

# RESEARCH STATEMENT

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Innovation is probably the most misused buzzword of the decade. Politicians, executives, commentators, and scholars use it as a panacea for all problems. Unfortunately, it is not a free lunch. Fostering a technology breakthrough at least requires two successful decisions: pipeline development and fundraising. However, our knowledge of them is still limited. My research focuses on the entrepreneurial management of innovation in a world with financial frictions, through both theoretical and empirical lenses.

The highlighted friction is information asymmetry. To many investors, new technologies are mysterious alchemy. So there is always a fear of scams and bubbles. We do not want the innovative sector to be a lemon market, which requires informed participants to send signals. However, some strategies generate deadweight losses, for example, cash burning and price war. I focus on choices that improve efficiencies and reduce uncertainties at the same time.

One difficulty of studying innovation is that we do not have accurate measures of innovative activities. Traditional literature either uses R&D expenditure from Compustat or patent citations. Both of them are not perfect (Koh and Reeb, 2015; Kogan et al., 2017). I overcome this problem by focusing on the healthcare industry. The detailed micro-level data document when firms initiate, acquire and suspend drugs in development. Such information helps researchers inspect actual decisions when developing pipelines.

Lastly, pipeline development and fundraising do not operate in isolations. Instead, firms jointly make optimal decisions. The venture capital (VC) industry is an excellent example to study their interactions. The incentives of VCs do not always align with the entrepreneurs, which sometimes hurts the innovative progress.

## SIGNALING

Although the Economist may be making a bold statement when saying “Signalling explains all kinds of behaviour”,<sup>1</sup> there is no denying that information asymmetry is a major obstacle for innovation.

Existing M&A literature focuses on acquisitions by large public companies. However, deals by private acquirers comprise the majority of M&A activities but exhibit very different patterns from the public ones. My job market paper, “*The Race of Unicorns: A Signaling Story of Private Acquisitions*”, presents a tractable dynamic model to explain private deals. I establish two main results. First, acquisitions represent efficient assets reallocations as only the more productive firms will acquire. Second, the occurrence of acquisitions is delayed and even prevented by information imperfections. This theoretical framework not only reconciles

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<sup>1</sup>Secrets and Agents, *The Economist*, July 2016.

the distinct patterns but also generates a novel prediction on the signaling effect of private M&As. I further document empirical evidence in support of this new effect.

The conventional wisdom is that entrepreneurs have private information about their technologies and abilities. We may be understating the flip side of the story. Many investors are veterans in the technology sectors, and their experience helps them evaluate the startup’s viability. How can they credibly deliver their assessment? In a project with Martin Szydlowski, we study a setting in which a financially constrained VC privately learns the survival rate of an experimentation project and then designs contracts with the startup manager. Signaling through milestone payments, though feasible, is too costly. Therefore VCs with different priors will offer the same pooling contracts. A deep-pocketed VC, however, can signal either with cash payouts or pivoting the startup operation.

## R&D STRATEGIES

We see a growing literature in finance and management utilize the institutional settings and data availability in the pharmaceutical industry. I contribute to this literature by studying the feedback effects of the downstream product market on the upstream R&D decisions.

In “*Find and Replace: R&D Investment Following the Erosion of Existing Products*”, joint with Joshua L. Krieger and Richard T. Thakor, we investigate how innovative firms respond to sudden adverse product shocks. Our identification exploits the institutional design of FDA Public Health Advisories, which exogenously reveals previously unknown severe side effects of drugs. We show that adverse product market shocks lead affected firms to increase R&D expenditures. Inspecting their research pipeline, we find that these firms allocate the investments to acquiring external innovation, rather than developing novel drugs internally.

There is a long debate on how the degree of competition in product markets affects the incentives to engage in innovations (Aghion et al., 2005). This question has regulatory implications as policies on the generic entries have substantial impacts on our welfare. In a joint project with Andrew W. Lo and Richard T. Thakor, “*The Crowding out Effect of Strategic Settlements*”, we explore how innovative firms respond to competitive pressures when they can use “pay for delay” strategies. This pathway enables them to lure potential entrants into suspending competing products. We show that such strategies dampen innovation incentives as firms are less concerned about entrant threats.

## VC INDUSTRY

VCs contribute to the majority of technology IPOs (Kaplan and Lerner, 2010). However, their financing process may still have efficiency losses, especially when their incentives do not perfectly align with the entrepreneurs. In “*Do Venture Capitalists Stifle Competition?*”, which is joint work with Tong Liu and Lucian A. Taylor, we find that 39% of startups share a VC with a close competitor. This common ownership stifles *ex post* innovation competition. After a startup sees a close competitor make progress on a new drug project, the startup is less likely to advance its project. The channel we document is that VCs cut off follow-up funding on the lagging startup, which creates a hold-up effect. These anticompetitive effects, however, are concentrated in markets with few competitors, VCs with larger equity stakes, and projects with similar technologies.

For VCs, the role as a “scout” receives much less academic attention compared to the role as a “coach”. However, fishing in a better pond can make as much, if not more, difference as being a better fisherman. The project, “*Secret Scouting*” (with Fangyuan Yu), focuses on the fact that VCs prefer secrecy when searching for targets. As a result, only the investments in viable startups are disclosed, but the failed ones are discarded silently. We extend the standard preemption game to explain the efficiency loss and the individual rationale of doing so. We show that secrecy creates pessimism. Compared to the fully disclosing case, VCs will stop hunting for startups too early in an initially promising industry. This could happen even if no technology failures are observed in realization. However, hiding failures becomes a dominant strategy when the return of the VC industry is right-skewed. VCs use secret scouting to make the competitors believe that the industry is a dead end and reduce the preemption threats.

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