A Theory on R&D Investment Dynamics Under Optimal Effort Allocation*

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Abstract

We introduce a two-step model to study the investment dynamics of R&D investments. Entrepreneurs follow sequential decisions: first, they decide how to allocate effort towards short-term assets and a long-term R&D project; second, they decide the optimal timing to invest in the R&D project. Our model endogenously shows that the investment decision, in non-extreme events, is state-dependent so that it provides an additional explanation for the cyclical nature of R&D investment. This life-cycle hypothesis explains why firms tend to invest less in R&D as they mature. We then study which factors govern this hypothesis. We find that uncertainty amplifies the life-cycle hypothesis which corroborates the evidence that the life-span of firms operating in volatile industries is shorter than for firms in less volatile industries. We also retrieve that the effort allocation decision smooths out the positive relationship between the investment trigger and market uncertainty. We conclude that one-dimensional investment real options models exaggerate the influence of uncertainty in the investment trigger, by ignoring the role of the effort allocation decision. We then analyze individually how the quality of the innovation, technical uncertainty and the managing skills of entrepreneurs affect both the effort allocation and the investment decision, as well as its influence on the life-cycle hypothesis. These conclusions spawn important policy implications on how can firms try to counter the life-cycle trap.

Keywords: Real options; Effort Allocation; Investment Timing; Uncertainty; Business Life-Cycle; Innovation.
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