

A Model of Productivity Growth through Creative Destruction by Employee Spinout: Updates

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May 1, 2018

Updates - Overview

- ▶ Preliminary proposal for nesting model in general model
 1. Exogenous shock making knowledge public (easy, but very ad-hoc)
 2. Always free entry into R&D race, but spinouts have higher productivity
- ▶ Ideas for calibration / identification of parameters
 1. Model predictions
 2. Challenge: model is stylized. What is data counterpart to entrant (which only performs R&D) in the model?

Model recap

- ▶ Time t is continuous
- ▶ Agents:
 - ▶ Households
 - ▶ Intermediate goods firms
 - ▶ Final goods firm

Model recap

- ▶ Standard quality ladders model, step size $\lambda > 1$
- ▶ Continuum of intermediate goods, indexed by $j \in J = [0, 1]$
- ▶ Frontier quality of good j by q_j
- ▶ x_j is amount produced
- ▶ Each good produced with technology

$$x_j = \bar{q} l_j$$

where $\bar{q} = \int_0^1 q_j dj$ is the average quality level of the economy

- ▶ Each good j has monopolist, standard assumptions to guarantee no limit pricing
- ▶ Demand (final goods production) CES across goods j implies constant markup

Nesting: Version I

At time t with average quality \bar{q}_t , incumbent in the R&D race for good j of quality q_j begins with monopoly on good j R&D



- ▶ Hires R&D labor; at rate $\nu(q_j/\bar{q}_t)^{-1}$ per unit of R&D labor hired, employees learn, adding to mass of potential entrants (**scaling factor** $(q_j/\bar{q}_t)^{-1}$ **for BGP**))
- ▶ Simultaneously, with arrival rate θ , “knowledge spillover” shock hits → **free entry** into R&D race



At some point, either an incumbent or an entrant firm wins the race, and obtains a monopoly on production and R&D on good j of quality λq_j

Nesting: Version II

- ▶ Free entry into R&D
- ▶ Spinouts more productive – χ as they emerge, spinouts replace ordinary entrants in R&D race
- ▶ Making precise:
 - ▶ Let \bar{z} denote total innovation effort by entrants – spinouts and non-spinouts alike
 - ▶ Assume that the R&D production functions are

$$R_S(z_S; \bar{z}) = \chi_S z_S \eta(\bar{z})$$

$$R_E(z_E; \bar{z}) = \chi_E z_E \eta(\bar{z})$$

for spinouts, non-spinouts, respectively.

- ▶ Both depend on $\eta(\bar{z}) \Rightarrow$ standard model when $\chi_E \geq \chi_S$
- ▶ If instead draw from different pools of ideas (with Inada conditions) need to assume $\chi_S = 0$ to get standard model

Identification

- ▶ Specialize $\phi(z) = \eta(z) = z^{-\psi}$
- ▶ Parameters in baseline model: $\{\beta, \rho, \lambda, \chi, \psi, \nu, \xi, \theta\}$
- ▶ No closed forms so even when a certain moment “identifies” a parameter, I will have to do identification with indirect inference.
- ▶ General parameters: $\{\rho, \beta\}$
- ▶ R&D parameters: $\{\psi, \lambda, \chi\}$
- ▶ Spinout parameters: $\{\nu, \xi, \theta\}$
 - ▶ Empirical component of my paper
 - ▶ Attempt to identify using data on spinouts and creative destruction (details on next slide)

Identification: ρ, β

- ▶ Calibrating ρ :
 - ▶ Agents in model are risk-neutral \Rightarrow Interest rate = ρ
 - ▶ To get realistic interest rate, have to assume unrealistic discount factor
- ▶ Calibrating β :
 - ▶ In model, β determines elasticity of substitution across intermediate goods varieties labor share of final goods firm value-added
 - ▶ In my model, makes more sense to have realistic markups than realistic labor share of final goods production
 - ▶ Idea: follow AK 2017 in identifying based on profit / sales ratio (of, say, incumbent firms)
 - ▶ How to interpret final goods labor in this model if I think of intermediate goods as actually goods? Retail workers? Does this pose a problem given that I have required R&D workers to be indifferent?

Identification: R&D parameters ψ, λ, χ

- ▶ Difficult to disentangle using data generated from a single BGP
- ▶ Setting ψ :
 - ▶ Literature has identified using (1) elasticity of R&D spending to tax changes, (2) elasticity of patents to R&D spending
 - ▶ Both suggest $\psi \approx 2$
- ▶ Calibrating λ :
 - ▶ Literature has typically tried various values (approx 1.2) and checked robustness
 - ▶ AK 2017: identify based on patent citation distribution
- ▶ Calibrating χ :
 - ▶ Given other R&D parameters, can identify from measures of R&D intensity

Model predictions re: spinouts

- ▶ Aggregate moments
 - ▶ Fraction of firms which were spinouts vs. non-spinouts originally
- ▶ Individual moments
 - ▶ Depending on “state” of some good j , what is incumbent / spinout / non-spinout individual and aggregate R&D intensity
 - ▶ How to measure “state” m of good j ? Note that this is really a good j , not an industry.
 - ▶ How to measure R&D intensity of non-incumbents?
 - ▶ If can't measure m , can maybe measure “creative destruction” events; model has predictions for how R&D typically evolves over time after a “creative destruction” event.
- ▶ Causal relationships: more R&D leads to more spinout entrants. How to measure?!?

Bringing model to data

- ▶ Previous slide: shows that bringing this model to the data is somewhat contrived
- ▶ In the data:
 - ▶ Can't find individual good / service j
 - ▶ Individual goods are not completely overtaken by creative destruction
- ▶ Would be useful if my model had “market share” object in it, because that I can bring to the data.
- ▶ Can I do this while maintaining endogenous growth flavor?
- ▶ Idea: distribution of consumer types, every version of product is best for some consumers but not for others. Spinouts decide which consumers to go for, get incomplete overtaking. Models like this? Seem reasonable to keep thinking along these lines?

Research plan

- ▶ Empirical work: similar to Balasubramaniam & Sakakibara 2015, "Human capital of spinouts"
- ▶ **My contribution:** Link patent data (NBER patent database) and R&D data (Compustat)
- ▶ Question is roughly: does more R&D output (patents, or spending as another proxy for output) lead to more / more successful spinouts?
- ▶ Get out of R&D paradigm: does faster parent firm productivity growth lead to more spinouts? **For this, need to argue they are not demand shocks.**
- ▶ Rationalize this result taking seriously a model where R&D (broadly defined) "sows the seeds of future competing spinouts"
 - ▶ Currently have a model I am working on, but it is difficult to relate to the data.
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