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## **REVISITATION TO R&D MARKET FAILURE WITH SPILLOVER EFFECTS: A REAL OPTION GAME APPROACH**

### **Abstract:**

One of the main topics regarding R&D investment in economics is "R&D market failure". This is imputed that knowledge, which is the primary output of R&D, has spillover effects due to its public-good-like properties. It cause incomplete appropriability of innovating firm and will lead the underprovision of R&D investment in the economy which hinders the process of economic growth as a result. To explain and find solutions for R&D market failure, spillover effects generated in R&D should be thoroughly analyzed. Following earlier literatures on R&D spillovers, we consider two dimensions of spillovers in R&D simultaneously. First one is related to input-side knowledge spillover and second one is related to output-side knowledge spillover. The former implies that information about research activities at one firm may trickles out and influences the research activities of other firms. They are different in affecting incentives to invest in R&D. To consider both spillover effects concurrently, we take real option game approach which can be used to analyze situations with combined strategic interactions among players and uncertain environment. As a benchmark, we first derive an optimal R&D investment rule of a monopolist. Next, we derive an optimal R&D invest rule of a duopolist. To compare both of them, we can find how incomplete appropriability problem of R&D investment is affected by two dimensions of spillover effects. Further, we can derive policy implications such as private R&D investment is stimulated if input-side or output-side spillovers could be mitigated.

### **Keywords:**

R&D market failure, Knowledge spillovers, Real options game