# Complex Innovation and the "Visible Hand": the Role of Knowledge Interdependence in Employee Entrepreneurship

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## Abstract

How does growing knowledge interdependence in firm innovation activities affect potential entrepreneurs' decision to start their own business ventures? To answer this question, I adopt an **abductive approach** and leverage matched employee-employer data from the U.S. Census Bureau between 2000-2014. Results show that **higher knowledge interdependence is negatively associated with employee entrepreneurship**, and the negative effect is even **stronger**, not weaker, **among the highest-performing individuals**. These suggest that firms strategically manage human resources to retain valuable human assets, which also leads to **greater compensation dispersion within firms** with higher knowledge interdependence. Together, these create a strong **selection on the quality of spinouts** being formed especially by individuals ranked highest on the human capital distribution. A theoretical model suggests when knowledge interdependence creates large enough competitive advantage, it could also raise **between-firm income inequality.**

## Introduction

The intellectual debate about the roles of **Adam Smith's Invisible Hand** and **Alfred Chandler's visible Hand** in innovation and technological progress is quite old, as is also exemplified by Schumpeter's shift in attribution of economic growth from small, new firms to large, established firms (Schumpeter 1911, 1942).

However, it may be worthwhile revisiting it once again, as **the complexity and interdependence of knowledge** necessary for innovation has been **rising** (Wuchty, Jones and Uzzi, 2007; Jones, 2009; Bloom, Jones, Van Reenen and Webb, 2020), while the U.S. has experienced a generally **declining business dynamism** (Decker, Haltiwanger, Jarmin and Miranda, 2014; Akcigit and Ates, 2019). *Does the nature of technological change, i.e., rising knowledge interdependence, bring competitive advantage to large established firms? Is it transforming the roles of large established firms to become relatively more important hotbeds for innovation and the engine of economic growth as opposed to startup?*

This paper uses abductive reasoning to yield plausible explanations that are then formalized in an economic model. Empirical results suggest <u>higher knowledge interdependence does not merely create frictions of knowledge transfer via the labor market, but innovative firms are also proactively managing and incentivizing the best talents to stay.</u> This is the best explanation for the observed lower likelihood of employment entrepreneurship in particular among high-performing employees, the higher within-firm earning dispersion, and better quality of startups conditional on formation that are associated with higher knowledge interdependence.
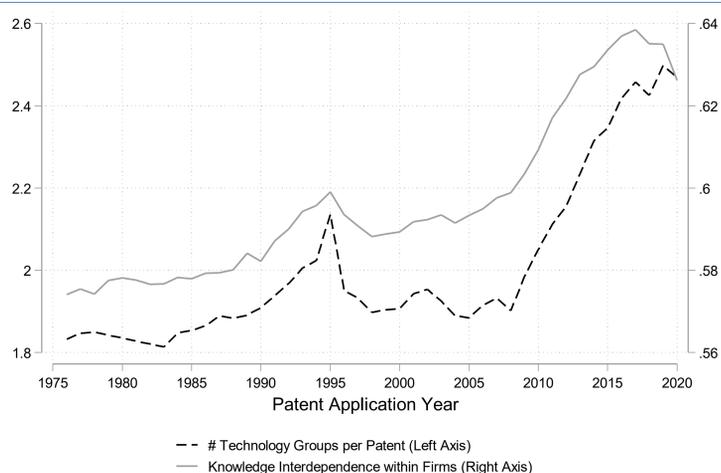


## Data and Sample

The primary data sources for this study are the USPTO patent data, the Longitudinal Employer-Household Dynamics (LEHD), and the Longitudinal Business Database (LBD) from the U.S. Census Bureau between 2000 and 2014. There are three interconnected samples I used for the multi-level analysis in this paper: 1) a near census of patenting firms in the U.S. between 2000 and 2014, 2) all startups founded by previous employees of these innovative firms, and 3) all employees including both startup founders and non-founder employee.

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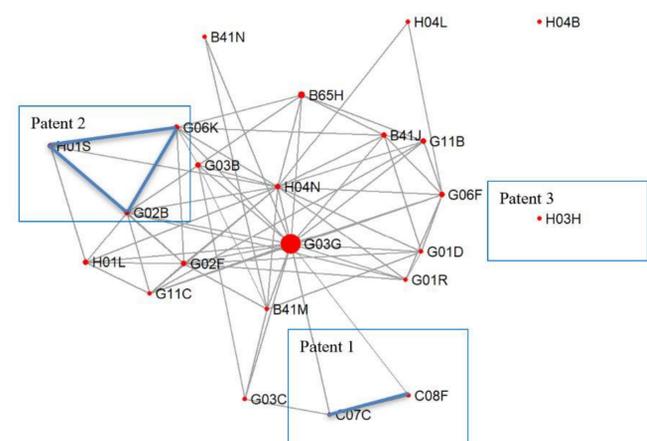
## Knowledge Interdependence

Similar previous research, knowledge interdependence is measured based on co-occurrence of multiple technology groups in the same invention (Ganco, 2013; Fleming and Sorenson, 2001, 2004; Sorenson et al., 2010). Specifically,

$$K_{j,t} = \sum_{c \in \phi_{j,t}} K_{c,j,t}/N_{j,t}$$

And,

$$K_{c,j,t} = \sum_{x \in \phi_{j,t}, x \neq c} N_{c,x,t}^j/N_{c,t}^j$$

$\phi_{j,t}$ is the set of technology groups in firm $j$ in year $t$, $N_{c,x,t}^j$ is the number of patents co-assigned to CPC group $c$ and $x$, $N_{c,t}^j$ is the number of patents assigned to CPC group $c$, $N_{j,t}$ is the number of CPC group in firm $j$'s patent portfolio. In essence, $K_{j,t}$ measures the (normalized) number of technology groups combined with a randomly selected technology group in the firm knowledge technological network as shown below.



An Example of A Firm's Technological Knowledge Network.

## Results

There has been an increasing time trend of firm knowledge interdependence and a declining trend of employee entrepreneurship from highly innovative firms over the past two decades.

Importantly, higher knowledge interdependence is associated with:
1. Lower likelihood of employee entrepreneurship, with a significantly stronger, not weaker, effect among high-performing individuals;
2. Greater within-firm earning dispersion;
3. Higher survival rate of the startup in particular if it's founded by high-performing individuals.

A theoretical model explaining these empirical findings suggests higher knowledge interdependence may also lead to higher **between-firm** income inequality when firms are able to extract high enough rents from the product market.
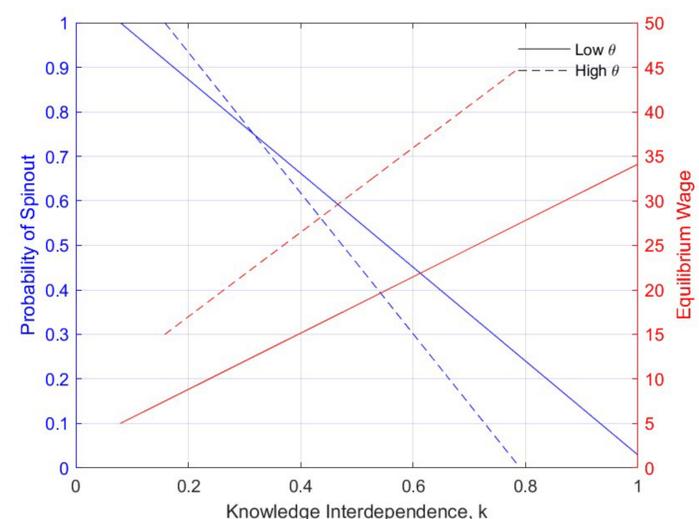


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