Spin-off Formation and Cluster Dynamics

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Industry evolution, entry, and cluster formation

- **Observation:**
  - Spin-off formation appears to play a crucial role in many clusters
  - Big examples: Silicon Valley (“Fairchildren”), Detroit (automobiles), Akron (tires)

- **Basic dynamics of spin-off-based cluster formation:**
  1. Historical accident: successful early firm enters in a region (possibly based on prior presence of related industry)
  2. Spin-off process: superior firms have more / better spin-offs
  3. Like other entrants, spin-offs tend to enter locally → clustering based on entry of indigenous firms, not attraction of entrants from elsewhere
  4. Cluster performance explained by superiority of its firms
     → In principle, cluster performance explicable without reference to agglomeration economies
The Akron Tire Cluster

(Buenstorf and Klepper, 2005, 2006)
Setting: the U.S. tire industry, 1900-1930

- More than 500 entrants
- Firm number peaks in 1922, then drastic shakeout
- Most entry in Northeast & Midwest
- Industry activity extremely concentrated in Ohio
  - 24% of all entrants
  - Up to 65% of total output
Geography of entry in Ohio

- Heavy concentration of entrants in and around Akron
- 3 of 4 national industry leaders located in Akron (Goodrich, Goodyear, Firestone)
- Tire industry as extreme case of geographic concentration
- What processes drove the concentration?
The Conventional Account of the Akron Tire Cluster

- **Ingredient 1: Historical Accident**
  - BF Goodrich attracted to Akron by distance to Eastern competition and local inducements
  - Early diversification into tires (proximity to carriage firms)

- **Ingredient 2: Proximity to Demand**
  - Akron located close to Detroit (< 200 miles) and to the center of national replacement tire market

- **Ingredient 3: Attraction of Entrants**
  - Success of Akron firms attracts new entrants

- **Ingredient 4: Agglomeration Enhances Performance**
  - Labor pooling, specialized inputs and knowledge spillovers
  - Akron firms leading in product and process innovations
The Conventional Account Revisited

- **Ingredient 1: Historical Accident**
  - Crucial role of BF Goodrich
  - Key early entrants directly linked to Goodrich

- **Ingredient 2: Proximity to Demand**
  - U.S.-wide entry patterns follow demand
  - But hardly any entry in and around Detroit

- **Ingredient 3: Attraction of Entrants**
  - Few firms move to Akron; most entrants have local roots

- **Ingredient 4: Agglomeration-Based Performance**
  - Performance based on firm background
  - Spillovers have broader range than performance effect
Data for empirical analysis

- Complete firm population over life cycle of narrowly defined industry

- For all 532 U.S. entrants through 1930 (listings in Thomas’ Register)
  - Entry and exit years (through 1980)
  - Information on diversifying pre-existing firms and on acquired exits
  - Location of entry and subsequent moves

- For 117 Ohio entrants through 1930 also (various sources / archives)
  - Founding background of *de novo* entrants: spin-offs versus startups
  - Spin-off founders’ prior employer and often position
  - Anecdotal evidence on founding circumstances (entrepreneurial opportunities, strategy conflicts in existing firms etc.)
  - Location of origination
Firm Origination and Entry
Geography of firm origination: model (1)

- **Variant of Klepper's model of industry evolution (AER, 1996)**
  - Idea: R&D reduces average cost of production $\rightarrow$ larger firms conduct more R&D $\rightarrow$ larger firm more profitable $\rightarrow$ grow further
  - Through growth process, advantages to early entrants

- **Model of background and performance**
  - Firms differ in their capabilities (R&D productivity); two types H (high) versus L (low)
  - Effect of pre-entry background on capabilities:
    - Diversifiers: H-types enter as H or L; L-types can only be L in new industry
    - Spin-offs: can be H or L; H-type spin-offs emerge only from H-type incumbents
    - Other startups are all L-types
Geography of firm origination: model (2)

- Geographic inertia: all diversification and spin-off activities remain within same region
  (location of origination = location of entry)

- Additional assumptions on regional “birth potential”
  - Likelihood of diversification:
    - All firms in related industries have same likelihood to be L-type diversifiers
    - In addition, H-types may also be H-type diversifiers (⇒ higher total div. prob.)
  - Spin-off likelihood:
    - All firms in industry have same likelihood to spawn L-type spin-offs
    - In addition, H-types also spawn H-type spin-offs (⇒ higher total spin-off rate)
  - Startup likelihood:
    - Employees of firms in related industries and others can organize startups, which are all of L-type
Geography of firm origination: model (3)

- **Implications of model:**
  - Diversifiers and spin-offs on average superior to startups
  - More/better firms in related industries → more/better diversifiers enter in region
  - More/better incumbent firms → more/better spin-offs enter in region
Agglomeration economies and firm origination

- If agglomeration increases expected profitability of entry → larger # of potential entrants in region actually enters
- This effect still holds if entry outside region of origination is possible but costly
- Implication:
  - Localization: more/better incumbent firms and firms in related industries → more entrants in region
  - Urbanization: more urbanization → more entrants in region

→ Identification problem: our model has similar predictions as cluster accounts based on agglomeration economies!
Empirical approach

- **Two steps of empirical analysis**
  - Location of origin (Ohio county level)
  - Location of entry given location of origin (Ohio county level)

- **Origination: key criterion to discriminate effects**
  - Agglomeration economies
    - Expect same effects of localization / urbanization on all entrants
  - Regional birth potential
    - Expect that effects vary by type of entrant

- **Entry: Location of entry conditional on origination**
  - Birth potential effects are controlled for by home county dummy
    - Cleaner measure of agglomeration effects
  - Distinguish between effects on home county and on other counties
    - Allows for „localized“ capabilities (Figuereido et al., JUE 2002)
Econometric model

- Use conditional logit (Carlton, 1983) to study origination / entry:

\[ p_{ij} = \frac{\exp\{x_{ij} \beta\}}{\sum_j \exp\{x_{ij} \beta\}} \]

- Likelihood of entry in region depends on its characteristics

- Panel data at county level; county fixed effects capture unobserved heterogeneity

- Independent variables (% of Ohio total):
  - Population
  - Existing tire firms
  - Existing rubber firms
  - Automobile firms; manufacturing firms / production volume
Expected effects: origination

- If agglom. econ. shape origins:

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<thead>
<tr>
<th></th>
<th>Divs</th>
<th>Starts</th>
<th>Spins</th>
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<tbody>
<tr>
<td>Tire firms / region</td>
<td>+</td>
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<tr>
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- If capabilities shape origins:

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Findings: origination

- Find the expected (type-specific) effects of birth potential
- Also find (modest) effect of tire firms on origination of startups → localization
- Results robust to entering county fixed effects
- Consistent with firm-level analysis of spin-off process:
  - Leading firms had more (+ better) spin-offs
  - Spin-off founders came out of top management

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## Determinants of spin-off likelihood in Ohio

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
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<tbody>
<tr>
<td>Top 4 Firm</td>
<td>2.244***</td>
<td>(.703)</td>
</tr>
<tr>
<td>Other Major Firm</td>
<td>1.159**</td>
<td>(.481)</td>
</tr>
<tr>
<td>Survival_Years</td>
<td>-.003</td>
<td>(.010)</td>
</tr>
<tr>
<td>Active Firm</td>
<td>1.272**</td>
<td>(.561)</td>
</tr>
<tr>
<td>Nonspin_Entry</td>
<td>.022**</td>
<td>(.009)</td>
</tr>
<tr>
<td>County_Prodshare</td>
<td>.001</td>
<td>(.009)</td>
</tr>
</tbody>
</table>

Note: standard errors in parentheses; ***p ≤ .01; **p ≤ .05; *p ≤ .10
Findings: entry (given origination)

- Localization and urbanization economies attract entrants
- Effect is limited to choice of county away from home; decision for home entry unaffected by agglomeration
- If further distinction by type and inclusion of fixed effects:
  - Effect of localization economies only
  - Effect is limited to startups and diversifiers

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<tr>
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<th>Entry in Home County</th>
<th>Entry in Other County</th>
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<tbody>
<tr>
<td>Home county</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Tire firms / region</td>
<td>O</td>
<td>+</td>
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<tr>
<td>Population / region</td>
<td>O</td>
<td>+</td>
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</table>
Implications for Akron

- Akron had pre-existing rubber firms and successful early entrants
  - Powerful “birth potential” for new entrants
  - Akron entrants indeed were mainly diversifiers and spin-offs

- Evidence of agglomeration effects is strongest for startups and firms entering outside of their home region
  - Both played limited role in Akron
Firm Performance
Geography of firm performance: model

- Hazard of firm exit determined by entry time and pre-entry background
- **Akron: many early entrants; diversifiers and spin-offs**
  → On average expect lower hazard in Akron
- **When distinguishing by entry types**
  → Expect lower hazard only for Akron spin-offs and diversifiers
- **When competence of entrants is fully controlled**
  → Expect same average hazard in Akron and elsewhere
Empirical approach

- Perform analysis on national level, some background info available only for Ohio firms

- Use Gompertz specification for firm’s exit hazard:
  
  \[ h(\tau) = \exp[\beta_0 + \beta'z] \cdot \exp[(\gamma_0 + \gamma'x)\tau] \]

  - Allows hazard to vary with firm’s age
  - Age-dependent hazard terms included for entry cohorts and diversifier dummy (Klepper, RAND 2002)
  - Acquired firms treated as censored exits

- Perform series of model specifications to distinguish agglomeration effects from effects of firm background
Firm performance: effects of agglomeration

- Model 1 suggests agglomeration (localization) effect on performance
- Model 2: Adding Akron control wipes out general agglomeration effect
- No agglomeration effect in counties close to Akron
- No effect of proximity to Detroit
- Model 3: Akron effect not confined to set of key early entrants

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<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other tire firms (cnty)</td>
<td>-.025**(.010)</td>
<td>.006(.012)</td>
<td></td>
</tr>
<tr>
<td>Akron</td>
<td></td>
<td>-.867***(.299)</td>
<td></td>
</tr>
<tr>
<td>Neighboring Counties</td>
<td></td>
<td>.232(.206)</td>
<td></td>
</tr>
<tr>
<td>&lt;200 miles to Detroit</td>
<td></td>
<td>-.092(.173)</td>
<td></td>
</tr>
<tr>
<td>Akron_ini</td>
<td></td>
<td></td>
<td>-.620***(.206)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.759***(.063)</td>
<td>-1.807***(.067)</td>
<td>-1.795***(.058)</td>
</tr>
<tr>
<td>Age</td>
<td>-.046***(.005)</td>
<td>-.042***(.005)</td>
<td>-.046**(.005)</td>
</tr>
<tr>
<td>Obs.</td>
<td>4786 (532 firms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log-likelih.</td>
<td>-802.519***</td>
<td>-793.258***</td>
<td>-800.609***</td>
</tr>
</tbody>
</table>

Note: standard errors in parentheses; ***p ≤ .01; **p ≤ .05; *p ≤ .10
Firm performance: effects of agglomeration

- Model 4: Akron effect robust to entry time, background controls
- Model 5: Akron effect limited to Akron spin-offs
- Model 6: Entry size as proxy of spin-off capabilities → Akron spin-off effect no longer significant

<table>
<thead>
<tr>
<th></th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akron_ini</td>
<td>-.455*** (1.195)</td>
<td>-.097 (1.194)</td>
<td>-.095 (1.194)</td>
</tr>
<tr>
<td>Akron spin-off</td>
<td></td>
<td>-1.062** (1.016)</td>
<td>-.522 (1.406)</td>
</tr>
<tr>
<td>Diversifying firm</td>
<td>-.592*** (1.205)</td>
<td>-1.607*** (1.208)</td>
<td>-1.605*** (1.208)</td>
</tr>
<tr>
<td>Spin-off</td>
<td>-.355* (1.190)</td>
<td>-.128 (1.202)</td>
<td></td>
</tr>
<tr>
<td>Large TopSpin-off</td>
<td></td>
<td></td>
<td>-1.702* (1.102)</td>
</tr>
<tr>
<td>Medium TopSpin-off</td>
<td></td>
<td></td>
<td>-.601** (1.286)</td>
</tr>
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</table>

(see paper for cohort effects and age-dependent coefficient estimates)

Log-likelihood: -718.523, -715.952, -713.885
Discussion
The alternative account of the Akron tire cluster

- **Evolution of Akron tire cluster**
  - Initial set of high-performance tire firms (Goodrich et al.)
  - Better firms have more, and more successful, spin-offs
  - All firms (including spin-offs) tend to locate close to their origin
  - Self-reinforcing concentration based on historical accident

- **Why did Akron firms perform better?**
  - Performance explained by entrants’ background (spin-offs from leading firms; diversifiers)

- **Why so little entry in Detroit?**
  - U.S. Rubber plant moves to Detroit only in 1905
  - U.S. Rubber was not an ideal source of spin-offs
Clusters emerge at roughly the same time in closely related industries

Striking parallels between both clusters (Klepper, MS 2007)

- Initial successful entrant (B.F. Goodrich / Olds Motor Works) (note, however, that Detroit “missed” the auto industry’s first years)
- Four additional early successful Detroit entrants had links to Olds; were prolific breeders of spin-offs
- 50 out of 61 Detroit spin-offs located also there
- Detroit effect on performance was limited to spin-offs
- Controlling for spin-off background, Detroit spin-offs performed similar to spin-offs located elsewhere

Similar role of spin-off entry also in more contemporary clusters, most notably Silicon Valley (Klepper in Audretsch and Strom (eds.) 2007)
Intershop and the Emerging E-Commerce Software Industry in Jena

(Buenstorf and Fornahl, MPI Preprint 2006)
Motivation

- **Observations**
  - For investors, dot.com shares mostly were a desaster
  - Regional perspective: Single firms can trigger regional development and the emergence of localised clusters

- **Research Question**
  - How does a temporarily successful dot.com affect regional conditions and spin-off activities?

- **Approach**
  - Qualititative case study of former German dot.com star: Intershop Communication
The Rise and Fall of Intershop (1)

- **Before March 10, 2000**
  - Poster child of Germany’s New Economy
  - Founded in 1992 in Jena by three founders
  - Early producer of e-commerce software
  - First East German firm with substantial VC funding
  - Dot.com boom supported rapid growth
  - Peak stock market value € 11.1 billion with 1,218 employees, € 123 million revenue

- **After March 10, 2000**
  - 70% of stock market value lost on a single day
  - All three founders resigned
  - Expert consensus: Intershop had high quality products, but weak marketing and strategy
  - Downsizing: at present, 222 employees, € 15 million revenue
The Rise and Fall of Intershop (2)

Development of number of employees (10 year period)

Development of stock price in Euro (3 year period)
Software Spin-offs from Intershop (1)

- **Serial Entrepreneurship**
  - All three Intershop founders started new firms (ePages, Demandware, Pixaco)
  - Only Demandware located outside Jena (Boston); other ventures even stayed in Intershop Tower
  - Hired key managers and employees from Intershop
  - Strategy and Performance:
    - Demandware: VC-based attempt to develop and market on-demand e-commerce software
    - ePages: further development of first-generation Intershop software
    - Pixaco (Snapfish): online photo development; 2005 acquired by Hewlett Packard
  - Intershop experiences influenced new ventures
    - 2 remained in Intershop's core market (e-commerce software)
    - 1 used web portal based on Intershop software
Software Spin-offs from Intershop (2)

- At least 30 spin-offs in total; 20 located in Jena or its environs
- Employee spin-offs reflect Intershop experiences
- Examples:

<table>
<thead>
<tr>
<th>Spin-off</th>
<th>Intershop position</th>
<th>Business model / field of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clienthouse</td>
<td>Customer and partner services</td>
<td>Customer relation management consulting</td>
</tr>
<tr>
<td>Cresco Services</td>
<td>CFO</td>
<td>Financial consulting services</td>
</tr>
<tr>
<td>J-media</td>
<td>Press relations</td>
<td>Standard software for marketing / PR</td>
</tr>
<tr>
<td>Moccafish</td>
<td>User interface design</td>
<td>Interface design, e-learning</td>
</tr>
<tr>
<td>Towerconsult</td>
<td>VP Human resources</td>
<td>Human resource consulting (recruiting); software development</td>
</tr>
<tr>
<td>Xceptance</td>
<td>Quality control</td>
<td>Quality management for software development</td>
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</table>
Software Spin-offs from Intershop (3)

- Business models related to e-business, but no spin-off employee spin-off entered in Intershop‘s core market
- Interviews: Founders report exploitation of Intershop knowledge and experiences
- Intershop supported spin-off emergence
- Social network of founders based on common Intershop experience
- TowerByte eG as a privately organized technology park (cooperative of 16 software firms)
  - Joint infrastructure services in Intershop Tower
  - Labor pooling and knowledge spillovers
  - Reputation and size effects; lobbying efforts
  - Cooperative has attracted non-spin-off member firms from Jena and elsewhere
Software Spin-offs from Intershop (4)

**Overall assessment**

- Substantial number of spin-offs emerged
- Evidence for inheritance of Intershop knowledge
- Spin-offs formed by top employees closer to Intershop strategy / core market
- Intershop's peculiar situation: Failure breeds success?
  - Intershop spin-offs as necessity spin-offs → expected to be less successful
  - Intershop problems in part due to industry crisis
  - Downsizing → Existence of high quality capabilities and opportunities that Intershop itself could not exploit
- Industry characteristics: heterogeneity, modularity, low barriers to entry
Discussion

- **Spin-off-based cluster formation**
  - Intershop created new technological trajectory in Jena
  - Intershop crisis triggered spin-off process
  - Spin-offs’ business models reflect Intershop experience → on-the-job learning
  - Majority of spin-off entrepreneurs stayed in the region
  - Spin-off activities helped to keep IT-related human capital in the region

→ **Albeit at smaller scale, basic dynamics are similar to Akron, Detroit, Silicon Valley etc.**

→ **Subtle difference: extreme modularity → entry in submarkets**

→ **From regional perspective, Intershop seems to have lasting positive effects**
Policy Implications

(relax, this is a single-slide section…)
Discussion: some potential policy issues

- **Spin-off process**
  - Spin-offs are substantial fraction of high-tech firm formation (30-40 % and more)
  - How to evaluate spin-off formation?
  - Adverse effect on training / openness in parent firms?
  - Can/should public policy encourage spin-off formation (e.g., non-compete clauses; trade secrets)?

- **Spin-off-based cluster formation**
  - If pervasive form of cluster dynamics, what role for public policy?
  - Can spin-off-based clustering be supported by policy makers?
  - Industry (lifecycle)-specific cluster policies?
  - What role for traditional cluster policies?
  - What role for academic institutions?