Golden Cage: Paradox of Early Funding and Growth

By

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Submitted to the Department of Civil and Environmental Engineering
in partial fulfillment of the requirements for the degree of

Master of Science in Transportation
at the
Massachusetts Institute of Technology
February 2026

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ABSTRACT

Flexibility predicts startup growth, yet the funding that enables growth systematically suppresses flexibility. The mechanism is belief-based sorting. When founders commit to specific strategies, investors who share those beliefs fund; skeptics self-select out. The resulting board lacks cognitive diversity to advocate pivots. I formalize this phenomena as golden cage theory: founders cannot reposition because governance lacks advocates for alternatives.

Analyzing 168,011 U.S. ventures, I establish three empirical regularities. First, **early funding predicts less repositioning**. Second, **repositioning predicts success**. Third, the **early funding and growth correlation** varies systematically by industry: negative where dominant designs constrain exploration (e.g. Hardware and Mobility), neutral or positive where uncertainty releases the cage (Software and Quantum).

Three contributions emerge. *Empirically*, the funding-growth paradox holds as a robust regularity across 168,011 ventures. *Theoretically*, belief-based sorting in governance explains why commitment and flexibility trade off. *Prescriptively*, founders can balance commitment and flexibility with the 3S framework: **Scope** (commit to thesis, not architecture—moderate breadth outperforms both extremes), **Sequencing** (stage capital from non-dilutive to thesis-driven VC, delaying governance lock-in until market signals clarify), and **Synchronization** (match capability investment to market validation, avoiding the traps of over-building or over-promising).

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자기 앞의 생이 끝나갈 때
When the Life Ahead Draws to an End

흐린 창문 사이로 하얗게 별이 뜨던 그 교실
나는 기억해요 내 소년 시절의 파랗던 꿈을
세상이 변해 갈 때 같이 닮아 가는 내 모습에
때론 실망하며 때로는 변명도 해보았지만

Through the foggy classroom window, stars rose—
I remember the azure dreams of my childhood.
As the world changed, I grew to resemble it,
Sometimes disappointed, yet making excuses.

흐르는 시간 속에서 질문은 지워지지 않네
우린 그 무엇을 찾아 이 세상에 왔을까?
그 대답을 찾기 위해 우리는 홀로 걸어가네

Yet within the flow of time, the question never fades:
What did we come to this world to seek?
To find that answer, we walk alone.

세월이 흘러가고 우리 앞의 생이 끝나갈 때
누군가 그대에게 작은 목소리로 물어보면
대답할 수 있나 지나간 세월에
후회는 없노라고, 그대여 -

When years have flown and the life ahead draws to an end,
If you were asked in a gentle voice—
Can you answer, to all those days gone by,
That I have no regrets, my dear?

▷ Listen to the song by N.EX.T

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Chapter 1

Introduction

1.1 Early Funding and Growth Paradox

Why would resources hurt?

Over the past decade, venture capital has deployed hundreds of billions of dollars annually to fuel startup growth [48]. Yet a puzzle emerges from the data: ventures that raise more early funding (e.g. series A, B) are *less* likely to succeed later. The pattern holds across 168,011 U.S. ventures. It sharpens in capital-intensive industries. It demands explanation.

The answer lies not in the capital, but in who provides it. To secure funding, founders commit to specific strategies. These commitments attract investors who believe in those strategies. Skeptics never join. The resulting board contains only believers. When market signals suggest pivoting, people are hesitant to advocate for change, away from what all of them believe in.

I call this the *golden cage*: founders cannot reposition because governance lacks advocates for alternatives. The cage is not inherently destructive; it enables resource acquisition and focused execution. But the cage becomes fatal when founders need to adapt and cannot. The question is not whether to build the cage. It is whether to preserve flexibility within it.

1.2 Two Ventures, Two Fates

The golden cage explains why two ventures pursuing the same goal met opposite fates.

Tesla and Better Place both sought to revolutionize transportation. Both raised hundreds of millions. One survived; one liquidated. The difference was not capital, conviction, or technology. It was the structure of commitment.

Tesla positioned itself as "accelerating sustainable transport"—a Thesis broad enough to attract believers in electrification, autonomy, and energy storage. Each investor projected a different path onto the same vision. When Tesla pivoted from Roadster to Model S, this cognitive diversity became governance fuel: at least some board members could advocate for the shift.

Better Place raised $850 million for "battery swapping infrastructure"—an Architecture so specific that it filtered for one type of believer. When charging technology advanced, the board contained no voice for pivoting (which includes the ego of the founder). The coalition's

binding logic dissolved with the mechanism. Better Place liquidated in 2013; its assets sold for less than $1 million.

The contrast reveals the core insight: commitment and flexibility are not opposites but *architectural choices*. Flexibility is not preserved by raising less capital. It is preserved by committing at the right level of abstraction—broad enough to attract diverse believers, specific enough to mobilize resources.

1.3 Two Patterns in the Data

Analyzing 168,011 U.S. ventures from PitchBook (2021–2025), I find two regularities that constitute the golden cage.

The Commitment Cage. Early funding predicts less repositioning ($\rho = -0.133$, $p < 0.001$). The correlation persists after controlling for industry, cohort, and founder characteristics. Well-funded ventures do not pivot—not because founders resist, but because boards cannot advocate.

The Flexibility Flex. Repositioning predicts success. Movers outperform Stayers by 2.60× (17.6% vs. 6.7%). The direction does not matter: zooming in and zooming out both beat standing still. Movement itself distinguishes survivors from the caged.

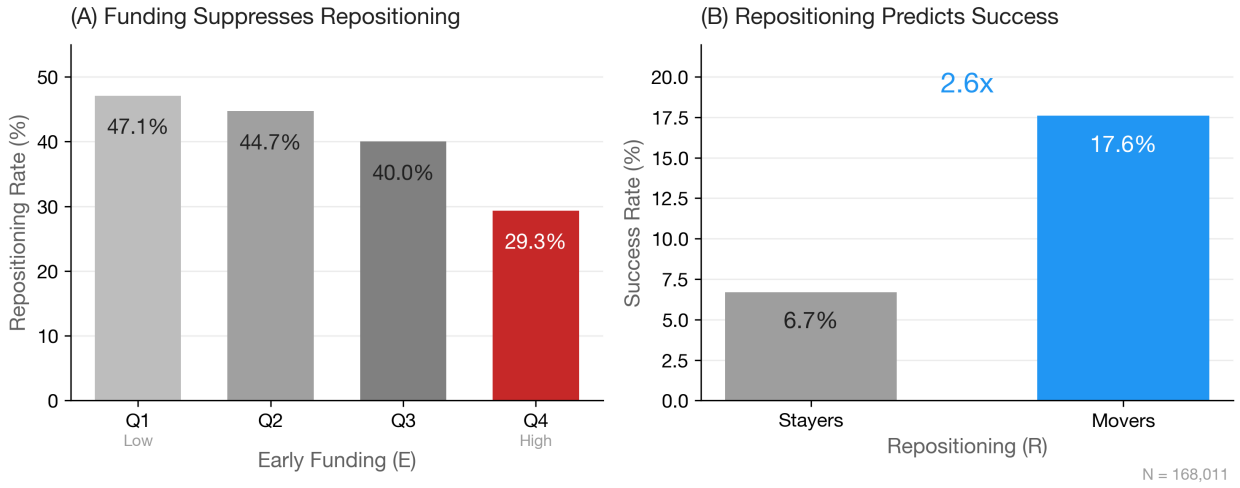

Figure 1.1: Two Patterns of the Golden Cage ($N = 168{,}011$). (A) Funding suppresses repositioning: Q4 ventures reposition at 29.3% vs. 47.1% for Q1. (B) Repositioning predicts success: Movers outperform Stayers by 2.6× (17.6% vs. 6.7%).

Together, these patterns form the **Funding-Growth Paradox**: early funding correlates negatively with later success, mediated by suppressed repositioning. The mechanism chains: funding homogenizes governance (H1), homogenized governance blocks repositioning, and blocked repositioning prevents growth (H2). The net effect: $(-) \times (+) = (-)$. Figure 1.2 captures the structure.

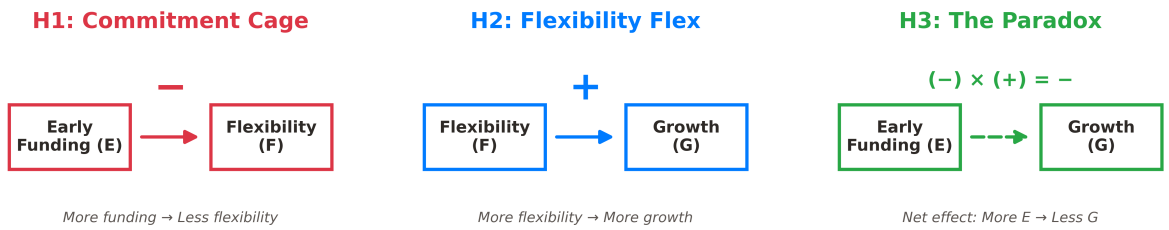

Figure 1.2: Mediation Structure of the Golden Cage. **H1: Commitment Cage**—funding suppresses flexibility (−). **H2: Flexibility Flex**—flexibility enables growth (+). **H3: The Paradox**—the net effect: $(-)\times(+) = (-)$.

1.4 Contributions Preview

This thesis makes three contributions.

The first is empirical. I establish the funding-growth paradox as a robust regularity. The pattern holds at the firm level ($\rho = -0.04$), sharpens in capital-intensive industries (Hardware: -0.11; Mobility: -0.10), and reverses where dominant designs do not yet exist (Quantum: $+0.10$). This boundary condition is not noise; it refines the theory's scope.

The second is theoretical. I explain why commitment and flexibility trade off through belief-based sorting. Investors who fund share the founder's optimism; skeptics self-select out. This sorting homogenizes governance until no voice remains to advocate for change. I formalize the boundary condition as **Theorem 1 (Caged Learning)**: learning ceases when $\mu(1-\mu) < \varepsilon/B$, where μ captures belief homogeneity from sorting, ε captures signal strength lost without skeptics, and B captures strategic breadth narrowed by commitment. The theorem specifies when the cage locks shut.

The third is prescriptive. I provide the **3S Framework** for founders navigating the cage. *Scope*: commit to Thesis, not Architecture; moderate breadth (Q3) achieves 15.0% survival, outperforming both extremes. *Sequencing*: stage capital from non-dilutive to thesis-driven VC, delaying governance homogenization until market signals clarify. *Synchronization*: match operational investment to market validation, avoiding the traps of over-building or over-promising. These principles help founders attract resources without sacrificing the cognitive diversity required to use them.

Chapter 2 develops the theory.

Chapter 2

Commitment and Flexibility

2.1 Introduction

Early funding relaxes *resource constraints* yet accelerates the *irreversibility* that extinguishes the *option value* of flexibility. To understand this tradeoff, I formalize the conditions under which startups operate. Drawing on Gans et al. [19], I define the pre-funding state through four axioms:

- **Freedom (Axiom 1):** The venture has multiple viable paths to commercialize an idea.
- **Constraints (Axiom 2):** Limited resources prevent pursuing more than one path simultaneously.
- **Uncertainty (Axiom 3):** The true value of any path is unknown ex-ante.
- **Irreversibility (Axiom 4):** Choosing a path requires commitments costly to reverse.

For a bootstrapped venture, constraint dominates. The founder retains maximum freedom but lacks capacity to execute any path effectively. Funding inverts this structure. Capital resolves the constraint, granting capacity to execute. But resolution triggers irreversibility. Uncertainty demands *freedom* to pivot; capital creates binding *irreversibility*, trading the *option value* of future alternatives for the capacity to execute today.

I call this structural condition the **golden cage**: founders cannot reposition because the governance that funding creates lacks advocates for alternatives. The cage is not inherently destructive. It enables resource acquisition and focused execution. The question is whether founders can preserve flexibility within it.

The Strategy Orthodoxy

Traditional strategy views commitment as an asset. Porter [52] argues that competitive advantage requires trade-offs; Ghemawat [21] defines commitment as the source of value through lock-in. These arguments assume firms know which path to commit to. Under the high uncertainty of nascent markets, this assumption fails. Dixit and Pindyck [10] and Sanchez [55] show that when path value is unknown, the option value of waiting often dominates the benefits of early commitment.

This thesis resolves the debate: commitment and flexibility are not opposites but *architectural choices*. The golden cage explains *when* commitment destroys value (through governance homogenization) and *how* founders can preserve flexibility while making credible commitments (through the 3S framework). The key insight: the *level* of commitment matters. Vision-level commitment attracts diverse believers who can advocate for pivots; operational commitment attracts homogeneous believers who cannot.

2.2 Commitment

How does the cage form? Through *belief sorting*. This section traces the mechanism by which funding produces governance homogeneity, formalizes its boundary condition, and derives the first hypothesis.

2.2.1 Belief Sorting

Drawing on Van den Steen's (2010) sorting equilibrium, I describe belief sorting in three steps (Figure 2.1):

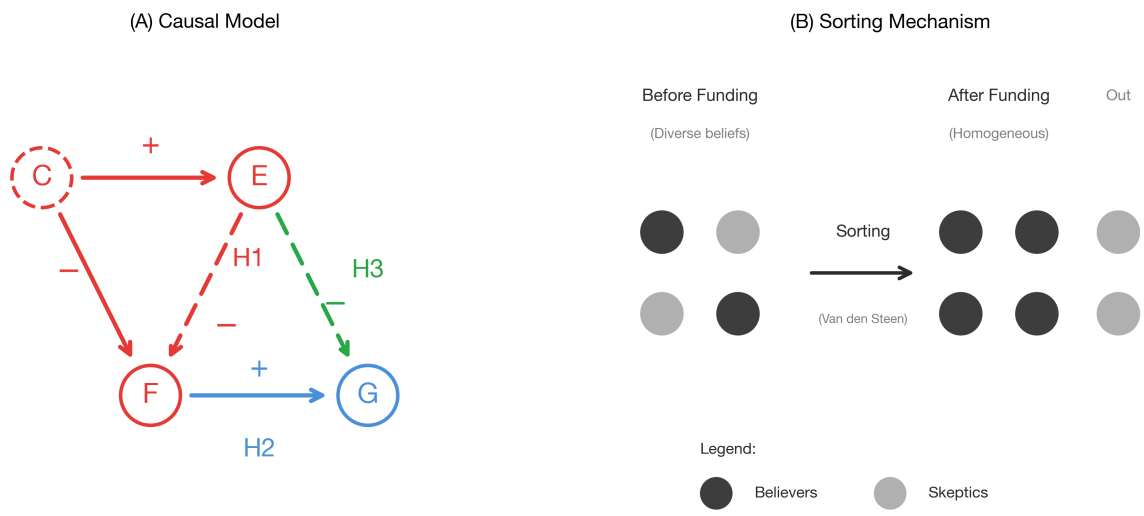

Figure 2.1: The Sorting Mechanism. **(A)** Causal model: Commitment (C) increases funding (E) but reduces flexibility (F). H1: E suppresses F (dashed). H2: F enables growth (G). H3: E's net effect on G is negative. **(B)** Sorting dynamics: Funding triggers belief homogenization; believers stay, skeptics self-select out, leaving governance without advocates for alternatives.

1. **Selection:** Entrepreneurs are naturally optimistic. Investors who fund share this optimism; skeptics self-select out.

2. **Homogenization:** As capital scales, the board fills with believers in Plan A. Internal alignment rises; cognitive diversity falls.

3. **Signal Loss:** Without skeptics, disconfirming market signals lack advocates. Belief convergence aids exploitation but destroys exploration [39, 9].

This three-step process has a tipping point. Building on Levinthal and March's (1993) concept of competency traps, I formalize when homogenization locks the cage shut.

Theorem 1 (Caged Learning). *Learning ceases when*

$$\mu(1-\mu) < \frac{\varepsilon}{B}$$

where μ = belief homogeneity produced in Step 2, ε = signal strength lost in Step 3, and B = strategic breadth narrowed by commitment. (Proof: Appendix B.)

The theorem identifies two conditions for the cage to lock: consensus (μ) too high, breadth (B) too narrow. Both follow from funding. Van den Steen's sorting produces high agreement; operational commitments narrow the path. The cage is not an accident. It is built into the funding process itself.

2.2.2 Hypothesis on Commitment

If belief sorting homogenizes governance, and homogenized governance cannot advocate for change, then funding should suppress repositioning.

Hypothesis 1 (Commitment Cage): *Early-stage funding correlates negatively with repositioning.*

$$H_1 : \frac{dR}{dE} < 0$$

2.3 Flexibility

The previous section explains how funding produces commitment. Commitment enables execution but may restrict adaptation or reduce flexibility. This section explains why the ventures that succeed are those that preserve flexibility within the cage. The argument proceeds in two steps: strategic ambiguity preserves flexibility, and preserved flexibility enables the repositioning that predicts success.

2.3.1 Strategic Ambiguity as Flexibility Enabler

Strategic ambiguity [12] preserves flexibility by attracting diverse believers. Founders who articulate broad visions, rather than narrow operational commitments, attract stakeholders who project their own interpretations onto the vision. Dorfman and Bhui [11] formalize this projection mechanism: when outcomes are ambiguous, individuals interpret them through prior beliefs, filling informational gaps with their own expectations. In governance terms, a vague vision functions like an incomplete signal; each investor imputes meaning consistent with their thesis. This diversity becomes governance fuel for pivots: when market signals suggest changing direction, at least some board members advocate for alternatives.

This dynamic played out differently in two ventures pursuing the same goal. Tesla articulated "accelerating sustainable transport," attracting believers in electrification, autonomy,

and energy transition. Each projected a different thesis onto the same vision. When signals suggested changing direction, this diversity ensured at least some governance voices advocated alternatives. Better Place committed to "battery swapping infrastructure," attracting only believers in that specific mechanism. When market feedback favored charging over swapping, no governance voice advocated pivoting. Tesla repositioned and survived; Better Place stayed put and liquidated.

2.3.2 Hypothesis on Flexibility

Strategic ambiguity preserves flexibility. Flexibility enables repositioning. Repositioning reveals that governance retained the capacity to adapt. If this chain matters under uncertainty, repositioning should predict success.

Hypothesis 2 (Flexibility Flex): *Strategic repositioning correlates positively with later-stage growth.*

$$H_2 : \frac{dG}{dR} > 0$$

where G denotes binary growth (1 if reached Later Stage VC, Series C+).

2.4 Conclusion: The Paradox

The golden cage theory synthesizes mechanism (H1) and outcome (H2) into the core paradox (H3). The mechanism chains: funding homogenizes governance, homogenized governance blocks repositioning, and blocked repositioning prevents growth. The observed negative relationship between funding and growth is therefore not direct but mediated:

$$\underbrace{\frac{dG}{dE}}_{\text{H3: Paradox (-)}} = \underbrace{\frac{dG}{dR}}_{\text{H2: Flex (+)}} \times \underbrace{\frac{dR}{dE}}_{\text{H1: Cage (−)}}$$

Hypothesis 3 (Funding-Growth Paradox): *Early-stage funding correlates negatively with later-stage growth, mediated by lost flexibility.*

$$H_3 : \frac{dG}{dE} < 0$$

Founders seek capital to fuel growth, yet the governance structure accompanying that capital often destroys the strategic optionality required to achieve it. The constraint is structural: founders *cannot* pivot because governance lacks advocates. This differs from moral hazard [5], where founders *will not* pivot due to misaligned incentives. The distinction matters for intervention: moral hazard requires monitoring; structural constraint requires governance redesign.

Chapter 3

Data and Identification

3.1 Introduction

The core challenge is measuring flexibility. Flexibility is a latent capability; it cannot be directly observed. My solution: measure its behavioral manifestation. Repositioning, the observable shift in a venture's strategic breadth over time, reveals flexibility exercised. I analyze 168,011 U.S. ventures from PitchBook (2021–2025), using dictionary-based text analysis to compute how much each venture's positioning changed between funding rounds. The method draws on category spanning [66] and linguistic concreteness [64].

A key identification concern is selection. High-conviction founders may both raise more capital and resist pivoting, producing correlation without causation. I address this in Section 3.5, arguing that selection is part of the mechanism—not a confound to eliminate. Code repository is github.com/hyunjimoon/golden-cage-thesis.

3.2 Data Sources and Sample Construction

I construct a panel of 168,011 ventures from PitchBook, covering the period 2021–2025. PitchBook provides comprehensive coverage of U.S. venture-backed companies, including funding rounds, company descriptions, and outcome data.

Sample Construction. The initial universe contains 488,381 ventures. I filter to U.S.-headquartered ventures at early stage (Seed through Series B) with at least 24 months of observable history and complete data on core variables, yielding 168,011 ventures (34.4% retention).

3.3 Variable Operationalization

Table 3.1: Variable Definitions and Causal Structure

Symbol	Variable	Type	Operationalization
C	Commitment	Choice	Initial strategic specificity index (0–100): product category count, milestone granularity, funding structure
E	Early Funding	Outcome	Early-stage capital secured (first_financing_size, M USD, log-transformed)
F	Flexibility	Capacity	Governance-permitted change capacity (inferred from R)
B	Strategic Breadth	State	Market positioning specificity (0–100 scale via dictionary-based vagueness)
R	Repositioning	Action	$\lvert B_T - B_0 \rvert$, magnitude of strategic change
G	Growth	Outcome	Binary: $G = 1$ if reached Later Stage VC (Series C+); base rate 11.5%
G_{multi}	Growth Multiple	Outcome	K_t/E = Total raised / Early funding; continuous funding scale (illustrative cases only)

From latent flexibility to observable repositioning. The theory treats strategic flexibility (F) as a latent capability: the ability to keep multiple viable paths live under uncertainty. Because F is unobserved in administrative data, I proxy it with **repositioning** (R), the observable behavioral manifestation of latent flexibility. Ventures that reposition reveal they retained flexibility—and that governance permitted its exercise. Ventures that remain static may lack the capability or may be structurally caged. This proxy motivates the empirical focus on $E \to R$ and $R \to G$ in Chapter 4.

3.3.1 Strategic Breadth (B)

I operationalize **Strategic Breadth** (B) using dictionary-based text analysis of company descriptions. Drawing on category spanning research [66, 51] and linguistic concreteness research [64], I construct a continuous measure (0–100) capturing the breadth of a venture's positioning.

The measure combines two components. The first is *Categorical Breadth*: the degree to which a description uses broad umbrella terms ("platform," "ecosystem," "solution") rather than specific market categories ("mobile payments," "enterprise SaaS"). A company describing itself as a "technology platform" spans many categories; one describing itself as "inventory management software for small retailers" does not. The second component is *Concreteness Deficit*: whether the description lacks binding markers such as quantitative targets ("10,000 users") or narrow technical specifications ("HIPAA-compliant cloud storage").

The resulting score ranges from 0 to 100. A score of 0 means maximally specific positioning

(Architecture-level commitment); a score of 100 means maximally broad positioning (Thesis-level commitment). The sample mean is $B = 45.2$ (SD = 12.6). Full construction details appear in Appendix A.

Illustrative Examples. Table 3.2 demonstrates how the breadth measure captures strategic positioning using examples from the autonomous vehicle industry.

Table 3.2: Breadth Measure: Illustrative Examples from AV Industry

Company	2021 Description	2025 Description	ΔB	Growth
Panel A: Movers (Zoom-Out) — Architecture to Thesis				
Aurora	"Developer of autonomous trucks for freight logistics" (Architecture: trucking)	"Autonomous driving platform powering trucking, ride-hailing, and delivery" (Thesis: autonomous mobility)	+38.2	3.2×
Panel B: Movers (Zoom-In) — Thesis to Architecture				
Cruise	"Developer of self-driving vehicles for urban mobility" (Thesis: urban mobility)	"Provider of personal autonomous vehicle technology for OEMs" (Architecture: OEM licensing)	−35.6	2.9×
Panel C: Stayers — Locked Architecture				
Argo AI	"Developer of Level 4 autonomous driving technology for robotaxis" (Architecture: robotaxis)	"Developer of Level 4 autonomous driving technology for robotaxis" (Architecture: robotaxis)	0.0	1.0×*

*Notes: B = breadth score (0–100); $\Delta B = B_T - B_0$; Growth Multiple = F_t/E. *Argo AI shut down in October 2022.*

The Key Pattern. Both Movers achieved ∼3× growth; the Stayer achieved 1.0×. The *direction* of repositioning differed—Aurora broadened from Architecture to Thesis, Cruise narrowed from Thesis to Architecture—but *movement itself* distinguished survivors from the caged. Argo's unchanged position revealed governance that could not advocate for change. This pattern motivates the binary Mover/Stayer classification used throughout.

3.3.2 Repositioning (R)

Repositioning (R). Repositioning magnitude measures absolute change in strategic breadth: $R_T = |B_T - B_0|$, where B_0 is breadth at baseline (2021) and B_T at endpoint (2025). Most ventures do not reposition: 61.2% show $R = 0$ (Stayers), while 38.8% show $R > 0$ (Movers). This skewed distribution is consistent with the golden cage theory: belief sorting produces governance that constrains repositioning.

Growth (G). I use a binary outcome: $G = 1$ if the venture reached Later Stage VC (Series C or beyond) by end of observation, $G = 0$ otherwise. The base growth rate is 11.0%. The **Mover Advantage** (2.60×) compares growth rates: $P(G = 1|\text{Mover})/P(G = 1|\text{Stayer})$ = 17.6% / 6.7%. Robustness checks using alternative thresholds appear in Appendix C.

3.4 Descriptive Statistics

Table 3.3: Descriptive Statistics (N = 168,011)

Variable	Mean	SD	Min	Median	Max
Early Funding (E, M USD)	40.2	376.7	0.0	1.0	—
Strategic Breadth (B_0)	45.2	12.6	0	44.7	100
Repositioning (R = $\lvert B_T - B_0 \rvert$)	4.0	7.8	0	0.06	62
Growth (G, binary)	0.11	0.31	0	0	1

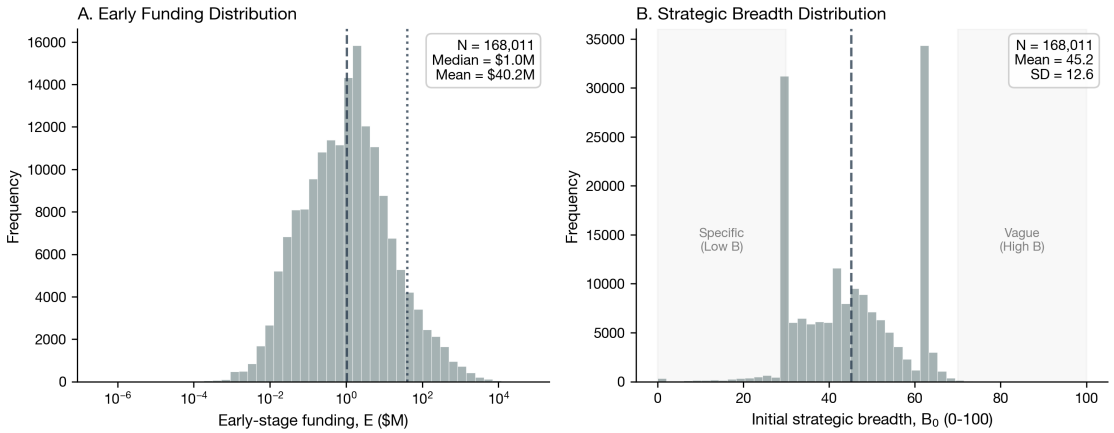

Figure 3.1: Distributions of Early Funding (E) and Baseline Strategic Breadth (B_0). Early funding is right-skewed with median $1M and mean $40M; strategic breadth shows bimodal distribution.

The sample divides into Stayers (102,742 ventures, 61.2%) and Movers (65,269 ventures, 38.8%). Overall, 11.0% of ventures reach Later Stage VC by end of observation.

3.5 Identification Strategy

The central identification concern is selection: founders with high conviction may both raise more capital *and* resist pivoting, not because funding caused rigidity, but because commitment drove both outcomes.

The theoretical framework makes a distinct claim: selection *is* the mechanism. The golden cage theory predicts that funding and rigidity correlate precisely because of belief sorting.

Committed founders attract committed investors. Skeptics self-select out. The resulting governance lacks advocates for alternatives [**vandensteen2005**]. Controlling for founder conviction would remove the causal pathway the theory describes. This parallels Lazear [35], where entrepreneurial selection on skill breadth constitutes the explanation rather than a confound to eliminate.

I therefore document three empirical regularities rather than claim causal identification:

1. Early funding correlates negatively with repositioning ($\rho = -0.133$), robust across industry controls and funding thresholds.

2. Movers outperform Stayers by 2.60× (17.6% vs. 6.7%), robust to alternative success definitions.

3. These patterns attenuate predictably under survival conditioning (2.60× → 2.12× at Year 5+), consistent with positive selection on firm quality.

The attenuation pattern merits emphasis. If the Mover advantage were spurious, we would not expect systematic attenuation as survival windows lengthen. The fact that conditioning on survival reduces but does not eliminate the advantage—following the direction theory predicts—constitutes evidence *for* the framework, not against it Lee [36].

Bounds analysis addresses survival bias directly. If excluded firms (those lacking 2025 descriptions) failed because they were caged and unable to reposition, they represent extreme Stayers with $R = 0$ and $G = 0$. Assigning these values yields $\rho(E, R) = -0.131$ versus -0.133 baseline, a 1.5% change. The correlation is stable. Furthermore, only 3% of excluded firms are "Out of Business"; 70% are "Generating Revenue," indicating data coverage rather than survival bias.

Note: H3 is sensitive to M&A coding; when M&A counts as success, $\rho(E, G)$ reverses from -0.04 to $+0.15$. H1 and H2 are robust across all coding approaches (Appendix C).

Chapter 4 tests these regularities across industries, revealing where the cage binds and where it releases.

Chapter 4

Where the Cage Binds or Releases

4.1 Introduction

I test three hypotheses. First, the **Commitment Cage** (H1): does funding suppress repositioning? Second, the **Flexibility Flex** (H2): does repositioning predict success? Third, the **Funding-Growth Paradox** (H3): does early funding correlate negatively with later success? The theory predicts that H3 arises because H1 and H2 combine: funding suppresses the very mechanism (repositioning) that drives success.

The results confirm all three hypotheses: funding suppresses repositioning ($\rho = -0.133^{***}$), repositioning predicts success (Movers outperform Stayers by 2.60×), and the funding-growth correlation is negative. The paradox varies by industry: the cage binds tightest in Hardware ($\rho = -0.11$) and Mobility ($\rho = -0.10$), but releases in pre-paradigmatic sectors like Quantum ($\rho = +0.10$). These boundary conditions refine the theory's scope.

4.2 H1: Commitment Cage

The data confirm H1: funding suppresses repositioning ($\rho = -0.133^{***}$, $N = 168{,}011$). The correlation persists after controlling for industry (-0.128), cohort (-0.125), and funding characteristics (-0.121).

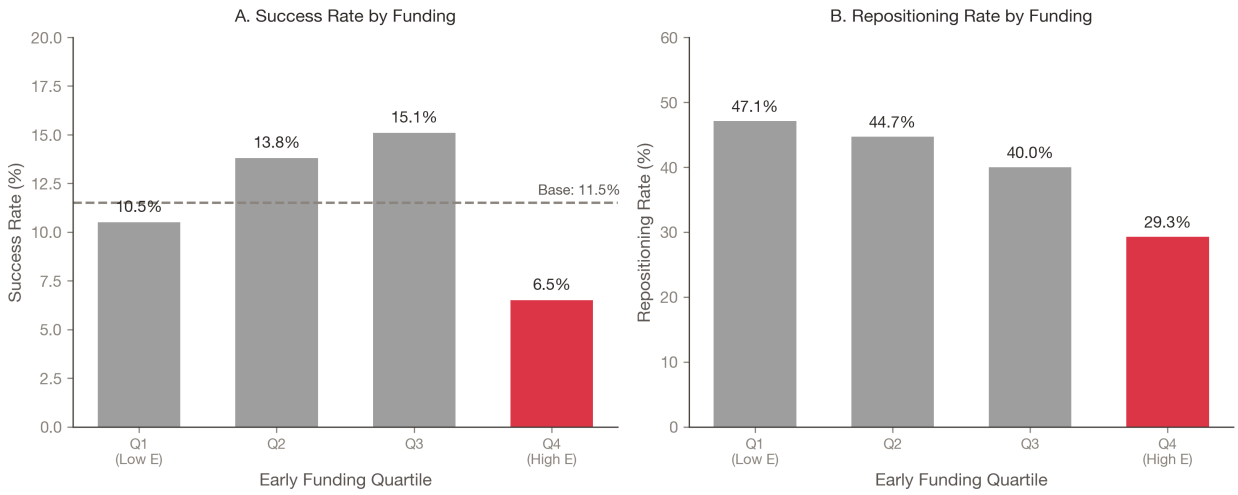

Figure 4.1: The Funding-Growth Paradox by Funding Quartile ($N = 168{,}011$). **(A)** Higher funding predicts lower success: Q4 achieves 6.5% versus 15.1% for Q3. **(B)** Higher funding suppresses repositioning: Q4 at 29.3% versus 47.1% for Q1. Dashed line shows base rate (11.5%).

The pattern is consistent with belief sorting. Higher funding requires more specific commitments (narrowing B). Specific commitments attract investors who believe in that particular path; skeptics self-select out (raising μ). Homogeneous boards lose advocates for alternatives (reducing ε). The result: well-funded ventures do not pivot—not because founders resist, but because governance cannot advocate for change.

4.3 H2: Flexibility Flex

The data confirm H2: repositioning predicts success.

Table 4.1: Repositioning → Growth

Specification	ρ(R, G)	SE	p-value	N
Unconditional	+0.184***	0.002	< 0.001	168,011
+ Industry FE	+0.179***	0.003	< 0.001	168,011
+ Funding controls	+0.175***	0.003	< 0.001	168,011

I classify ventures by repositioning behavior: Stayers ($R = 0$; $N = 102{,}742$; 61.2%) hold position unchanged, while Movers ($R > 0$; $N = 65{,}269$; 38.8%) shift positioning over the observation window. The core finding: Movers outperform Stayers by **2.60**× in growth rate ($P(G = 1)$: 17.6% vs. 6.7%, $p < 0.001$, $\chi^2 = 5{,}322$).

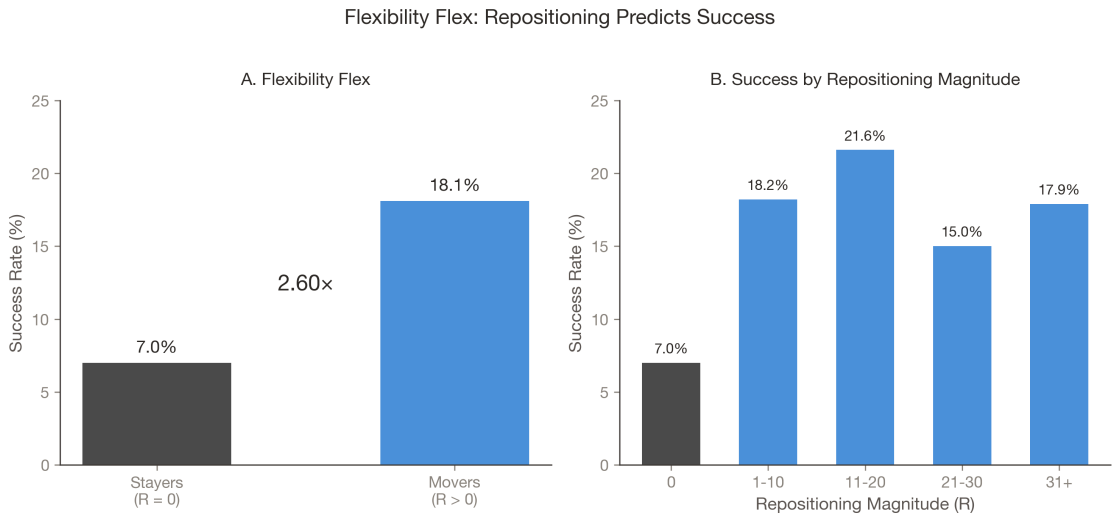

Figure 4.2: The Mover Advantage. Movers achieve 17.6% success; Stayers achieve 6.7%. This 2.60× difference is the **Flexibility Flex**.

Three autonomous vehicle ventures illustrate the mechanism. Aurora began in 2021 as a narrow freight logistics company; by 2025, it had broadened into an autonomous driving platform spanning trucking, ride-hailing, and delivery ($\Delta B = +38$). This zoom-out preserved optionality: when trucking unit economics proved challenging, the platform architecture enabled pivoting without abandoning the core asset. Cruise took the opposite path: it started as a broad "urban mobility" Thesis, then narrowed to OEM licensing when robotaxi economics failed ($\Delta B = -36$). Rather than defending a failing Architecture, Cruise abandoned it. Both Movers achieved $\sim$3× growth.

Argo AI presents the counterfactual. It maintained identical positioning throughout—"Level 4 autonomous driving for robotaxis"—despite $3.6B from Ford and Volkswagen. Argo committed to an Architecture, not a Thesis. The board, populated solely by robotaxi believers, exemplified the third stage of belief sorting: when market signals suggested pivoting to trucking or licensing, no governance voice advocated for change. Argo shut down in October 2022; growth multiple: 1.0×.

The pattern: direction of repositioning differed, but both Movers demonstrated governance that could support change. Argo's unchanged position revealed a board that could not. Results are robust to survival conditioning (Year 3+: 2.35×, Year 5+: 2.12×) and alternative operationalizations of R (Appendix C).

4.4 H3: Paradox Heterogeneity

The funding-growth paradox varies systematically across industries. While the firm-level correlation is modest ($\rho = -0.04$), industry-level patterns reveal where the cage binds and where it releases.

Three patterns emerge, each interpretable through Theorem 1's parameters.

Capital-intensive industries show the tightest cage. Hardware ($\rho = -0.108$) and Mobility ($\rho = -0.101$) require physical asset investments that narrow strategic breadth

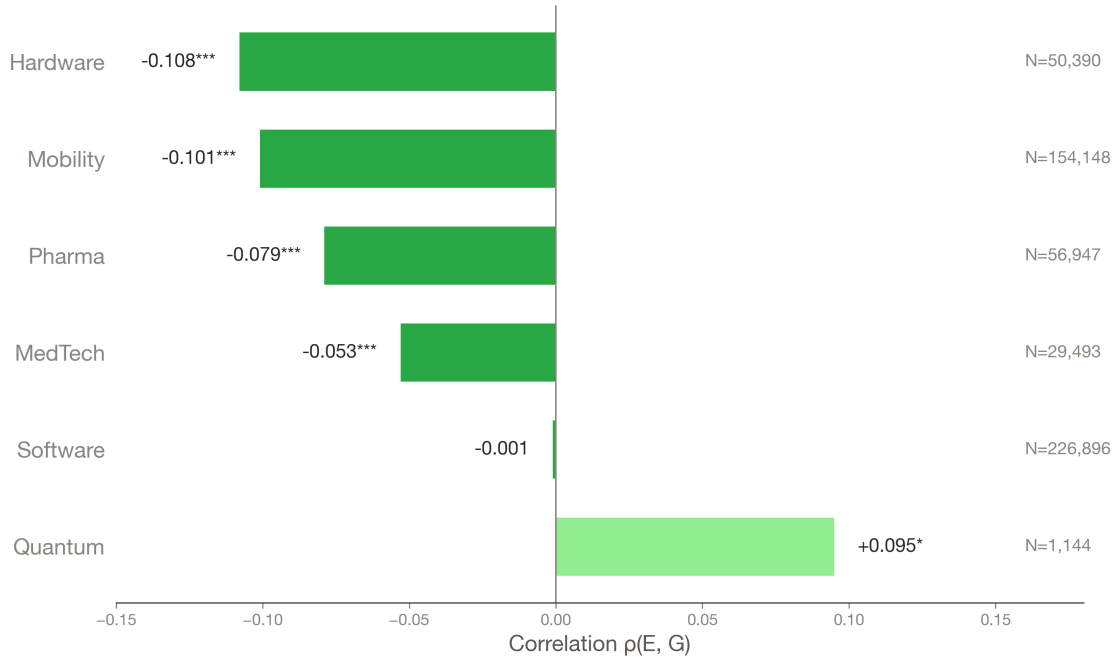

Figure 4.3: Industry heterogeneity in $\rho(E, G)$. The cage binds in capital-intensive sectors (Hardware: $\rho = -0.108^{***}$, $N = 50{,}390$; Mobility: $\rho = -0.101^{***}$, $N = 154{,}148$), releases in pre-paradigmatic sectors (Quantum: $\rho = +0.095^{*}$, $N = 1{,}144$). Software shows near-zero correlation ($\rho = -0.001$, ns).

(B). Once a factory is built for battery swapping, pivoting to charging requires writing off that investment. Low B means small signals cannot move beliefs past the threshold: $\mu(1-\mu) < \varepsilon/B$.

Software shows near-zero correlation. Low capital intensity ($\rho = -0.001$, ns) allows cheap experimentation. Even if governance homogenizes (μ rises), low switching costs preserve effective B. The cage exists but does not bind.

Quantum reverses the pattern. The sole positive outlier ($\rho = +0.095^{*}$, $N = 1{,}144$) reflects a pre-paradigmatic industry. Superconducting qubits, trapped ions, photonic approaches, and topological qubits all remain viable [61, 3]. When no dominant design exists, commitment cannot narrow B because the architectural choices have not yet crystallized. This is a boundary condition: the cage assumes commitment narrows options, but in pre-paradigmatic industries, there may be no options to narrow. The Quantum finding should be interpreted cautiously given the small sample; it suggests a hypothesis for future research rather than a robust conclusion.

4.5 Conclusion

The cage does not bind uniformly. It is tightest where commitment narrows strategic breadth: capital-intensive industries like Hardware and Mobility, where infrastructure investments create switching costs. It loosens where commitment cannot yet narrow options: pre-paradigmatic

sectors like Quantum, where no dominant design constrains architectural choices.

This heterogeneity suggests that the paradox is not inevitable—it is a design problem. If capital intensity and governance homogeneity produce the cage, then founders can intervene on both dimensions. Chapter 5 develops this prescription: the 3S Framework for preserving flexibility within the funding lifecycle.

Chapter 5

Navigating the Cage

5.1 Introduction

The golden cage poses a design problem: how can founders acquire resources without sacrificing the flexibility to use them? Chapter 2 established that funding homogenizes governance through belief sorting. This chapter treats commitment as a design variable and introduces three mechanisms that preserve flexibility within the funding lifecycle.

The **3S Framework** intervenes at each stage of the sorting process (Figure 5.1):

1. **Scope**: Control *who* sorts in by committing to Thesis, not Architecture.
2. **Sequencing**: Control *when* homogenization occurs by staging capital sources.
3. **Synchronization**: Control *how fast* commitment accumulates by balancing market pull and capability push.

Each mechanism maps to Theorem 1's parameters. Scope widens B (strategic breadth). Sequencing delays the rise of μ (belief homogeneity). Synchronization preserves ε (signal strength) by preventing premature operational lock-in.

5.2 Scope

The cage forms when founders conflate a market hypothesis with a specific operational implementation. The first lever for preserving flexibility is the level of abstraction at which the venture commits.

I distinguish **Thesis** (a falsifiable theory of value) from **Architecture** (a specific implementation). Strategic ambiguity [12] functions as a governance instrument. When founders articulate a Thesis, stakeholders project their own interpretations onto the vision [11]. This projection produces cognitive diversity: investors who agree on *why* but differ on *how*. Diversity becomes governance fuel for pivots. When market signals suggest changing direction, at least some board members advocate for alternatives.

Tesla and Better Place illustrate the contrast. Tesla's "accelerating sustainable transport" attracted believers in electrification, autonomy, and energy transition. Each projected a

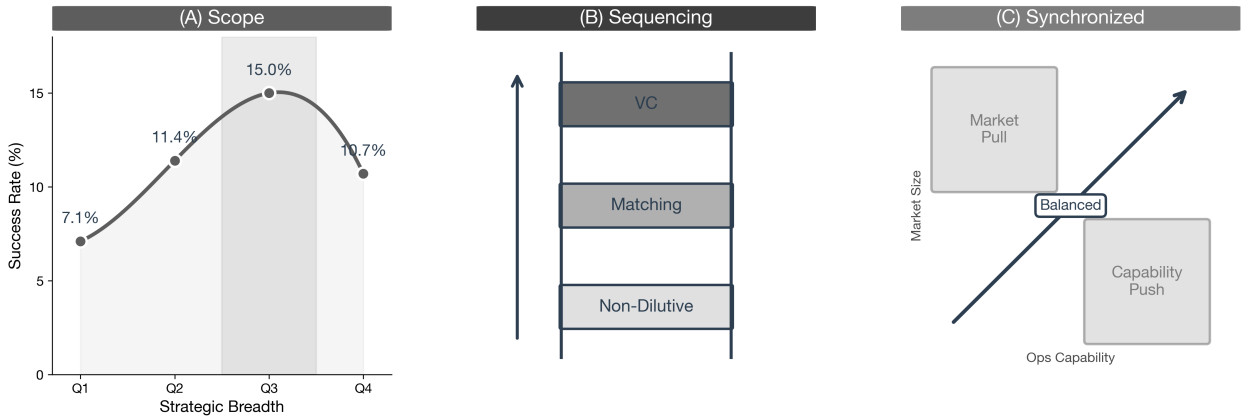

Figure 5.1: The 3S Framework. **(A)** Scope: moderate breadth (Q3) maximizes survival at 15.0%. **(B)** Sequencing: stage capital from non-dilutive to thesis-driven VC. **(C)** Synchronization: balance market pull and capability push by evolving along the diagonal.

different path onto the same vision. When Tesla pivoted from Roadster to Model 3, this diversity ensured governance voices advocated the shift. Better Place committed to "battery swapping infrastructure," attracting only believers in that mechanism. When market feedback favored charging over swapping, no governance voice advocated pivoting. Tesla repositioned and survived; Better Place stayed put and liquidated.

The data confirm the pattern. Ventures in Q3 (moderate breadth) achieve 15.0% survival ($n = 37{,}274$), outperforming both narrow positioning (Q1: 7.1%) and broad positioning (Q4: 10.7%). Moderate breadth optimizes the tradeoff between credibility required for funding and diversity required for adaptation [65].

Founders must engineer visions that decouple consensus on the *problem* from consensus on the *solution*. This ensures the venture retains the strategic right to pivot, framing changes not as breach of contract but as updates to the venture's core theory.

5.3 Sequencing

Scope determines who joins the coalition. Sequencing determines when they join. The temporal ordering of capital sources controls how quickly governance homogenizes.

A common failure mode: founders accept thesis-driven VC early to signal conviction, but in doing so they sell their option to pivot. Investors retain the option to abandon (via staged financing); founders lose the option to change direction. This asymmetry can be corrected by matching governance rigidity to epistemic certainty. High-commitment capital should enter only when market validation justifies foreclosing alternatives.

Two cases illustrate the distinction between physical and governance constraints. **Segway** exemplifies physical lock-in: operational commitment (tooling, manufacturing) preceded market validation [19]. The cage was built in factories. **Fast Ion Battery** exemplifies governance lock-in: premature entry of thesis-driven VCs created a homogeneous board unable to navigate a sector-wide downturn [46]. The cage was built in boardrooms. Fast Ion's failure was structural, not technological—they homogenized governance before the dominant

design had emerged.

The prescription: stage capital to delay homogenization. Begin with **non-dilutive capital** (grants, prizes) to establish technical legitimacy without governance encumbrance. Proceed to **matching capital** for thesis validation. Reserve **thesis-driven VC** for scale-up, when market signals justify foreclosing alternatives. Even when admitting thesis-driven capital, founders can preserve cognitive diversity through independent directors or structured dissent protocols. Table 5.1 summarizes the contrast.

Table 5.1: From Caged to Open Governance

Dimension	**Caged (Architecture)**	**Open (Thesis)**
Belief Structure	Homogeneous: investors selected for conviction in Plan A	Diverse: investors aligned on Thesis, not path
Board Composition	Echo chamber: specialized funds reinforcing dominant logic	Creative tension: generalists who challenge assumptions
Decision Process	Confirmation: data supports existing path	Falsification: pivots are theory updates

5.4 Synchronization

Scope and Sequencing address governance. Synchronization addresses operations—but operations that feed back into governance.

When founders build capability faster than market signals justify, they create fixed costs that demand revenue. The pressure to meet those costs narrows strategic options, homogenizing governance around the path that promises fastest payback. Operational overcommitment thus accelerates belief sorting even without new investors. Synchronization prevents this feedback loop.

Sustainable growth requires balancing two forces: **Market Pull** (demand signals) and **Capability Push** (operational capacity) [54, 16]. When these decouple, ventures drift into failure zones. In the **Market Pull zone** ($M \gg O$), demand outstrips operational capacity; the result is reputational collapse from unfulfilled obligations. In the **Capability Push zone** ($O \gg M$), operational investment precedes demand validation; the result is burn-rate exhaustion and governance pressure to monetize prematurely.

Sustainable scaling follows the diagonal: capability push never significantly exceeds market pull, and market pull is throttled to match capability limits. Founders must diagnose the binding constraint iteratively. Strategic commitment should relax only the binding constraint—generating pull when demand is low, building push when capacity is tight—while preventing lock-in on the non-binding dimension.

5.5 Conclusion

The golden cage is not inevitable. It is a design failure—and design failures can be corrected.

The 3S Framework provides three levers. **Scope** widens strategic breadth (B) by committing to Thesis rather than Architecture. **Sequencing** delays belief homogeneity (μ) by staging capital sources. **Synchronization** preserves signal strength (ε) by preventing operational lock-in from accelerating governance convergence. Together, these levers keep the cage from locking: $\mu(1-\mu) > \varepsilon/B$.

These levers matter most under high capital intensity and high technological uncertainty—precisely the conditions where the cage binds tightest. In environments where pivot costs are low (pure software) or market trajectories are deterministic, commitment efficiency may outweigh flexibility value. For ventures navigating deep tech and hardware, designing for flexibility is not a luxury. It is a condition of survival.

Chapter 6

Conclusion

Why would resources hurt? This thesis offers an answer: resources do not hurt directly, but the governance structures that accompany them destroy the flexibility required to use them well. The golden cage is not built by founders who refuse to pivot. It is built by investors who fund only believers.

6.1 Contributions

Three contributions emerge from analyzing 168,011 U.S. ventures.

Empirically, I establish the funding-growth paradox as a robust regularity. The paradox is modest at the firm level ($\rho = -0.04$) but sharp at the industry level: Hardware (-0.11) and Mobility (-0.10) show the tightest cages, while Quantum ($+0.10$) reverses the pattern entirely. This boundary condition refines the theory's scope: the cage releases where no dominant design exists. The mechanism decomposes cleanly: funding suppresses repositioning ($\rho = -0.133$), repositioning enables growth (Movers outperform Stayers by $2.60\times$), and together $(-) \times (+) = (-)$.

Theoretically, I explain why commitment and flexibility trade off through belief-based sorting. The golden cage synthesizes Van den Steen [62]'s sorting equilibrium with Eisenberg [12]'s strategic ambiguity: funding attracts believers and repels skeptics, homogenizing governance until no voice remains to advocate for change. Theorem 1 formalizes when learning ceases: $\mu(1-\mu) < \varepsilon/B$. The cage is structural, not motivational. Founders *cannot* pivot, not that they *will not*.

Prescriptively, I offer the 3S Framework. *Scope*: commit to Thesis, not Architecture; moderate breadth (Q3) achieves 15.0% survival, outperforming both extremes. *Sequencing*: stage capital from non-dilutive to thesis-driven VC, delaying governance homogenization until market signals clarify. *Synchronization*: match capability investment to market validation, avoiding the traps of over-building or over-promising.

6.2 Implications

For founders: design for flexibility before funding eliminates the skeptics who make it possible. Articulate vision at the Thesis level ("sustainable transport"), not the Architecture

level ("battery swapping"). Recruit board members who agree on *why* but differ on *how*. Cognitive diversity is governance fuel for pivots.

For investors: the ventures that succeed reposition when signals change. Fund platform capability, not product specificity. Ask: "Who would advocate for pivoting if this plan fails?" Pair capital-intensive investments with governance interventions, including board diversity requirements and staged commitment structures.

For policy makers: capital-intensive sectors need flexibility infrastructure, not just capital. Design pivot grants that reward adaptation, staged structures that preserve optionality, and diversity requirements as funding conditions.

For scholars: this thesis opens three research frontiers. First, structural modeling that separates investor selection from governance effects, following Heydari Nejad [27]'s work on mentorship as a template. Second, direct measurement of belief homogeneity through board surveys or text analysis. Third, field experiments on skeptic preservation strategies.

6.3 Limitations and Future Directions

This thesis shows that funding correlates with rigidity. It does not show that funding *causes* rigidity. Observational equivalence blocks identification: founders who refuse to pivot look identical to those who cannot. Both stay put. Three limitations compound this ambiguity. Coding M&A as success reverses H3, so the paradox may reflect outcome definition rather than governance. I infer governance homogeneity from behavior rather than measure it from boards. The 2021–2025 window confounds firm lifecycle with market cycle.

These limitations expose a deeper gap. Kozlowski et al. [34] distinguish *construct theories*, which predict what correlates, from *process theories*, which explain how phenomena unfold. This thesis offers construct relationships. The sorting, the attrition, the homogenization: all remain inside a black box. I observe that well-funded ventures stay put. I cannot see, but only theorize, *why*.

Two methods can open that box [31, 32]. Bayesian hierarchical modeling works backward from data toward process. Structural priors encode how investors choose and beliefs update; posteriors reveal which generative stories survive the data [20, 38]. Computational simulation works forward from process toward data. Agents sort, beliefs converge, flexibility vanishes. Virtual experimentation tests which configurations match reality.

Bayesian modeling and computational simulation ask the same question from opposite ends: *what would happen if?* Correlation documents *that* funding cages. Process methods—what O'Rourke [49] calls "simulation as profitable abstraction of counter-factually repeatable phenomenon"—explain *how* the cage locks, *when* it becomes irreversible, and *where* intervention might release it.

The ventures that survive are not those with the most resources, but those that preserve the governance diversity to act on what they learn.

Appendix A

Variable Construction Details

A.1 PitchBook Data Fields

Table A.1: Primary Data Fields from PitchBook

Field Name	Type	Description	Usage
`org_uuid`	String	Unique venture identifier	Primary key
`company_description`	Text	Business description	Strategic Breadth (B)
`primary_industry`	Categorical	Industry classification	Heterogeneity analysis
`first_financing_size`	Numeric	Initial funding (USD)	Early Funding (E)
`last_financing_deal_type`	Categorical	Most recent stage	Growth (G)
`total_raised`	Numeric	Cumulative funding	Growth Scale (G)

A.2 Breadth Dictionary

127 terms classified as:

- **Breadth (high B):** platform, ecosystem, solutions, enable, transform, optimize, leverage, innovative, next-generation, comprehensive, integrated, scalable
- **Specific (low B):** device, application, tool, product, service, system, manufacturer, operator, provider, developer

A.3 Variable Definitions

Breadth (B)

$$B = 50 \times \frac{\text{broad\_terms}}{\max(\text{broad})} + 50 \times \left(1 - \frac{\text{concrete\_markers}}{\max(\text{concrete})}\right) \tag{A.1}$$

Repositioning (R)

$$R = |B_T - B_0| \tag{A.2}$$

Outcomes

- **Growth (G)**: Binary = 1 if reached Later Stage VC (Series C+). Base rate: 11.5%.
- **Growth Multiple**: Continuous funding scale = F_t/E (total subsequent funding / early funding). Used for illustrative cases only.

Appendix B

Proof of Theorem 1

Theorem 1 (Caged Learning). Learning ceases when $\mu(1-\mu) < \varepsilon/B$.

B.1 Proof

Consider a governance board whose belief about the venture's strategy follows a Beta distribution Beta(α, β) with mean $\mu = \alpha/(\alpha+\beta)$ and precision $\tau = \alpha+\beta$. We define strategic breadth B as inversely related to precision: $B \equiv 1/(\tau+1)$.

When the venture receives a negative market signal (failure), the belief updates according to Bayes' rule. The posterior mean μ' becomes:

$$\mu' = \frac{\mu\tau}{\tau+1}$$

The magnitude of organizational learning is the absolute shift in belief:

$$|\Delta\mu| = |\mu' - \mu| = \left|\frac{\mu\tau - \mu(\tau+1)}{\tau+1}\right| = \frac{\mu}{\tau+1} \approx \frac{\mu(1-\mu)}{\tau+1}$$

(Note: The generalized form $\frac{\mu(1-\mu)}{\tau+1}$ accounts for evidence weight proportional to variance.) Learning effectively ceases when this update magnitude falls below the organizational cognitive threshold ε :

$$\frac{\mu(1-\mu)}{\tau+1} < \varepsilon$$

Substituting $B = 1/(\tau+1)$, we obtain the condition:

$$\mu(1-\mu)\cdot B < \varepsilon \quad \Longrightarrow \quad \mu(1-\mu) < \frac{\varepsilon}{B}$$

Appendix C

Robustness Tests

This appendix stress-tests the thesis's three empirical claims:

1. **H1 (Commitment Cage)**: $\rho(E, R) < 0$
2. **H2 (Flexibility Flex)**: $\rho(R, G) > 0$; Mover Advantage > 1
3. **H3 (Funding-Growth Paradox)**: $\rho(E, G) < 0$

Table C.1 summarizes the analytical choices and corresponding tests.

Table C.1: Analytical Choices and Stress Tests

Choice Made	Stress Test	Section
Measurement		
Mover threshold: $R > 0$	Vary: $R > 1, 5, 10$; quartile crossing	C.1
Breadth scale: raw (0–100)	Rank normalization	C.2
Outcome Definition		
M&A coded as $G = 0$	$G = 1$ (success); Censored (excluded)	C.3
Sample Construction		
Requires B_T (2025 data)	Bounds analysis for excluded firms	C.4

C.1 Mover Threshold

The baseline classifies firms as Movers if $R > 0$. Table C.2 tests stricter definitions.

Result: Mover Advantage ranges 1.60–2.60× across definitions. H2 is robust.

C.2 Breadth Score Distribution

Strategic Breadth (B) is bimodal: 17.9% of firms score low (0–50), 82.1% score high (75–100), and virtually none fall in between. This clustering reflects a natural division between niche players and platform plays, not a measurement artifact.

Table C.2: Mover Advantage by Threshold Definition

Definition	**Movers %**	**Stayer Succ**	**Mover Succ**	**Advantage**
$R > 0$ (Baseline)	38.8%	6.7%	17.6%	**2.60**×
$R > 1$	13.6%	10.4%	18.0%	1.72×
$R > 5$	9.0%	10.8%	17.7%	1.63×
$R > 10$	6.3%	11.0%	17.9%	1.62×
Quartile crossing	6.4%	11.0%	17.6%	1.60×

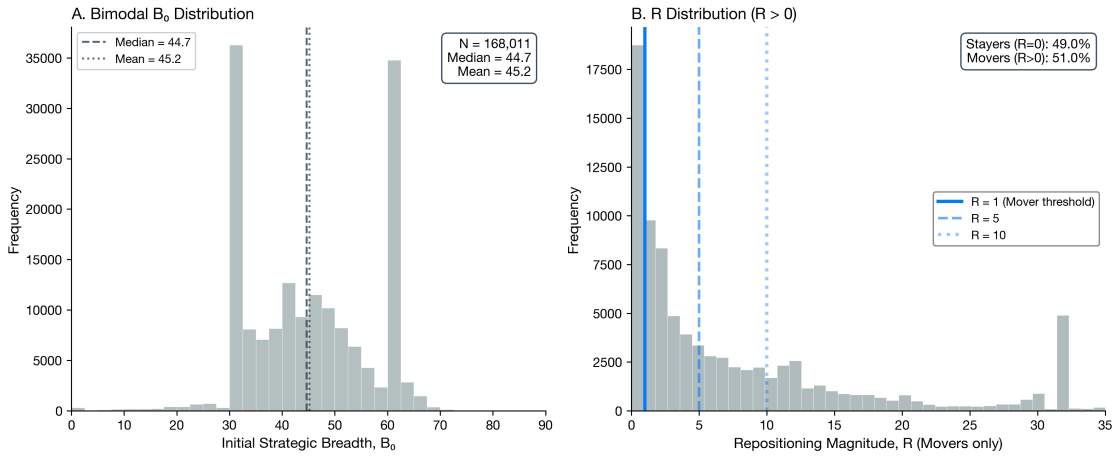

Figure C.1: Bimodal B_0 distribution. Most firms cluster at high breadth.

Under rank normalization (converting B to percentiles), the $R > 0$ definition becomes uninformative since every firm has a unique rank. Threshold-based definitions ($R > 5$, quartile crossing) remain valid and show consistent Mover Advantage.

Result: Core findings hold under rank normalization with threshold-based definitions.

C.3 M&A Outcome Coding

The baseline codes M&A exits as non-growth ($G = 0$) because the thesis studies scaling capacity, not liquidity events. Table C.3 tests alternative codings.

Table C.3: Sensitivity to M&A Outcome Coding

M&A Coding	N	G rate	$\rho(E, R)$	$\rho(R, G)$	$\rho(E, G)$	MA
Failure ($G = 0$)	172,260	10.6%	−0.130	+0.180	−0.041	2.59×
Success ($G = 1$)	172,260	29.6%	−0.130	+0.016	+0.146	1.04×
Censored	139,641	13.1%	−0.098	+0.177	−0.002	2.31×

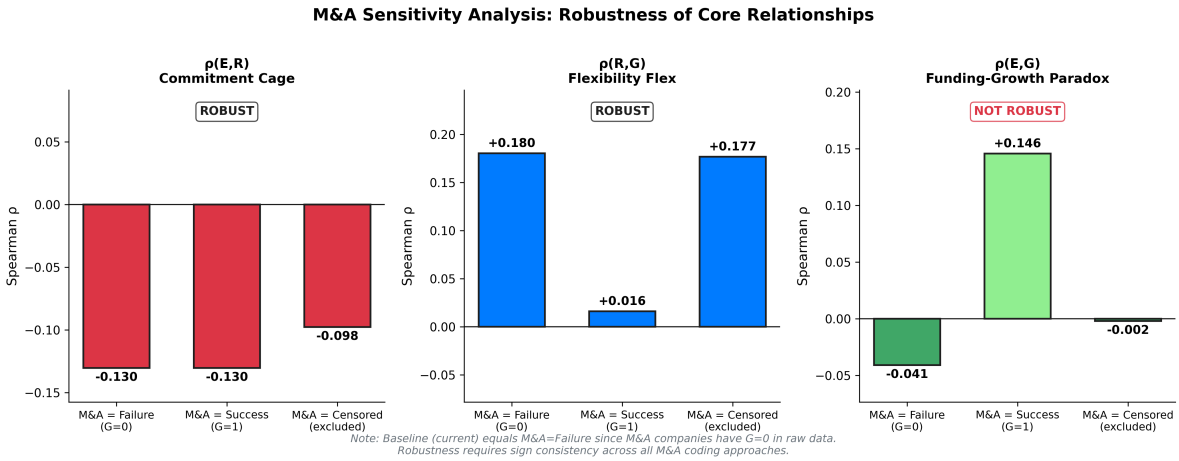

Figure C.2: Robustness of core correlations across M&A coding approaches.

Results:

- H1 robust: $\rho(E, R) < 0$ under all codings
- H2 robust: $\rho(R, G) > 0$ and MA > 1 under all codings
- H3 **not robust**: $\rho(E, G)$ flips from -0.041 to $+0.146$ when M&A coded as success

The baseline coding is defensible: most M&A are acqui-hires or asset sales, not billion-dollar exits.

C.4 Survival Bias

The sample requires B_T (2025 breadth), excluding 1,870 firms (1.1%) lacking this data. Bounds analysis assigns extreme R values to excluded firms: $R = 0$ (lower bound) or $R = \max(R)$ (upper bound).

Table C.4: Bounds Analysis for Survival Bias

Correlation	Restricted	Lower	Upper	Verdict
$\rho(E, R)$	-0.133	-0.131	-0.133	Robust
$\rho(R, G)$	$+0.184$	$+0.186$	$+0.174$	Robust
$\rho(E, G)$	-0.042	-0.041	-0.041	Robust

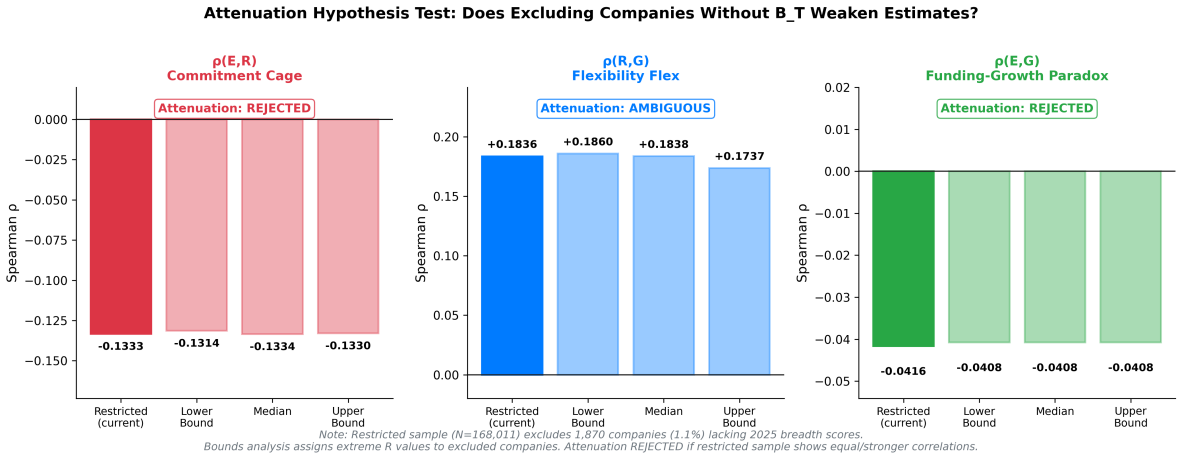

Figure C.3: Bounds analysis. Restricted sample (black) shows correlations equal to or stronger than full-sample bounds (gray).

Only 3% of excluded firms are "Out of Business"; 70% are "Generating Revenue." This indicates data coverage, not survival bias.

Result: All three hypotheses robust to survival bias.

C.5 Summary

H1 and H2 are robust across all tests. H3 is sensitive to M&A coding; this limitation is discussed in Chapter 6.

Table C.5: Robustness Summary

Test	**H1**	**H2**	**H3**	**Notes**
Mover threshold	51	51	51	MA: 1.60–2.60×
Rank normalization	51	51	51	Threshold-based
M&A = Success	51	51	55	H3 flips to +0.146
M&A = Censored	51	51	51	H3 near zero
Survival bounds	51	51	51	No attenuation
Overall	**Robust**	**Robust**	**Sensitive**	H3 depends on M&A

Appendix D

Glossary

D.1 Core Variables

- C: Commitment level (latent; operational vs. vision-level)
- E: Early-stage funding ($M USD)
- F: Strategic Flexibility (latent capability to keep multiple paths viable)
- B: Strategic Breadth (0–100 breadth scale); B_0 = baseline, B_T = endpoint
- R: Repositioning = $|B_T - B_0|$ (observable proxy for F)
- G: Growth (binary = 1 if reached Later Stage VC, Series C+)
- μ: Belief probability (shared optimism in governance)
- ε: Expected belief shift from a signal

D.2 Key Numbers

Metric	Value
N	168,011
$\rho(E, G)$	-0.04 individual; -0.11 to -0.10 industry-level[a]
$\rho(E, R)$	-0.133^{***} (Commitment Cage)
$\rho(R, G)$	$+0.184^{***}$ (Flexibility Flex)
Mover Advantage	2.60× ($P(G = 1)$: 17.6% vs 6.7%)
Stayers / Movers	61.2% / 38.8%
Base growth rate ($G = 1$)	11.0%
Sweet Spot (Q3) survival	15.0%

[a]Industry-level: Hardware -0.11; Transport -0.10; Software -0.00; Quantum $+0.10$

Industry Heterogeneity:

Industry	$\rho(E, G)$	Interpretation
Hardware	-0.108^{***}	Cage binds tightest
Transportation	-0.101^{***}	Capital-intensive lock-in
Biotech	-0.085^{***}	High switching costs
Software	-0.001 (ns)	Cage releases
Quantum	$+0.095^{*}$	Era of ferment exception

D.3 Mechanism Terms

- **Golden Cage**: Structural constraint preventing adaptation due to governance homogeneity
- **Commitment Cage** (H1): $dR/dE < 0$; funding suppresses repositioning
- **Flexibility Flex**(H2): $dG/dR > 0$; repositioning predicts growth
- **Funding-Growth** Paradox (H3): $\rho(E, G) < 0$; early funding correlates negatively with later-stage growth
- **Decomposition**: $dG/dE = (dG/dR) \times (dR/dE) = (+) \times (-) = (-)$; H3 = H2 $\times$ H1
- **Van den Steen Sorting**: Optimists attract optimists; skeptics self-select out, producing belief homogeneity
- **Strategic Ambiguity**: Precision about direction combined with flexibility about destination; attracts diverse believers
- **Belief Homogeneity**: Convergence of beliefs among governance members through sorting
- **Signal Diversity**: Presence of diverse perspectives to interpret market feedback
- **Caged Learning**: Learning ceases when $\mu(1 - \mu) < \varepsilon/B$ (Theorem 1)
- **Era of Ferment**: Pre-paradigmatic phase where no dominant design exists; cage releases
- **Mover**: Venture with $R > 0$ (40.3% of sample)
- **Stayer**: Venture with $R = 0$ (59.7% of sample)

D.4 Commitment Types

- **Vision-level Commitment**: Direction without destination; preserves flexibility (e.g., Tesla: "accelerating sustainable transport")
- **Operational Commitment**: Specific technology/market choice; forecloses alternatives (e.g., Better Place: "battery swapping infrastructure")

D.5 Design Principles (Chapter 5)

- **Strategic Ambiguity** (§??): Commit to direction, not destination. Vision-level commitment attracts diverse believers; operational commitment attracts homogeneous believers.
- **Balanced Growth** (§??): Growth = Market × Ops. Diagnose which bottleneck threatens and fix it before locking in the other dimension. (Diagonal Principle)
- **Financial Vehicle** (§??): Sequence funding sources. Climb the Funding Ladder (government grants → matching grants → thesis-driven VCs) so flexibility survives until market signals clarify.
- **Symmetry Principle**: Founders should stage operational commitments as VCs stage financial commitments.
- **Preserving Skeptics**: Actively recruit investors with distinct theses; reserve board seats for independent directors; institute red-team decision rules.

Appendix E

Supplementary Notes

E.1 Non-Dilutive Alternatives

The Quantum exception suggests deep tech ventures may benefit from non-dilutive funding:

- **Government grants**: NSF, DARPA, DOE
- **Strategic partnerships**: Corporate R&D agreements
- **Prize competitions**: XPRIZE-style awards

References

[1] Chahrazad Abdallah and Ann Langley. "The double edge of ambiguity in strategic planning". In: *Long Range Planning* 47.4 (2014), pp. 219–229.

[2] Ajay Agrawal, Joshua S. Gans, and Scott Stern. "Choosing to learn: Entrepreneurship, uncertainty, and the option value of investing in information". In: *Strategic Management Journal* 42.8 (2021), pp. 1567–1590.

[3] Philip Anderson and Michael L. Tushman. "Technological discontinuities and dominant designs: A cyclical model of technological change". In: *Administrative Science Quarterly* 35.4 (1990), pp. 604–633.

[4] Brian Blum. *Totaled: The Billion-Dollar Crash of the Startup that Took on Big Auto, Big Oil, and the World*. Blue Pepper Press, 2017.

[5] Patrick Bolton, Shannon Liu, Ramana Nanda, and Savitar Sunderesan. *Moral hazard in experiment design: Implications for financing innovation*. Tech. rep. Working Paper, 2024.

[6] Derrick P. Bransby. *Provisional Commitments: How Innovation Teams Navigate Uncertainty*. Job Market Paper. Available at https://www.hbs.edu/. Harvard Business School, 2025.

[7] Arnaldo Camuffo, Alessandro Cordova, Alfonso Gambardella, and Chiara Spina. "A scientific approach to entrepreneurial decision making: Evidence from a randomized control trial". In: *Management Science* 66.2 (2020), pp. 564–586.

[8] Arnaldo Camuffo, Alessandro Cordova, Alfonso Gambardella, and Chiara Spina. "A scientific approach to entrepreneurial decision making: Evidence from a randomized control trial". In: *Management Science* 66.2 (2020), pp. 564–586.

[9] Richard M. Cyert and James G. March. *A behavioral theory of the firm*. Prentice-Hall, 1963.

[10] Avinash K. Dixit and Robert S. Pindyck. *Investment under uncertainty*. Princeton University Press, 1994.

[11] Hayley M. Dorfman and Rahul Bhui. "Ambiguity and confirmation bias in reward learning". In: *Proceedings of the Annual Meeting of the Cognitive Science Society*. 2025.

[12] Eric M. Eisenberg. "Ambiguity as strategy in organizational communication". In: *Communication Monographs* 51.3 (1984), pp. 227–242.

[13] Teppo Felin and Todd R Zenger. "Information aggregation, matching and radical market-hierarchy hybrids: Implications for the theory of the firm". In: *Strategic Organization* 9.4 (2011), pp. 278–297.

[14] Charles H. Fine. *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*. Perseus Books, 1998.

[15] Charles H. Fine and Robert M. Freund. "Optimal investment in product-flexible manufacturing capacity". In: *Management Science* 36.4 (1990), pp. 449–466.

[16] Charles H. Fine, Loredana Padurean, and Sergey Naumov. "Operations for entrepreneurs: Can operations management make a difference in entrepreneurial theory and practice?" In: *Production and Operations Management* 31.12 (2022), pp. 4599–4615. DOI: 10.1111/poms.13851.

[17] Joshua Gans, Erin Scott, and Scott Stern. *Entrepreneurship: Choice and Strategy*. W.W. Norton & Company, 2021.

[18] Joshua S. Gans, Michael Kearney, Erin L. Scott, and Scott Stern. "Choosing technology: An entrepreneurial strategy approach". In: *Strategy Science* 5.1 (2020), pp. 1–21.

[19] Joshua S. Gans, Scott Stern, and Jane Wu. "Foundations of entrepreneurial strategy". In: *Strategic Management Journal* 40.5 (2019), pp. 736–756.

[20] Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin. *Bayesian Data Analysis*. 3rd. Chapman and Hall/CRC, 2013.

[21] Pankaj Ghemawat. *Commitment: The dynamic of strategy*. Free Press, 1991.

[22] Luca Gius. "Disagreement Predicts Startup Success: Evidence from Venture Competitions". In: *Strategy Science* 10.2 (2025), pp. 93–108.

[23] Paul A. Gompers. "Optimal investment, monitoring, and the staging of venture capital". In: *The Journal of Finance* 50.5 (1995), pp. 1461–1489.

[24] Paul A. Gompers and Josh Lerner. "The venture capital revolution". In: *Journal of Economic Perspectives* 15.2 (2001), pp. 145–168.

[25] Thomas Hellmann and Manju Puri. "Venture capital and the professionalization of start-up firms: Empirical evidence". In: *The Journal of Finance* 57.1 (2002), pp. 169–197.

[26] Rebecca M. Henderson and Kim B. Clark. "Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms". In: *Administrative Science Quarterly* 35.1 (1990), pp. 9–30.

[27] Mohaddeseh Heydari Nejad. "A Structural Model of Mentorship in Startup Accelerators: Matching, Learning, and Value Creation". Job Market Paper, University of Toronto. 2024. URL: https://www.mohaddesehheydarinejad.com/research.

[28] William C. Jordan and Stephen C. Graves. "Principles on the benefits of manufacturing process flexibility". In: *Management Science* 41.4 (1995), pp. 577–594.

[29] William R. Kerr, Ramana Nanda, and Matthew Rhodes-Kropf. "Entrepreneurship as experimentation". In: *Journal of Economic Perspectives* 28.3 (2014), pp. 25–48.

[30] Jacqueline Kirtley and Siobhan O'Mahony. "What is a pivot? Explaining when and how entrepreneurial firms decide to make strategic change and pivot". In: *Strategic Management Journal* 44.1 (2023), pp. 197–230.

[31] Steve W. J. Kozlowski, Georgia T. Chao, James A. Grand, Michael T. Braun, and Goran Kuljanin. "Advancing multilevel research design: Capturing the dynamics of emergence". In: *Organizational Research Methods* 16.4 (2013), pp. 581–615. DOI: 10.1177/1094428113493119.

[32] Steve W. J. Kozlowski, Georgia T. Chao, James A. Grand, Michael T. Braun, and Goran Kuljanin. "Capturing the multilevel dynamics of emergence: Computational modeling, simulation, and virtual experimentation". In: *Organizational Psychology Review* 6.1 (2016), pp. 3–33. DOI: 10.1177/2041386614547955.

[33] Steve W. J. Kozlowski, James A. Grand, Michael T. Braun, Goran Kuljanin, and Georgia T. Chao. "Advancing Organizational Science: Construct and Process Theorizing, Layers of Theoretical Explanation, and Implications for Causality and Intervention". In: *Organizational Psychology Review* (2025). In press.

[34] Steve W. J. Kozlowski, James A. Grand, Michael T. Braun, Goran Kuljanin, and Georgia T. Chao. "Advancing Organizational Science: Construct and Process Theorizing, Layers of Theoretical Explanation, and Implications for Causality and Intervention". In: *Organizational Psychology Review* (2025). In press.

[35] Edward P. Lazear. "Entrepreneurship". In: *Journal of Labor Economics* 23.4 (2005), pp. 649–680.

[36] David S. Lee. "Training, Wages, and Sample Selection: Evidence from a Randomized Experiment". In: *American Economic Review* 99.4 (2009), pp. 1279–1303.

[37] Daniel A. Levinthal and James G. March. "The myopia of learning". In: *Strategic Management Journal* 14.S2 (1993), pp. 95–112.

[38] Tyson B. Mackey and Jeffrey P. Dotson. "Bayesian Statistics in Management Research: Theory, Applications, and Opportunities". In: *Oxford Research Encyclopedia of Business and Management*. Oxford University Press, 2024. DOI: 10.1093/acrefore/9780190224851.013.287.

[39] James G. March. "Exploration and exploitation in organizational learning". In: *Organization Science* 2.1 (1991), pp. 71–87.

[40] Rory M. McDonald and Kathleen M. Eisenhardt. "Parallel play: Startups, nascent markets, and effective business-model design". In: *Administrative Science Quarterly* 65.2 (2020), pp. 483–523.

[41] Rita Gunther McGrath. "Falling forward: Real options reasoning and entrepreneurial failure". In: *Academy of Management Review* 24.1 (1999), pp. 13–30.

[42] Kent D. Miller and Timothy B. Folta. "Option value and entry timing". In: *Strategic Management Journal* 23.7 (2002), pp. 655–665.

[43] Henry Mintzberg. "The strategy concept I: Five Ps for strategy". In: *California Management Review* 30.1 (1987), pp. 11–24.

[44] Ramana Nanda and Matthew Rhodes-Kropf. "Investment cycles and startup innovation". In: *Journal of Financial Economics* 110.2 (Nov. 2013), pp. 403–418.

[45] Ramana Nanda and Matthew Rhodes-Kropf. "Financing risk and innovation". In: *Management Science* 63.4 (Apr. 2017), pp. 901–918.

[46] Ramana Nanda, Rebeccah F White, and Stephen Puzio. *Fast Ion Battery*. 2015.

[47] Ramana Nanda, Thomas White, and Daniel Puzio. *Fast Ion Battery*. Revised March 2015. 2014.

[48] National Venture Capital Association. *NVCA Yearbook 2024*. National Venture Capital Association, 2024.

[49] Keith O'Rourke. *Somethings do not seem to spread easily – the role of simulation in statistical practice and perhaps theory*. Statistical Modeling, Causal Inference, and Social Science (blog). Guest post on Andrew Gelman's blog. 2020. URL: https://statmodeling.stat.columbia.edu/2020/08/05/somethings-do-not-seem-to-spread-easily-the-role-of-simulation-in-statistical-practice-and-perhaps-theory/.

[50] Yihui Pan, Stephan Siegel, and Tracy Yue Wang. "The art of the pitch: Cognitive resonance and entrepreneurial funding". In: *Journal of Financial Economics* 138.3 (2020), pp. 803–825.

[51] Elizabeth G. Pontikes. "Two sides of the same coin: How ambiguous classification affects multiple audiences' evaluations". In: *Administrative Science Quarterly* 57.1 (2012), pp. 81–118.

[52] Michael E. Porter. "What is strategy?" In: *Harvard Business Review* 74.6 (1996), pp. 61–78.

[53] Matthew Rhodes-Kropf. "Entrepreneurial experimentation and the cost of trying". In: *Working Paper* (2024).

[54] Roy Rothwell. "Towards the fifth-generation innovation process". In: *International Marketing Review* 11.1 (1994), pp. 7–31.

[55] Ron Sanchez. "Strategic flexibility in product competition". In: *Strategic Management Journal* 16.S1 (1995), pp. 135–159.

[56] Michael Spence. "Job market signaling". In: *Quarterly Journal of Economics* 87.3 (1973), pp. 355–374.

[57] Barry M. Staw. "Knee-deep in the big muddy: A study of escalating commitment to a chosen course of action". In: *Organizational Behavior and Human Performance* 16.1 (1976), pp. 27–44.

[58] Sara Steegen, Francis Tuerlinckx, Andrew Gelman, and Wolf Vanpaemel. "Increasing transparency through a multiverse analysis". In: *Perspectives on Psychological Science* 11.5 (2016), pp. 702–712. DOI: 10.1177/1745691616658637.

[59] David J. Teece, Gary Pisano, and Amy Shuen. "Dynamic capabilities and strategic management". In: *Strategic Management Journal* 18.7 (1997), pp. 509–533.

[60] Michael L. Tushman and Philip Anderson. "Technological discontinuities and organizational environments". In: *Administrative Science Quarterly* 31.3 (1986), pp. 439–465.

[61] James M. Utterback and William J. Abernathy. "A Dynamic Model of Process and Product Innovation". In: *Omega* 3.6 (1975), pp. 639–656.

[62] Eric Van den Steen. "Interpersonal authority in a theory of the firm". In: *American Economic Review* 100.1 (2010), pp. 466–490.

[63] Ashlee Vance. *Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future*. Ecco/HarperCollins, 2015.

[64] Andy El-Zayaty, Martin Ganco, and Bekhzod Khoshimov. "Vague Language, Founding Team Human Capital, and Resource Acquisition". In: *Working Paper* (2024). Available at SSRN.

[65] Eric Yanfei Zhao, Greg Fisher, Michael Lounsbury, and Danny Miller. "Optimal distinctiveness: Broadening the interface between institutional theory and strategic management". In: *Strategic Management Journal* 38.1 (2017), pp. 93–113.

[66] Ezra W. Zuckerman. "The categorical imperative: Securities analysts and the illegitimacy discount". In: *American Journal of Sociology* 104.5 (1999), pp. 1398–1438.

[67] Tiona Zuzul and Mary Tripsas. "Start-up inertia versus flexibility: The role of founder identity in a nascent industry". In: *Administrative Science Quarterly* 65.2 (2020), pp. 395–433.