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World in Transition

Semiconductors: from cyclical to secular?

RADAR

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When we hear the term transition we think of renewable energy projects, wind turbines, solar farms, and electric vehicles (EVs). These technologies are critical to reducing emissions, but the global economy cannot transition without semiconductors (or "chips").

Decarbonisation represents a long-term, structural driver for semiconductor demand in an industry that has historically been characterised by pronounced "boom and bust" cycles, dictated by economic growth and supply-demand imbalances.

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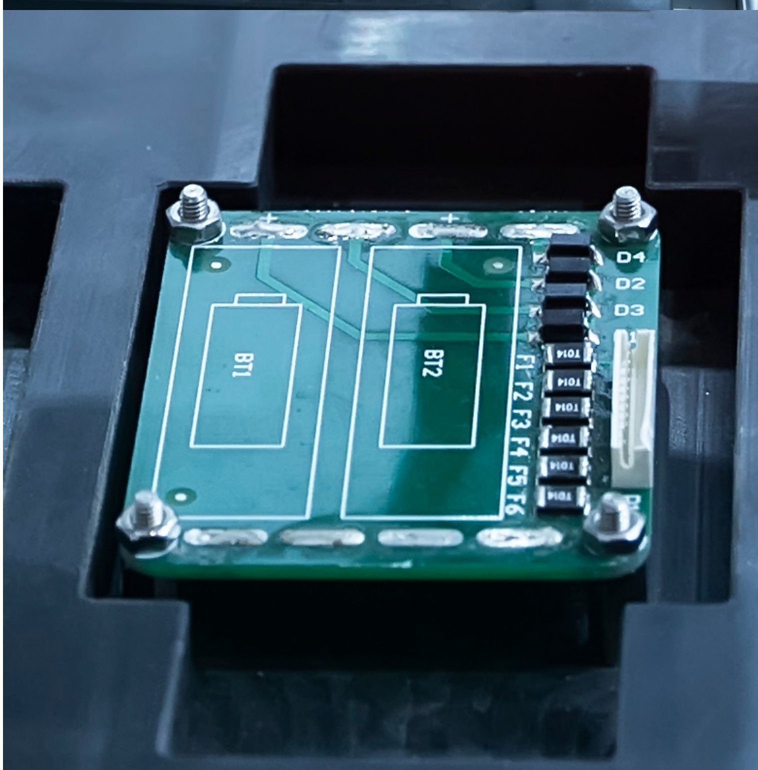
Overview

- Semiconductor technology is paramount if we are to achieve climate targets and the global transition, serving as critical components for a host of clean-technology products.
- The semiconductor industry has historically moved in "boom and bust" cycles in tandem with global economic growth and trade conditions.
- We believe that decarbonisation represents a long-term, structural driver for future semiconductor sector growth.
- Growing exposure to transition-critical sectors, such as electric vehicles (EVs), will add a higher degree of revenue-stream diversification that should make the impact of cycles less severe going forward.
- The supply-side landscape also looks to be improving, following a period of industry consolidation across the value chain.
- Government financial incentives to re-shore clean-tech manufacturing will further improve the supply- and demand-side landscapes.

Introduction

When we hear the term transition, we think of renewable energy projects, wind turbines, solar farms, and electric vehicles (EVs). These technologies are critical to reducing emissions. But the global economy cannot transition without semiconductors (or “chips”). As of the second half of 2022, the volume of chips used in the global renewable energy sector is expected to grow at a compound annual rate of ~8-10% through to 2027.[1] Moreover, within the automotive sector, which accounts for ~15% of global CO_2 emissions, EVs and charging infrastructure are big users of semiconductors. EV penetration continues to rise globally, with growth forecast at a compound annualised rate of ~17% through 2027.[2]

Decarbonisation represents a long-term, structural driver for semiconductor demand in an industry that has historically been characterised by pronounced “boom and bust” cycles, dictated by economic growth and supply-demand imbalances. The covid-19 pandemic gave rise to such a boom-bust cycle, with the latest cyclical turndown providing an opportunity to look for undervaluation in a sector with a promising structural growth runway. This is not surprising given the market’s propensity for hyperbolic discounting (a common cognitive bias in which people prioritize smaller, short-term benefits over potentially more meaningful rewards at a later date). Our belief is that the global transition will continue to serve as a long-term driver of semiconductor demand over the coming decades and that this will open up a series of new end-markets – themselves the beneficiaries of structural tailwinds – for chips which should reduce the impact of cyclicality going forward.



A brief history of semiconductor cycles

The semiconductor industry has historically run in “boom-and-bust” cycles that are correlated to global GDP and trade volumes (Fig.1). Increasing demand for consumer electronics – the PC boom in the 80s and 90s, mobile phones in the 2000s, and the emergence of smartphones in the 2010s – spurred a ramp up in production, fuelling the “boom” phase of the cycle. When demand began to subside, supply eventually trumped demand.

These supply-demand imbalances were caused by a combination of excess capacity leading to overproduction, technological innovation making legacy semiconductors (and the equipment used to produce them) obsolete, and macro-economic cycles. The impact in each case was a reduction in semiconductor customer capital investment (demand), which in turn negatively impacted sales volumes and industry pricing. This “bust” phase would eventually give way to a period of rising demand for a new product, restarting the cycle (Fig. 2).

Fig. 1. The global semiconductor industry has moved in step with GDP growth

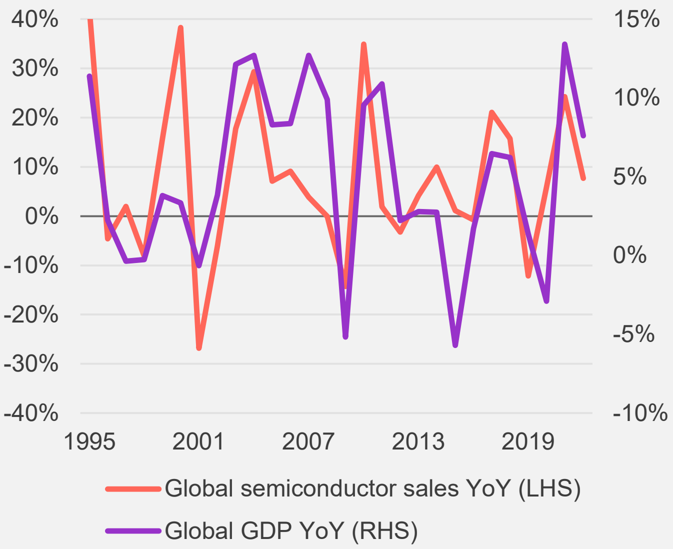
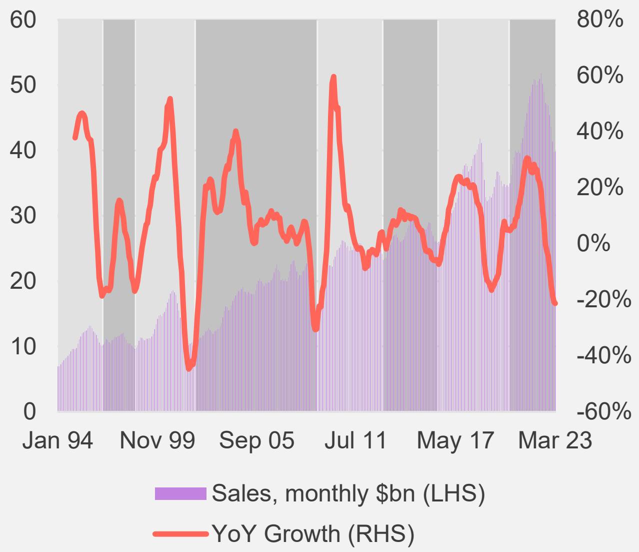
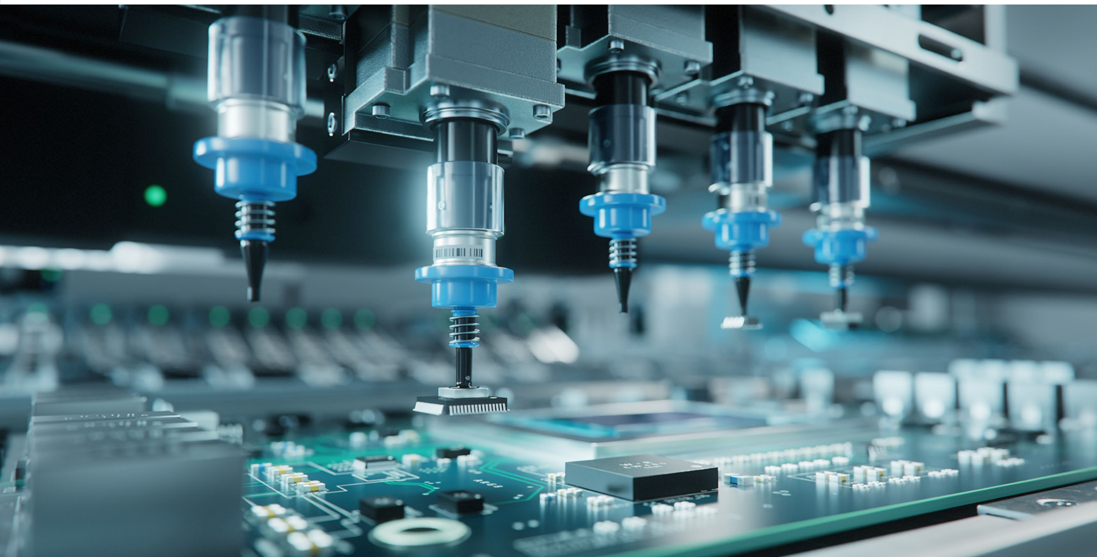
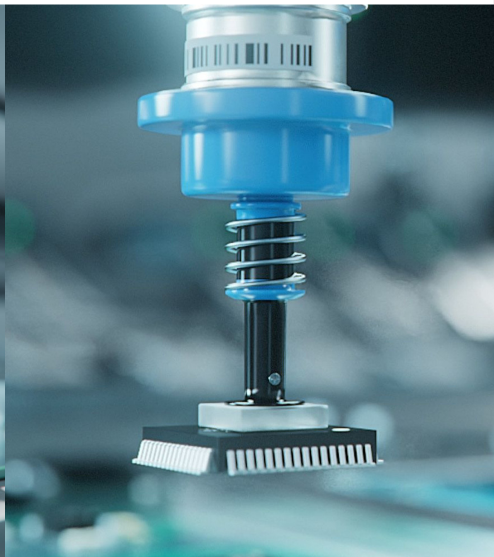


Fig. 2. Semiconductor sales ($bn), y/y growth & cycles



Source: Fig. 1: Semiconductor Industry Association (SIA); IMF; Bloomberg; JOHCM; Regnan. Fig. 2: SIA; Bloomberg; JOHCM; Regnan. Shaded areas denote semiconductor cycles.

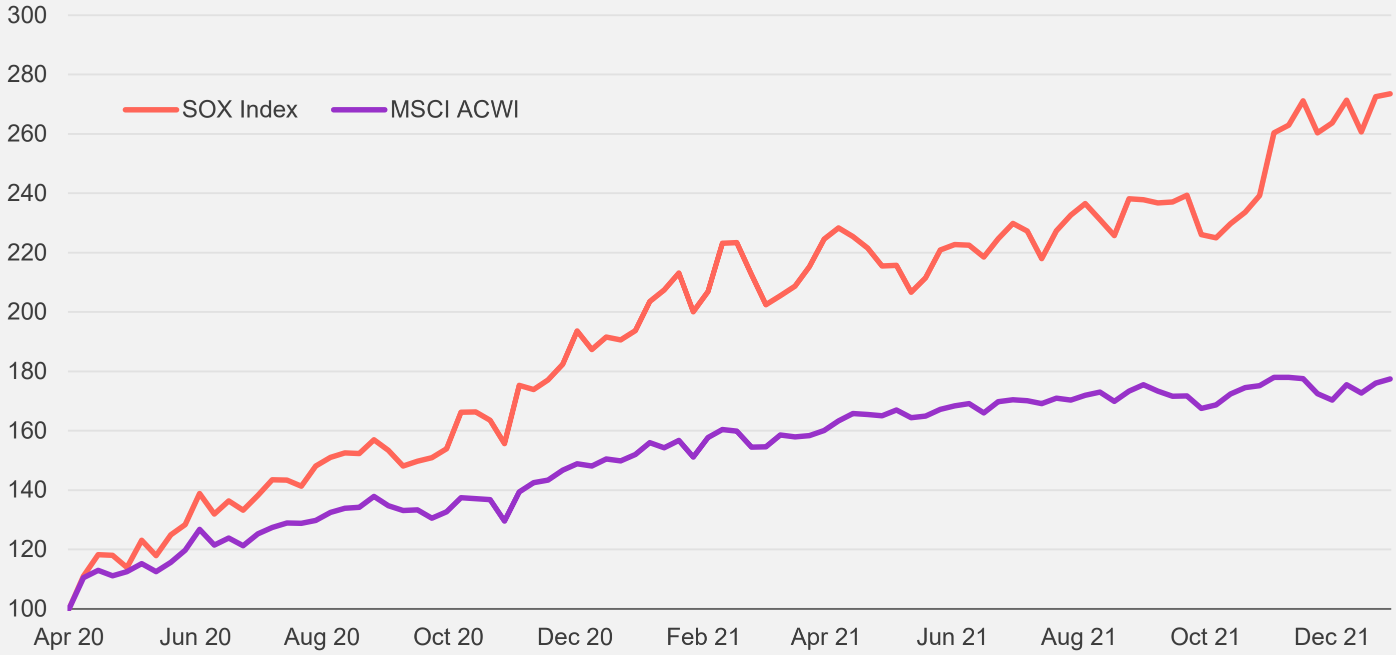




In the most recent semiconductor cycle, following the initial outbreak of the covid-19 virus, capacity was ramped up in response to a surge of consumer and corporate demand for electronics as the global workforce began to work-from-home and businesses continued to shift workloads to the cloud. Greater demand led to more pricing power and incremental margin expansion. This was reflected in semiconductor share prices. In the immediate aftermath of the pandemic-induced market sell off, the semiconductor industry (SOX Index) delivered a total return of +183% to the end of 2021, with a +99.6% excess return versus global equities (Fig. 3).

In 2022, the cycle began to turn, with a build-up in inventories and waning consumer and, to a lesser extent, enterprise demand. A flare up in US-Sino tensions over Taiwan and the Russian invasion of Ukraine – around 35% of US palladium, which is used in the metal connections attaching chips to circuit boards, is sourced from Russian companies – exacerbated supply constraints and added to negative sentiment. The Covid-cycle appears to be something of an aberration in historical terms, inducing a massive, rapid, and unprecedented ramp up in demand (and a concurrent expansion of capacity), followed by an equally sharp drop that led to a glut of supply at a time when companies worldwide sought to preserve capital. The idiosyncratic nature of the pandemic cycle notwithstanding, going forward we believe this cyclical pattern could become smoother, giving way to a long-term, secular growth runway.

Fig. 3. The semiconductor industry performed strongly in the aftermath of the pandemic (April 2020=100)



Source: Bloomberg; JOHCM; Regnan. Semiconductor industry uses SOX (Philadelphia Semiconductor) Index. This is a modified capitalisation-weighted index comprised of companies involved in the design, distribution, manufacturing, and distribution of semiconductors. Returns are in USD.

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Why we believe semiconductor boom & bust cycles could become less severe in the future

The demand landscape is becoming more diversified across end-markets which themselves are experiencing secular tailwinds.

Semiconductors have become almost ubiquitous, serving as essential components in various end-market applications. Transition-critical sectors such as electric transport and charging, renewable energy equipment, and grid infrastructure are all reliant upon chips. Greater diversification of end-market exposures leaves the semiconductor industry less vulnerable to a single retail end market (consumer electronics).

These new end-markets are the beneficiaries of their own long-term structural tailwinds: EV penetration rates will continue to rise; clean-tech adoption is paramount if countries and companies are to achieve climate targets; workloads are migrating to the cloud; a growing volume of data creation will require additional storage in the form of data centres; and growth in artificial intelligence (AI) applications will bolster demand for high-performance computing.

Crucially, it is in these new end-markets that demand growth for semiconductors will be highest going forward (Fig. 4). Data centres, automotive, and industrial markets, while smaller in absolute terms, are forecast to grow at a higher rate than the overall semiconductor market and the more mature smartphone and computer segments.

Moreover, products in these markets typically require more (and more complex) chips per unit than consumer electronics. In the autos sector, for example, an EV or hybrid, which use around 2,000 semiconductors per vehicle, requires double the chip content of an internal combustion engine vehicle. Around three-quarters of the incremental content used in EVs comes from power semiconductors; these are used to perform the modified electronic functions of regular semis but are capable of withstanding much higher voltage and current with reduced power loss. We believe these new end-markets, with their longer and less volatile cycles, will help to reduce semiconductor revenue volatility. Or put another way, semiconductor customer spending in these new markets is a much more stable and diversified source of long-term revenue than consumers purchasing new electronic equipment.

Fig. 4. Semiconductor end-market sales and growth, 2020-2026E

Sales ($bn)	2020	2021	2022	2023E	2024E	2025E	2026E	2020-22 CAGR	2023E-26E CAGR
Data Centre	52.5	64.2	73.4	66.9	74.4	86.0	98.2	12%	10%
Automotive	39.8	53.6	61.4	69.4	80.2	90.0	98.7	16%	9%
Industrial	50.7	64.8	71.6	75.4	83.3	91.0	98.2	12%	7%
PCs	123.8	155.4	159.1	149.2	153.9	165.6	183.0	9%	5%
Infrastructure	36.3	43.8	49.9	52.3	56.1	59.8	63.0	11%	5%
Consumer	49.9	66.3	72.8	70.2	73.8	78.8	82.0	13%	4%
Smartphones	117.9	146.8	151.0	139.7	144.5	152.1	159.5	9%	3%
TOTAL	**470.9**	**594.9**	**639.2**	**623.1**	**666.2**	**723.3**	**782.6**	**11%**	**6%**

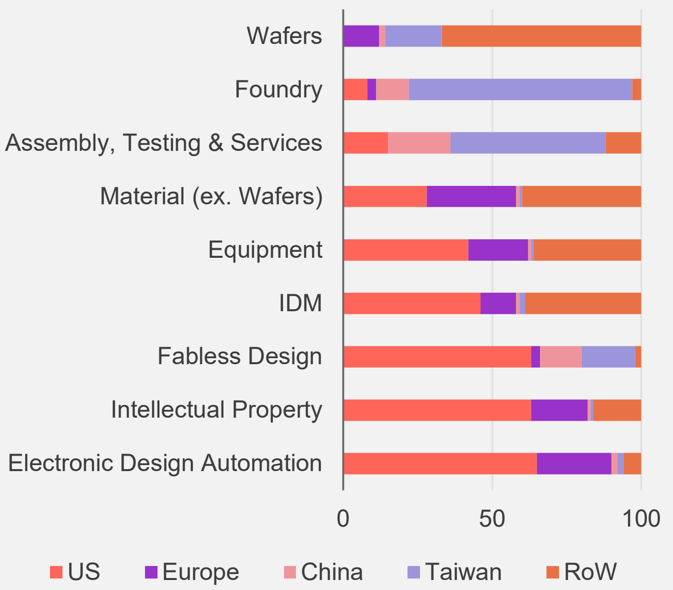
Source: Gartner; JOHCM; Regnan as at 2022.

That said, even within the consumer electronics market, technological upgrades to both smartphones and computers will give rise to a series of replacement cycles that should support on-going demand for semiconductors. This will continue to be one of the more cyclical markets for semiconductor companies, but we should not forget that much of the demand from this segment is essential to everyday lives across the globe. Across developed markets smartphone penetration is very high, but we can reasonably assume that consumers will continue to upgrade devices, while in some emerging economies penetration rates are still climbing; in India, for example, with its population of 1.4 billion, penetration currently sits at ~46%.[3]

Supply chains, national security, and government incentivisation

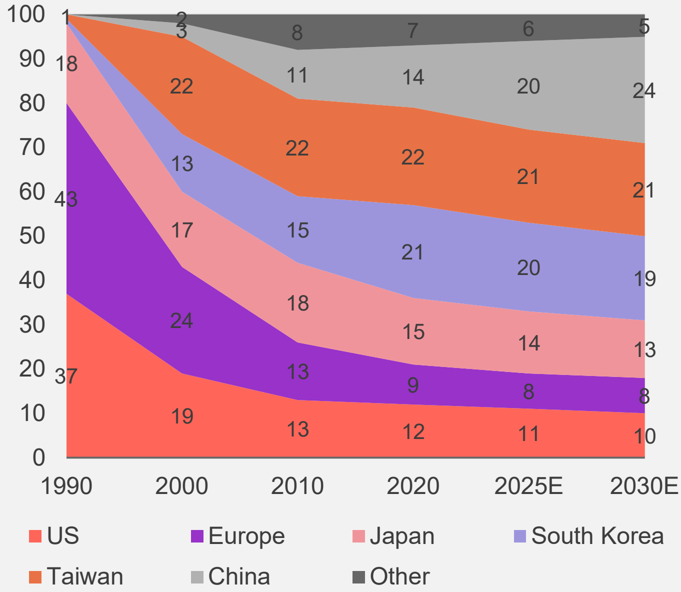
A defining feature of the semiconductor industry in the mid- to late-twentieth century was the willingness of US and European companies to offshore production to cheaper, foreign locations. On the one hand this enabled western companies to concentrate capital investment and resources on improving chip design and less capital-intensive parts of the value chain (Fig. 5); on the other it meant that the European and US share of global chip manufacturing fell from 81% to 21% over the course of 30 years to 2020. Without the recent wave of government intervention, it was projected that this would have fallen to less than 20% by 2030 (Fig. 6).

Fig. 5. US and European companies have higher market share in lower capex areas of the value chain



Source: GlobalWafers Presentation; McKinsey; JOHCM; Regnan as at 2022.

Fig. 6. Share of global semiconductor manufacturing by country



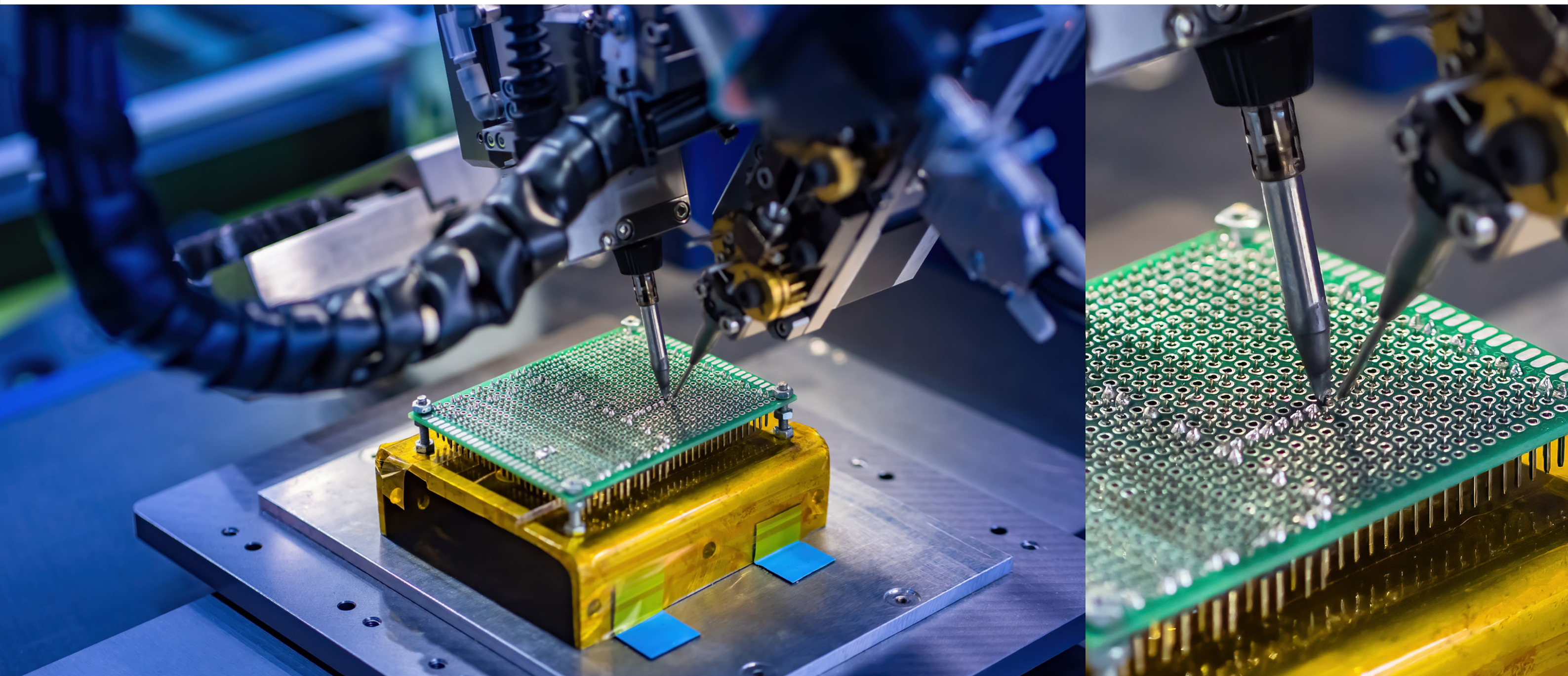
Source: VLSI Research; Boston Consulting Group; JOHCM; Regnan as at 2022.

As the US and European share of global semiconductor manufacturing declined, emerging economies in Asia – notably South Korea, Taiwan and, to a lesser extent, China – captured share in more capital-intensive parts of the value chain: foundries, wafers, and assembly. These Asian countries can now manufacture with economies of scale and a significantly reduced cost base. With global supply chains fully-functioning, western semiconductor companies were able to employ a "just-in-time" approach to production, reducing costs and bolstering margins.

For decades this proved a highly efficient and profitable approach, but with the onset of the covid-19 pandemic, the underlying fragility of this supply structure was exposed. An almost unprecedented acceleration in demand at the beginning of Covid was met with an equally precipitous drop in the ability to supply critical semiconductor materials and components. Combine this with an on-going deterioration in US-Chinese relations – in what has in essence become a technology arms-race – and the scene has been set for western policymakers to introduce a wave of legislative incentives to promote (or re-shore) more manufacturing at home.

In the US, this took the form of the CHIPS and Science Act, which, at its core, appropriates ~$280bn in funding to re-invigorate the domestic semiconductor industry. Not to be outdone, the European Union introduced its own Chips Act in 2023, aiming to double its share of global production to 20% by 2030. To achieve this the bloc has committed ~€43bn in funding to promote manufacturing and supply resiliency.

How does this reduce future semiconductor cyclicality? First, government incentives and public funding have been met with a wave of company announcements to add manufacturing capacity within the US and Europe. This leads to a multiplier effect that should spur additional private fixed asset investment: historically, each dollar of public investment has generated between 1.1 and 1.6 dollars spent on private fixed asset investment.[4] Equally important, with more of the value chain re-or near-shored it is hoped that the supply shock that took place during the pandemic can be avoided going forward. Second, semiconductor incentivisation strategies form part of a wider, concerted legislative effort to re- or near-shore production of clean-tech equipment. With newer semiconductor end-markets, such as autos and industrials, the beneficiaries of public funding, semiconductor companies have, in effect, a form of subsidised customer investment for the next 10 years and beyond.



Is this playing out? The short time since the legislation was introduced can make an assessment of the long-term viability tricky, but the initial data is encouraging. As of April 2023, companies have committed to >$200bn in larger-scale semiconductor and clean-tech manufacturing projects in the US (Fig. 7). Much of this planned investment has come from US companies, but international companies have also announced capacity additions (Fig. 8). For context, that is ~2x the total capital investment commitments made in the same sectors in 2021 and, for a pre-Covid comparison, more than 20x the 2019 level.[5]

The wider supply-side landscape is improving

Following decades of consolidation across the semiconductor value chain, the industry now resembles something more closely approaching an oligarchic structure. Barriers to entry are much higher. In manufacturing, capital requirements for scaled and profitable production are higher, pricing out new entrants. In the design space, increasing semiconductor complexity means that IP is consolidating around fewer names. Consolidation leads to greater industry discipline. Companies can shift their focus away from rapidly scaling up production (and diluting margins through price reductions) and focus on margin expansion, cash flow generation, and balance sheet fortification.

Fig. 7. Cumulative announced projects ($bn)

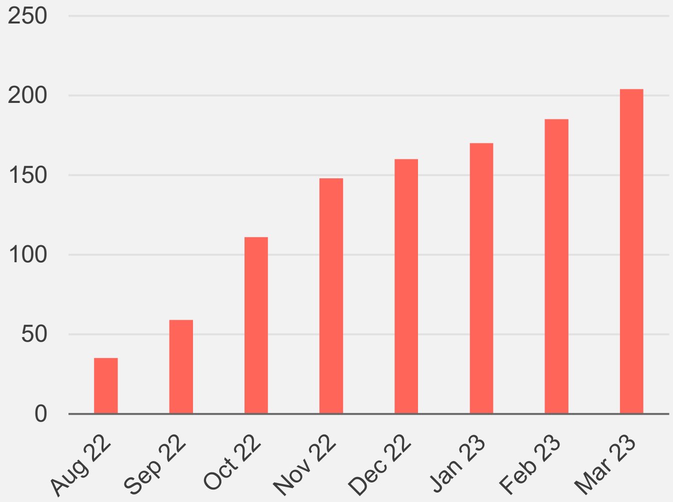
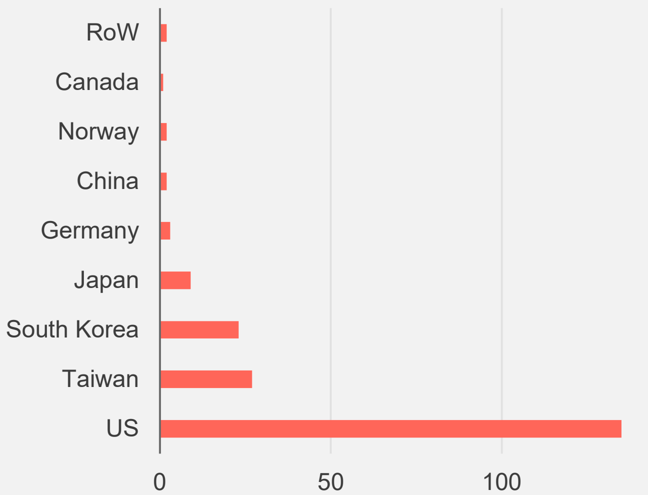


Fig. 8. Announced investment by country ($bn)



Source: fDi Markets; Rystad Energy; SIA; JOHCM; Regnan as at April 2023.

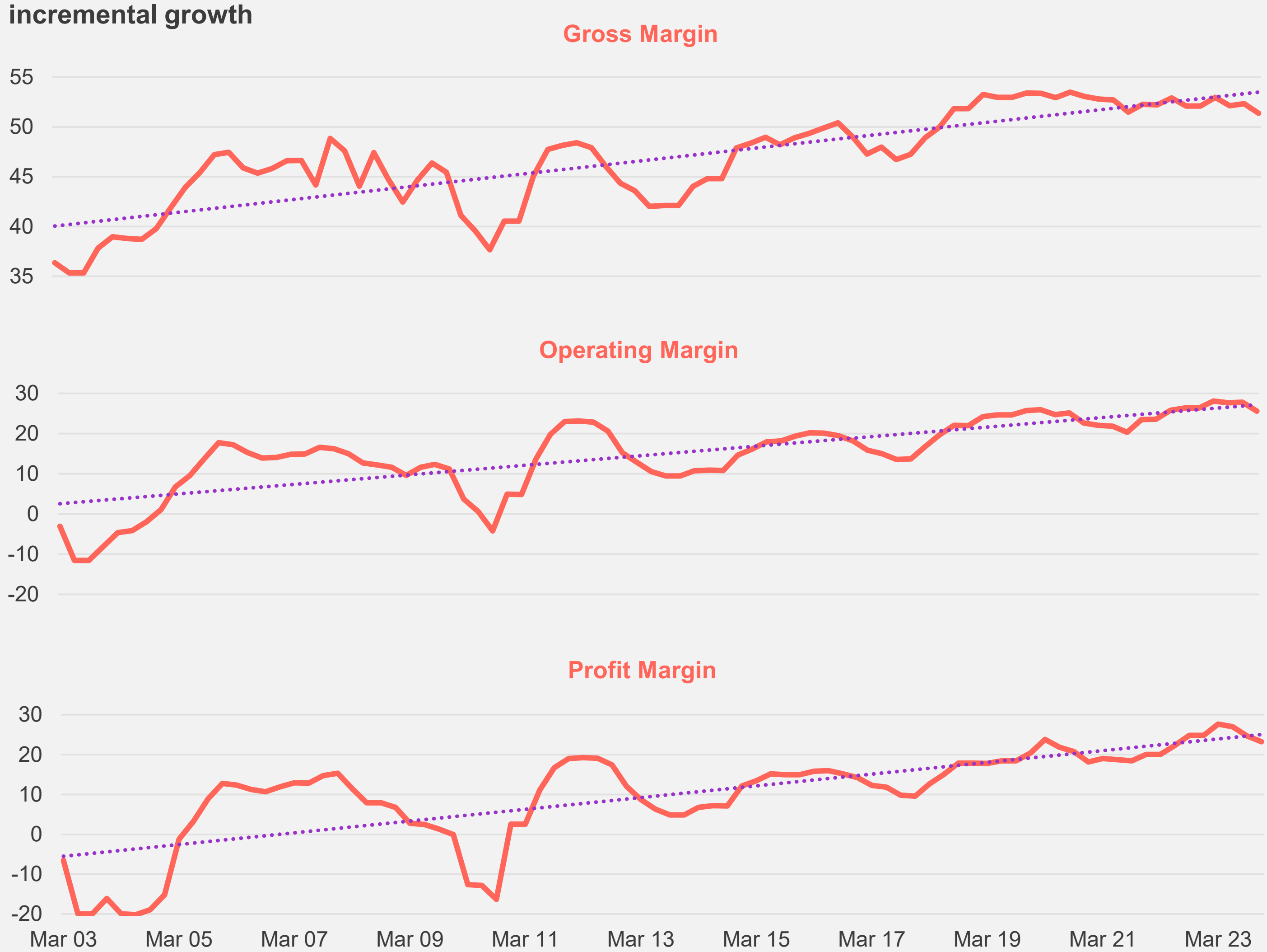
Why semiconductors now?

Ubiquity of semiconductors translates to higher growth potential

We believe that semiconductor companies have the potential to grow earnings in the mid- to high-teens range over the coming decade (a level in excess of the global equity market). Future earnings growth is built on a foundation of high double-digit revenue growth from new market segments and incremental margin expansion.

The structural trend for semiconductor gross, operating, and profit margins has been one of steady expansion over the previous two-decades, interspersed with moments of cyclicality (Fig. 9). As semiconductor companies gain greater exposure to a wider range of end-markets, themselves the beneficiaries of secular tailwinds, we can expect this trend to continue.

Fig. 9. Semiconductor margins exhibit cyclical tendencies, but the structural trend has been one of incremental growth



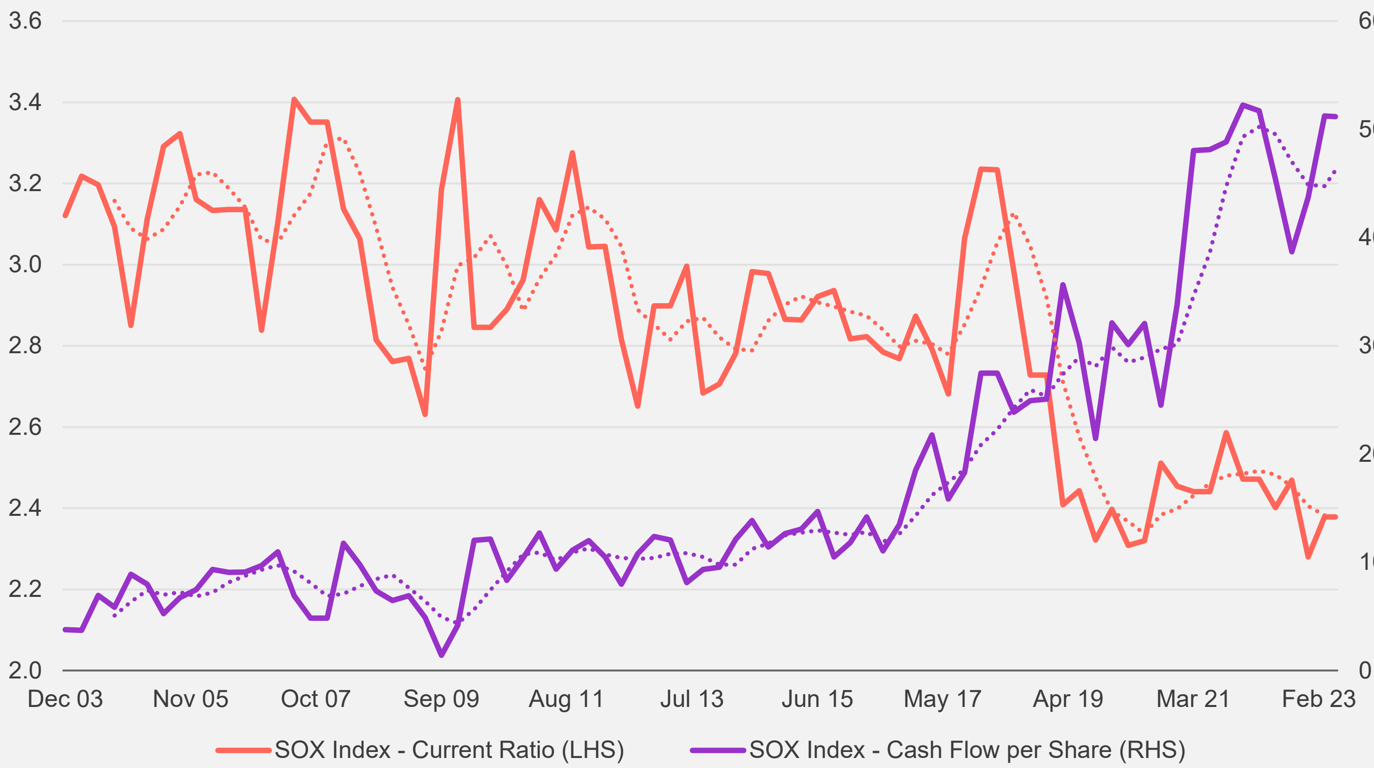
Source: Bloomberg; JOHCM; Regnan. Data is from the SOX Index.

Consolidation has allowed the remaining players to strengthen balance sheets

Industry consolidation, and the concurrent increase in pricing power, has enabled larger semiconductor companies to fortify their balance sheets with strong cash positions and much lower debt levels (helpful given the cost of serving this debt has increased). Greater balance sheet strength should help to provide resilience during an economic downturn, as well as mitigate the impact of higher borrowing costs.

Importantly, it enables companies to continue investing and generating healthy returns on those investments on a through-the-economic-cycle-basis (Fig. 10). To satisfy future demand from transition-critical end-markets, the semiconductor industry must continue to invest to deliver next generation capabilities.

Fig. 10. The semiconductor industry has strengthened balance sheets and improved cash flow generation over the course of previous cycles



Source: Bloomberg; JOHCM; Regnan. Data is from the SOX Index.

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[1]"The Role of Semiconductors in the Renewable Energy Transition", Earth.org (October 2022).

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[5]fDi Markets; Semiconductor Industry Association data; Bloomberg. Comparisons of capital investment were achieved looking at historic data from specific sectors from the aforementioned data providers.

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