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Implications of fast technological change for international transfer of technology

New challenges and emerging approaches

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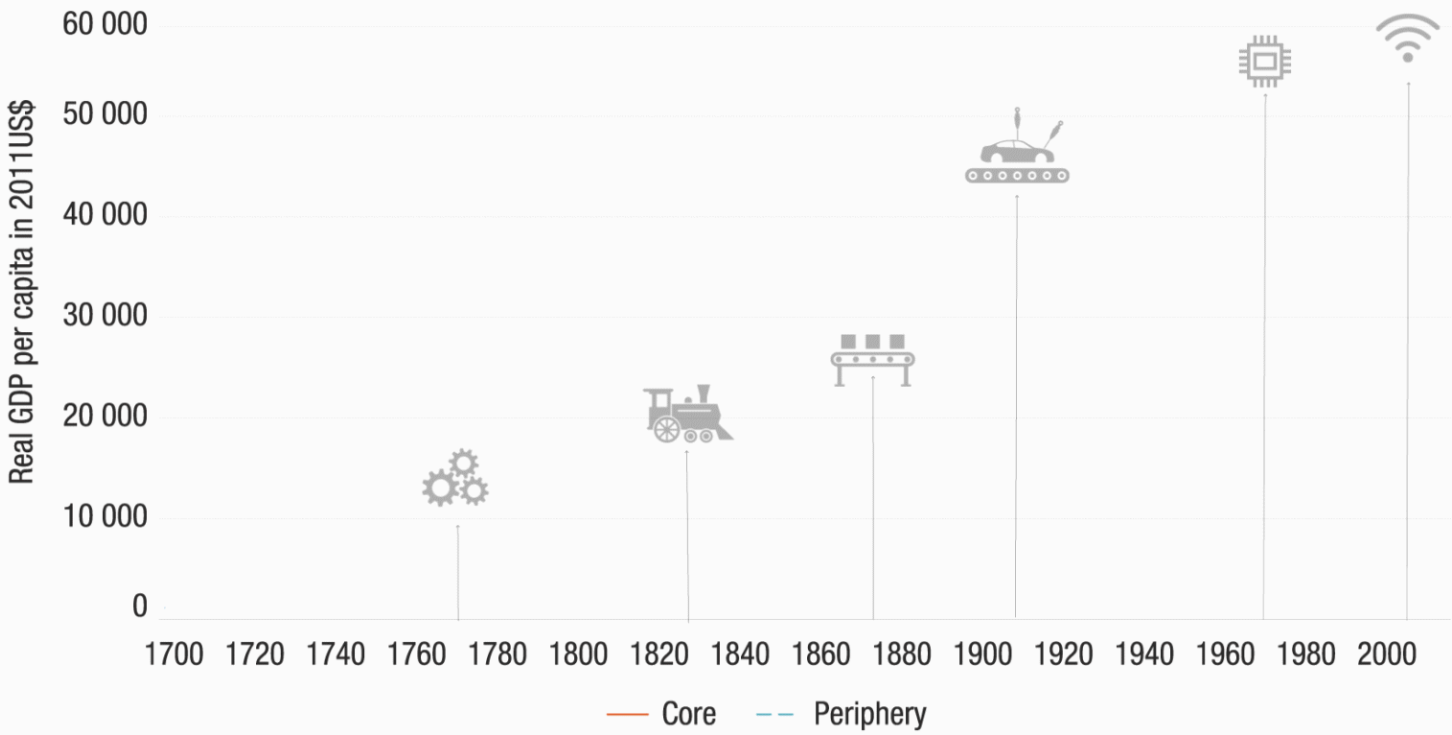
CATCHING THE WAVES

The great divide, and waves of technological change.

Technological change and inequality through the ages

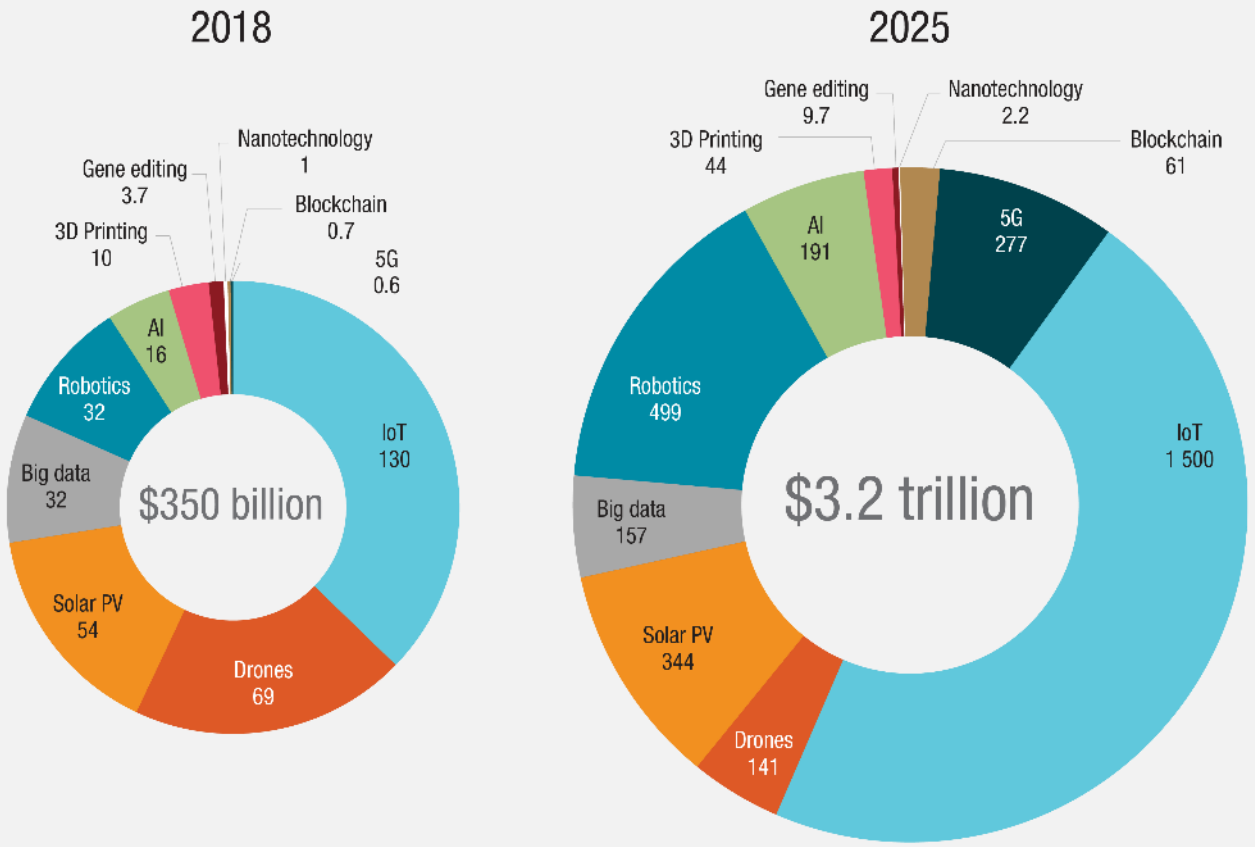


Source: UNCTAD's Technology and Innovation Report 2021

Source: UNCTAD, based on data from Maddison Project Database, version 2018, Bolt et al. (2018), Perez (2002), and Schwab (2013).
Notes: "Core" corresponds to Western Europe and its offshoots (i.e. Australia, Canada, New Zealand, the United States) as well as Japan. "Periphery" corresponds to the world, excluding the "core" countries.

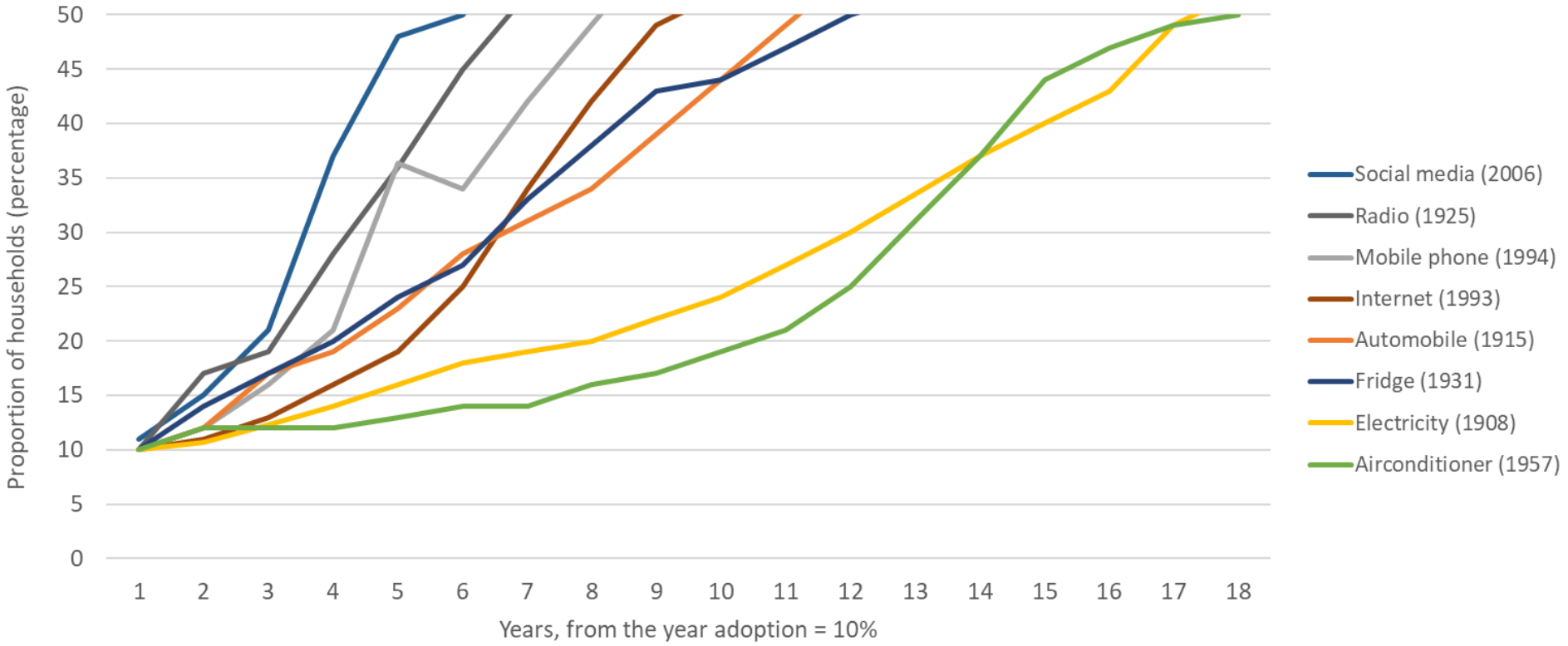
FRONTIER TECHNOLOGY MARKETS ARE EXPECTED TO GROW RAPIDLY

Market size estimates of Frontier technologies, $billions



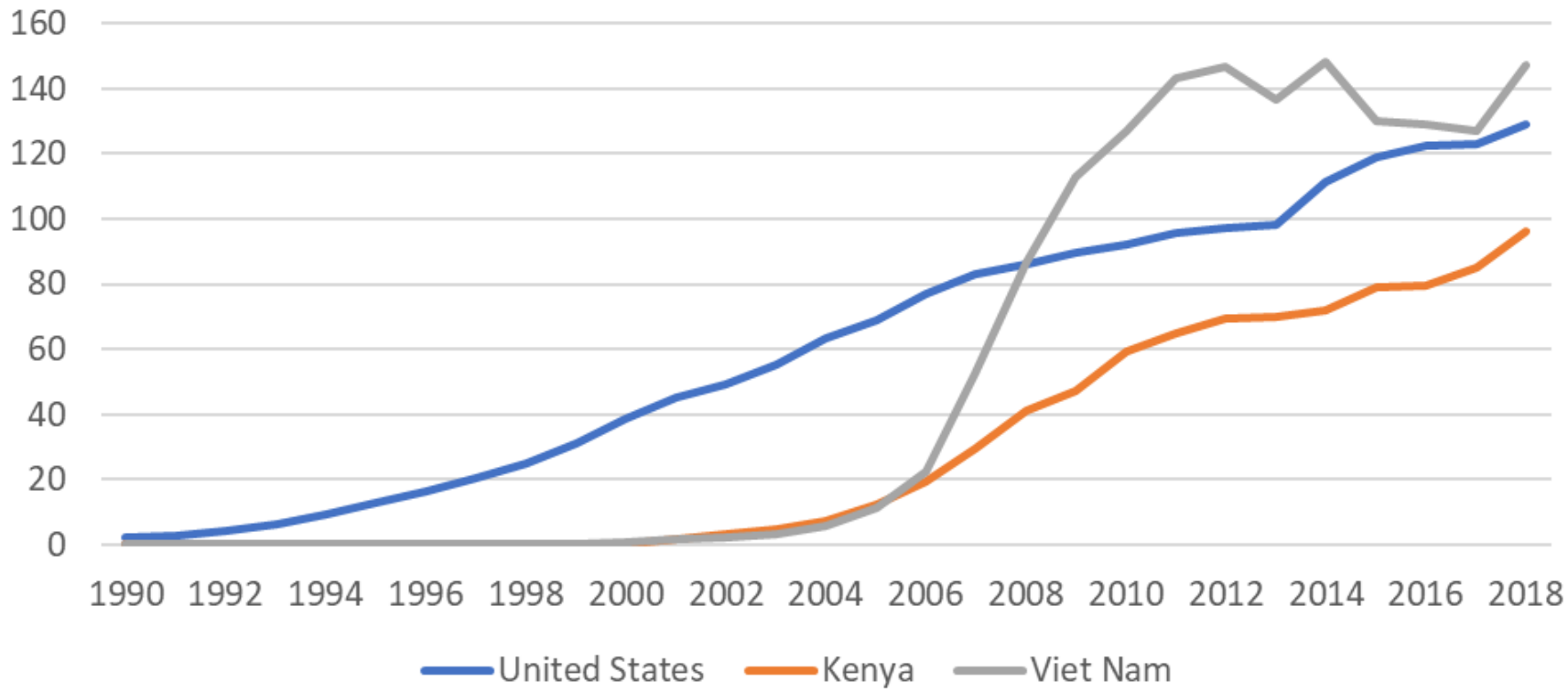
Source: UNCTAD based on data estimates from Froese (2018), MarketsandMarkets (2018), Sawant and Kakadee (2018), Business Wire (2019), Chaudhary et al. (2019), GlobeNewswire (2019b), MarketsandMarkets (2019), MarketWatch (2019a), MarketWatch (20191), Raza (2019), Tewari and Baul (2019), Wagner (2019b), Mordor Intelligence (2020a).

Diffusion of selected technologies, the United States

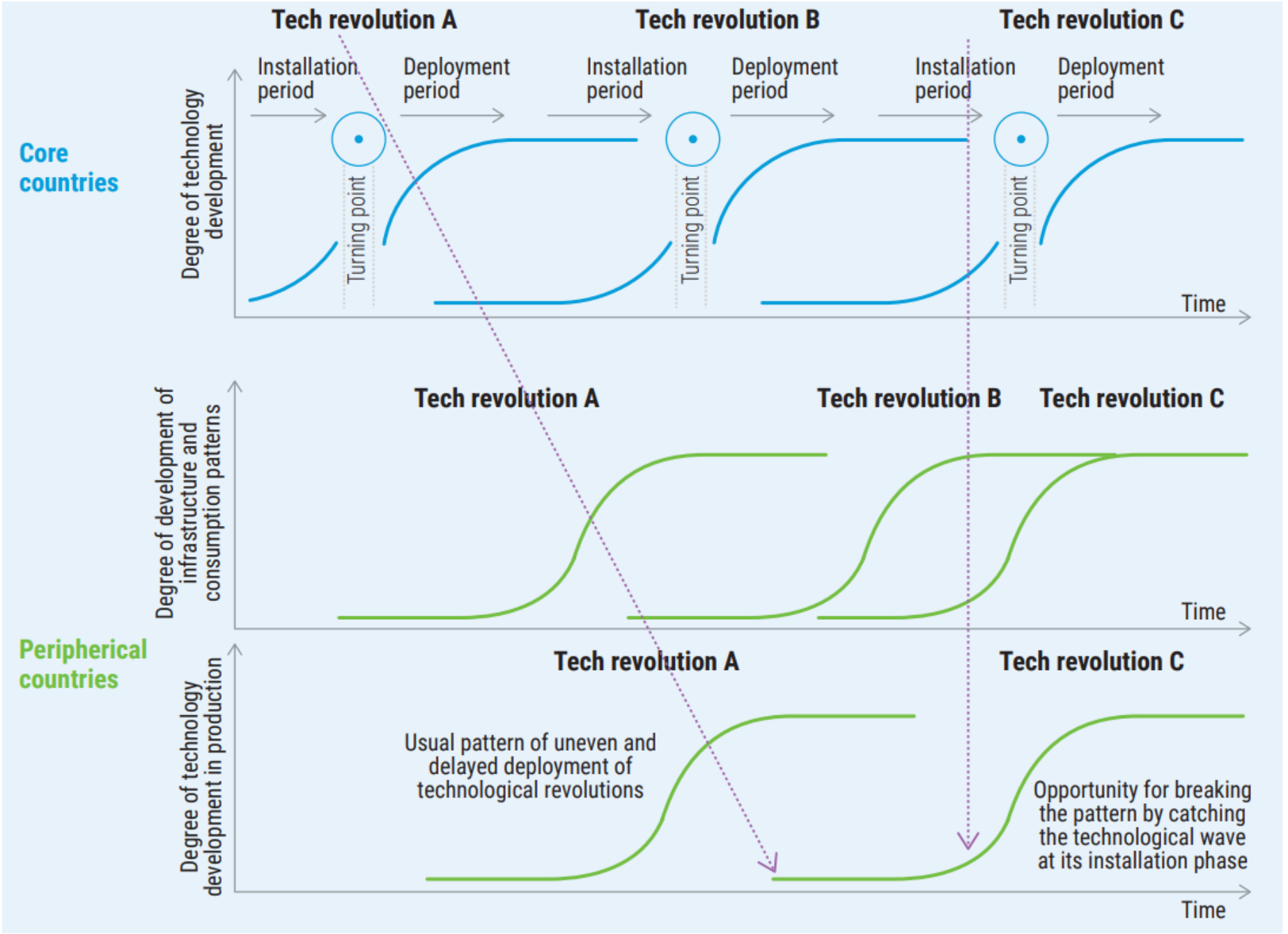


Source: UNCTAD based on (Ritchie and Roser, 2017)

Mobile cellular subscriptions, selected countries (per 100 persons)



Source: UNCTAD based on World Bank Development Indicators.



Source: UNCTAD based on Perez (2002).

Typical channels of technology transfer

Channels	Comment
Exports or imports of final goods (trade)	Technology embodied in traded capital goods is transferred through learning by using, imitating or reverse engineering. The tacit component of knowledge is not easily transferred.
Licenses	Licensing is linked to the overall technological sophistication of the economy and tends to be more prevalent in developed and some emerging economies.
Purchase of foreign firm (M&A)	To acquire technology; merger.
Strategic alliance or joint venture	Partial or 100%-owned
Migration of people for work or education	Human capital is a fundamental determinant of a country's absorptive capacity Movement of skilled labour and sending students abroad has been a key source of technology acquisition, which, however, can become limited by "brain drain".
Open sources of knowledge	Exhibitions, fairs, books, patent documents, and more recently the Internet are important open sources of information about new technologies.
Contract with research entity	IP is negotiated with foreign university lab, research institute, firm
Collaborative RD&D	
Inter- university collaborations on technology transfer	Universities can acquire skills, technologies, and knowledge of their international partner universities, which may lead to joint publications and patenting.
Bi-lateral or multi-lateral technology agreement	Research, development, demonstration

Sources: Gallagher 2013, Lanjouw and Mody 1996, Mowrey and Oxley 1997, Gallagher 2006, Barton 2007, Lewis 2007, Odigiri et al. 2010, Lema and Lema 2010, UNCTAD (2007).

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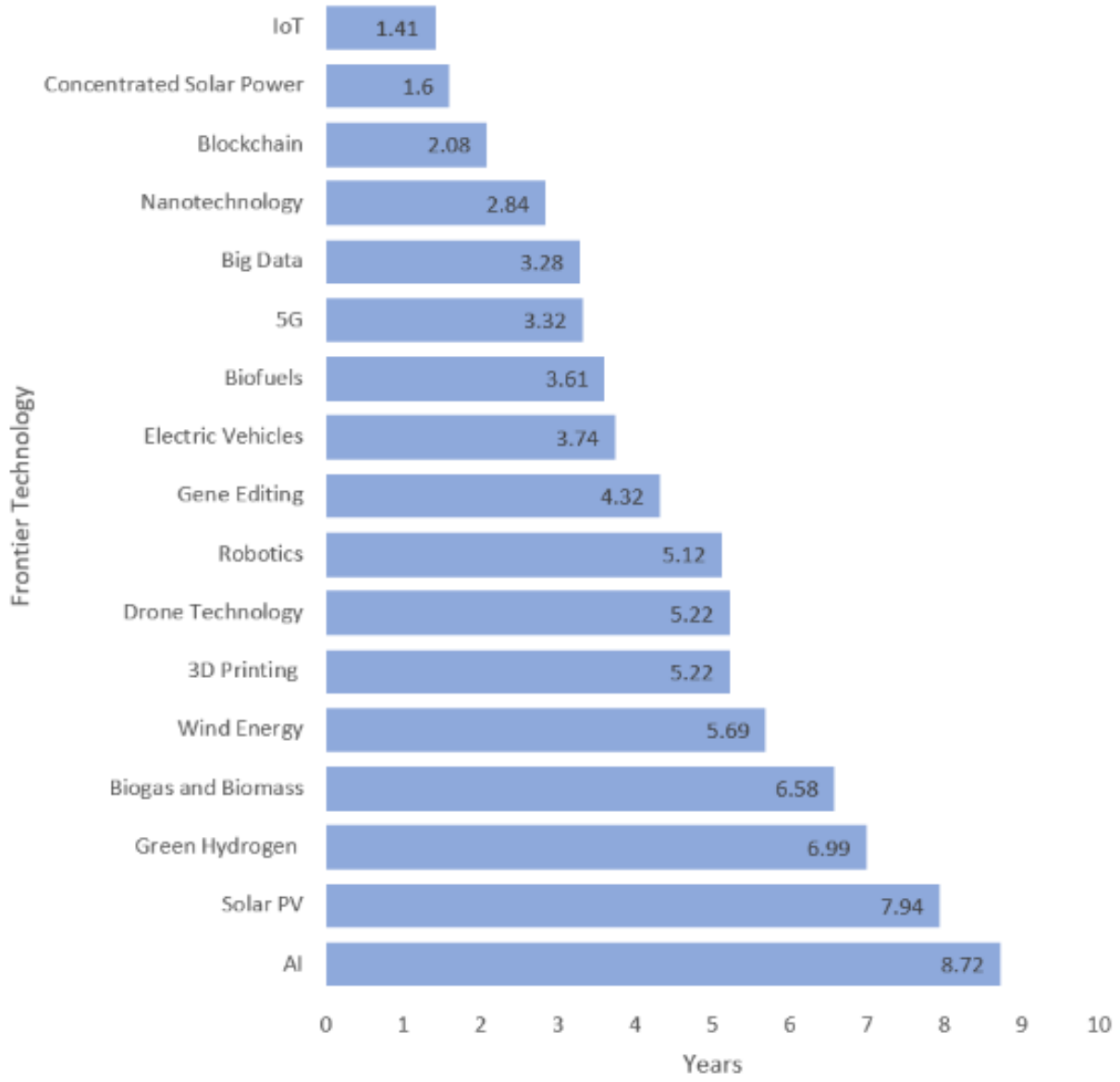
Patent maturity of frontier technologies



Source: UNCTAD.
Note: For each technology, the number in the bar graph shows the patent maturity, which is the difference between the weighted average patent application year and the weighted average year of the 20 most cited patents between 2000 and 2021.

Top frontier technology providers

AI	IoT	Big data	Blockchain	5G
Alphabet	Alphabet	Alphabet	Alibabaan	Ericsson
Amazon	Amazon	Amazon Web Services	Amazon Web Services	Huawei (network)
Apple	Cisco	Dell Technologies	IBM	Nokia
IBM	IBM	HP Enterprise	Microsoft	ZTE
Microsoft	Microsoft	IBM	Oracle	Huawei (chip)
	Oracle	Microsoft	SAP	Intel
	PTC	Oracle		MediaTek
	Salesforce	SAP		Qualcomm
	SAP	Splunk		Samsung Electronics
		Teradata		

3D printing	Robotics	Drone technology	Gene editing	Nanotechnology	Solar PV
3D Systems	ABB	3D Robotics	CRISPR Therapeutics	BASF	Jinko Solar
ExOne Company	FANUC	DJI Innovations	Editas Medicine	Apeel Sciences	JA Solar
HP	KUKA	Parrot	Horizon Discovery Group	Agilent	Trina Solar
Stratasys	Mitsubishi Electric	Yuneec	Intellia Therapeutics	Samsung Electronics	Canadian Solar
	Yaskawa	Northrop Grumman	Precision BioSciences	Intel	Hanwa Q cells
	Hanson Robotics	Lockheed Martin	Sangamo Therapeutics		
	Pal Robotics	Boeing			
	Robotis				
	Softbank				
	Alphabet/Waymo				
	Aptiv				
	GM				
	Tesla				

Biofuels	Wind energy	Green hydrogen	Electric vehicles	Concentrated solar power	Biogas and biomass
Archer Daniels Midland	GE Power	Siemens Energy	Tesla	Abengoa Solar	Future Biogas
ALTEN Group	Mitsubishi Heavy Industries	Linde	Ford	Iberolica Group	Air Liquide
Louis Dreyfus	ABB	Toshiba Energy	Hyundai	ENGIE	PlanET Biogas Global
Brasil Bio Fuels	Siemens Gamesa Renewable Energy	Air Liquide	Chevrolet	NextEra Energy Resources	Ameresco
BIOX Corp	Goldwind	Nel ASA	BYD	BrightSource Energy	Quantum Green
Renewable Energy Group	Enercon	Air Products and Chemicals	Volkswagen		Envitech Biogas
Wilmar international		Guangdong Nation-Synergy Hydrogen Power Technologies	Renault-Nissan-Mitsubishi Alliance		Weltec Biopower

Source: UNCTAD based on various sources. *Notes*: American companies in dark blue, Chinese companies in orange, others from developed economies in light blue and developing economies in yellow.

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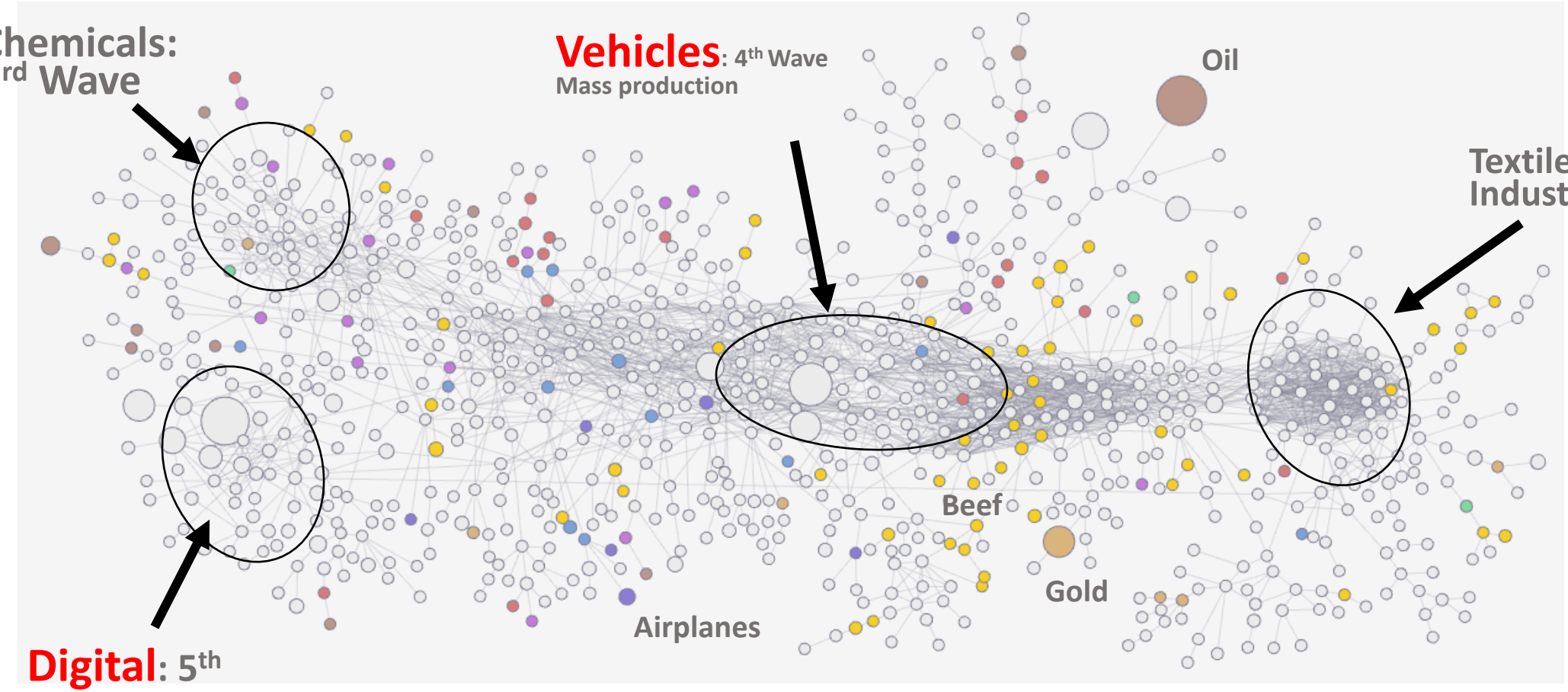
TECHNOLOGICAL CHANGE MOVES OVER TIME FROM CORE SECTORS TO MORE TRADITIONAL SECTORS



Product space showing products connected to each other based on the likelihood of they being exported together

Source: Atlas of economic complexity (http://atlas.cid.harvard.edu)

Emerging approaches:
Learn by doing & learning together

- North-South: Towards a more partnership-oriented approach to technology development

- South-South: Shifting research from the national to the multilateral level, including open innovation approaches among countries with similar levels of development

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WHO: The Global mRNA Vaccine Technology Transfer Hub

- Organizer/sponsor: WHO
- Beneficiaries: Developing and least developed countries
- Purpose: Help countries manufacture mRNA vaccines at scale and according to international standards, through technology transfer hubs which will deliver technology transfer packages and provide appropriate training
- Tools: Intellectual property resulting from this activity will be held by the inventors but will be made freely available to the spokes in the hub
- Achievements:
  - Establishment of the South African consortium to run the hub which serves all developing and LDCs. This hub comprises Afrigen Biologics, the South African Medical Research Council (SAMRC) and Biovac, a South African vaccine producer.
  - To date, over 20 countries have requested access to the hub's technology transfer.
  - Overall, 15 developing and LDCs have received training on mRNA vaccine production, including Argentina and Brazil.

SENAI Cluster of advanced technology for family agriculture

- UNCTAD & SENAI PE
- 16 international participants from 10 countries
- Workshop + Cluster

Thank you!

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