

# Which Capabilities to Build? The Impact of Market Forces

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# From friendly conversations...



# My Initial Mental Model: Myopic Resource Allocation

- There is much evidence that managers regularly under-invest in long-term capabilities:
  - Reactive maintenance getting the lion share, to the detriment of planned maintenance. (**Allen 93, Zuashkiani et. al. 2011, Lyneis and Sterman 2015**)
  - Process improvement sacrificed for production (**Repenning and Sterman 02**)
  - Concept design neglected for detailed design (**Repenning 01**)
  - Bug fixes overshadow high quality development (**Rahmandad and Repenning 15**)
  - New approaches abandoned prematurely in favor of old ways (**Morrison 05**)

# My Theoretical Lens

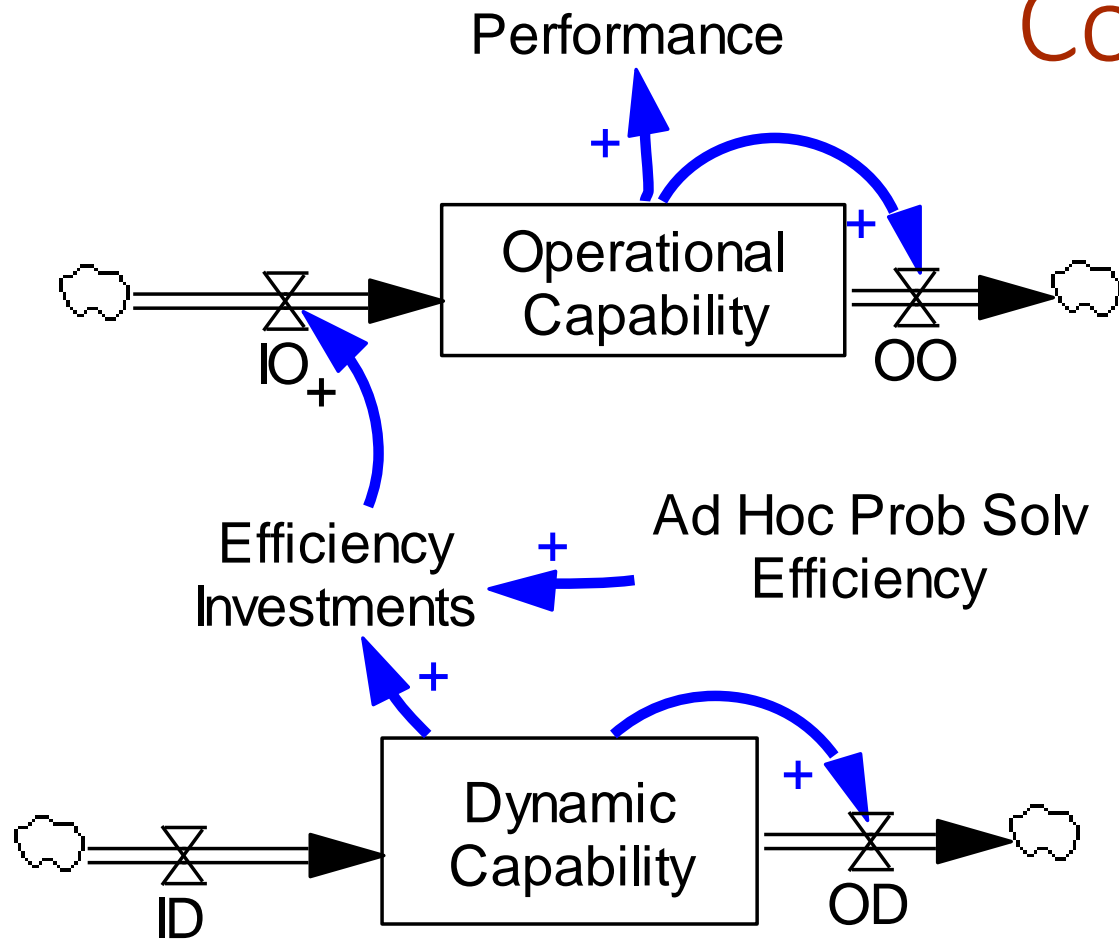
## Resource Based View

- Firms as bundles of assets and capabilities, competitive advantage often from capabilities (Barney, Teece, Wernerfelt, Henderson ...)
- **Capability**: Routines that provide a firm the option for producing specific outputs or changing other routines, e.g. production, product development, maintenance, alliancing (Nelson and Winter 82)
- Capabilities have **inertia** and only change slowly through investment and depreciation (Dierickx and Cool 89); i.e. they are stocks.

# Capability interactions

- **Operational capabilities:** those that allow the firm to accomplish its goal and make a living (e.g. production, sales)
- **Dynamic capabilities:** Those routines that operate to modify and change operational ones (e.g. product development, process improvement)
- **Ad hoc problem solving:** None-routinized activities aiming at modifying and revitalizing existing capabilities

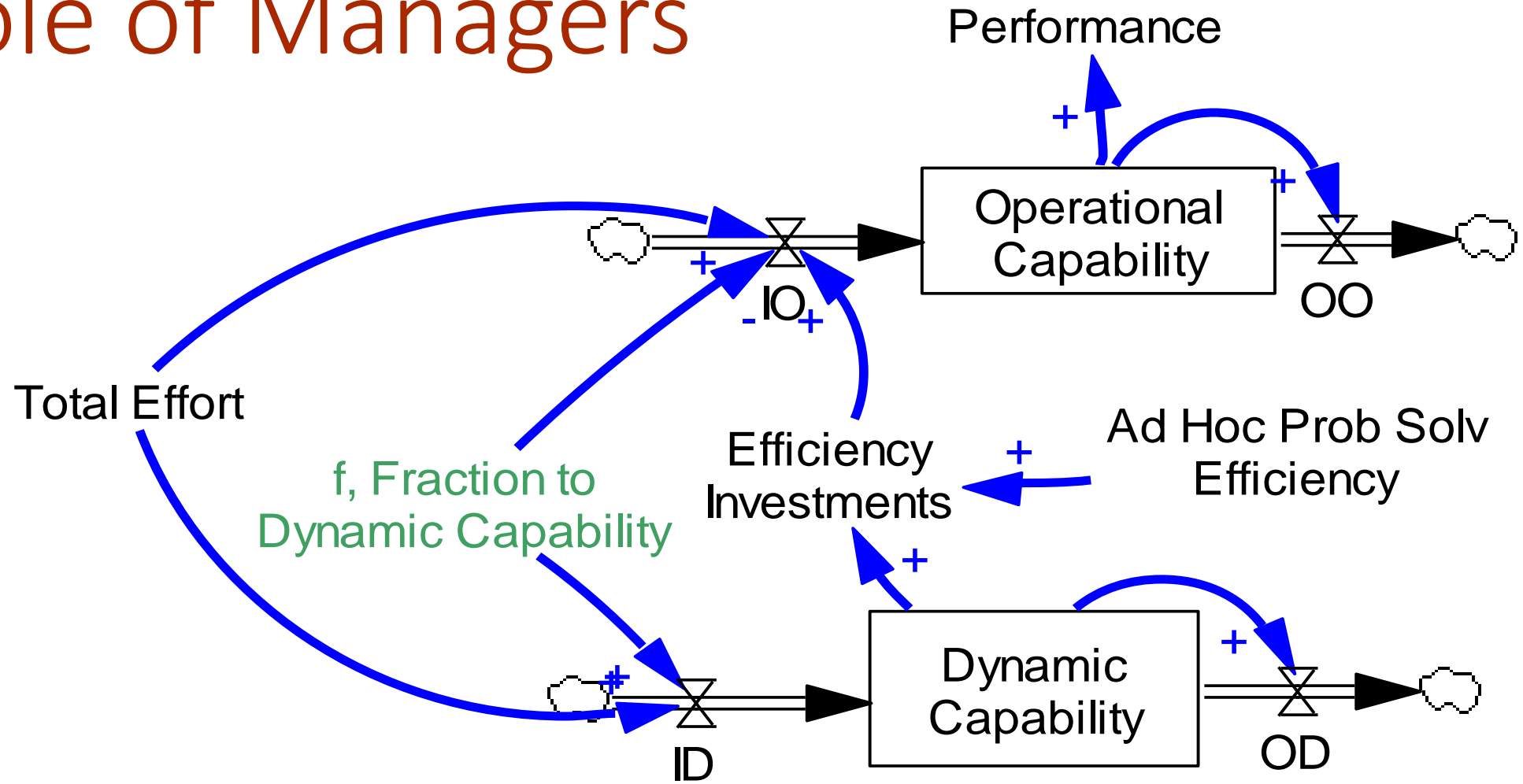
# Conceptualizing Relationships Among Capabilities



<b>Operational</b>	<b>Dynamic</b>
<b>Production</b>	<b>Product Development</b>
<b>Sales</b>	<b>Human Resource Training</b>
<b>Production</b>	<b>Process Improvement</b>
<b>Marketing</b>	<b>Alliance Formation</b>
<b>Production</b>	<b>Proactive Maintenance</b>

Increase in operational capability depends on dynamic capability, resources invested, and efficiency of ad hoc problem solving. Dynamic capabilities have decreasing returns.

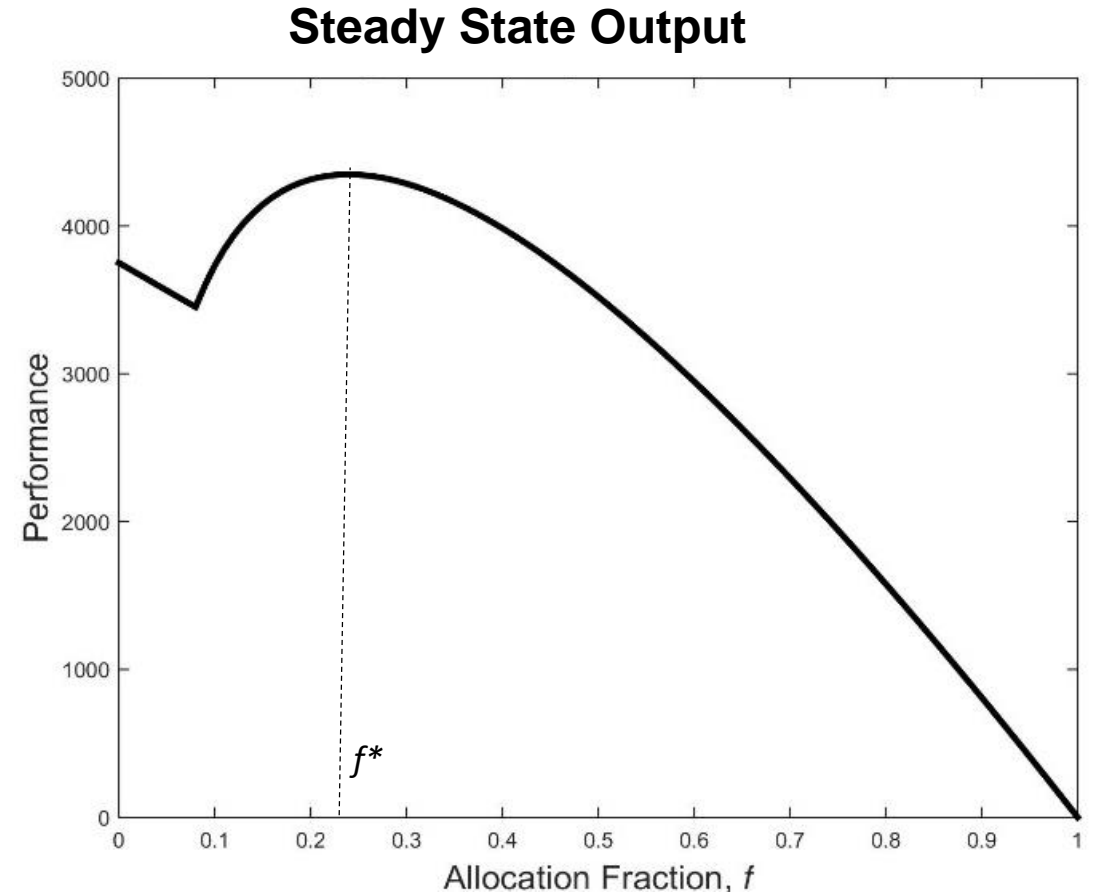
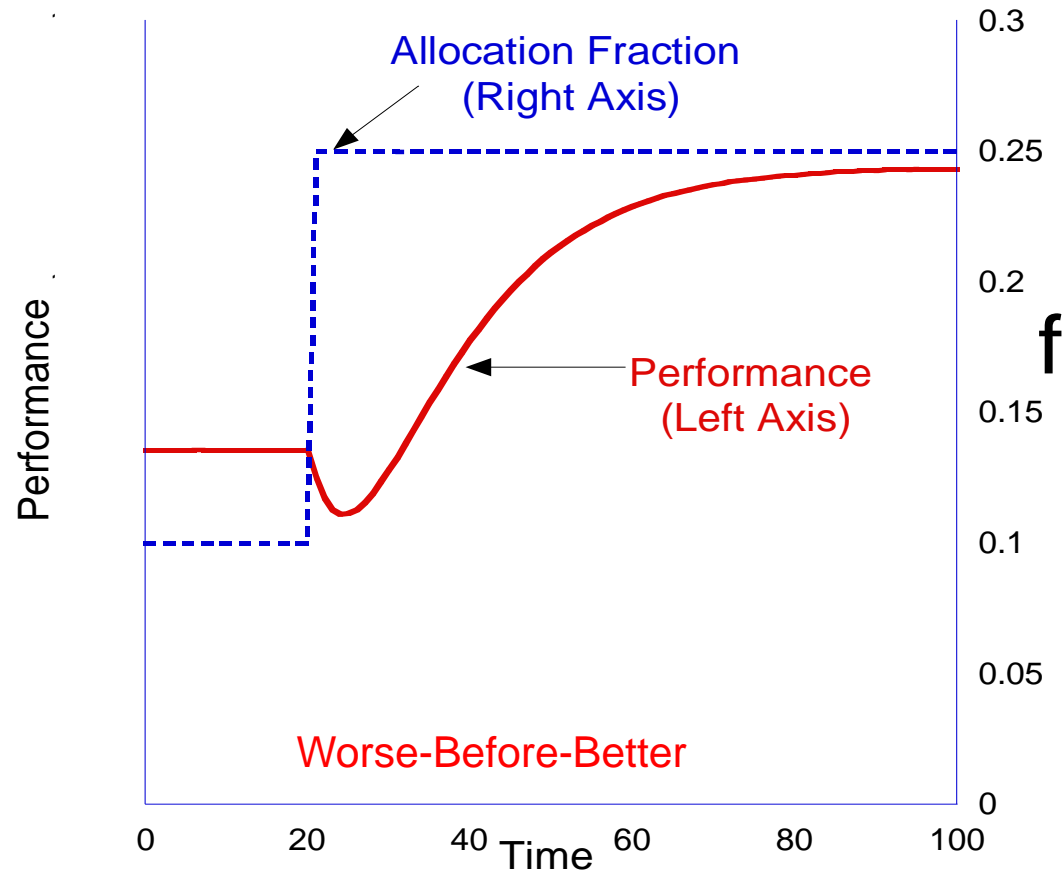
# Role of Managers



## Key managerial decision:

Allocate total effort between the two types of capabilities, reflected in the fraction  $f$  allocated to dynamic capabilities.

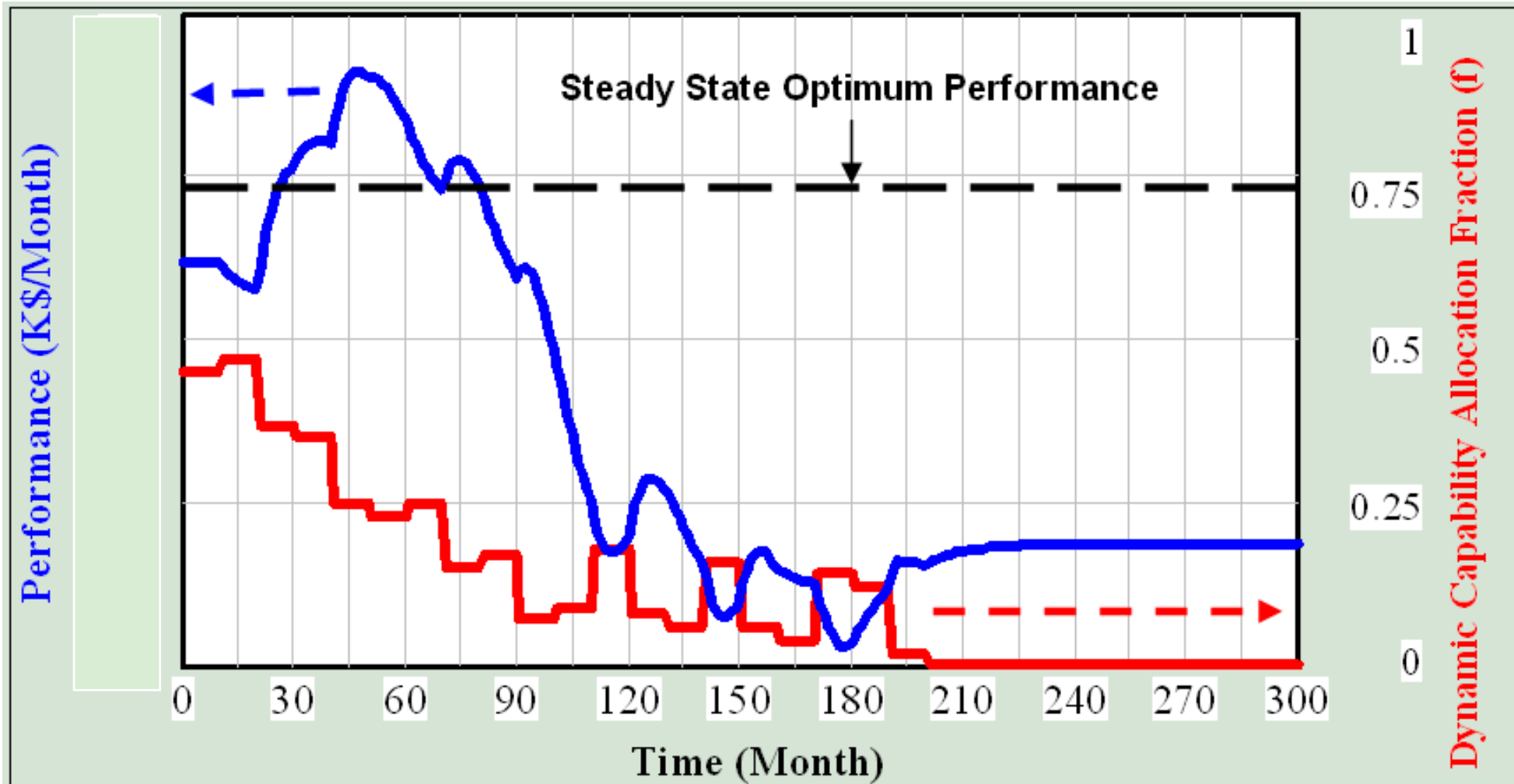
# Capability Investment Tradeoffs



$$f^* = 0.24$$



# Adaptation Dynamics



**Learning Heuristic:** Allocation policy (f) is changed, results monitored for a while, and if overall performance increases (decreases), then f is changed in the same (opposite) direction.

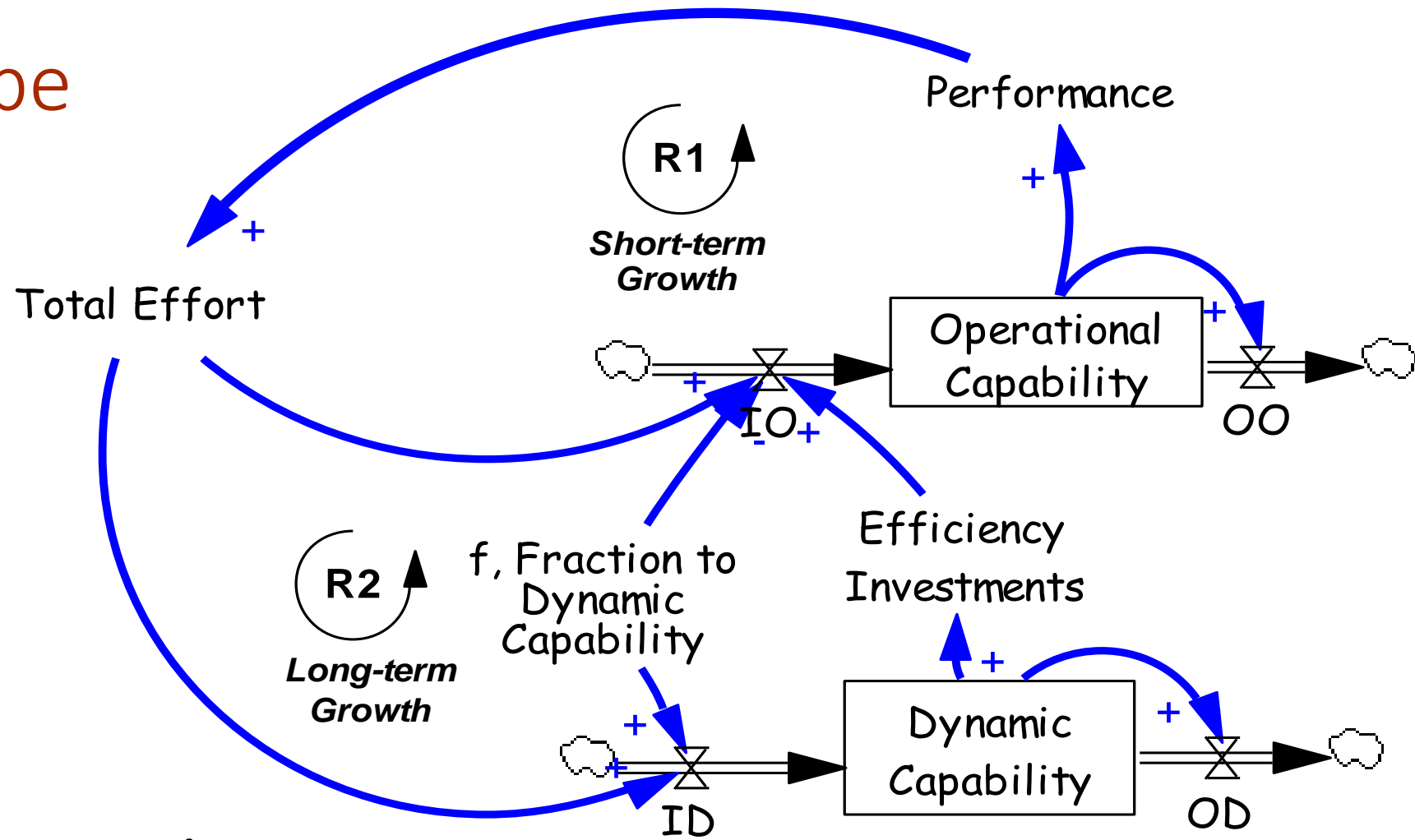
# So far...

- A generic model of a firm that replicates the worse before better and better-before-worse dynamics and the learning challenges that come with them
- One explanation for the persistence of myopic policies (typical explanation in SD research)

# However...

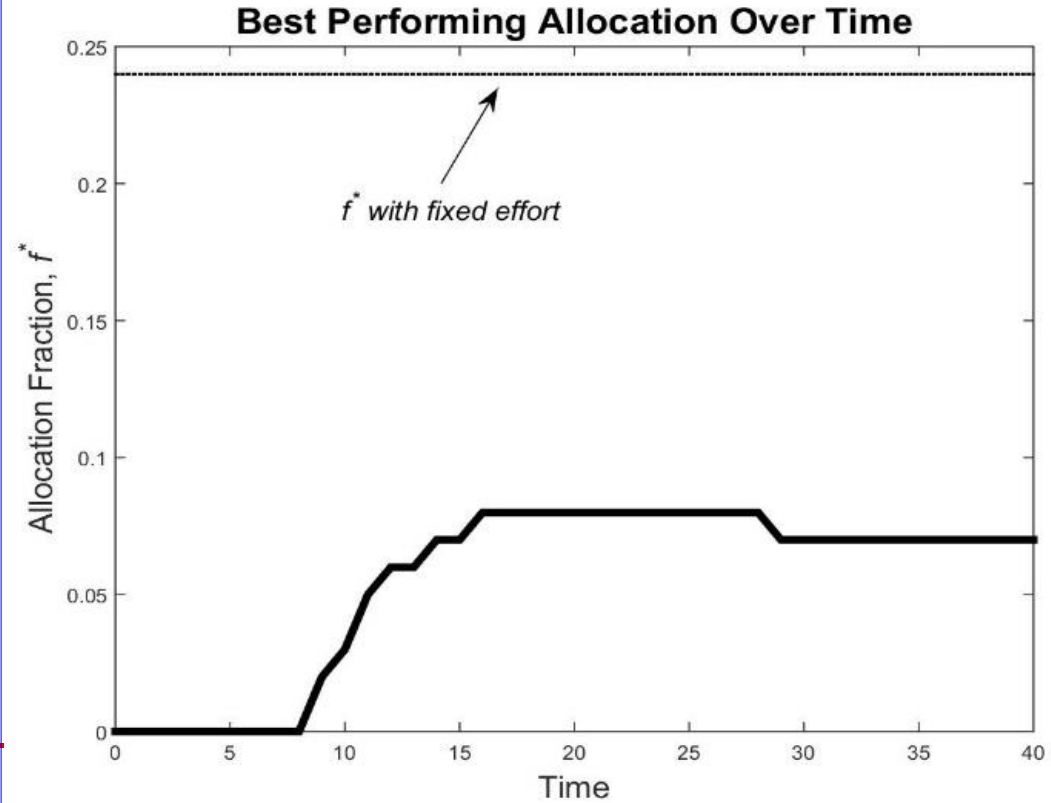
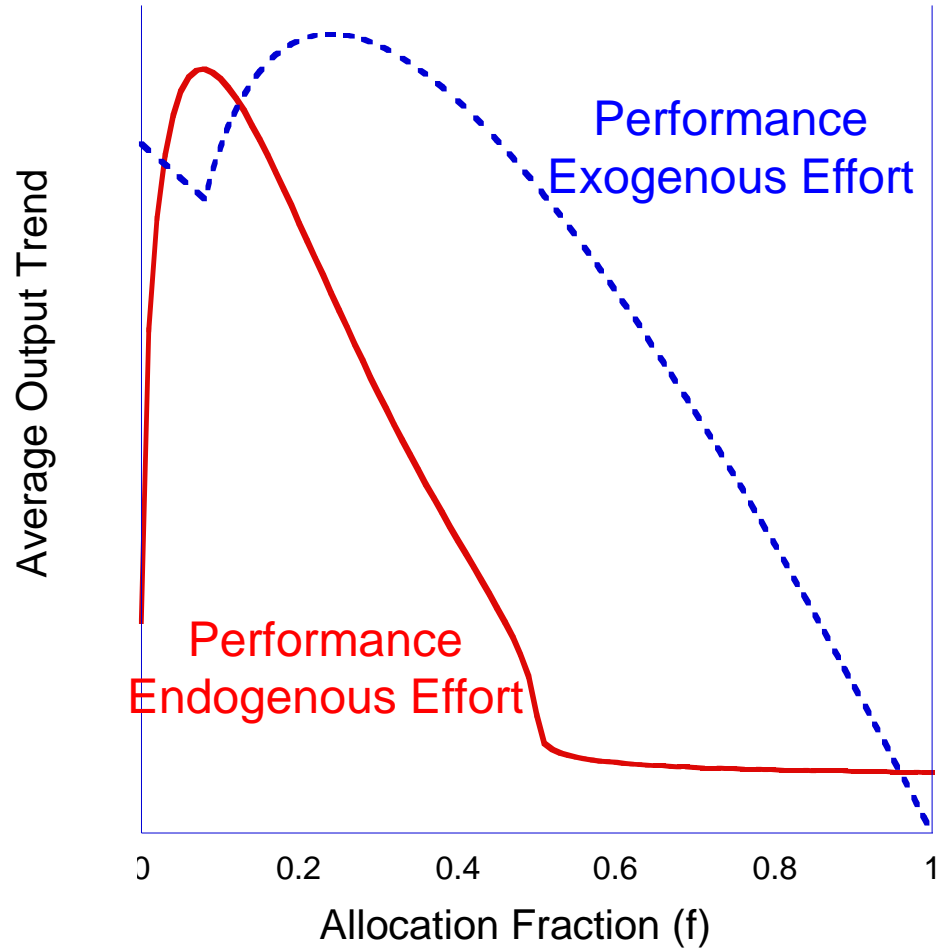
- My friend insisted that he was aware of the value of long-term investments, but he just didn't think they should have priority at this point
  - He needed to show enough progress to get the next round of funding
  - He was worried about other start-ups taking over the market

# Total Effort Could be Endogenous



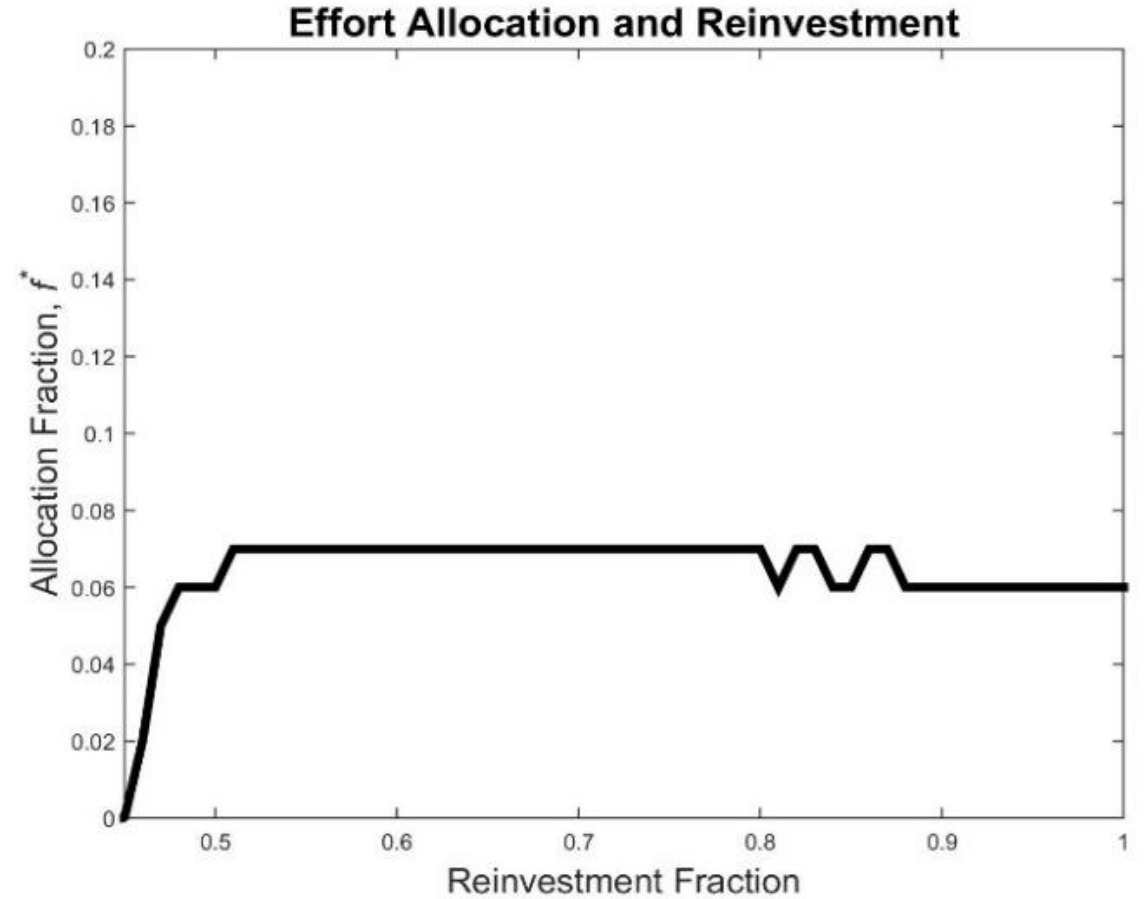
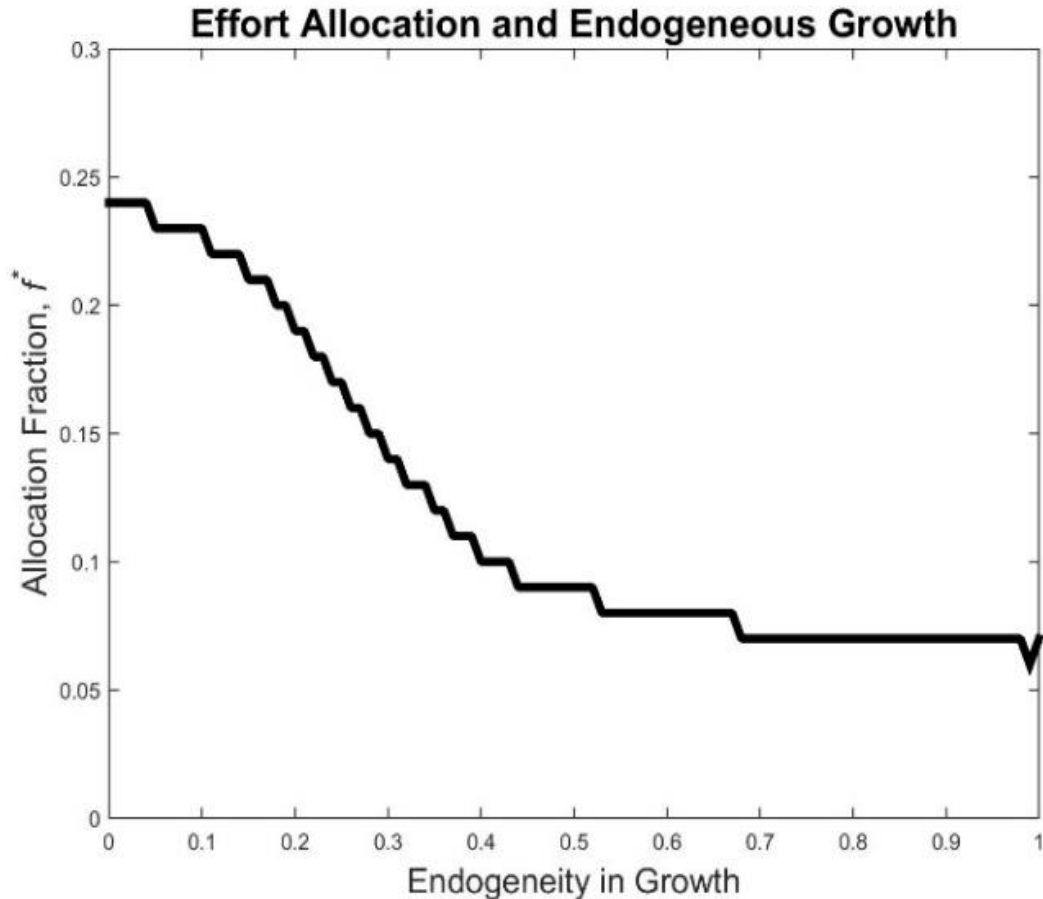
- A fraction of profit goes to investment
- Two new reinforcing loops push growth through expanding the two capabilities
- These loops compete with each other

# Capability tradeoffs with endogenous effort



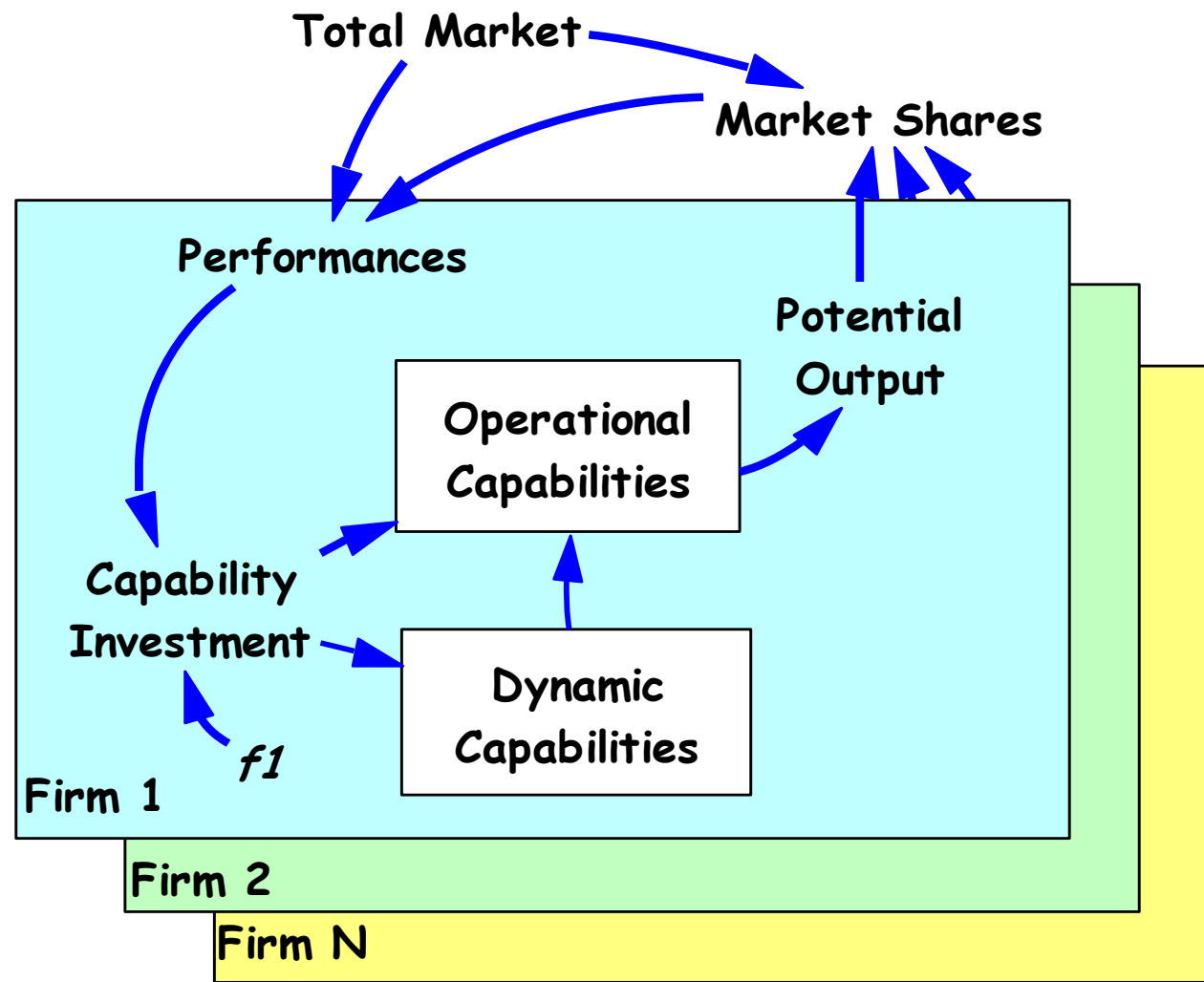
- Short-term growth loop has shorter delays, and is thus a more potent force for exponential growth. Using that loop (instead of long-term one) enables faster growth in total effort and expansion of both capabilities
- Decreasing returns to dynamic capabilities require a smaller fraction at larger sizes.
- Temporal dynamics still matter: in the short-run zero investment in dynamic capabilities beats the alternatives.

# Sensitivity of Efficient Allocation



- Moving from fixed effort to endogenous, the efficient allocation changes significantly
- Results robust to fraction of effort that is re-invested

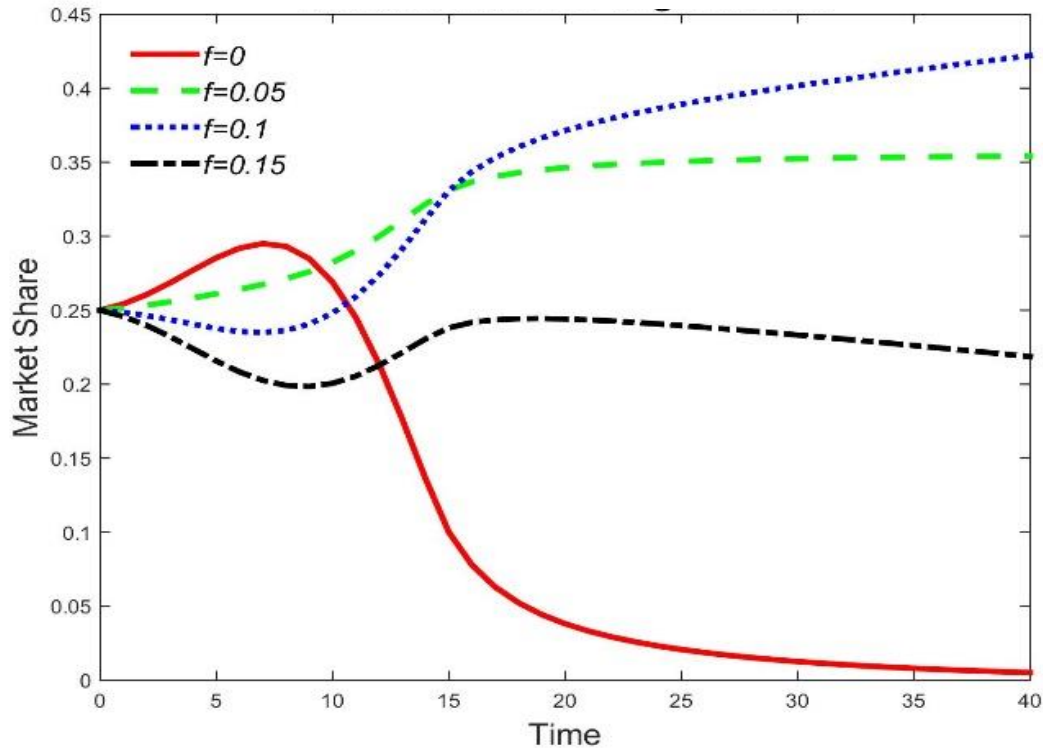
# What about competition?



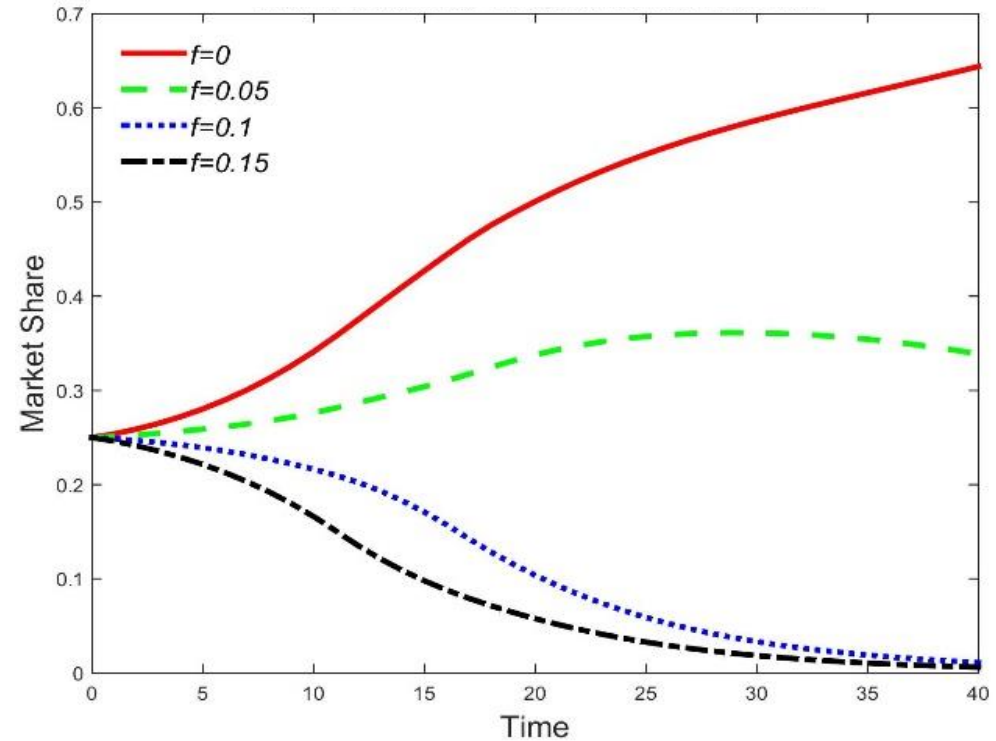
- Fixed market size
- Similar firms, differ only in allocation fractions
- Starting from equal market shares
- How does market share change for different firms over time?

# Market Share Dynamics

## Large Market



## Saturated Market



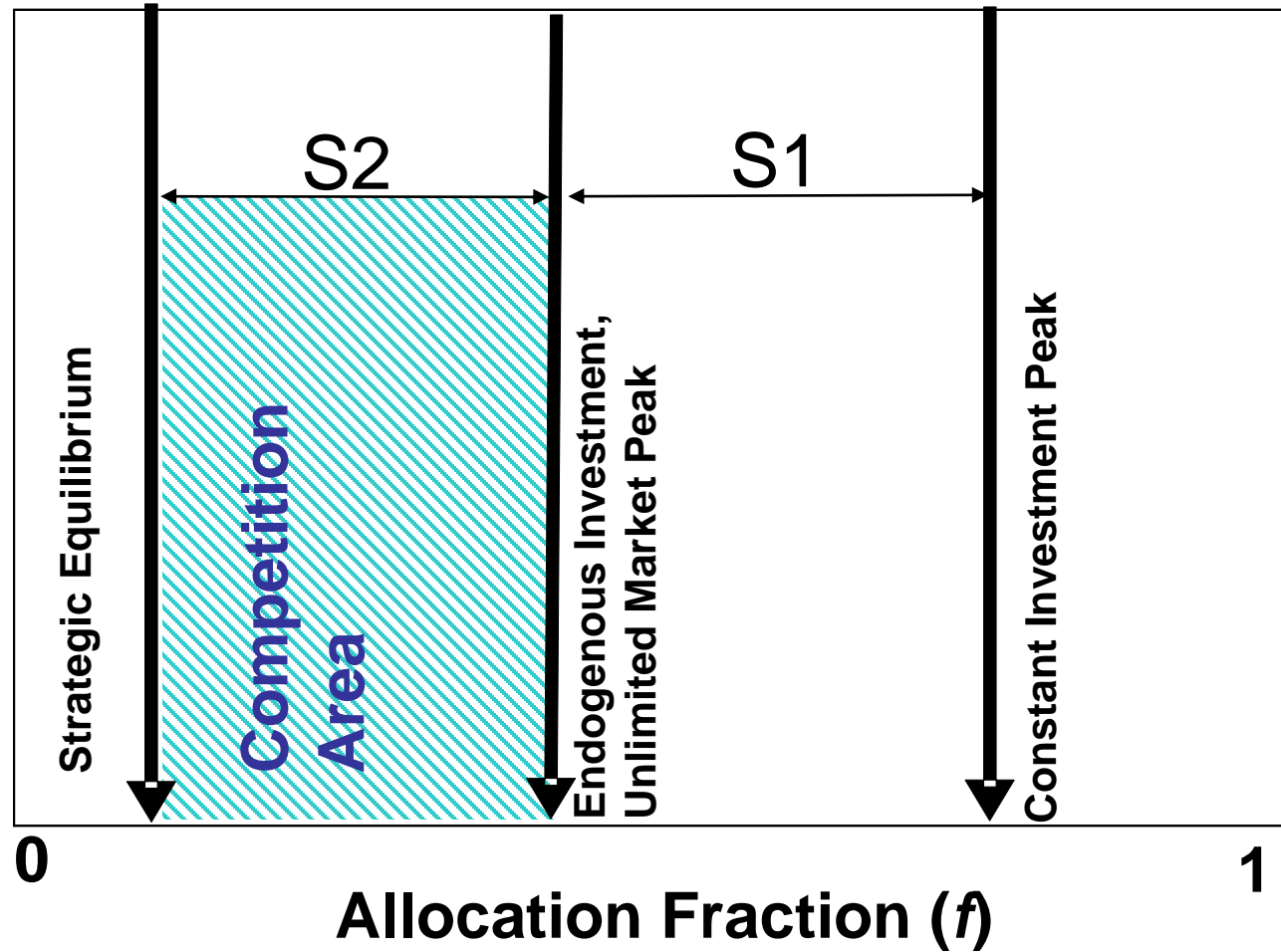
- A focus on the short-term helps firms gain market share
  - Saturated markets promote more short-termism, because any loss of market share quickly results in reduced effort for investment
- While market is not saturated, firms have a window of opportunity to build some dynamic capabilities

# What if firms are rational?

- Numerical solution of the game shows rational firms may invest little in dynamic capabilities:
  - Saturated markets create a zero sum game:
    - **The firms with lower  $f$  gain initially, bankrupting the ones with higher  $f$**
  - Thus, strategically all firms want to be lower than average  $f$
  - Therefore, if growth loops are fast enough, the Nash equilibrium for this strategic game is  $f=0$



# Summary: Shifts in Efficient Allocation



# Robustness & Boundary Conditions

Factor	Impact
Parameter settings	Robust as long as some firms are profitable
Decreasing returns on operational capabilities	Limited; makes it harder for firms in competition to deviate from efficient allocation
Time compression diseconomies	Promote more balanced investment
Buffer between profits and investment	Gets us closer to the fixed effort case
Single capability	Limited
Dynamic capability impacting productivity of operation capability	Limited
Ad hoc problem solving working together with dynamic capabilities	Strategic equilibrium becomes non-zero
Large markets	Strategic equilibrium can become non-zero

# Theoretical Implications

- Efficient investment is contingent on market condition and technology, so some settings welcome myopic managers and others don't
- Dynamic capabilities not promoted in dynamic markets!
- Factors that encourage dynamic capabilities:
  - **A growing market or when marginal operational capability does not impact market share**
  - **When resources can be decoupled from performance**
  - **In markets with decreasing returns and time compression diseconomies**

# My Process Learnings

- **Theory vs. case driven modeling:** Cases provide many benefits, in their absence
  - Focus on modeling a set of mechanisms
    - **Only keep structures that are essential for capturing those mechanisms**
  - Allow existing theory drive building blocks and concepts we use
    - **Audience buy-in**
    - **Opportunity to refine theory (à la Sastry 1997)**
  - Use more extensive sensitivity and boundary condition testing to build confidence in generalizability of results

# My Process Learnings

- Without assuming managers are “rational”, we can use “Optimum” as a benchmark
  - **Simplifies “policy sensitivity” analysis**
  - **Explore a range of decision rules including “rational” ones**
  - **Side-steps the rationality debate and engages a broader audience**
- Potential room for game theoretic methods
  - **Iterative solution method (not analytically robust; but fine for many applications)**
  - **Can explore different levels of rationality**

# Writing for a different audience

- Start with Repenning's (2003) recommendations:
  - **Target communities interested in your phenomenon (not just modelers)**
  - **Ground your work in their literature**
  - **Develop simple models**
  - **Build intuition about behavior-structure link**

## ... and to get there

- Name the top ten researchers in the target community
- Read until you know 50% of citations you see
- Identify their motivation: Policy question, theoretical gap, empirical puzzle, or testing existing theory? Focus on one!

## ... and to get there

- Do not exceed the complexity of existing models
- Emphasize what is in common with prior models
- Conduct counterfactuals before declaring victory
- Test understanding of mechanisms before writing



# Why target other academics?

- Solutions not just technical; they should change mental models (basic tenant of SD)
  - **Prevalent concepts and basic assumptions influenced by academic discourse; people trust concepts they know**
  - **Some academics are gatekeepers to debates you want to influence**
  - **We can influence academic discourse as well**

# ***“Only Jay could be Jay!”***

- Without learning from others we *can't* find a better technical solution
  - **In every field there are very competent people who have spent years on a topic**
  - **Analytical sophistication is not unique to SD**
  - **We need to learn their language and methods to appreciate what they have done**
  - **Only then we can seriously assess if our way of thinking and modeling adds further value**
  - **And if it does, we then know how to convince them in their own language**

# Why target other academics?

- SD can learn from others
  - **We can adopt many tools from operations research, anthropology, econometrics and many other fields**
  - **Broadens the range of assumptions we can draw on to fit the application at hand**
- Personally rewarding
  - **Build collaborative relationships**
  - **Find communities you can connect to and enjoy**

Thank you!