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Supply chain challenges: From just-in-time to just-in-case

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Introduction

Rather than tie up capital in stockpiles of extra goods in warehouses, a just-in-time supply chain is designed to move material right before it is needed in the manufacturing process. Today, this system is proving to be a double-edged sword. Its ability to wring out significant cost savings is often coming at the expense of not being sufficiently resilient to deal with events such as the COVID-19 pandemic and geopolitical tensions.

This is forcing companies and countries to prioritize security of supply and resilience over efficiency.

Just-in-time encourages specialization among ever fewer companies

One of the main characteristics of this system is that it tends to eventually narrow the production of key components to a small group of the most efficient suppliers. While this has created significant gains in productivity, if any of these companies were to experiences major production-related challenges, it could be very difficult to find alternative sources of supply. Two examples of specialized sectors with a relatively small number of suppliers come to mind.

- **Semiconductors:** The number of companies able to manufacture leading-edge chips has plunged from over 25 in 2000 to only three today: Taiwan's Semiconductor Manufacturing Company (TSMC), Samsung of South Korea, and U.S.-based Intel. TSMC alone accounts for about one-fifth of all the world's chip manufacturing and for half the production of the most advanced chips on the market today.[1]
- **Electric vehicle batteries:** Four companies—LG, Samsung SDI, Panasonic, and CATL-- dominate the production of car batteries.[2]

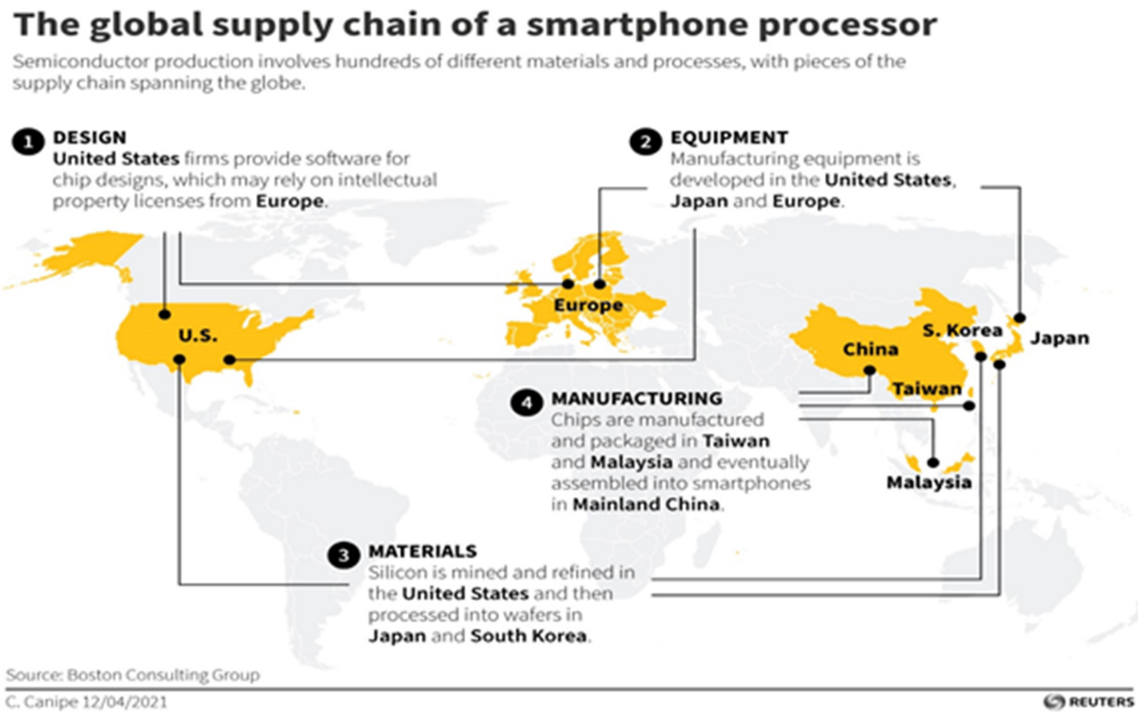
Efforts to re-shore production of semiconductors

The current shortage of semiconductors has intensified the efforts of major countries to boost their domestic production capacity.

While the United States and Europe still have a significant presence in the chip-manufacturing software and equipment sectors, they have lost considerable ground in the actual manufacturing of these chips. From 1990 to 2020, America's share of global semiconductor manufacturing capacity fell from 37% to just 12%, while Europe's went 44% to only 9%.[3]

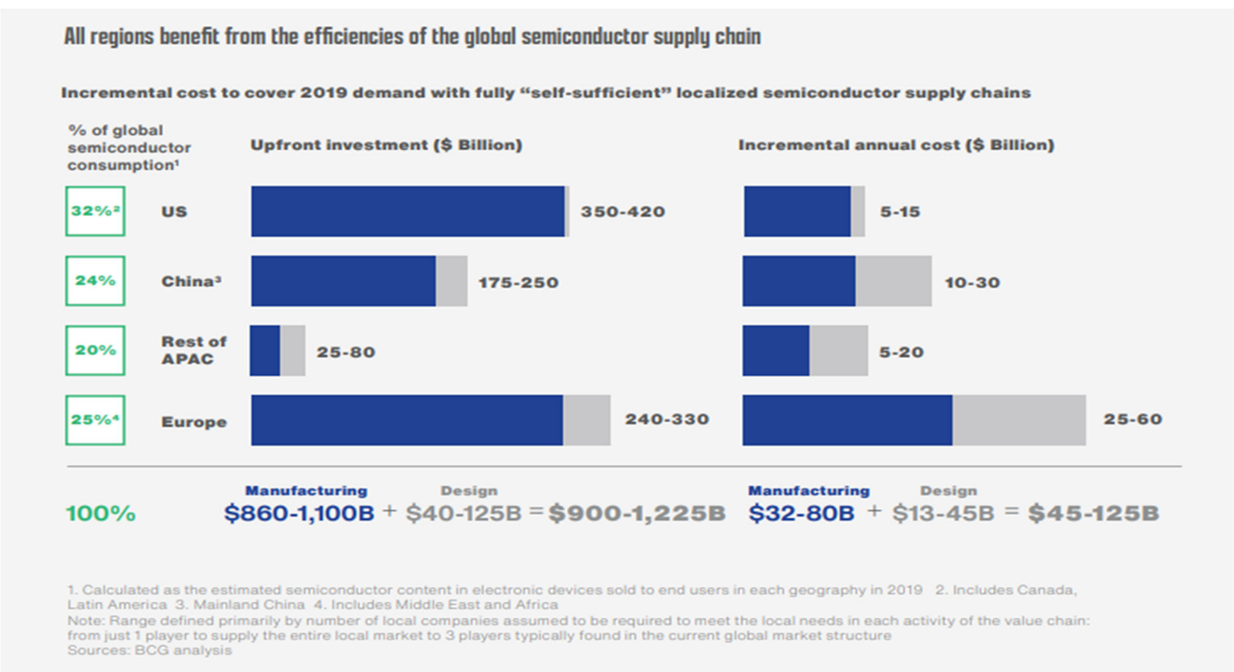
Reshaping these complex supply chains will not be easy, however. Producing a single computer chip can involve more than 1,000 steps and 70 separate border crossings.[4]

[1] "Chipmaking is being redesigned. Effects will be far-reaching," The Economist, January 23, 2021
[2] "Battery recalls and supply crunch challenge electric vehicle revolution," Financial Times, September 7, 2021
[3] "In charts: Asia's manufacturing dominance," Financial Times, March 24, 2021
[4] "Biden's chip dreams face reality check of supply chain complexity," Reuters, April 13, 2021



Source: "Biden's chip dreams face reality check of supply chain complexity," Reuters, April 13, 2021

If all of the four regions cited in the chart below wanted to develop self-sufficient domestic semiconductor supply chains, it would require an estimated upfront investment of $900 billion to $1.2 trillion.[5] This would require becoming autonomous in the areas of raw material production, wafer fabrication assembly, packaging, and testing. Tens of billions of dollars would also be needed annually to maintain and upgrade this infrastructure. **While it is highly unlikely that any of these region would be willing or able to become fully self-sufficient, this price tag illustrates the high cost involved in reshoring even only parts of the supply chain.**



Source: "Strengthening the global semiconductor supply chain in an uncertain era," Boston Consulting Group & Semiconductor Industry Association, April 2021

[5] "Strengthening the global semiconductor supply chain in an uncertain era," Boston Consulting Group & Semiconductor Industry Association, April 2021

It is also estimated that building and operating a semiconductor fabrication facility would cost about one-third more in the United States over 10 years than it would in Taiwan, South Korea, or Singapore. In China, such a facility is 37% to 50% less expensive to build.[6] It is safe to assume that building and operating a semiconductor factory in Europe would be even more expensive than in America on account of higher energy costs, among other things.

One major factor behind these cost differentials is the level of government support provided.

State aid will be crucial in trying to recreate these supply chains

China, which is trying to acquire the ability to develop advanced chips, has long provided significant financial aid to its companies. The OECD estimated that, from 2014 to 2018, government funds accounted for over 30% of the annual revenue of China's two major semiconductor companies: Semiconductor Manufacturing International and Tsinghua Unigroup.[7] China is on track to spending as much as $200 billion to subsidize semiconductor companies over the period of 2000 to 2025.

Other Asian countries, too, provide significant financial support to semiconductor companies. Taiwan pays for almost half of the cost of land and construction, while Singapore foots 25% of the total bill.[8]

Subsidies: If you can't beat them, join them

In a stark reversal, Western countries have gone from trying to stop countries such as China from providing significant levels of aid to their companies to ramping up their own levels of financial support.

Last June, the U.S. Senate passed—with strong bipartisan support—legislation that would commit roughly $250 billon in financial support to key areas, including $52 billion for the semiconductor sector. The bill will likely pass easily once it reaches the House of Representatives before being signed into law by the President.

As for the EU, it plans to spend $175 billion on financing chip investments to try and increase its share of worldwide chip manufacturing from 9% today to 20% by 2030.[9]

The semiconductor shortage made worse by geopolitics

The current shortage of chips is not only the result of a surge in demand for computers, cars, and other electronic goods, it is also due to geopolitical tensions between the United States and China.

- Before the full force of U.S. trade restrictions went into effect last year, Chinese companies like Huawei and ZTE rushed to build up huge stockpiles of chips. Fearful of shortages, their Western counterparts also began to increase purchases. It has been reported that Huawei will by sometime next year run out of the advanced semiconductors it stockpiled, which could put further pressure on global supplies.[10]
- When Semiconductor Manufacturing International Corporation, China's main chip producer, was barred from buying U.S. technology, many of its customers switched to other companies. The problem is that many of these companies were already running at near full capacity.

The just-in-time system does not work well in a low-trust environment. For example, even though most executives in this sector realize that widespread stockpiling leaves everybody worse off, they will nonetheless continue to build up reserves for fear that competitors are doing the same.

Expanding capacity will require time and money. It can take up to two years to build and equip a semiconductor fabrication plant.[11] TSMC recently built a plant capable of manufacturing 3-nanometre semiconductors, its most advanced chip, at a cost of $19.5 billion.

[6] "In charts: Asia's manufacturing dominance," Financial Times, March 24, 2021
[7] "Industrial Policy' Is Back: The West Dusts Off Old Idea to Counter China," Wall Street Journal, July 29, 2021
[8] "Countries lavish subsidies and perks on semiconductor manufacturers as a global chip war heats up," Washington Post, June 14, 2021
[9] "Countries lavish subsidies and perks on semiconductor manufacturers as a global chip war heats up," Washington Post, June 14, 2021
[10] "Huawei's Decline Shows Why China Will Struggle to Dominate," Bloomberg, September 19, 2021
[11] "Why the Chip Shortage Is So Hard to Overcome," Wall Street Journal, April 19, 2021

The Colonial gas pipeline shutdown is a casebook example of how a low-trust environment creates hoarding

On May 7, the Colonial Pipeline, which supplies half the gas and diesel for the U.S. east coast, was hit by a cyberattack and forced to shut down for five days. At the time operations ceased, Colonial had 26 to 27 days' worth of gasoline available in the network under normal demand conditions. However, people immediately began to hoard gasoline supplies and within days widespread shortages developed.[12]

Conclusion

As the following bullet points highlight, the shift in focus from efficiency to security of supply and resiliency means higher structural costs throughout the global supply chain.

- While reshoring certain supply chains for products deemed strategic, such as semiconductors, will eventually help improve security of supply, producing components in a multitude of locations will reduce economies of scale and significantly add to costs.
- Global companies are shifting away from the practice of keeping very limited levels of key components to building up significant stockpiles. Even Toyota, the creator of just-in-time supply management, is now attempting to build a four-month stockpile of certain parts.
- In a reversal of a decades-long trend, many companies will expand their ability to produce items in-house, instead of relying on third parties to build them. For instance, Volkswagen is planning to build six battery factories with a partner in Europe by 2030 in order to ensure access to sufficient supply.[13]
- More companies will attempt to lock in access to commodities rather than buy them from open markets in just-in-time fashion. Tesla is a case in point. Last year, it signed a deal that would give it guaranteed access to lithium from a mine under development in North Carolina, and it is looking to do the same for nickel.[14]
- China currently controls about 60% of the world's production of rare earth minerals and nearly 90% of the refining capacity.[15] If the United States and other Western countries fail to develop alternative supply chains for these minerals on a wide enough scale, they risk going from being energy independent in most fossil fuels to relying on inputs from China as they transition to green energy. However, the trade-off for greater security of supply is that any production brought online in the West will have higher operating costs compared with imports from countries with lower environmental standards and wages.
- Like other manufacturing operations, pharmaceutical and healthcare equipment plants have moved in large numbers from the West to countries such as China and India to take advantage of lower labour, construction, and regulatory costs. But persistent shortages during the pandemic is now pushing these very same countries to reverse course and focus on building up their domestic capacity to produce medical supplies. While this will help ensure supply in times of crisis, smaller supply chains focused on domestic markets equals higher costs.
- While most companies will maintain a presence in China, they will expand operations elsewhere, to avoid the risk of having production concentrated in one region.

Bottomline: Are the factors listed above yet another sign that the cycle of low inflation that has been in place for the last 20 years is coming to an end?

[12] "The great American gas shortage that isn't actually a gas shortage," The Globe and Mail, May 13, 2021
[13] "Volkswagen plans six battery factories to ramp up electrics," Associated Press, March 15, 2021
[14] "Tesla is trying to mine its own lithium," Fortune, September 28, 2020
[15] "The Role of Critical Minerals in Clean Energy Transitions," International Energy Agency, May 2021

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