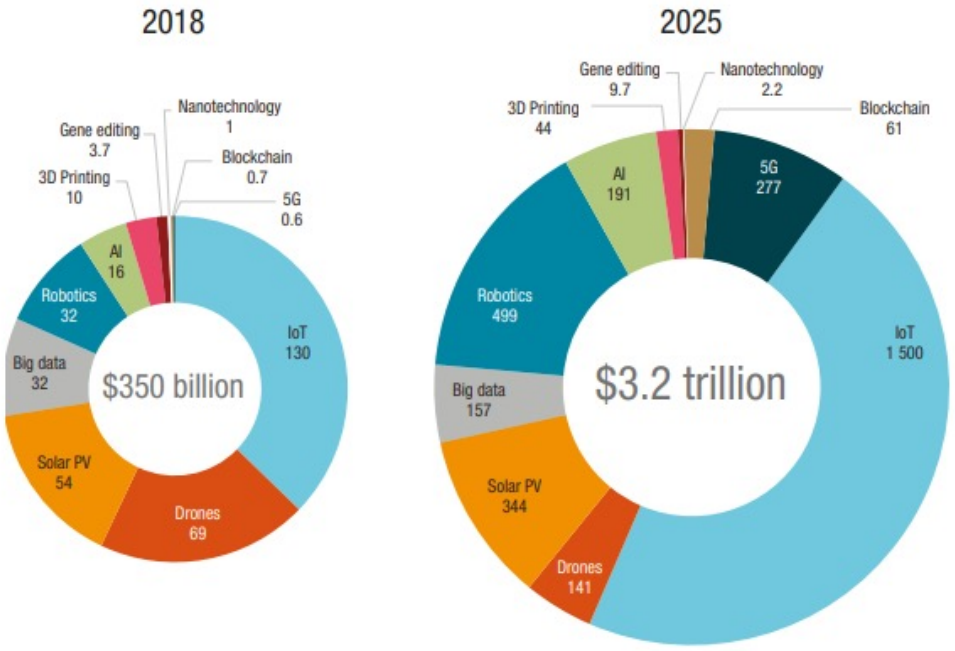
Development Policy

TECHNOLOGY AND INNOVATION

Packing groceries in the UK, 2019

An unprecedented wave of technological change

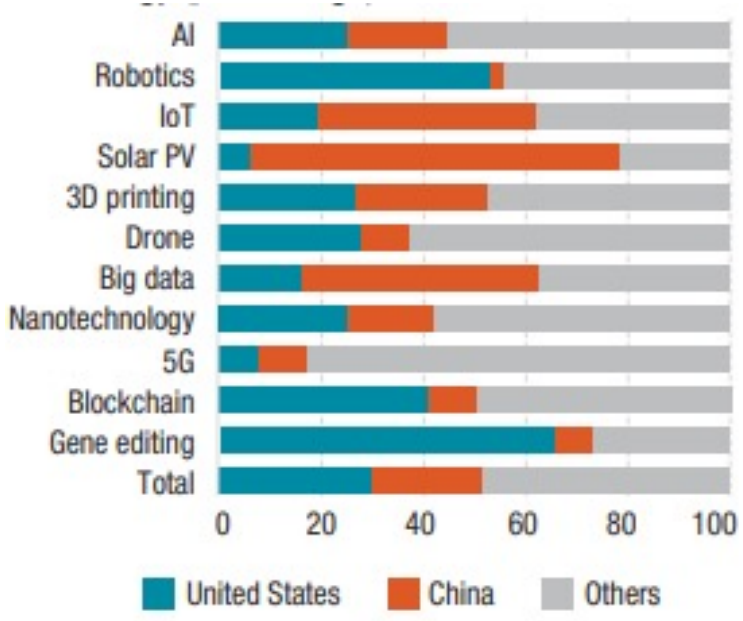
Market size of frontier technologies, US B



- 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

Source: UNCTAD

‘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

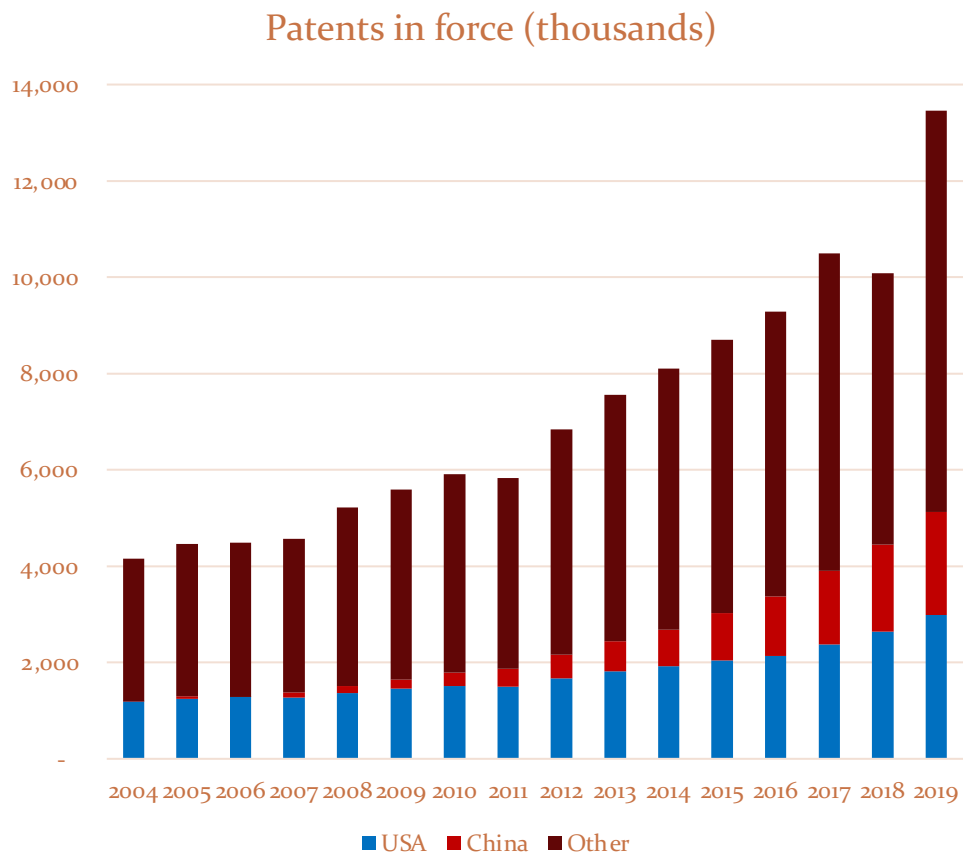
Stage 4: Production and assembly -- Shenzhen

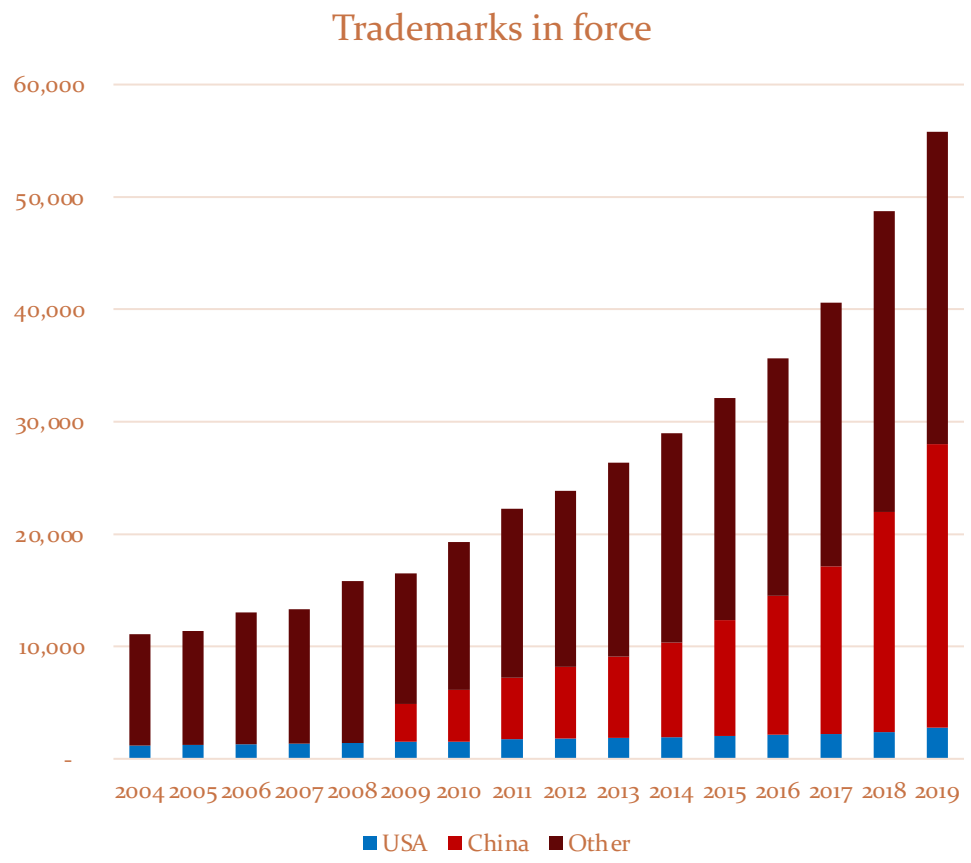
- World leader in manufacturing: mobile phones, computers, electric vehicles, telecommunications equipment etc
- Agglomeration effects: concentration of production created public goods in knowledge, capabilities, labor force skills
- Local companies started making bootleg phones with local parts, which 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
- Ronald Coase "The Problem of Social Cost" (1960) made the argument that externalities only arise when property rights are not properly specific.
- Strong IPR written into laws and trade agreement, given inventors monopoly rights over innovation.
  - 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
- Intellectual property rights are an obstacle to technological catching up