APEM journal

Advances in Production Engineering & Management
Volume 18 | Number 1 | March 2023 | pp 104–115
https://doi.org/10.14743/apem2023.1.460

ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

Supply chain game analysis based on mean-variance and price risk aversion under different power structures

Wang, Y.L.[a], **Yang, L.**[a], **Chen, J.H.**[a], **Li, P.**[b,*]

[a]Research Center for Enterprise Management, Chongqing Technology and Business University, Chongqing, P.R. China
[b]Department of Economics and Business Administration, Yibin University, Yibin, P.R. China

ABSTRACT

In view of the random retail price and retailer's preference for retail price risk aversion, we used mean-variance to describe the uncertainty risk of retail price. To study the impacts of both the retail price uncertainty risk and retail price risk aversion preference on supply chain (SC) decision-making, we constructed a SC game model based on three different power structures, including Manufacturer Stackelberg (MS) game, Retailer Stackelberg (RS) game, and Vertical Nash (VN) game. The results showed that the retail price uncertainty risk and the retailer's retail price risk aversion preference weakened the manufacturer's production effort input, decreased the retailer's enthusiasm for ordering, and damaged the interests of manufacturer and retailer. Under the three different power structures, the production effort input of the manufacturer depended on the production effort affecting wholesale price efficiency and retail price efficiency. The retailer's expected utility was largest under the MS game model and smallest under the VN game model. The manufacturer's profits were closely related to each parameter under the three respective power structures. This study provides theoretical guidance for the decision-making of SC enterprises with retail price risk and retailer with retail price risk aversion preference under different power structure situations.

ARTICLE INFO

Keywords:
Supply chain game;
Mean-variance;
Retail price risk aversion;
Different power structures;
Game theory;
Vertical Nash game;
Retailer Stackelberg game;
Manufacturer Stackelberg game

**Corresponding author:*
lznxliping88@126.com
(Li, P.)

Article history:
Received 13 February 2023
Revised 8 April 2023
Accepted 17 April 2023

References

[1] Fang, I.W., Lin, W.-T. (2021). A multi-objective optimal decision model for a green closed-loop supply chain under uncertainty: A real industrial case study, *Advances in Production Engineering & Management*, Vol. 16, No. 2, 161-172, doi: 10.14743/apem2021.2.391.
[2] Meng, J.L. (2021). Demand prediction and allocation optimization of manufacturing resources, *International Journal of Simulation Modelling*, Vol. 20, No. 4, 790-801, doi: 10.2507/IJSIMM20-4-CO20.
[3] Liu, L., Gong, L.J., Shi, W.Q. (2016). Three-stage supply chain coordination of emergency quantity discount contract, *Computer Integrated Manufacturing Systems*, Vol. 22, No. 6, 1600-1608, doi: 10.13196/j.cims.2016.06.022.
[4] Liu, M., Cao, E., Salifou, C.K. (2016). Pricing strategies of a dual-channel supply chain with risk aversion, *Transportation Research Part E: Logistics and Transportation Review*, Vol. 90, 108-120, doi: 10.1016/j.tre.2015.11.007.
[5] Zhou, Y.-W., Li, J., Zhong, Y. (2018). Cooperative advertising and ordering policies in a two-echelon supply chain with risk-averse agents, *Omega*, Vol. 75, 97-117, doi: 10.1016/j.omega.2017.02.005.
[6] Li, X., Qi, X. (2021). On pricing and quality decisions with risk aversion, *Omega*, Vol. 98, Article No. 102118, doi: 10.1016/j.omega.2019.102118.

[7] Wang, R., Zhou, X., Li, B. (2022). Pricing strategy of dual-channel supply chain with a risk-averse retailer considering consumers' channel preference, *Annals of Operations Research*, Vol. 309, 305-324, doi: 10.1007/s10479-021-04326-3.
[8] Li, C.-F., Guo, X.-Q., Du, D.-L. (2021). Pricing decisions in dual-channel closed-loop supply chain under retailer's risk aversion and fairness concerns, *Journal of the Operations Research Society of China*, Vol. 9, 641-657, doi: 10.1007/s40305-020-00324-7.
[9] Cai, J., Sun, H., Hu, X., Jin, K., Ping, M. (2022). Demand information sharing in a two-echelon supply chain with a risk-averse retailer: Retail price decision versus retail quantity decision, *International Transactions in Operational Research*, Vol. 29, No. 6, 3657-3680, doi: 10.1111/itor.13083.
[10] Dai, J.S., Tang, Y.F. (2021). Purchasing and promoting strategies of a risk-averse retailer under delayed payment. *Journal of Industrial Engineering and Engineering Management*, Vol. 35, No. 5, 141-153.
[11] Adhikari, A., Bisi, A., Avittathur, B. (2020). Coordination mechanism, risk sharing, and risk aversion in a five-level textile supply chain under demand and supply uncertainty, *European Journal of Operational Research*, Vol. 282, No. 1, 93-107, doi: 10.1016/j.ejor.2019.08.051.
[12] Liu, Z., Hua, S., Zhai, X. (2020). Supply chain coordination with risk-averse retailer and option contract: Supplier-led vs. retailer-led, *International Journal of Production Economics*, Vol. 223, Article No. 107518, doi: 10.1016/j.ijpe.2019.107518.
[13] Fan, Y., Feng, Y., Shou, Y. (2020). A risk-averse and buyer-led supply chain under option contract: CVaR minimization and channel coordination, *International Journal of Production Economics*, Vol. 219, 66-81, doi: 10.1016/j.ijpe.2019.05.021.
[14] Niu, B., Xu, H., Chen, L. (2022). Creating all-win by blockchain in a remanufacturing supply chain with consumer risk-aversion and quality untrust, *Transportation Research Part E: Logistics and Transportation Review*, Vol. 163, Article No. 102778, doi: 10.1016/j.tre.2022.102778.
[15] Liu, L., Wang, H., Huang, D.H. (2021). Buy-back contracts of retailer risk aversion under asymmetric information of production cost, *System Engineering – Theory and Practice*, Vol. 41, No. 1, 113-123, doi: 10.12011/SETP2019-0535.
[16] Yuan, X., Bi, G., Li, H., Zhang, B. (2022). Stackelberg equilibrium strategies and coordination of a low-carbon supply chain with a risk-averse retailer, *International Transactions in Operational Research*, Vol. 29, No. 6, 3681-3711, doi: 10.1111/itor.13140.
[17] Wan, Y.M. (2021). Amos-based risk forecast of manufacturing supply chain, *International Journal of Simulation Modelling*, Vol. 20, No. 1, 181-191, doi: 10.2507/IJSIMM20-1-CO3.
[18] Sedehzadeh, S., Seifbarghy, M. (2021). Redesigning a closed loop food supply chain network considering sustainability and food banks with different returns, *Economic Computation And Economic Cybernetics Studies And Research*, Vol. 55, No. 4, 85-100, doi: 10.24818/18423264/55.4.21.06.
[19] Gao, Y.Y., Jin, S.Y. (2021). The impact mechanism between the incentive to hold financial assets, financial risk and innovation activities, *Journal of Logistics, Informatics and Service Science*, Vol. 8, No. 2, 80-102, doi: 10.33168/LISS.2021.0205.
[20] Wang, Y.L., Yin, X.M., Zheng, X.Y., Cai, J.R., Fang, X. (2022). Supply chain coordination contract design: The case of farmer with capital constraints and behavioral preferences, *Advances in Production Engineering & Management*, Vol. 17, No. 2, 219-230, doi: 10.14743/apem2022.2.432.
[21] Cachon, G.P., Lariviere, M.A. (2005). Supply chain coordination with revenue-sharing contracts: Strengths and limitations, *Management Science*, Vol. 51, No. 1, 30-44, doi: 10.1287/mnsc.1040.0215.
[22] Wang, Y.-L., Yin, X.-M., Zheng, X.-Y., Chen, W. (2023). Supply chain decision-making considering green technology effort: Effect on random output and retail price with fairness concerns, *Economic Computation And Economic Cybernetics Studies And Research*, Vol. 57, No. 1, 103-120, doi: 10.24818/18423264/57.1.23.07.
[23] Duan, H.W., Wang, M.T., Ye, Y.S. (2022). Financing and information sharing in capital-constrained supply chain, *Advances in Production Engineering & Management,* Vol. 17, No. 3, 263-278, doi: 10.14743/apem2022.3.435.
[24] Xie, G., Yue, W., Wang, S., Lai, K.K. (2011). Quality investment and price decision in a risk-averse supply chain, *European Journal of Operational Research*, Vol. 214, No. 2, 403-410, doi: 10.1016/j.ejor.2011.04.036.
[25] Chiu, C.-H., Choi, T.-M. (2016). Supply chain risk analysis with mean-variance models: A technical review, *Annals of Operations Research*, Vol. 240, No. 2, 489-507, doi: 10.1007/s10479-013-1386-4.