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How Long Will the Semiconductor Crisis Affect the Traditional Automotive Sector?

Implications for car fuel demand

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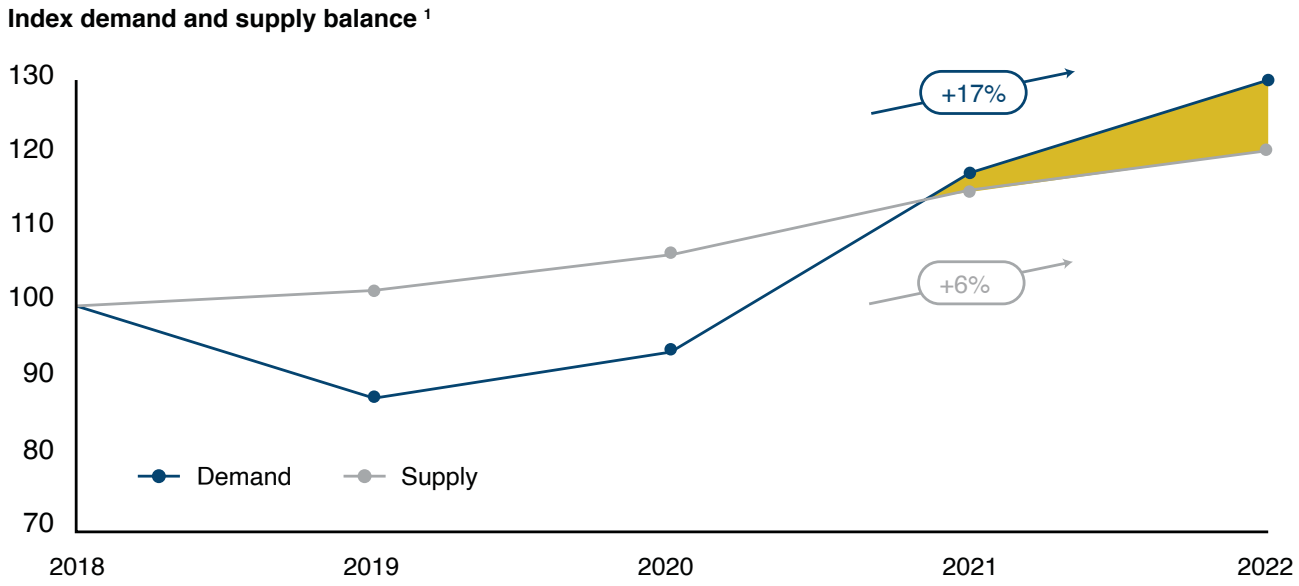
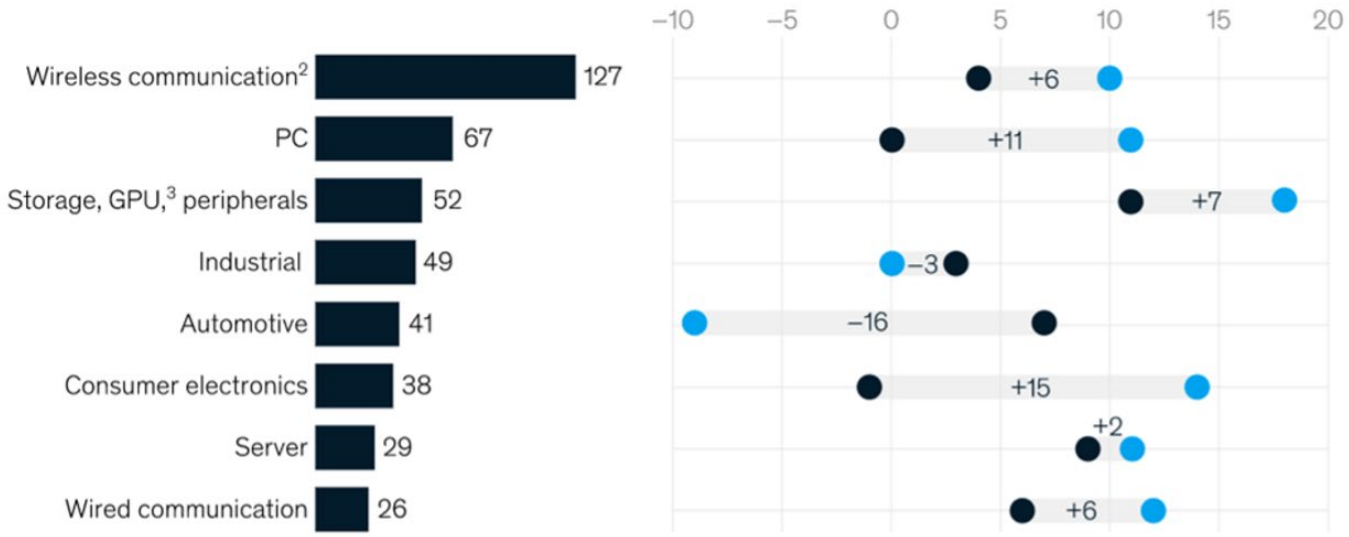
The 2020 semiconductor crisis has hit the automotive sector, as well as many other sectors. As a consequence of the COVID-19-induced shock, a worldwide semiconductor supply-demand imbalance arose between 2020 and 2022. Demand grew by around 17% annually while manufacturing capacity grew by only 6% annually (Figure 1). However, this supply-demand gap was not uniform across all semiconductor applications. For instance, during the early months of the COVID-19 pandemic (i.e., the first half of 2020), car demand plummeted by as much as 80% in Europe, 70% in China, and over 50% in the United States (U.S.). Due to a lack of demand, automobile manufacturing facilities shut down, and semiconductor chip orders for vehicles plummeted. According to some estimates, the demand for semiconductors in the automotive industry in 2020 was 15 percentage points below the pre-pandemic estimates, as shown in Figure 2. In contrast, other sectors increased their chip purchases as remote work and the need for connectivity during lockdowns boosted demand for computers, servers, and wired communications equipment that use semiconductors. In particular, the demand for semiconductors from other industries is believed to have exceeded pre-pandemic growth expectations by 5% to 9%. While the latter half of 2020 witnessed a somewhat higher than anticipated recovery in new car sales in some parts of the world, such as China, due to the easing of lockdowns, automakers did not increase chip orders due to imprecise sales projections. Moreover, by then, the semiconductor industry had already adjusted its manufacturing output to meet other industries' growing demand.

Figure 1. Demand and supply prospects for semiconductors.



Source: Meissner et al. (2021)

Figure 2. (a) Semiconductor sales in 2019 by application; (b) forecast versus actual sales growth (%) for 2020.



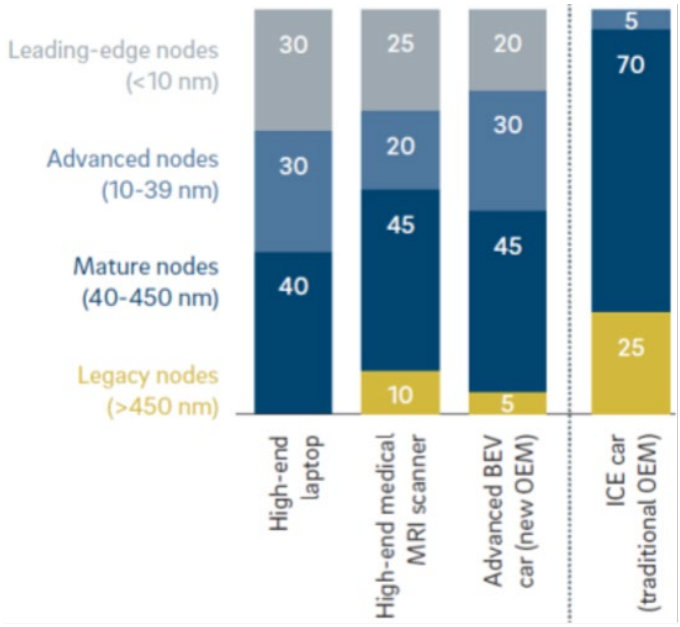
Source: Burkacky, Lingemann, and Pototzky (2021).

To address the supply-demand mismatch, key semiconductor suppliers are investing in new production. However, not all semiconductor devices use the same type of semiconductors. Increased manufacturing capacity for leading-edge semiconductors, essentially smaller and faster chips used in high-end laptops (Figure 3), is on the way, since most recent investments have been directed toward them (Figure 4). However, due to limited capacity growth plans, legacy semiconductor devices are projected to remain in low supply. Due to the significant demand for these legacy and mature nodes[1] in the conventional automotive sector (Figure 3), the supply of traditional internal combustion engine (ICE) cars is expected to remain constrained in the short term. By contrast, new electric car manufacturers have an advantage: They utilize leading-edge chips, which are receiving most of the new investment.

The global short-term supply constraints for new ICE vehicles has led to a decline in new car sales, an increase in the price of new cars, and a migration of customers to an already overpriced used car market. These trends are likely to continue in 2022. For instance, between 2020 and the beginning of 2022, new car prices in the U.S. increased 27% year-over-year while used car prices increased by 36% over the same period, as shown in Figure 5.

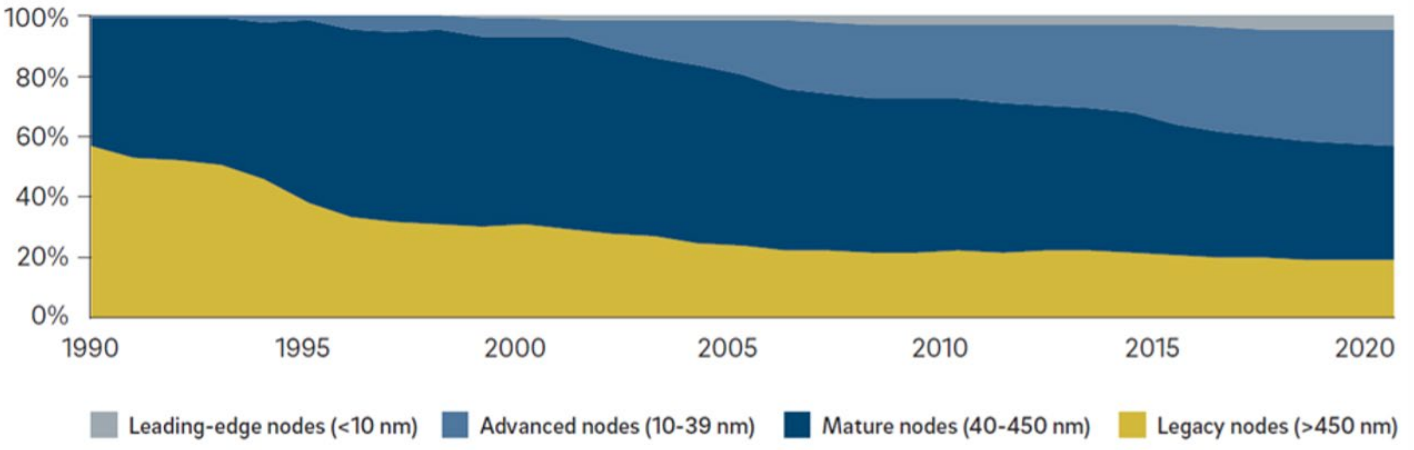
[1] The term 'node' is used to describe a particular semiconductor manufacturing process and the rules that govern it. In general, the lower the technology node, the smaller the feature size, resulting in smaller, quicker, and more power-efficient transistors.

Figure 3. Semiconductor usage in selected devices.



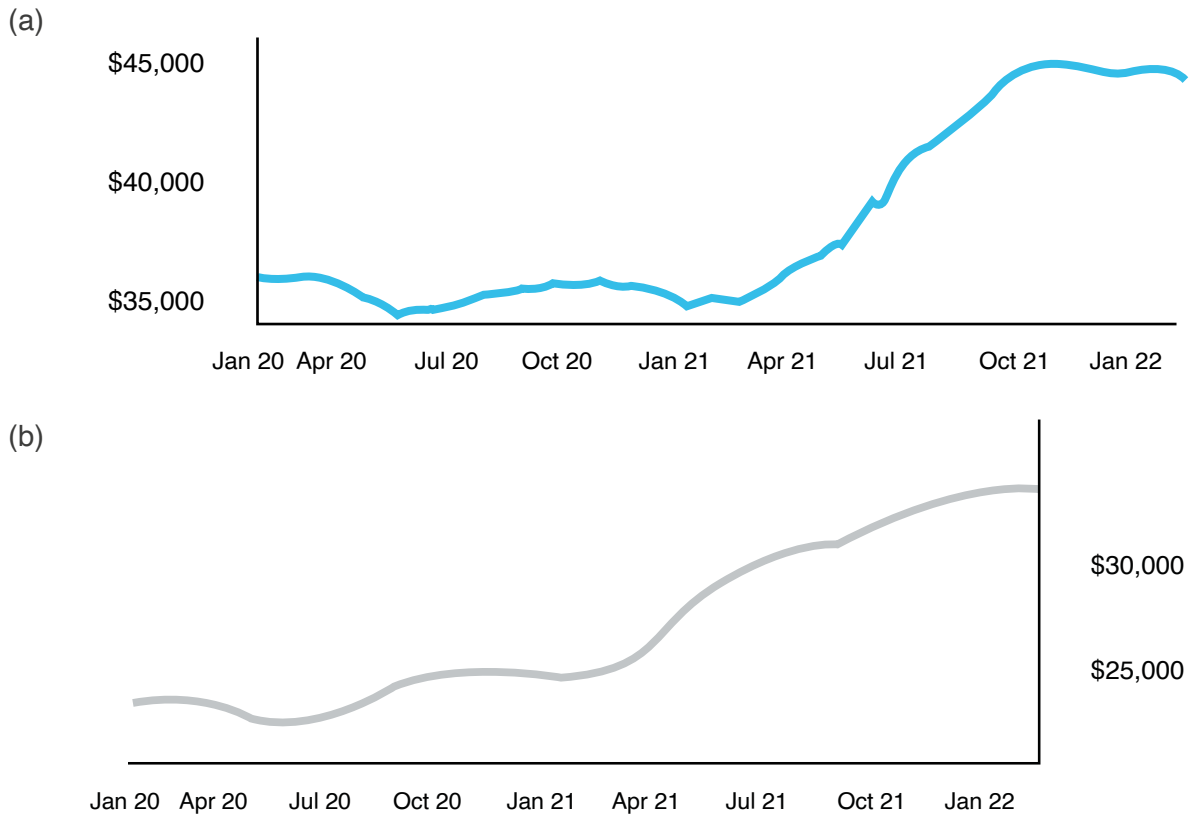
Source: Meissner et al. (2021)

Figure 4. Share of total installed semiconductor production capacity (%)



Source: Meissner et al. (2021)

Figure 5. U.S. car prices for (a) new and (b) user cars.



Source: Shefska (2022).

A continued trend of fewer new car sales due to reduced supply and correspondingly higher prices for both new and used cars could lead to an increase in the use of alternative modes of transportation. For instance, countries with well-established public transportation systems, such as European nations, may see an increase in public transportation usage. In other countries, such as the U.S., households may decide to increase their use of emerging modes, such as ride-hailing, or keep their older cars rather than scrapping them. Bento, Roth, and Zuo (2018) report an elasticity close to 1 between the number of new cars sold and the number of cars scrapped in the U.S.[2] Thus, a decline in new car sales is likely to be accompanied by a proportional decline in the scrappage of old cars. Correspondingly, it could be argued that the overall impact of decreased new car sales due to the semiconductor crisis on gasoline and diesel demand is unlikely to be significant, particularly in countries like the U.S. that have fewer well-established alternatives to car use. Globally, it is anticipated that the number of new cars sold in 2022 will be approximately 12.3 million fewer than in 2019 (Winton 2022), which represents approximately 1% of the global car stock of approximately 1 billion vehicles (Albrahim et al. 2019). It is unlikely that a 1% decrease in the global car stock, which is likely to be mitigated by a decreased scrappage of older cars, will have a significant impact on gasoline and

[2] Bento, Roth, and Zuo (2018) report that the elasticity of the used car scrappage rate in relation to the turnover rate is approximately 1. The used car scrappage rate is defined as the number of cars scrapped divided by the number of cars in operation, and the turnover rate is defined as the number of new cars registered divided by the number of cars in operation.

diesel demand in the short term. In addition, because a scrapped vehicle has a lower fuel economy than a new one, the potential reduction in gasoline and diesel consumption is likely to be diminished and could even be reversed.

In the mid-term, multiple semiconductor suppliers have announced fabrication plant conversions, but they are unlikely to be sufficient to address the supply gap in mature nodes before 2023 (Meissner et al. 2021). As a result, experts anticipate that automakers will cancel plans to produce seven or eight million cars in 2022 and four million cars in 2023, as demand for semiconductors exceeds supply by 10% (Schuh et al. 2022). In the long-term (five-year horizon), traditional automakers are likely to shift to centralized designs based on advanced and leading-edge nodes, even in ICE cars.

In conclusion, it appears likely that the semiconductor supply-crisis-induced increase in car prices will persist until 2023, albeit without a significant impact on car fuel demand.

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