FULBRIGHT UNIVERSITY VIETNAM

FULBRIGHT SCHOOL OF PUBLIC POLICY AND MANAGEMENT

Technology and Innovation

Development Policy

Summer 2023

Japan’s technology policy as a developing country

- Japan opened up to the world with the Meiji Restoration in 1868
- Imports of foreign technology and training for engineers to use it in local firms.
- 1870s and 1880s government set up businesses in mining, shipbuilding, machinery and textiles
- Motivated by need to build military to counter Russia and imperial powers in China
- Ban on FDI 1950s force foreign companies to sell technology to Japanese firms
- Automobiles and electronics: Reverse engineering and licensing technology

Toyota AA, first production car in 1936

What is innovation?

- Adoption of new or significantly improved product (good or service)
- A new or improved or process or marketing method
- A new organizational structure or business practices, workplace organization or external relations
- Creating, adopting, adapting technologies
- Upgrading technological capacity with the firm
- Imitating or importing existing technologies
- Adapting existing products and production methods to the needs of local producers and customers

Technology, innovation and development

- Large-scale innovation is costly and depends on prior innovations (path dependent) and therefore Innovation is highly concentrated in rich countries, linked to large, global firms.
- Adaptation of technology does not necessarily coincide with invention:
  - Small Nordic countries have not produced many technological breakthroughs, but they have become competitive through efficient diffusion of new ideas.
  - China now a leader in renewable energy although these technologies were invented elsewhere.
- Innovations are not all the same:
  - some require less up-front investment or previous experience/expertise
  - may spread more rapidly in developing countries.
- Workers moving between firms is a source of innovation
  - Skilled workers from FDI firms can be a source of innovation for domestic firms
  - Agglomeration effects when firms in one sector/activity congregate in one location

Innovation and fragementation of production

- Suppliers and assemblers used to be located near each other, and often connected through ownership and movement of staff
- Manufacturing is now fragmented:
  - Digitization: sharing of precise information in real time in automated processes
  - Trade liberalization: lowering of tariffs and other trade costs
  - Containerized shipping: lowered costs of moving goods long distances

Automobile assembly: 30,000 parts

- OEM: designs, assembles, markets
- Tier 1: Supplies directly to OEM, close relationships
- Tier 2: Specialists in materials and machinery required by Tier 1
- Tier 3: Producers of metal, plastic and leather

Why is fragmentation of production profitable?

- Research and development, design, management of supply chain retained by system integrator firms
  - System integrators pressure suppliers to continually improve quality and reduce costs
  - Cascade effect: Tier 1 suppliers, also huge companies, pressure their supplier for lower costs and better quality
- Labor-intensive processes sent to countries with lowest wages
- Companies specialize in specific components or processes: develop capabilities and realize economies of scale
  - TSMC specializes in microchip fabrication (pure-play foundry): they don’t design chips, but no one makes chips better or cheaper
  - Wipro: Indian software and project management company that write much of the code that is used in our cars, online banking and appliances.

Barriers to innovation in developing countries

- Factors external to firms
  - Political instability, corruption, criminality
  - Monopoly or other barriers to entry of new firms the reduce competition
  - Absent or fragmented National Innovation System
- Factors internal to the firm
  - Domestic firms more likely to invest in R&D than foreign firms
  - Level of education, experience of workers can hold back innovation
  - Access to finance
  - Access to knowledge networks

National Innovation Systems

- Christopher Freeman: Innovation in Japan arises from interactions between organizations and networks.
- Technological capacity as the crucial factor in national competitiveness: Exports depend on innovation, not just prices
- Three facets of NIS:
  - Science policy: Production of scientific knowledge for the economy, security, health and environment.
  - Technology policy: Focus on strategic technologies with impact on economic and social objectives, for example energy transition
  - Innovation policy: Diffusion of science and technology through society, creating networks, feedback loops, for example national research institutions, universities, professional associations, business associations, specialized financial institutions.

Thailand

- Science and Technology Strategic Plan for 2004–2013 for first time includes firms.
- Recognized role of innovation in competitiveness.
- Several industrial development banks established: Industrial Finance Corporation of Thailand (IFCT), SME Bank, Small Industry Credit Guarantee Corporation (SICGC) and Innovation Development Fund (IDF).
- Cluster strategy to encourage local firms to collaborate

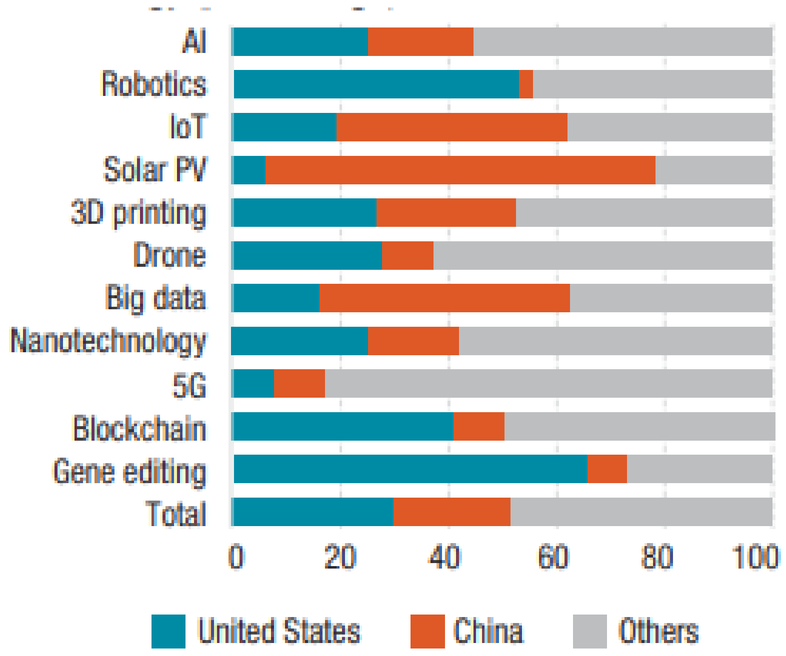
Policy objective	Instrument
Increase technological capacity of Thai firms	R&D tax incentives; Soft loans for R&D investments; Industrial Technology Assistance Program; Clusters; Regional Science parks and incubators
Increase number and quality of researchers	Creation of excellence centers; R&D tax incentives for training
Strengthen local initiatives	The Village Fund; The People's Bank
Upgrade science and technology management system	Mobility of staff between policy agencies

Shortcomings

- Larger, more advanced firms benefit from financial support and networking, but weaker firms cannot participate
- Smaller, less capable firms rely primarily on testing facilities and quality control from government
- Still heavily biased to science and technology rather than adaptation and implementation
  - Needs more emphasis on Learning by Doing
  - Networking above the local level
  - More informal training with suppliers and users rather than rely solely on university-based training

Innovation is not the same as invention

- Patents in frontier technologies dominated by US and China
- China is top in R&D spend in these technologies, US second, ROK third, Vietnam 66th
- R&D spending is not the objective, it is a means
  - The goal is innovation not R&D or invention
  - Invention is creating something new, innovation is making something usable and better
  - Innovation is measured in exports, not R&D



Share of patents in frontier technologies, 2018 (UNCTAD)

Four stages of innovation

- Invention
- Design
- Second generation product and component innovation
- Production and assembly

Stage 1: Invention—Israel

- Office of the Chief Scientist created in 1973 but did not gain traction until 1980s with small investments in high tech products
- Yozma (1992): Invested $8 million in 10 VC funds that had to find at least $12 million in private funds, at least one local and one foreign
- MAGNET (1992): Created consortia to develop generic technologies, share IP in the group and sell to other Israeli companies.
- Israel became the home of multinational companies R&D centers (for example, Amazon’s AI research center)
  - Creates good jobs for high-skilled Israelis but has starved local companies for talent
  - Stage 1 innovation isn’t the best stage for economic growth and equality

Stage 2: Design, prototype development and production engineering – IDEO

- Designers of the first Apple Mouse and now designing for a wide range of industries and public sector institutions
- Includes training companies how to use the designs in marketable products (but not design the manufacturing process, which is stage 3)
- Similar Stage 2 design companies exist in every industry from designer footwear to aircraft

- Combine specialized design skills with wide network of manufacturing firms, often centered on a geographic production hub

Stage 3: Second generation product and component innovation – United Microelectronics Corporation, Taiwan

- Industrial Technology Research Institute established 1973 from merger of three public sector labs to take on the riskiest research (least likely to pay off) and give it to private companies
- Bought old semiconductor technology from RCA in the US
- Electric Research and Service Organization created within ITRI: perfected chip fabrication skills
- UMC was established as a private company (with government support) by ERSO scientists – no private company would take the risk
- ITRI focuses on R&D, private companies focus on manufacturing processes and final product development

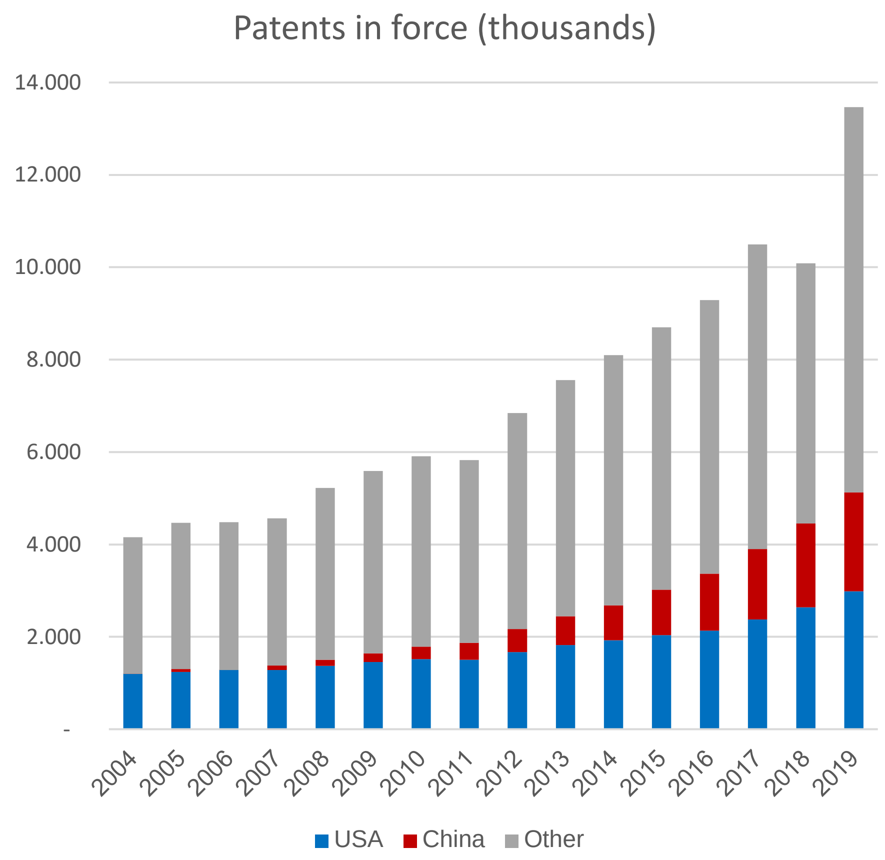
Stage 4: Production and assembly -- Shenzhen

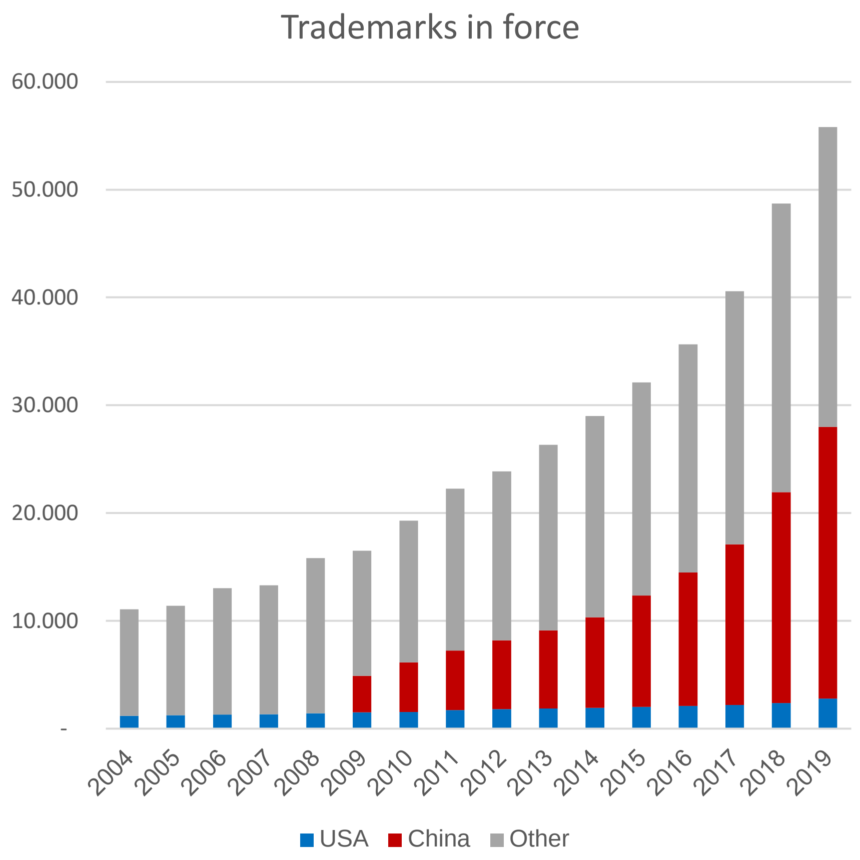
- World leader in manufacturing: mobile phones, computers, electric vehicles, telecommunications equipment etc
- Agglomeration effects: concentration of production created public goods in knowledge, capabilities, labor force skills
- Local companies started making bootleg phones with local parts, which eventually become large local companies with original designs
- Role of government:
  - Land and facilities
  - Access to labor (migration permits, recruitment of highly skilled personnel)
  - R&D: supported linkages with provincial universities, set up labs shared with companies

Intellectual property rights

- Intellectual property rights intended to increase the returns to innovation by providing limited protection for commercially viable ideas
- Coase theorem: If property rights are not well defined the economic outcome will be suboptimal.
- Strong IPR written into laws and trade agreement, given inventors monopoly rights over innovation.
    - But is monopoly over intellectual property really more efficient?
    - This slows down global economic growth and is bad for income equality
    - Protection for patents and trademarks is a barrier to entry and slows down technological learning.

Patents and trademarks





Source: World Intellectual Property Organization

Trade-Related Intellectual Property Rights (TRIPS)

- TRIPS agreements protect the incumbents (advanced countries) at the expense of developing countries
- Expected to increase trade because exporters would have less fear of imitation
- But trade volumes fell because firms behaved monopolistically (reduce supply and increase price)
- TRIPS provisions have reduced policy space for developing countries to design their own IPR systems
- Particularly damaging in health and pharmaceutical industries.
- Developing countries should tax IPR rents accrued by FDI firms.

Policy implications

- The pace of technological change is rapid and developing countries need policies to promote innovation.
- Innovation is not just about creating Silicon Valleys – that is just one of four stages of innovation
- Countries and regions need to identify the stage of innovation that fits with their comparative advantage
- Government has an important role to play at every stage of innovation: US government providing Intel with $50 in subsidies to bring chip foundries to Arizona and Oregon.
- Intellectual property rights can be an obstacle to technological catch-up

Discussion questions

1. Are “inclusive institutions” necessary for rapid growth? Why or why not?
2. Do the World Bank’s governance indicators explain differences in growth and development outcomes in Southeast Asia