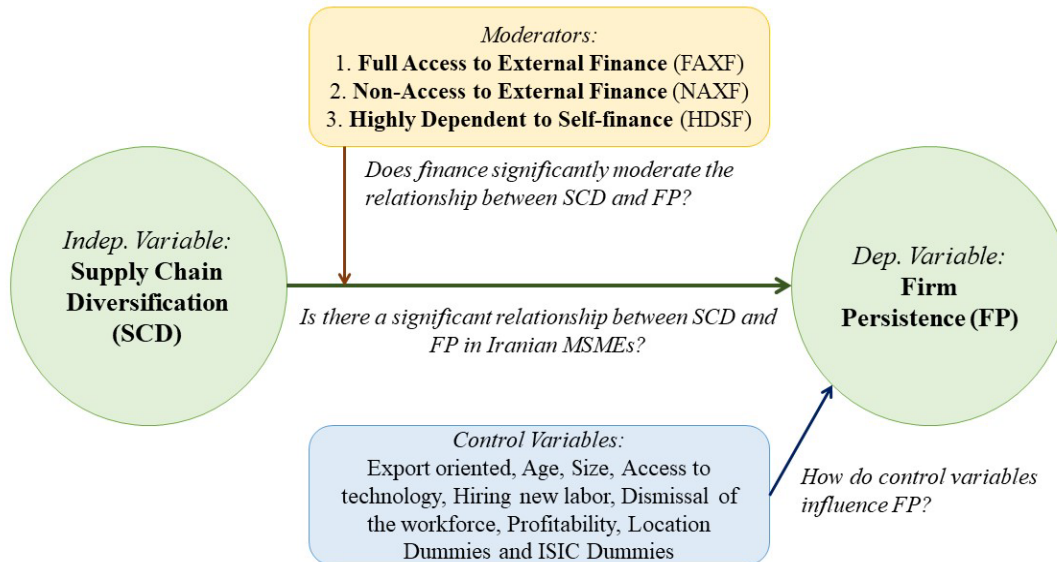
Due to the binary nature of our dependent variable, we opted to use a Probit regression with robust standard errors, following the recommendations of Long (1997), Aldrich and Nelson (1984), and Cameron and Trivedi (2010). Cohen et al. (2013) suggest that moderation occurs when the

independent and moderating variables jointly affect the variance of the dependent variable beyond what can be explained by the direct effect. The empirical model is specified as follows:

$$\begin{aligned}
 \text{Firm Survival}_i & \qquad \qquad \qquad \text{Eq. (1)} \\
 & = \beta_0 + \beta_1 \cdot \text{Supply Chain Diversification}_i + \beta_2 \\
 & \quad \cdot \text{Access to Finance (Full, Non, Self – finance)}_i \\
 & + \beta_3 \\
 & \quad \cdot [\text{Supply Chain Diversification} \\
 & \quad \times \text{Access to Finance (Full, Non, Self – finance)}]_i \\
 & + \sum \beta_c \cdot \text{Controls}_c + \varepsilon_i
 \end{aligned}$$

To provide a clearer understanding of the research model, the following outlines the conceptual framework presented.

Figure 1. Conceptual framework



4. Empirical results

4.1. Probit regression

The results of our Probit regressions are presented in Table 2. Column 1 lists the key independent variable, moderators, interaction terms, and control variables. Columns 2 to 4 show the estimation results by including each moderator separately. In each specification, we include the same control variables. Across the three estimations, the results indicate a significant negative relationship between SCD and firm persistence in Iran, aligning with previous studies by Kanyepe et al.,

(2025), Fernando et al. (2024), Stevens and Teal (2024), and Colombo et al. (2014). SCD, while intended to reduce risks, often strains SMEs through heightened complexity in managing multi-regional suppliers, causing inefficiencies and delivery delays that damage customer relations. Limited resources are misallocated toward supplier coordination at the expense of innovation, while over-diversification weakens quality control and amplifies operational risks. Paradoxically, complex networks increase vulnerability to disruptions (e.g., pandemics, geopolitical crises, and economic sanctions) that MSMEs—lacking contingency reserves—struggle to absorb. Additionally, MSMEs' limited bargaining power leads to unfavorable supplier terms, further diverting focus from core operations. Collectively, these challenges undermine resilience, stifle growth, and threaten long-term viability unless diversification aligns strategically with MSMEs' capacity and risk management maturity.

Moreover, the main effects in Table 2 reveal that none of the finance variables are statistically significant. We also observe a positive interaction between SCD and full access to external finance on firm persistence, while the interaction term between SCD and lack of access to external finance is negative and significant. Together, these findings support the theoretical framework of Grossman et al. (2023) and are consistent with Kuppuswamy and Villalonga (2016). The result demonstrates that external finance critically influences MSMEs' ability to sustain SCD. Full access enhances firm persistence by enabling investments in operational optimization, innovation, and risk management, thereby improving efficiency and competitiveness (Cheratian et al., 2024; Kumar et al., 2023). Conversely, financial constraints negatively interact with SCD, limiting MSMEs' capacity to manage complex supplier networks and absorb costs, undermining long-term resilience. The findings emphasize financial accessibility as a key determinant of MSMEs' success in leveraging SCD for persistence.

Our results also show that if a firm has financial independence, SCD does not positively affect firm persistence, affirming the findings of Xu et al. (2023) and Bui (2020). Self-financing, which involves using retained earnings to fund operations, provides firms with autonomy and credibility but can constrain SCD. This limitation may reduce a firm's ability to adapt to market changes and build resilience, impacting long-term stability. Thus, while self-financing offers advantages, it can hinder the benefits of SCD for firm persistence (Li et al., 2023; DeTienne et al., 2016).

In terms of the control variables, our findings reveal that firm persistence can be enhanced by hiring new labor, consistent with studies by Thomas and Douglas (2021) and Varum and Rocha (2014). Our results also show that the relationship between workforce dismissal and firm persistence is negative, supporting the idea that job insecurity can reduce worker effort, lower job involvement, and weaken commitment to the firm, as noted by Wang et al. (2015) and Wang et al. (2024). Additionally, the results suggest a significant positive relationship between firm profits and persistence, aligning with George (2005) and Delmar et al. (2013). Furthermore, the results do

not find significant evidence of an association between export activities, firm age, size, and access to technology with firm persistence.

Overall, our findings indicate that SCD reduces firm persistence during sanctions, suggesting that firms should avoid diversification in economic crises. Financial conditions significantly influence firm persistence, as SCD positively affects persistence only when firms have full access to external financing. A lack of access to financing does not alter the negative relationship, and sole reliance on internal funding fails to mitigate SCD's negative impact on firm persistence.

Table 2. Results of the Probit regression models

Dep. Var.: Firm Persistence (FP)	Model (1)	Model (2)	Model (3)
Independent Variable			
Supply Chain Diversification (SCD)	-0.490***	-0.308**	-0.541**
Moderator: Main			
Full Access to External Finance (FAXF)	-0.633		
Non-Access to External Finance (NAXF)		0.582	
Highly Dependent to Self-finance (HDSF)			-0.212
Interaction Terms			
SCD × FAXF	1.449**		
SCD × NAXF		-1.285**	
SCD × HDSF			0.211
Control Variables			
Export Oriented	0.387	0.295	0.321
Age	-0.010	-0.008	-0.009
Size	0.002	0.003	0.002
Access to Technology	0.143	0.107	0.152
Hiring New Labor	0.263*	0.270*	0.266*
Dismissal of the Workforce	-0.495***	-0.486***	-0.471***
Profitability	0.981***	0.948***	0.929***
Dummy ISIC Code	Yes	Yes	Yes
Dummy Location	Yes	Yes	Yes
Model Fit Statistics			
C	-4.854***	-4.943***	-4.710***
N. Obs.	480	480	480
W. chi2	464.72	463.77	459.33
Prob.	0.0000	0.0000	0.0000
Log L.	-253.63	-253.86	-256.77

Note: (a) *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. (b). Standard errors are robust.

4.2. Marginal effects

While Probit models provide coefficient estimates for independent and interaction variables, these coefficients do not directly translate to either the standalone effect of the independent variable or the specific moderating effect of the interaction term. This limitation arises from two main factors. First, in a Probit model, the marginal effect of an independent variable differs from its estimated coefficient. Second, the effect of an interaction term is conditional on the values of all other independent variables in the model. Therefore, to assess the moderating influence of a variable in a Probit model, we must evaluate the statistical significance of its marginal effect across all sample

values of the independent variable (Brambor et al., 2006). Table 3 presents the average marginal effects, estimated using Probit with robust standard errors, for the probability of a firm having full access to external finance, no access to external finance, or high self-finance dependence. Our analysis reveals that the interaction terms offer more nuanced insights than the Probit model coefficients alone. Specifically, all interaction terms exhibit statistically significant marginal effects. The marginal effect of SCD is positive (0.299) when firms have full access to external finance. This finding suggests that diversification increases the probability of firm persistence by 29.9 percent when firms have full access to external finance. For firms lacking access to external finance, the marginal effect is negative (-0.464), meaning that diversification decreases the probability of firm persistence by 46.4 percent. For firms heavily reliant on internal finance, the marginal effect is negative (-0.102), indicating that SCD reduces the likelihood of persistence by 10.2 percent.

Moreover, Figures 2(A-C) depict these marginal effects through plots illustrating how the relationship between SCD and firm persistence varies depending on a firm's access to external and internal finance. Figure 2(A) demonstrates a negative main effect of SCD on firm persistence. However, a crucial finding emerges: for firms lacking full access to external finance, diversification appears detrimental to persistence during crises. Interestingly, sole reliance on external finance without diversification offers no persistence advantage either. A firm's probability of persistence significantly increases only when it has both full access to external finance and a diversified supply chain.

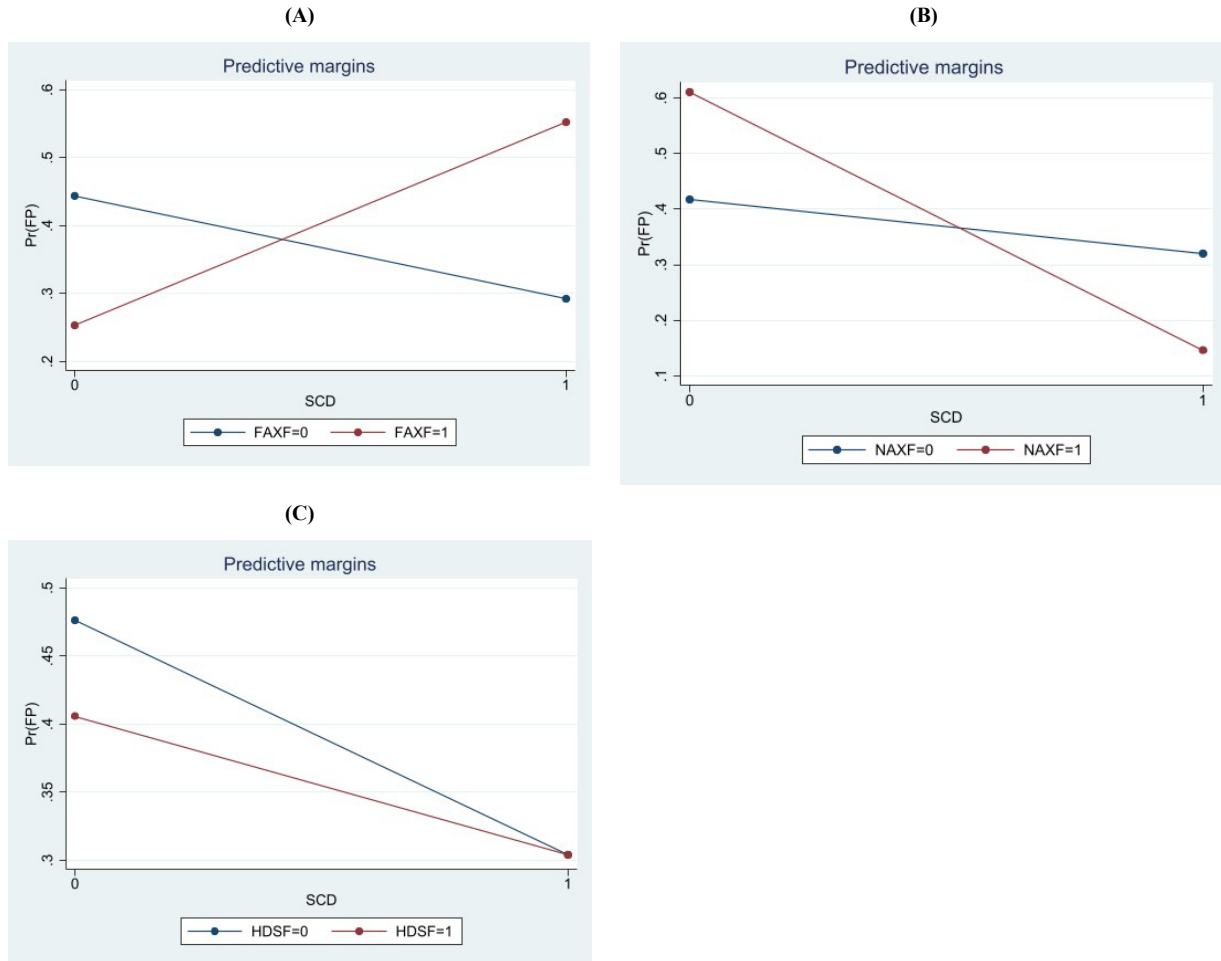
Table 3. Average marginal effects after Probit estimation, dependent variable: firm persistence

	<i>at (0)</i>	<i>at (1)</i>
<i>dydx</i> (SCD) <i>at</i> Full Access to External Finance = (0 1)	-0.151^{***} [0.046]	0.299[*] [0.165]
<i>dydx</i> (SCD) <i>at</i> Non-Access to External Finance = (0 1)	-0.097^{**} [0.046]	-0.464^{***} [0.143]
<i>dydx</i> (SCD) <i>at</i> Highly Dependent to Self-Finance = (0 1)	-0.172^{**} [0.077]	-0.102[*] [0.054]

Note: (a) ^{***} $p < 0.01$, ^{**} $p < 0.05$ and ^{*} $p < 0.1$. (b) Standard errors are reported in brackets. (c) SCD: Supply Chain Diversification

Figure 2 (A-C)

Probit Marginal Effect Plots for the Interactive Variable of Full Access to External Finance (A), Non-Access to External Finance (B), and Highly Dependent to Self-finance (C). SCD: Supply Chain Diversification, FP: Firm Persistence, FAXF: Full Access to External Finance, NAXF: Non-Access to External Finance, HDSF: Highly Dependent to Self-finance.



The plots in Figure 2(B) reveal a markedly negative relationship between SCD and firm persistence for firms lacking access to external finance. In essence, the lack of external financial resources exacerbates the negative impact of diversification on persistence in these scenarios. Figure 2(C) illustrates the link between internal financial resources and firm persistence. While allocating internal finances shows no significant impact on a firm's persistence, firms heavily reliant on internal financing exhibit lower persistence rates than those with less dependence.

4.3. Robustness analysis

Considering the discussions in the reviewed model, the reverse causality could exist where the prospect of negative persistence influences diversification decisions. To mitigate this, we introduce an instrumental variable (IV) approach in our Probit model. The instruments used are exogenous

to the persistence of the MSMEs but strongly correlated with SCD decisions. Thus, regarding the potential endogeneity in our analysis, Table 3 presents the results of the IV-Probit regression models. The findings align with the results observed in the Probit outcomes shown in Table 2. The results highlight the complex relationship between SCD and firm persistence in determining access to finance. While diversification may introduce risks, access to external finance can mitigate these risks, underscoring the importance of financial resources in managing supply chain complexities. SCD has a consistently negative and statistically significant impact on firm persistence across all models (coefficients: -1.878, -1.011, -3.714, all significant at the one percent level). This suggests that firms with more diversified supply chains are less likely to persist, possibly due to increased complexity, coordination costs, or exposure to external shocks.

The negative impact of full access to external finance on persistence suggests that firms may face trade-offs between leveraging external resources and maintaining financial stability. This counterintuitive result may reflect an over-reliance on external finance, leading to higher leverage and financial fragility.

The interaction terms between SCD and access to external finance reveal nuanced effects. The positive and significant coefficient indicates that firms with full access to external finance can mitigate the negative impact of SCD on persistence. This suggests that financial resources play a critical role in managing the complexities of diversified supply chains. In Model (2), the negative and significant coefficient implies that firms without access to external finance face even greater challenges in managing diversified supply chains, further reducing their persistence. In Model (3), the coefficient is positive but not statistically significant, suggesting that self-financed firms may not experience the same detrimental effects of SCD as those without any access to external finance.

The coefficient for export-oriented firms is positive and significant in Model (1). This suggests that export orientation may enhance firm persistence. The coefficient for firm age is negative and significant in Model (2), indicating that older firms are less likely to persist. Access to technology is positive and significant in Model (3), highlighting the role of technological capabilities in enhancing firm persistence. The positive and significant coefficients across models suggest that firms that hire new labor are more likely to persist, possibly due to increased productivity or adaptability. The role of labor dynamics in enhancing persistence highlights the importance of human capital in sustaining firm operations. Profitability has a positive and significant effect in Models (1) and (2). This underlines the importance of profitability in sustaining firm operations.

Log-likelihood and chi-squared statistics indicate that the models are well-specified and fit the data well. Additionally, the null hypothesis of exogeneity is rejected at the one percent significance level. The significant chi-squared statistics and corresponding probabilities confirm the validity of the instrumental variables used in the IV-Probit models, addressing potential endogeneity concerns.

Table 3. Results of the IV-Probit regression models

Dep. Var.: Firm Persistence (FP)	Model (1)	Model (2)	Model (3)
Supply Chain Diversification (SCD)	-1.878***	-1.011***	-3.714***
Full Access to External Finance (FAXF)	-1.383***		
Non-Access to External Finance (NAXF)		0.622	
Highly Dependent to Self-finance (HDSF)			-2.158
SCD × FAXF	2.475***		
SCD × NAXF		-1.510**	
SCD × HDSF			3.485
Export Oriented	0.486*	0.395	0.410
Age	-0.012	-0.011*	-0.008
Size	0.005	0.004	0.002
Access to Technology	0.062	0.053	0.258**
Hiring New Labor	0.272*	0.249*	0.326**
Dismissal of the Workforce	-0.215	-0.486	-0.091
Profitability	0.625***	0.498*	0.295
Dummy ISIC Code	Yes	Yes	Yes
Dummy Location	Yes	Yes	Yes
C	-4.247***	-4.008***	-1.048
Model Fit Statistics			
N. Obs.	480	480	480
W. chi2	1876.02	8189.89	747.72
Prob.	0.0000	0.0000	0.0000
Log L.	-529.04	-527.55	-270.88
Wald Test of Exogeneity (chi2)	10.02	8.66	7.75
Prob.	0.0015	0.0033	0.0054

Note: (a) *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$. (b). Standard errors are robust.

5. Summary and concluding remarks

This study sheds light on the complex relationship between SCD and the persistence of MSMEs in Iran, particularly under the constraints of sanctions. Our findings suggest that although SCD is commonly viewed as a risk-mitigation strategy, its effectiveness is heavily contingent upon the financial condition of the firm. Our analysis reveals that SCD may, in fact, undermine the persistence of firms lacking full access to external financial resources. For these firms, diversification can add strain to already limited resources, potentially worsening operational difficulties. This finding supports prior research emphasizing the crucial role of financial resources in optimizing the benefits of diversification. Importantly, our study also finds that relying solely on internal financing does not alleviate SCD's negative impact. Without adequate external financial support, internal resources alone are insufficient to offset the risks associated with diversification. Conversely, firms with full access to external finance experience a positive impact from SCD, as it enhances their persistence rates during crises. This suggests that access to external finance is essential for managing the complexities and costs of maintaining diversified supply chains. Thus, the interaction between SCD and financial resources is a critical determinant of firm persistence.

Our findings also highlight the importance of factors such as labor management and profitability. Investing in new hires is positively associated with firm persistence, indicating that human capital plays a key role in operational stability. Workforce reductions, on the other hand, seem to negatively impact persistence, likely due to reduced morale and productivity. Higher profitability also correlates with increased persistence rates, emphasizing the importance of financial health in navigating economic challenges.

The findings of this study suggest that policymakers must prioritize the improvement of MSMEs' access to external finance to ensure that SCD strategies can be effectively leveraged. Specifically, targeted financial instruments, such as low-interest loans, credit guarantees, and government-backed lending programs, should be designed to provide the necessary financial support. Furthermore, alternative financing mechanisms, such as crowdfunding, impact investment, and public-private partnerships, could offer accessible solutions, especially in regions where traditional financial systems are under strain.

Given the unique challenges faced by MSMEs in sanction-hit regions like Iran, local governments should partner with regional development agencies, NGOs, and local financial institutions to create resilient funding pools insulated from external geopolitical risks. Such partnerships could ensure that MSMEs have continuous access to the financial resources needed for persistence. In addition to financial access, policymakers should provide MSMEs with support programs that include training in supply chain management, digital transformation subsidies, and advisory services. These complementary measures will enhance the resilience of MSMEs and allow them to maneuver the complexities of SCD more effectively.

Finally, international collaboration with multilateral organizations and regional development banks could offer new funding avenues for MSMEs in economically volatile regions. These partnerships can help bypass the restrictions imposed by sanctions and provide financial resources through local intermediaries. Policymakers should also establish monitoring frameworks to evaluate the success of these interventions, tracking key metrics such as loan uptake rates, default rates, and firm persistence post-diversification.

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