E-ISSN: 2676-6167 | P-ISSN: 2538-5100

Journal of Applied Research on Industrial Engineering

www.journal-aprie.com

J. Appl. Res. Ind. Eng. Vol. x, No. x (xx) x–x.

Paper Type: Original Article

The effect of economic uncertainty on the supply chain risks of industrial plants

Hadi, Rahmani Fazli[1],*, Hamid Reza Teymori

[1] Department of Political Economy and Public Policy, Faculty of Law and Political Science, Allameh Tabatabai University; hadirahmani@atu.ac.ir;

[2] Faculty of Economics and Accounting, Islamic Azad University, Tehran Center, Tehran, Iran ; hamid.teymori.1972@gmail.com ;;

Citation:

LastName, (Initial)., & LastName, (Initial). (Date). Paper Title. *Journal of applied research on industrial engineering, Volume* (Issue), PP.

Received: Reviewed: Revised: 202 Accepted:

Abstract

Supply chain management constitutes a strategic discipline involving the meticulous coordination of planning, execution, and efficient control in directing the flow of raw materials, works-in-progress, finished goods, and pertinent information from origin to consumption. This intricately woven process profoundly influences all dimensions of industries and enterprises; therefore, a meticulous understanding of its opportunities and threats holds paramount significance in the landscape of industry and commerce. So, evaluating industries' resilience to existing risks is pivotal, underscoring the importance of managing supply chain risks. The global landscape has witnessed profound late-century breakthroughs, leading to the heightened complexity of supply chains. This complexity exposes supply chains to various risks, requiring managers to navigate environmental uncertainties arising from sudden shifts in demand, supply, and production processes within fiercely competitive environments. Consequently, risk management has emerged as a critical facet of effective supply chain management. This study employed structural equation modeling (SEM) and Amos software for analysis, utilizing random sampling based on Morgan's table to collect 385 observations from managers of manufacturing joint-stock companies, ranging from production workshop supervisors to higher positions, through a questionnaire. Findings indicate that preventive risk mitigation can trigger supply and manufacturing risks, subsequently leading to delivery risks, indicating a cascade effect of supply-side risks on downstream supply chains. Consequently, focusing on reducing supply risks can be advantageous in mitigating production and delivery risks. Furthermore, economic uncertainty, with coefficients of 1.1, 2.8, and 1.95, significantly influences supply, production, and delivery risks within the supply chain, resulting in reduced profitability and economic stability. Policymakers are urged to take action to minimize market uncertainties. Additionally, since competitive intensity exhibits a negative correlation with supply chain risks, measures should be taken to intensify industry competition by enforcing anti-monopoly legislation.

Keywords: economic uncertainty, supply chain risks, industrial plants, structural equation modeling.

Corresponding Author:

1 | Introduction

Supply chains have evolved into intricate global networks, interconnecting suppliers, manufacturers, distributors, and retailers through material/product flows, information exchange, and financial transactions [9]. This complexity exposes these networks to numerous risks, necessitating an intensified focus on risk management within supply chains, particularly as businesses face an increasingly dynamic environment and strive for lean processes. The significance of supply chain risk management has heightened significantly, especially after the global financial crisis 2007, which amplified the prominence of financial risk. For instance, Circuit City, once a major U.S. electronics retailer, declared bankruptcy and liquidated its stores in 2009 due to suppliers' apprehensions about its financial stability, refusing to extend trade credits [8]. Similarly, around 670,000 suppliers shuttered in China in 2009 due to insufficient demand, delayed payments, and constrained credit markets [10]. A recent McKinsey Quarterly global survey highlighted financial volatility as a top-three concern for supply chain managers [24]. Consequently, managers are compelled to reassess strategies, re-evaluate the values of their supply chain partners, and navigate financial and economic uncertainties.

Another trend amplifying the importance of supply chain risk management is the intricate supplier networks, especially in the automotive industry. Concepts like outsourcing and offshoring have expanded businesses' international engagements, creating additional dependencies and complexity within the network [19]. The resulting complexity often heightens vulnerability [32]. Moreover, globalized business relationships introduce transportation, cultural, and exchange rate risks, compelling companies to actively address supply chain risk management. Even small and medium-sized enterprises (SMEs) encounter these challenges and should be aware of the associated risks and coping mechanisms. Companies have to deal with significant environmental uncertainties to achieve this objective, making the supply chains more complex. For example, frequent product introductions increase demand uncertainty, while diverse products requiring advanced technology often lead to uncertainties in supply and production processes [41].

On the other hand, the increasing complexity of the supply chain hinders transparency and subsequently reduces control over the processes. At a time when the risk is not properly controlled, it affects other members of the chain [18]. There are a variety of risks in the supply chain, such as:

A) Supplier risks:

- Delivery errors
- Material shortages
- Timely raw material delivery
- Direct supplier disconnection with customers
- Raw material quality
- Price fluctuations
- Demand fluctuations
- Technological changes
- Competitor conditions
- Inadequate transport
- IT issues
- Inventory inadequacies
- Supplier bankruptcies
- Environmental factors

B) Producer risks:

- Raw material quality
- Technology transfer
- Design and product engineering changes
- Product life cycle changes
- Production planning errors
- Production control inadequacies

- Inventory issues

- Environmental risks
- Supplier affiliations
- Supplier inflexibility
- Environmental problems
- Customer financial capabilities.

C) Distributor risks:

- Inaccurate demand forecasting
- Market dynamics
- Expected product quality
- International regulations
- Price changes
- Outstanding payments
- Product returns
- Shipping risks
- Environmental factors.

D) Final customer risks:

- Price competitiveness
- After-sales service
- Quality assurance
- Timely delivery [25].

Consequently, companies in the supply chain cycle face increased exposure to disruptions, production and delivery delays, leading to reputation damage, lost sales, and poor financial performance. A recent global survey on supply chain and risk management underscores that frequent shifts in product supply and production requirements due to new product introductions and standardization contribute significantly to supply chain complexity, elevating risks [33].

Therefore, in a business environment characterized by uncertainty and complexity, effective supply chain risk management becomes imperative to enhance efficiency and responsiveness [41]. Reducing risky events and mitigating their impacts on long-term business performance allows companies to outperform competitors. Therefore, based on the aforementioned explanations, this paper investigates the factors influencing supply chain risk amidst economic uncertainty. Initially, the study measures the factors impacting risk reduction and uncertainty across various risk types.

2 | Literature review

Due to the complex and rapidly changing nature of supply chains, market needs often lead to sudden changes in demand, affecting the company's supply and production processes, ultimately resulting in risk in the supply chain. Therefore, the structure of environmental uncertainties is considered in terms of demand, production, and supply. As suggested by Ton and Heung (2011), measuring supply chain structure involves assessing the probability of an event and the corresponding impact of that event, representing supply failure, production operation failure, and delivery failure.

Based on previous research, demand uncertainty includes measures reflecting demand fluctuations, while production uncertainty measures the variety of production in the volume and composition of products required. Companies with a product line characterized by frequent introductions of new offerings, a wider variety, and a higher level of customization find it challenging to predict product demand patterns [19]. While demand uncertainty, primarily involving unknowns related to product characteristics, is one of the primary sources of uncertainty in supply chains, there are other sources of uncertainty, including production and supply uncertainty.

Supply uncertainty includes indicators reflecting fluctuations in supply requirements and changes due to frequent alterations in supply components. While offering innovative and highly customized products helps companies gain a sustainable competitive advantage, it also leads to greater complexity in upstream suppliers' manufacturing and logistics processes, resulting in more significant uncertainty in the entire supply chain. Therefore, the uncertainty of supply is characterized by unpredictable and unmanageable factors in the supply of materials, mainly attributed to the complexity of technology and the variety of production in the composition and volume of the product.

Uncertainty in production is characterized by technical complexity and the degree of technological change in the industry. Frequent changes in production technology not only increase the complexity of production but also necessitate technical changes at the suppliers' end. Additionally, further changes in order size lead to frequent changes in the company's production, production volume, and supplier mix.

Therefore, supply risk is defined as a possible failure in the supply of goods in terms of "time, quality, and quantity" and as a result of incomplete orders [23]. Demand risk increases the risk of shortage or excess supply due to the unpredictable innovations of products in the market. Because of rapid fluctuations in the characteristics of demand and supply of products, the possibility of loss due to the delivery of wrong products or the delivery of the right products but at the wrong time is very high. Uncertainty in production also increases the uncertainty in the volume or composition required for an order, reducing the ability of suppliers to deliver on time and with the right quality.

2.1 | Research background

The last decade has witnessed numerous calls for increased empirical research in operations and supply chain management, emphasizing its role in theory development and validation [27]. Despite a multitude of studies exploring supply chain risk, research grounded in empirical evidence remains relatively nascent. Consequently, there exists a pressing need for an empirical approach to delineate the interplay between various elements, environmental uncertainties, and supply chain risks. This necessity arises to bridge the gap in empirical research within the domain of supply chain management operations [35].

Supply chain risk management emerges as an attempt to ensure the profitability and continuity of the business, avoiding or managing the impacts of disruptions in the different nodes of the supply chain. These objectives can be achieved through coordination and collaboration between the supply chain partners to identify and monitor risk sources and vulnerabilities, analyze the consequences of disruption, and create and apply possible mitigation strategies [23].

According to Jüttner et al. (2003), supply chain risk management aims to identify possible sources of risks in the supply chain and implement appropriate actions to avoid or contain the supply chain's vulnerabilities. They classify the sources of risks into three groups: organizational, network, and environmental risks. Christopher and Peck (2004) further suggest the following classification:

Internal to the firm: includes risks inherent to internal managerial and internal decisions, being sub-divided into "process" and "control."
External to the firm but internal to the supply chain network: composed of risks emerging from the buy-sell relationships with customers and suppliers. They are sub-divided into "demand" and "supply."
External to the networks: composed of man-made or natural disasters [39], political, social, economic, and technological threats [34].
The interest in geopolitical, economic, and social risks has increased considerably due to the internationalization of firms and global outsourcing. These subjects have been broadly addressed in the strategic literature. Nevertheless, they have been addressed less in depth in the supply chain risk management literature, which focuses on the internal supply chain network and, more recently, on natural and social disasters [42].

The interdependence of global supply chains increases firms' exposure to the vulnerability of the nations they deal with. Consequently, political, social, regulatory, and macro-economic turbulence may directly or indirectly affect their product flows and profitability [34], emphasizing the theme's relevance. According to Manuj and Mentzer (2008), external or environmental risk sources manifest themselves by disturbing a combination of other risk sources such as supply, demand, operational, and security. Environmental turbulences may include social-political instability and economic crises that affect interest and exchange rates, inflation, salaries, labor availability, and changes in regulatory and tax regimes [6].

Subsequently, these changes increase costs and reduce demand and potential economies of scale while increasing the instability and insolvency of customers and suppliers, resulting in additional internal crises within the supply chain. Thus, this network structure may amplify the risk, acting as a knock-on effect triggered by the environmental risk sources [19] and threatening the whole supply chain [36]. Suppliers in these regions under environmental turbulences would be avoided in a supply chain strategy, as these turbulences may cause insolvency, opportunistic behaviors, or extra costs resulting from changes in operational dynamics [45].

Furthermore, the effect of economic and political hazards increases governments' probability of performing adverse changes in regulation, taxes, and even expropriation, affecting business performance and reducing the investment level of multinational companies [43]. These factors reinforce the economic and political turbulences, contributing to worsening the current crisis as a cycle.

۳ | Methodology of research

This research adopts a correlational methodology with a practical objective, utilizing field research methods encompassing note-taking and questionnaire techniques. The initial phase involves a comprehensive literature review from various scholarly sources, including library materials, publications, articles, and reputable scientific websites, to establish a foundation in theories and literature relevant to the research topic. Subsequently, the primary data collection phase commences with information extraction from the questionnaire. Finally, employing specialized software and structural equation modeling allows the determination of mathematical relationships between independent and dependent variables.

The questionnaire comprises two sections: general inquiries and those pertaining to research variables, utilizing a five-point Likert scale for responses. Moreover, three control variables (illustrated in Figure 1) are employed to account for potential influences on our model's main variables and mitigate unwanted variances. Firstly, we quantify firm size—potentially impacting the adoption of supply chain risk management practices—using the number of employees. Secondly, industrial competition and market entry serve as controls to manage supply chain risk mitigation, potentially influencing supply chain risks.

Based on the preceding rationale, the following hypotheses have been formulated:

Firms that have high environmental uncertainty are exposed to high manufacturing process risk.
Firms that have high environmental uncertainty are exposed to high delivery risk.
Firms that have high environmental uncertainty are exposed to high distribution risk.
These hypotheses aim to establish and explore the potential correlations between environmental uncertainty and distinct risks within the supply chain.

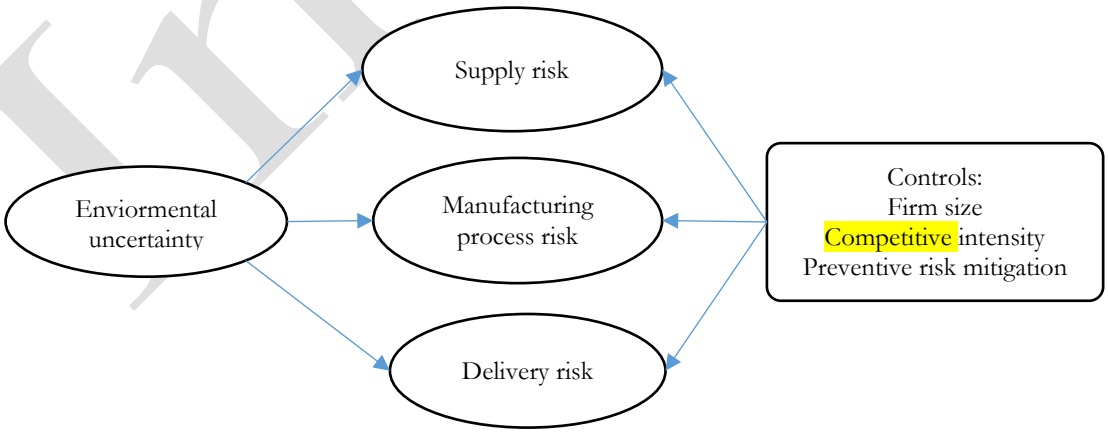

Fig. 1. Research model.

To estimate variables, the following indicators in Table 1 are used:

Table 1. Definition of variables.

variable	index
Environmental uncertainty	Demand fluctuates drastically from week to week Total manufacturing volume fluctuates drastically from week to week Mix of products you produce changes drastically from week to week Supply requirements (volume and mix) vary drastically from week to week Suppliers frequently need to carry out modifications to the parts/components they deliver to your plant
supply risk	A key supplier fails to supply, affecting your operations-probability A key supplier fails to supply, affecting your operations – impact
manufacturing process risk	Risk management of the plant's dominant activity. Please evaluate the probability of occurrence and impact of the following risks
Delivery risk	Risk management of the plant's dominant activity. Please evaluate the probability of occurrence and impact of the following risks
Competitive intensity	Market concentration Competitive rivalry within industry Market entry
Preventive risk mitigation	Preventing operations risks (e.g., select a more reliable supplier, use clear safety procedures, preventive maintenance) Detecting operations risks (e.g., internal or supplier monitoring, inspection, tracking)

۳,1 | The population, sampling method, and sample size

The statistical population for this research comprises managers within stock production companies, including supervisors of production workshops and those in higher positions who play influential roles in policy-making and final decision-making processes. The targeted companies have a minimum of 50 employees. Employing random sampling methods based on Morgan's table, a sample size of at least 385 individuals will be analyzed for this study. This sampling strategy ensures a representative subset of participants for a comprehensive and reliable analysis.

۳,2 | Methods and tools for analyzing data:

The methodology for data analysis in this research involves the utilization of Structural Equation Modeling (SEM) to assess the hypotheses proposed in this study. The analysis will be conducted using Amos software, employing single-variable and multi-variable regression techniques, including several dependent variables.

Structural Equation Modeling integrates a structural component, delineating relationships among latent variables, and a measurement component that elucidates the mapping of latent variables and their indicators. Within this framework, the least squares minor method is utilized. Furthermore, the methodology encompasses a distinct aspect termed "weight ratio," instrumental in estimating the values of items or factor loadings for individual samples within latent variables.

This modeling approach excels in predicting the final dependent variable with exceptional precision. Moreover, it facilitates estimating relationships across all elements within the model, encompassing interactions among latent variables and the weight of all measurable indicators associated with each latent variable (coefficients outside the measurement model). Consequently, factor analysis of the variables is performed to evaluate their interrelationships comprehensively.

.4 | Model Estimation Using Structural Equations

For the data analysis, we used the Amos software, and the prerequisites of the model were rigorously assessed. The results indicate that both Cronbach's alpha (α) and CR values surpass the established threshold of 0.7, as commonly cited in the literature. Additionally, all scales demonstrate an AVE exceeding the acceptable cutoff of 0.50. These findings affirm the satisfactory convergent validity of all constructs utilized in our models.

We compared AVE and CR values against the squared correlations of latent constructs to evaluate discriminant validity. Notably, both AVE and CR values surpassed the squared inter-construct correlation values, validating discriminant validity.

As the software estimates, the model is depicted in Table 2, illustrating the relationships among latent variables—both control and dependent. These results affirm the established relationships within the model, validating the theoretical constructs utilized.

Table 2. Structural Equation Model Results

Effective structure	dependent variable	Effect coefficient and test statistic			
		Coefficient	Standard deviation	Test statistic	prob.
Environmental uncertainty	supply risk	1.1	0. 2٠0	5. 416	***
Competitive intensity		-1.687	0. 203٠	-8. 329	***
Preventive risk mitigation		-1. 072	0. 246٠	-4. 357	***
Firm size		1. 11٠	0. 08٠	13. 875	***
Environmental uncertainty	manufacturing process risk	2. 867	0. 403٠	7. 114	***
Competitive intensity		-3. 702	0. 246٠	-15. 048	***
Preventive risk mitigation		-3. 011٠	0. 67٠	-4. 494	***
Firm size		3. 687	0. 853٠	4. 322	***
Environmental uncertainty	Delivery risk	1. 952	0. 426٠	4. 582	***
Competitive intensity		-0. 012٠	0. 001	-11. 05	***
Preventive risk mitigation		-0. 207٠	0. 035	-٥.٩١٤	***
Firm size		4. 143	1. 068	3. 879	***

* parameters at a meaningful level have 1 percent significance.

It should be noted that since the estimate of relative variance and curvature variance is more than 0.9 and the remaining variance and covariance are relatively small, it can be said that the model has a relatively good fit. Among the control variables, company size has the greatest impact on supply chain risks, so its impact on environmental uncertainty is 1.1 for supply risk, 3.687 for the production process risk, and 4.143 for delivery risk. Therefore, in larger companies, one can expect more sophisticated approaches to supply chain risk management, which, in turn, can increase the ability of those companies to manage risks. This size effect also emphasizes that the smaller the firm, the more attention it should pay to the best possible use of resources.

Our findings illuminate the positive impact of competitive intensity in diminishing supply chain risks. This trend is likely attributed to the industry-wide elevation of standards and capabilities as competition intensifies. For supply chain managers, navigating heightened competition involves fostering stronger partnerships within the supply chain, aiming to mitigate risks. Conversely, prospective managers considering entry into such competitive industries should seek established partners capable of providing industry-specific insights and guidance, leveraging their experience to navigate industry complexities. Entering a fiercely competitive industry without such guidance is discouraged.

Moreover, our study reveals that preventive risk reduction initiatives negatively impact supply chain risks. This outcome aligns with the focus of preventive measures aimed at minimizing the likelihood of risk events, contrasting with reactive risk reduction efforts that aim to mitigate the negative consequences following a risk event.

Overall, the empirical analysis in this study elucidates managerial concepts and outcomes, shedding light on the nexus between a company's environmental uncertainty, susceptibility to supply chain risks, and the conditions conducive to risk reduction. The study underscores how environmental uncertainties contribute to heightened supply chain risks.

5| Conclusions

Supply chains form the backbone of the global economy and promote trade, consumption, and economic growth. The changing stages of globalization, lean manufacturing processes, and outsourcing to low-income countries have made supply chain networks more efficient and changed the risk profile of the supply chain. Due to globalization, competition between supply chains has intensified. Companies strive to provide the best value to customers with the highest productivity at the lowest cost. Communication with vendors/suppliers will play a vital role in many organizations. Supply chain cost reduction can be achieved through optimally designed supply chain flows and goods' physical movement. This process can be simplified by increasing trade credit and reducing risk through common distribution methods, reducing inventory level costs in supply chain management, and increasing access to trade finance organizations.

To our knowledge, few empirical studies in the supply chain risk management literature specifically examine supply chain risk drivers and the effectiveness of risk mitigation strategies. This study fills this gap by establishing complex connections between environmental uncertainty and supply chain risk.

On the other hand, to stay in the competitive market, companies must expand their products and offer extensive customization, leading to increased uncertainty in their supply chain. Inadequate preparation to handle these uncertainties can create cascading effects in the company's supply chain and increase the probability of supply failures and wrong product deliveries to customers. Due to the complex connection of supply chains, the failure of a company affects not only its performance but also the entire upstream and downstream parts of the supply chain, exposing them to more risks.

While significant supply chain uncertainty may be inevitable in today's highly competitive environment, such uncertainty does not necessarily equate to increased risks. Companies can mitigate these challenges by implementing flexible supply and production systems as preventive measures. Despite industry experts stressing the importance of adaptive supply chain processes to meet evolving market demands, many companies fail to invest in and build flexible supply chains.

Two primary reasons hinder the widespread adoption of flexible supply chains: the perceived high cost and the challenge of realizing immediate benefits from such capabilities. Additionally, it's crucial to discern the appropriate type and degree of flexibility tailored to fit the firm's operating environment.

Our findings underscore that firms grappling with high uncertainty are markedly more susceptible to supply chain risks. This correlation is substantiated by the results of our hypothesis tests, outlined comprehensively in Table 3.

Table 3. Hypothesis testing

hypothesis	Independ variable	depend variable	Null hypothesis	opposite hypothesis	Test result
			$\beta = 0$	$\beta \neq 0$	
First hypothesis:	Environmental uncertainty	Manufacturing flexibility	✗	✓	The effect is direct and significant.
Second hypothesis:	Environmental uncertainty	Supply flexibility	✗	✓	The effect is direct and significant.
hypothesis:	Environmental uncertainty	Distribution/logistics flexibility	✗	✓	The effect is direct and significant.

A noteworthy discovery from our study is the revelation that preventive risk mitigation measures can inadvertently trigger supply and manufacturing risks, subsequently influencing delivery risk. This implies a cascading effect wherein supply-side risks impact downstream aspects of a firm's supply chain. Consequently, prioritizing the mitigation of supply risks not only addresses those risks directly but also extends benefits in mitigating manufacturing and delivery risks.

Given that uncertainty contributes to diverse risk types within the supply chain and as firms increase their risk exposure, policymakers are urged to intervene to reduce market uncertainties. Furthermore, our findings suggest that competitive intensity within the industry negatively correlates with supply chain risks. Therefore, intensifying competition within the industry could serve as a strategic approach to mitigate these risks effectively.

Conflicts of Interest

All co-authors have reviewed and agreed with the manuscript's contents, and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

References

[1] Aqlan, F.,& Lam, S.S., (2016), Supply chain optimization under risk and uncertainty: A case study for high-end server manufacturing, *Computers & Industrial Engineering* 93 , 78–87

[2] Atashsoz, A., Fefi, K., Kazazi, A.,& Alfat, L, (2015), A Model for Relationship Risks of the Supply Chain of the Petrochemical Industry in Iran, *Industrial Management*, Volume 7, Number 3, 405-424

[3] Azizi Yousefvand, R., Nahavandi, N.,& Farzandi, Gh., (2017), The Effect of Supply Chain Management on the Efficiency of Pharmaceutical Distribution Companies, *Journal of Industrial Engineering and Production Management*, Issue 1, Vol. 28, 121-137.

[4] Bogataja, D. & Bogataj, M. (2007). Measuring the supply chain risk and vulnerability in frequency space. *International journal Production Economics*, 108: 291-301

[5] Brindley, C. (2004), supply chain risk, England, ASHGATE

[6] Christopher, M. and Peck, H. (2004), "Building the resilient supply chain", The International Journal of Logistics Management, Vol. 15, No. 2, pp. 1-14.

[7] Christopher, M., & Holweg, M. (2011). "Supply Chain 2.0": Managing supply chains in the era of turbulence. International journal of physical distribution & logistics management, 41(1), 63-82.

[8] Church, S., Clothier, M., (2009). Circuity City go out of business after 60 years. Bloomberg News, January 16.

[9] Coyle, J.J., Langley, J.C., Gibson, B., Novack, R.A., Bardi, E.J., (2008) . Supply Chain Management: A Logistics Perspective, 8th ed. South-Western Cengage Learning, Mason, OH, USA.

[10] Fenton, S., (2009). China bankruptcies create cracks in global supply chain. New York Times, March 9.

[11] Ganeshan, R., and Terry,& P.Harrison, (1995), An Introduction to Supply Chain Management, Department of Management Sciences and Information Systems, *303 Beam Business Building*, Penn StateUniversity Park, PA

[12] Ghadge, A., Dani, S.,Ojha , R.,& Caldwell, N , (2017), Using risk sharing contracts for supply chain risk mitigation: A buyer-supplier power and dependence perspective, *Computers & Industrial Engineering* 103,262–270

[13] Harland, C., Brenchley, R., Walker, H., (2003). Risk in supply networks.*Journal of Purchasing and Supply Management* 9, 51

[14] Hayati, M., Ataei, M., Khalou Kakai, R.,& Sayadi, A. R. (2014), A Model for Assessing Supply Chain Risks Using Multi-Attribute Decision Making Techniques, *Journal of Industrial Management Studies*, Vol. 12, No. 34 , 19 - 40

[15] Hendricks, K., & Singhal, V. (2005). Association between supply chain glitches and operation performance. *Management Science*, 51(5), 695–711

[16] Hombach, L. E., Büsing , C,& Walther, G, (2017) Robust and sustainable supply chains under market uncertainties and different risk attitudes –A case study of the German biodiesel market, *European Journal of Operational Research* , 1–11

[17] Hossein G., Asefa,& Rabbani, M. (2012), Choosing Suppliers in the Supply Chain with an Order-Based Supply Based Approach, Taking Value at Risk, *Supply Chain Management*, Year 14, Issue

[18] Jafari, D.,& Qizilbash, A.M. (2015), Selection of an appropriate reduction strategy for supply chain risks using the classic network analysis process (ANP) Case study of Iran's automotive industry. *Management Conference in the 21st Century* 34

[19] Jüttner, U., Peck, H. and Christopher, M. (2003), "Supply chain risk management: outlining an agenda for future research", International Journal of Logistics: Research and Applications, Vol. 6, No. 4, pp. 197-210.

[20] Lavastre, O., Gunasekaran, A., & Spalanzani, A. (2012). Supply chain risk management in French companies. *Decision Support Systems*, 52: 828- 838.

[21] Li, G., Fan, H., Lee, P.K.,& Cheng, T.C.E., (2015). Joint supply chain risk management: an agency and collaboration perspective. *Int. J. Prod. Econ*. 164, 83–94.

[22] Liua, F., Chene W.L.,& Bin F., D,(2017) Optimal coordination strategy of dynamic supply chain based on cooperative stochastic differential game model under uncertain conditions, *Applied Soft Computing* , 56 669–683

[23] Manuj, I., & Mentzer, J. T. (2008). Global supply chain risk management. Journal of Business Logistics, 29(1), 133-155.

[24] McKinsey & Company, (2008), Managing global supply chains: McKinsey Global Survey Results, McKinsey Quarterly, August 2008.

[25] Mazaheri A., Karbassian M.,& Shirooyzadeh H., (2011), Identification and Prioritization of Supply Chain Risk in Manufacturing Organizations Using Multi-criteria Decision Making, *Second Conference on Management Execution* 34

[26] Mirghfouri, S. H., Marvoti S.i, Ali,& Asadian Ardakani, F. (2012), An Analysis of Suppliers' Risks in the Supply Chain with a Hybrid Relationship Approach and Fuzzy VIKOR, *Industrial Management*, Volume 4, Issue 2, 153 – 178

[27] Mehrabadi, M. S., Najafizadeh, S. A., & Ghafari Ashtiani, P. (2021). Factors Affecting Stock Prices Regarding Uncertainty and Asymmetric Information in Tehran Stock Exchange. *Advances in Mathematical Finance and Applications*, 6(3), 535-554. doi: 10.22034/amfa.2019.1866542.1214

[28] Mohammadi, A, Shojaee, P, Yazdani, H. R,& Sadeghi Moghadam, M.R., (2016), Risk Management of Supply Chain Management Project in Gas Transmission Pipes: *A Theory Based on Data Journal of Industrial Management Studies* - Vol. 14, No. 42, 765-751137

[29] Mohammadi, A, Moslehshirazi, A., Ahmadi, M.B.,& Shojaei, P, (2014), Designing a Hierarchical Model for Reducing the Risks of the Project Supply Chain Based on the Future (Case Study: Fars Gas Company), *Industrial Management*, Period 6, Number 3, 591-614

[30] Naghizadeh, M, Bamdad Sufi,& M, Mirafshar, M (2014), Identification and Prioritization of Risks of Technology Cooperation Projects, *Quarterly of Technology Development Management*, Volume 2, Number 3

[31] Paydar M.M., Babaveisi,V.,& Safaei A.S., (2017), An engine oil closed-loop supply chain design considering collection risk, *Computers and Chemical Engineering* 104 , 38–55

[32] Peck, H., (2005). Drivers of supply chain vulnerability: an integrated framework. International Journal of Physical Distribution & Logistics Management, 35 (4), 210–232.

[33] PwC, MIT, (2013). Making the right risk decisions to strengthen operations performance. Tech. Rep

[34] Punniyamoorthy, M., Thamaraiselvan, N. and Manikandan, L. (2013), "Assessment of supply chain risk: scale development and validation", Benchmarking: An International Journal, Vol. 20 No. 1, pp. 79-105.

[35] Rajagopala,V, Prasanna Venkatesana, S,& Gohb, M, (2017)Supply chain network design under uncertainty: A comprehensive review and future research directions, *Computers & Industrial Engineering* 113, 646–682

[36] Roberta Pereira, C., Christopher, M., & Lago Da Silva, A. (2014). Achieving supply chain resilience: the role of procurement. Supply Chain Management: an international journal, 19(5/6), 626-642.

[37] Sandeep S,& Manjunath K, (2018), Understanding the value of upstream inventory information sharing in supply chain networks , *Applied Mathematical Modelling* 54 , 393–412

[38] Shahbandarzadeh, H, Jamali, G,& Shafiee, F, (2013), An Analytical Approach to Identify the Factors Affecting the Supply Chain Risk in the Dairy Industry of the Country, *Supply Chain Management*

[39] Sheffi, Y. and Rice Jr, J. B. (2005), "A supply chain view of the resilient enterprise", MIT Sloan Management Review, Vol. 47, No. 1, p. 41.

[40] Sodhi, M. S., Son, B. G., & Tang, C. S. (2012). Researchers' perspectives on supply chain risk management. Production and Operations Management, 21(1), 1-13.

[41] Tang, C.S., (2006). Perspectives in supply chain risk management. *Int. J. Prod. Econ*. 103(2), 451–488

[42] Tomas, R. N., & Alcântara, R. L. C. (2013). Exploring linkages among external integration, supply chain risk reduction and performance outcomes: a study with Brazilian companies. African Journal of Business Management, 7(31), 3135

[43] Xavier, W. G., Bandeira-de-Mello, R., & Marcon, R. (2014). Institutional environment and Business Groups' resilience in Brazil. Journal of Business Research, 67(5), 900-907.

[44] Wagner, S. M., & Bode, C. (2008). An empirical examination of supply chain performance along several dimensions of risk. *Journal of Business Logistics*, 29(1),307–325.

[45] Zsidisin, G. A., & Wagner, S. M. (2010). Do perceptions become reality? The moderating role of supply chain resiliency on disruption occurrence. Journal of Business Logistics, 31(2), 1-20