The Discrepancy between Microchip Production and Automotive Industry born in Covid Pandemic Period 2019-2022

Maria Cvetanova Hristova – Politicova
PhD, University of National and World Economy (UNWE)
Sofia, Bulgaria
Email: Lazur2000 [AT] yahoo.com

ABSTRACT – ***During the Covid-19 pandemic period the tiny particles - the microchips proved to be in high demand by various industries – from IT to the production of simple consumer goods. Main objective of this analysis is to explain the reasons for the shortage of chips and semi-conductors for the automotive industry as the auto maker resumed their activities after the lock downs. Haltering of orders by the major auto producer and rerouting of chip production towards supplies for the electronic industry which proved willing to pay more are the main reasons. Trade specialization and globalization which are endemic for the contemporary world economy do not help to restore the broken supply-demand equilibrium of microchips.***

Keywords--- supply-demand equilibrium, anti-pandemic measures, discrepancies in the international trade, restructuring of microchip industry, flaw in global supply chain, shortage of chips, automotive industry

1. INTRODUCTION

Contemporary global world proved to be extremely vulnerable to the spread of negative phonomenons. The Covid pandemic very rapidly grew from regional to global pandemic. What is more it caused huge discrepancies in international trade, broke the smoothly running global supply-chain. The pandemic period radically changed the world, the ordinary life routine, the way people communicated and all this became possible due to "small" digital revolution that silently took place. A process of technological restructuring was triggered and the only way to adapt to it proved further restructuring in connected industries.

2. METHODOLGY

The main methods involved in the study are the most popular scientific methods these of analysis, synthesis, induction and deduction. Method of induction is applied in the empiric verification of hypothesis. Statistical data concerning the studied issue are collected, systematized and analyzed. The process of analysis is supported by scientific descriptions and comparisons of data. Certain tendencies are observed and on their basis respective conclusions are drawn.

3. ANALYSIS AND FINDINGS

3.1. What Initiated the Deep Discrepancy in Chips Supply-demand Equilibrium?

The main goal of this analysis is to reveal the reasons for the shortage of chips for the automotive industry following the global spread of Covid-19 pandemic. What actually has initiated the process is that the automakers strictly applied anti-pandemic measure in the form of plant closures. Major automakers have elected to halt production in the US and Europe.

Ford shut down all European and North American production on March 19 to help combat the spread of COVID-19. While Ford intended to reopen facilities and restart production on March 30th, the company on March 31st delayed that goal indefinitely and actually only in the beginning of May announced that it will return to work on May 18th. GM joined Ford on March 18th in informing about a total suspension of all North American production starting March 19th . The automaker made the decision to build personal protective equipment on its own before the Trump administration forced it to do so by invoking the Defense Production Act before resuming work on May 18th. FCA also suspended all North American operations to help stop the spread of COVID-19 between March 18th and May 18th. Mercedez-Benz, Mazda, Astin Martin, Volvo, Jaguar – Land Rover, Wolkswagen, BMW, Toyota, Nissan closed their plants for the same period [1].

After a bleak 2019, which already saw a marked decline of almost 5% in world auto production (down to less than 92.2 million cars, trucks and buses) and which has ended 10 years of growth, the world auto industry faces a new, unprecedented challenge in 2020 due to the COVID pandemic. With shutdowns of a large part of the auto industry and its many suppliers around the world during several weeks, 2020 marks "the worst crisis ever to impact the automotive industry, a key sector of the world economy" according to OICA's president, Mr FU Bingfeng.

The collected data show a 16 % decline of the 2020 production, to less than 78 million vehicles, which is equivalent to 2010's sales levels [2].As noted by Mr Fu, "the 2020 results wipes off all the growth made over the last 10 years".

Europe as a whole sees a drop in auto production of more than 21 % on average [3]. All main producing countries have sharp declines, ranging from 11 % to almost 40 %. Europe represents an almost 22 % share of the global production. In America, the 2020 production of 15,7 million units represents a 20 % share of the global production. The NAFTA region sees production declining by more than 20 %, with U.S. manufacturing declining by 19 %.

Table 1: World motor vehicle production 2019-2020

WORLD MOTOR VEHICLE PRODUCTION BY COUNTRY/REGION AND TYPE

UNITS	YTD 2019	YTD 2020	VARIATION	SOURCES
ALL VEHICLES	Q1-Q4	Q1-Q4		
EUROPE	21 579 464	16 921 311	-21,6%	
EU 28 countries	18 002 188	13 771 638	-23,5%	
EU 15 countries	13 622 777	10 189 787	-25,2%	
AUSTRIA	179 400	104 544	-41,7%	WKO
BELGIUM	285 797	267 460	-6,4%	Febiac
FINLAND, CARS ONLY	114 785	86 270	-24,8%	VDA
FRANCE, CARS AND LCV ONLY	2 175 350	1 316 371	-39,5%	CCFA
GERMANY, CARS AND LCV ONLY	4 947 316	3 742 454	-24,4%	VDA
ITALY	915 291	777 165	-15,1%	ANFIA
NETHERLANDS, CARS ONLY	176 113	127 058	-27,9%	VDA
PORTUGAL	345 688	264 236	-23,6%	ACAP
SPAIN	2 822 632	2 268 185	-19,6%	ANFAC
SWEDEN	279 000	249 000	-10,8%	Bilsweden
UNITED KINGDOM	1 381 405	987 044	-28,5%	SMMT
AMERICA	20 148 849	15 690 215	-22,1%	
- NAFTA	16 822 606	13 375 622	-20,5%	
CANADA	1 916 585	1 376 623	-28,2%	
MEXICO	4 013 137	3 176 600	-20,8%	
USA	10 892 884	8 822 399	-19,0%	

Source: OICA(International organization of Motor Vehicles Manifacturers)

OICA also compiles sales/registration figures in its member countries. The 2020 sales trend shows a similar decline, however limited to around 12 % [4].

The massive automotive plants closures for average 2,5 months in the spring of 2020 lead to huge production drop which is supported also by drop of sales. It can be stated that the interruption of the global chip supply chain has been initiated by halted orders to producers by the automakers

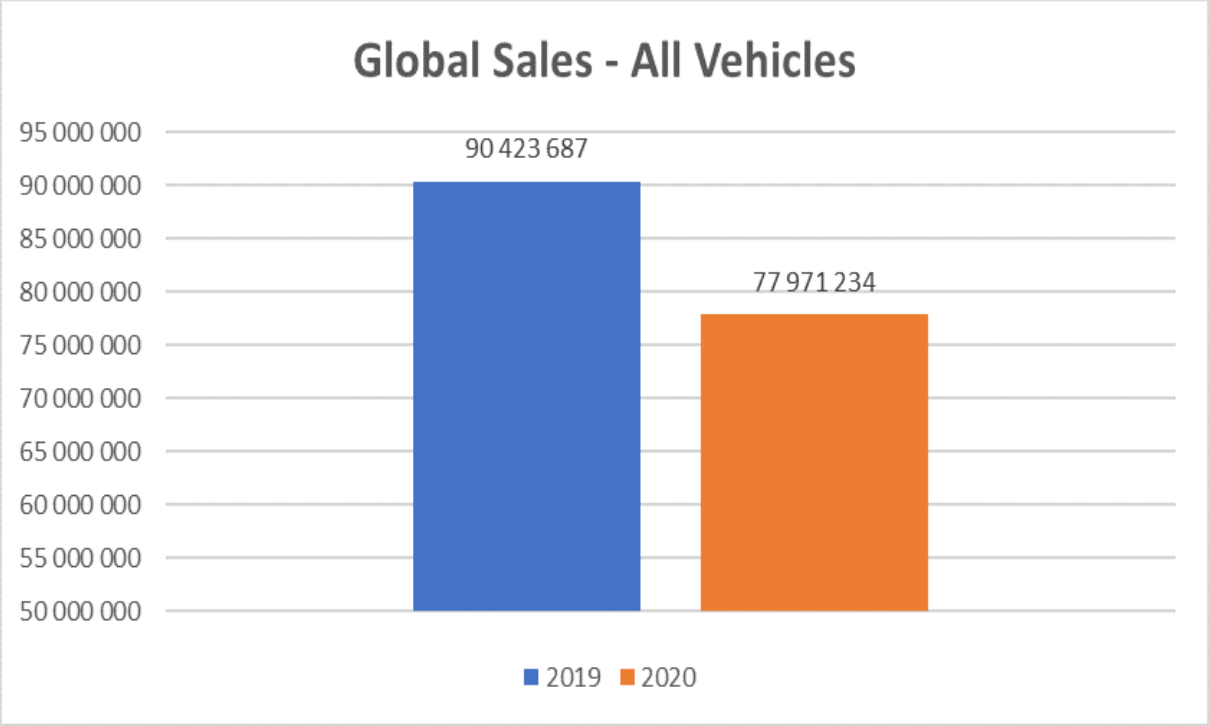

Figure 1 Global sales of motor vehicles

source: OICA

3.2. Restructuring in Chip Production Lines

Chip producers who have also been undertaking anti-pandemic measures have been refused orders for basic chips applied in the automotive industry. Simultaneously another trend has been spreading – surge of demand for the more complex computer chips used in computers, mobiles phones and other information technology medias. The on-line living – working, studying, shopping etc. has boosted the demand for digital medias. The increased demand for new generation - more complex chips with better financial returns - urges the chip producers to restructure their production lines. Chipmakers reroute their supply to the electronics industry, which also has shown willingness to pay more for the silicon wafers.

Technological innovations extremely smoothly and almost unnoticeably were adopted by the society not exactly as the communication professor Everette Rogers [5] describes the process in his theory diffusion of innovations. Apart from that we witness how one innovation can bring another in the way the auto producers are trying to fight the simple chip shortage by the special modes of production organization and in prioritizing the production of certain models (explained in 3.4.).

3.3. The Shortage of Microchips for Auto Industry

3.3.1. Difficulties to Restore the Halted Orders

When the auto industry comes back online faster than expected in the summer of 2020, it finds the chips needed are not available and suppliers content to keep their more lucrative contracts with others. Big orders can't be met quickly; it takes about three months to make even the simplest of semiconductors. The automotive sector, which relies on chips for everything from the computer management of engines to driver assistance systems, is still the hardest hit. Companies like Ford, Volkswagen and Jaguar Land Rover have shut down factories, laid off workers and slashed vehicle production. The systemic flaw in the supply chain has become very noticeable. The shortage costs the global auto industry about $210 billion in lost revenue in 2021, according to Alix Partners [6]. The auto industry's is trying to rebound after the first pandemic wave in the spring of 2020 until the chip crisis prolongs and threatens the expected recovery cycle according to Colin Couchman, executive director of Global Automotive Sales Forecasting at IHS Markit. The world will have lost 11.3 million units of production in 2021 because of the chip shortage, as per Auto Forecast Solutions. The impact is evaluated

at another 7 million units in 2022 and 1.6 million in 2023 by HIS forecasts. Economists at Cox Automotive do not expect the wholesale car market to reach pre-pandemic and pre-chip crisis levels until at least 2025.

3.3.2. The specialization in international trade worsens the chips shortage for the automotive industries.

Globalization of the contemporary economy and trade specialization [7] worsens the breaking down of supply chain. The main producers are in Asia whereas the biggest automotive plants are in Europe and USA. Semiconductors are a $450 billion global industry. U.S. capacity accounts for only 12 % of the world's semiconductor chip production in 2020, down from 37 % capacity in 1990, according to the Semiconductor Industry Association. Unanticipated rising demand for semiconductors needed during the pandemic response, couples with significant fluctuations in chip demand for other products such as cars, triggers a rippling supply-demand imbalance felt across the world. The semiconductor industry has worked diligently to increase production to address high demand, shipping more semiconductors on a monthly basis than ever before by the middle of 2021, but most industry analysts expect the shortage to linger into 2023.The shortage increases awareness of the importance of America's semiconductor supply chains. Although geographic specialization in the global chip supply chain has enabled tremendous growth and innovation in the industry, vulnerabilities in the supply chain have emerged in recent years. For example, in 2019, 100% of the world's most advanced logic semiconductors (< 10 nm) are produced overseas [8].

Europe currently accounts for less than 10% of global chip production, although that is up from 6% five years ago. The China, Taiwan, and South Korea are bigger players when it comes to microchip production.

The broken equilibrium between supply and demand for chips and semi-conductors for the automotive industry will be difficult to restore for a short period of time. Although the world's largest chip manufacturer, TSMC (Taiwan Semiconductor Manufacturing Company), is positive to be able to catch up with automotive demand by June 2022 other major producers are not so sure. Patrick Armstrong, CIO of Plurimi Investment Managers shares with CNBC "Street Signs Europe" that the timeline is highly ambitious. The difficulties logistics businesses have been also having for the last two years do not amend the situation.

3.4. Measures to Cope with the Shortage

3.4.1. Special Modes for Production Organization

Automakers try to manage the shortage by finding ways to make cars with fewer chips or use more of the higher-tech wafers that are more plentiful until the chipmakers increase capacity of needed wafers. One innovation brings about another one. The auto-industry has no other choice but to adapt to the new technological level the microchips reached. The cars equipped with the more complex technologies are more sophisticated and respectively more expensive.

Automakers prioritize the production of most profitable vehicles such as SUV-s as well as luxury vehicles, putting in them the precious semiconductors they have. At the peak of the chip shortage Ford has been forced to stop making F-series trucks as well as GM. Many, including GM, put forward their electric vehicles, with that automaker making sure its new family of EVs using the Ultium platform remains on schedule, starting with the recent timely launch of the 2022 GMC Hummer EV pickup. Given that, it can be definitely concluded that not only the microchip industry is getting restructured but also the automotive one is urged to reach a new stage of technological development. The transition that is going on in microchip and automotive industry is just a perfect example of the third, final stage of cybernetic revolution – namely the self- regulating systems.[9] The scientist L. and A. Grinin are taking the theory of production principles into account and also revise the sequence of change of the major (leading) production sectors during the change of K-waves. They argue that new basic technologies do not occur naturally, but only within the appropriate social political environment. So the global changes in major spheres of life in the pandemic period 2020-2022 offers crucial incentives for new basic technologies to be born. The self-regulating systems in terms of health both of man and nature are driving force of sixth Kondratieff's wave[10]. Ecological challenges before the auto makers are supported by chip production restructuring incentives. In this scientific light the trade discrepancies acquire new meaning as a part of constructive forwarding self-regulating process.

Automotives companies adopt tactic of shipping vehicles without specific features such as wireless charging, lumbar support in the passenger seat, automatic start-stop, or extra key fobs to save chips. Going forward, automakers are working to reduce the number of chips needed in each part. Volkswagen of America CEO Scott Keogh estimates the attitude towards the chips before the crisis as if they were nearly infinite. The car makers used to put chips in every module, every window lift, every modulator. Now VW is looking at whether cars can be developed with more modules and fewer chips [11].

The impact of the above mentioned processes on transaction includes longer terms of supply of bought new vehicle and higher sales prices of about 12% according to a white papers released by KPMG i.e. getting a new car becomes more expensive and takes longer which is also a mark for self-regulating system in aspect of ecology and safety on the road.

Measure the automotive companies take are innovative and radical although still insufficient. Yet they drive the whole automotive industry to a new stage of technological development which is the trampoline for economic growth looking back in history.[12]

3.4.2. Tech sovereignity

Nations are now being forced to think about how they can increase the number of chips they produce. Taiwan, China, and South Korea combine for roughly **87%** of the global foundry market.

Table 2: The biggest semiconductor companies

Company	Market share	Country
TSMC	54%	Taiwan
Samsung	17%	South Korea
UMC	7%	Taiwan
GlobalFoundries	7%	U.S.
SMIC	5%	China
HH Grace	1%	China
PSMC	1%	Taiwan
VIS	1%	Taiwan
DB HiTek	1%	China

source: https://www.visualcapitalist.com/top-10-semiconductor-companies-by-market-share/

The U.S. government has taken notice of the need to fortify America's semiconductor supply chains through robust investments in U.S. chip production and innovation. In June 2021, the U.S. Senate passed the United States Innovation and Competition Act (USICA), broad competitiveness legislation that includes $52 billion to bolster domestic chip manufacturing, research, and design. Intel also announced in March that it intends to spend $20 billion on two new chip plants in Arizona. The CEO Gartner's Priestley. realizes It's going take time before the effect is felt but still that's really looking to meet future demand.

The European Commission, the executive arm of the EU, has said it wants to build up chip manufacturing capacity in Europe as part of an effort to become more self-reliant on what it sees as a critical technology. Europe wants to boost that figure to 20% and is exploring investing 20-30 billion euros ($24-36 billion) to make it happen. U.S. tech giant Intel has offered to help but it reportedly wants 8 billion euros in public subsidies toward building a semiconductor factory in Europe. The Tech giant urged the EU governments to make it competitive for them to build the plant in Europe not in Asia.

3.4.3. Global surge in micro-chip production investments

The world has realized the need to expand global production. In 2021 global chip suppliers have committed to spending about $146 billion, up about a third from 2020, according to research firm Gartner. Unfortunately, less than one-sixth will be used to manufacture the older legacy chips most in demand. In addition to being less lucrative, investing to make low-tech chips is riskier because they are in danger of being phased out which would mean less return on the investment. Taiwan Semiconductor Manufacturing Co. plans to spend $100 billion to build new chip plants over the next three years. TSMC and Sony are partnering to build a new plant in Japan to make the older legacy chips most in demand. But it won't be ready for mass production until 2024.Taiwan Semiconductor is also adding a new plant in the U.S. and expanding production in China and at its $12 billion factory in Arizona. Samsung Electronics has announced it will build a $17 billion chip-making plant in Taylor, Texas, but production is not expected to start until later in 2024. Samsung has one U.S plant now, in Austin, Texas. Taylor is about 30 miles from Austin. The new plant will make advanced chips.

The chip investment process is a sure mark that global economy is at a turning point according to various theories for economic cycles. It is well known that there is no agreement about periodization of the Kondratieff waves [11] among researchers. Some believe that the downward phase of the fifth K-wave ends in the mid-2020s. However, for example, Leo Nefiodow [13] argue that the sixth K-wave has begun in the late 1990s. Thus, according to Nefiodow's logic, the period 1990-2020 corresponds to upward phase (however, the crisis of 2008–2014 and prospects for the next years contradict this), and in the 2020s the downward phase should come. The common point of both contradictory theories is that the period 2020-2030 will be abundant in challenges and changes. Undoubtedly the global word reaches the peak of elaborated microelectronics wave which at the same time overlaps with the rising sixth Kondratieff`s[15] wave having as basic innovations "psychosocial health" and "biotechnology"[16]. The focus is on resource and energy saving in many spheres including the automotive industry.

3. CONCLUSION

The Covid-19 pandemic crisis puts to test not only the physiological health of people but the pshycological, social and economical stability of the global world. The trend of micro-miniaturization of particles, mechanisms, electronic devices, implants, etc. together with increasing information complexity marks all the spheres of economy and routine life. The discrepancy in chips supply and their demand by auto producer upon resumption of producing process after the lock downs remains stable flaw for almost two years. Restructuring in microchip production lines into components of greater complexity brings about restructuring in the models offered by automotive companies. As most analyzers of economy cycles agree in the period 2020-2030 the peak of cybernetic revolution is to be reached overlapping with the uprising of sixth Kondratieff wave focused on health of person and nature. Seen in the light of these theoretical assumptions the crises in automotive industry provoked by chip shortage seems to be just a stage of long hopefully healing and progressive process.

5. REFERENCES

[1.] COVID-19 and plant closures: The auto industry's response, potential return dates, https://www.cnet.com/roadshow/news/covid-19-automakers-plant-shutdowns-coronavirus-pandemic-return-date/, 2020

[2.] Global auto production in 2020 severely hit by COVID-19 crisis with a 16% drop in world auto production , https://www.oica.net/global-auto-production-in-2020-severely-hit-by-covid-19-crisis-with-a-16-drop-in-world-auto-production/, 2021

[3.] https://www.oica.net/category/production-statistics/2021-statistics/

[4.] https://www.oica.net/category/sales-statistics/, 2021

[5.] Everett Rogers, Diffusion of Innovations, 1962

[6.] What Happened With the Semiconductor Chip Shortage—and How and When the Auto Industry Will Emerge, Alisa Priddle, https://www.motortrend.com/news/automotive-car-industry-semiconductor-chip-shortage-reasons-solution/, Dec 2021

[7.]Kenen, P. Nature, Caital and Trade – Journal of Political Economy, oct 1966, pp. 457 – 460

[8.]2021 State of the US Semiconductor industry, https://www.semiconductors.org/state-of-the-u-s-semiconductor-industry/, 2021

[9.] Grinin, L., & Grinin, A., The Sixth Kondratieff Wave and the Cybernetic Revolution, 2016

[12.] Korotayev A. V., and Grinin L. E.,Kondratieff Waves in the World System Perspec-tive. In Grinin L. E., Devezas T. C., and Korotayev A. V. (eds.), Kondratieff waves. Dimensions and prospects at the dawn of the 21 st century (pp. 23–64). Volgograd: Uchitel, 2012

[11.]Chip shortage is forcing automakers to cut popular features, R. Ferris, https://www.cnbc.com/search/?query=chip%20shortgage%20for%20auto%20industry&qsearchterm=chip%20shortgage%20for%20auto%20industry, 20th Feb, 2022

[12.] Šmihula, Danie,"Long waves of technological innovations", Studia Politica Slovaca. 2011 (2): 50–69. ISSN 1337-8163, 2011

[13.] Nefiodow L., and Nefiodow S., The Sixth Kondratieff. The New Long Wave of the Global Economy. Amazon,2014

[14.]Kleinknecht, A., Innovation, Accumulation, and Crisis: Waves in Economic Development? Review 4 (4): 683–711,1981

[15.] Grinin, L. E., The Dynamics of Kondratieff Waves in the Light of the Production Revolu-tions Theory. In Grinin L. E., Korotayev A. V., and Malkov S. Yu. (eds.), Kondratieff Waves: The Spectrum of Ideas (pp. 31–83). Volgograd: Uchitel, 2013

[16.] Goldschmidt, Andreas JW; Hilbert, Josef, Health Economy in Germany - Economical Field of the Future (Gesundheitswirtschaft in Deutschland - Die Zukunftsbranche). Germany: Wikom Publishing house, Wegscheid. p. 22., 2009