Does Trading Spur Specialization?  
Evidence from Patenting

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Motivation

• “The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labour.”

• “The division of labour was limited by the extent of the market.”
Research Questions

How does patent trading affect:

• a firm’s incentives to innovate?
• division of innovative labor?
Patent trading: promote or discourage innovation?

• When opportunities of patent trading arise:
  • *complementarity effect*: easier to *sell* $\implies$ stronger incentives to innovate
  • *substitution effect*: easier to *buy* $\implies$ weaker incentives to innovate

• How does patent trading affect innovation?
  • *Promote* innovation if complementarity effect $>$ substitution effect
  • *Discourage* innovation if complementarity effect $<$ substitution effect
Division of innovative labor

• No markets for technology $\implies$ 2 distinct types of activities:
  • Create an innovation in-house
  • Commercialize this innovation and market its products
  • E.g., discover a compound for a new drug vs advertise it to the pharmacies

• When opportunities of patent trading arise:
  • Firms with a comparative advantage of creating innovation
    • Specialize in patenting its inventions and sell them to others
  • Firms with a comparative advantage of commercializing innovation
    • Buy patents from others and specialize in marketing its products
  • E.g., adventurous biotech startups vs established big pharma
Innovation and market for technology in China

• Booming innovation in China
  • China’s R&D in 2017: 496 billion (PPP $), 22.5% of global R&D
  • U.S. R&D in 2017: 549 billion (PPP $), 25.0% of global R&D

• A flourishing market for technology
  • Transaction value of technology transfer: 9.7% of in-house R&D
  • Patents granted between 2001 and 2017: 8.6% traded
  • Patent-filing publicly listed firms: 50.3% participated in patent trading
Patent exchanges in China

• What’s a patent exchange?
  • A facility where patents can be traded
  • A focal point for trading
  • A major organizer of technology trade fairs
  • Search frictions ↓, matching efficiency ↑, information frictions ↓
Shenzhen patent exchange
Patents posted for sales

An Account Management System Based on Cloud Service

¥ 52,000

Industry

Electronic Information Source

Information Digitalization

了解详情

More Details

¥ 48,000

Industry

Instrument and Apparatuses

了解详情

More Details

A Gear Cutter For 3D Printing Waste
Technology trade fairs
Patent exchanges: staggered establishments

• Patent exchanges were gradually established across different regions of China over time
  • 15 exchanges were established in 2006, 4 in 2007, 16 in 2008 and 6 in 2009
  • Up to 2016, there are 41 exchanges in 26 provinces

• Affected different firms at exogenously different times

• Quasi-experiment for causal analysis
\[ y_{i,t+1} = Treatment_{i,t} \times \beta + \delta'X_{i,t} + \gamma_i + \gamma_t + \epsilon_{i,t} \]

- \( Treatment_{i,t} = 1 \) if a patent exchange has been established in the province where firm \( i \) is located by year \( t \)
- \( \gamma_i \): firm fixed effect
- \( \gamma_t \): year effect
- \( X_{i,t} \): value of assets, age, R&D intensity (R&D expenditures / assets), return on assets, capital expenditures ratio (capital expenditures / assets), PPE ratio (net value of property, plant, and equipment / assets), leverage ratio (debt / assets), Tobin’s Q (market-to-book ratio)
Findings: DiD analysis

• Patent trading promotes innovation
  • Establishment of patent exchanges leads to a 7.5% increase of patenting
  • Complementarity effect > substitution effect

• Patent trading spurs specialization
  • in-house innovation: patent sellers ↑, buyers ↓
  • advertising expenditures: patent sellers ↓, buyers ↑
  • sellers (buyers) specialize in creating (commercializing) innovation
Findings: DDD analysis

• Establishment of patent exchanges could be correlated with other factors that affect firm innovation and specialization

• DDD analysis: refine treatment and control groups
  • Patent traders vs non-traders
  • Liquid market for trading vs illiquid market
Findings: dynamic DiD analysis

• A patent exchange could be chosen to be established in provinces with more vigorous patenting activities
  • If so: a significant difference in patenting btw treatment and control should have been observed even before the establishment of patent exchanges

• Dynamic DiD analysis:
  • Replace the treatment dummy in DiD setup by a set of dummies representing the years around the treatment
  • No significant differences btw treatment and control before the patent exchanges
  • Treatment effect: significant after the patent exchange has been established and persistent in the long run
Findings: patent licensing

• Patent licensing spurs specialization btw licensors and licensees
  
  • in-house innovation: patent licensors ↑, licensees ↓
  
  • advertising expenditures: patent licensors ↓, licensees ↑
  
  • licensors (licensees) specialize in creating (commercializing) innovation
Findings: R&D-efficiency-based specialization

• Specialization btw patent buyers and sellers
  • net number of patents sold: informative of its “revealed” competitive advantage

• Specialization based on a firm’s R&D efficiency
  • R&D efficiency: gauges the efficiency of transforming innovative input (R&D expenditures) into innovative output (patents)
  • proxy of competitive advantage in creating innovation
Findings: R&D-efficiency-based specialization

• R&D efficiency: predictor for supply and demand in trading
  • high R&D efficiency $\implies$ net sellers of patents, supply $\uparrow$ in R&D efficiency
  • low R&D efficiency $\implies$ net buyers of patents, demand $\downarrow$ in R&D efficiency

• Specialization based on a firm’s R&D efficiency
  • in-house innovation: high efficiency firms $\uparrow$, low efficiency firms $\downarrow$
  • advertising expenditures: high efficiency firms $\downarrow$, low efficiency firms $\uparrow$
  • high (low) efficiency firms specialize in creating (commercializing) innovation
Findings: patent trading and specialization

- The establishment of patent exchanges induces
  - Specialization between patent **buyers and sellers**
  - Specialization between patent **licensors and licensees**
  - Specialization based on a firm’s **R&D efficiency**
- The market for technology spurs comparative-advantage-based specialization
  - Firms with a comparative advantage of **creating** innovation
    - Specialize in **patenting** its inventions and sell it to others
  - Firms with a comparative advantage of **commercializing** innovation
    - Buy patents from others and specialize in **marketing** its products
Findings: patent trading and firm performance

• The establishment of patent exchanges contributes to:
  • Quality of innovation: patent quality ↑
  • Firm productivity: total factor productivity ↑
  • Firm profitability: return on assets ↑
  • Stock market response: firm market value ↑
Findings: Patent trading and IO

• After the Establishment of Patent Exchanges:
  • Patenting activities is increasingly concentrated among firms with a comparative advantage of creating innovation
  • Advertising activities is increasingly concentrated among firms with a comparative advantage of commercializing innovation
Thanks!

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