Firm Expansion through Innovation Network

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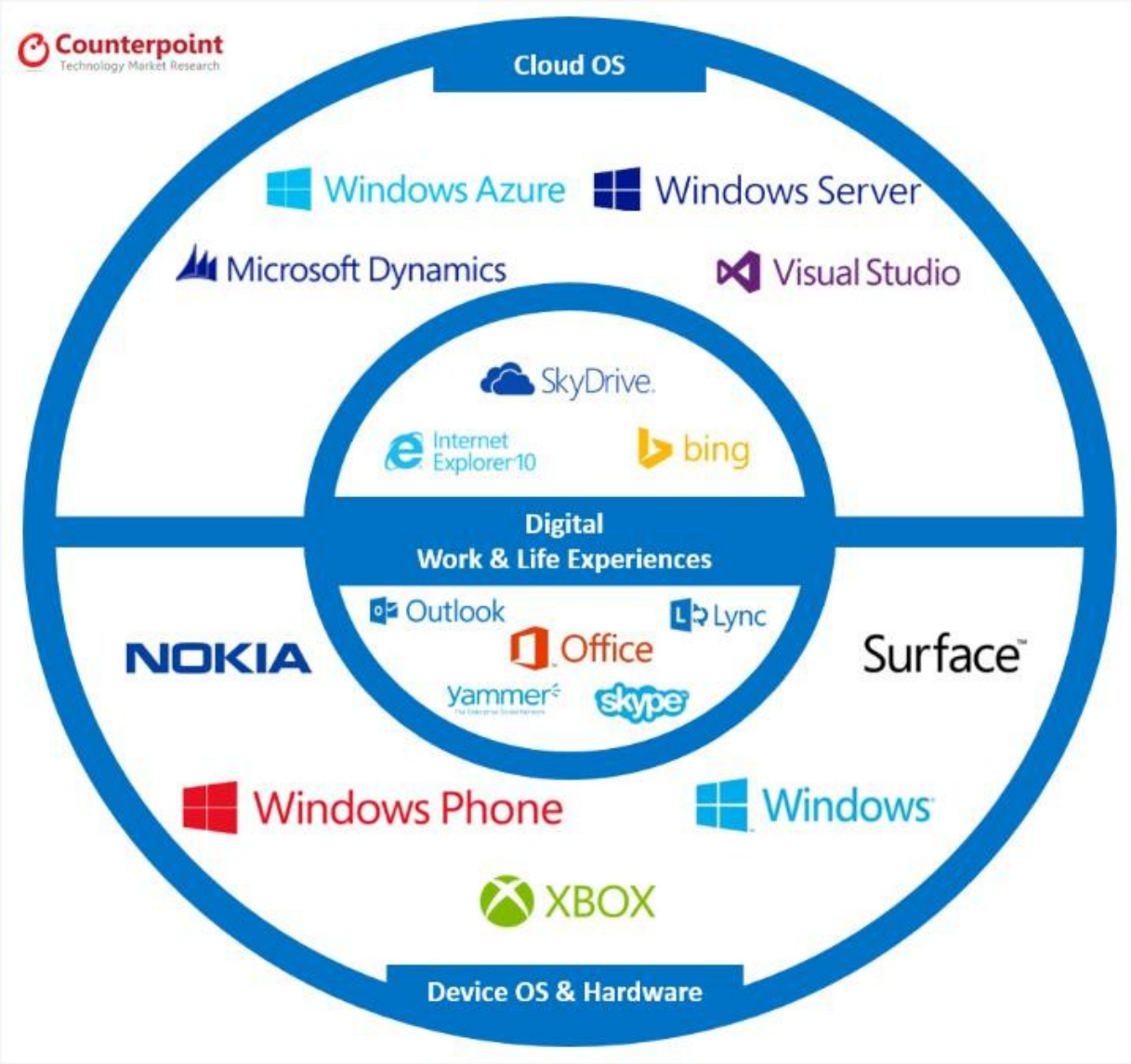


https://www.linkedin.com/pulse/20140721180246-21534059-microsoft-mobile-first-nokia-last

Questions

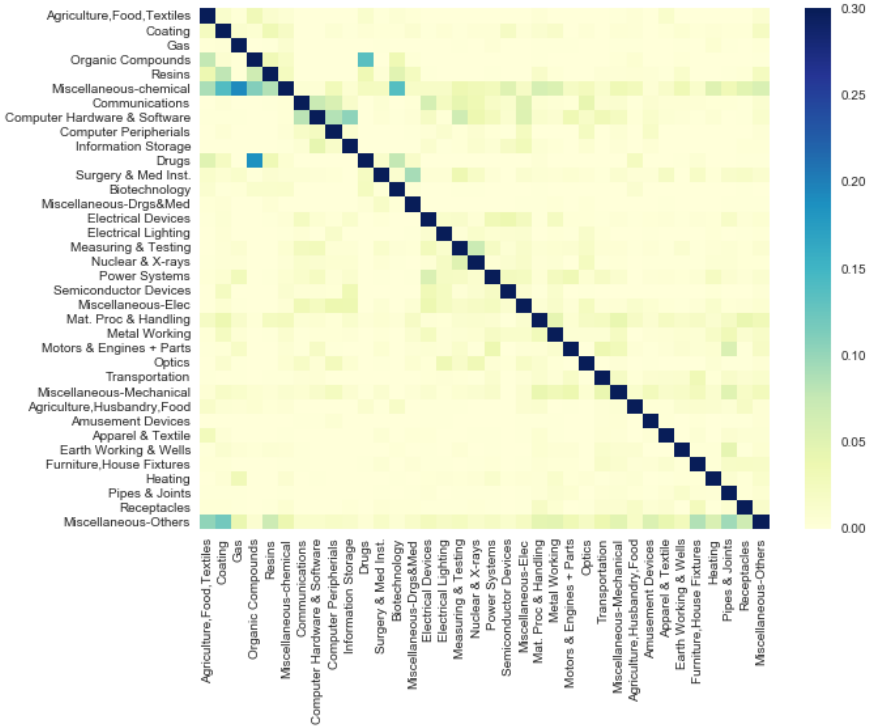
- Why are firms diversifying their portfolio?
  - Agency theory: e.g., Jensen & Meckling (1976); Williamson (1975);
  - Resource-Based theory: See Wan et al. (2011) for a review;
  - Within-firm R&D spillover: Klette (1996); MacDonald (1985); Jovanovic and Gilbert (1993); .
- Where do they expand?
  - Related industries: e.g., product similarity (Berry, 1975); similarity of customers (Lemelin, 1982); similar intensity of R&D (MacDonald, 1985).

My answer: Firms expand into new industries due to the R&D spillovers through innovation network.

Innovation Network

Innovation network captures how knowledge is shared and transferred across knowledge fields (Acemoglu et al., 2016).

Figure: Citation Matrix ($\alpha_{ij} = \frac{\text{Citation}_{i \to j}}{\sum_h \text{Citation}_{i \to h}}$)



Adapted from Acemoglu et al. (2016)

Results and Contributions

- Result:
  - Firms tend to expand into indutries that are closely connected in innovation networks, both upstream and downstream.
- Contribution:
  - Provide a new explanation and evidence of corporate diversification in a dynamic perspective with detailed mechanism;
  - Propose a framework for endogenous growth models that incorporates hetergeneous industries and innovation networks;
  - Give policy suggestions under heterogeneous industries.

Empirical Evidence

Strategy

- Data: NBER patent and citation data 1963-1997 (U.S. non-government organization only)
- Identify "expansion":
  - Accumulation Period: Firms built their portfolios $\mathbf{m}_f$ during this period;
  - Expansion period: Once a firm holds patents in a new industry above certain thesholds (e.g., 30% of current portfolio), it is counted as an expansion;

Empirical Evidence

Index Construction

Network Strength:

- Upstream$_j = \frac{1}{N} \sum_{i \in \mathbf{m}_f} n_i \alpha_{ij}$
- Downstream$_j = \frac{1}{N} \sum_{i \in \mathbf{m}_f} n_i \alpha_{ji}$

$$V_{fji} = \beta_1 \text{Upstream}_{fj} + \beta_2 \text{Downstream}_{fj} + \beta_j \mathbf{x}_{fj} + \epsilon_{fji}$$

Empirical Evidence

Results

Table: Network Strengths and Probability of Expanding into a Certain Industry

	Probability of Expanding into a certain industry			
	(1)	(2)	(3)	(4)
Upstream	14.009***	17.308***	11.625***	20.571***
	(1.364)	(3.215)	(4.248)	(4.466)
Downstream	16.311***	20.347***	20.437***	17.352***
	(1.360)	(3.235)	(4.473)	(4.354)
Avg. Marginal Effect: Up	0.367	0.45	0.3	0.532
Avg. Marginal Effect: Down	0.428	0.529	0.527	0.449
Min. Percentage	30%	30%	50%	30%
Min. Num	1	3	3	3
Accumulation (yr)	10	10	10	15
Expansion (yr)	10	10	10	5
Observations	2,641	585	296	270

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Theoretical Model

Main Features

Firms' R&D function:

$$x_i = [\prod_h s_h^{\alpha_{ih}}]^{\alpha}, \sum_{\alpha_{ih}} = 1$$

Consider a firm targeting in innovating in industry i:

- Upstream effect: It will invest higher in industry j where α_{ij} is larger;
- Downstream effect: It will invest heavily in i, generating higher innovation rate in industry j where α_{ji} is higher.

Theoretical Model

Simulation (Partial Equilibrium)

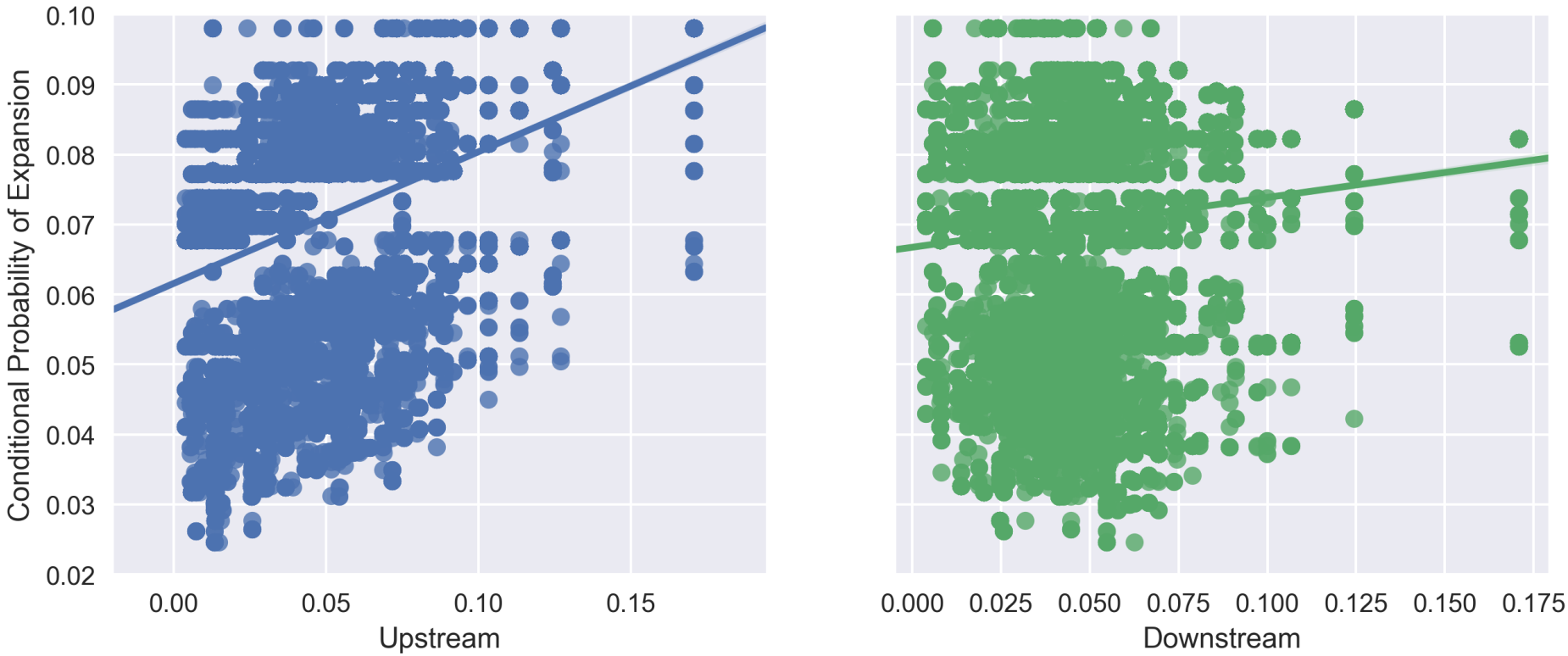


Figure: Simulated Results in Partial Equilibrium

Further Steps

- Derive general equilibria;
- Use Simulated Moment Method (SMM) to calibrate the model;
- Analyze policy instruments.