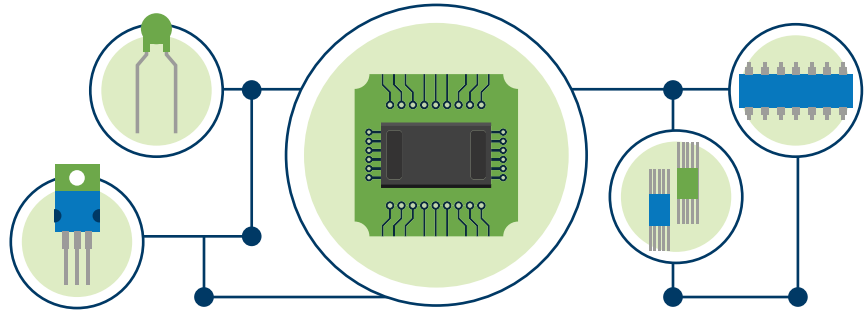


Box Article 6.1

PERFORMANCE AND OUTLOOK OF THE ELECTRONICS CLUSTER IN SINGAPORE

CHANGE IN COMPOSITION IN SINGAPORE'S ELECTRONICS CLUSTER

The nominal value-added (VA) of the semiconductors segment expanded by a compound annual growth rate of 9.3 per cent from 2000 to 2022, increasing the VA share of the semiconductors segment within the electronics cluster.



THE DOWNTURN IN THE ELECTRONICS CLUSTER WAS DRIVEN BY A REDUCTION IN CONSUMER DEMAND AND HIGH INVENTORY LEVELS

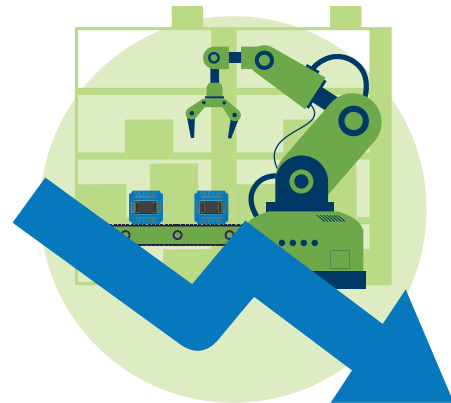
DRIVER 1

There was a reduction in consumer demand in the smartphone and PC markets starting in 2H22 as consumer spending on goods reversed from its pandemic-fuelled highs.



DRIVER 2

Original equipment manufacturers (OEMs) of consumer electronics held higher-than-normal levels of chip inventories to shore up supply chain resilience during the pandemic. With demand softening, OEMs moved to draw down their chip inventories and cancelled orders placed with semiconductor manufacturers as they lowered their production of consumer electronics.



OUTLOOK

The electronics cluster is projected to recover over the course of 2024, driven by a restocking of depleted chip inventories and a recovery in the PC and smartphone end markets.



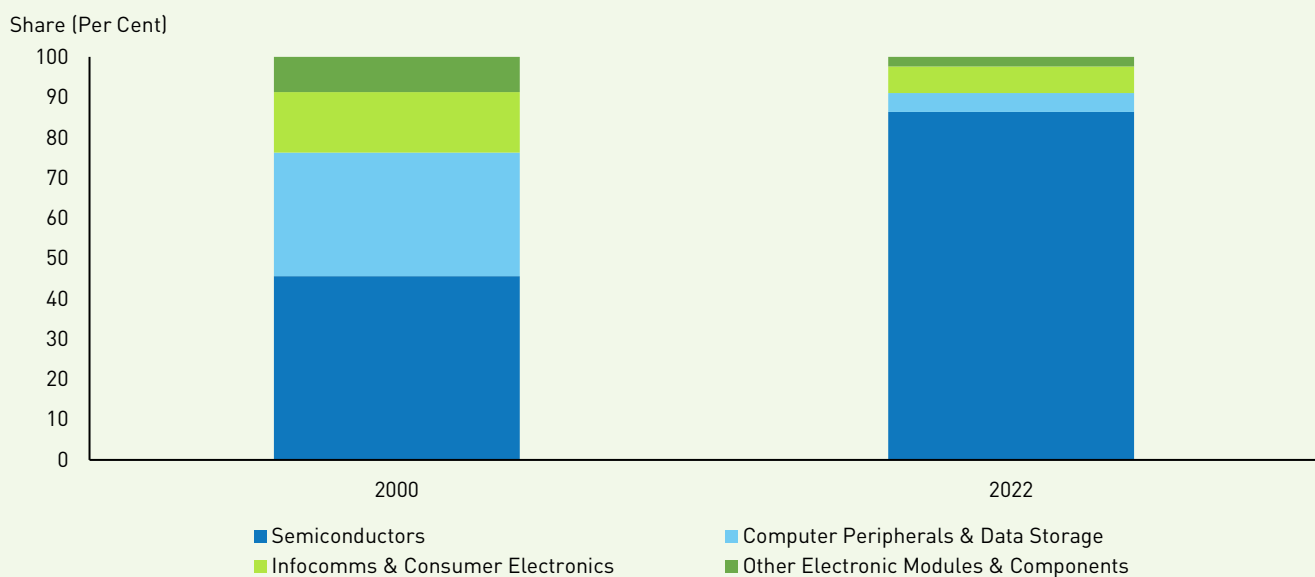
BOX 6.1: PERFORMANCE AND OUTLOOK OF THE ELECTRONICS CLUSTER IN SINGAPORE

The electronics cluster is the largest cluster within the manufacturing sector in Singapore, accounting for 46.9 per cent of the sector's nominal value-added (VA) and 9.7 per cent of Singapore's overall nominal VA in 2022. This box article examines the composition of the electronics cluster, its recent performance¹, as well as its outlook in the short and longer term.

Singapore's electronics cluster is dominated by the semiconductors segment

The electronics cluster in Singapore is made up of four segments, namely the semiconductors, computer peripherals & data storage, infocomms & consumer electronics and other electronic modules & components segments. From 2000 to 2022, the nominal VA of the semiconductors segment expanded by a compound annual growth rate (CAGR) of 9.3 per cent, outstripping the 6.1 per cent CAGR for the electronics cluster as a whole over the same period. This reflects Singapore's success in attracting and anchoring high VA activities within the semiconductor value chain. As a result, the nominal VA share of the semiconductors segment within the cluster rose from 45.6 per cent in 2000 to 86.4 per cent in 2022 (Exhibit 1). The semiconductors segment is expected to continue to be an important contributor to the cluster's VA as semiconductor companies ramp up their production capacities in Singapore.

Exhibit 1: Nominal value-added shares of segments in the electronics cluster, 2000 – 2022



Source: Economic Development Board

Over the past four years, the electronics cluster experienced an upturn followed by a downturn in line with developments in the global electronics industry

Over the period of the COVID-19 pandemic, Singapore's electronics cluster, along with those in regional economies such as Japan and South Korea, experienced a strong upcycle, driven by global consumer spending on goods during the pandemic (Exhibit 2). In particular, there was an increase in demand for electronic products, and hence the semiconductor chips used in these products, due to the growth in data centres and cloud services, as well as the greater prevalence of work-from-home practices during the pandemic.

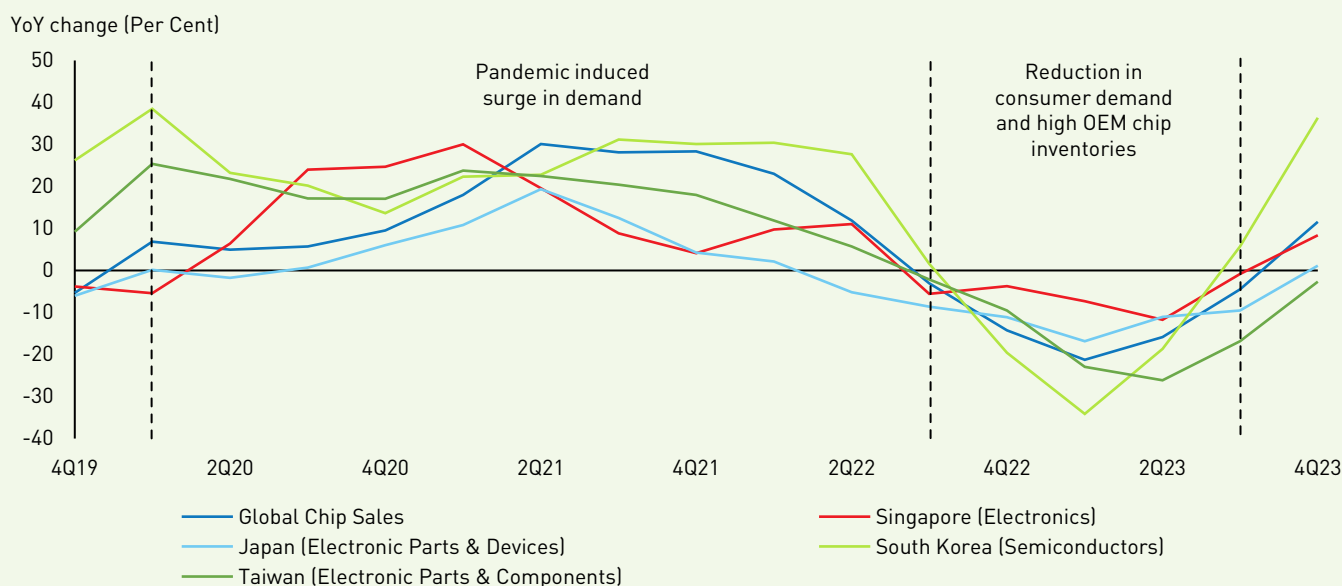
Indeed, the spike in demand, coupled with pandemic-induced supply chain disruptions (e.g., shipping delays and lockdowns), led to severe component and chip shortages globally. In response to these shortages, original equipment manufacturers (OEMs) of consumer electronics started to hold higher-than-normal levels of chip inventories to shore up supply chain resilience.

¹ See Kuan (2008) for a previous overview of the electronics cluster.

However, with the post-pandemic reopening, consumer spending on goods reversed from its pandemic-fuelled highs. Notably, there was a reduction in consumer demand in the smartphone and PC markets starting in 2H22. With demand softening, OEMs moved to draw down their chip inventories and cancelled orders placed with semiconductor manufacturers as they lowered their production of consumer electronics. Semiconductor manufacturers in turn slashed capacity utilisation and reduced their supply of chips to correct demand-supply imbalances along the supply chain.

Reflecting this global electronics downturn, Singapore's electronics output underwent five consecutive quarters of contraction from 3Q22 to 3Q23, with the extent of decline reaching 11.7 per cent year-on-year in 2Q23 before moderating to 0.8 per cent in 3Q23. Much of the fall in the cluster's output over this period was driven by the semiconductors segment. For the full year of 2023, electronics output registered a decline of 3.2 per cent, reversing the 2.6 per cent expansion in 2022. This electronics downturn was also seen in regional economies like Japan, South Korea and Taiwan.

Exhibit 2: Global chip sales and electronics industrial output in Singapore, Japan, South Korea and Taiwan, 4Q19 – 4Q23



Source: CEIC, Economic Development Board, World Semiconductor Trade Statistics

The domestic electronics cluster is expected to recover in 2024 following the normalisation of inventory levels and an increase in demand for PC, smartphone and automotive chips

With the bottoming of the electronics downcycle², the domestic electronics cluster is projected to recover over the course of 2024, driven by two main factors.

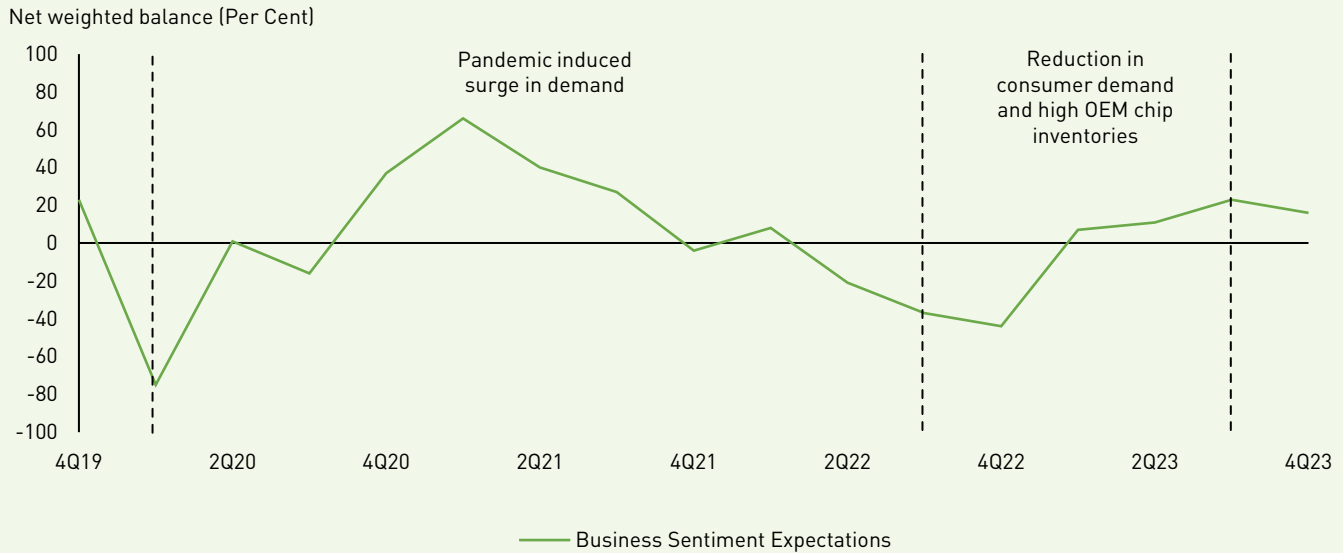
First, after several quarters of inventory drawdowns, semiconductor chip inventories at OEMs have trended down for several end markets. Semiconductor manufacturers also reported “rush orders” for chips as early as 3Q23, with some OEMs requiring urgent deliveries of chips after having depleted their inventories. The OEMs are expected to continue replenishing their chip inventories in the year ahead, thereby boosting the demand for chips from semiconductor manufacturers, including those in Singapore.

Second, shipments of both PCs and smartphones are expected to recover in 2024 after having contracted in 2023, driven by new refreshment cycles as consumers and enterprises upgrade their electronic devices. The automotive market is also projected to continue to grow, albeit at a more moderate pace as compared to 2023, underpinned by the growing market for electric vehicles (EVs). The growth in these end markets is expected to raise the demand for chips from semiconductor manufacturers, including those in Singapore.

² There were signs of improvement in the electronics cluster in 4Q23, with the cluster growing by 8.3 per cent during the quarter, reversing the 0.8 per cent contraction in the preceding quarter, supported by improved demand for smartphone and AI chips.

Reflecting domestic electronics manufacturers' positive sentiments in 2024, a net weighted balance³ of 16 per cent of firms in the electronics cluster are projecting improved business prospects for the period of January to June 2024 relative to 4Q23, a sharp reversal from the net weighted balance of -44 per cent recorded over the same period in 2023 (Exhibit 3).

Exhibit 3: Business sentiment expectations in the next six months relative to the current quarter for the electronics cluster, 4Q19 – 4Q23



Source: Economic Development Board

Over the longer term, while the PC and smartphone end markets are expected to mature, the automotive and artificial intelligence end markets are likely to continue to see strong growth

The drive to meet net-zero goals has prompted governments across the globe to subsidise the adoption of EVs. The International Energy Agency expects EV sales to reach 45 million in 2030, up from 10 million in 2022, if all announced government targets on electromobility are met in full and on time, representing a CAGR of 20.7 per cent. Moreover, EVs contain a significantly higher amount of semiconductor content as compared to non-EVs. These include power semiconductors used for voltage conversion, and battery management and microcontroller chips for advanced driver assistance systems. The rapid growth of the EV market, coupled with EVs' higher semiconductor content, are expected to boost the demand for automotive chips in the longer term.

Meanwhile, with the advent of generative artificial intelligence (AI), enterprise demand for AI servers has skyrocketed as such servers are deployed in the training and operation of large language models like ChatGPT. In turn, AI servers require chips such as graphic processing units, central processing units, application-specific integrated circuits and field-programmable gate arrays. At the same time, there will be higher demand for DRAM chips given the requirement for high bandwidth memory⁴ in AI servers, while NAND chips will also see demand growth due to the increase in storage capacities needed to support more numerous and larger datasets. As the AI ecosystem matures, the adoption of on-device generative AI⁵ in devices such as PCs and smartphones will further support the demand for AI-related chips in the longer term.

Taken together, while the PC and smartphone end markets are likely to register lower growth in the longer term as they mature, global demand for semiconductor chips is expected to remain strong, contributed in large part by the robust growth projected for the automotive and AI end markets.

³ Establishments were asked to indicate their expectations of general business conditions in terms of directional change (i.e., "up", "same" or "down"). Establishments' responses were then weighted by total output and aggregated to derive the weighted percentage for "up", "same" or "down" at the sub-cluster and cluster level. Net weighted balance was calculated by taking the difference between the weighted percentage of "up" responses and the weighted percentage of "down" responses. A positive number indicates a net positive balance or net upward movement, while a negative number denotes a net negative balance or net downward trend.

⁴ High bandwidth memory is made up of vertical stacks of DRAM chips, which allows for greater power efficiency and higher data read speed.

⁵ On-device generative AI will allow users to run large language models directly on their devices without the need to connect to generative AI models that are hosted on the cloud. This reduces privacy concerns while also allowing for greater customisability by taking advantage of available user data on the device.

Singapore's electronics cluster is poised for growth in both the short and long term

Over the coming year, the domestic electronics cluster is expected to benefit from the turnaround in global semiconductor demand, driven in part by the recovery in the PC and smartphone end markets, as well as the restocking of depleted chip inventories. Over the longer term, the cluster's growth will be supported by stronger semiconductor demand in the automotive and AI end markets.

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