

# Competitive Action Repertoires and Firm Performance: The Evolving Role of Stakeholders and Competitors over the Industry Life Cycle

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## MOTIVATION

Existing work highlights two broad means by which firms seek to gain and maintain a competitive advantage over rivals.

### The “fit” perspective

- Selecting and honing an appropriate “position” on the competitive landscape based on a set of unique activities is a fundamental precept (Porter, 1996; Ghemawat, 1991)
- Complementarities among activities may explain firm performance differences (Lenox, Rockhart, and Lewin, 2006; Ghemawat and Levinthal, 2008)
- Positions evolve and reinforced along a stable trajectory through a refinement of path-dependent capabilities (e.g., Gavetti, 2005)

#### As a consequence:

- Firms exploit complementarities and invest along a trajectory which results in *consistent competitive repertoires* (Lamberg et al., 2009)

### The “hyper-competition” perspective

- At the same time, evidence suggests “hyper-competition” is more common, with only transient advantage available (McGrath, 2013; Sirmon et al., 2010; D’Aveni, 1994)
- A “gale” of competitive activity can erode returns quickly through imitation (Young et al., 1996; Derfus et al., 2008)
- Threats to sustainability can be a water mattress (pushing one down can exacerbate another) (Polidoro and Toh, 2011)

#### As a consequence:

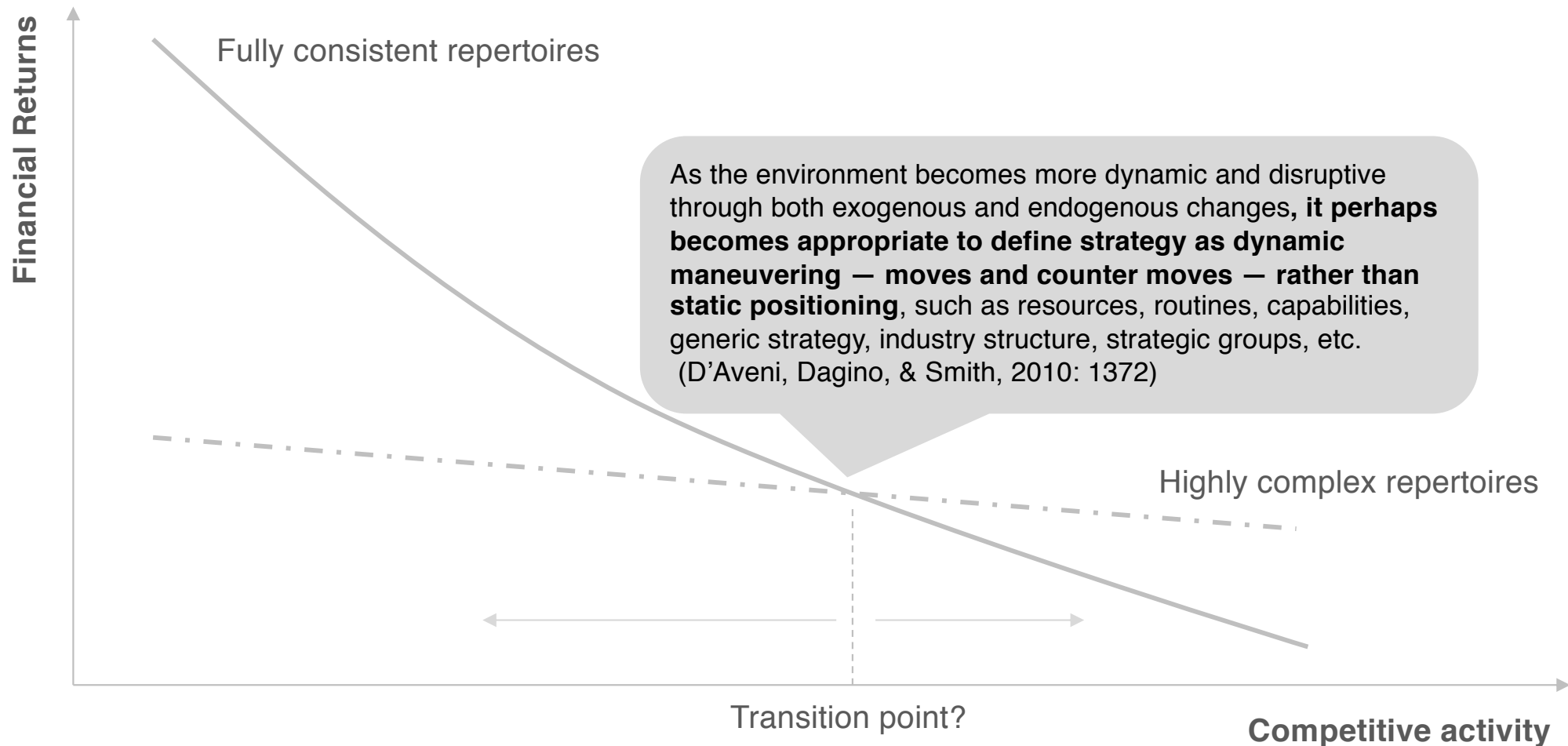
- *Complex competitive repertoires* may help forestall imitation and substitution (Ferrier, 2001; Connelly et al., 2017)



## MOTIVATION

**But less is known about how competitor activity affects the comparative performance of these two approaches.**

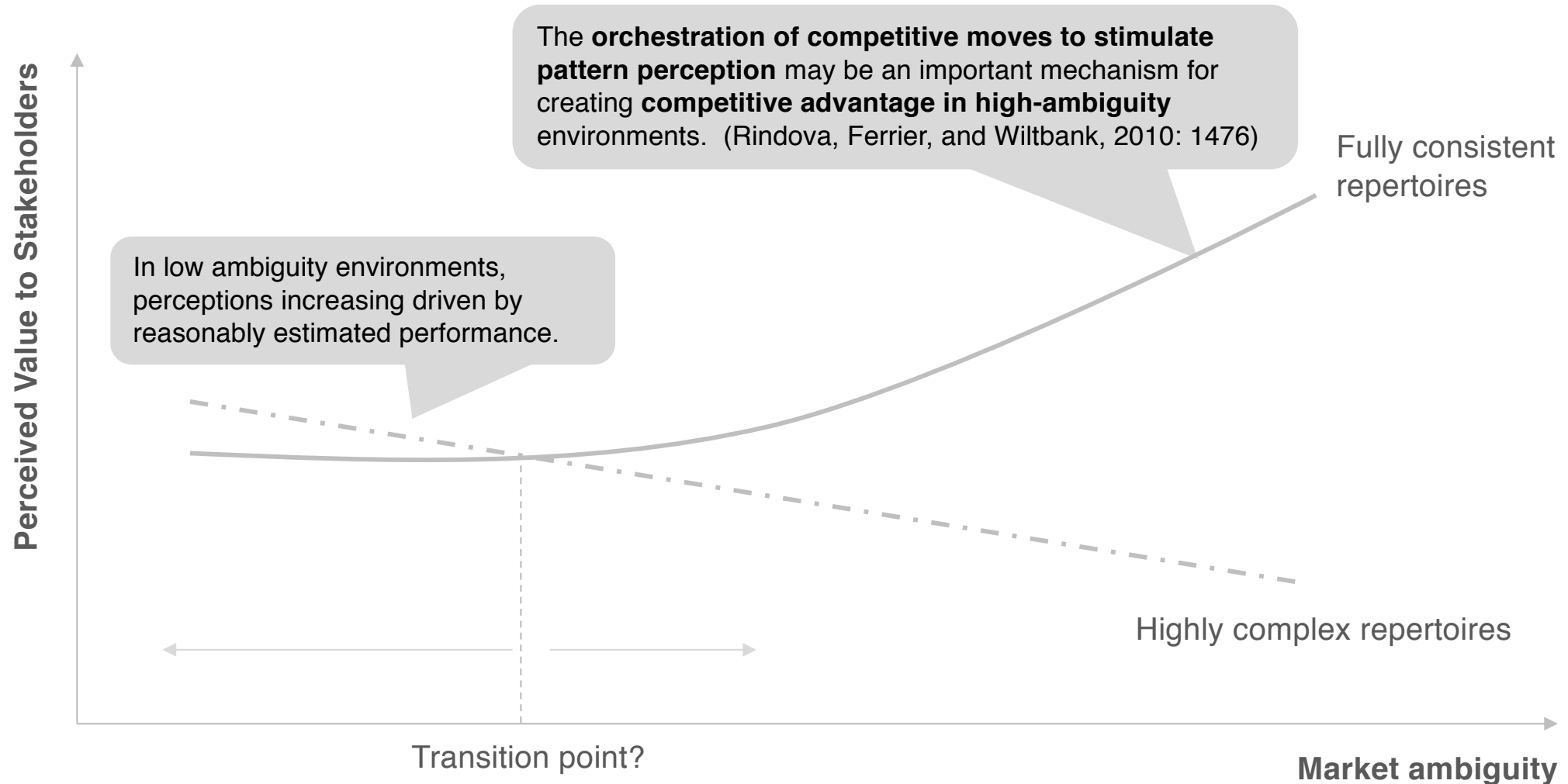
While these approaches can be pursued in tandem, which confers a larger marginal benefit?





## Likewise, ambiguity can change what behavioral patterns stakeholders look for when forecasting future performance.

Each approach differs in its ability to deepen or dispel ambiguity regarding future intentions.

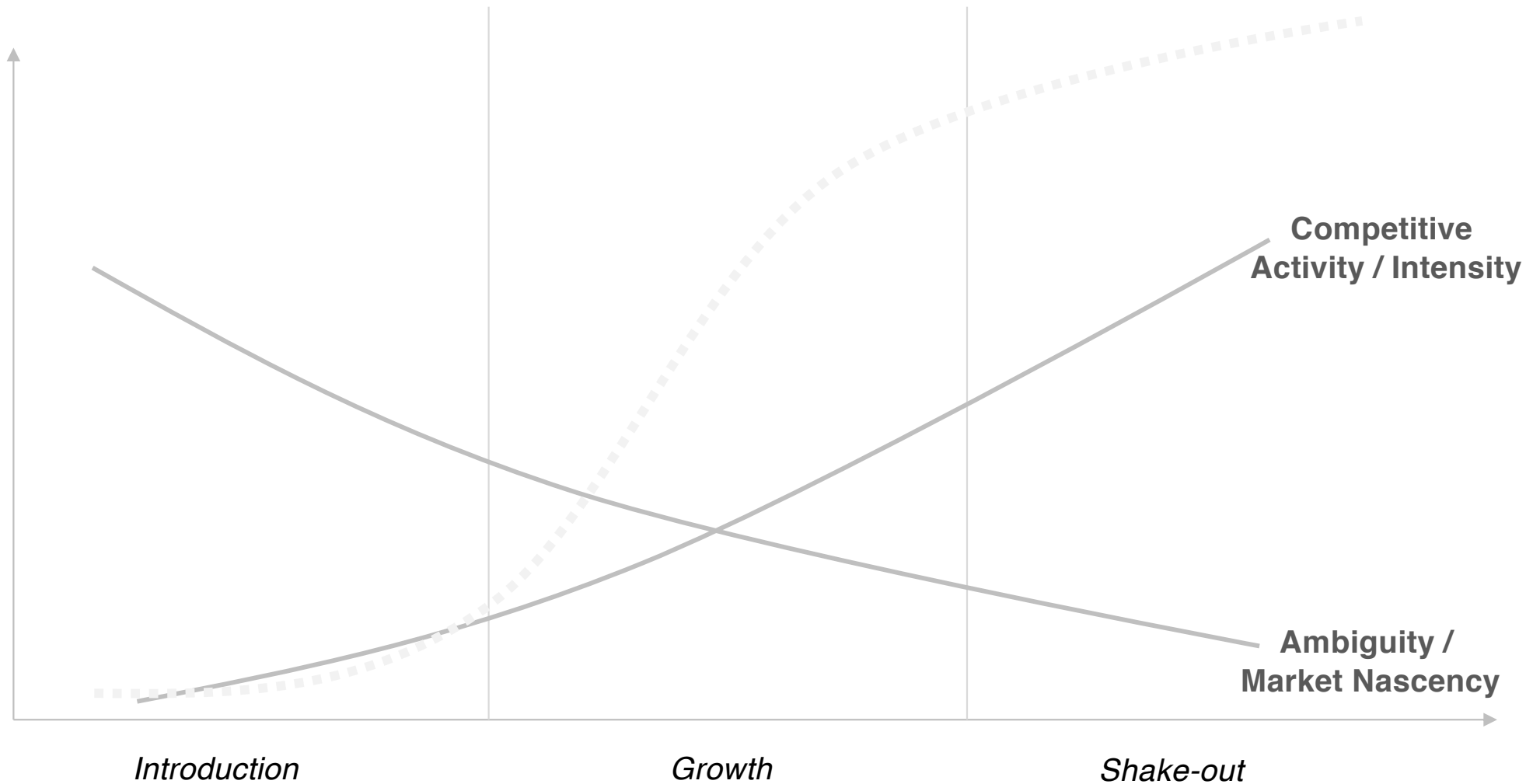




## THEORY AND HYPOTHESES

**Notably, both competitive activity and market ambiguity evolve in line with the industry life cycle.**

Thus, competitive repertoire patterns likely differ in their efficacy as the life-cycle unfolds.



## These considerations leads us to the following question:



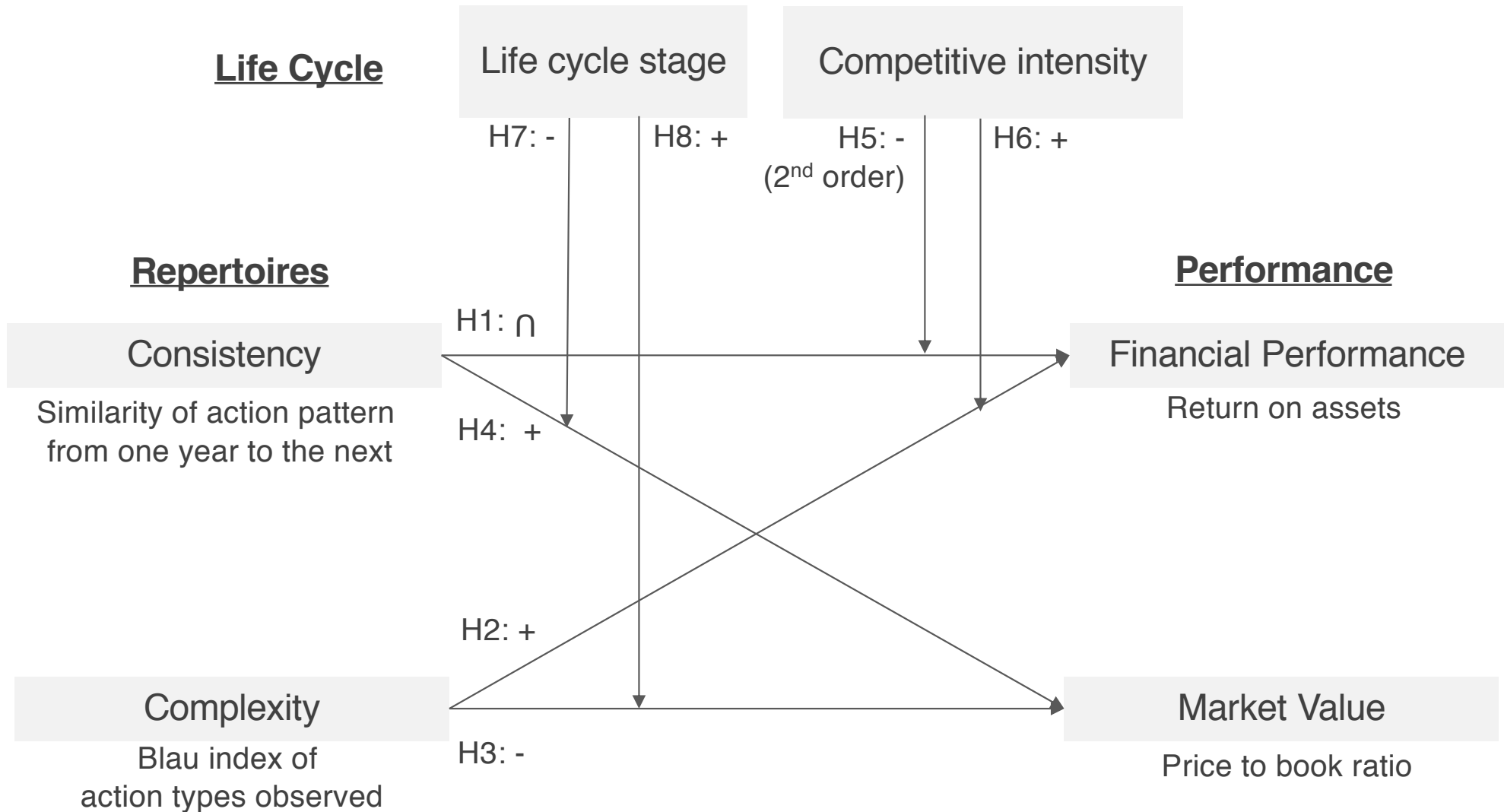
Are complex and consistent repertoires related to different aspects of firm performance, and do the implications of the industry life cycle (specifically, competitive activity and market ambiguity) affect the form of these relationships?



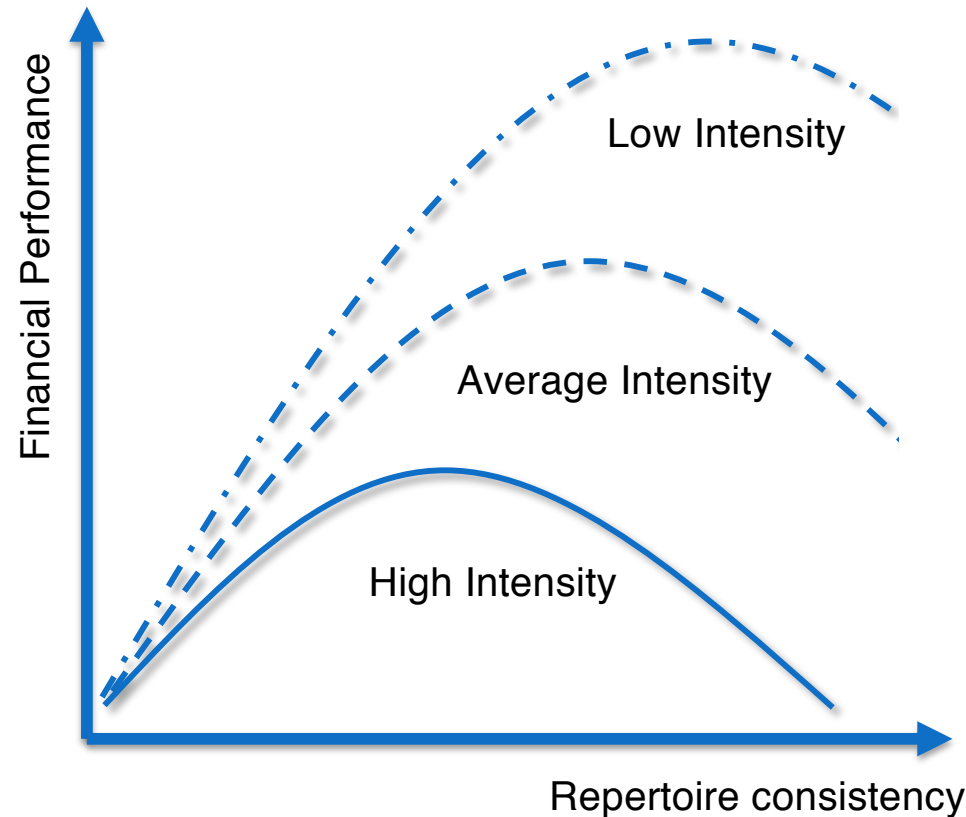
“Therefore, I recommend that we do.”



To address this question, we advance and test the following empirical model in the context of the 3D printing industry.



# The curvilinear effect of repertoire consistency on financial performance

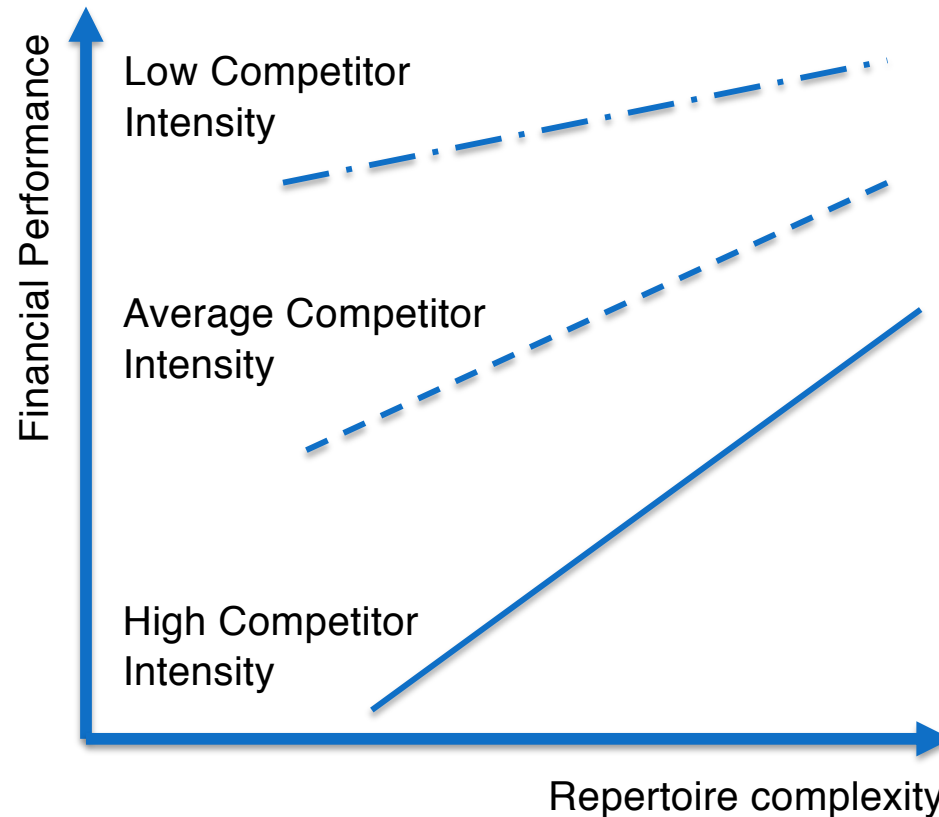


*As competitive intensity increases, the level of repertoire consistency at which performance reaches a maximum will decrease, and the performance achieved at this optimum will be lower.*

Sources: Lamberg et al., 2009; Nelson & Winter, 1982; Langlois, 1997, Gersick, 1991, Tripsas & Gavetti, 2000; Chen, 1996, Nadkarni & Narayanan, 2007

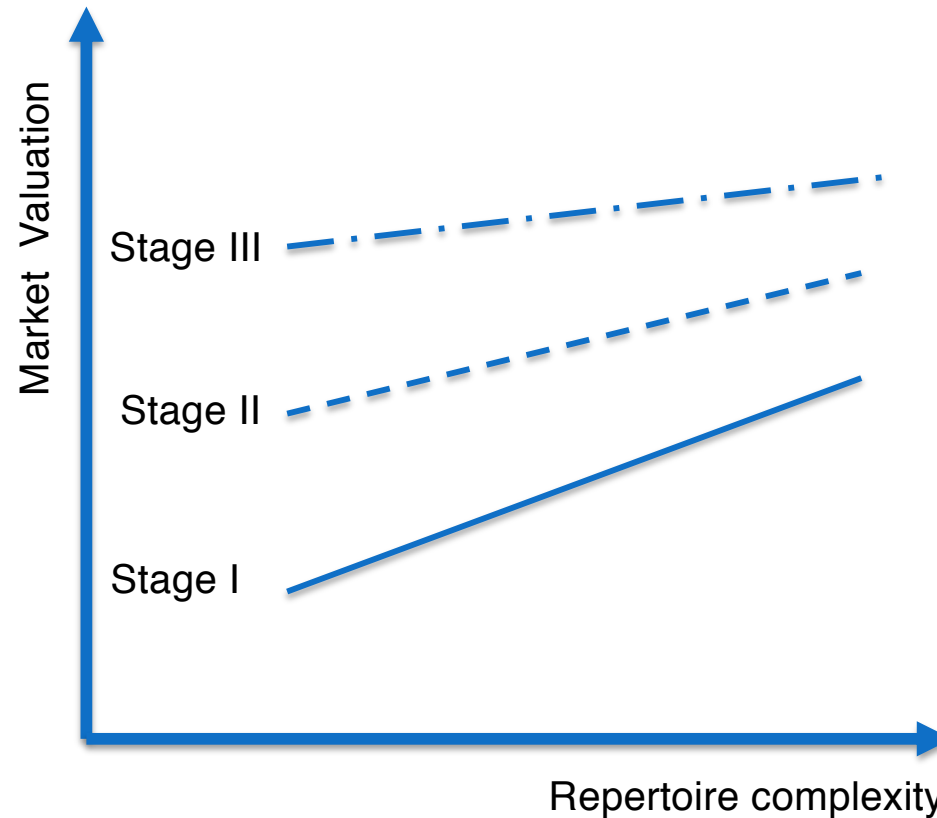


# The link between repertoire complexity and financial performance as a function of competitor pressure



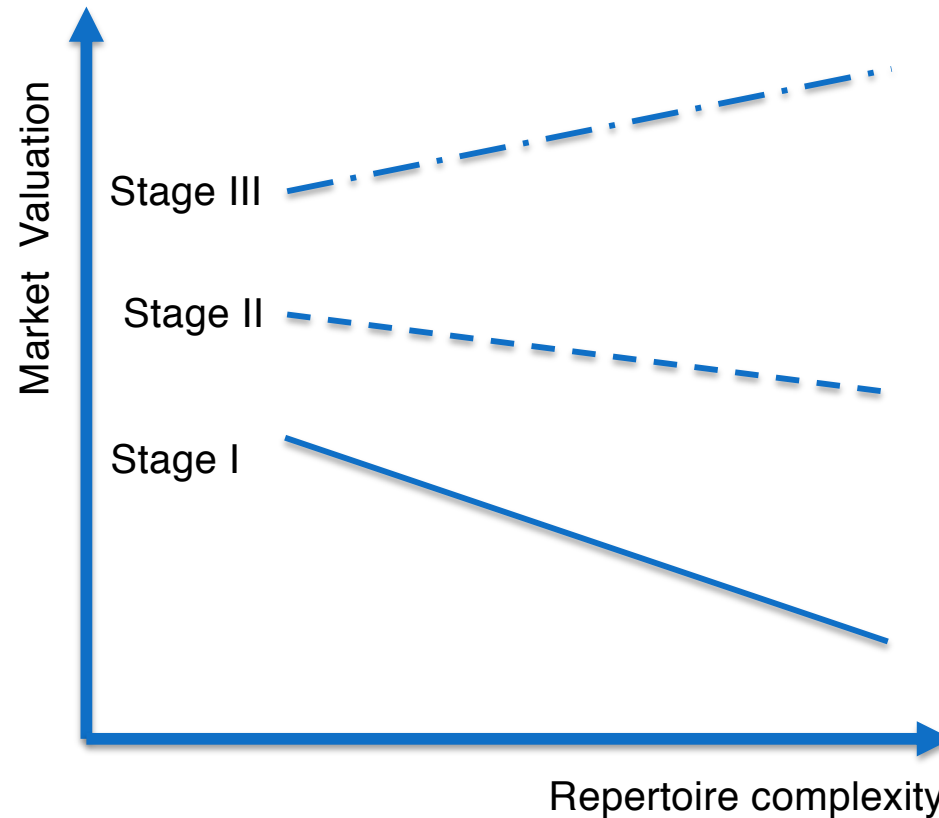
*As competitive intensity increases, the positive relationship between repertoire complexity and financial performance will become stronger in magnitude.*

# The link between repertoire complexity and market valuations across different life cycle stages



*As the life cycle advances, the positive relationship between repertoire consistency and market valuations will become weaker in magnitude.*

# The link between repertoire complexity and market valuations across different life cycle stages



*As the life cycle advances, the negative relationship between repertoire complexity and market valuations will become weaker in magnitude.*

# The commercial 3D printer market is well suited to test these relationships for multiple reasons.



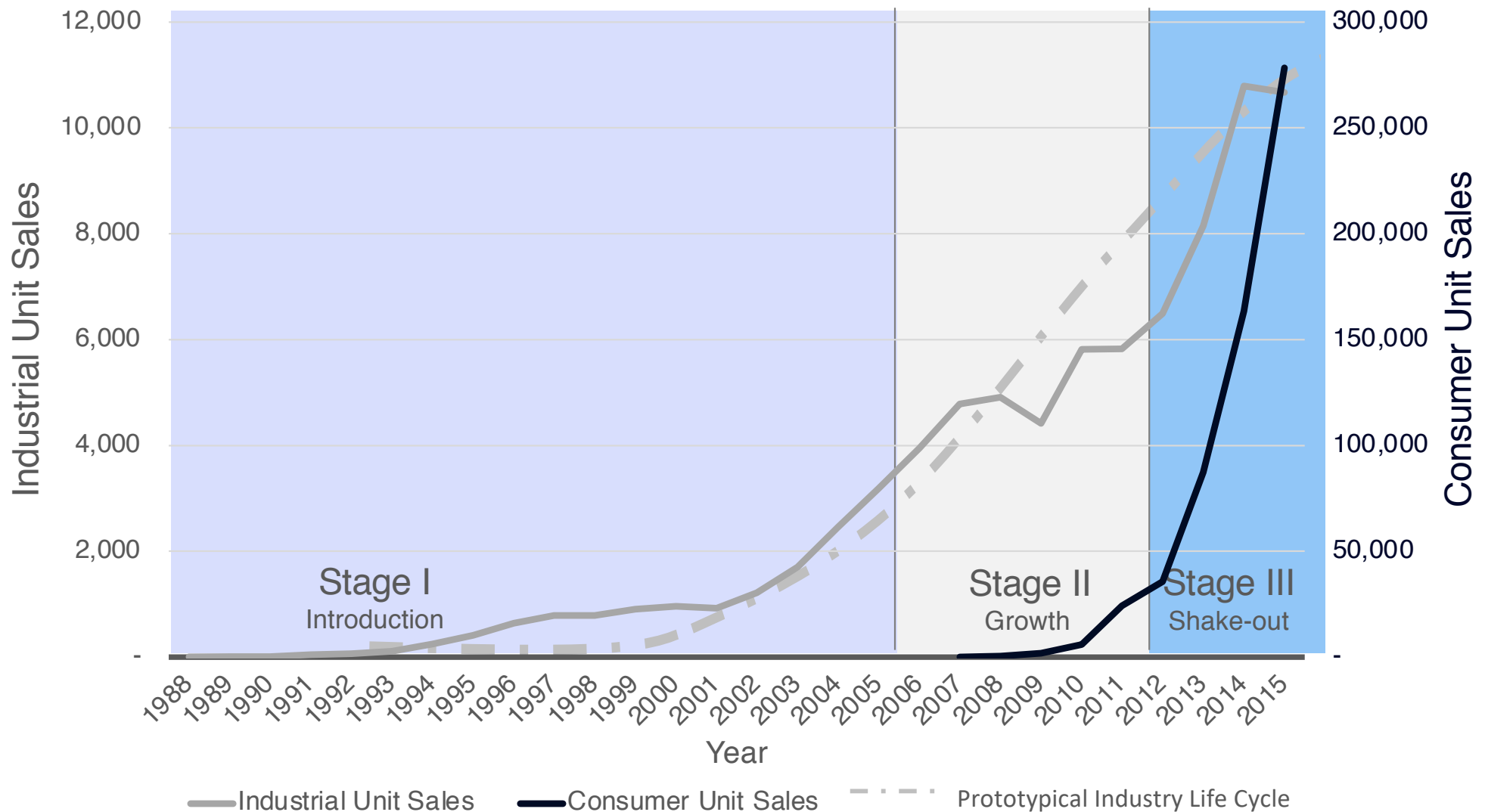
## Appropriateness of setting

- Repertoire constructs are measurable
  - Variability in actions taken by industry participants as life-cycle unfolds
  - Firm actions well-documented
- Competitive pressures can be assessed
  - Multiple stages of life cycle observable with different levels of competition
  - Strategic groups present and are at different stages of development
  - Lack of outside-industry substitutes “insulates” competitive process
- Public and private firm performance data

Note: The industry has progressed through three stages of the life cycle and has at least four strategic groups.



**Not only do we have a window into an evolving context that is less often examined by competitive dynamics research...**



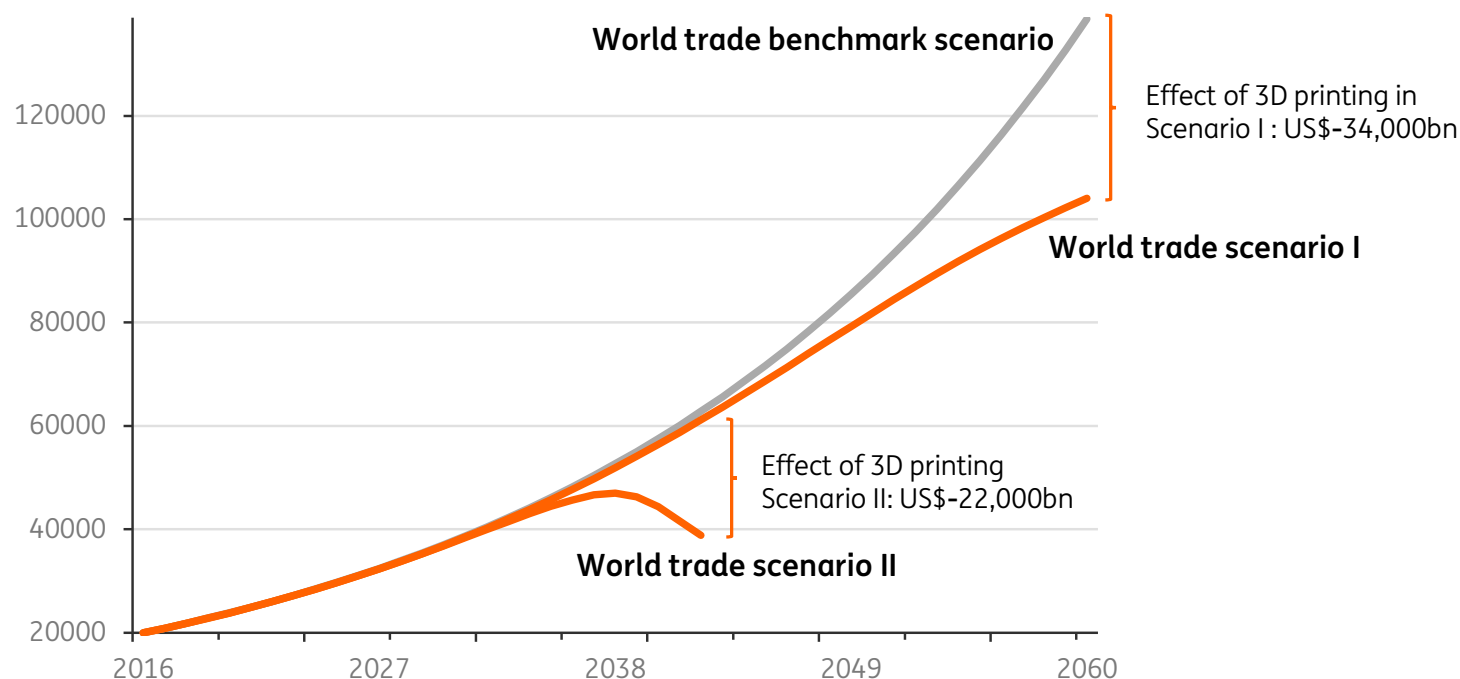
Source: Wohler's Reports 1993 – 2015.

**Details**



Analysis predicated on when 3D printing production estimates equal those of traditional methods.

**Fig 7 Scenarios for effect of 3D printing on world trade (goods and services) (US\$bn)\***



\*See note below Figure 5 for explanation of scenarios and *Appendix 2* for calculations

Source: Oxford Economics; Wohlers report 2017, 3D printing and additive manufacturing, state of the industry, annual progress report; Unctad, calculations by ING

MEASURES

# Key study measures



Firms selling at least one unit were at risk for inclusion from the point of first sale.

Variable	Operationalization	Mean	SD
Repertoire complexity	Entropy index of repertoire components based on a portfolio of five action types (price, product, marketing, capacity, and service related) (Ferrier and Lyon, 2004)	.66	.13
Repertoire consistency	Magnitude and direction of change in action space (5-dimensional) based on Lamberg et al. (2009)	.57	.22
Financial Performance	Return on assets in the following year (t+1)	-1%	10%
Market Valuation	Price to book ratio for the firm in the following year (t+1)	3.16	2.62
Competitive pressure	Count of all actions taken by set of firms in the same strategic group less the actions of the focal firm	119 acts	215 acts
Life cycle stage	Identified using a generalized discriminant procedure (Gort and Klepper, 1982)	Factor	

Performance Data	
Sources	EDGAR; S&P Capital IQ; Wohler’s Reports; PrivCo
Observations	221 ROA observations for 18 firms that sell 3D printers (matched n = 110)
Coding	As is, concatenated from sources

Action Data	
Sources	Factiva
Observations	360 firm-year observations of 24 companies compiled from 11,993 actions coded from 20,179 articles (matched n = 110)
Coding	Computer-aided text analysis

Control variables included total competitive activity, industry concentration, firm size and age, total firm activity, change in competitor count, among others. We also included an underlying time trend as a control, but this was non-significant and introduced collinearity to the model. Max potential n = 767.



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- **Analytical tools:**

- Random effects panel models (Hausman tests insignificant)

- **Control variables:**

- Industry level: Concentration, growth rate, industry age, change in competitors, number of patents
- Firm level (time varying): Firm size (log of assets), firm age, number of actions taken, management team size, publicly traded

- **Variance structure:**

- Heteroscedasticity robust standard errors

- **Robustness tests:**

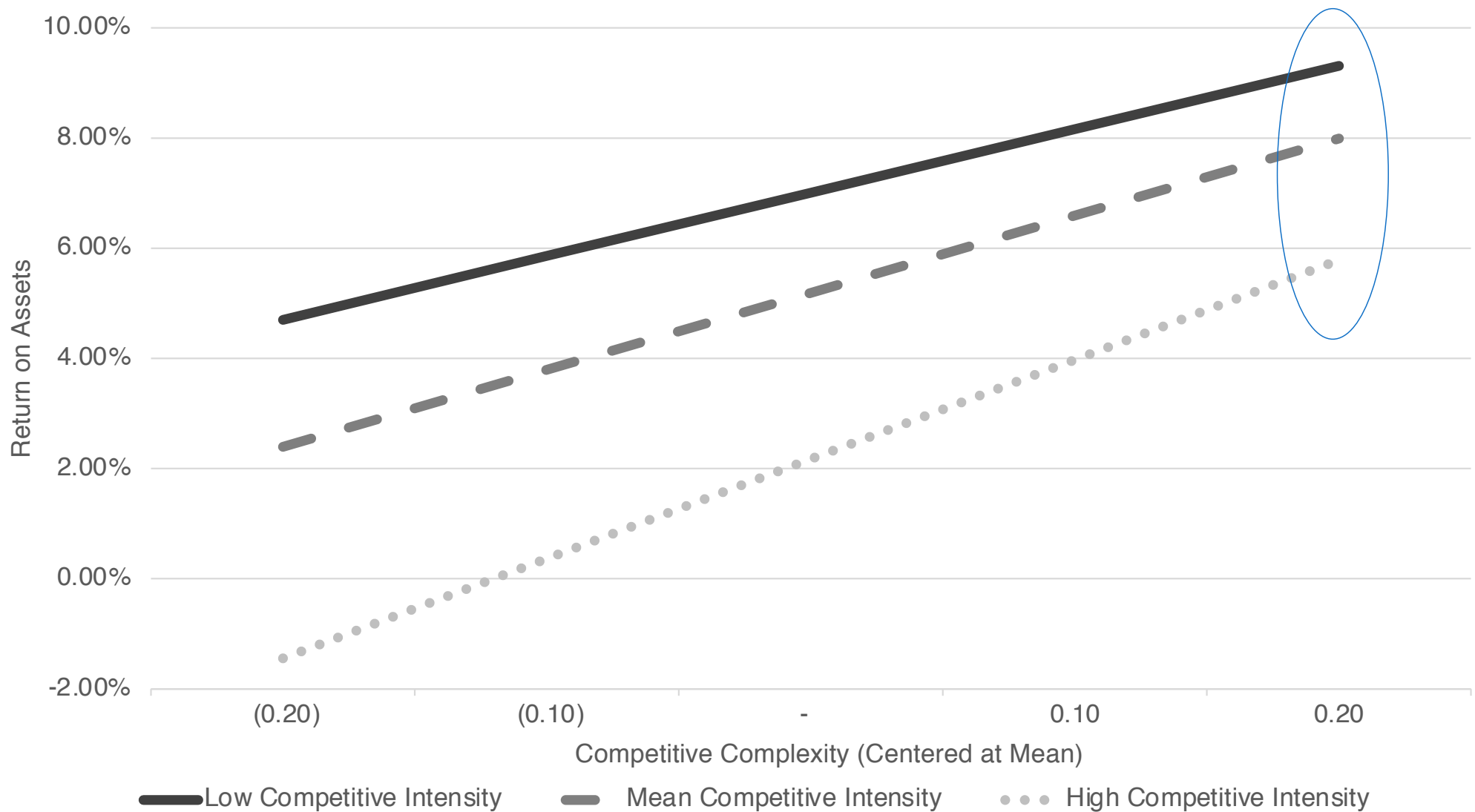
- Fixed effects models
- Lagged DV models





## Complexity seems to mitigate the negative effects of competition on performance to some degree.

(Random effects model, interactions plotted at -1 / +1 SD, Hausman  $\chi^2(15) = 3.06$ ).

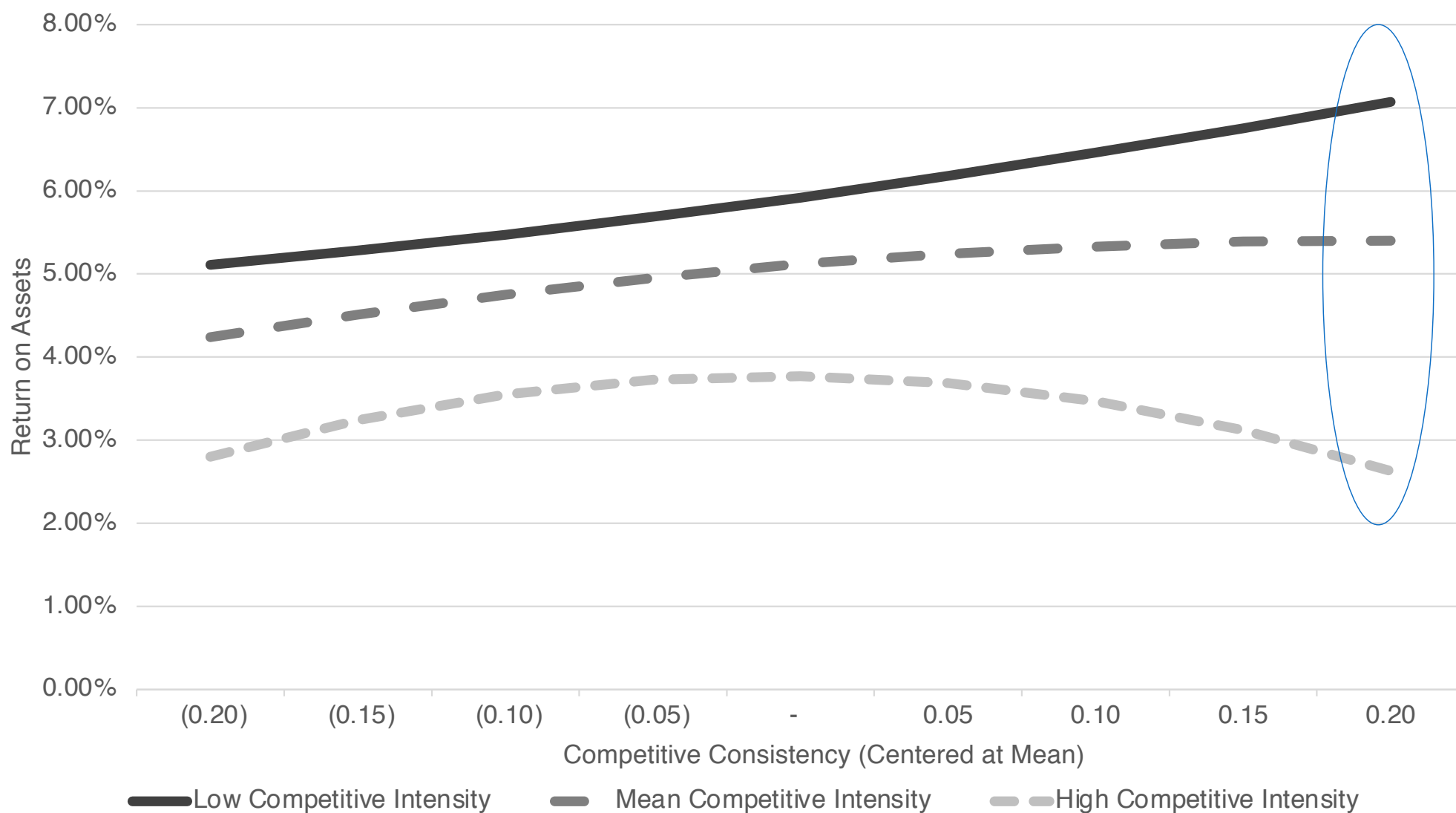


Source: Table 2, Model 1b, 1d. The main effect is significant when no interaction is present; interaction is significant at  $p < .05$  in random effects and fixed effects model, but not in lagged dependent variable model. All VIFs below recommended value of 10. Wald test for moderation  $\chi^2(1) = 3.94$ .  $n = 110$ .



## We find consistency is broadly beneficial if competition is low, but a tradeoff emerges as competition increases.

(Random effects model, interactions plotted at -1 / +1 SD, Hausman  $\chi^2(15) = 6.66$ ).



Source: Table 2, Model 1c, 1e. Consistency linear effect significant at  $p < .10$  with no interaction; squared interaction term is significant at  $p < .05$  in the random and fixed effects models. Result robust to lagged DV. All VIFs below recommended value of 10.  $n = 110$ . Wald test for moderation  $\chi^2(2) = 60.89$ .



### Limitations and related questions

- How can we better measure nascency / market valuation using industry data?
- What is the best way to capture the nexus between our arguments about “fit”, consistency and strategic groups?
- Should we examine the relative performance consequences between these characteristics, and if so, how?
- Currently a correlational study; what exogenous variation could we use for identification purposes given that we are looking at a life cycle in one industry?
- How can we better show the linkage between actions taken and the underlying strategy; reliability / validity of repertoire?

### Other thoughts for consideration

- Interactions between complexity and consistency – tradeoffs and capability differences? (e.g., Connelly et al., 2017)
- How can we “lean in” to the context more?
- Consistency of conclusions with other assessing action patterns, such as typologies or investments (Wowak et al., 2016)
- Incorporating timing of attacks more explicitly (e.g., Ferrier, 2001)
- How does the Red Queen factor in? (e.g., Derfus et al., 2008; Giachetti et al., 2018)
- How can managers apply these findings since these patterns are not a decision making “primitives”?

Some current ideas are to look at trailing sales volatility to capture uncertainty / nascency / dynamism. We are also processing more data to increase sample size and associated statistical power.