

Does Trading Spur Specialization? Evidence from Patenting

Pengfei Han

Guanghua School of Management, Peking University

Chunrui Liu

PBC School of Finance, Tsinghua University

Xuan Tian

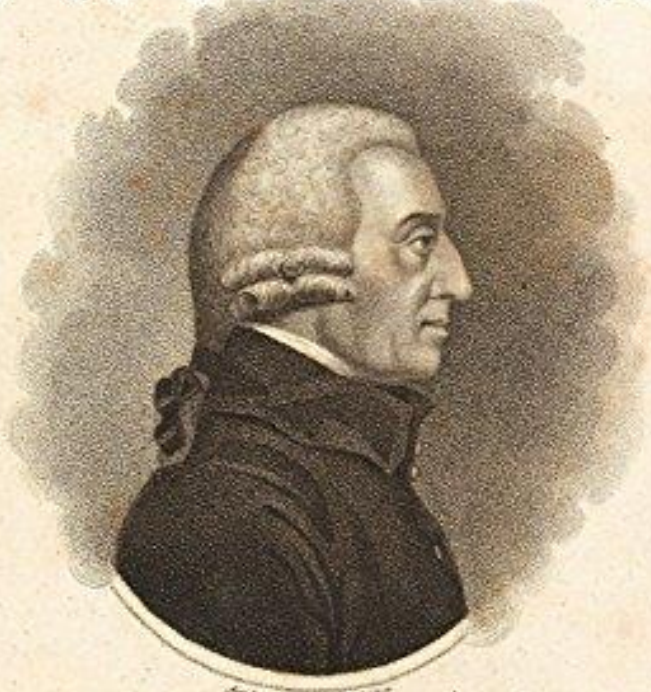
PBC School of Finance, Tsinghua University

AFA Ph.D. Student Poster Session

Jan. 3, 2021

Motivation

THE WEALTH OF NATIONS

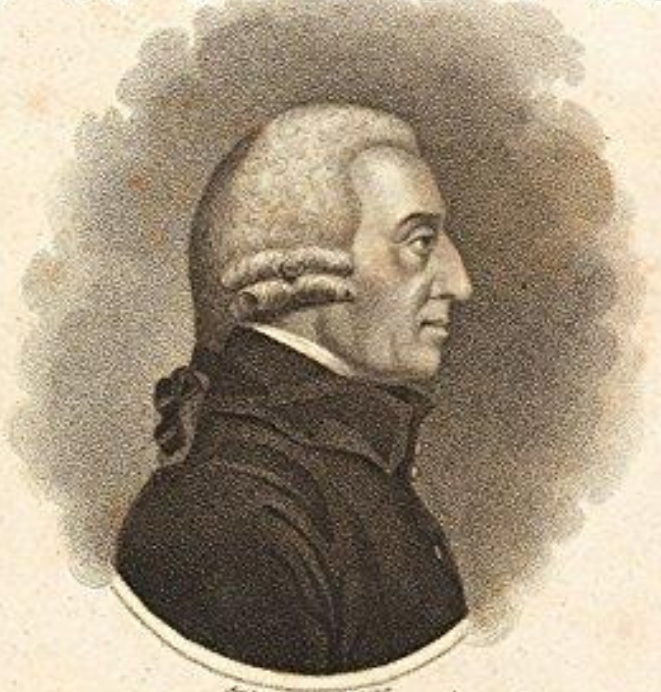


ADAM SMITH

- *“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

THE WEALTH OF NATIONS



ADAM SMITH

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* \Rightarrow stronger incentives to innovate
 - *substitution effect*: easier to *buy* \Rightarrow 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 \Rightarrow 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

首页

服务大厅

交易大厅

资讯大厅

下载中心

关于我们

Homepage

Service Hall

Trading Hall

Information Hall

Download Center

About Us



我要发布专利

Post A Patent
For Sales



我要查找专利

Look For
Patents For
Sales



我要发布需求

Post
Patent Demand
Information



我要查找需求

Search For
Patent Demand
Information

Patents posted for sales

The interface features three search filters at the top: 'Select An Industry' (with a dropdown menu showing '选择行业分类'), 'Select Patent Type' (with a dropdown menu showing '选择专利类型'), and 'Select Patent Name' (with a text input field '输入专利名称' and a search button 'Q').

Two patent listings are displayed below the filters:

- Patent 1:**
 - Title: 一种基于云服务的账户管理系统及... (An Account Management System Based on Cloud Service)
 - Price: ¥ 52000
 - Industry: 所属行业 电子信息源 (Information Digitalization)
 - Patent Type: 专利类型 发明
 - Buttons: 了解详情 (Learn More), More Details
- Patent 2:**
 - Title: 一种3D打印用废弃垃圾齿轮式快速... (A Gear Cutter For 3D Printing Waste)
 - Price: ¥ 48000
 - Industry: 所属行业 仪器仪表 (Instruments and Apparatuses)
 - Patent Type: 专利类型 发明
 - Buttons: 了解详情 (Learn More), More Details

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

DiD specification

$$y_{i,t+1} = Treatment_{i,t} \times \beta + \delta' X_{i,t} + \gamma_i + \gamma_t + \varepsilon_{i,t}$$

- $Treatment_{i,t} = 1$ if a patent exchange has been established in the province where firm i is located by year t
- γ_i : firm fixed effect
- γ_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 \Rightarrow net **sellers** of patents, supply \uparrow in R&D efficiency
 - **low** R&D efficiency \Rightarrow 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!

Pengfei Han: pengfeihan@gsm.pku.edu.cn

Chunrui Liu: liuchr.16@pbcfsf.tsinghua.edu.cn

Xuan Tian: tianx@pbcfsf.tsinghua.edu.cn