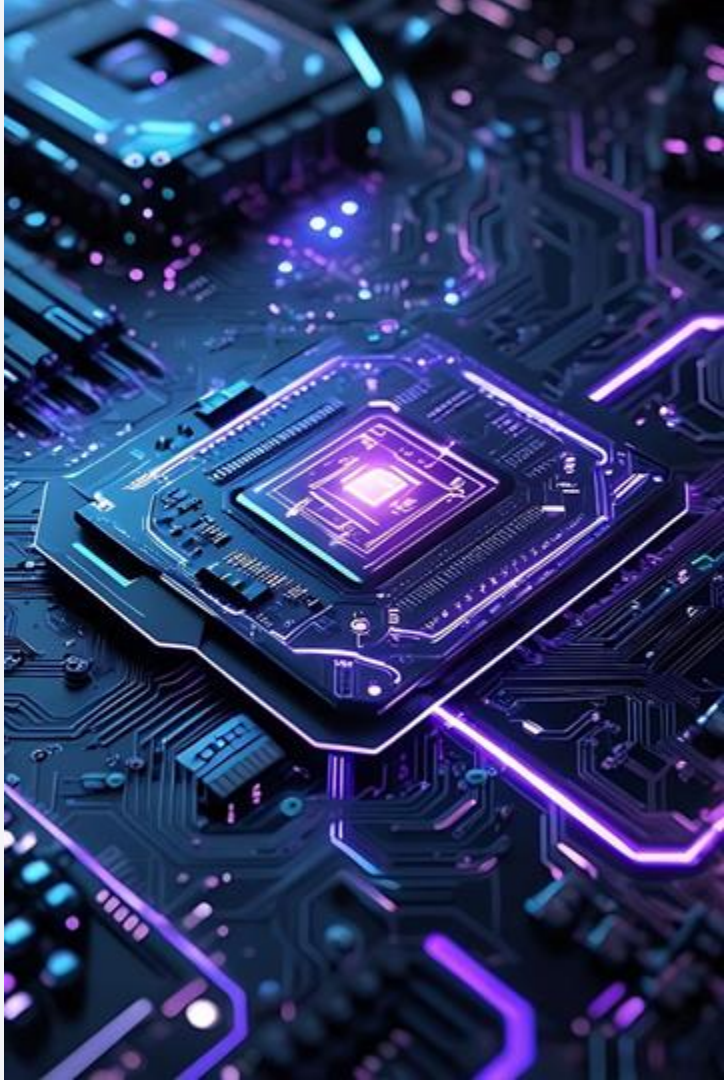
Are Advanced Chips the New Oil?

distracted_franklin: Chi Min Liu, Elian Guessoum, Chia-Min Chiu

October 30th 2025



Agenda

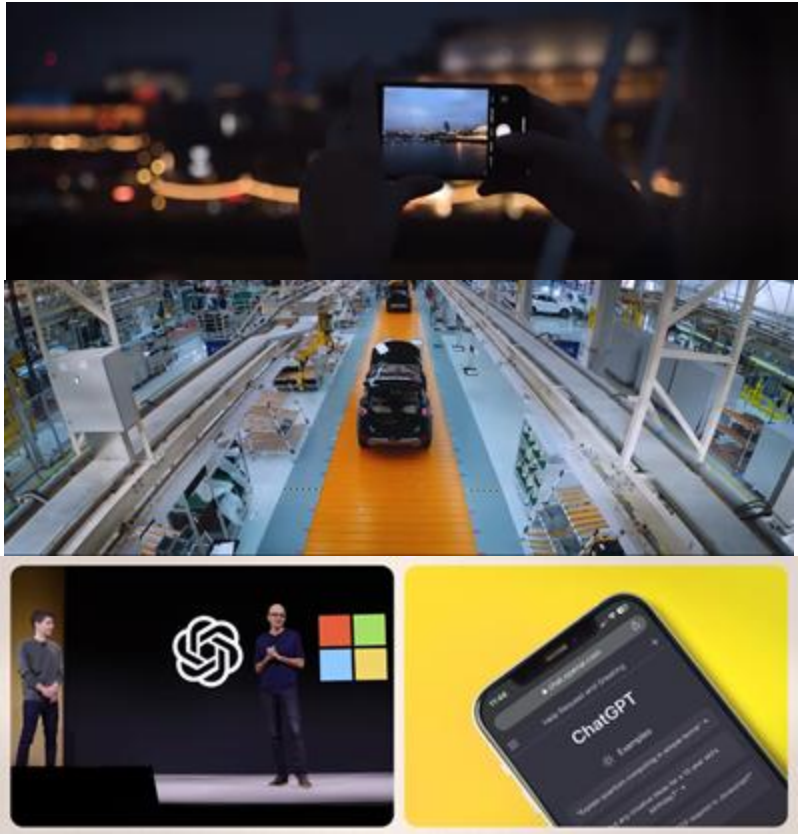
01 Importance of Semiconductor Industry

02 Global Market Dynamics & Export

03 Cross-Sector Influence of Semiconductors

04 Insights from Data

Why Semiconductors Matter



Chips Power Modern Technology

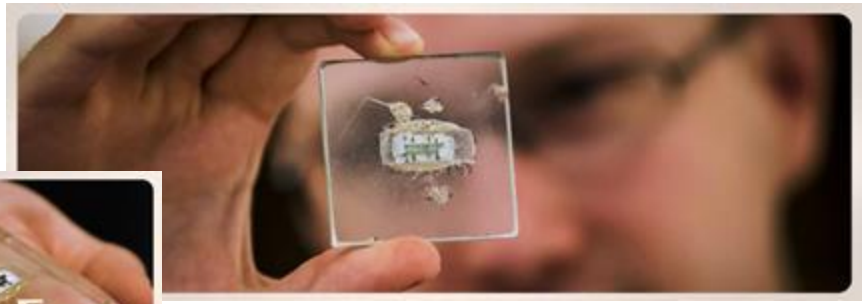
- From smartphones to autonomous driving to AI computing
- Semiconductors form the backbone of today's digital infrastructure.

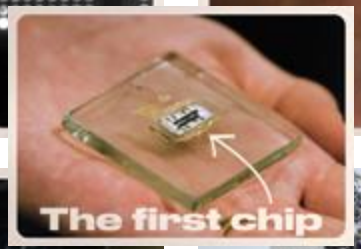
Chips Are Everywhere

Semiconductors in Everyday Life

The Evolution of Chip Technology

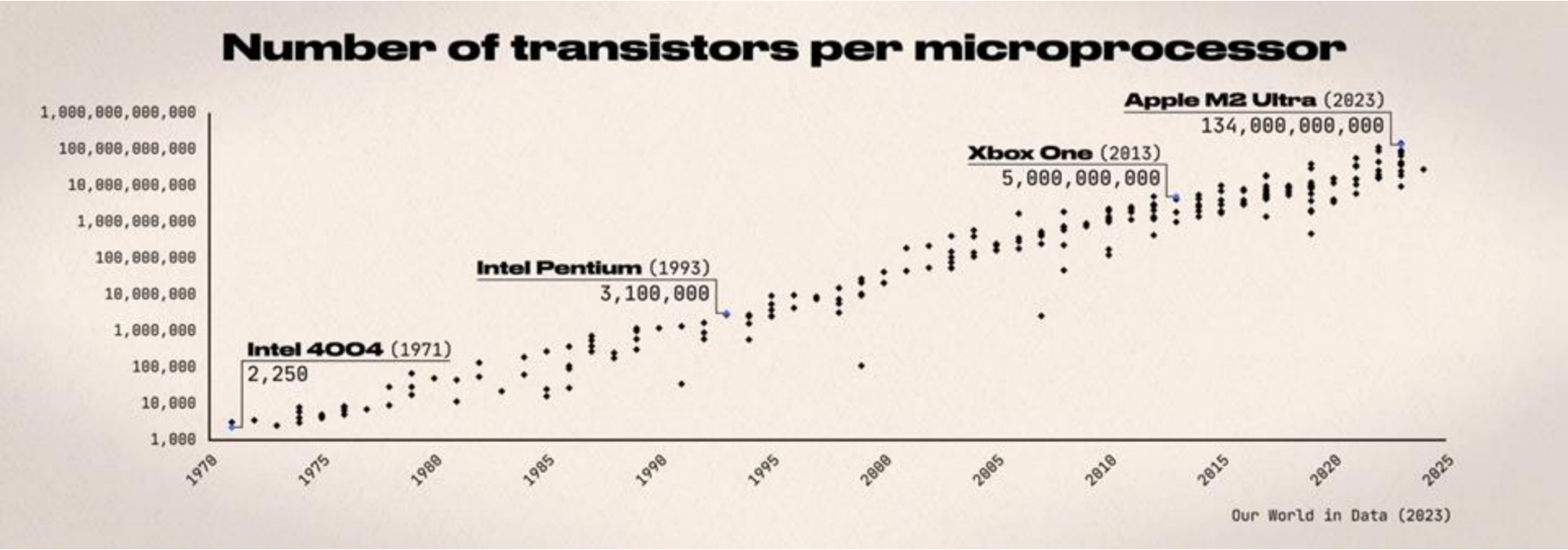
- From vacuum tubes to microchips, the continuous miniaturization and efficiency gains of semiconductors have enabled exponential advances in computing power.





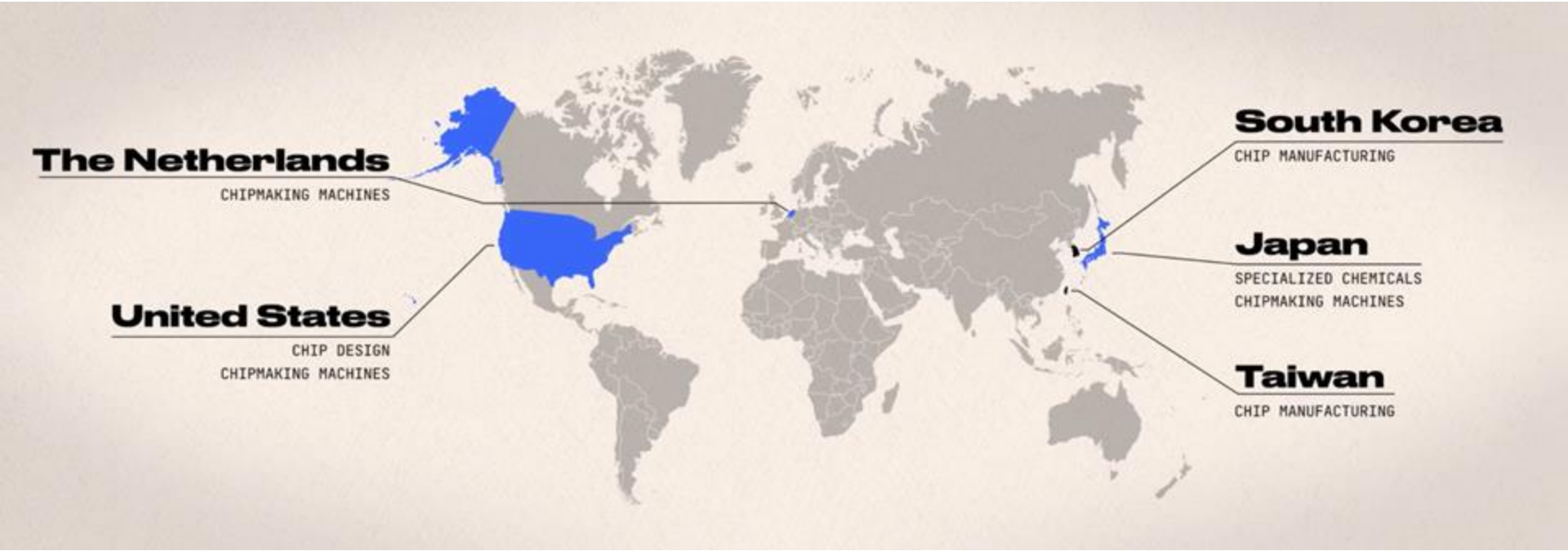
Moore’s Law

- The number of transistors on a chip doubles approximately every two years, driving performance improvements and cost reductions.



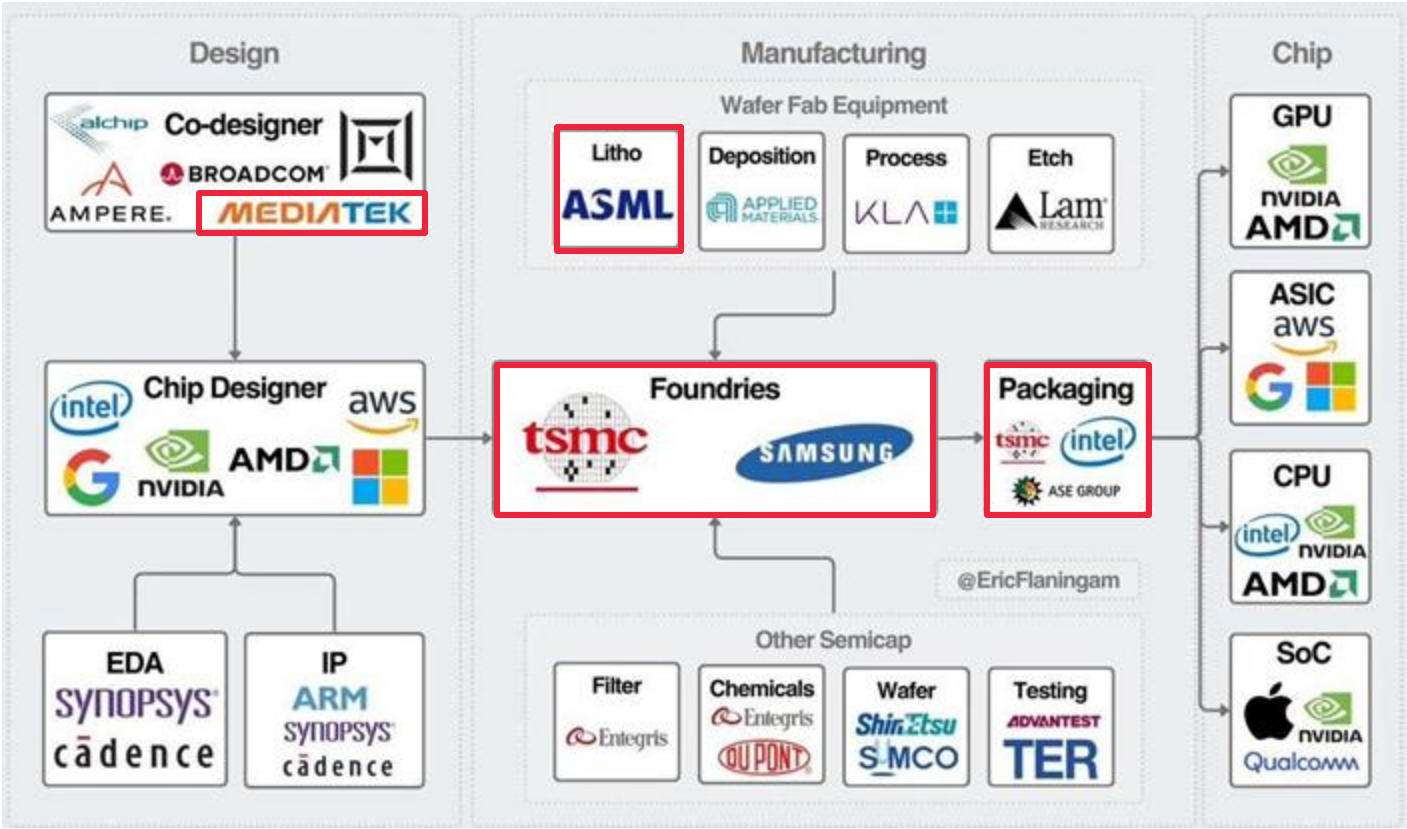
Source: *Chris Miller for The Freethink Interview*

The Chip Industry Is A Global Industry



Source: *Chris Miller for The Freethink Interview*

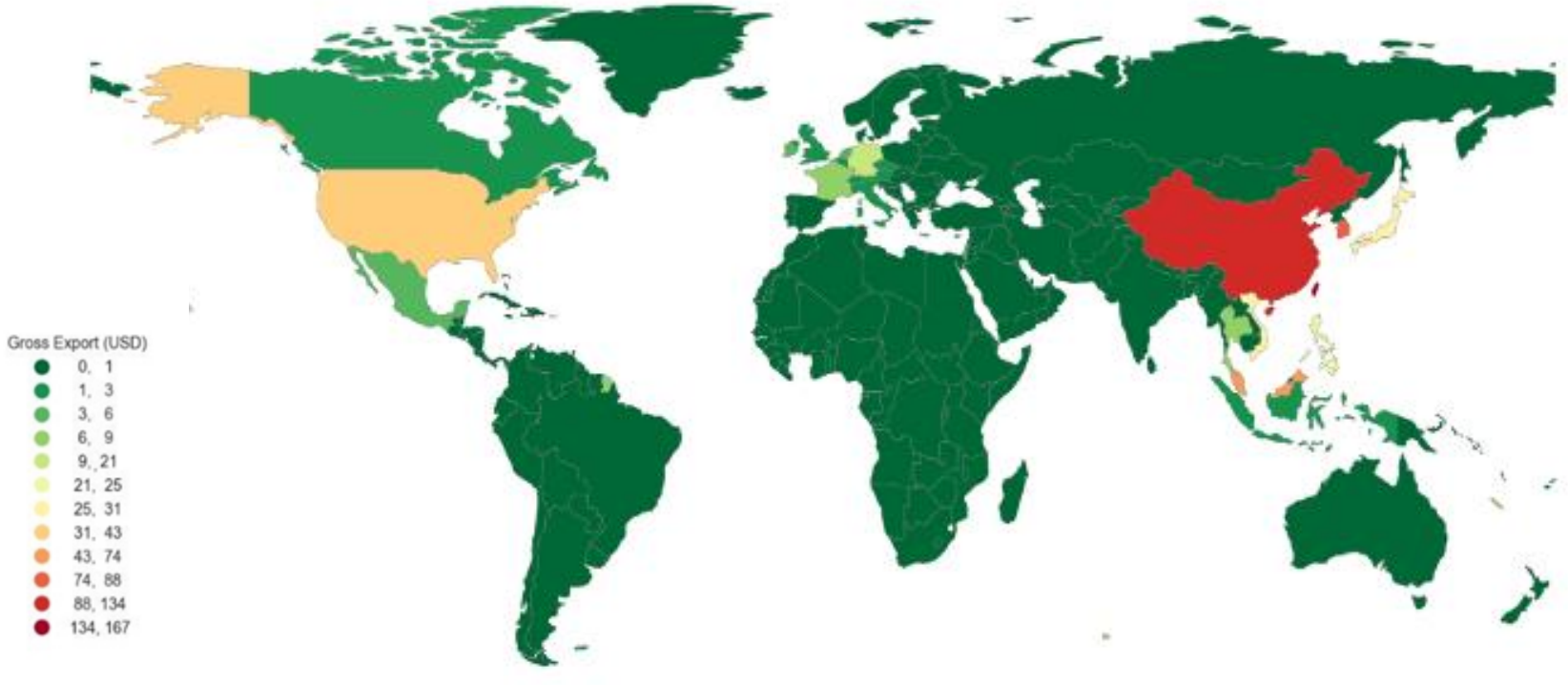
Supply Chain of Chip Industry



Source: *@Eric Flaningam*

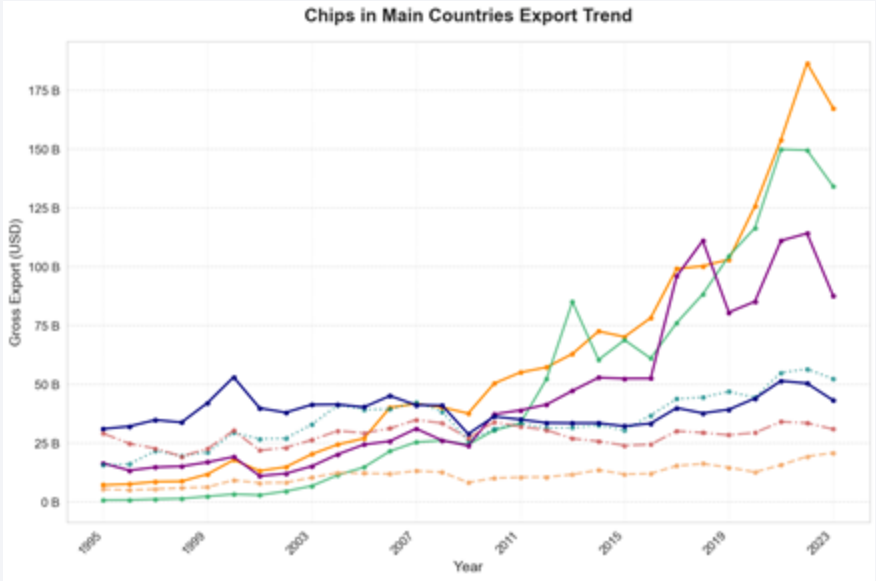
The Chip Industry Is A Global Industry

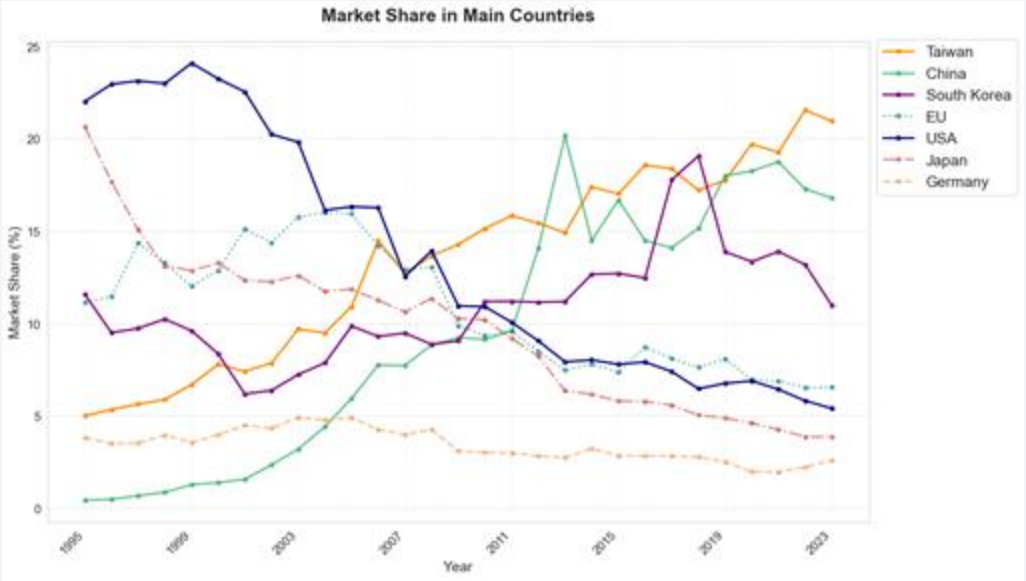
Global Semiconductor Exports Heat Map - 2023



Descriptive Statistics

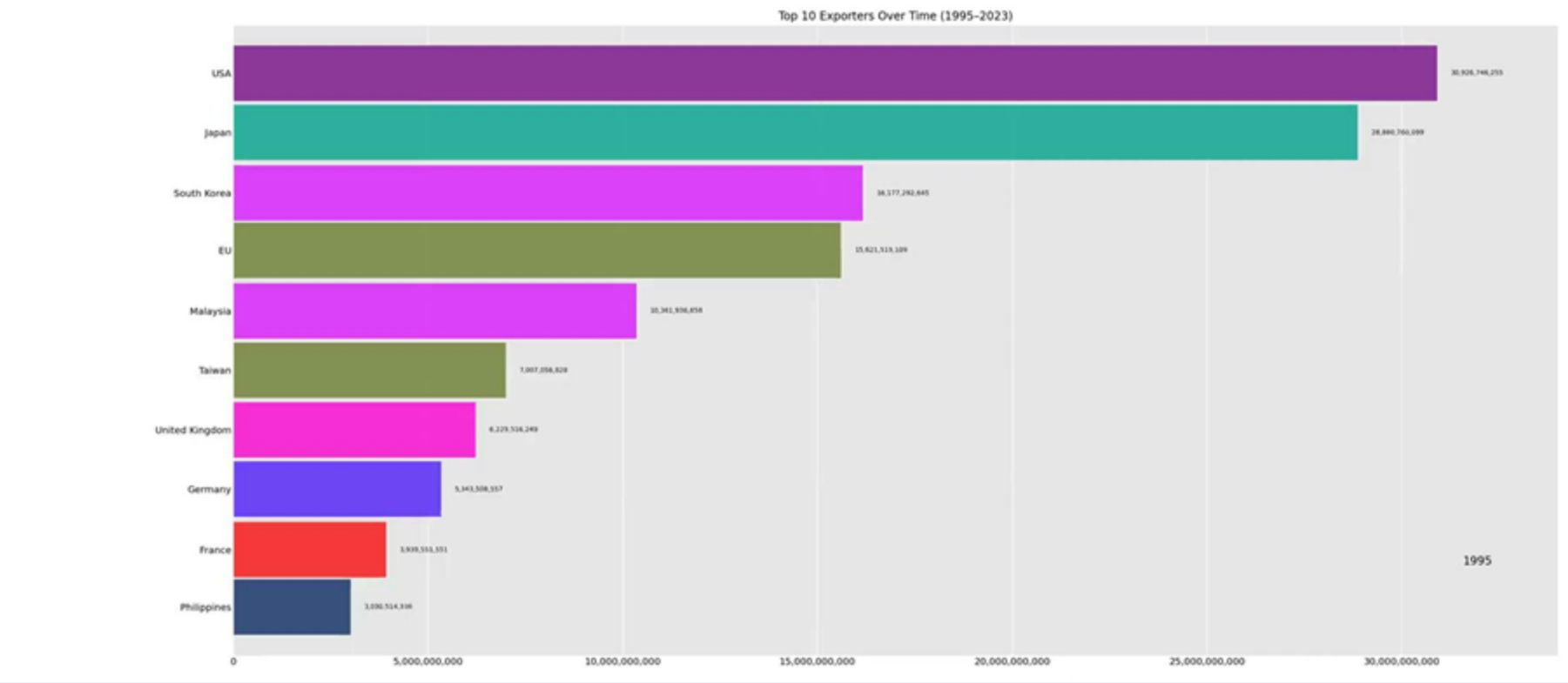
Global Export: Values and Market Shares





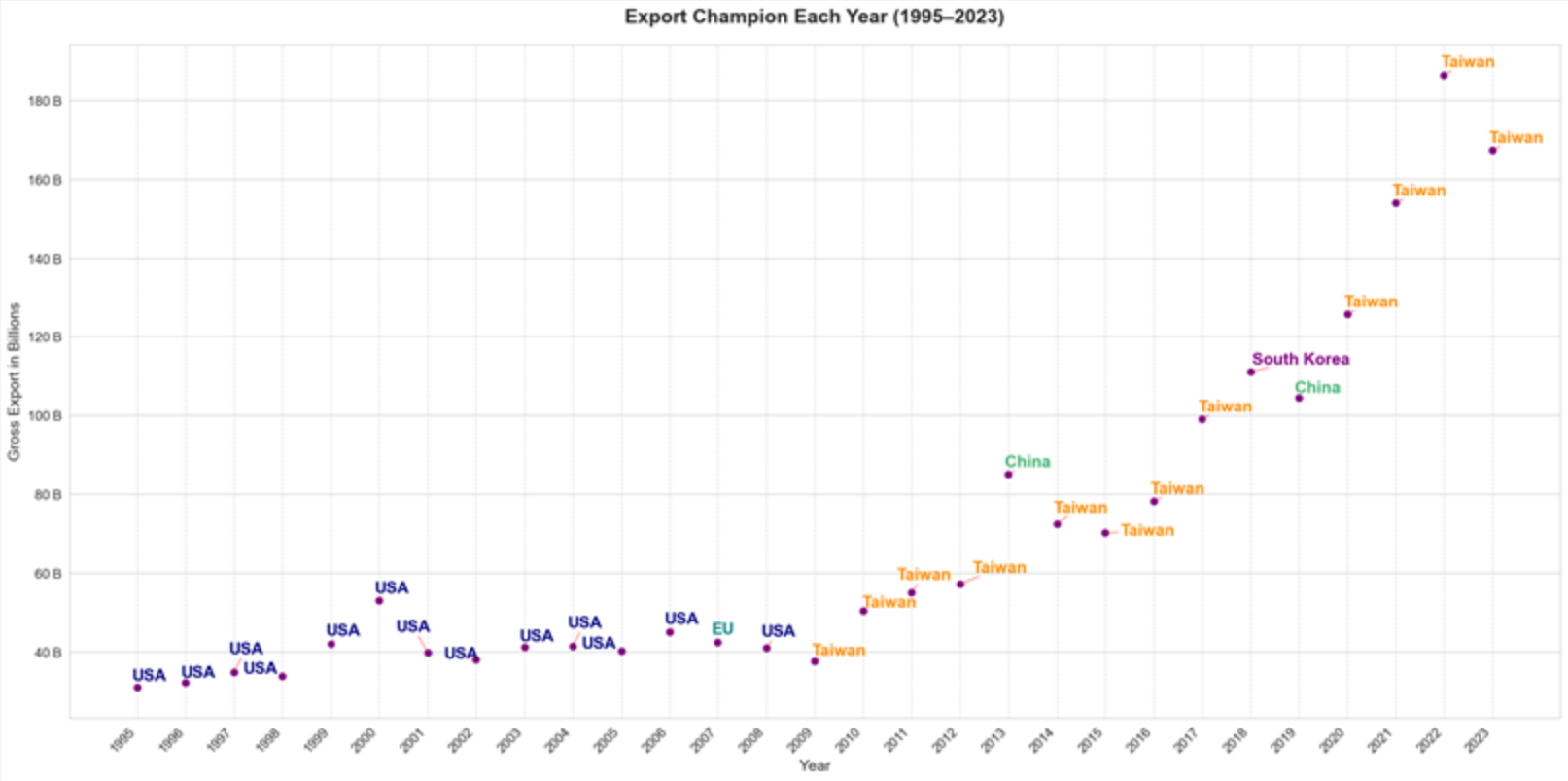
Descriptive Statistics

Export Race



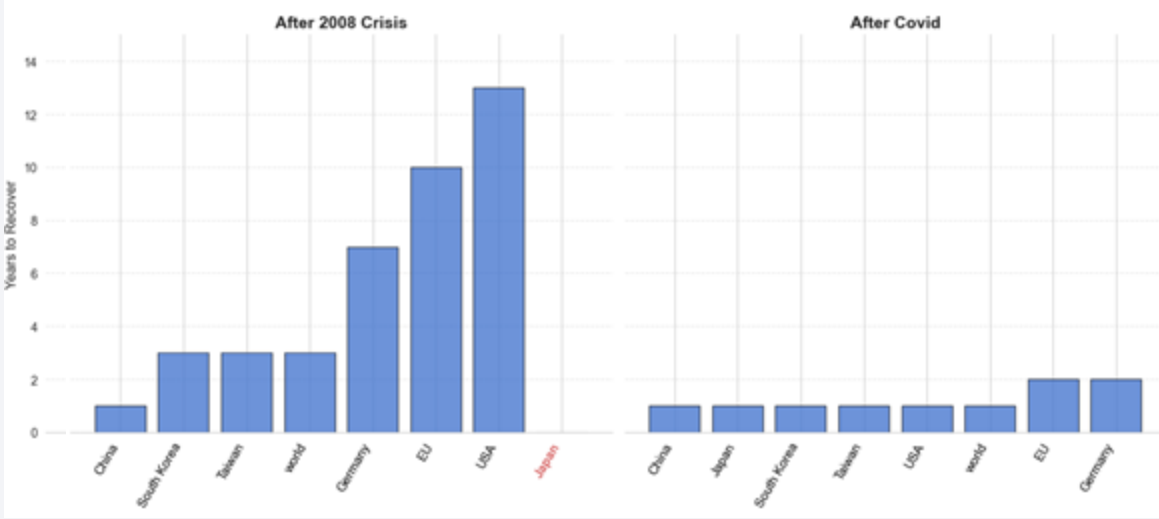
Descriptive Statistics

Who's the market dominator?



Descriptive Statistics

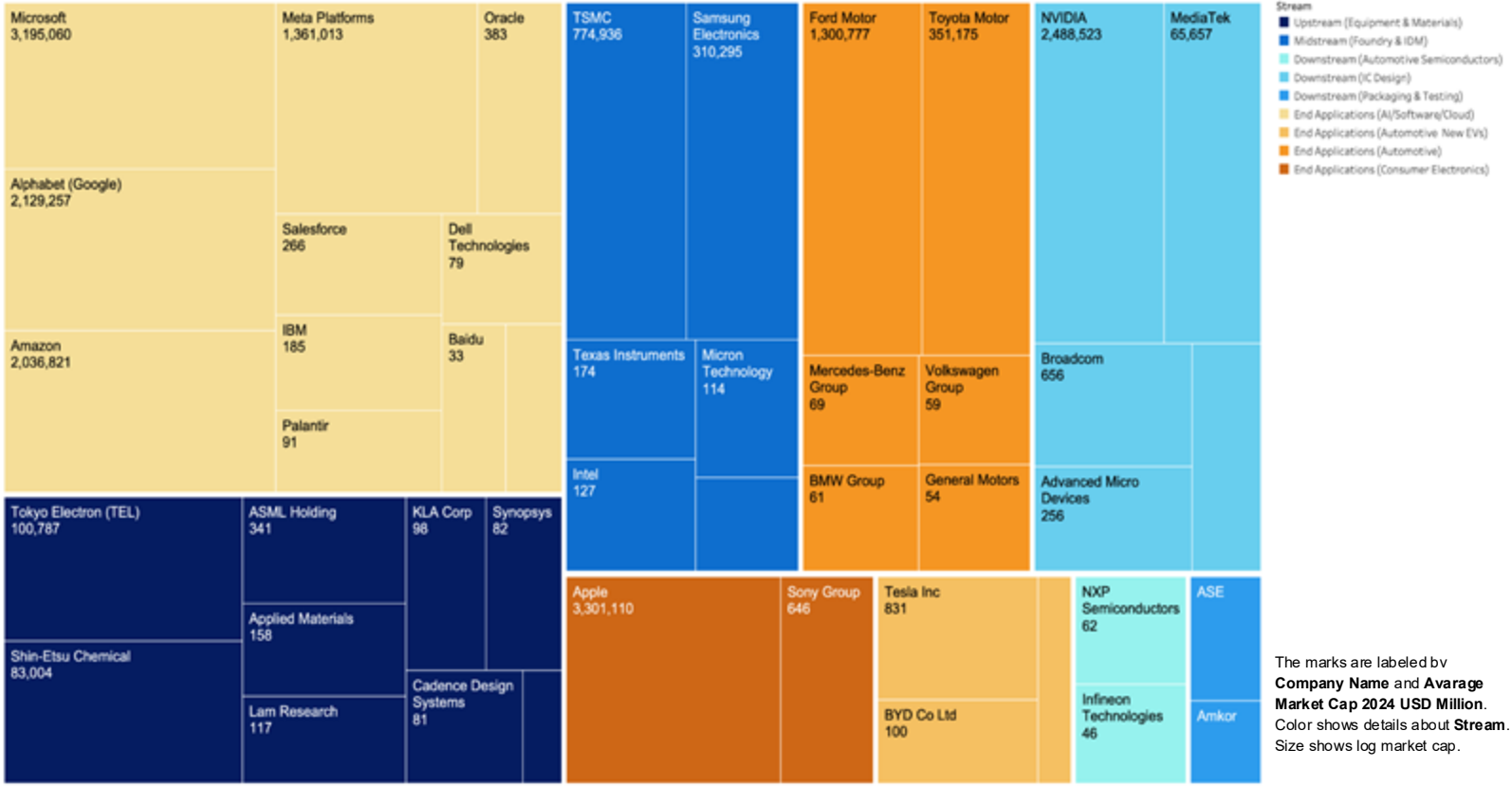
Supply Chain Crisis



Data Sources and Variables

- **Industry streams**
- Financial and market data obtained from **Bloomberg (2000–2025)**

  – market capitaliza
  – revenue
  – net income
  – R&D expenditures
  – capital expenditure
  – stock price



The marks are labeled by **Company Name** and **Avarage Market Cap 2024 USD Million**. Color shows details about **Stream**. Size shows log market cap.

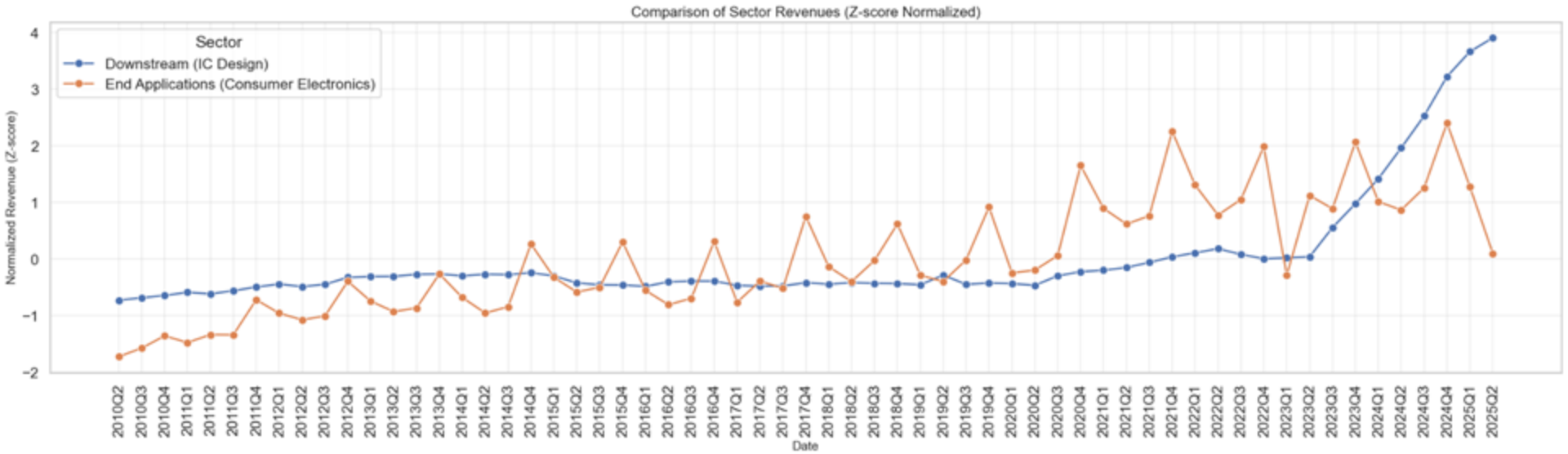
Methodology

1. Data Cleaning	Removed missing and inconsistent entries
2. Transformation	Weighted mean and Z-score transformation
3. Cross-Correlation	Identify temporal link patterns
4. Granger Causality Tests	Determine directionality of sectoral impacts

Consumer electronics revenue drives semiconductor demand

Semiconductor IC Design & Consumer Electronics

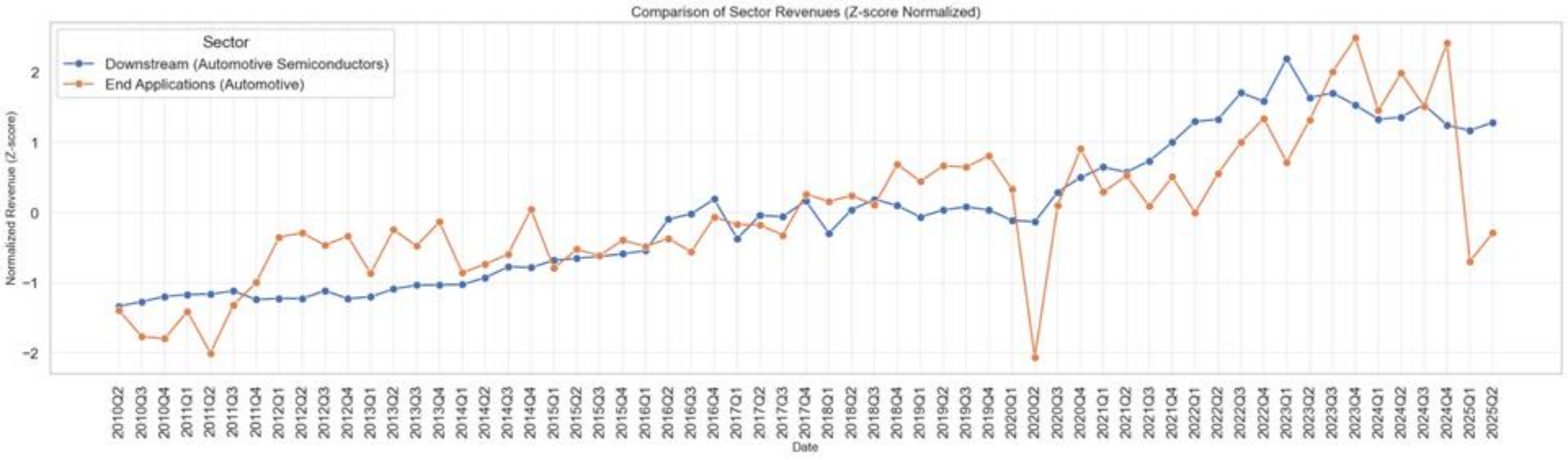
- **Consumer Electronics revenue** exhibits strong cyclical fluctuations tied to product launches and demand waves.
- Granger causality indicates Consumer Electronics leads IC Design
  - **Lag -4 → p-value =** 0.0001 (measures how likely the observed effect is due to chance, p-value < 0.05: statistically significant)
  - Suggests semiconductor revenue typically follows consumer electronics trends by **~4 quarters**



Automotive production drives semiconductor demand

Automotive Semiconductors & Automotives (End Applications)

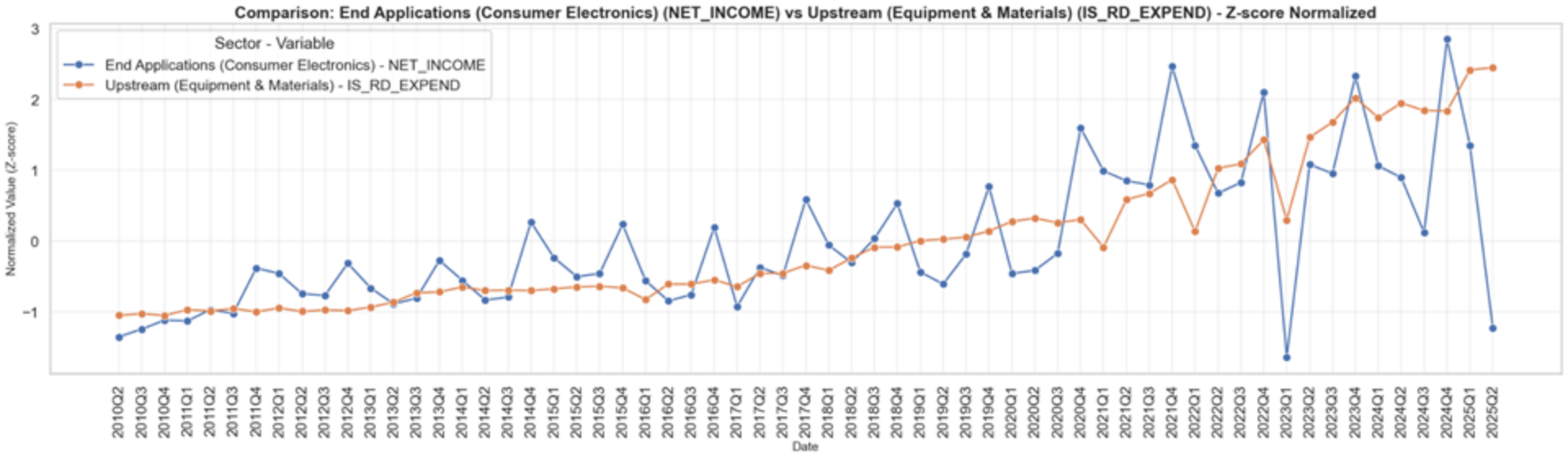
- Both **automotive** and **semiconductor revenue** show **strong correlated movements**.
  - Granger causality indicates automotive revenue leads semiconductors revenue
    - **Lag -1 → p-value** = 0.0004
    - Suggests semiconductor demand typically follows automotive revenue/production trends by **~1 quarters**



Consumer electronics expansion stimulates innovation

Consumer Electronics Net Income → Semiconductor Upstream (Equipment & Materials) R&D Expenditure

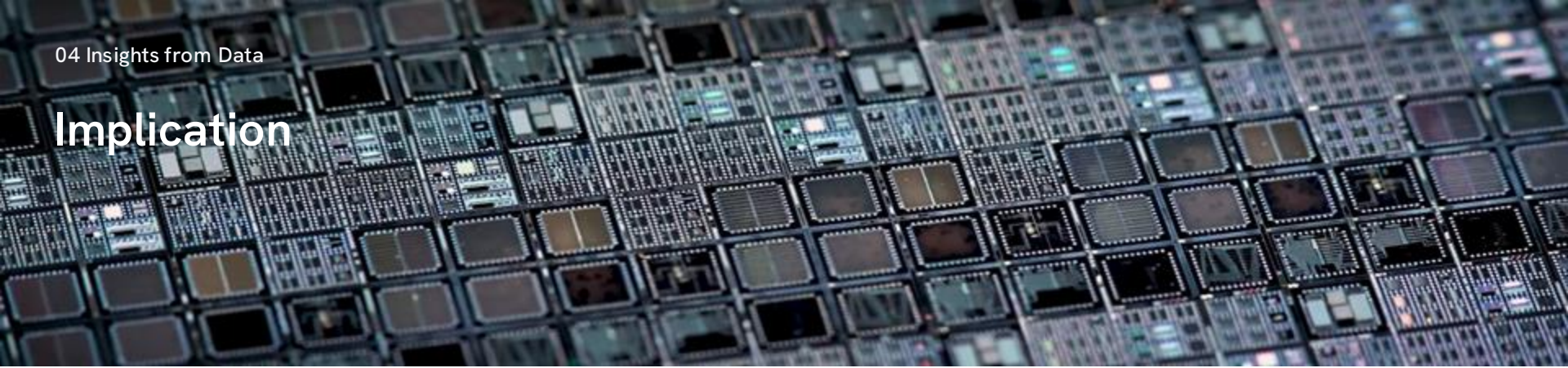
- Significant Granger causality ($p < 0.05$ at lag 3–4) : consumer electronics income growth precedes upstream R&D expansion by **~3–4 quarters**. (Innovation investment responds to profitability cycles in downstream consumer markets.)



Summary

Semiconductor Demand and Sectoral Feedback Loops

Causal Direction	Lag / p-value	Interpretation
Consumer Electronics (Revenue) → Semiconductors (Revenue)	lag 4 (p=0.0004)	Consumer electronics revenue drives semiconductor demand
Automotive (Revenue) → Semiconductors (Revenue)	lag 1 (p=0.0001)	Demand feedback from automotive production
Consumer Electronics (Net income) → Semiconductors (R&D)	lag 3 (p=0.02)	Consumer electronics growth leads semiconductor innovation



Implication

Semiconductors as the “Digital-Era Oil”

Understanding semiconductor dynamics helps us anticipate future technological and economic transitions.

- **Downstream demand** drives semiconductor growth, with consumer and tech sectors leading innovation cycles. (demand-pull cycle of innovation)
- As industries evolve, semiconductors remain **the core catalyst of digital transformation and economic progress**.
- Semiconductors act as the “Digital-Era Oil”, powering productivity and technological progress.

Thank you

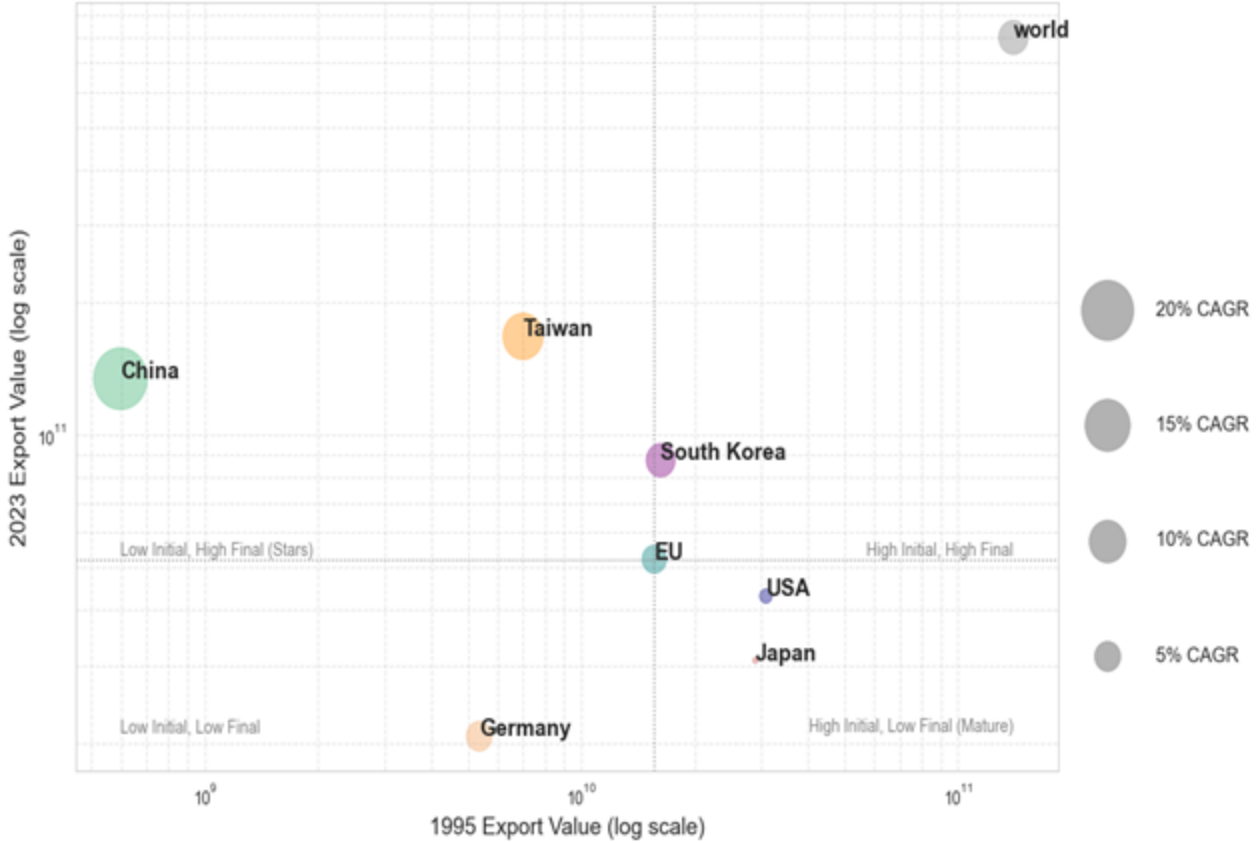
Appendix

Summary of Correlations and Causality Tests

Sector	Factor	Lag	Direction	P-value
Automotives	Revenue	lag = -1	**Automotive → Semiconductors**	p = 0.0001 (**significant**)
	R&D	lag = 4	**Semiconductors → Automotive**	p = 0.03 (**significant**)
EVs	Revenue	lag = 0	no significant causality	p > 0.05 (not significant)
	R&D	lag = 1	**EVs → Semiconductors**	p = 0.02 (**significant**)
Consumer Electronics	Revenue	lag = -4	**Consumer Electronics → Semiconductors**	p = 0.0004 (**significant**)
	R&D	lag = 0	no significant causality	p > 0.05 (not significant)
	Net Income → R&D	lag = 3 – 4	**Consumer Electronics (Net Income) → Upstream R&D**	p ≈ 0.01 (**significant**)
AI/Software/Cloud	Revenue	lag = 0	no significant causality	p > 0.05 (not significant)
	R&D	lag = 1	**AI/Software/Cloud → Semiconductors**	p = 0.04 (slightly significant)

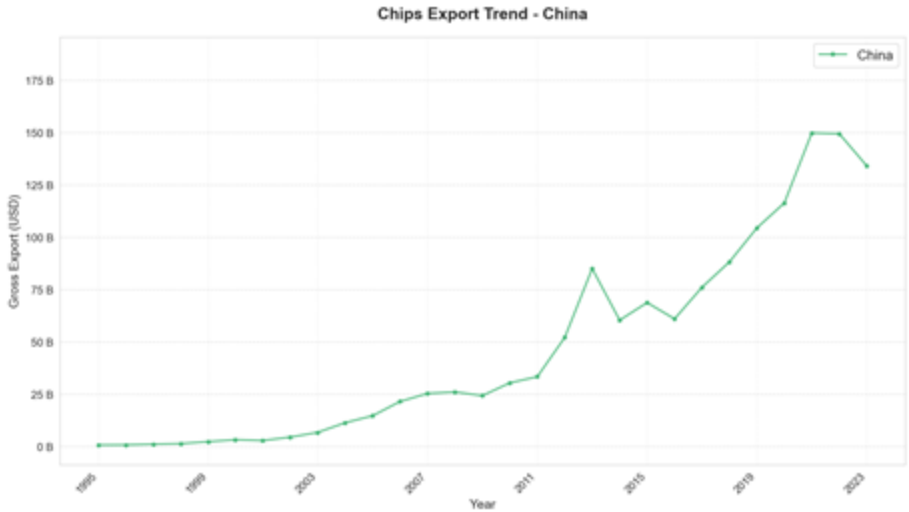
Chips Export Value with CAGR % (1995-2023)

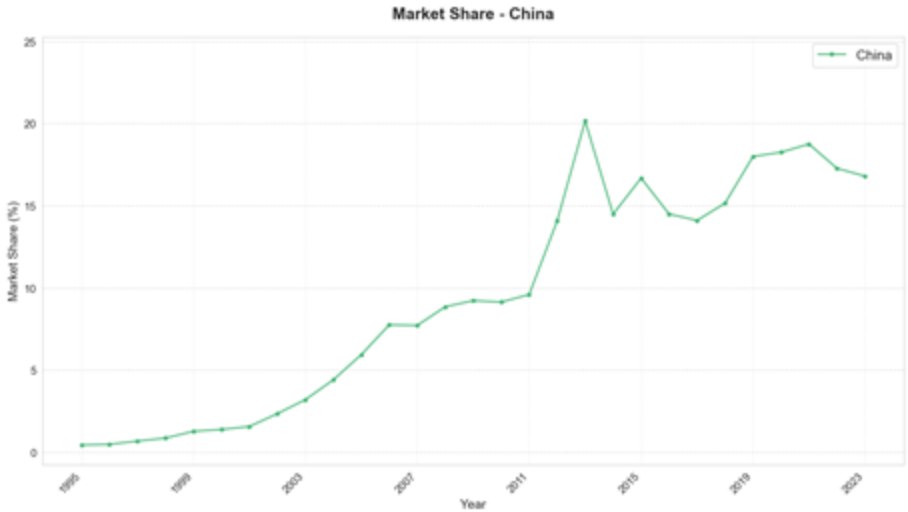
- Log-log scale chart
- Four Quadrants
  - High Initial, Low Final (Mature)
  - Low Initial, High Final (Stars)
  - Low Initial, Low Final
  - High Initial, High Final



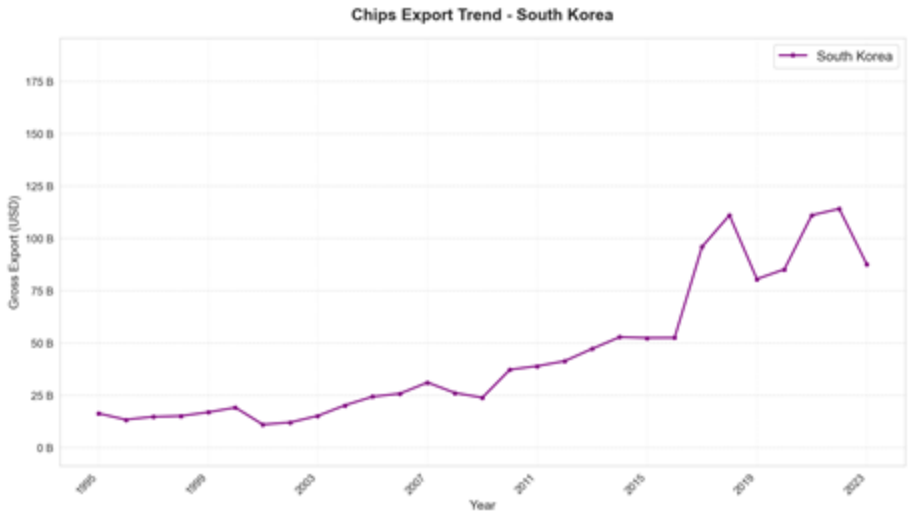
Chips Exported Value & Market Share - Taiwan

Chips Exported Value & Market Share - China

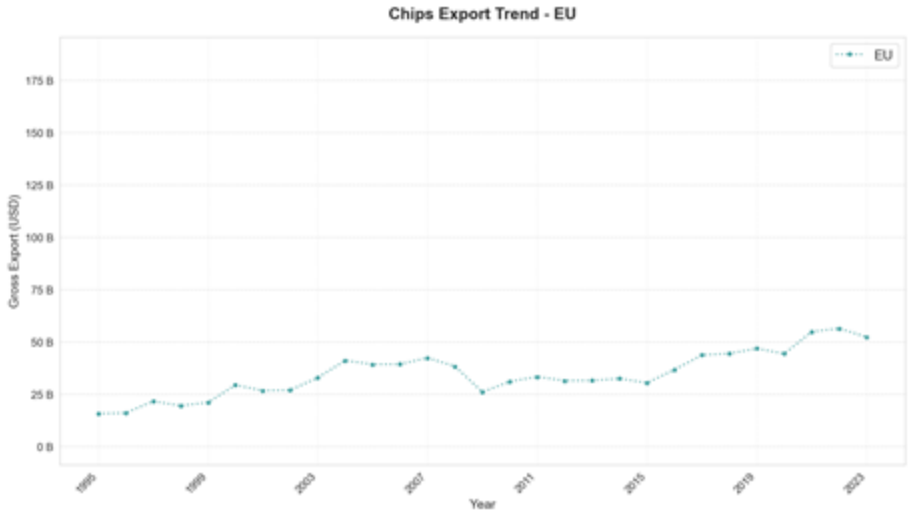




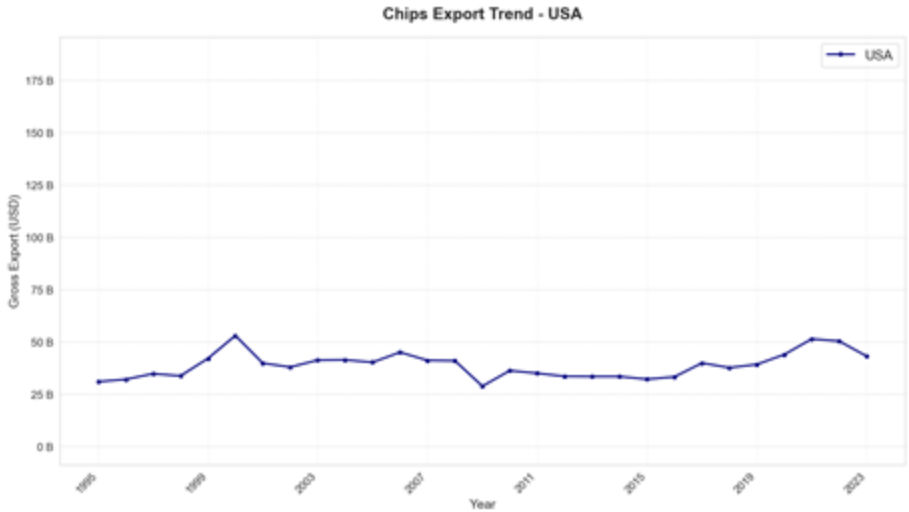
Chips Exported Value & Market Share - South Korea



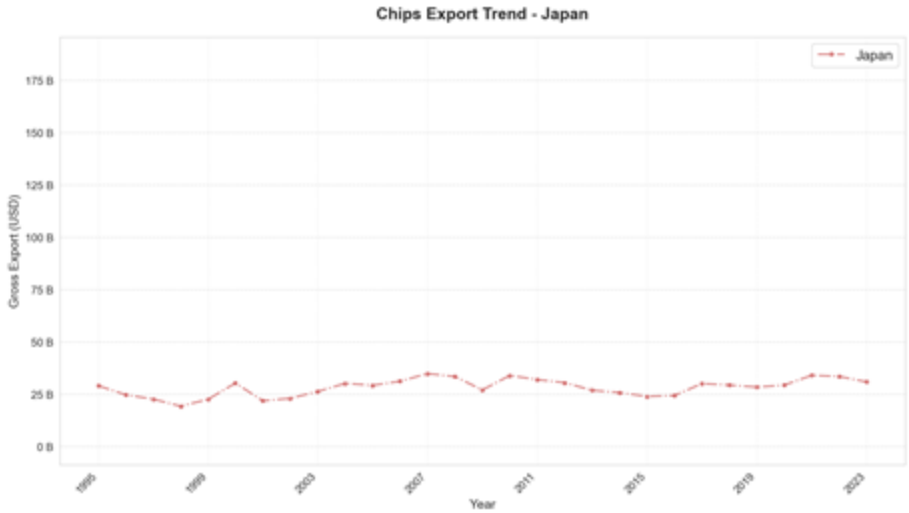
Chips Exported Value & Market Share - EU



Chips Exported Value & Market Share - USA



Chips Exported Value & Market Share - Japan



Chips Exported Value & Market Share - Germany