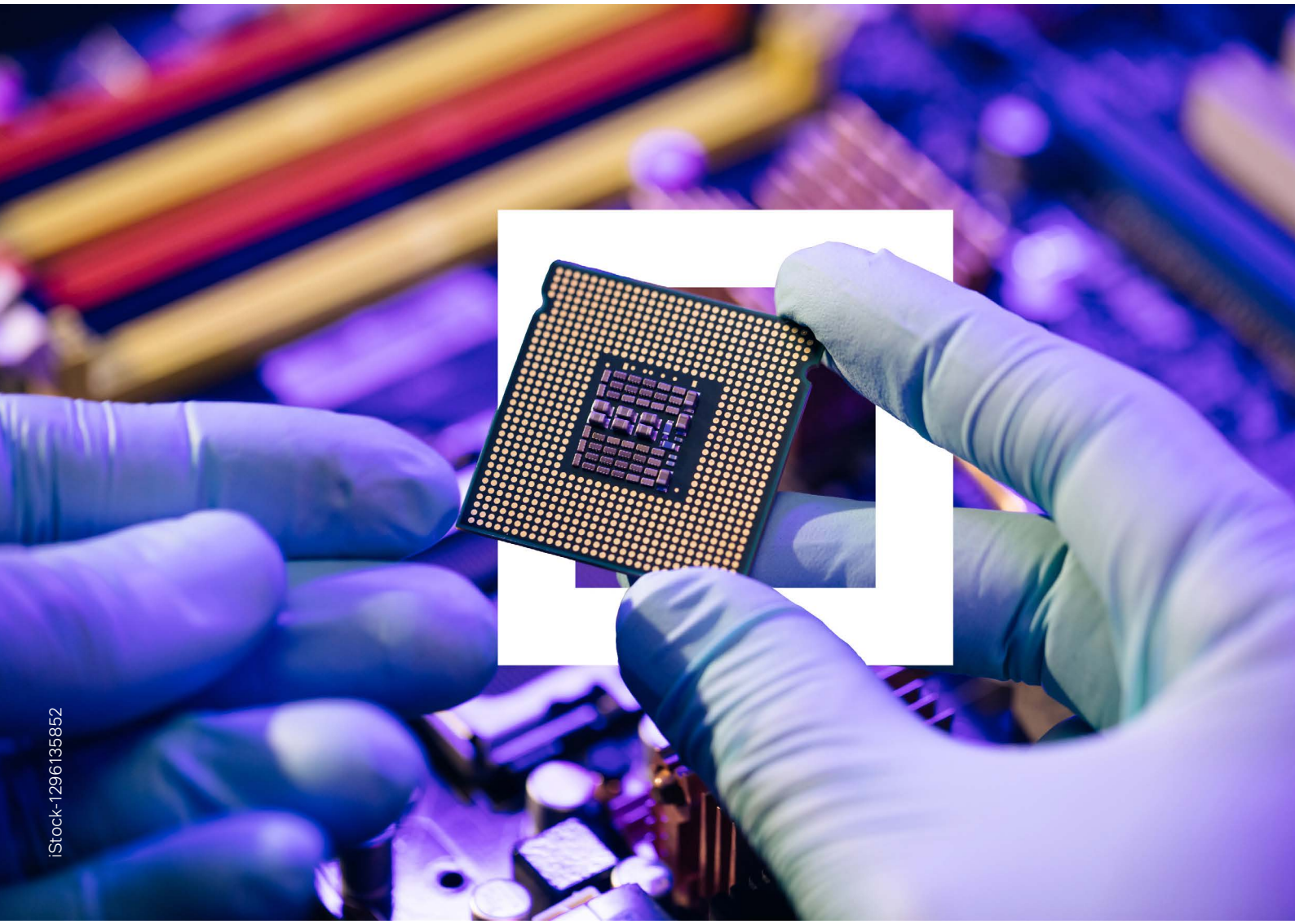
Analysis



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Semiconductors and the persisting shortages, two years later

Key take-aways

- One major cause of the global semiconductor shortages has been the global lockdowns during Covid-19, which caused disruptions to both supply and demand. When auto manufacturing and other key industries closed down, semiconductor suppliers shifted to fill the higher demand for consumer electronics and communications equipment. Then when businesses re-opened, there were few semiconductors available.
- Other causes of the shortages have been the scaling back of production levels during Covid-19, and the concentrated nature of the semiconductor supply market.
- Manufacturers' use of "Just-In-Time" models, and their excessive re-stocking, have exacerbated the shortages. Some manufacturers are opting to keep higher stocks going forward as one of the lessons learned from Covid-19.
- Many believe more manufacturing capacity will be added to meet an expected growing demand for semiconductors as more electric vehicles, robots, cryptocurrencies and other electronic gadgets come onto the market.

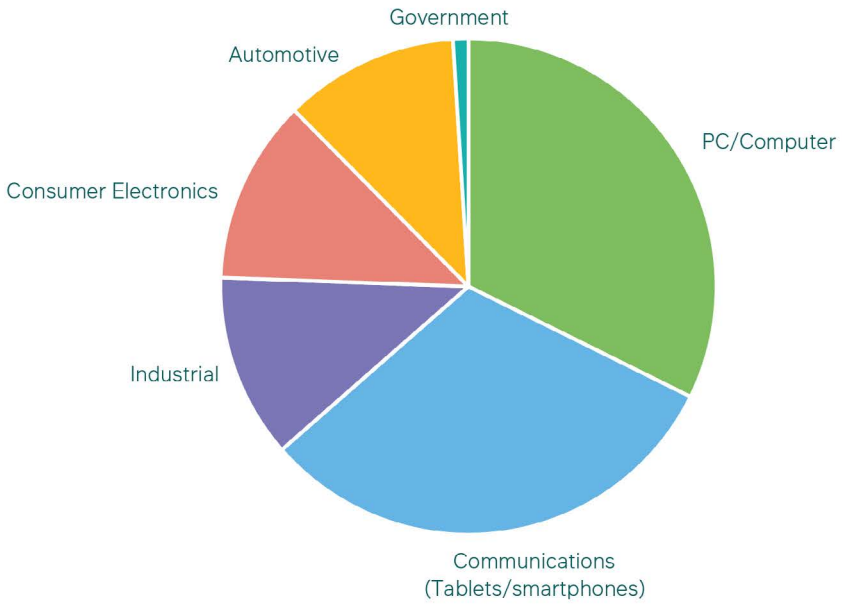
With the initial spread of Covid-19 in early 2020, life as we knew it changed almost overnight. The way we worked, socialised, and generally lived life transformed. To comply with lockdown regulations, global supply chains came to a standstill and manufacturing capacities across the world ground to a halt, as nations and businesses prioritised public health over profits and economic objectives. What was considered an essential service a month before, such as taxi or transport services, was no longer as critical, and other services, such as online meeting platforms, became more critical. It should therefore have been no surprise that, amid these conditions, dramatic supply and demand imbalances emerged as the pandemic evolved.

Fast forward to late 2020 into 2021, we began to learn of a rare development: new vehicle shortages. Car dealerships struggled to secure enough volumes of new vehicles to satisfy demand. The cause? Global shortages of those tiny but essential components in many everyday items – semiconductors.

About semiconductors

Semiconductors are silicon chips of varying sizes between 5-28 nanometers (one centimetre contains 10 million nanometers) which are packed with billions of transistors. As Graph 1 shows, these chips power the systems of all electronic devices, from cars, computers, cellphones, medical and industrial equipment to even the growing cryptocurrency market.

Graph 1: 2020 total global semiconductor demand share by end-use



Source: Semiconductor Industry Association (SIA)

The semiconductor industry can be categorized into three segments: upstream, midstream and downstream.

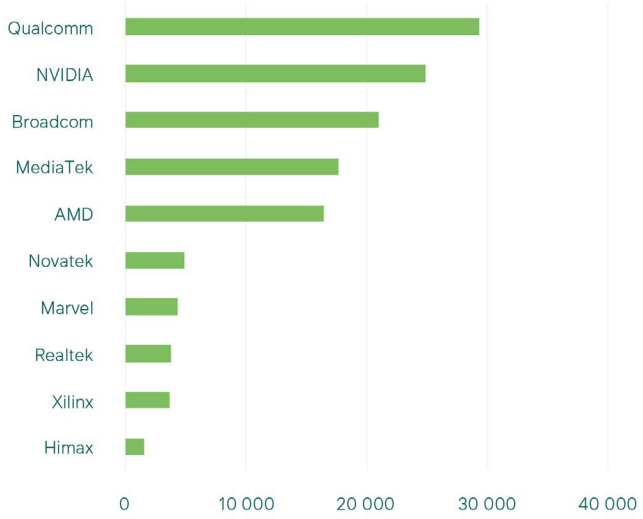
1. **Upstream** comprises the companies which design the chips and own the intellectual property, commonly known as "Fabless companies".

2. **Midstream** comprises the businesses involved in the manufacture of semiconductors. These manufacturers, referred to as "foundries", are seldom involved in the chip design and operate as contract manufacturers for the Fabless chip designers. Taiwan Semiconductor (TSMC) is the world's largest foundry, with 59% of manufacturing/foundry market share globally.

Integrated Design Manufacturers (IDMs) are those businesses which attempt to vertically integrate, by having their own in-house chip design and manufacturing. Korean electronics giant Samsung and the US technology firm Intel are two of the largest IDMs globally.

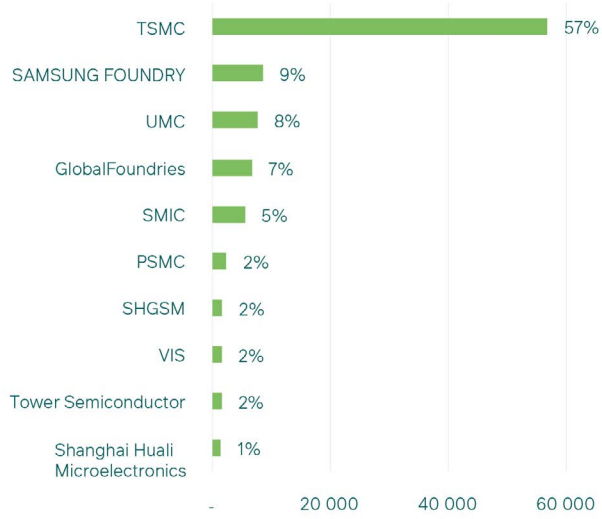
3. **Downstream** involves the testing and packaging of semiconductors.

Graph 2: Top 10 global fabless companies
(By revenue USD millions)



Source: TrendForce, March 2022

Graph 3: Top 10 global foundries by revenue
(By revenue USD millions)



Source: Gartner

What caused the shortages?

The answer to this question has continued to evolve over the past 18 months, but one can only explain it as a series of seemingly sporadic and unrelated events that have resulted in continued bottlenecks across the semiconductor supply chain. At the onset of the pandemic, auto manufacturers halted vehicle

manufacturing, as vehicle demand fell to almost zero, thus not absorbing their usual share of semiconductor supply. Instead, the communications equipment and consumer electronics sector, which saw a surge in demand driven by work- and school-from-home, absorbed the capacity that ordinarily would have been allocated to auto manufacturers.

Then 12-18 months into the pandemic, as infection rates began to ease, vaccine rollouts were ramping up in most developed nations, and economies began returning to “normal” operations, pent-up demand for vehicles emerged, and auto manufacturers began to re-open for operation. However, a major hurdle emerged at this point - chip capacity that had previously been allocated to the automotive sector had been reallocated to other active sectors. Traditionally, auto manufacturers operate on a just-in-time (JIT) basis, which means they order components on an as-needed basis and keep very low inventories of components on hand. So they faced a challenge in being able to source sufficient chip volumes to meet their production schedules. Meanwhile, demand for consumer electronics was still relatively high, as businesses such as Apple, Dell and the like were taking more than their fair share of the semiconductor output.

Furthermore, not only were automakers ordering chips to meet their current production needs, but they were also attempting to build up their inventory of chips, thus ordering more than current requirements, as one does after having experienced a severe shortage. This exacerbated the supply constraints, causing demand to appear unusually high.

On the supply side, chip manufacturers were intermittently required to scale back their operating levels to comply with respective national lockdown requirements. For example, in Malaysia, where an estimated 14% of global chip packaging and testing capacity is located, in the second half of 2021 as the Omicron variant took hold, factories were required to operate with reduced workforces (at the lowest point only about 47% of the workforces in Malaysian factories were operational). So, in an environment where there was an influx of demand, some supply capacity was being sporadically removed, further contributing to the problem.

Lessons learned in the industry

A few important lessons have been learned from the ongoing supply bottlenecks that could potentially change the way businesses will operate going forward. Among these is that auto manufacturers are likely to permanently reconsider their JIT model, which has rendered them unable to operate effectively in the face of supply chain problems. Going forward they are likely to begin to carry higher component inventories on hand, which can be corroborated by the current over-procurement trends.

Also, the world's capacity for chip manufacturing is concentrated in Asia, most notably in Taiwan, which accounts for 65% of the world's production capacity. When there is a seamless flow of goods across borders, this is not a problem, but this condition did not hold during the height of the pandemic. This has resulted in major governments across the US and Europe committing billions of dollars in capital spending to build manufacturing facilities in different parts of the world – yet another form of de-globalisation.

Outlook: When will the supply constraints ease?

One school of thought has been that existing semiconductor production capacity is sufficient for normal demand, so that if customers ceased trying to build up inventories quickly and global supply chains returned to full and normal operations, we could see an easing in the current supply tightness.

However, another school of thought is that there have been structural changes on the demand side and that new supply needs to come online to correct the current tightness. One can see the merits to this argument:

- Most of the world has adopted a hybrid working environment where both a home and workplace working station is maintained, necessitating additional equipment used per person.
- With the electrification of vehicles and the move to Assisted Driving Systems (ADS), chip content within a vehicle is significantly higher today compared to a decade ago.
- Artificial intelligence, 5G, the Internet of Things... all potentially introduce multitudes of new-use cases for semiconductors. And this is not forgetting the proliferation of cryptocurrencies, where crypto mining has been a growing source of demand for semiconductors.

As it stands, a majority of the global capacity for semiconductor production is fully operational, yet shortages persist. This can be attributed to the logistics challenges we are faced with at the

moment – shipping container availability, the structural demand changes discussed above and customers continuing to build up inventories. In the short term, it appears that the shortages may persist, while chip manufacturers work on building additional capacity. The complete construction of a semiconductor "fab" takes two to three years, and these specialised factories are required to have extremely clean, dust-free environments with regulated temperatures and humidity levels.

Semiconductors are to a large extent commoditised products, and due to the current supply tightness and favourable pricing, there is increased motivation to add to capacity. Several of the world's largest chip manufacturers have in the last year announced investment projects to expand capacity in various geographies: TSMC is building a fab in Arizona; Samsung plans to spend US$116 billion over the next decade developing manufacturing capacity; and Intel has committed US$20 billion for capacity expansion. Therefore we can expect to see a gradual easing of supply constraints over the next 12-24 months as this additional capacity comes online.

Impact on local auto companies

Looking at the local new vehicle market, the updates at this point from South African auto dealers indicate that the shortages in new cars are persisting. However, it is the higher-end or premium vehicle segment, with higher chip content, that is still impacted the most. Lower-end and value brands are impacted to a lesser extent. Listed auto groups Motus and CMH (Combined Motor Holdings), which we hold in our client portfolios, are geared to the value segment of the auto market and thus should be seeing a

slight improvement in supply, however not anywhere near reaching pre-pandemic levels. The result is that new car prices remain high, and margins in new car sales are still at peak levels, contributing to good profitability for these companies. However, this is offset somewhat by lower sales volumes versus 2019 levels. Looking ahead, we believe that the current market valuations of Motus and CMH are still attractive amid these changing dynamics in the global semiconductor market, and continue to hold them in our client portfolios. □

Boitumelo joined M&G Investments in January 2021 as a Trainee Equity Analyst, and is currently responsible for investment research in the South African and emerging markets. With three years of industry experience, Boitumelo previously worked for Allan Gray, where she completed her SAICA (CA(SA)) articles, rotating throughout the business, in finance, risk and investment analyst roles. Boitumelo's qualifications include: B.Comm (CA Stream) and Post Graduate Diploma (Accounting), both from the University of Cape Town and with distinction. She is also a qualified Chartered Accountant (SA).