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A blind spot in the EU's Chips Act

The European Chips Act neglects dependencies on older Chinese semiconductor factories. But for many industries, these larger chips play a vital role

Current efforts to boost technological competitiveness and security of supply in the semiconductor sector often focus on the most advanced chips, also known as 'cutting-edge' chips. However, what legislation such as the proposed European Chips Act often neglects to take into account, is the continued relevancy of established semiconductor factories – an area where China is in a much stronger position.

At the very heart of modern, digital life lie the different chips that keep everything running – from cars to laptops, servers and even medical devices. In view of continuous technological advances, some of these semiconductors are under enormous pressure to innovate. In line with Moore's law, chip manufacturers try to double the transistor density (and in turn the processing power) in a circuit every two years. This means they can continue to produce these cutting-edge chips. Processors, which are needed for increasingly powerful smartphone or server generations, are particularly good examples. The structural width – which is measured in nanometres, i.e. one-millionth of a millimetre – of the transistors can provide an insight into the processor's computing power. As a rule of thumb, the smaller the size, the more refined the manufacturing process and the higher the performance. But what we're looking at here is just one single category of semiconductor; there are also numerous other chips with different functions that have become essential for modern society: chips for charging smartphone batteries, controlling braking systems, activating an airbag, reading a fingerprint or providing power to a server. These chips aren't just about processing power – they have different physical characteristics with different uses.

Europe's continued dependency on older factories

Unlike the most advanced processors, which are designed to carry out increasingly complicated calculations, the chips we're talking about here

are not manufactured in ultra-modern semiconductor factories. They tend to be made in numerous smaller and often older factories. And a particularly large number of these are located in China. When talking about China's competitiveness in the semiconductor industry, a lot of the conversation recently has centred around cutting-edge chips. But what we actually need to remember is that China – along with Taiwan – still remains at the top of semiconductor manufacturing in older, more established factories. So, only considering the country's technical competitiveness in the cutting-edge chip sector fails to recognise its importance in the overall semiconductor value chain, which looks at a range of different specific semiconductors, their functions and the end-user industries where they can be found.

For Europe's consumer industries in the automotive, medical device and Industry 4.0 sectors, chips with larger structural widths play an important role, even more important than cutting-edge chips. So, if our priority is to increase European resilience and the supply of strategically important semiconductors, we need to be aware of how our current manufacturing capacities are spread out, so that we can evaluate dependencies and potentially reduce them. This does not appear to have been factored into the proposed industrial legislation, such as the European Chips Act. Europe's continued dependency on older factories in China and Taiwan is a clear example of this.

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To better understand how the manufacture of chips with larger structural widths fits into the full picture when it comes to semiconductors, it helps to zoom out a little and focus on the underlying, highly complex, specialised superstructure with a great deal of interconnected cogs. Over 1,000 individual process steps, 80 different types of production machines and up to 400 different chemicals are needed to make a modern semiconductor. The market leaders involved in this complex process are the US, Taiwan, South Korea, Japan, China and Europe. They all play a vital – and often irreplaceable – role in the value chain. What's more, the chips' function in the final product can vary widely. A modern processor in a smartphone, for instance, has very little to do with a power semiconductor used in charging EV batteries. So what we're actually dealing with here is a whole network

of different value chains based on closely coordinated manufacturing processes, all depending on the function and technology of the individual chip types – from the materials to the devices.

A modern car contains around 1,000 semiconductors including microcontrollers, power semiconductors, sensors and chips used for radio transmissions. They control the motor, brakes and airbags, help drivers park and navigate, receive data from the web and control the windscreen wipers. And the need for them is growing: developing self-driving features will require the very latest processors and AI chips. But these new chips in modern cars will only increase the number required, not replace already existing chips. Simply put, for many of these vehicle semiconductors, it's not a question of replacing older technologies over time with modern chips with smaller structural widths – this just isn't always possible due to their technical function. Market analysts believe that, by 2030, every other semiconductor found in a vehicle will be based on so-called mature nodes – chips with larger structural widths of at least 28 nanometres. And the same goes for the health, engineering and defence sectors. The shortages of 40-180 nanometre chips that we saw in the manufacturing processes in 2020 showed particular scarcity, with entire production lines for cars, medical devices and industrial machinery having to be shut down temporarily.

More than just subsidies

China has been attempting to build its own local, competitive semiconductor ecosystem for over a decade now, seeking independence from other countries by applying modern manufacturing techniques – with limited success. This is mainly due to the high level of specialisation of international value chains, which can require decades to build up the necessary process expertise and major investment in very specific manufacturing or process steps. Dutch company ASML's much-discussed extreme ultraviolet (EUV) lithography technology – essential for manufacturing the latest chips – is based on research and development of more than two decades, with the help of a network of a good 5,000 suppliers. It will take more than huge subsidies to overcome such a technological lag. Equally, we mustn't forget the export restrictions imposed on China by the US in October 2022, partly designed to slow down the country's production of new semiconductors and to thwart its capabilities in this area.

So, China still lags quite a few years behind when it comes to cutting-edge semiconductors, but the story is very different when it comes to

technical advances in the country's production capacity for mature nodes. The barriers to entry are lower than in the cutting-edge market, as this type of chip is neither covered by American export controls nor requires the same high levels of innovation, capital and process expertise. China has unrestricted access to the required machines, development software and contract manufacturers. In fact, when it comes to the 20-45 nanometre range, Taiwan leads the way in production capacity, followed by China with more than three times the capacity of Europe. For older technologies in the 50-180 nanometre range, the difference is even greater: for this type of chip, China's production capacity is more than double that of Taiwan. Currently, Japan, Europe and the US wouldn't be able to manage without China and Taiwan's production capacities for these two sizes of chips, even though all three countries operate some older factories themselves.

Europe needs to consider the entire spectrum of chip production to position itself strategically well.

The current global distribution of the production capacities for mature nodes proves that Europe's strength in this sector has been facing challenges from Chinese and Taiwanese companies for some time now. It is a clear consequence of European semiconductor manufacturers' previous decision to relocate their production processes to Asia, taking advantage of lower wages and energy costs. China in particular continues to expand its production sector: SMIC (the leading Chinese contract manufacturer) alone has announced its goal to build three new mature node factories in Tianjin, Shanghai and Beijing. The latest US export restrictions have also made it more attractive for China to continue developing its production capacities for older chip types and to consolidate its already leading role even further. This likely means we are going to become even more dependent on mature nodes manufactured in China.

As these more established manufacturing processes are not eligible for subsidies for innovative semiconductors, this issue is not factored into the draft of the European Chips Act. If we take into account the strategic relevance of these chips for our automotive, engineering and health industries, this blind spot in the legislation is completely incomprehensible. This is an area where we really should do better: serious debate on the reliability of supply to end-user industries will need

to address the major relevance of mature node manufacturing processes and draw conclusions on the different dependencies in this sector. Europe needs to consider the entire spectrum of chip production to position itself strategically well.

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