A search dilemma in semiconductor value chain: the cases of Korea and Taiwan in a Time of US-China High-Tech Decoupling

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Acknowledgement

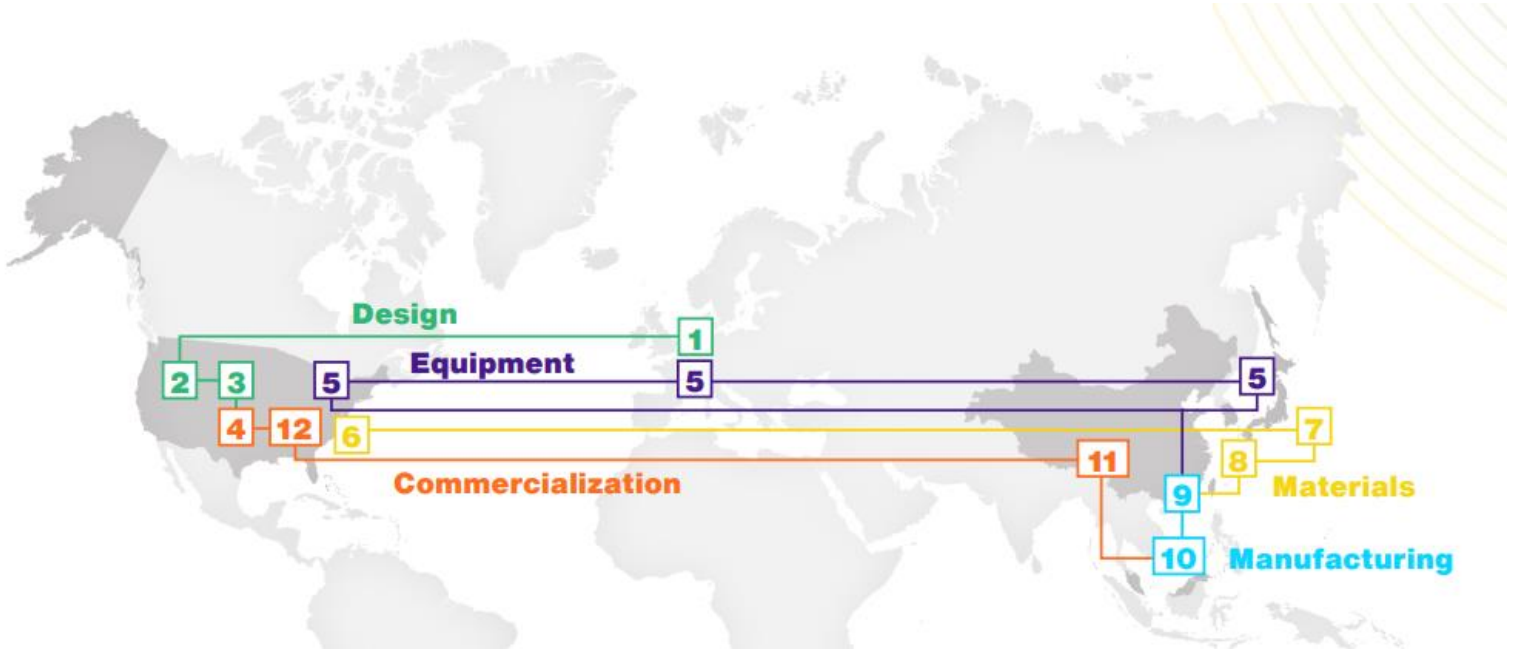
- Some of the contents are adopted from an ongoing joint research work:
- Chan-Yuan Wong, Henry Wai-Chung Yeung, Shaopeng Huang, Jaeyong Song and Keun, Lee (2023), Geopolitics and Changing Determinants of GVCs in the Global Semiconductor Industry: Responses by East Asian Firms and their Economic Trade-offs.

Era of Globalisation

- Division of labor
- Comparative advantage
- Off shoring of MNCs
- Economies of scale led to efficiency and productivity
- As the developed nations losing their productive competitiveness, catch-up nations contracted the lower value operations
- Globalisation and stability of world trading order **proliferate off shoring and skill transfer** to developing economies

EXHIBIT 12

The semiconductor value chain is truly global and relies on the specialized capabilities of different geographic areas



Source: BCG+SIA report (2021)

Business model that generate specific kinds of competitive edge

Semiconductor : globally distributed supply chain for intermediate parts and services where specialisation are geographically concentrated

TSMC (Moore Inspired tech push)

- R&D (materials and process) that improve yield
- Exclusive agreements with fabless channels

Samsung Electronics (Economies of scope)

- Announcing ahead the shipping of advanced chips to gain market visibility/acknowledgement
- Complementary from smart phone division

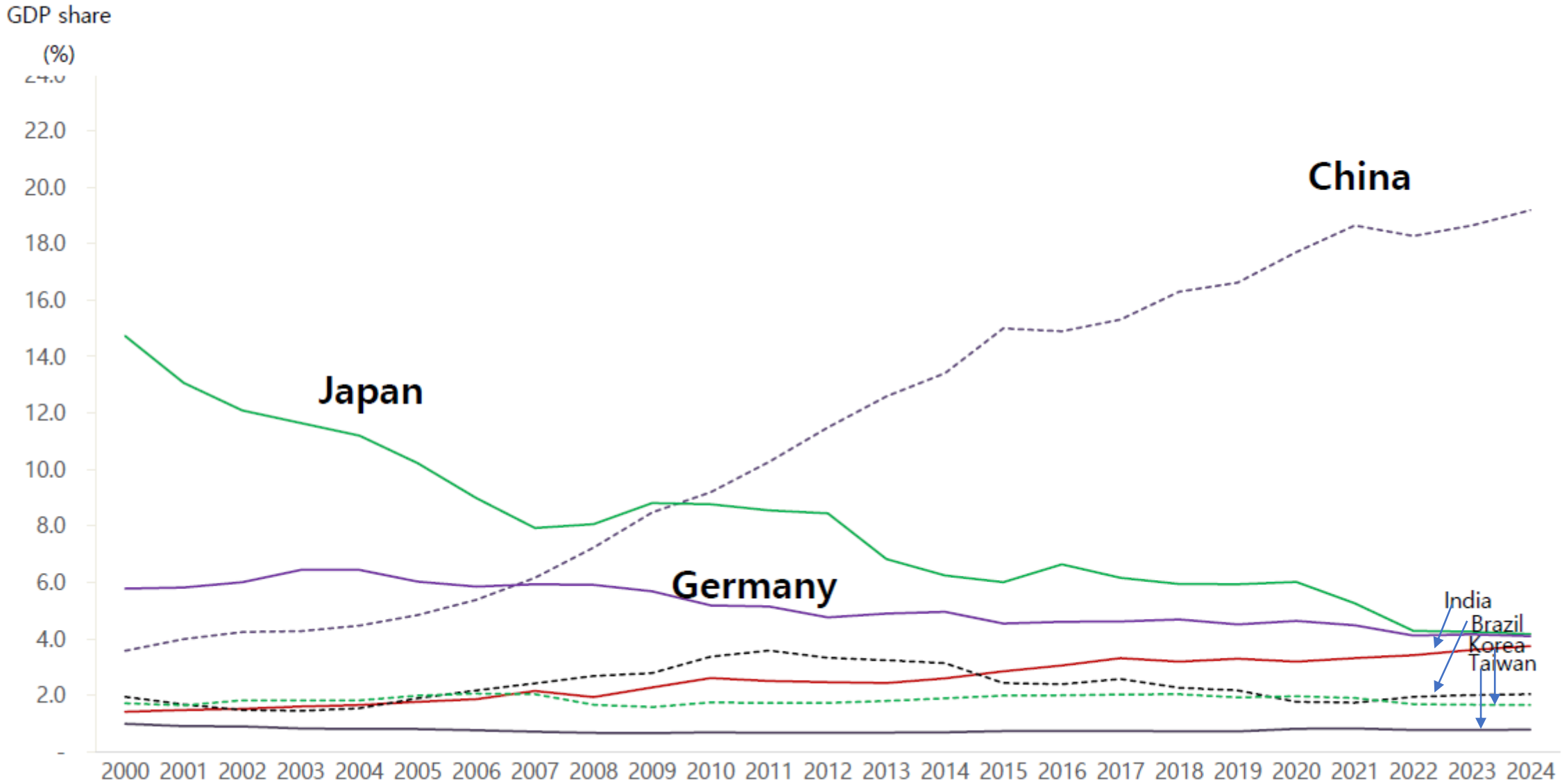
Source: Author

changes since mid 2010s

- Trade conflict between the US and China
- Decelerated export orientation (especially R&D intensive goods) in **China** in favour of stronger focus to develop domestic economy (see Schmoch and Gehrke, 2022)
  - Reducing reliance on Western technologies (EV, 5G, AI)
- Covid-19 outbreak: rebalancing **efficiency and resiliency** of GVCs and both redefining their "**economic rationality"**
- The **US** is seemed to deploy industrial policy to develop/ protect local industries
  - Pointing to decoupling of high tech industries

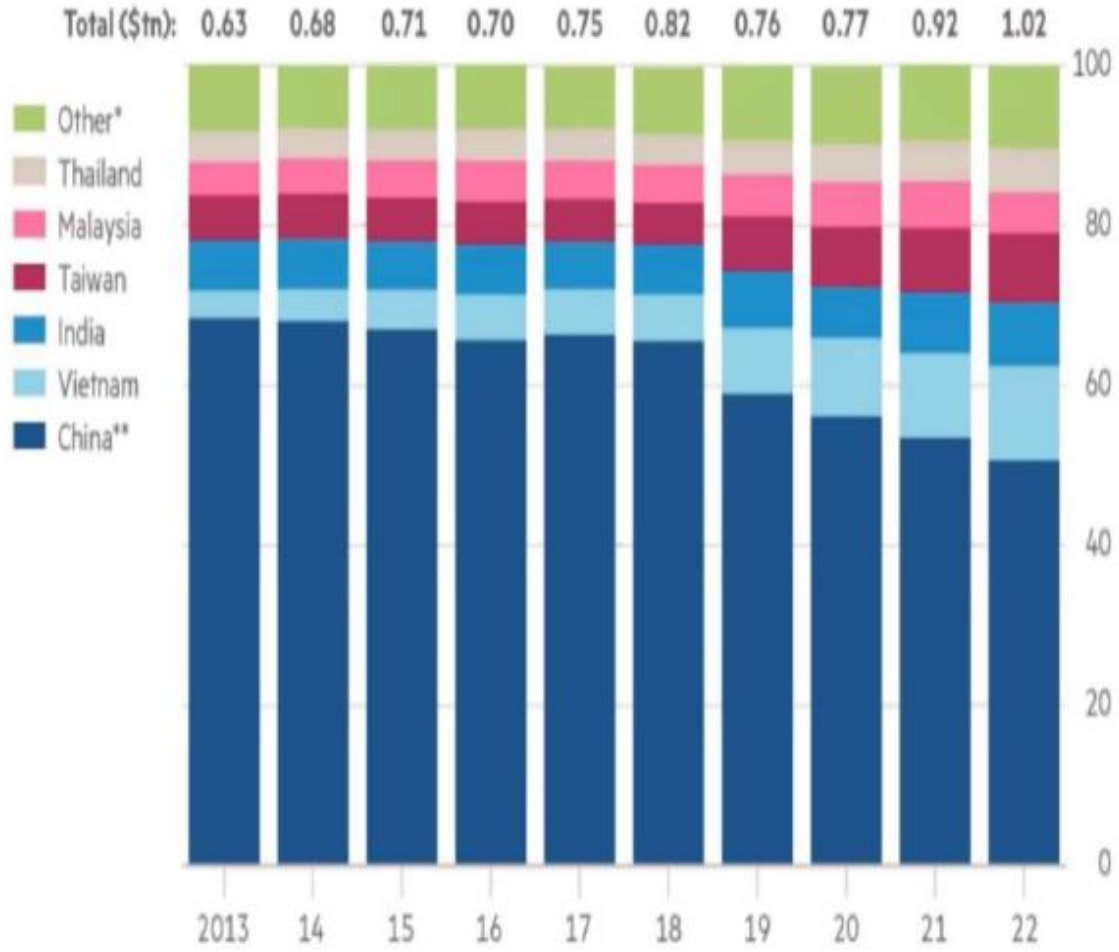
- China is competent in assimilating foreign technologies and determined to have (and command) own supply chain
  - SMIC producing 7nm chip using DUV machine; none economical viable but gaining traction as it is deemed strategic
- **Reshoring** is evident for some cases. CN and the US are procuring products and services that are produced in their respective economies.
- **Thucydidies Trap** (US-China tension over global hegemony): the quest for hegemony lead to sacrificing economic rationality for the higher-level goals of national security or global hegemony

Share in World GDP (%)



US is importing more from other low-cost Asian countries at China's expense

Breakdown of imports from Asian low-cost countries (%)



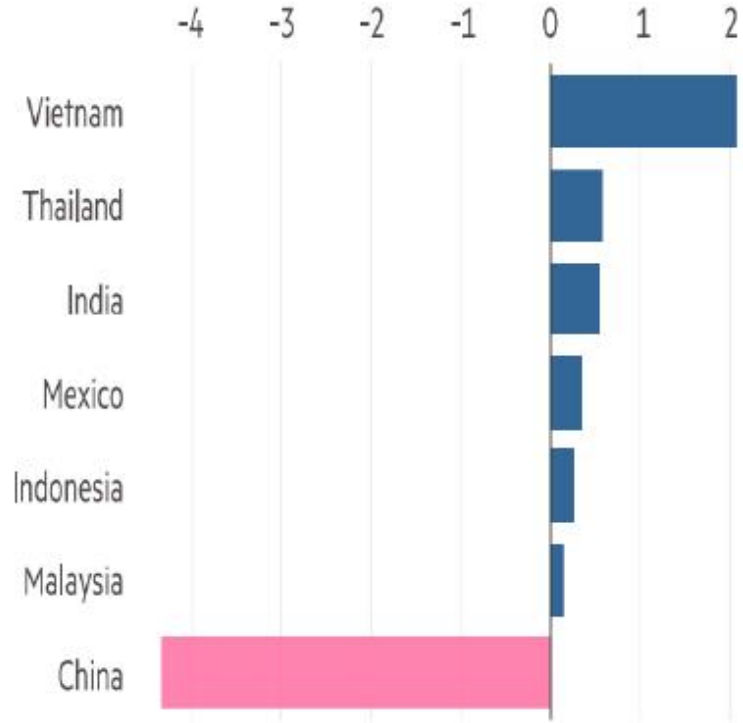
* Includes Philippines, Indonesia, Pakistan, Sri Lanka, Bangladesh, Singapore and Cambodia

** Includes US imports from Hong Kong

Source: Kearney Reshoring Index

South-east Asia benefits the most from reshoring away from China

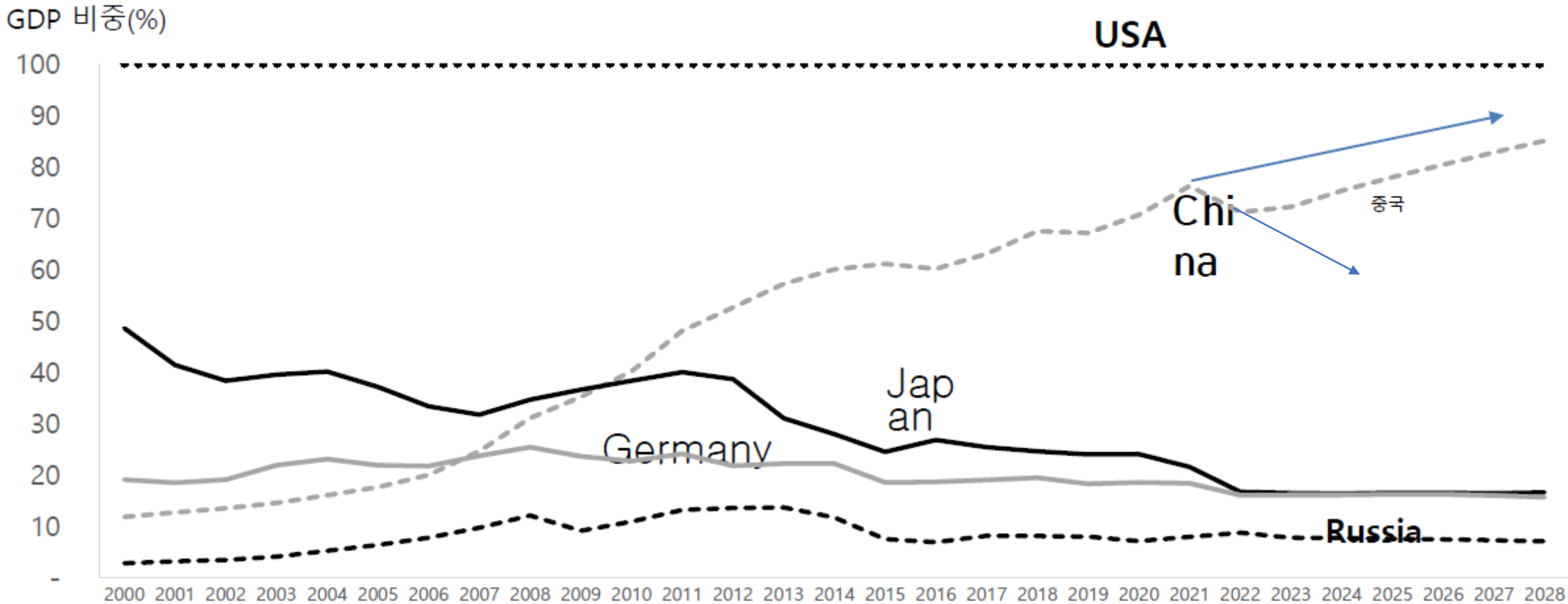
Change in share of US imports between Jan 2018 and Oct 2022 (percentage point)



Source: Morgan Stanley

FT Data: Andy Lin/@imandylin2

FINANCIAL TIMES



GDP to that of the US level

About semiconductor

- National Security: Semiconductor determines future military
  - US's cruise missiles with computing power is found superior over Soviet's fixed flight ones in the cold war
- Domestic Jobs: commitment of the US gov. to lay a ground for domestic industrial value chain
- Chip 4 Alliance
- US market without China + China market without US- is it good for Korea and Taiwan?
  - To some extent: *China would have domesticated* more of the *major value-added segments* in key manufacturing GVCs
- Dilemma for Korea and Taiwan: how to strike a balance between the US as the source of technologies and China as the biggest market

The Case of Korea: Recent Changes

- **Falling surplus in current account**
- **Lower demand for ICT commodities** (DRAM) while making effort to produce more differentiated parts and products (logic chips) to compete with TSMC
- Samsung to reduce price for memory chips to maintain dominant share of production
- Deficit trading with China
- A worry about local contracting trend for lower value added parts and components
  - Apple contracting **NAND chips from YMTC**
  - YMTC to launch 232 layer NAND (the US restricts export of 128-layer NAND chip
- US incentives and subsidies
- Competitive environment as well as endowed local SMEs in the two giant economies may challenge Korean firms to supply intermediate goods and services

The Case of Taiwan: Recent Changes

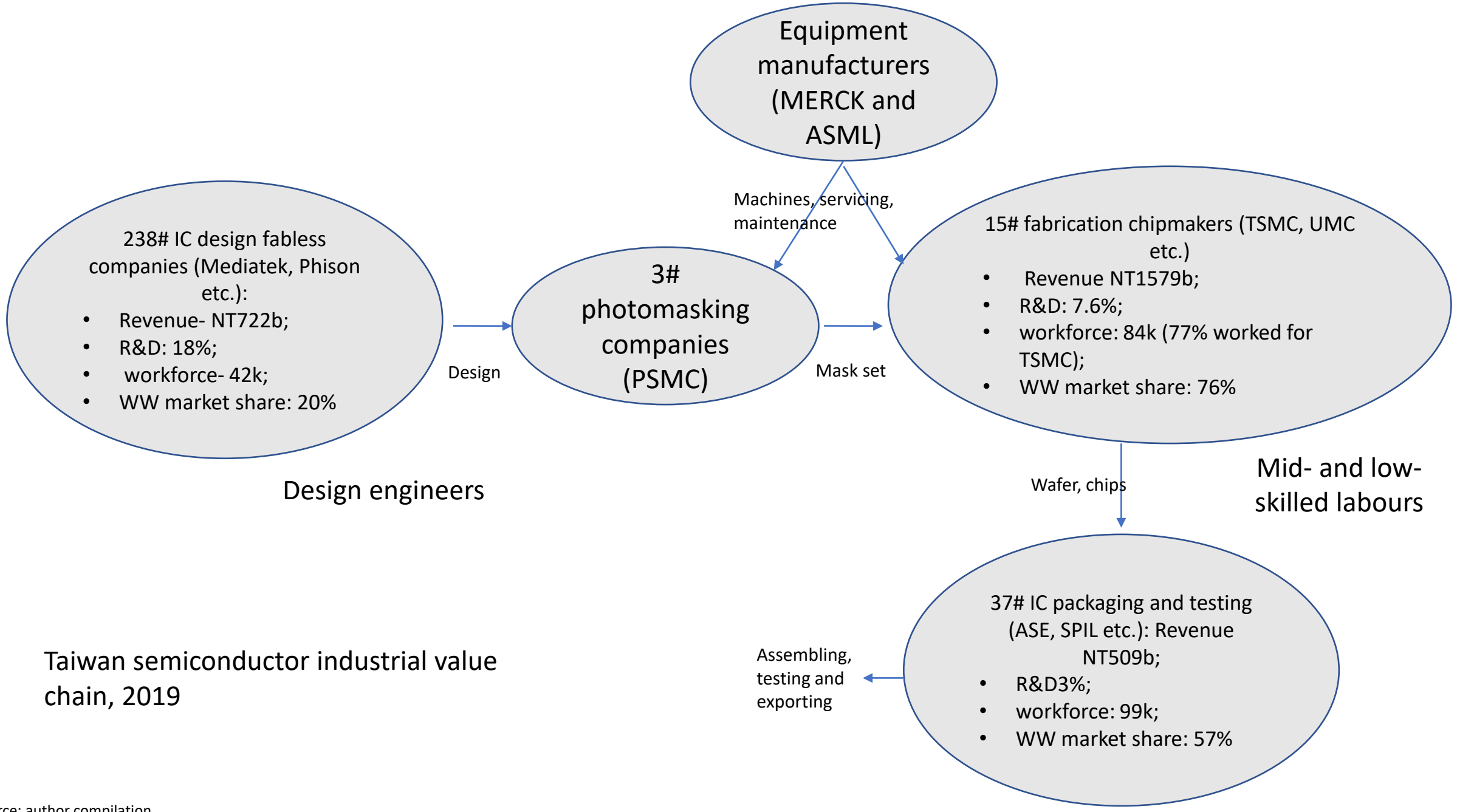
- Facing similar challenge for firms producing memory chips
- Soon, 28/22nm logic chip producing firms such UMC would need to compete with SMIC
- **Migration of skilled labors** and Taishang
- Shortage of labor to supply to semiconductor (fabrication and designing) industry
- TSMC current model maybe affected if carbon nanotube is applied to replace silicon-based semiconductor material
- Worrying about skills and industrial **value migration to the US** and other economies in long term (e.g. investment of $40B in Arizona)
  - TSMC production capacity per week in Taiwan: 1.3million chips
  - TSMC in Arizona (intended) for 30-50k chips per week
- **Likely 2023 contraction** of the three revenue pillars for Taiwan semiconductor - high speed computing, Apple phone and auto electronics- would affect the economy

On high end chip producers:

- **TSMC** emerged to gain **with bargaining chips** to populate plants everywhere
  - Enjoyed subsidies from multiple countries and window of opportunity to internationalise its operations
- Others like **Mediatek** feel **the pressure for being taken** over by Chinese firms in China as it try to domesticate technologies, especially the lower tech ones
- Opinions in Tw are divided

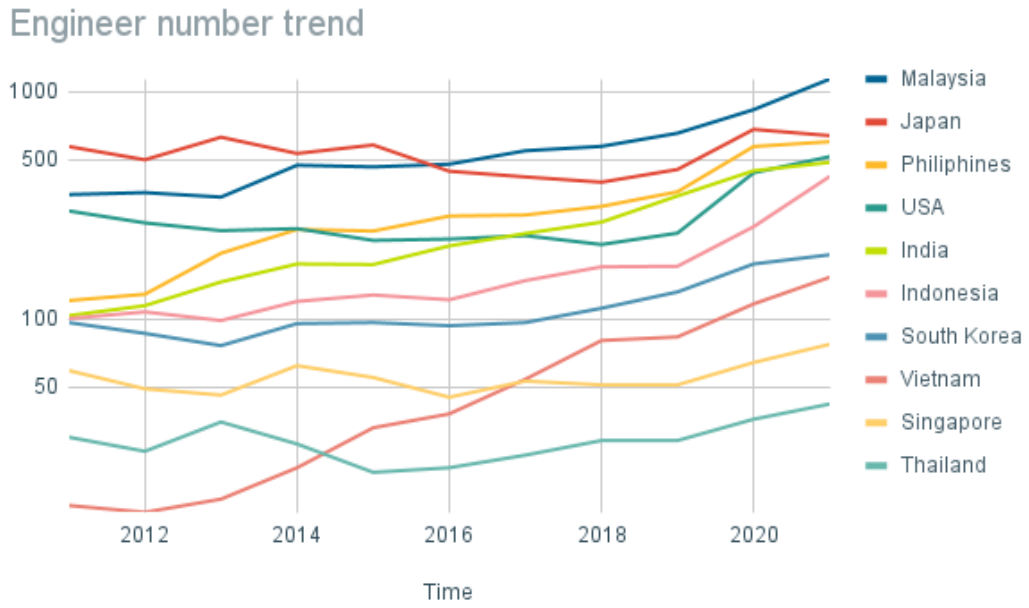
  1) pessimistic about TSMC production in US

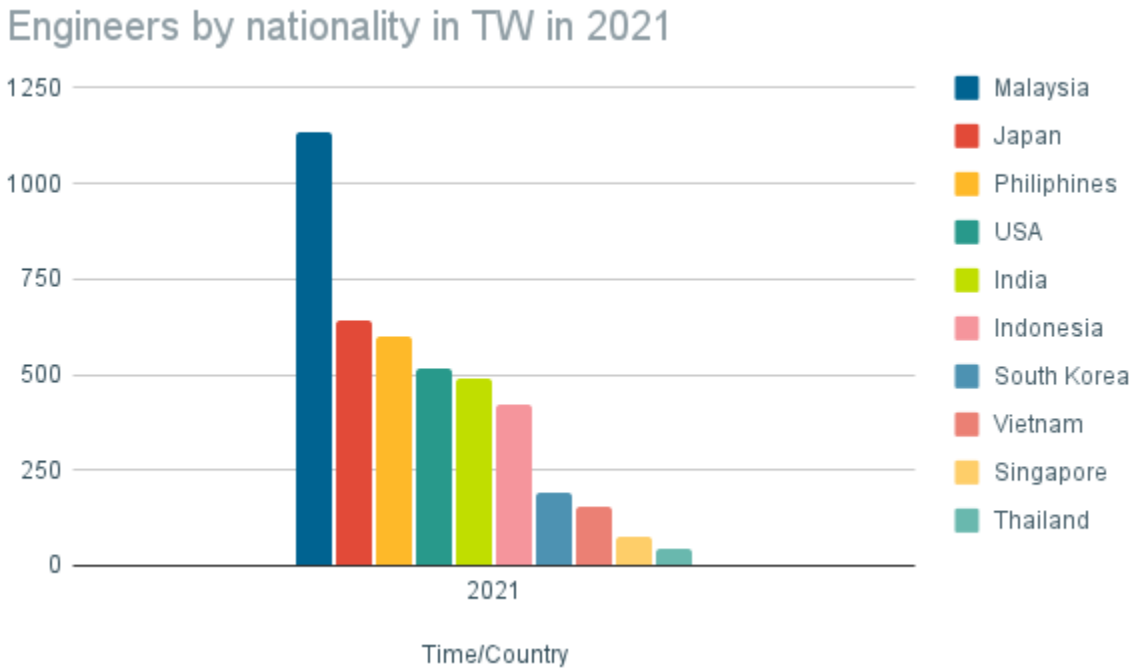
  2) optimistic as TSMC to gain more for higher tech production
- Possible endgame:
  - winners to gain big (due to scale, reliability and tech competencies). Gains are attributable to economic reasons.
  - ..while others (lower tech Taiwanese firms supplying to China) are pushed to compete (and many may be losing their competitive advantages/favour due to geopolitical change)



Taiwan semiconductor industrial value chain, 2019

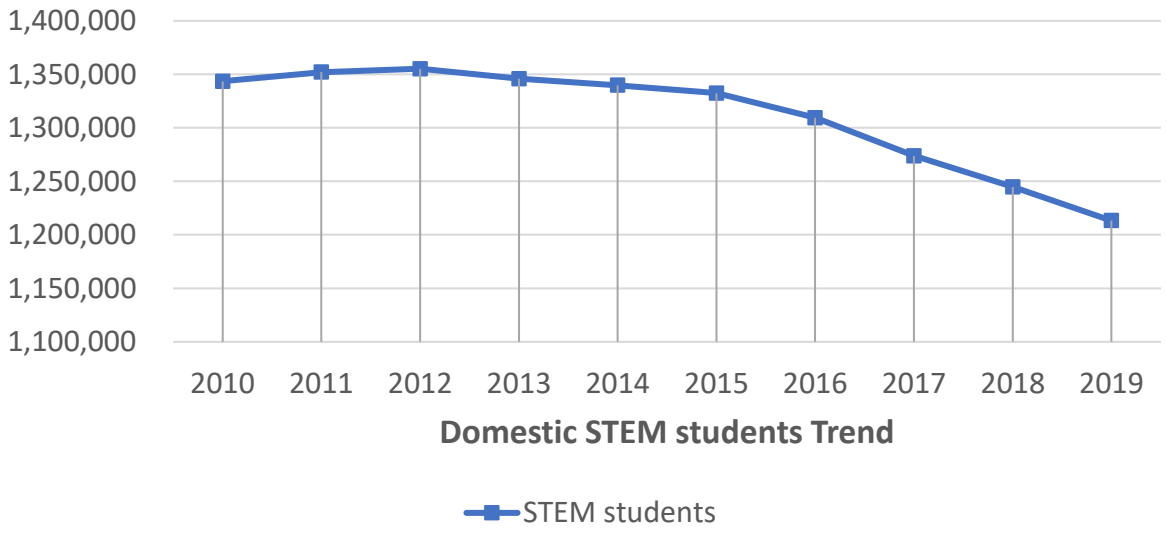
Source: author compilation

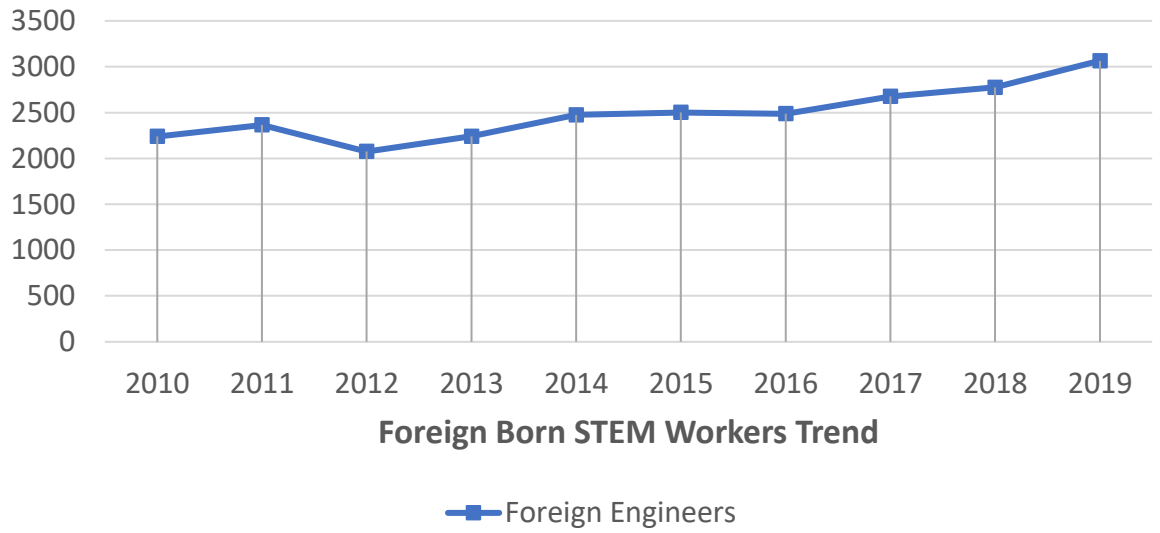




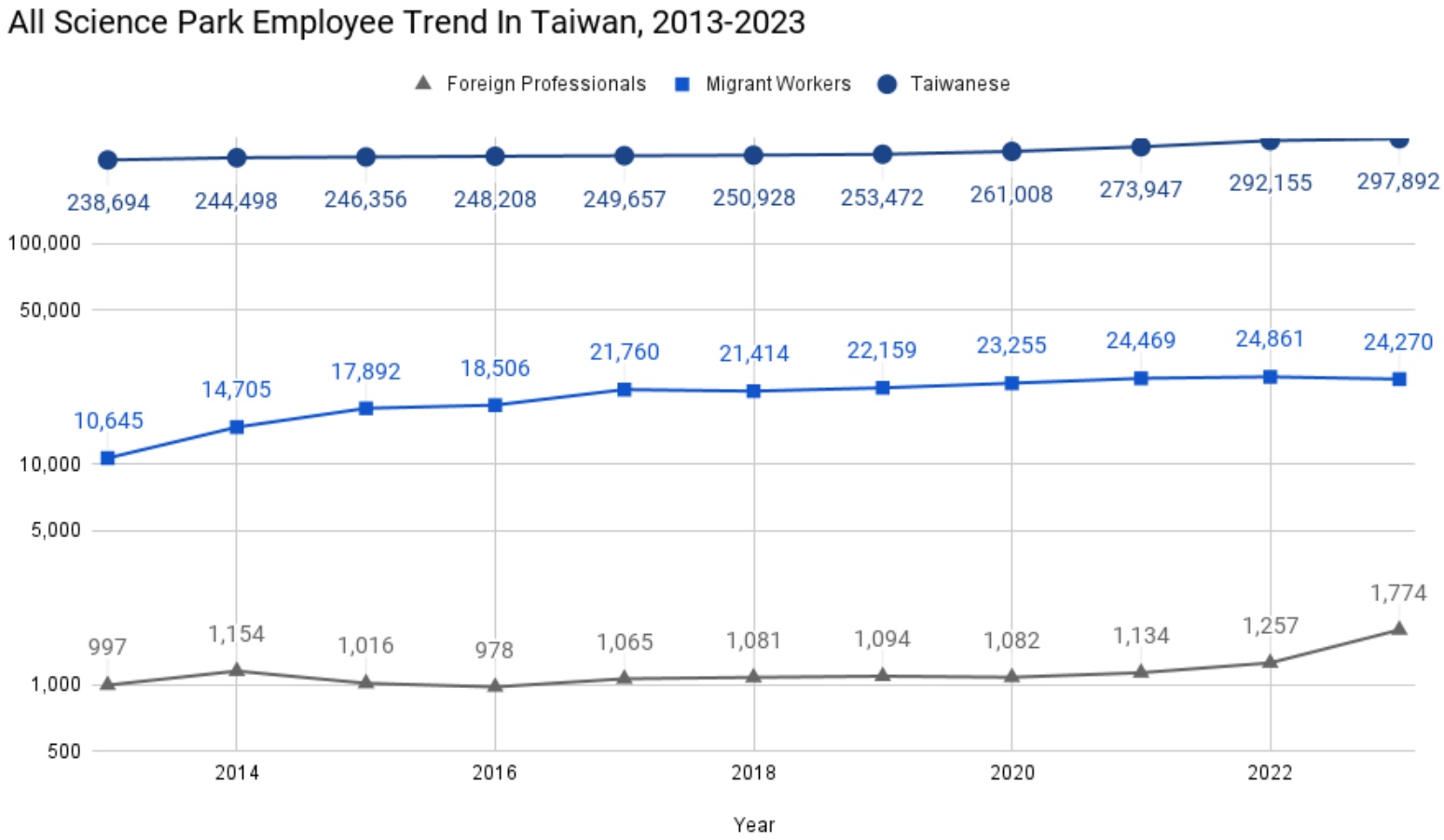
Taiwan losses 3000 chip engineers to “Made in China 2025” (2015-2019). Their roles seem to have been substituted by engineers from Malaysia, Philippines, India etc.

Growing Gap in Domestic Talents





Source: Yeh and Wong (2023)



Source: Yeh and Wong (2023)

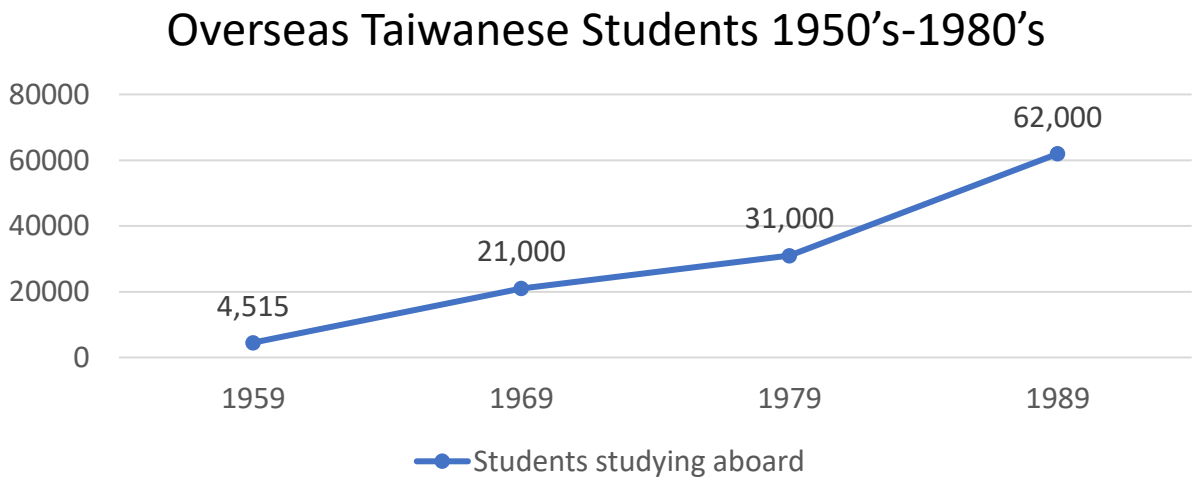
1950-1990’s

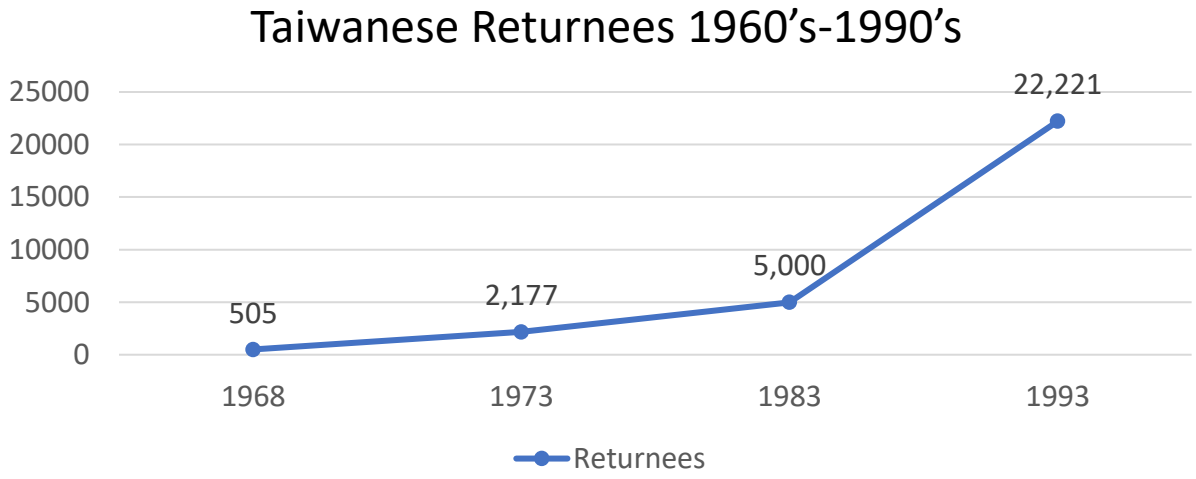
Brain drain Factors

- Loosen migration policy
- Overseas study in developed nations

Brain Gain Factors

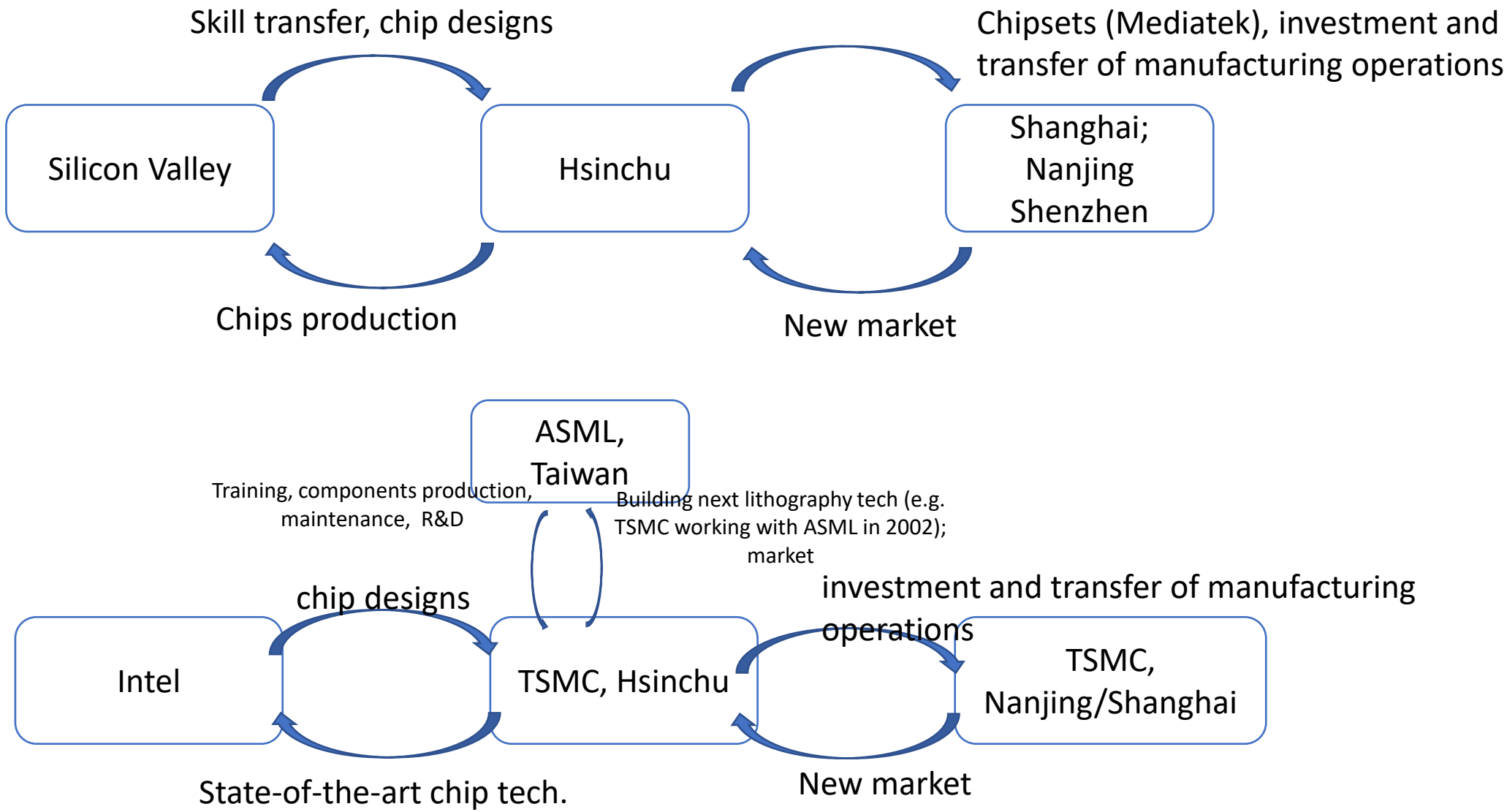
- Ten Construction Projects
- IC industry investment
- Hsinchu Science Park & ITRI
- Policy encouragement of returnee recruitment & domestics talent development





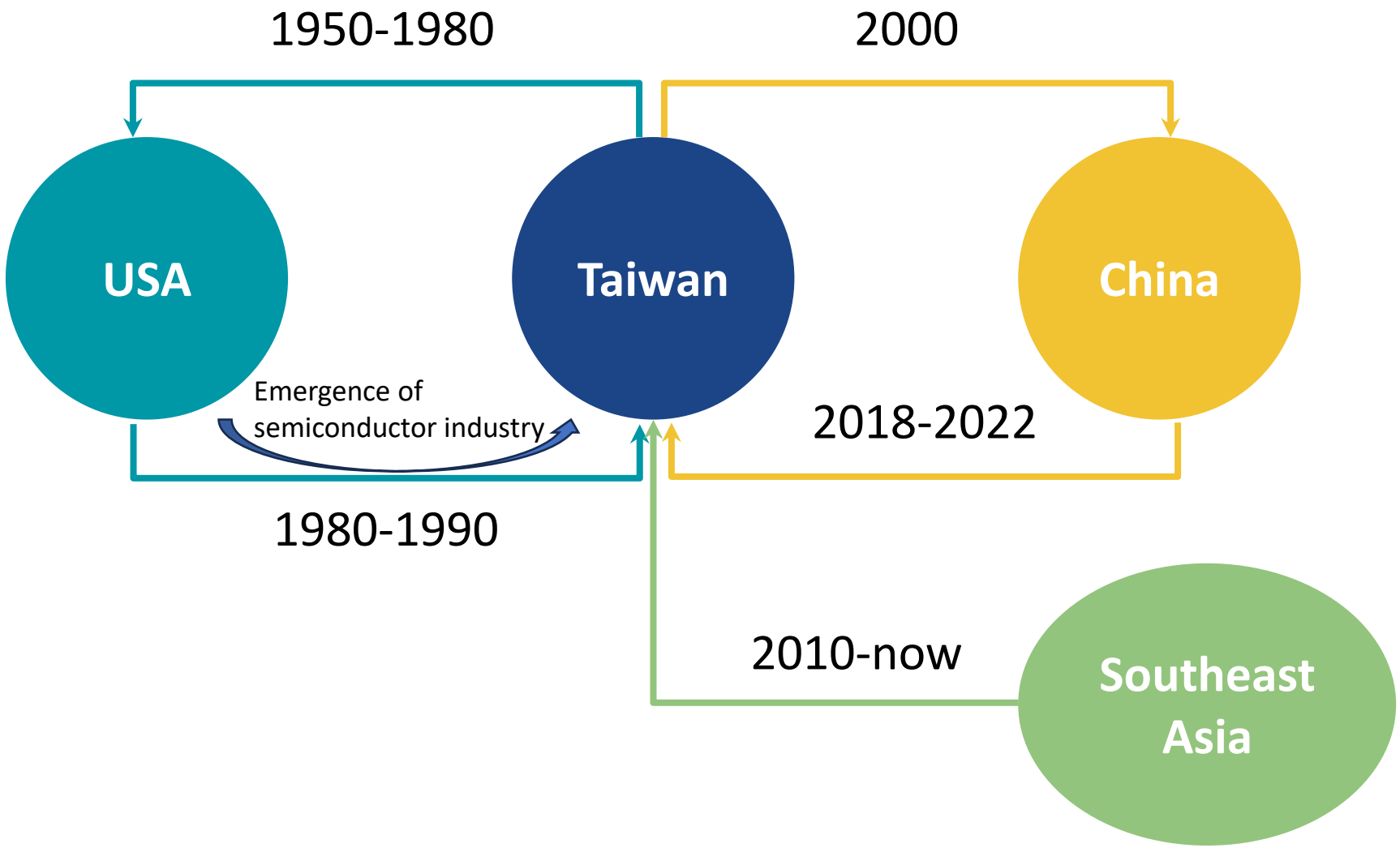
Lin. Y, The Brain Gain Experience of Taiwan, 2009
(non-aggregated numbers)

Source: Yeh and Wong (2023)



Productive Knowledge Cluster Economies

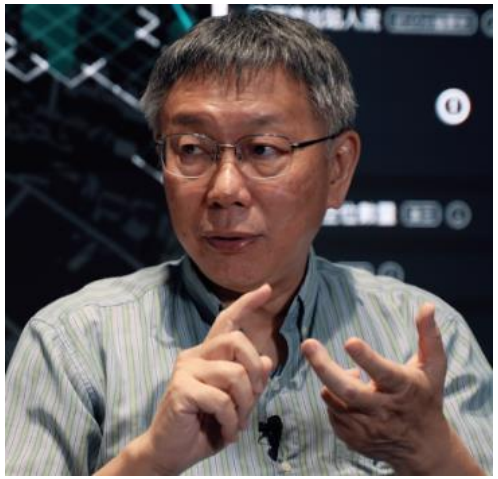
Dynamics of Migration



Source: Yeh and Wong (2023)

Context and conclusion

- ..going to be a tough years ahead..
- Winners in the two giant economies may keep winning..
  - Both have market commanding power
  - The US and China would favour their (local) firms at their respective shores to develop state-of-the-art tech.
  - China can sway the use of lower tech chips in its market and therefore rely less on firms abroad
- TW and KR are not in middle income trap, not middle innovation trap…
- but a trap in the time of reconfiguration of global supply chain



What are you going to do for young people?
-Innovation is the way forward not (only) manufacturing
-Creativity and entrepreneurship
-High quality (high paid) job

- Innovation system to search and create new niches
- Talents from abroad
- Evon and I seeing Israel's **pro-intermediary** approach as a case to propose:
  - The then government did not have any clue what to search/create
  - The government did not know how to mobilise talents (Jewish returnees after the collapse of Soviet U.)
  - Seeing VC firms instrumental
  - Provide fund of fund to VC firms in Sillicon Valley to search and create niches in Israel