How to empower commercial satellite supply chain:Insurance, government subsidy or blockchain adoption?

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Abstract

The burgeoning commercial satellite industry faces the risk of launch failures, posing substantial financial losses for vehicle manufacturers and satellite operators. To mitigate these risks and reduce costs, industry stakeholders commonly seek launch insurance from financial institutions and explore government-backed subsidy programs. Recently, the adoption of blockchain technology within satellite launch supply chains has emerged as a promising solution to enhance data sharing and workflow efficiency, thereby minimizing launch risks. However, limited research exists on the decision-making processes and interactions among industry players, as well as the potential empowerment of the satellite supply chain (SSC) through insurance, government subsidies, or blockchain technology. This paper presents several Stackelberg game models to investigate various SSC scenarios: launch insurance (Model I), insurance and government subsidies (Model IG), blockchain-embedded insurance (Model B), and blockchain-embedded insurance with government subsidies (Model BG). The models are formulated to derive optimal expressions for launch prices, satellite data retail prices, and the effort required to improve launch success probabilities. Additionally, this study explores the optimal allocation conditions for government subsidies and determines the cost thresholds for adopting blockchain technology through an analysis of equilibrium outcomes. The analysis reveals that government subsidies should be directed towards satellite operators employing cost-effective launch vehicles, rather than offering unconditional subsidies. This approach creates a virtuous circle (improve the successful launch probability), leading to an optimal allocation of funds. Furthermore, the findings indicate that while government subsidy programs may not directly benefit consumers,

the adoption of blockchain technology has positive implications. Once blockchain technology is integrated, launch prices may rise, vehicle manufacturers may exert more effort, and premium rates may decrease as launch missions become more efficient and credible. Moreover, the implementation of blockchain technology under government subsidies generates positive spillover effects, mitigating the upward momentum of launch prices. Additionally, the study highlights that when satellite operators choose cost-effective launch vehicles, the cost advantage of blockchain-embedded platforms benefits all participants. The implications of these findings for the commercial space launch market are discussed in detail.

Once blockchain technology is adopted, launch prices will go up, the vehicle manufacturer will exert more effort, and the premium rate will decrease as the launch missions become more efficient and credible. Besides, adopting blockchain technology under government subsidies has a positive spillover effect. Specifically, it will weaken the up forward momentum of the launch price. Moreover, when the satellite operator chooses an inexpensive launch vehicle, the cost-advantage blockchain-embedded platform benefits all participants. Besides, the adoption of blockchain technology can also improve the benefits from government subsidies. Moreover, when the satellite operator chooses an inexpensive launch vehicle, the cost-advantage blockchain-embedded platform benefits all participants. Finally, coupling these findings, we further discuss the managerial implications for the commercial space launch market.

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