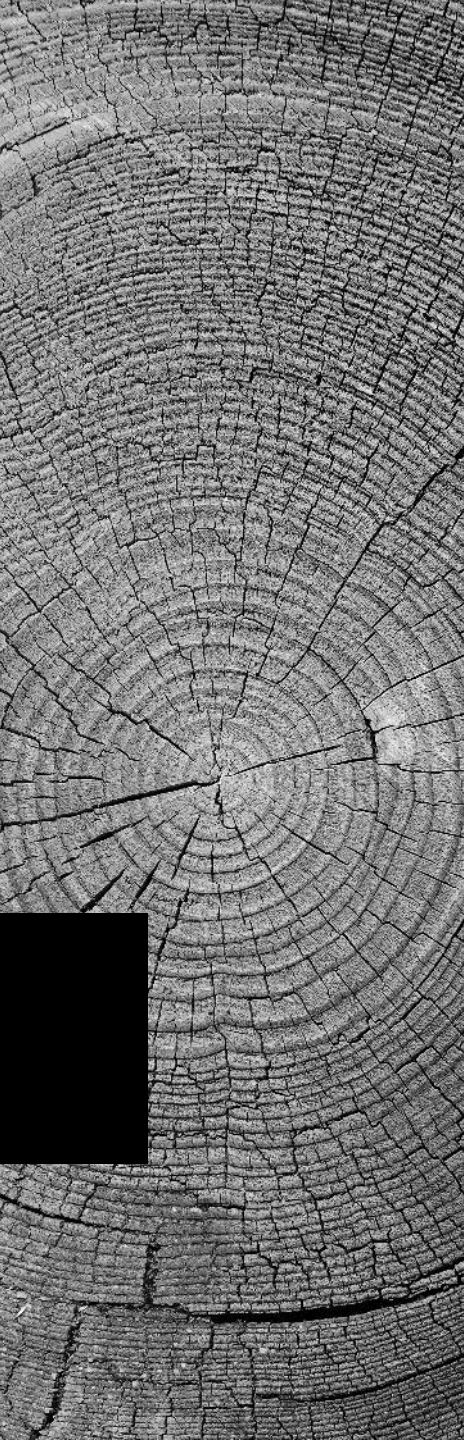


Jonathan Pincus
Summer 2022

TECHNOLOGY AND INNOVATION

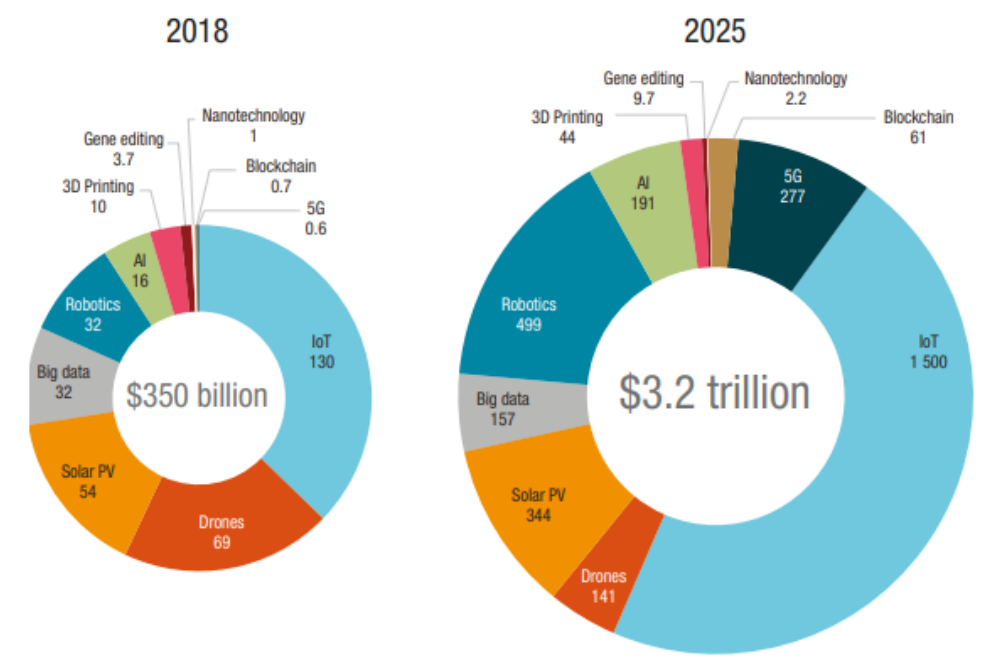
Development Policy

FSPPM

INTEL'S PLAN TO REGAIN CHIP DOMINANCE

AN UNPRECEDENTED WAVE OF TECHNOLOGICAL CHANGE

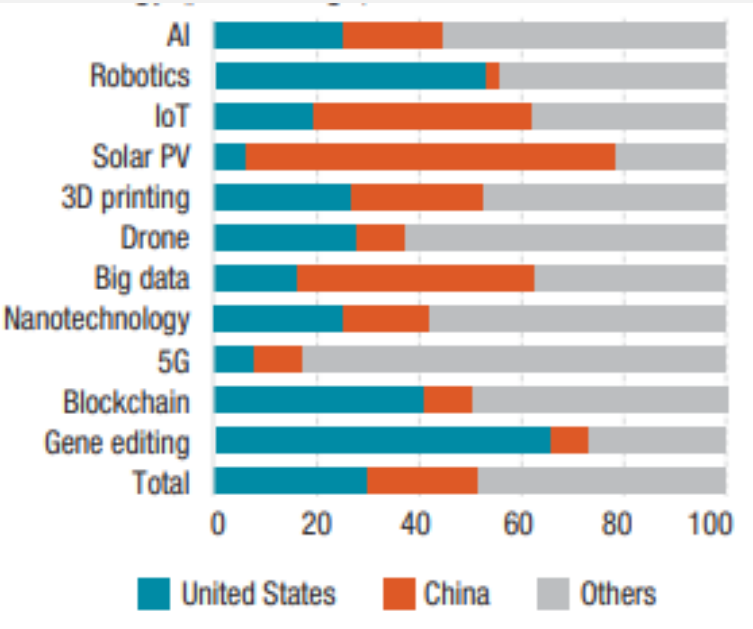
Market size of frontier technologies, US B



Source: UNCTAD

- Frontier tech produced in a few countries but will affect everyone
- Automation will eventually create new jobs, but the transition will be difficult
- Job creation will be mostly in skill-intensive sectors
- Conflict between the small number of countries that control these intellectual property rights and everyone else

‘INNOVATION’ IS NOT THE SAME AS ‘INVENTION’



Share of patents in frontier technologies, 2018 (UNCTAD)

- 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

FRAGMENTATION OF MANUFACTURING PROCESSES

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

- 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

WHY IS FRAGMENTATION 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.

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

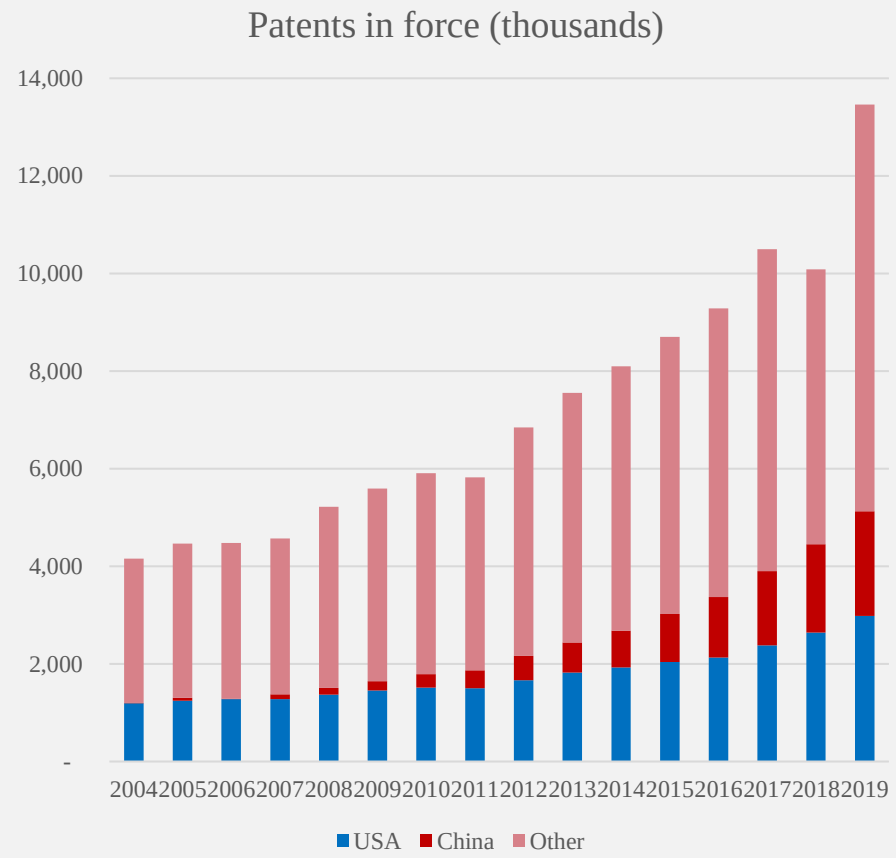
STAGE 4: PRODUCTION AND ASSEMBLY -- SHENZHEN

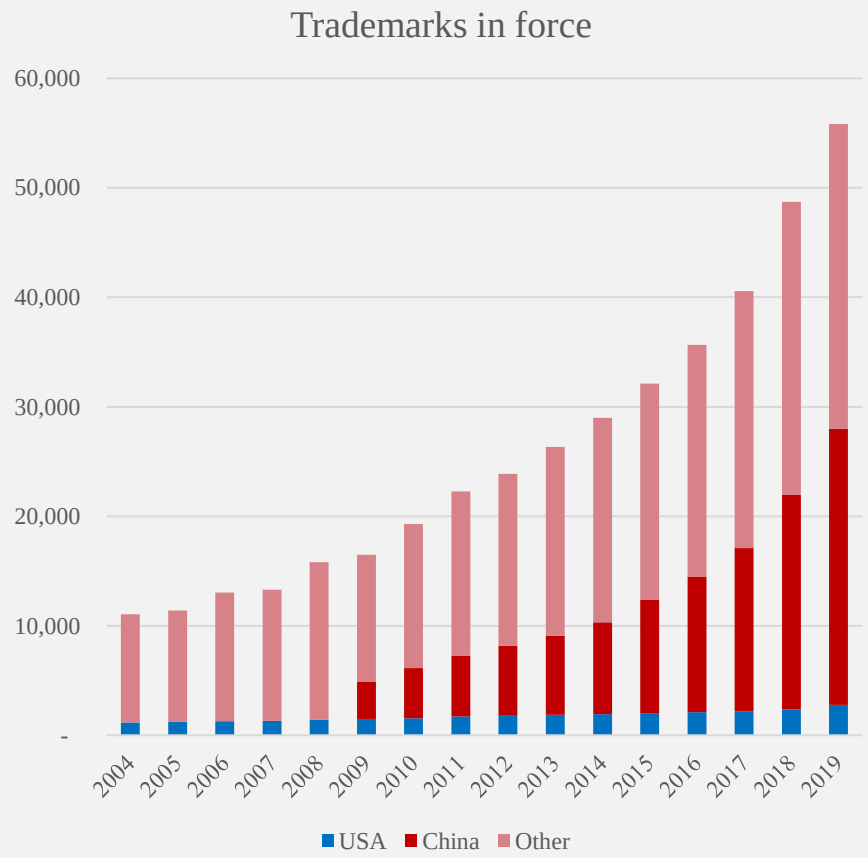
- World leader in manufacturing: mobile phones, computers, electric vehicles, telecommunications equipment etc
- Agglomeration effects: concentration of production created public goods in knowledge, capabilities, labor force skills
- Local companies started making bootleg phones with local parts, which 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 (WORLD INTELLECTUAL PROPERTY ORGANIZATION)





TRIPS

- Trade Related Intellectual Property Rights (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 actually *reduced* trade 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 most developing countries are not prepared to be producers (and not just consumers) of new innovations
- 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 are an obstacle to technological catching up

DISCUSSION QUESTIONS

- Has fragmentation of production reached its limits? Are we moving from globalization to “slowbalization”? (Paul Krugman)
- Discuss the different forms that innovation can take and which form you think is most appropriate for Vietnam.