The Impact of First Mover Advantage on Business Model Innovation in SMEs

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Abstract. While empirical studies highlight knowledge's role in SME innovation, how SMEs leverage knowledge through first-mover advantage for business model innovation remains underexplored. This study constructs a tripartite evolutionary game model incorporating competitors and customers to capture the dynamic adjustments of first-mover advantage under market uncertainty. Findings suggest that emphasizing first-mover advantage through alternative strategic logic facilitates business model innovation and enriches innovation theory. The model not only aids decision-making but also clarifies coordination mechanisms in uncertain markets, with simulations helping managers grasp the dynamic interactions essential for innovation.

Keywords: First Mover Advantage, Business Model Innovation, Evolutionary Game Theory.

1 Introduction

Business model innovation needs the right strategic positioning, but this is hard for SMEs because positioning depends on pre-launch forecasts of market conditions. Strategic positioning means choosing which activities to do [1-3], and it is affected by market uncertainty. More uncertain markets require more knowledge to turn inputs into accurate forecasts. Positioning also decides what market knowledge is needed to make forecasts and handle uncertainty [4-6].

Past research shows that good positioning increases success. Even innovative firms can fail with bad positioning [3,7]. Some studies look at internal capabilities [8-11], others at incumbents using low costs and subsidies [6,12-14]. But they don't explain how firms find optimal positioning from the start, or how to gain first mover advantage, especially for SMEs. We fill this gap by studying how first mover advantage affects initial business model innovation.

First mover advantage is very hard for SMEs because they face technological and market dilemmas [6,15,16]. SMEs lack knowledge resources for first mover advantage. They enter late and struggle to compete with incumbents. Customers prefer incumbents, which strengthens incumbents' barriers to entry [12,17]. SMEs need market knowledge to

P. S. Borah et al. (eds.), *Proceedings of the 2026 6th International Conference on Enterprise Management and Economic Development (ICEMED 2026)*, Advances in Economics, Business and Management Research 394,
https://doi.org/10.2991/978-94-6239-719-4_44

manage forecasts and positioning [12], but they have far fewer knowledge resources than incumbents.

Recent studies say SMEs should differentiate knowledge inside and outside the firm [4,8,12]. But they don't show how integrating knowledge leads to first mover advantage when SMEs face both dilemmas. We examine how knowledge flows affect initial first mover advantage. Using evolutionary game theory, we build a tripartite game model (SMEs, competitors, customers) to study dynamic adjustments to market uncertainty.

2 Model Framework

SMEs can adopt either an effectuation or causation orientation in their initial strategic positioning. Effectuation prioritizes exploration and control over planning, using "effect-dependent" means and innovating amid market uncertainty. Causation, an alternative approach, focuses on innovating based on existing knowledge resources. Both orientations benefit all SMEs, whether their goals are technology-led, market-led, or both. However, how to improve competitiveness for technology- and market-oriented SMEs by applying internal or newly acquired external knowledge remains a considerable debate.

Competitors have idiosyncratic knowledge to improve innovation capability and provide attractive product to customers who have increasing brand loyalty and are growing into a bigger group. They are confident that SMEs who faces both technological and market dilemmas do not pose a significant threat to them, regardless of the strategies employed. Such consideration helps to explain why competitors adopt the ignoring strategy. Another important reason is that competitors are not aware of the threat at all. For decreasing the possibility of competitors putting obstructions during business model innovation progress, SMEs consciously hide their competitive intentions and behaviors [9], so that competitors will not perceive risk from competitors in the market.

In line with the findings of previous studies, the relationships among SMEs, competitors and customers are considered significant since they do have a direct influence on SMEs' business model innovation process [3, 14]. Previous literatures do not accurately capture actual conditions that need to be revealed for SMEs to launch an appropriate first mover advantage. How this relationship works and affects each other is a dynamic evolution process. This research issue should be further investigated.

3 Model Formulation

3.1 Theorical Hypothesis

Assumption 1. We assume that SMEs, competitors and customers are capable of learning and making decisions that potentially result in maximum benefits.

Assumption 2. Every participant has two pure strategies. SMEs have effectuation strategy and causation strategy. Competitors have restriction strategy and ignoring strategy. Customers have information supplying strategy and non-information supply-

ing strategy. Then x, y and z are the representatives of the probability when three participants choose first strategy, and x, y and z are functions of time t and $x, y, z \in [0, 1]$.

Assumption 3. Selecting effectuation strategy, SMEs will take C as cost but attain extra benefit (ΔP_1 or ΔP_2) ($\Delta P_1 \geq \Delta P_2 \succ 0$) that is slightly different under different scenarios.

Assumption 4. If customers select information supplying strategy, customers would gain ΔP_3 ($\Delta P_3 \succ 0$) as their payoff and take S_2 ($S_2 \succ 0$) as their loss when SMEs choose to take causation strategy. In addition, if customers select non-information supplying strategy, it incurs external loss ΔS ($\Delta S \succ 0$).

Assumption 5. If competitors select ignoring strategy, they will take S as loss with a slight fluctuation under different scenarios.

(1) If SMEs select effectuation strategy and customers select non-information supplying strategy, the loss is S_1 ($S_1 \succ 0$).

(2) If SMEs select market orientation strategy and customers select information supplying strategy, the loss is S_3 ($S_3 \succ 0$).

Assumption 6. If competitors select restriction strategy, they will gain extra benefit (ΔP_4 or ΔP_5) ($\Delta P_4 \geq \Delta P_5 \succ 0$)as their payoff but take αm as cost through restricting access to technology, patent etc., otherwise taking βn as cost through restricting access to customers. ($\alpha + \beta = 1$, $\alpha \in [0, 1]$, $\beta \in [0, 1]$, $m \succ 0$, $n \succ 0$).

3.2 Payoff Matrix and the Evolutionarily Stable Strategy

For SMEs, the expected payoff of selecting the causation strategy is:

$$E_{11} = P - y\alpha m - zy\beta n,$$

the expected payoff of selecting the effectuation strategy is:

$$E_{12} = P - C + (1 - y)\Delta P_1 + z\Delta P_2.$$

For competitors, the expected payoff of selecting the restriction strategy is:

$$E_{21} = P_1 - \alpha m - z\beta n + x(1 - z)\Delta P_4 + xz\Delta P_5,$$

the expected payoff of selecting the ignoring strategy is:

$$E_{22} = P_1 - xS_1 + xzS_1 - xzS_3.$$

For customers, the expected payoff of selecting the information supplying strategy is:

$$E_{31} = y\beta n + x(P_2 + \Delta P_3) + (1 - x)(-S_2 - \Delta S),$$

the expected payoff of selecting the non-information supplying strategy is:

$$E_{32}=xP_2+(1-x)(-S_2).$$

Finally, the average expected payoff is:

$$E_i=pE_{i1}+(1-p)E_{i2},\ i=1,2,3.$$

In the end, the replicator dynamics equations of each player derived from calculating the expected payoff are shown as follows:

$$\begin{cases} U_1=x(1-x)[C-y\alpha m-zy\beta n-\Delta P_1+y\Delta P_1-z\Delta P_2] \\ U_2=y(1-y)[x(1-z)(\Delta P_4+S_1)+xz(\Delta P_5+S_3)-\alpha m-z\beta n] \\ U_3=z(1-z)[y\beta n+x\Delta P_3-(1-x)\Delta S] \end{cases}$$

For SMEs, there are two equilibrium points in the replicator dynamics, x=0 and x=1. When $C-y\alpha m-zy\beta n-\Delta P_1+y\Delta P_1-z\Delta P_2=0$, $U_1=U_1'=0$, this means that x is stable for any value. No matter what SMEs choose, the system is stable. When $C-y\alpha m-zy\beta n-\Delta P_1+y\Delta P_1-z\Delta P_2\neq 0$, the two game equilibriums of latecomers are x=0 and x=1. According to evolutionary game theory, when $C+y\Delta P_1\succ y\alpha m+zy\beta n+\Delta P_1+z\Delta P_2$, then $U_1'|_{x=0}\succ 0$ and $U_1'|_{x=1}\prec 0$, the equilibrium point of SMEs is x=1. On the other hand, when $C+y\Delta P_1\prec y\alpha m+zy\beta n+\Delta P_1+z\Delta P_2$, the equilibrium point of latecomers is x=0.

For competitors, there are two equilibrium points in the replicator dynamics, y=0 and y=1. When $x(1-z)(\Delta P_4+S_1)+xz(\Delta P_5+S_3)-\alpha m-z\beta n=0$, $U_2=U_2'=0$; this means that y is stable for any value. When $x(1-z)(\Delta P_4+S_1)+xz(\Delta P_5+S_3)-\alpha m-z\beta n\neq 0$, the two game equilibriums of competitors are y=0 and y=1. When $x(1-z)(\Delta P_4+S_1)+xz(\Delta P_5+S_3)\succ\alpha m+z\beta n$, then $U_2'|_{y=0}\succ 0$ and $U_2'|_{y=1}\prec 0$, the equilibrium point of competitors is y=1. On the other hand, when $x(1-z)(\Delta P_4+S_1)+xz(\Delta P_5+S_3)\prec\alpha m+z\beta n$, the equilibrium point of competitors is y=0.

For customers, there are two equilibrium points in the replicator dynamics, z=0 and z=1. When $y\beta n+x\Delta P_3-(1-x)\Delta S=0$, $U_3=U_3'=0$; this means that z is stable for any value. When $y\beta n+x\Delta P_3-(1-x)\Delta S\neq 0$, the two game equilibriums of customers are z=0 and z=1. According to evolutionary game theory, when $y\beta n+x\Delta P_3\succ(1-x)\Delta S$, then $U_3'|_{z=0}\succ 0$ and $U_3'|_{z=1}\prec 0$, the equilibrium point of customers is z=1. On the other hand, when $y\beta n+x\Delta P_3\prec(1-x)\Delta S$, the equilibrium point of customers is z=0.

4 Simulation Test and Sensitivity Analysis

4.1 Simulation Test

Adjusting the probabilities of SMEs, competitors, and customers adopting effectuation, restriction, and information supplying strategies, competitor choices are more influenced by SMEs and customers, leading to a complex dynamic evolution shaped by the equilibrium of SME and customer strategies. Customers increasingly supply information regardless of market conditions. SMEs prefer effectuation, especially when customers supply information. Thus, for latecomers, integrating external knowledge from dynamic markets is more effective for business model innovation than relying solely on internal resources, better matching innovation speed with market adjustments and enabling rapid responses to uncertainty.

4.2 Sensitivity Analysis

In summary, we examine sensitivity analysis results of parameter α, parameter C and parameter S_3. The simulation diagrams are formed and showed the same ESS and similar trajectory with the main simulation test results. Even if the value of parameter α, parameter C and parameter S_3 were subjected to extreme conditions, the ESS of the triple game model and its evolutionary trajectory still followed our expectations. Consequently, all results of sensitivity analysis support the validity and robustness of our findings.

5 Conclusion and Discussion

First, SMEs favor effectuation strategies as they efficiently integrate external knowledge, boosting competitiveness and market responsiveness. This preference also encourages customer information sharing, clarifying why SMEs adopt such strategies. Second, competitors face more complex positioning, needing to consider both SMEs and customers. Importantly, competitors' potential losses alter the evolutionary game's dynamics and stability. SMEs can leverage these losses to design dynamic, flexible positioning and drive business model innovation.

The research issue is novel and important for managerial studies, though empirically challenging. Our study finds limited empirical support for the complex relationships among SMEs, competitors, and customers. The theoretical hypotheses are derived from practical observations; future work could use a theoretical model to shape them. Additionally, the tripartite game model of SMEs' first-mover advantage and adjustments is dynamic, as many factors influence participants' strategic positioning and evolutionary trajectories. Although we aimed to identify an appropriate strategic positioning for SMEs to achieve business model innovation initially, unobserved variables may still affect the positioning of all parties. Thus, future research should refine the model by optimizing the hypotheses and incorporating additional variables.

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