

Real Options Theory in Venture Capital: Case Analyses of Moderna, CureVac, Meituan, and ofo

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Abstract

This paper applies Real Options Theory (ROT) to analyze venture capital (VC) decision-making under uncertainty, reframing financing rounds, staged commitments, and exit timing as embedded options. Using a comparative case study of four ventures—Moderna, CureVac, Meituan, and ofo—the analysis contrasts deep-tech and replication-based models to show how timing and optionality drive divergent outcomes. The findings generate a novel typology: deep-tech ventures reward long-horizon growth and deferred exit strategies, while replication ventures require timely exercise or abandonment to avoid rapid value erosion. This typology underscores the practical importance of aligning fund structures with venture volatility, offering a theory-driven lens for capital-efficient growth and the disciplined management of high-risk innovation portfolios.

Keywords

Real Options Theory, Venture Capital, Fund Structure, Exit Strategy

1. Introduction: Real Options Theory in Venture Capital

Real Options Theory (ROT) provides a framework for valuing and managing investments under uncertainty by modeling managerial decisions as options (**Figure 1**). Instead of committing all capital upfront, investors can stage investments and maintain flexibility, analogous to holding financial options that can be exercised or abandoned as conditions evolve. In essence, a venture capitalist has the right but not the obligation to undertake further investment—akin to a call option to

expand—or to halt a project—akin to a put option to abandon—as new information emerges. This is especially relevant in venture capital, where each financing round offers a chance to reassess progress. By embedding real options—such as the ability to exercise a call option, defer investment, or exercise an abandonment option—investors can adapt to the high-uncertainty environments common in technology ventures.

In ROT, a call option refers to the investor's right to increase their commitment when early signs are positive, such as advancing to a new funding round or scaling operations. A put option allows the investor to withdraw support or abandon the project when negative signals emerge, limiting downside risk. These core mechanisms allow for adaptive decision-making and underpin the staged investment logic of many venture capital strategies.

While ROT has been widely applied to corporate capital budgeting and R&D decisions, its application to venture capital (VC) remains underdeveloped. Existing ROT literature has mostly focused on strategic investments in large firms, often overlooking the unique temporal dynamics of early-stage financing environments. In contrast, much of the VC literature emphasizes valuation methods, founder selection, or fund performance, but often lacks theoretical support and fails to manage timing and exit mechanisms as flexible, staged decisions under uncertainty. This paper addresses this shortcoming by reframing VC financing rounds and exit mechanisms as embedded real options—specifically, growth options, abandonment options, and extension options. Through a comparative analysis of a set of deep tech and replicator firms, this study constructs a typology that links firm types to optimal option exercise strategies, providing conceptual insights and practical guidance for investors operating in turbulent innovation ecosystems.

In the following sections, we first outline the theoretical framework and methodological approach, and then apply ROT to four venture capital cases: two deep-tech biotechnology projects (Moderna and CureVac) and two market-replication platform projects (Meituan and ofo). In the deep-tech cases, uncertainty is extreme and development timelines are long, highlighting the value of holding options until pivotal breakthroughs occur. In contrast, the replication cases involve rapid market expansion and fierce competition, underscoring the importance of exercising options—such as exiting an investment—at the right moment. Each case illustrates how interpreting investment decisions as real options helps explain the venture's ultimate success or failure (**Figures 1-6**).

The contribution of this article to the theory of venture capital real options:

- It reframes VC financing rounds and exit decisions as embedded real options, offering a structured interpretation of strategic flexibility under uncertainty.
- It constructs a comparative typology linking venture type (deep-tech vs. replication) to optimal option strategy (hold, defer, exit).
- It demonstrates that real options logic can explain not only when to invest, but also when to abandon or delay, which is often underexplored in traditional VC literature.

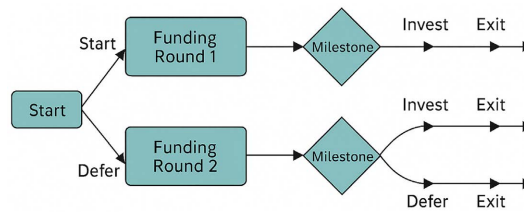


Figure 1. Real Options-based Staged Investment Decision Framework. Each funding round is treated as a decision node, where investors may exercise a growth option (invest), abandon the project (exit) or defer commitment. This structure underlies the ROT analysis used throughout the case studies.

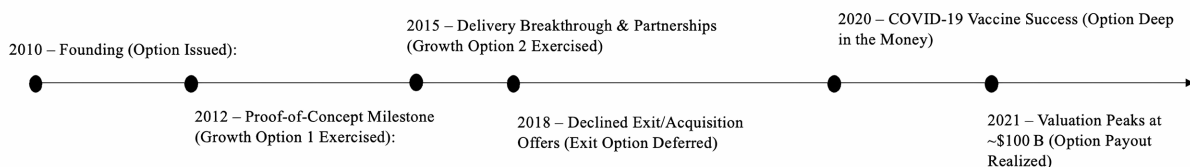


Figure 2. Timeline of Moderna’s staged investment milestones and corresponding real options decisions. Each point represents a key inflection in scientific development or funding commitment, mapped to an ROT concept such as option issuance, growth option exercise, exit deferral, or payoff realization.

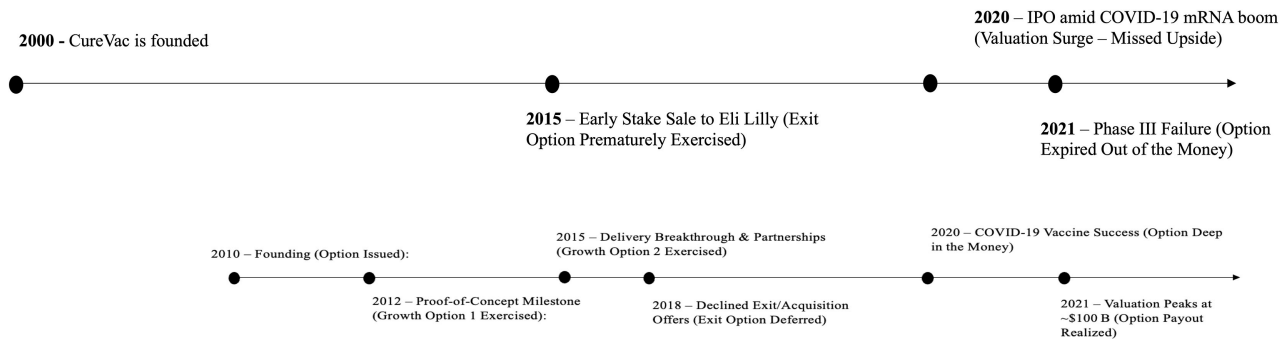


Figure 3. Comparative timelines of Moderna and CureVac, mapping key investment milestones to real option behavior. While Moderna’s path reflects a staged investment strategy aligned with ROT principles—exercising growth options and deferring exit—CureVac’s investors exited prematurely, forfeiting time value and exposure to later information events.

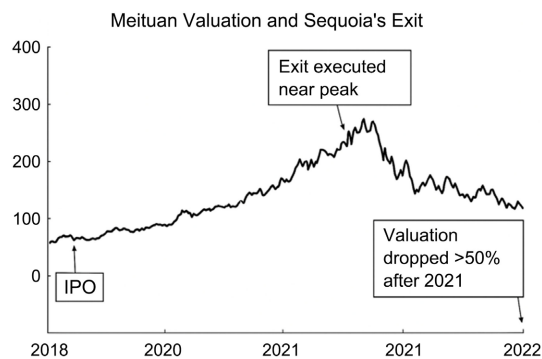


Figure 4. Meituan valuation timeline from IPO to post-2021 downturn, overlaid with Sequoia Capital’s staged exit window. The diagram illustrates how Sequoia exercised its exit option near the valuation peak, thereby avoiding a sharp drawdown during China’s regulatory crackdown.

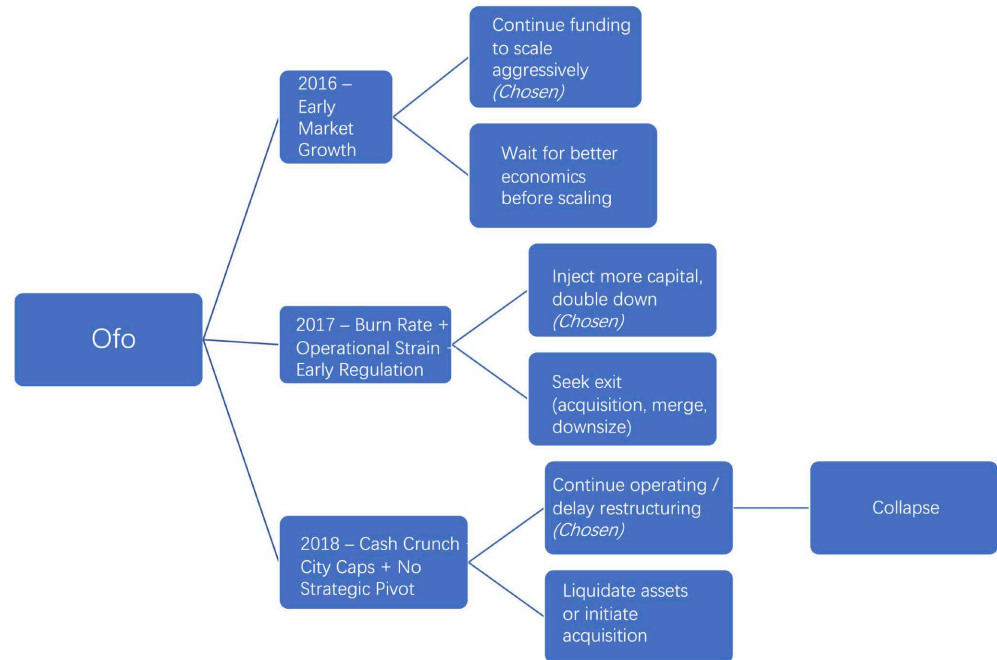


Figure 5. Decision tree illustrating ofo’s investment trajectory from 2016 to 2018 through the lens of ROT. Each decision point is mapped to a specific real option: exercise of a growth option (continued funding), exercise of an abandonment option (exit), or option deferment (delaying additional capital). The tree shows that investors repeatedly chose to exercise the growth option despite mounting negative signals, ultimately allowing the opportunity to abandon the project to lapse, resulting in a total write-off.

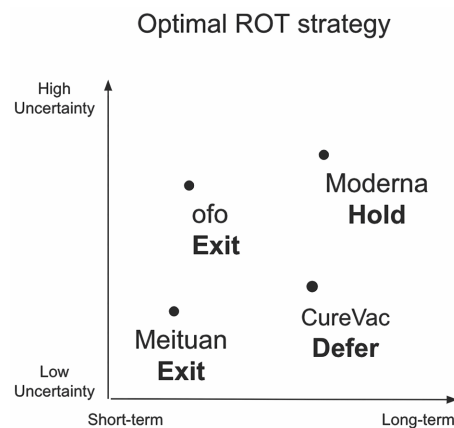


Figure 6. Maps four venture cases—Moderna, CureVac, Meituan, and ofo—across two axes: time horizon and uncertainty level. Moderna, positioned in the long-term and high-uncertainty quadrant, exemplifies a “deferred exit, staged growth” strategy. CureVac, while similarly long-term, exited prematurely and missed potential upside. Meituan, with a short horizon and lower uncertainty, succeeded through a timely exit. In contrast, ofo failed to abandon its position in a high-uncertainty, short-term context, leading to a total loss. The chart highlights how aligning venture type with real-options strategy is critical for investment outcomes.

- It provides a decision-making lens that integrates timing, optionality, and fund structure alignment—filling a theoretical gap between static valuation models

and dynamic strategic behavior.

In contrast to conventional VC models that treat timing as exogenous or fund-driven, this real options approach frames investment as an active, adaptive process—enabling investors to reassess at each stage and manage high uncertainty with disciplined optionality.

2. Theoretical Framework: Applying Real Options to Venture Capital

We now turn to the theoretical foundations of this analysis. Building on the overview provided in the introduction, this section elaborates on the theoretical underpinnings of ROT as applied to venture capital. ROT originates from financial options theory but extends its logic to real-world investment decisions where managers retain flexibility under uncertainty. Unlike static net present value (NPV) approaches, ROT explicitly values the ability to revise or defer commitments based on evolving information. In doing so, it provides a dynamic lens for understanding strategic behavior in high-risk environments such as early-stage investing.

Within this framework, a call option represents the opportunity to deepen financial commitment when a project shows favorable progress. For example, a Series A investment might grant the investor an implicit call option to participate in the Series B round conditional on milestones being met. Conversely, a put option reflects the investor's ability to abandon a project or decline further funding when signals turn negative. The investor thereby limits downside exposure while preserving the upside through selective continuation. ROT thus encourages contingent, staged commitments that mirror the inherently uncertain and path-dependent nature of venture development.

These principles are particularly salient in VC settings, where investment unfolds through rounds, each acting as a decision node. At every stage, investors must evaluate whether to “exercise” their option to continue, “defer” in the face of ambiguity, or “abandon” to cut losses. As we will explore in the following case studies, ROT offers a structured vocabulary and framework for interpreting why certain decisions—such as holding on through a long R&D cycle, exiting prematurely, or failing to abandon a failing venture—led to divergent outcomes. It also sharpens our understanding of timing, optionality, and the discipline required for capital-efficient growth.

These principles are rooted in the foundational work of [Dixit and Pindyck \(1994\)](#), who developed a comprehensive framework for investment under uncertainty. Their formulation of real options emphasizes the value of managerial flexibility in the face of irreversible investment decisions, especially when future outcomes are highly uncertain. Unlike static NPV approaches that assume a one-time, all-or-nothing commitment, their model underscores the strategic importance of deferring, expanding, or abandoning projects based on updated information. This insight directly informs the venture capital context, where staged financing mimics the dynamic option valuation structure that Dixit and Pindyck

articulated. In early-stage investing, each funding round can be seen as an opportunity to either “exercise” a growth option or “abandon” when the investment is no longer favorable—precisely the type of contingent decision-making their theory models.

3. Methodology

Having established the theoretical framework, we now outline the comparative case study methodology used to examine real-options behavior in different venture types. This paper adopts a comparative case study methodology to explore how ROT can illuminate patterns in venture capital decision-making across different strategic contexts. Case study methods are particularly suited for theory-driven inquiry in complex, uncertain environments where the full range of variables cannot be experimentally controlled. By applying a consistent theoretical lens to multiple real-world examples, this approach enables grounded, context-sensitive interpretation while retaining analytical coherence.

The analysis focuses on four venture capital cases selected to illustrate divergent outcomes within two archetypal investment models. The first pair—Moderna and CureVac—represents deep-tech biotechnology ventures characterized by high technical uncertainty and long development cycles. To be more specific, it centers on novel technologies with high technical uncertainty and long development cycles. Value derives from intellectual property and barriers to replication. In ROT terms, they emphasize growth options through staged R&D and abandonment options if technical hurdles prove insurmountable. The second pair—Meituan and ofo—represents consumer-facing platform ventures based on replicating existing models with rapid market execution. Thus, Replication-Based Venture Adapt proven business models with low technical but high market and competitive risk. Success depends on execution speed, scaling, and network effects. In ROT terms, they highlight timing options to capture market share early and switching/abandonment options if competition erodes viability. Each category includes one case of strategic success and one of strategic failure. This structure allows for controlled comparison within and across venture types, enabling clearer identification of how staged decision-making aligned—or failed to align—with ROT principles such as timing, optionality, and abandonment.

Case selection was based on four criteria: 1) representativeness within their respective venture typologies; 2) availability of reliable public data on funding rounds, milestones, and outcomes; 3) clear resolution of the venture’s trajectory (e.g., IPO, acquisition, shutdown); and 4) relevance to strategic timing decisions. All case information was drawn from publicly accessible sources, including investment databases (e.g., Crunchbase), press releases, company filings, and secondary reporting. Though less generalizable, this theory-driven approach yields rich insights into how real investment decisions align—or conflict—with ROT (**Figure 5**).

For the data validation approach. Case data was primarily sourced from Crunch-

base and cross-checked with company filings (e.g., Hong Kong SAR Exchanges and Clearing Limited), investor press releases, and financial media such as Bloomberg and Reuters. Qualitative insights were triangulated with public statements and secondary reports to ensure reliability and consistency.

4. Case Analysis

We now turn to the comparative case studies, applying the ROT framework to four ventures—Moderna, CureVac, Meituan, and ofo—to investigate how timing and optionality shaped investment outcomes.

Moderna: Staged Investment as a Long-Term Real Option

Moderna (2024) reports that a pioneer in mRNA therapeutics exemplifies how venture capital can function as a series of staged call options on a platform technology. Founded in 2010, the company spent years developing a novel mRNA delivery system amid significant scientific and regulatory uncertainty. Flagship Pioneering, the founding venture investor, approached the investment as a portfolio of real options rather than a single-point bet. At each inflection point, Flagship evaluated whether to expand its commitment—effectively treating each funding round as an opportunity to exercise an embedded growth option contingent on reduced uncertainty.

The 2012 proof-of-concept milestone marked the first major decision node, at which Flagship exercised its initial growth option by providing continued funding after early signs of scientific viability. A second key moment came in 2015, when Moderna achieved a breakthrough in delivery mechanisms and secured major research partnerships with AstraZeneca and DARPA. These milestones reduced technical and commercial risk, justifying the sequential exercise of additional options to expand investment. Each round of funding represented a contingent, stage-gated commitment aligned with ROT principles, where capital was deployed only after prior sources of uncertainty were partially resolved.

Critically, Flagship showed restraint by deferring its implicit exit option in 2018 despite unsolicited acquisition offers. Choosing to defer the exit—analogue to holding a valuable put option rather than locking in a capped gain—reflected a strategic judgment that the upside potential had not yet been fully realized. This patience was ultimately rewarded: in 2020, Moderna's COVID-19 vaccine succeeded clinically and commercially, unlocking exponential value and driving the company's market capitalization above \$100 billion by mid-2021. The underlying ROT logic helps explain this outcome: in high-volatility, high-uncertainty contexts, the optimal strategy is often to hold until a decisive information event resolves ambiguity and propels valuation.

To support the preceding analysis, **Figure 2** summarizes Moderna's staged investment process as a sequence of real option decisions. Each milestone—whether scientific, commercial, or strategic—served as an informational checkpoint. Funding rounds were exercised as growth options following reduced uncertainty, while the choice to delay exit in 2018 illustrates a deferred put option. The timeline high-

lights how patience and strategic optionality, rather than early liquidation, allowed investors to fully capture the asymmetric upside of a breakthrough platform.

Moreover, Flagship's fund structure was integral to enabling this strategy. As an evergreen fund without fixed-term pressure, it had the structural flexibility to delay exit and continue exercising growth options over an extended horizon. Had Flagship operated under a conventional 10-year venture fund, it may have been forced to exit prematurely, potentially in 2018 when Moderna remained pre-revenue and high-risk. By contrast, its long-term holding strategy illustrates how real options logic—combined with structural patience—can convert radical scientific uncertainty into asymmetric payoff.

A common critique is that Flagship's success with Moderna may appear to be hindsight bias, with the COVID-19 pandemic serving as an exogenous tailwind (Loftus, 2022). However, ROT addresses this by emphasizing optionality over prediction. Flagship did not bet on COVID-19; it accumulated time-sensitive exposure to a platform with multiple potential applications—each an option in its own right. The pandemic merely accelerated one option into the money. Others, such as oncology or personalized vaccines, could have matured under different conditions. In this light, Moderna should not be viewed merely as an ex-post outlier, but rather as an archetype of how long-horizon staged investing under ROT can capitalize on technological volatility without requiring precise forecasting. Unlike many cases where cognitive biases distort rational discipline, Flagship's decisions show a relative absence of sunk-cost escalation or herding, underscoring how structural patience can safeguard against behavioral pitfalls.

CureVac: Premature Exit and Lost Upside

CureVac—an early mRNA vaccine company founded in 2000—provides a contrasting case to Moderna, highlighting the pitfalls of exiting an investment option too early. Whereas Flagship Pioneering chose to hold its Moderna stake through late-stage breakthroughs, some of CureVac's early venture backers exercised their "exit option" prematurely. By 2015, well before any pandemic was on the horizon, early investors sold a significant stake to the pharmaceutical firm Eli Lilly, effectively cashing out years before the technology's ultimate resolution. In ROT terms, this move was akin to exercising a call option long before maturity—locking in a modest, relatively safe return but forfeiting the remaining upside optionality. Analogous to the Black-Scholes framework (Black & Scholes, 1973)—a foundational model in financial economics that prices options based on factors like volatility, time to expiration, and risk-free interest rate—an investor should generally avoid early exercise of a high-growth, high-volatility call option when time value remains significant. CureVac's investors, by exiting in 2015, gave up this time value, surrendering the benefit of waiting as uncertainty continued to unfold.

The cost of this premature exercise became evident a few years later. When the mRNA field was dramatically validated by the COVID-19 pandemic, CureVac's valuation surged. The company went public in August 2020, and its market capitalization temporarily reached several tens of billions of dollars. Investors who had

retained their stakes would have seen enormous gains on paper. By selling out in 2015, however, the early investors missed this upside entirely. From a ROT perspective, the timing of exit was suboptimal: they realized the intrinsic value but forfeited the extrinsic upside tied to unresolved uncertainty. Notably, in deep-tech ventures like mRNA, the underlying payoff distribution is highly asymmetric. The gains from success are enormous, while the losses are limited to committed capital. Coupled with extreme uncertainty and volatility, this asymmetry amplifies the option value of waiting.

Ironically, CureVac's COVID-19 vaccine ultimately failed. Its lead candidate showed only 47% efficacy in Phase III trials, leading to program abandonment in 2021 (Burger, 2021). Thus, even if the early investors had held on, they would have needed to time their exit carefully to realize gains. From a real-options perspective, CureVac illustrates both the opportunity cost of a premature exit and the inherent risk that some options expire out of the money. The key strategic error was exiting before a major information event—namely, the resolution of clinical trial uncertainty. ROT logic dictates that in scenarios with high volatility and potential asymmetric upside, the optimal strategy is often to hold the option until that uncertainty resolves. Early exercise in such a setting results in the destruction of potential option value.

In sum, CureVac demonstrates how exercising a venture investment option too early in a high-uncertainty, high-potential context can forfeit the very payoff that justified the initial risk. In contrast to Flagship's patient hold of Moderna's option through a decisive inflection point, CureVac's investors choose safety over strategic flexibility. The case serves as a cautionary tale: exiting too soon may secure a small win, but at the cost of missing the rare but transformative upside that real options are designed to capture. The strategic divergence between Moderna's staged hold and CureVac's premature exit is further illustrated in the comparative timeline **Figure 3**, which maps each firm's investment trajectory through an ROT lens.

Figure 3 presents a side-by-side comparison of Moderna and CureVac investment trajectories through the lens of ROT. Moderna's timeline illustrates a staged investment approach: key technological milestones such as the 2012 proof-of-concept and 2015 delivery breakthrough triggered sequential growth option exercises. The decision to delay exit in 2018—despite acquisition offers—demonstrates a clear application of ROT principles: holding the option until uncertainty resolves and upside potential becomes more visible. This strategy ultimately paid off when Moderna's COVID-19 vaccine success in 2020 made the option “deep in the money,” resulting in a market capitalization exceeding \$100 billion in 2021.

In contrast, CureVac's timeline is defined by a single premature exit: in 2015, early investors sold their stakes before the mRNA field had fully matured. This action—analogue to early exercise of a call option—ignored the substantial time value and asymmetry typical of deep-tech opportunities. Although CureVac went public in 2020 during the mRNA investment surge, and its valuation spiked

briefly, the early investors missed this upside entirely. Moreover, the company's ultimate failure to deliver a viable vaccine in 2021 illustrates that even held options can expire worthless. From a real-options perspective, the CureVac case underscores the cost of exiting before a decisive information event—whereas Moderna's timeline exemplifies how ROT can guide patient capital toward outsized returns under uncertainty.

Behaviorally, this premature exit may also reflect short-termism or excessive risk aversion, where investors locked in modest gains rather than preserving the option's remaining time value.

Meituan: Timely Exit in a Winner-Takes-All Market

Meituan, China's leading food delivery and local services platform, illustrates how real options thinking applies to market-driven, fast-cycle ventures. Unlike biotech R&D, Meituan's growth depended on rapid market expansion and execution rather than scientific discovery. Sequoia Capital China was an early investor in Meituan (starting in 2011) and provided follow-on funding through the startup's explosive scale-up phase. By 2018, Meituan had achieved dominance in its market (e.g., >50% share in food delivery after merging with Dianping), and it went public in Hong Kong SAR. At this point, Sequoia held a valuable equity stake with considerable embedded optionality—functionally equivalent to an option with flexible exercise timing, allowing exit at any chosen point prior to expiration. Applying ROT, Sequoia's key decision was when to exercise the exit option for maximal return. The venture capitalists exited primarily during 2020-2021, unloading shares in batches when Meituan's valuation was at its peak. By early 2021, Meituan's market capitalization had surpassed \$200 billion amid investor euphoria, reflecting very high earnings multiples, even a Shiller P/E in the 97th percentile historically (HKEX, 2021). This was precisely the moment Sequoia began to exercise its option by selling—locking in gains. The result was a reported >50× return over roughly a decade of investment (Figure 4).

The wisdom of this timing can be understood through ROT. In winner-takes-all markets, once a company has “won” (captured the market and reached lofty valuation), the upside potential may be limited relative to the looming downside risks. Holding the option too long can be dangerous if adverse events occur. In Meituan's case, soon after the 2021 peak, China's regulators launched an antitrust crackdown on tech giants (Crunchbase, 2024). Meituan subsequently lost roughly half of its market value as new regulations and penalties hit the sector. By having exercised the exit option before this downturn, Sequoia avoided a drastic erosion of value. This exemplifies optimal timing: exit when the investment is deeply “in the money” and further holding offers diminishing returns but growing risk. In contrast to the deep-tech cases, where the advice was to hold as long as possible, here the ROT insight is to not overstay once the favorable conditions begin to invert. Meituan's investors effectively monetized the option at the optimal point, demonstrating how timely exit is critical for model-replication projects in volatile competitive environments.

A natural counterfactual is: what if Sequoia Capital had held its Meituan shares

beyond 2021? In that case, China's regulatory crackdown—including antitrust actions and platform restrictions—would likely have cut its returns by 40% - 50%, as Meituan's stock fell from 460 HKD in early 2021 to below 220 HKD within months. Market capitalization halved in less than a year.

From a Real Options perspective, it serves as a reminder that, for replication-based ventures, timing is as critical as execution. Sequoia's early exit illustrates that the value of the exit option lies not in holding longer, but in recognizing when upside has peaked and downside risks loom. Even in dominant firms, overextending the holding period can rapidly destroy value in fast-moving, policy-sensitive markets. While the timing was optimal in ROT terms, it also coincided with broader herding around technology IPO valuations, suggesting that rational and behavioral drivers can reinforce each other.

ofo: Overexpansion and the Option That Expired Worthless

The ofo case exemplifies the consequences of failing to exercise an abandonment option when market signals clearly indicated deterioration. As a Chinese bike-sharing startup that pursued an aggressive blitzscaling strategy in 2016-2017, ofo rapidly expanded its footprint across urban centers, backed by over \$2 billion in venture capital from firms such as Didi Chuxing and Alibaba (Zhu, 2018). The early promise of viral user growth and low entry barriers led investors to treat each funding round as a call option on a potentially dominant position in a winner-takes-all market. However, the fundamental economics of the business—thin margins, high maintenance costs, and weak retention—were never validated. In ROT terms, these investments represented sequential exercises of growth options without first resolving key uncertainties about sustainability.

By late 2017, evidence of structural weakness had become difficult to ignore: cash burn intensified, regulatory constraints emerged, and asset degradation accelerated. The underlying business "asset" was declining in value, and the rational course of action would have been to exercise the abandonment option—analogue to a put option that limits further downside (Bai, 2022). Instead, investors escalated their commitment, continuing to fund operations in hopes of a turnaround. This overholding behavior violated core ROT principles: rather than preserving optionality or minimizing losses, it allowed the option to expire worthless. By the end of 2018, ofo was insolvent, unable to refund deposits, and facing public scrutiny. The entire capital stack was effectively wiped out.

From a ROT perspective, the critical failure lay in the timing. The abandonment option was most valuable at the point where market saturation and regulatory pressure intersected with negative operating signals. Yet no decisive action was taken. Investors may have been influenced by sunk cost fallacies or organizational inertia, but structurally, they failed to create or respond to meaningful informational checkpoints—moments when the project's value could be re-evaluated. The comparison with Meituan is instructive: whereas Meituan exercised growth options aggressively but conditionally based on traction, ofo expanded blindly, treating scale as a substitute for validation. In this sense, ofo's strategy conflated exer-

cising an option with obligation, rather than discretion.

Moreover, the counterfactual does not require a full pivot or turnaround to be meaningful. Even a partial recovery—via merger, soft landing, or strategic asset sale—could have preserved some investor value if the abandonment option had been exercised earlier. This reinforces a central ROT principle: options are valuable precisely because they allow for flexibility in the face of unresolved uncertainty. Exercising an expansion option without verifying the underlying asset's viability undermines this flexibility. By contrast, a disciplined approach would have treated each funding round as a contingent commitment, requiring validation before scale.

In sum, the ofo case represents a failure to act when exit was still possible, leading to total loss. It highlights the inverse of successful ROT application—not a misjudged gamble, but the absence of strategic withdrawal. While venture capital celebrates risk-taking, ROT reframes risk as a sequence of managed decisions, each with its own threshold of activation. ofo's collapse serves as a cautionary example: when investors neglect to construct and act on decision checkpoints, even scalable models can decay into irreversible loss. Real Options discipline requires not only knowing when to expand, but when to strategically exit.

Synthesize the four case studies:

Table 1 compares each venture across core real-options dimensions: timing strategy, investor behavior, theoretical interpretation, and outcome. This matrix format highlights how decision timing—whether to exercise, defer, or abandon an option—critically shaped investment trajectories. It also reinforces the central claim of the paper: that venture type (deep-tech vs. replication) strongly correlates with optimal ROT behavior and ultimate success or failure. This reluctance to abandon illustrates a classic sunk-cost fallacy, where prior commitments distorted rational real-options discipline and prolonged value destruction.

Table 1. Summarizes the key parameters of the four cases analyzed in this study, including sector, founding year, outcome, investment strategy, and their respective interpretations under ROT. This comparative structure enables clear identification of how venture type and timing influence the application and consequences of staged investment decisions.

Case	Sector	Founded	Outcome	Investment model	ROT framing
Moderna	Biotech/Pharmaceuticals	2010	IPO in 2018, \$100B + valuation by 2021	Deep-tech/Platform R&D	Growth option exercised; exit deferred
CureVac	Biotech/Pharmaceuticals	2000	IPO in 2020, failed vaccine 2021	Deep-tech/Platform R&D	Premature growth option exercise
Meituan	Local services/platform	2010	IPO in 2018, peak exit by 2021	Replication/Market Execution	Timely exit option exercise
ofo	Urban mobility/Sharing	2014	Collapsed in 2018	Replication/Blitzscaling	Abandonment option ignored

5. Comparative Analysis and Insights

The following section synthesizes the insights from the four cases, highlighting

how differences in venture type shape optimal real-options strategies. Across these four cases, we see how project type dictates the optimal real-options strategy in venture capital. Deep-tech R&D projects like Moderna and CureVac are analogous to long-dated options with potentially huge payoffs but significant technical uncertainty. The ROT lesson for such projects is that investors should hold onto the option (continue supporting the venture) through early setbacks and lengthy validation periods—if they have the capacity to do so (Brealey, Myers, & Allen, 2019). The success of Moderna’s 12-year marathon was enabled by patient capital willing to stage investments and wait for the technology’s value to materialize. In contrast, CureVac’s early investors, constrained by shorter horizons or lacking conviction, exited well before the critical value-inflection point; in doing so, they surrendered the chance at outsized returns. Thus, for deep-tech ventures, ROT emphasizes long-term flexibility: the ability to delay exit and double-down at milestones is crucial, because time and technical breakthroughs are the primary value drivers. Of course, not every long-held option will pay off—CureVac’s failure reminds us that even an optimal strategy cannot eliminate technical risk—but the principle is to give breakthrough innovations the optionality to succeed.

Model replication projects like Meituan and ofo, on the other hand, behave more like short-term options in a high-speed race. Their value is highly sensitive to timing, competition, and external market conditions. ROT in these cases stresses the importance of timely exercise or abandonment. Meituan’s investors exemplified exercising the option at just the right time: once the company achieved dominance and market valuations were euphoric, they captured value before any decline. This suggests a disciplined approach to exit timing, taking profits when an opportunity is deep in-the-money. By contrast, ofo’s outcome shows the danger of waiting too long to act. In a rapidly deteriorating competitive scenario, the window to exit profitably can slam shut quickly. Investors who fail to cut losses essentially forfeit the remaining option value. In summary (Table 2), for replication or market-dependent startups, ROT implies a bias toward earlier exercise (realizing gains or ending the experiment) once the growth narrative either has played out favorably or is clearly breaking down.

Table 2. Summary table.

Case	Option Timing Strategy	Investor Behavior	ROT Interpretation	Outcome
Moderna	Deferred exit, staged growth	Flagship exercised growth options gradually; exit delayed	Optimal staging and exit deferral in high uncertainty	Massive IPO success, >\$100B valuation
CureVac	Premature exit	Early investors sold stake in 2015	Early exercise of call option forfeited time value	Missed valuation spike, failed vaccine
Meituan	Timely exit at peak valuation	Sequoia exited in 2020 before regulatory downturn	Well-timed exit when option was deep in-the-money	>50x return, avoided crash
ofo	Failed to exit; overcommitted	Investors ignored negative signals and kept funding	Abandonment option not exercised	Total write-off, collapse in 2018

Another insight from these cases is the role of investment structures and incentives in enabling or hindering real-option optimality. Flagship's evergreen fund structure was pivotal for Moderna: it provided the freedom to hold an investment for 12+ years, whereas a typical VC fund might have been forced to "expire" the option prematurely. Similarly, strategic considerations (e.g., regulatory foresight) helped Sequoia make the call on Meituan—they anticipated the crackdown risk and acted before it hit. In contrast, CureVac's backers and ofo's backers may have been driven by pressures (fund cycles, fear of missing scale) that led to suboptimal timing. Thus, aligning funding strategy with project type (e.g., using longer-horizon capital for deep-tech, and maintaining agility for quick-cycle tech) is critical for applying ROT in practice (Schwienbacher, 2008).

Fund structure plays a critical role in shaping how investors implement real options strategies in venture capital. For instance, evergreen funds—which lack fixed lifespans—enable patient capital allocation and support long-horizon option holding, as demonstrated in the Moderna case. In contrast, traditional closed-end VC or PE-style funds, typically operating on 10-year cycles, may be pressured to exercise exit options prematurely to meet return timelines, even when the underlying option still holds time value. This structural mismatch can undermine optimal ROT execution, especially in deep-tech settings where value inflection points occur late. Moreover, corporate venture capital (CVC) units may pursue strategic rather than purely financial returns, leading to option behavior that prioritizes technology access over payoff maximization. As Schwienbacher (2008) highlights, the duration and incentive structure of funds significantly affect not just investment selection but also continuation and abandonment decisions. Thus, aligning fund architecture with venture type and expected uncertainty profile is essential for realizing the full benefits of ROT informed decision-making.

A closer comparison of fund structures across the four cases further illustrates how institutional design shapes real-options execution. Flagship's evergreen structure enabled patient capital in Moderna, supporting deferred exits and staged commitments over more than a decade. By contrast, many of CureVac's early backers operated through conventional closed-end VC funds, where the ten-year cycle created pressure to realize returns prematurely—contributing to their early exit in 2015 before major uncertainties had resolved. Sequoia Capital's management of Meituan also reflected the dynamics of closed-end funds: once the option was deeply in the money, fund-cycle incentives reinforced the decision to exercise the exit option and return capital to limited partners. Finally, ofo's case highlights the role of corporate strategic investors such as Alibaba and Didi, whose objectives extended beyond financial returns to ecosystem positioning. These structural differences shaped whether investors prioritized patient holding, timely profit-taking, or overcommitment, reinforcing the importance of aligning fund architecture with venture type and uncertainty profile.

Finally, while ROT provides a valuable strategic guide, we must acknowledge the element of luck in these outcomes. Moderna's timing benefited immensely

from an unforeseeable pandemic tailwind, and Meituan grew during a relatively permissive period before regulators tightened rules. Conversely, CureVac was unlucky that its vaccine lagged in efficacy, and ofo was unlucky (or unwise) facing a harsh competitive and regulatory storm. ROT does not eliminate such external uncertainties, but it does equip investors with a mindset to navigate them, to keep options alive when potential payoff justifies the risk, and to exercise or abandon decisively when either the upside is realized or the downside risks dominate. In conclusion, applying ROT to venture investing helps explain why successful strategies often involve carefully staged commitments and well-timed exits, whereas failed strategies can frequently be traced to misjudging the value of flexibility and timing in the face of uncertainty.

Literature comparison

The traditional venture capital literature, such as the influential work of [Gompers and Lerner \(Gompers & Lerner, 2001\)](#) focuses on capital structure, governance, selection criteria, and fund dynamics. These studies shed light on how incentive alignment and information asymmetry affect early-stage investments. However, they often treat exit timing as an exogenous or static factor—determined by fund cycles, market conditions, or IPO windows—rather than a dynamic managerial decision. As a result, the intertemporal flexibility available to investors across rounds is often undertheorized. This paper builds on this foundation by introducing ROT (ROT) as a framework that interprets timing not only as a market response but also as an inherent strategic choice.

As such, this analysis is more aligned with real options-based research on innovation and strategic investment ([Trigeorgis, 1996](#)), which models investment as a series of contingent decisions under uncertainty. Prior ROT literature has explored technology development, resource allocation, and firm innovation, but relatively little research has mapped these dynamics to the venture capital landscape. Although the application of ROT to venture capital has been described as underdeveloped, there are a few notable exceptions. For example, [Schwienbacher \(2008\)](#) applied a real-options framework to analyze financing strategies for different types of startups, while [Bowman and Moskowitz \(2001\)](#) discussed real options in the context of strategic decision making, including early-stage innovation. These contributions demonstrate that ROT can indeed be extended to entrepreneurial finance, yet they stop short of developing a systematic typology of how venture types align with specific option strategies. This study advances that stream by explicitly linking deep-tech and replication-based ventures to distinct real-options logics, thereby offering a comparative framework that clarifies when investors should prioritize growth, timing, or abandonment options.

By applying ROT to deep tech and replication-based ventures, this paper proposes a comparative typology of option strategies—linking venture type, timing logic, and investment outcomes. In this way, this paper connects theoretical advances in financial flexibility to practical decisions about early-stage investing and anchors venture exit and financing sequencing in a more rigorous temporal model.

Beyond traditional ROT applications, related tools such as real option games and binomial decision tree models have been developed to enhance strategic investment analysis. Real option games integrate game-theoretic elements into ROT, emphasizing competitive interactions under uncertainty (Smit & Trigeorgis, 2004). While this approach is powerful for modeling strategic behavior among rival firms, it often assumes more structured payoff environments than early-stage VC markets typically allow. Similarly, binomial decision tree models (Bowman & Moskowitz, 2001) offer a discrete-time framework for modeling sequential decisions with probabilistic outcomes. However, their application tends to remain quantitative and stylized, with limited attention to contextual factors like fund structures or investor cognition.

In contrast, this paper employs a qualitative, comparative case analysis grounded in ROT, which emphasizes flexible decision-making in unstructured, evolving innovation settings. Rather than modeling competition or discrete payoffs explicitly, it foregrounds how real-world investors use embedded options to stage capital, delay commitments, or abandon ventures. This approach offers a bridge between the formalism of ROT tools and the behavioral complexity of venture finance, providing theory-informed but practice-sensitive insights.

6. Conclusion and Implications

To conclude, we revisit the central argument and summarize how real options logic explains divergent outcomes in high-risk venture investments. This paper has examined how ROT offers an interpretive and strategic lens for venture capital decision-making under uncertainty. Through comparative analysis of four distinct cases—Moderna, CureVac, Meituan, and ofo—it becomes clear that different types of ventures demand different real-option strategies. Deep-tech projects resemble long-dated options, where patient capital and flexible staging are essential to capture asymmetric upside. In contrast, market-replication ventures are closer to short-term, high-volatility options, where mistimed execution or delays can rapidly erode value. In each case, success or failure was closely tied to how well investors exercised, deferred, or ignored the real options embedded in their strategic choices.

Practical Recommendations for Venture Capital Investors

Building on these case-based insights, we offer practical recommendations for investors seeking to apply ROT in venture capital settings. These findings suggest several practical implications for venture capitalists, particularly in aligning financing models with venture type:

- **For deep-tech or platform R&D ventures**, investors should adopt evergreen or open-ended fund structures that allow sufficient time for scientific or technical breakthroughs to emerge. Flagship Pioneering support for Moderna shows that success often hinges on the ability to stage commitments across a decade or more. Premature exits—such as those seen in CureVac—can destroy long-term upside embedded in the option's time value.

- **For replication-based or execution-driven startups**, investors should build predefined checkpoints tied to operational, regulatory, and financial milestones. As Meituan’s case illustrates, optimal exit often occurs when the venture is already “in the money” but just before external risks invert conditions. ofo’s collapse shows that failing to act decisively at inflection points can lead to a total loss of option value.
- **Institutionalizing real-options logic** within VC firms—using tools like decision trees, scenario-based payoffs, and structured option-value review processes—can guard against escalation bias and overcommitment. Embedding ROT into investment memos or board-level discussions provides a disciplined way to frame uncertainty, rather than relying on reactive or intuitive decisions.
- **Match fund duration to project volatility**: Long-horizon ventures need flexibility, while high-churn sectors demand agility. A mismatch between capital structure and project uncertainty can lead to either forced premature exit or delayed unwinding of doomed ventures.

Directions for Future Research

This study also opens up several promising areas for future research:

- **Apply ROT to frontier domains such as Web3**, decentralized platforms, or climate-tech. These sectors feature latent optionality (e.g., regulatory shifts, user network emergence) that may benefit from staged, ROT-informed capital allocation.
- **Integrate ROT with behavioral finance** and decision theory. Many failed option exercises in venture settings are due not to mispricing but to cognitive biases—sunk cost fallacy, herding, or fear of regret—which real-options modeling could adapt to include.
- **Build quantitative real-options models for staged VC** using tools such as binomial decision trees, dynamic programming, or Monte Carlo simulations. This could yield more predictive insights on when to defer, exercise, or abandon in a probabilistic manner.
- **Examine fund structure and incentive alignment** as mediators of option strategy: for example, how carry structures, GP-LP dynamics, or time pressure distort rational option behavior.

By developing these avenues, researchers can not only expand the theoretical foundations of ROT in venture contexts but also equip practitioners with more refined instruments to navigate uncertainty.

Ultimately, ROT does not offer certainty in uncertain environments—but it offers clarity in structuring choices, discipline in deferring or acting, and a language for understanding the asymmetry between commitment and flexibility. As innovation continues to evolve across scientific, digital, and geopolitical frontiers, ROT offers a strategic mindset for evaluating when to double down—and when to walk away.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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