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Pioneering a microchip renaissance: *Even with the newly introduced Chips Act, the EU is still likely to fall behind other continents in its race for R&D and production. What further steps can the EU take to decrease its dependency on third countries for microchip and semiconductor production?*

by Zdeno Sekerák (CZ/SK)

INTRODUCTION

Microchips - the tiny pieces of silicon and metal, are what the whole world runs on. Even while reading these words, you are very likely on some kind of an electronic device, or you have used one to get access to this text.

From the consumer standpoint, it seems simple. However, the majority of manufacturing and production of these chips takes place in countries **outside of the EU**, significantly limiting the continent's control over these critical technologies. Furthermore, production is dominated by a handful of foreign companies, with the top 10 companies holding nearly 60% of the market share. This trend of consolidation is expected to grow even further in the upcoming years. Considering that this metric takes into account the entirety of the supply chain, some parts of it are even more consolidated with a handful of companies dominating the respective field.

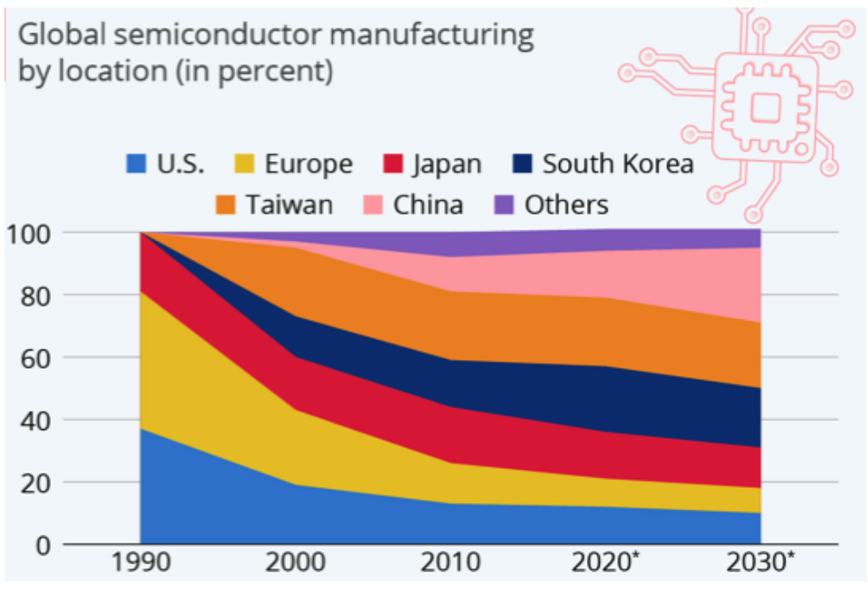

Figure 1 : *Global semiconductor manufacturing by location, Statista*

Currently, Europe does not possess the ability to manufacture advanced microchips, primarily because there is a lack of industry for it. However, the issue is more complex than that, requiring a more thorough examination. There are several underlying causes for this, for example, a lack of demand for these advanced microchips or insufficient attention towards the semiconductor industry during a time of crisis. Despite all this, the EU is still a key player in the global supply chain[1], primarily due to ASML - the only company capable of producing cutting-edge **machines used to manufacture chips** - being based in the EU. With Europe falling behind the world on several fronts, including semiconductor and chip manufacturing, what can it do to secure its position on the global scene and ensure a stable supply for its industry?

KEY TERMS

- **Fab** - Short for semiconductor fabrication facility, a building where microchips are manufactured.
- **Fabless company** - A company which specialises in the design of microchips but outsources the production to other companies (such as NVIDIA or Qualcomm).

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[1] A **global supply chain** is a network of suppliers, manufacturers, distributors, and customers that operate in multiple countries

- **Foundry Model** - A business arrangement where a fabless company outsources production to a manufacturing company (like TSMC). A company which manufactures microchips for others is called a foundry company.
- **Moore's law** - Formulated by Gordon Moore, states that the number of transistors on a microchip doubles approximately every two years. However, considering the rate of innovation in the industry, we are expected to approach the physical limits of semiconductor manufacturing sometime during the 2020s.
- **IC** - An Integrated Circuit is a compact chip made up of miniaturised electronic components and their interconnections, fabricated on a semiconductor material.

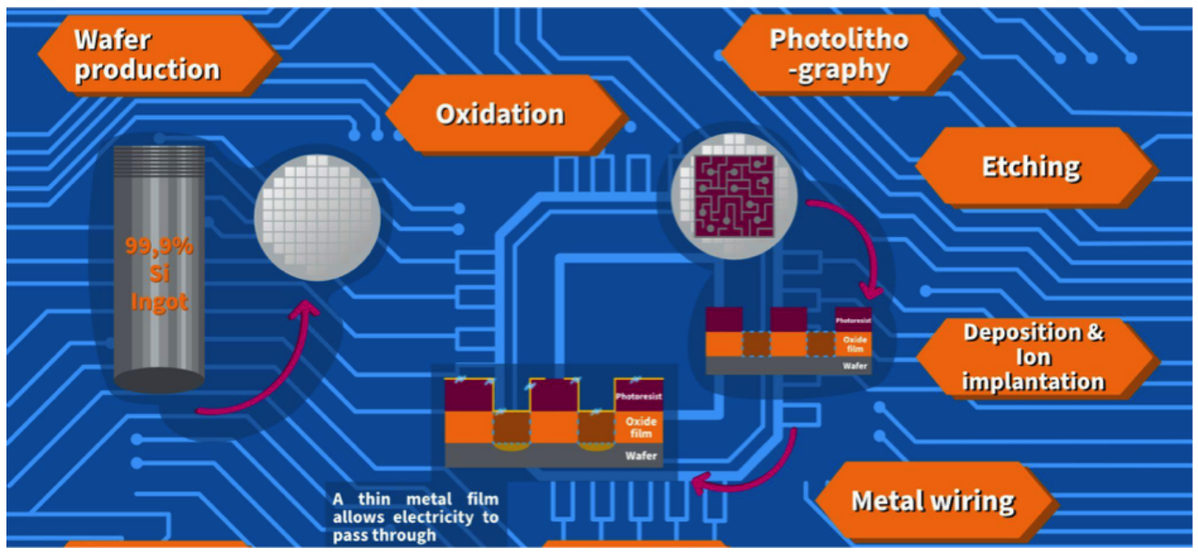

Figure 2: *Semiconductor manufacturing explained, Stefan Peters (DE), Editor*

WHY IS THIS IMPORTANT?

Microchips are devices which our modern world runs on playing a crucial role in European industry. However, Europe has very **little control** over how and where they are manufactured, relying heavily on **foreign** manufacturers for supply. While this dependency is manageable under stable conditions when the supply chain is established and functional, during turbulent times, such as the COVID-19 pandemic, this may cause industries dependent on chip production significant **issues**. For instance, the global chip shortage cost European auto manufacturers €100 billion (which is about **34%** of the nominal GDP of the Czech Republic in 2023). Apart from these direct costs, it is expected that the lack of high-tech microchip manufacturing capabilities will further discourage high-tech companies and innovation in the EU. This could even affect traditional industries such as the automotive industry, which could fall behind in areas like autonomous driving and cloud connectivity. On a broader scale, since approximately a quarter of EU GDP growth and 40% of productivity growth can be attributed to ICT (information and communication technology), attracting investment and stakeholders by prioritising this industry's stability is incredibly important for the continent and its future development.

STAKEHOLDERS AND MEASURES IN PLACE

The European Commission passed the European Chips Act in 2023 and will allocate **€43 billion** of public funds, with an additional **€15 billion** of private funds to bolster Europe's competitiveness and resilience in semiconductor technologies and applications while keeping in mind the digital and green transition. This investment is mainly aimed at adding a **degree of resilience** to the supply chain by setting up fabs on European soil and investing in R&D facilities.

The **Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)** is the department within the Commission that is dedicated to fostering an open, uninterrupted, and robust Single Market, where borders are open and goods and services can flow freely. It is the department shaping the EU's industrial strategy from the technical point of view. Furthermore, DG GROW works closely with the European Chips Act to ensure an in-depth understanding of the global semiconductor market, whilst addressing the skills shortage in the industry.

The US Government passed the Chips and Science Act in 2022 which allocated **$52.7 billion** towards R&D in the field of microchips and onshoring[2] of manufacturing. The long-term strategy of the US government is to strengthen its position **against China**, which is trying to catch up with the West and secure control over the supply chain by **onshoring manufacturing microchips**.

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[2] **Onshoring** is the process of sourcing or relocating a business' production operations within domestic national borders

ASML and **Zeiss** are two companies **based in the EU** which are years ahead of their competition in their field of operation and are indispensable for the microchip supply chain. **ASML** makes **photolithography machines** and **Zeiss** specialises in the **optics** for these machines (lithography optics and photomasks). These machines are then bought by other companies to manufacture microchips.

Intel is the **largest** company in microchips by market capitalisation[3], which possesses cutting-edge technologies in chip design and manufacturing. Intel is based in the US and is planning to be the second-largest manufacturer of microchips by 2030.

TSMC is the largest semiconductor manufacturing company by market share (with 54%) and is headquartered in **Taiwan**. Although TSMC does not play a large role in microchip design, it is one of two companies, which are able to **manufacture cutting-edge** microchips.

KEY CHALLENGES

The focus of the European Chips Act

The funding from the **European Chips Act** is mainly used to **build fabs**, allocating an estimated €43 billion from **public** and **private** funds towards the matter, despite the advantage the EU has due to companies such as ASML and Zeiss. Some argue it would be better to focus on the part of the industry the EU has already developed and use it to foster **cooperation** with its partners, mainly the US.

Another problem with the focus of the European Chips Act is that the industries and, therefore, microchip **requirements** of the US and EU are **different**. While the US has **tech giants** such as Apple, Microsoft, Amazon or Google, which utilise the most advanced microchips, the European industry is mostly based on the industrial sector which can use less advanced microchips. This goes in a different direction to the European Chips Act which focuses on cutting-edge microchips.

Lack of chip manufacturing companies headquartered in Europe

Chip manufacturing giants such as Intel, TSMC, Samsung, AMD, NVIDIA or Qualcomm, which possess the required technologies for cutting-edge microchip manufacturing are typically not headquartered in the EU. This leaves Europe **reliant on foreign** companies to set up fabs in the EU. There are several reasons why Europe has missed the digitalisation train.

The primary concern is the EU's historic emphasis on industry, rather than the digital world and high-tech innovations needed for its growth. Furthermore, Europe continues to **lag in research and development** (R&D), considering that the US spends more on R&D than their European counterparts, namely 3.46% of their GDP in 2021 compared to the European average of 2.23 % in 2022. Another factor could be the lower rate of venture capital[4] funding in Europe, making the US a more favourable destination for founding companies. Lastly, Europe's focus on other strategic areas might slow progress in the semiconductor industry. Recently, the EU's focus has been on sustainability and the quality of life, showing great results. However, a lack of attention to, for example, the technological industry, could result in the EU lagging behind some countries like China or the USA for example the automotive industry.

Consolidation of know-how

The microchip manufacturing supply chain is very complex, dominated by a **handful of companies** **significantly ahead** of others in their fields which gives competitors a hard time to establish. These companies, which are from all around the world, are, with some exceptions, **irreplaceable** in their area of expertise. Catching up would require considerable investment and many skilled and educated individuals. For example, China has been heavily

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[3] **Market capitalisation**, often referred to as market cap, is the total value of a publicly traded company's shares.
[4] **Venture capital** is a form of private investment that provides funding to early-stage, high-potential startups or companies with promising growth prospects.

investing in semiconductor manufacturing to catch up with the US, without much success.

Global supply chain

Although the industry has benefited from **geographical specialisation**, it has also exposed vulnerabilities that each region must evaluate based on its unique economic and security considerations. There are **over 50 points** within the supply chain where a single region dominates with more than **65% of the global market share**. If one of these choke points were to fail, it would disrupt the entire supply chain. It also suggests how far the market has gone in terms of specialisation and how hard it is for competition to establish itself. For example, chips with nodes under 10 nm, used in phones, computer parts and similar devices, are almost exclusively, namely 92% of the time, manufactured in Taiwan. This could be a big problem considering the uncertain political situation of the island nation and its neighbour, China. Any disruption to this vulnerable supply chain could lead to significant economic consequences on a global scale.

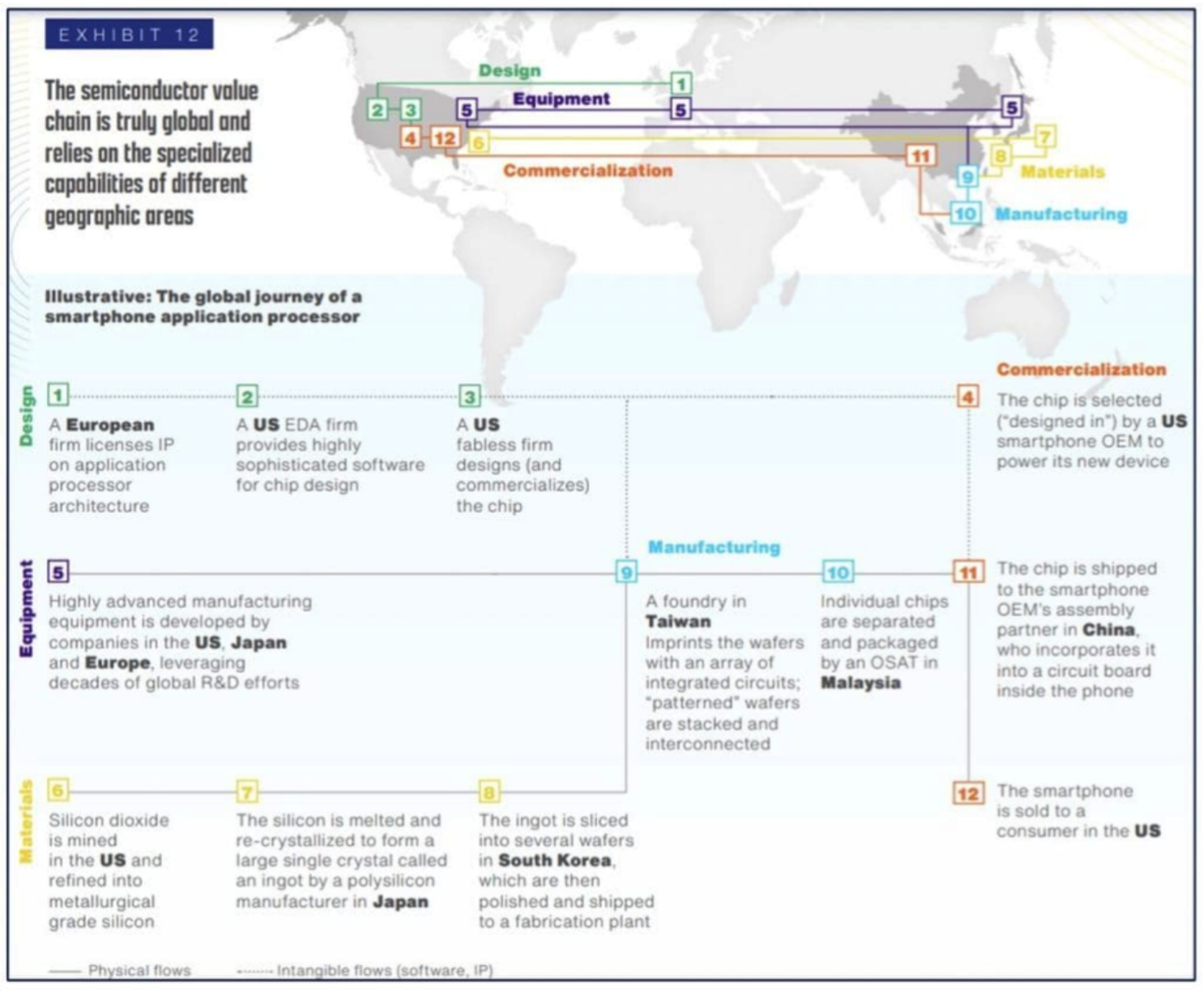

Figure 3: *The semiconductor supply chain, Varas et al.*

STATISTICS

1. Europe only produced 10% of the global microchip supply in 2022 while consuming 20%.
2. The EU plans to invest €43 billion into strengthening its supply chain via the European Chips Act aiming to boost its manufacturing market share from 9% in 2022 to 20% in 2030.
3. Technology accounts for more than 8% of Europe's economic output.
4. 10 Biggest Semiconductor Companies by revenue: 1. Samsung, 2. TSMC, 3. NVIDIA, 4. Intel, 5. Broadcom, 6. Qualcomm, 7. SK Hynix, 8. Applied Materials, 9. ASML, 10. AMD

ADDITIONAL LINKS

- "An assessment of the European microchip industry and its expansion strategy": This resource provides a comprehensive introduction to the subject, complete with significant details and statistical data.
- "The global battle over microchips | DW Documentary": An interesting YouTube video to watch to get an insight into the political aspect of the topic.
- "Why making chips is so hard": A great YouTube video to understand the technical and economical side of microchip manufacturing.
- "2 charts show how much the world depends on Taiwan for semiconductors": An article on the importance of Taiwan in this topic.
- "Chip shortage: Has Europe's plan arrived too late?": A news article which explores the EU's chip strategy.
- "I Can Die Now. - Intel Fab Tour!": A YouTube video which gives an insight into how fabs work.
- "With the EU Chips Act, Europe Enters the Global Semiconductor Race": An article about the European Chips Act in the global context.

WHAT NOW?

The EU is in a tough position when it comes to microchip manufacturing partly due to the reason that none of the companies that can manufacture cutting-edge microchips are headquartered within its borders. As a result, Europe currently **produces** only around **10%** of the global microchip supply while **consuming 20%**. In response, the EU is now trying to change its position and establish several fabs within its borders to ensure stability and to mitigate risks of another microchip shortage crisis. This will require the EU to rely on foreign companies such as **Intel** or **TSMC** to set up fabs in Europe funded partially by the European Chips Act. Additionally, creating an innovative environment for these fabs is crucial, necessitating the **development of research institutions and a highly skilled workforce**.

Despite these challenges, the EU is still a relevant player in the field since **ASML and Zeiss are de facto irreplaceable to the microchip industry**. Without them, TSMC or Intel would be unable to produce anything, which makes them a great strategic asset with the potential to be used to foster international cooperation. This requires EU institutions and Member States alike to take advantage of such opportunities to their fullest.

With all that being said, several questions remain. How can Europe ensure a reliable supply of microchips considering its current position? Is it even a good idea to try to catch up with the US, South Korea or Taiwan, or should the EU take a different approach? If yes, how should it be done?