

# Co-location of Manufacturing and Technology Creation: The Impact of Offshoring on Innovation

Teresa Fort

Dartmouth

Wolfgang Keller

U Colorado

Stephen Yeaple

Penn State

Nikolas Zolas

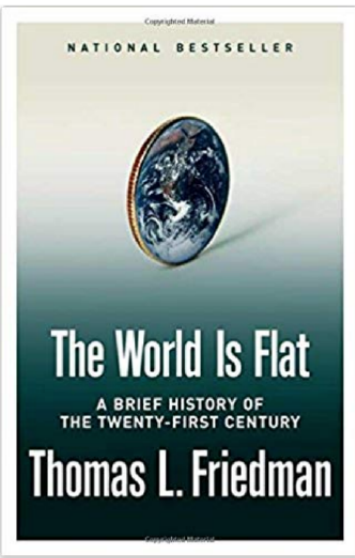
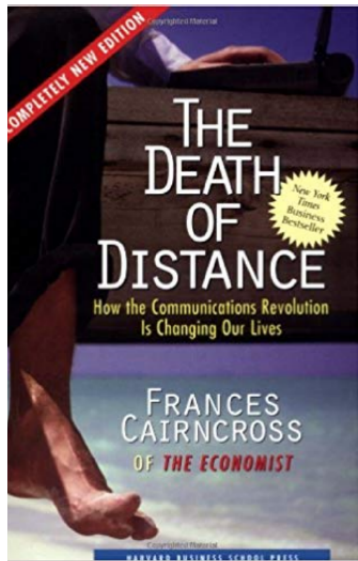
US Census Bureau

IBS, October 24, 2018

# Motivation

- ▶ US manufacturing employment on the decline
  - ▶ Big focus on import competition from China
- ▶ More recent work relates Chinese imports to decreased innovation
- ▶ Broader concern that US losing its manufacturing capabilities
  - ▶ Why would that be important?
  - ▶ One explanation is that innovation depends on production

## Geography: does it still matter?



# Key Potential Mechanisms and Channels

- ▶ Potential importance of proximity between production and research due to
  1. Face-to-face interactions between R&D scientists (engineers) and production workers (mechanics)
  2. Feedback from manufacturing on feasibility of design for production

# Main Questions

- ▶ Do manufacturing and R&D need to be co-located?
  - ▶ Is R&D more productive when manufacturing is nearby?
  - ▶ Does colocation need to be within the firm?
  - ▶ How has co-location changed over time?
- ▶ How does knowledge flow from firm to firm?
  - ▶ Do firms concentrate innovation in geographic areas?
  - ▶ How important are within vs. across firm patent citations?
  - ▶ Does knowledge flow farther within the firm?

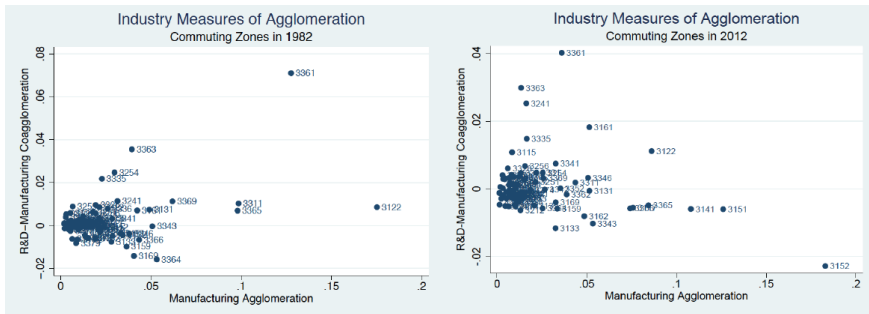
# Main Contributions w/ 1987 to 2012 Census data

- ▶ New evidence on the co-location of US R&D and manufacturing
  - ▶ Within-firm measures of distance between manuf and R&D
  - ▶ Characteristics of co-located establishments
- ▶ Measures of knowledge flows from firm to firm
  - ▶ Concentration of patenting and design activities within zip codes
  - ▶ Within versus outside the firm citation distances
- ▶ Estimates of innovation elasticities to co-location
  - ▶ Supplement production function of innovation with proximity
- ▶ Extension from US analysis to more recent offshoring

# Measuring the Co-location of R&D and Manufacturing

- ▶ Longitudinal Business Database
  - ▶ Every private, non-farm employer establishment
  - ▶ Establishments classied based on their main activity
- ▶ Focus on NAICS 5413-5417 and 551114 as R&D establishments
  - ▶ Headquarter establishments (firm can have more than one)
  - ▶ R&D labs (NAICS 5417)
  - ▶ Other design, engineering services establishments
- ▶ Associate with relevant manufacturing based on firm's plants
  - ▶ 4 digit manuf industries
  - ▶ Firms often span multiple industries
- ▶ Focus on firms with both manuf and professional estabs

# Manufacturing and R&D Co-location Patterns over Time





# Estimating Firm Size Using the Commodity Flows

Jacob Howard and Wolfgang Keller

University of Colorado at Boulder

Rocky Mountain RDC

October 24th, 2018

## Firms are Increasingly Interconnected

---

- ▷ Understanding how firm-level shocks are transmitted across the economy can inform policy
- ▷ Need firm-level transaction data to study these questions
- ▷ Commodity Flows Survey has data on domestic shipments by firms
  - CFS has value of shipment and destination-location, but can't identify destination-establishment

# Project Goal

---

- ▷ We will use a firm-level transaction dataset for Compustat firms to calibrate a firm-level economic geography model
- ▷ We will use this calibration to estimate the destination parent firm size for the CFS
- ▷ These estimates can be used to generate a firm level transaction dataset
  - Then use these estimates to study how China's ascension to the WTO affected workers across different firm sizes

## Researcher Provided Data

---

- ▷ Through SEC filings we observe a production network for publicly-traded firms
- ▷ Estimate parameters of a model where firms must endogenously form a production network as in Lim (2017)
  - Firms only sell to another firm if profitable
  - Size of the order, costs, and distance all matter in determining profit
  - Model predicts positive assortative matching
- ▷ Use these parameters to predict destination parent firm size in CFS

## Getting to a Production Network

---

- ▷ Merge our new estimates with LFTTD and LEHD
- ▷ Collapse merged data down to the firm-size level
  - We now have a firm production network dataset that includes international and domestic transactions
  - Also controls for workforce composition
- ▷ Using this production network, we can analyze how the structure of firms changed in response to China joining the WTO

# Why Using Production Networks Matter

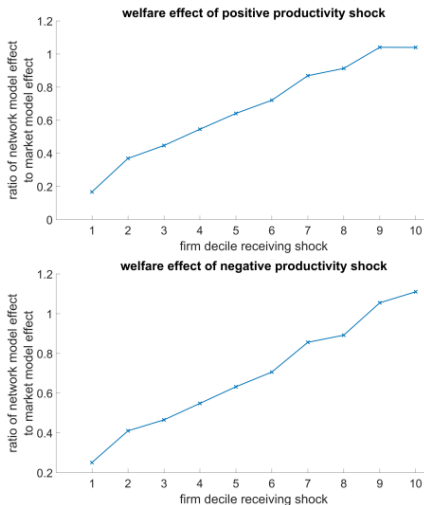
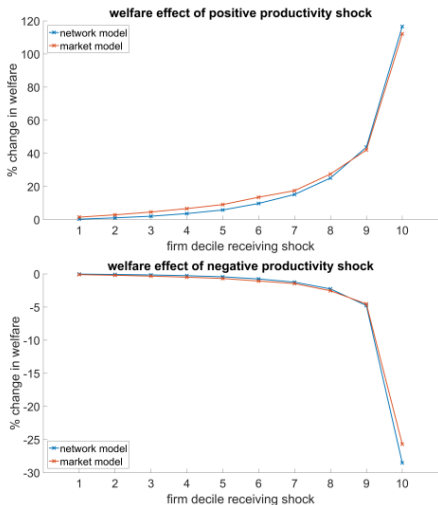


Figure 11, Lim 2017

Input output methods might be overestimating the negative effects of exposure to trade with China