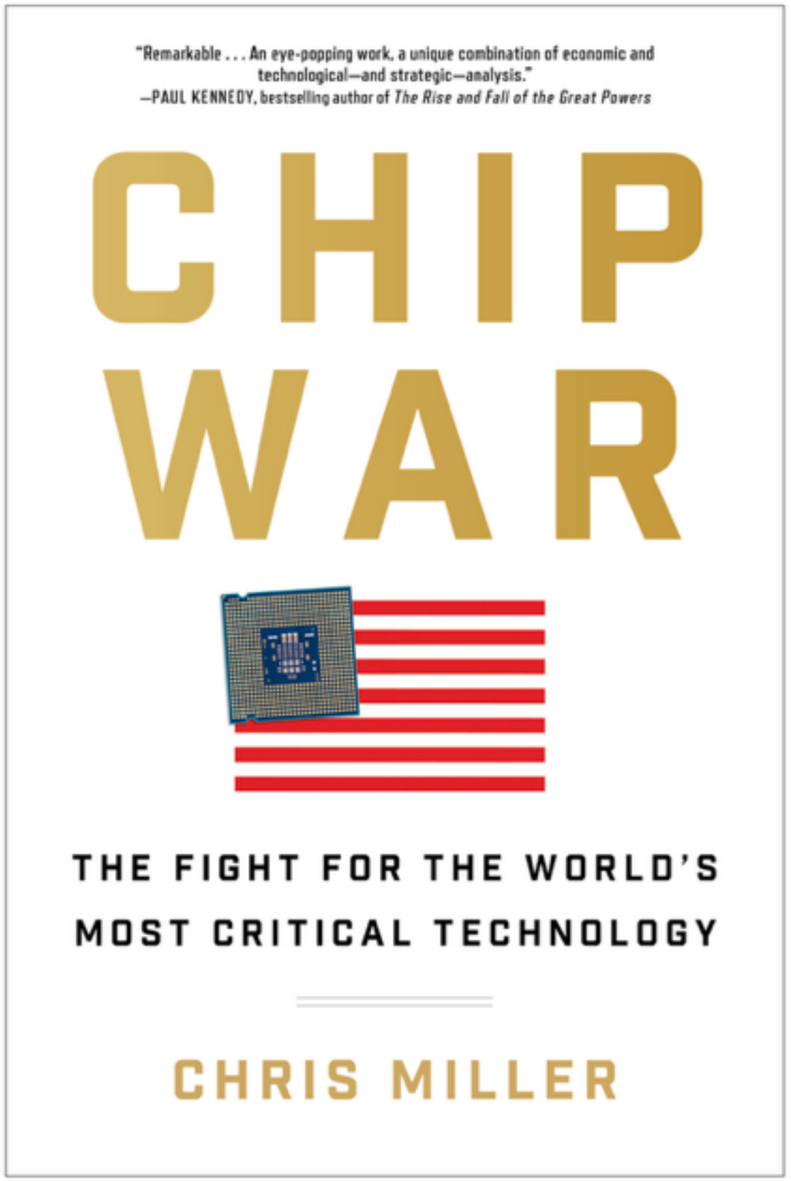


Bob & Torben
Sept. 5, 2024

What are we going to talk about?

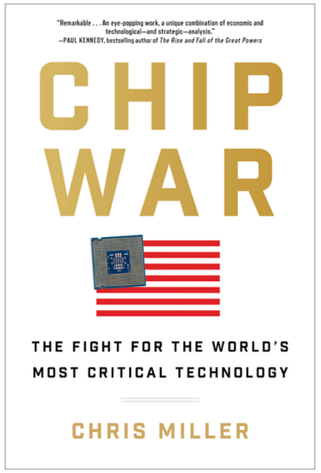
1. The background for "the problem”

   - The nine steps from design to your pocket

2. What IS “the problem?”

3. The Barriers of Technology & Investment

4. What is China’s position?



The scenario:
In the age of AI, it's often said that *data is the new oil*.

Enough *data* is not the problem - it's *processing* power that is the limitation
There's only so many semiconductors that can store and process data.
Producing them is mind-bogglingly complex and horrendously expensive

Unlike oil, which can be bought from many countries, production of computing power is limited and involves a series of **choke points**:
- tools
- chemicals
- software

that often are produced by only a handful of companies in a handful of countries—and sometimes only by one

U.S. defense depends on foreign sources
for state-of-the-art semiconductors

Semiconductors are the key to leadership in **electronics**

Electronics is the technology that can be leveraged most highly.

Therefore . . .
U.S. military forces depend heavily on
technological superiority to win

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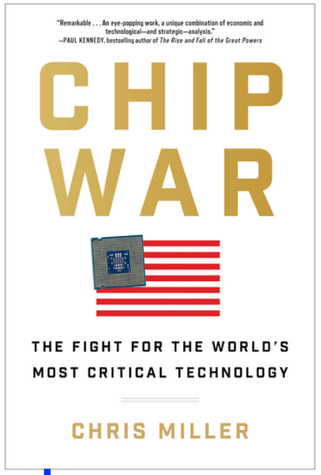

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The nine steps from design to your pocket

1. Software
   - the *software* used for the blueprints for designing chips come from the **United State and Israel**
2. Blueprints
   - the blueprints are made by a **Japanese-owned, UK-based company**
3. Design
   - the chips are designed by engineers in **California and Israel**
4. Design shipment
   - when a design is complete, it's sent to a **facility in Taiwan**

The nine steps from design to your pocket

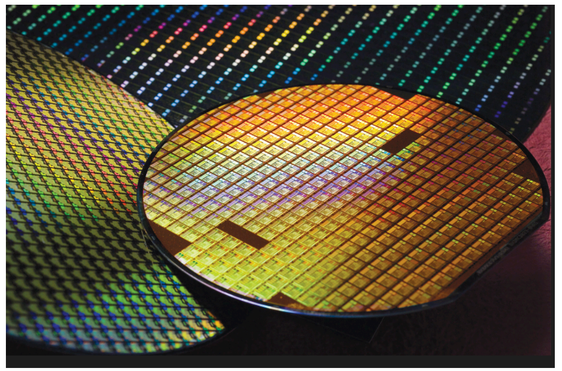
5. Wafer production

- Taiwanese company buys (a) ultra-pure silicon wafers and (b) specialized gases **from Japan**

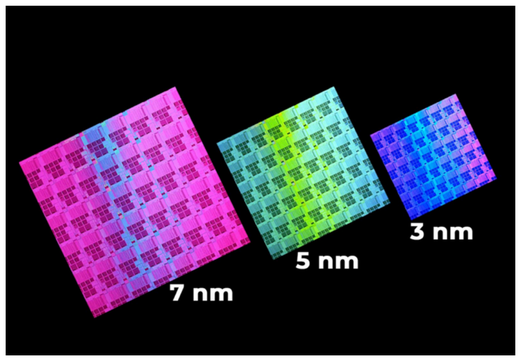
6. Wafer carving

- The design is carved into silicon using some of the world's most precise machinery, which are produced primarily by only five companies, **one Dutch, one Japanese, and three Californian**

Note: The difference between wafers and chips lies in the relationship between both components.
While the wafer serves as **a base** for the chip, the chip is **implanted/etched** in the wafer.



Silicone wafer



TSMC 3 mm chip - $20,000

The nine steps from design to your pocket

7. Testing & Packaging

-Then the chip is packaged and tested, often in **Southeast Asia**,

8. Assembly

- and then sent to **China** for assembly into a phone or computer

9. Shipping to customer

- that ends up in your hands **in USA**

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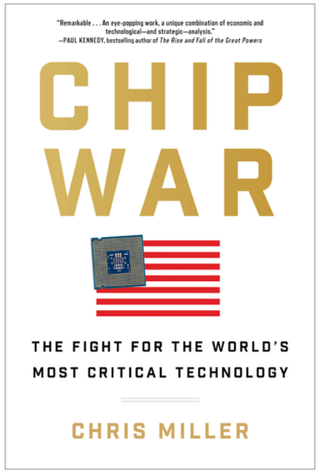

The nine steps from design to your pocket

The problem is:

If any 1 of these 9 steps in the production of chips is interrupted, the world's supply of new computing power is imperiled.

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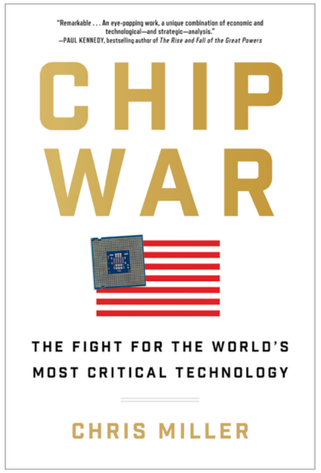

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Manufacturing Technology

By the early 2010s, the most advanced microprocessors had a billion transistors on each chip

To make such chips, lithography companies use **deep ultraviolet light** with wavelengths of 248 or 193 nm. The smaller the wavelength, the smaller the features can be carved onto chips

Intel spent billions of dollars on R&D and billions more on learning how to use **“extreme ultraviolet” (EUV) light** with a wavelength of 13.5 nanometers, to carve chips

Manufacturing Technology

The **software** capable of laying out these transistors was provided by three American firms, Cadence, Synopsys, and Mentor (controlling 75% of the market).

It was impossible to design a chip without using at least one of these firms' software.

###

Another problem with **EUV is that it is difficult to reflect**. The 13.5nm wavelength of EUV is close to X-rays and many materials *absorb* EUV. Zeiss began developing mirrors made of 100 alternating layers of molybdenum and silicon, each layer a couple nanometers thick.

That required highly sophisticated **machines . . .**

Advanced chips possess 3D transistors about a few nanometers across (~ coronavirus)

The most advanced lithography machines are made by ASML in the Netherlands. It took **three decades**; each machine costs well over **$100MM.**

It is built from **457,000 parts** requiring perfect identification and assembling.
A single defect could cause debilitating delays or reliability problems."

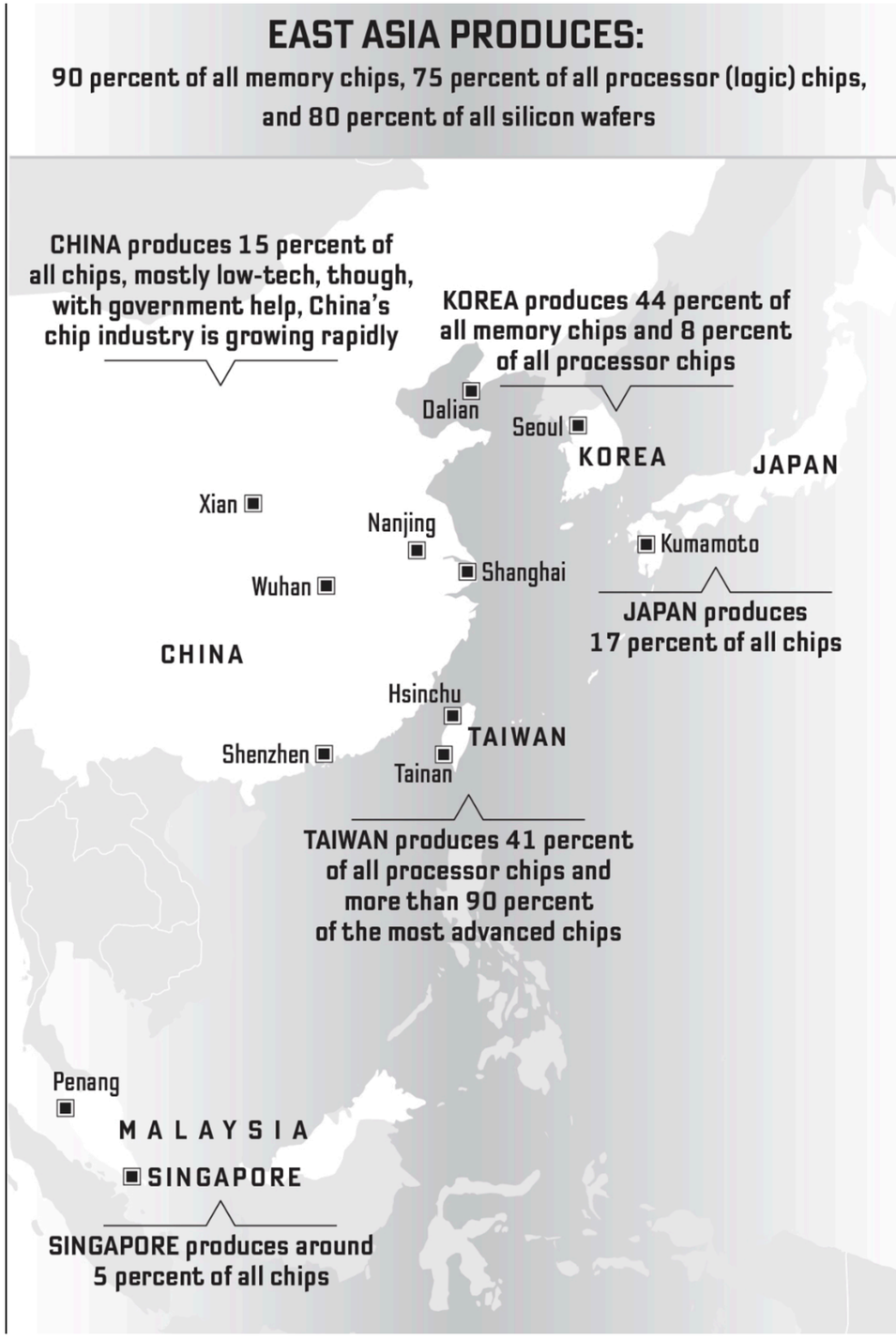
Manufacturing Technology

At the end of 2010, **only two companies in the world** could manufacture the most cutting-edge processors, TSMC and Samsung

As far as the United States was concerned . . .
both were problematic for the same reason:

Their location! Taiwan!

Now the entire world's production of advanced processors was taking place in Taiwan and - to a small extent - S. Korea.



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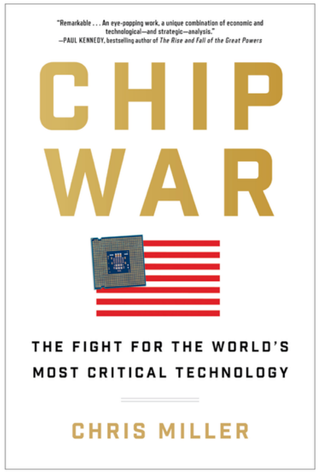

What China/Xi Jinping *says*

Chinese Communist Party, in 2014: “Without cybersecurity there is no national security, and ”without informatization, there is no modernization.”

2016: “However great its size, however high its market capitalization, if an internet enterprise critically relies on the outside world for core components, the ‘vital gate’ of the supply chain is grasped in the hands of others.”

Davos, 2017: “We must focus on gaining breakthroughs in core technology - meaning semiconductors - as quickly as possible.”
And: “No one will emerge as a winner in a trade war.”

Note: When it comes to core intellectual property, China’s market share is 2%!

What China/Xi Jinping *does*

- they poured $75 Bn into their semiconductor companies (WSJ estimate) incl. subsidized land, state-backed credit, and tax deductions AND also pressured private banks to lend

- tried to lure home their scientists and engineers who had been trained at U.S. universities and worked in Silicon Valley
  Note: 29% of the world's leading researchers in artificial intelligence are from/in China, as opposed to 20% from the U.S. and 18% from Europe [Marco Polo Thinktank]

- forged partnerships with foreign firms but required them to transfer technology or train local workers.

In summary:

Semiconductors “define the world we live in by determining

- the shape of international politics
- the structure of the world economy, and
- the balance of military power. ”

Thank You!