Chips run the world

Semiconductors are becoming crucial to almost every aspect of our lives, says Mikhail Zverev, manager of Amati Global's TB Amati Strategic Innovation Fund. Yet the sector is no pricier than the wider market

On what do the Chinese Communist Party, US Republicans, US Democrats and the European Union all agree? The strategic importance of semiconductors. The US Congress has just signed the Chips Act, a $52bn package to support investment in semiconductors. The EU is adding €15bn to its €30bn spending programme. China is committing hundreds of billions to the sector.

Heightened geopolitical tensions are adding to the sense of urgency. Bellicose rhetoric between Taiwan and China, combined with worsening Sino-American relations, is one such factor: Taiwan accounts for over 60% of contract semiconductor manufacturing. South Korea, which has ongoing tensions with its northern neighbour, accounts for another 20%.

The policymakers are discovering the importance of semiconductors to the global economy. This has been obvious to the industry for some time. Chips' critical role was brought home to everyone by recent crippling shortages. From domestic appliances and telecommunication equipment to cars, manufacturers had to stop or reduce production owing to post-pandemic disruption in semiconductor supply chains.

No wonder, then, that in our conversations with companies we hear stories about much closer relationships between end users and semiconductor manufacturers. Ford, for instance, has signed a strategic partnership with GlobalFoundries, a chipmaker, reflecting both the importance of chip supplies and the increasing content of semiconductors in its vehicles. These closer relationships are likely to come with longer-term supply agreements, more predictable pricing, bigger order books and more revenue visibility. This feels like a lasting positive change for the industry.

The dizzying demand for data

"Semiconductors run the world," says Pat Gelsinger, Intel's CEO, in his recent article. He may be biased – he runs the world's biggest chipmaker after all – but more and more investors and policymakers are coming round to this view. Computing problems are becoming harder, requiring more computing power. Data volumes continue to increase, and consumers and businesses find more useful things to do with that data. This all requires more semiconductors to store and process it.

The average user had about 600 photos stored on their phone in 2015. By 2022 this has increased to 2,000 photos, in much higher resolution. And now videos are becoming more popular, demanding ever more memory capacity and computing power.

Semiconductor content reflects this trend: in 2015, the new iPhone started with 16 gigabytes (GB) of flash memory. The latest iPhone models start at 128Gb and go up to one terabyte. No wonder the iPhone 5S cost $199, whereas the new iPhone 14 starts at $799. Consumers are happy to absorb this since the phones are so much more powerful and essential to our digital lives. As a result, Apple is selling more smartphones and the semiconductor market's value continues to expand.

"The industry is expected to double to $1trn between 2021 and 2030"

This is not just about human behaviour. Devices and appliances are becoming "smart" and connected, creating further demand for data and computing power to run machines without human intervention.

According to General Electric, each of its aircraft engines produces around one terabyte of data per flight. This data is used to optimise engine performance and drive predictive maintenance algorithms, detecting the problems before they occur. This boosts demand for semiconductors – both the sensors inside the engine that capture the data and the chips in the data centres processing it. Machines now perceive the world through their own sensors rather than relying on humans. They communicate with each other and the networks in which they operate in many ways: through near-field wireless connections if they are in proximity; over cellular networks if further afield; or via optical fibre if they need to transmit large amounts of data.

All this sensing and communication is powered by specialist chips, with a bewildering range of acronyms and technical terms – VCSEL lasers, CMOS image sensors, and RF filters – to name but a few. Actions such as opening a valve, moving a robotic arm or accelerating an electric car are increasingly enabled by semiconductor components as well. More and more energy that we use in industrial applications is electric, displacing internal combustion or hydraulics. This energy needs to be managed by a special class of chips – power semiconductors, capable of handling high voltages. The market for these is growing too.

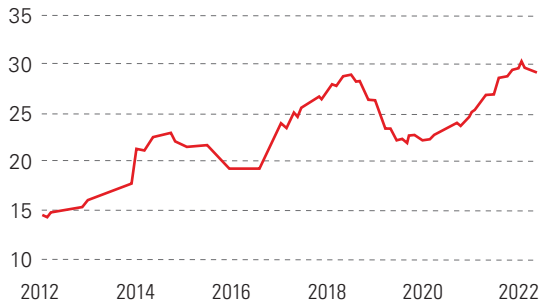
Industry estimates that transition from internal combustion to electric car adds about $500 worth of semiconductor components per vehicle, and we're in the early stages of this transition. Similar increases in content are happening in industrial automation, renewable energy and other areas. No wonder Gartner, a consultancy, expects the semiconductor market to double from $500bn in 2021 to $1trn by 2030.

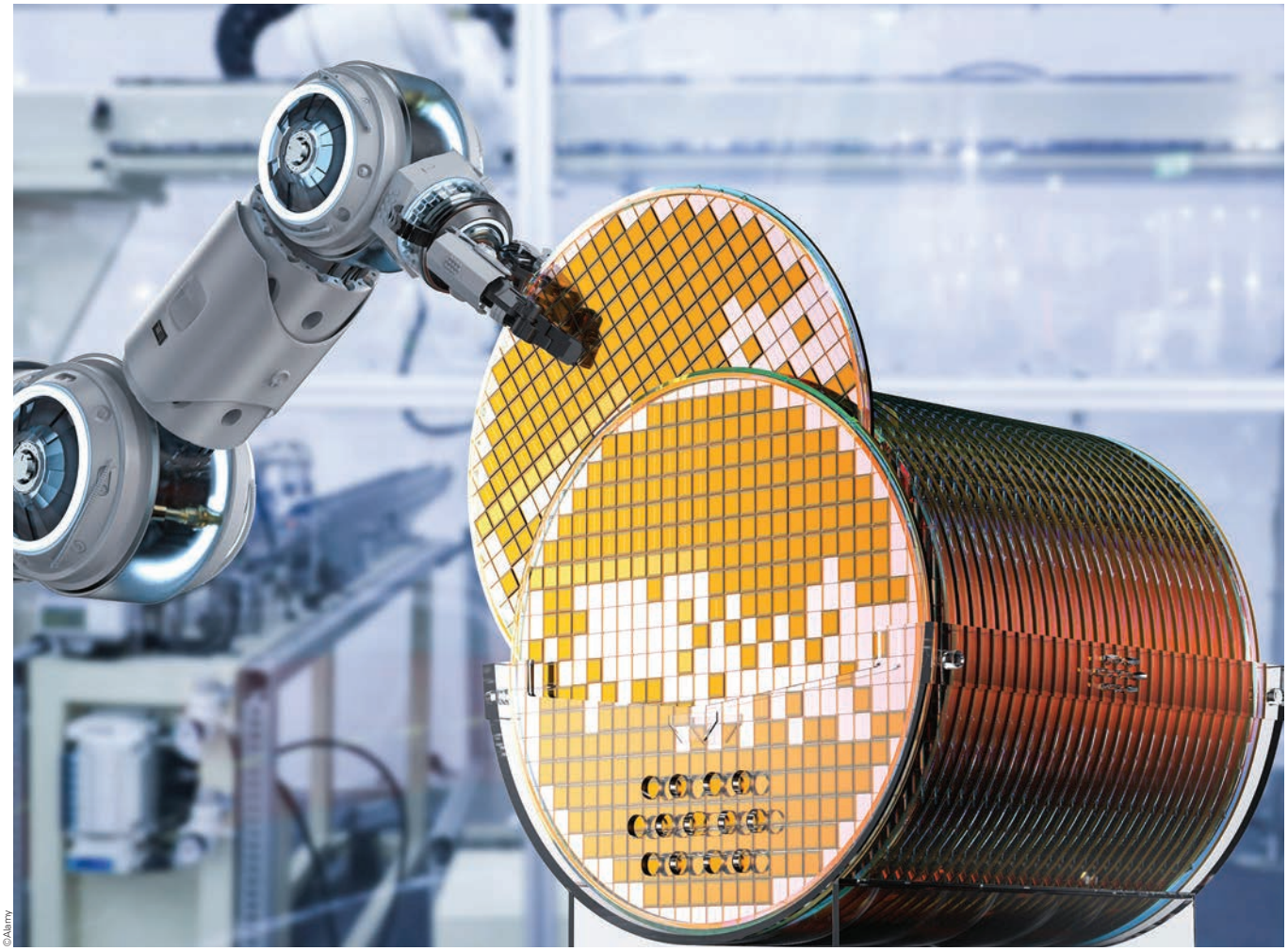
This growth comes with increasing diversity. The variety of jobs that chips are called upon to do has exploded. A decade ago, a typical data centre would be dominated by one-size-fits-all Intel microprocessors. Now there are chips tailored to specific jobs. We have graphics-processing units (GPUs) handling complex artificial intelligence (AI) and machine-learning work; field-programmable gate array (FPGA) accelerator chips handling specialist tasks that require particular speed and performance; and networking chips handling data transfers within the data centre and further afield.

This growth and diversity give rise to a multitude of specialist companies, often with dominant positions in their niches, with high and rising profit margins. Among the better-known stocks, **ASML (Amsterdam: ASML)** has an effective monopoly on some critical semiconductor-manufacturing equipment, while **Nvidia (Nasdaq: NVDA)** is the dominant supplier of graphics and AI chips. **TSMC (Taipei: 2330, NYSE: TSM)** dominates contract manufacturing of the largest and most sophisticated semiconductors.

Chip industry operating margin

MSCI ACWI Semi. and Semi. Equip. index, %





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The movement of robotic arms is enabled by semiconductor components

Samsung Electronics (Seoul: 005930, LSE: SMSN), SK Hynix (Seoul: 000660) and **Micron Technology (Nasdaq: MU)** are an oligopoly of three in the dynamic random access memory (DRAM) memory market. **Infineon Technologies (Frankfurt: IFX)** leads the market in power semiconductors for electric cars and renewable energy.

There are also several niches of the sector that many investors have yet to discover. **Lumentum (Nasdaq: LITE)** is a leading provider of optical communications chips for telecom and data networks; its lasers also power Apple's FaceID and sensors for cars and smart buildings. **Nordic Semiconductor (Oslo: NOD)** leads the market in low-power connectivity chips, enabling industrial equipment or devices in homes to be connected (in "smart homes" connected to the "internet of things"). Chips made by **Qorvo (Nasdaq: QRVO)** and **Skyworks Solutions (Nasdaq: SWKS)** process radio signals in devices ranging from 5G smartphones to military radars. **Ambarella (Nasdaq: AMBA)** makes image-processing semiconductors that enable computer vision in security cameras and autonomous vehicles.

As the semiconductor industry grows, it requires ever more sophisticated manufacturing techniques, which creates work for specialist equipment makers. One is **ASM International (Amsterdam: ASM)**, the leader in atomic layer deposition, a particularly precise technique that helps build more sophisticated semiconductors. **BE Semiconductor Industries (Amsterdam: BESI)** and **Onto Innovation (NYSE: ONTO)** help package chips into miniaturised and complex multi-functional systems and inspect their quality. **Aixtron's (Frankfurt: AIXA)** machines move the industry beyond silicon, making compound semiconductors from new materials that expand what chips can do in handling power, radio signal and light.

Cheap as chips

The sector's compelling backdrop and outlook is not reflected in market valuations, however. The MSCI ACWI Semiconductors and Semiconductor Equipment index is down by over 40% this year and is on a forward price/earnings (p/e) ratio of 14, in line with the broader global market – offering no premium for the industry's growth. Why? Semiconductors are cyclical and investors have learnt to get out when the cycle is turning down, as it is now.

There is no doubt that in the short-term things are turning south. Personal computer (PC) markets and part of smartphone markets are weak: consumers upgraded their phones and their home IT during the pandemic, and there is excess inventory in some parts of the market. Recession may dampen demand further.

But share performance suggests that much of this is in the price. Companies in more vulnerable areas had already seen double-digit downgrades to their earnings expectations. And in any case, focusing on such short-term dynamics overlooks the bigger picture.

The industry has become more consolidated and has emerged from previous cyclical downturns with better cash generation and higher profit margins (see chart). Chipmakers no longer rely on the PC market as their sole source of demand, as they did 15 years ago. Cars, industrial equipment, data centres, telecom networks, consumer electronics and smartphones all have cycles, but they do not cycle in sync, reducing the cyclicality of the whole complex. Semiconductors have become more mission-critical in more places, increasing visibility and underpinning multi-year revenue growth.

In trying to time the short-term cycle or avoiding this cyclicality altogether, investors risk missing compelling long-term opportunities in semiconductors. It is time to consider putting some chips back on the table.

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