An Analysis on the Crisis of "Chips shortage" in Automobile Industry
——Based on the Double Influence of COVID-19 and Trade Friction

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Abstract: The COVID-19 pandemic and various infection control measures have made a great impact on the regular operation of global integrated circuit companies, which caused the "Chips shortage" Phenomenon in the automotive industry. Based on data collected from official channels, industry associations, SIA and enterprises, this paper performed an empirical analysis on the structure of global integrated circuit market, and studied supply and demand in the market. The results of the analyses showed that: 1) the pandemic control measures and the re-allocation of market resources are the short-term factors unbalancing the supply and demand for automotive chips. 2) the global shortage of Chips of the automotive industry may continue and the risk of breaking the industrial chain is increasing. Because it is a long industry chain which relies on efficient cross-border collaboration, but it is lack of international prevention and control cooperation mechanism altogether. The current situation presents both challenges and opportunities to China. This paper proposes that China should take efforts in strengthening international cooperation; and improve the core competitiveness of China's chip industry by the top-level designing and encouraging domestic enterprises to invest in research and development, and to improve their technical performance.

1. Introduction
It is well-known that mobile phones and computers cannot be produced without chips. However, the "chips shortage" trends appeared in the second half of 2020 actually started in the automobile industry, which gradually attacked other industries. Generally, hundreds of chips are required for producing one car. Affected by both the COVID-19 and trade frictions, the industrial chain normality of the long-term tight supply and demand balance between upstream chip suppliers and downstream car manufacturers in the automotive industry has been broken. From the second half of 2020, many automobile manufacturers have no choice but to close partial production lines affected by the chip supply issues. For example, Volkswagen and Toyota have closed certain production lines in Chengdu and Guangzhou in China. And Fiat Chrysler has suspended the car production of plants in Mexico and Canada. Meanwhile, Nissan and Daimler reduced their automobile production in Japan and Europe. In addition, the automobile stocks in China's A-share market have also fallen sharply in stages for the "chip shortage". Why does the automobile industry suffer the chips shortage? How to break the dilemma? It is worth researching and discussing on how do automobile enterprises cope with the crisis of "chips shortage", and improve their emergency management capabilities.
2. Analysis of the reasons of the chips shortage in automotive industry

2.1 COVID-19 is a short-term factor breaking the tight supply and demand balance of automotive chips

Why did the automobile industry suffer the chips shortage first? Statistics showed that automotive chips only accounted for a relatively low proportion of global chip production capacity, with 12% of global chip production capacity in 2019 (shown in figure 1). The automotive chip industry refers to the order economy. And the industry chain normality of the long-term tight supply and demand balance between upstream chip suppliers and downstream car manufacturers has been impacted by the pandemic (Zhang Rui, 2021).

First, the pandemic prevention measures have disrupted the production. Various production factors were restricted due to the pandemic prevention and control measures. Measures such as personnel isolation, flight and port restrictions have suspended the production of chip enterprises, resulting in passive reduced production capacity and shipments. Under such circumstances, shipments could not be arranged on time since the production capacity was affected by the supply chain constraints. As a result, a large number of fabs and packaging and testing plants were forced to reduce their production scale. So that the sales of automotive chips had reached the bottom in April and May, 2020 (shown in figure 2).

Second, the semiconductor industry re-allocated resources due to the pandemic. Since automobile manufacturers had no choice but sharply reduced their production capacity affected by the pandemic,
demands for automobile chip suppliers decreased accordingly. Meanwhile, home office and classes online for students became popular due to the pandemic. So that demands for products such as computers, smartphones, game consoles increased. To this end, chip manufacturers seized the opportunity and switched their resources to highly-needed consumer electronics products of mobile phones and computers to cope with the crisis of insufficient orders of automotive chips. Such a change had also strengthened their special preference for these three major categories of chips (approximately accounting for 75% of the market share). Even if automobile manufacturers expands their future chip orders, chip manufacturers will still lower their impulse and enthusiasm in re-configuring the production lines.

Third, the chips shortage situation in automobile industry continued for market demands and resources mismatch. Currently, more and more global manufacturers rush into chip design, while less manufacturers engage in chip manufacturing constrained by the high barriers of cost and technology. As there was no manufacturer of the chip able to pick up orders, capacity was constrained. On the other hand, many chip manufacturers have transferred their resources to the more advanced and profitable 12-inch wafers over the past years, which directly decomposed the production capacity of the original 8-inch wafers. However, based on cost and usage habits, the markets continues its strong demand for old products with its own preferences. In this regard, the chips shortage in automobile industry is a kind of structural shortage. And it will continue and intensify as long as no upgrade and shift in demand appear.

2.2 "Chips shortage" in automobile industry may continue for the high-degree globalization of the industrial chain and the "high sensitivity" of geopolitics

Even though the high-degree globalization of the automotive industry chain has indeed greatly improved the efficiency and reduced costs, risks are hidden behind. The production of automotive chip electronic components requires multiple processes, most of which are usually completed in different factories distributing around the world. Problems occurred to any link may suspend the production schedule and delay the supply. In addition, the production process lasts for several months. The longer the time is required, the more uncontrollable factors may occur. Since the pandemic still affects, the chips supply can be impacted more easily by the economic conditions, geopolitics, and especially the trade frictions for the high-degree globalization of the automotive chip industry chain.

In a short-run, based on the current global chip design and manufacturing capabilities, the chips shortage in automotive industry may be improved in the short term after re-allocating resources. However, since 6 to 9 months are needed for the automobile chips to be designed, manufactured, packaged and tested, and delivered to car manufacturers(shown in figure 3), it is quite difficult to improve the chip shortage cycle in the global automotive industry before 2022.

For a long-run, as the automobile industry expands towards to the electrification and intelligence, demand for chips in automotive industry will be multiplied. The chips shortage in China's automobile industry may become a fatal rope "sticking" the development neck, so that crisis of chips shortage in automobile industry may continue to repeat for a long time. The objective fact of "chips suspension" suffered by Huawei and other enterprises vividly manifests the importance of breaking, and mastering and controlling the industrial chain, especially for China, the largest automotive consumer market in the world, and even the world’s largest consumer market for smart cars in the future. And the sensitivity of market derived from automotive chips will be more intensified.
3. Analysis on the strategy taken by the automobile industry in coping with chips shortage crisis

3.1. Policies issued by governments of various countries in coping with the "chips shortage" crisis in automobile industry

Although Europe has always been leading the machinery manufacturing, automobiles and other fields worldwide, it shows drawbacks in chips development. Germany, which relies on the important pillar of automobile industry, has realized the seriousness of the problem form the global chips supply crisis. So that the German Automobile Industry Federation has called on the German government to take relevant measures to insist enterprises solving the chips supply crisis.

And the Ministry of Industry and Information Technology of the People’s Republic of China has proposed to contribute more efforts in researching on automotive semiconductor technology, so as to break the "chips shortage" dilemma faced by the automobile industry, promote the connection of supply and demand, work hard in the technical research on automotive semiconductors, improve the manufacturing capacity of automotive semiconductor production, guide the construction of vehicle-level verification trial capacity, and strengthen the application and promotion of excellent automotive semiconductor solutions.

3.2. Strengthen international cooperation and communication, and jointly cope with the chips supply suspension risk

China should strengthen the communication with international communities, so as to promote the synergy between the upstream and downstream of the integrated circuit industry chain. Under the current globalization system background, as the two largest economies in the world, China and the United States should notice that "reconciliation benefits both, and struggle injuries both" in both pandemic prevention and control and the economic development. Therefore, communication shall be strengthened to achieve the synergy with European and American countries in integrated circuit and other industrial fields, and research a consensus on cooperation and build mutual trust in coping with the pandemic and restore the economy.

In Asia, China should promote the synergy between the upstream and downstream of the integrated circuit industry chain with Japan and South Korea. Because China, Japan and South Korea are highly complementary in integrated circuit industry chain. A basic closed loop of the industry china will be built with Japan's materials and equipment, South Korea's manufacturing capacity and China's application market. Meanwhile, China, Japan and South Korea are close geographically and share similar humanities. The mutual assistance in fighting against the pandemic favors them to overcome the difficulties, and further promotes the effective cooperation of the three parties. Regarding the integrated circuit and other industries with close industry chain, the governments of the three countries should cooperate to promote the establishment of the synergy mechanism covering multiple links such as production and marketing docking, logistics and transportation, and trade clearance.

3.3. The country should strengthen the top-level design, increases the localization rate of chips, and improve the independent controllable ability

Till now, the top 5 global automotive chip suppliers have occupied about 50% of the global automotive chips market. Although China's automobile production occupies one-third of the world's total, its automobile chips production only occupies 5% of the world’s total. Moreover, 100% of the core chips such as MCU and other key products are imported.

Considering from a long-term running, China should seize the pandemic of forcing the domestic substitution as an opportunity to strengthen the top-level design, contribute more efforts in supporting the automotive-grade chip industry, so as to make breakthroughs in domestic chip technology. In addition, it should formulate the development outline for domestic automotive chip technology, clarify the development objective of automotive chip localization rate, issue key support policies, strengthen the intellectual property protection, guide domestic enterprises to research and make breakthroughs and promote applications, constantly break through technical bottlenecks, expand and perfect domestic
integrated circuits industry chain, gradually increase the self-sufficiency rate of chips to cope with the increasing growing demand of automotive chips.

Considering from a short-term running, the national authorities should actively establish information release and transaction matching platforms for semiconductor enterprises and automobile enterprises in China, so as to achieve the direct connection of supply and demand, and improve the coordination synergy level and capacity utilization of domestic upstream and downstream enterprises to compensate for the foreign chips shortage.

3.4. Enterprises should cooperate with various parties, and take precautions from multiple perspective to cope with chips shortage crisis

Chinese enterprises should strengthen the overall coordination of production plans within a short term, so as to cope with chips shortage crisis. Meanwhile, automobile enterprises can strengthen coordination and cooperation with the upstream suppliers, and actively search for alternative products to cope with the current chips shortage in the short-term period. And in the long-term period, China should actively invest in the independent R&D and the production of chips.

Right now, domestic enterprises hold a conservative attitude in investing in chip supply chain. As a result, the automotive chip production capacity is squeezed, resulting in "popular upstream and unwanted downstream". Besides, the development of automotive semiconductor and key parts industry is also constrained for lacking of relevant standards and verification systems. And supply chain security issues become prominent. We suggest that enterprises as the front line of the production, can actively provide suggestions to the government to propose specific and feasible precise policies to support the development of automotive chip design and manufacturing enterprises, and improve the core competitiveness of China's chip industry.

4. conclusion

Affected by COVID-19, automotive semiconductor industry suffered passive reduction of production. Meanwhile, "chips shortage" attacked the global automobile industry due to the re-allocation of market resources. Although the situation can be improved within a short period, the "chips shortage" may continue to impact the global automobile industry for the high-degree globalization of the automobile chips industry chain and the “high sensitivity” of geopolitics, the continuous pandemic, and the uncertainty of trade frictions. To this end, this paper emphasizes that China should strengthen international cooperation to jointly cope with the chips supply suspension risk. Meanwhile, China should also strengthen the top-level design, increase the localization rate of chips, and improve the independent controllable ability of the industrial chain. And enterprises should cooperate with various parties, and take precautions from multiple aspects to cope with the "chips shortage" crisis of the automotive industry in a long-term running.

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