

**UNIVERSITAT
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**THE MICROCHIP CRISIS IN THE GAME
CONSOLE AND ELECTRONICS SECTOR**


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1. INTRODUCTION

This TFG is going to deal with a current problem that is weighing down several industries with millionaire losses and even temporary closure of factories due to lack of materials. It is a crisis in the supply of semiconductors.

To put this in context, these semiconductors, or "chips", are in theory small flat parts, composed mainly of silicon, and are the basis for the assembly of an electronic circuitry, which is mainly composed of small transistors.

Two types of integrated circuits are conceived: logic chips and memory chips. The first group includes processors (CPUs) in electronic devices or graphics processing units (GPUs), while the second category refers to working memory (RAM) and flash (NAND). On the other hand, the degree of sophistication of a chip is usually measured by the space separating the teeth of the transistors: the less empty space there is, the faster the information flows and the more components fit on the same board. Today, this space is reduced to just two nanometres¹ in the most advanced semiconductor devices. Since their appearance in the mid-20th century, microchips have become smaller and smaller and more efficient, extending their usefulness to increased objects. In fact, it is becoming increasingly difficult to find an electrical device that does not contain some kind of chip. From mobile phones to computers and tablets, from microwaves and ovens to refrigerators, cars and vehicles of any kind, toys, video consoles, televisions, medical and military equipment... Additionally, the growing use of the internet in recent decades has required the installation of new and gigantic servers and data centres capable of storing and processing so much information, for which state-of-the-art microchips are required. (Almagro, 2021, Libremercado).

The manufacturing process of a microchip is as follows, silicon which is the basis of all modern microchips, silicon has special properties because it is what we call a semiconductor, that means that depending on how it has been treated silicon can conduct or block electric current, it is this property that makes it perfect as a support for the millions of tiny transistors needed to make a modern microprocessor. The problem is that because these transistors are so small, the silicon base on which they rest has to be absolutely perfect, so it took decades to perfect the process of producing silicon with a perfect single-crystal structure. It starts with polycrystalline silicon or polysilicon, which is heated to 1,420 degrees Celsius in a special sealed furnace. This furnace has been purged with argon gas to remove air. The molten silicon lake we obtain is then spun in a

¹ A nanometre is one millionth of a millimetre.

crucible and a silicon crystal is introduced to act as a seed. This crystal has the dimensions and shape of a pencil and rotates in the opposite direction as the molten polycrystalline silicon cools down and the crystal, which acts as a seed, separates at a rate of one and a half millimetres per minute.

The result is a single silicon crystal that weighs about 200 kilos and has a diameter of about 200 millimetres. The crystal is so strong that it supports its entire weight with a single 3 mm thick wire. Specifically in this research we will address the problem of this crisis in the video game and electronics industries. These are especially important industries in the world economy, on which many jobs depend, and which, if this crisis continues, could seriously affect the economy of many countries and their infrastructures, as these semiconductors are present in all electrical appliances.

1.1 Justification for the choice of topic

The choice of the topic is justified as a concern for one of the most important junctures of the current economy and for the dependence of many sectors and industries on these materials for their economic and productive activity.

The aim is to seek a possible solution or set of recommendations to address the problem.

1.2 Objectives

- To understand the causes of this crisis and its origin.
- Know the countries and companies involved in this crisis.
- Analyse the countries involved through external analysis.
- Specific research on the video games and electronics sectors.
- Specific research on the companies that play a key role in this crisis and those most affected.
- Drawing conclusions from the research.
- Research-based recommendations and proposals to end this crisis.

2. ANALYSIS OF THE MAIN PRODUCERS

In this analysis, we are going to analyse the general aspects and structure of these countries, which are the main microchip producers in the world. We will analyse factor by factor, from a political, economic, social, technological, and environmental point of view.

2.1 PESTA Analysis USA

The US has some of the best-known companies in this sector such as Intel, but they are not able to supply the US market by themselves as they specialise in parts of the value chain as we will see below. The Boston Consulting Group with the Semiconductor Industry Association defines the role of the Americans in the value chain as follows: "Broadly speaking, the U.S. semiconductor industry maintains market share leadership in the activities that are most intensive in R & D: EDA and core IP, chip design, and manufacturing equipment". In addition, the U.S. is the largest consumer of semiconductors with a quarter of global demand (accounting for 25% according to the SIA). The US semiconductor industry stands out for its large investment in R&D, investing \$44 billion in 2020, with investment growing at an average annual rate of 7.2% since 2000. However, the manufacture of chips smaller than ten nanometres is concentrated entirely in Asia, which is its major weakness (Taiwan and South Korea).

Political and legal factors

On a political level, the US remains the global leader, with decisions made by the White House affecting the entire world to a greater or lesser extent. The trade war between China and the US began in March 2018 under the Trump administration, imposing tariffs on Chinese goods, since when tensions have continued under the Biden administration, with half of Chinese goods still under tariffs. This conflict, according to a report by Capital Economics, represents a "gradual decoupling" of the two giants, involving a reordering of global supply chains that affects semiconductors to a considerable extent. This dispute is joined by the "technology war", where Taiwan, the EU, Japan, and South Korea are the key allies of the Americans, however, the semiconductor chain reported by SIM², demonstrates the importance of China and the dependence of the global chain, with China being the assembly, packaging, and *testing* centre of the chain.

Given the interdependence with Asia, the House of Representatives has recently proposed measures to **subsidise the industry** and help improve the supply chain for high-tech products. The **America Competes Act** includes \$52 billion to encourage more semiconductor production in the US and \$45 billion for grants and loans to improve supply chain resilience and manufacturing. TSMC and Intel invest in the US. Intel will be producing five nanometre chips by 2021 and 3 nanometre chips by 2022. The role of the US in the Ukrainian conflict is noteworthy, as the US is NATO's most important member and has shown its support for Ukraine, increasing tension with the Russian giant.

² SMI: Semiconductor Industry Association

Economic factors

According to the above-mentioned SIA & Boston Consulting Group report, **demand for semiconductors** in 2020 is concentrated in **computers** at 32.3%, in **communications** at 31.2%, with the remainder split between automotive, industrial use and other consumer goods. Demand in these sectors is particularly strong in the USA, which produces in all these sectors. In the event of a prolonged semiconductor supply crisis that would force production to stop, the **national economy would suffer more than others**, with massive job losses, for example, the automobile industry is the second largest producer in the world, accounting for 2.5% of GDP and employing 2.8 million people.

Another crucial factor adds up in a post-pandemic context, inflation in the US has become a problem to be reckoned with, with the CPI having shot up by 7.5% according to the U.S. Bureau of Labour Statistics in January 2022, a figure not reached since 1982.

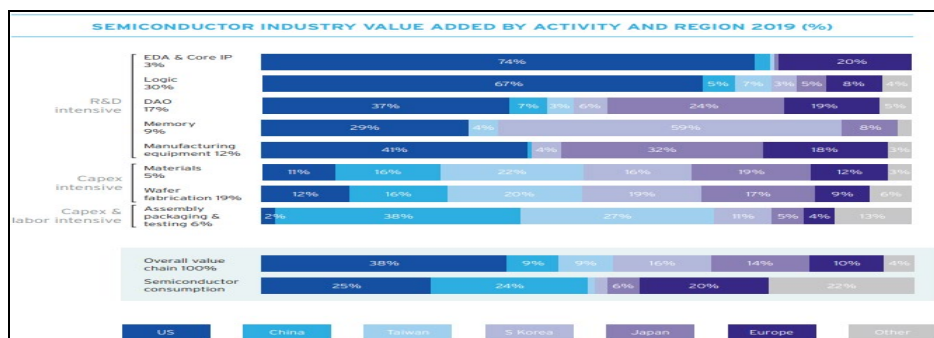
Social factors

As mentioned above, the USA is the main consumer of semiconductors with 25% of the total, ahead of China (24%), although the population of China is five times the 329 million recorded by the USA. This is due to the rapid increase in the consumption of technological products and the renewal of this every few years. For example, according to the International Telecommunications Union, the US had 87.27% of its population as internet users, being surpassed in absolute terms only by China (with 54% of its population) and India (with 34.45% of its population), and in relative terms by very few countries, such as Germany, the United Kingdom, and South Korea.

Technological factors

If we break down the value-adding activities, the US dominates in most of the R&D-intensive activities as shown in the figure below.

FIGURE 1: SEMICONDUCTOR INDUSTRY VALUE ADDED 2019 (%)



Source: 2021 State of the U.S. semiconductor industry

However, the US does not have the technology to manufacture the cutting-edge chips needed in the latest devices, as according to the SIA & BNG report it is not capable of producing chips of less than 10 nanometres so far, while Taiwan and South Korea produce 5 nanometre chips which are used in some of the new mobile phones and are on track to produce less than 3 nanometre chips in the very near future. While US companies such as Intel have not been able to reach this level, having recently allied with Taiwanese TSMC in order to achieve this technology, delegating between 15 and 20% of production to it, expecting to produce the expected 3 nm chips for Intel in the second half of 2022.

Environmental factors

The Biden administration's return to environmental commitments (Paris Agreement, Environmental New Deal, zero emissions by 2050) may weigh down the industry, but it may also bring added value and a better international image. American industry consumes enormous amounts of water and energy, and emits a lot of toxic waste, and the industry's carbon footprint is the largest for electronic devices, according to a Harvard University 2020 report. "In the US, a single fab, Intel 's 700-acre campus in Ocotillo, Arizona, produced nearly 15,000 tons of waste in the first three months of this year, about 60% of it hazardous. It also consumed 927m gallons of fresh water, enough to fill about 1,400 Olympic swimming pools, and used 561m kilowatt-hours of energy."

The increase in production needed to meet demand clashes with the environmental commitments of companies and government. Examples of this commitment are Intel, which has pledged to obtain 100% of its energy from such sources by 2030, or TMC, which uses almost 5% of all electricity in Taiwan and signed a 20-year agreement last year with Danish energy company Ørsted to supply it with renewable energy.

2.2 PESTA Analysis SOUTH KOREA.

South Korea, the world's second largest semiconductor manufacturer, has great ambitions for the future to become the world's largest producer. This ambition is explained later in this analysis:

Political factors:

South Korea uses a political system defined as a Presidential Democratic Republic. In which the head of state is the president, and where it is governed by a liberal multi-party system of representative democracy. Moon Jae-in is the President of South Korea, and Kim Boo-kyum is the Prime Minister. However, in South Korea the head of government is the prime minister. At the same time, there is a division of powers where the

government and the National Assembly represent the legislative branch. On the other hand, independent is the judiciary, which is in the hands of the Supreme Court, while the constitutional court is reserved for appeals. Based on the Korean public sector corruption perception index, it has a score of 62 points, i.e., Korean people have a low perception of government corruption.

Korea continues with its plan to become the world's largest semiconductor producer, encouraging chip producers through fiscal stimulus and state subsidies to increase investment, with a projected investment of \$433 billion by 2030. It is not surprising that it achieves its goal, as it is home to two of the world's largest producers of microchips, Samsung, and SK Hynix.

South Korea wants to be one step ahead in the next generation of semiconductors and has therefore drawn up the "K-semiconductor blueprint". This is a \$1.32 billion stimulus to encourage the development of next-generation artificial intelligence on chips. Yonhap (2021)

Economic factors:

When we talk about South Korea, we are talking about nothing less than one of the nineteen largest economies in the world in terms of GDP.

Samsung is the largest semiconductor producer in Korea, which has increased its revenue by 25 per cent over 2020, with revenues up \$16.66 billion, all thanks to strong demand for semiconductors in 2021. The second-largest producer, SK Hynix, also reported a profit of \$1.7 billion in the second quarter of 2021, up 56.5 per cent year-on-year.

Emphasising the economic scenario in South Korea, the latest data published in January 2022 in South Korea regarding the CPI³ show a 3.6% rate of change. The IMF⁴ estimated its forecasts in April 2021 positively and with a growth outlook of 3.6% for this year, although the prime minister was more positive and rounded up this growth to 4%.

³ CPI: consumer price index

⁴ IMF: International Monetary Fund

TABLE 1: MACROECONOMIC DATA SOUTH KOREA

Cuentas Nacionales - Gobierno		
PIB Trim Per Capita [+]	III Trim 2021	7.317 k
PIB anual [+]	2020	1.436.668 M€
PIB Per Capita [+]	2020	27.745 €
PIB Trimestral [+]	III Trim 2021	378.881 M€
Deuda total (M.€) [+]	2019	621.074
Deuda (%PIB) [+]	2019	42,13%
Deuda Per Cápita [+]	2019	12.011 €
Déficit (M.€) [+]	2019	5.485
Déficit (%PIB) [+]	2019	0,37%
G. Público (M.€) [+]	2019	332.671,6

Source: *datosmacro.com* (2022)

On the fiscal side in 2021, South Korea's tax revenue was USD 405.285 billion, an increase of USD 45.384 billion from the previous year. The tax burden in Korea represents 27.3% of its GDP, and is ranked 71st in the tax burden ranking, which means that South Korea is a country with a high tax burden.

Regarding South Korea's tariff policies, we can see that it applies an average of 8%, which is one of the lowest rates in the world. Its VAT (value added tax) is 10%, in force and unchanged since 1977. Regarding taxes on workers' income, in South Korea, in 2020 the average rate was 15%, while the maximum rate was 48.6%.

Social factors:

South Korea is a country of 54,781,000 million people, with a population density of 516 KM2, one of the highest in the world. According to the HDI5, Korea improved its human development from 0.914 points in 2018 to 0.916 points in 2019. But these data clash with the OECD satisfaction surveys6, where the population scored an average of 5.9, on a scale of 0 to 10, which implies that the Korean population is somewhat dissatisfied with their lives, as the world average is 6.5, on a scale of 0 to 10.

⁵ HDI: Human Development Index, an important indicator developed by the United Nations.

⁶ Organisation for Economic Co-operation and Development

COVID is a major player in this semiconductor crisis, since due to restrictions and factory closures, some countries have been favoured and others have been disadvantaged and seeing the large revenues that Korean companies have had and the strong seasonal demand they have had for semiconductors, Korea has been favoured. Not surprisingly, South Korea has been an amazingly effective country against COVID as shown in table 2, with very few cases compared to the rest of the world and an incredibly low mortality rate, one of the lowest in the world relative to its total population. It has also been amazingly effective in vaccination schedules with more than 85% of the population vaccinated.

TABLE 2: COVID SOUTH KOREA 2022 STATISTICS

COVID-19 - Muertos [+]	13/02/2022	7.102
COVID-19 - Confirmados [+]	13/02/2022	1.405.246
Completamente vacunadas [+]	13/02/2022	44.220.327
COVID-19 - Muertos por millón habitantes [+]	13/02/2022	137,15
Dosis administradas [+]	13/02/2022	116.867.806

Source: *datosmacro.com* (2022)

Technological factors

Faced with high competition in the semiconductor sector, South Korea wants to help its manufacturers to operate in a stable environment and has therefore promoted the creation of a new semiconductor cluster in 2021, located in Pangyo and Yonpaí, south of the country's capital.

South Korea tops the list of the most innovative countries, according to the Bloomberg Innovation Index, ranking number one seven times in the last nine years. This is due to an increase in patenting, manufacturing growth and its robust performance in areas of R&D and innovation, thanks in large part to its decades-long strategy, which has paid off. South Korea is accelerating the processes to implement Industry 4.0 in the country, with the aim of being the leader of this fourth industrial revolution, promoting the digitisation of its manufacturing sector, and also intends to do so in other areas such as the country's business fabric, public institutions, and start-ups.

TABLE 3: SOUTH KOREA'S POSITION IN TECHNOLOGY INDEXES

Posición de Corea en <i>rankings</i> mundiales	
Número de robots en la industria	5º
Densidad de robots en la industria	1º
Global Competitiveness Index	14º
World Most Innovative Economies Index	1º
Readiness for the Future Production Index	21º
Digital Economy Competitiveness Index	14º
ICT Development Index	2º
Fintech Adoption Index	14º

Source: ICEX Report⁷ 2019

Environmental Factors

Korea has promoted a low-carbon green growth plan with a medium- and long-term projection from 2009 to 2050. The aim of this plan is to reduce greenhouse gas emissions by 30%, and an institution called the National Trading Scheme (NTS) was set up to implement it.

In view of the increasing demand and production of chips, we must not forget the need to be sustainable, as the semiconductor manufacturing process uses a large number of chemicals, which poses a problem for the treatment of wastewater from this process. For this reason, environmental laws that do not interfere with or slow down the production of semiconductors are being studied in South Korea. To put the environmental context of South Korea in context, we can see in table 4 that there is a CO₂ consumption of 12.07 tonnes per inhabitant. In terms of electricity, the country consumed a total of 531,258 GWh (million watts) in 2020, generating a total of 549,868 GWh of electricity.

TABLE 4: CARBON FOOTPRINT STATISTICS SOUTH KOREA 2020

CO ₂ t per capita [+]	2020	12,07
Consumo GWh [+]	2020	531.258
Generación GWh [+]	2020	549.868

Source: datasmacro.com (2022)

⁷ ICEX España Exportación e Inversiones is a Spanish state-owned public business entity. Wikipedia (2022)

2.3 Analysis PESTA CHINA

Political and legal factors:

- Stable political environment: this is one of the main reasons behind the remarkable success of the Chinese giant, although it is true that its inhabitants do not have much freedom of expression, which means that its political system is subject to much criticism and has a large number of detractors both inside and outside the country.
- Foreign direct investment: as foreign investors always look for the infrastructure of an established country, cheap labour, and a relatively stable political environment before making any investment. In addition, during this last year China (despite COVID-19) has managed to increase in 2021 by 173.48 billion dollars, which in relative terms is an increase of more than 20.2% over the previous year according to the data provided by the Chinese Ministry of Commerce (MOFCOM).
- Membership of global organisations: it is a member of the United Nations Security Council and other major world organisations such as BRICKS and many others. As a result, it has been able to create and develop exceptionally good relations with the world's leading countries.
- Conflict with the US A relationship with the US government and the Trump administration is particularly difficult, as the communist and socialist system of government has never been viewed favourably by the Americans. The Americans themselves see China as the greatest threat to the world's security and freedom of expression. Although it is true that recently the conflict has been cooling down since Joe Biden took office.
- Government regulations: These are one of the main forces of the Chinese government and its regulatory element par excellence, as all businesses, companies, investors, etc. must comply with and follow these regulations. From a more external point of view this is perceived as a major source of political and economic constraints and censorship.
- Conflict with Taiwan: After decades of hostile rhetoric, China and Taiwan began to forge ties in the 1980s China advocated a formula known as "one country, two systems", under which Taiwan could exercise meaningful autonomy if it accepted reunification with China.

The offer was rejected by Taiwan, but the territory relaxed restrictions on visits to and investment in mainland China. Although this conflict has become increasingly

important as Taiwan has consolidated its position as the main microchip-producing country and enriched its economy, China no longer has a political or territorial interest, but there are now much more important economic reasons for claiming Taiwan as part of CHINA.

- Labour laws: In recent years China has introduced a number of new labour laws such as the Chen Administration Regulation in 2019 (), the PRC Labour Contract Law in 2007 () and the PRC Labour Law in 1995 (). These are all aimed at resolving labour disputes, providing greater advantages and benefits for employees and above all to protect employees.
- Protectionism: The Chinese government has banned certain social networks such as Facebook, WhatsApp, Twitter, and YouTube, thus preventing these companies from obtaining both revenue and information. In addition, it has also imposed a number of restrictions on investment by foreign companies, resulting in a decrease in the number of international companies that can invest in the Chinese market, but also giving the Chinese government itself more control over the market.
- Various categories: China divides its FDI catalogue into four categories: permitted, prohibited, restricted, and encouraged. As for the encouraged category, there are 484 industries engaged in food and beverage production. As for the restricted category, there are thirty-five industries mainly engaged in banking, stock market, power grid and construction. Thirdly, in relation to the prohibited category, there are twenty-eight industries engaged in air traffic, postal and domestic service.

Economic factors

- Highest GDP: At the end of 2020 China had a GDP of \$24.2 trillion, the highest in the world, and its annual per capita income of \$17206 was the 73rd highest, largely due to its large population. Furthermore, if we look at its reserves, we can see that China has three trillion dollars. These numbers are not easy to understand if we do not take into account the modernisation and updating of the economic model that China has undergone in recent years, as it has gone from being a communist-controlled economy to a market economy.
- Cost of growth: Today China has definitely become the world's largest and most powerful economy. However, it has had to pay for this success, as it has achieved it by damaging the environment, with an unbalanced development strategy that negatively affects urbanisation plans and waste of resources, and which has led

to a major crisis in the real estate sector as the purchase of real estate assets has been declining at a dizzying pace over the last 6 months. It must now work to address these problems in the best viable way in order to maintain its position.

- Cheap labour: One of China's greatest advantages lies in its labour force and its cost, which is why many of the world's leading manufacturers subcontract their production to China. But thanks to the current trend of economic growth that has occurred in recent years, we can see how its labour force has increased and therefore the wages of its workers, who are paid more than in some South American countries.
- Dominant investor: China has become an immensely powerful and dominant investor country thanks to its investments in countries such as Chad, Argentina, Venezuela, the United Arab Emirates, Australia, the United Kingdom, and the United States. This is a sign of the great power and influence that China wields in international and global markets.
- Lower taxes: Compared to the world's leading powers, China's corporate income tax used to be 25% and the government implemented a new policy of reducing it to 15% to promote the creation and acquisition of companies. Another important case is that personal income tax ranges from 3% to 45%, which is directly allocable through tax brackets that take into account annual income.

Social factors:

- Overpopulated country: China has more than 1.4 billion people, the largest population in the world, and therefore has the largest consumer market in the world and it is here where the market trend is oriented towards manufacturing products in order to meet the demands and needs of consumers. Although it is an overpopulated country unlike many others, it has one of the highest literacy rates in the world at 96.8% of the total population. As a result, the government has managed to reduce the level of poverty. According to a Poverty Alleviation and Development report, more than sixty-eight million people have been lifted out of poverty in the last five years. In addition, it has also led to an increase in spending on goods such as clothes, cars, and smartphones with which they intend to show their success and status to the rest, it should be noted that the increased willingness to spend will lead to and show the growth of local businesses, convenience stores, kiosks...

Technological factors

- Technological giant: According to an estimate by eMarketer, China is currently the country with the largest number of online users in the world, with approximately 914.1 million users, i.e., 65.5% of the Chinese population is connected online. And it is estimated that this year 2022 the number of users will increase to 975 million. This could be explained by the fact that China has some of the most important and influential technology companies in the world, such as Tencent, Xiaomi, TikTok and Alibaba, among many others. And if we also take into account their market share, we can affirm that no other country is able to compete with them.
- Science and technology leader: China wants to become the world leader in science and technology at all costs, and to this end it has been implementing an innovation and entrepreneurship plan since 2015. This plan aims to further facilitate the country's transition from an economy whose main attraction and competitive advantage was cheap labour to an economy based on technological progress and innovation. It should be noted that today the country is still in transition, but it is making profound changes and progress in the right direction, since, as we can see, it has increased its presence in global technology markets in recent years.

Environmental factors:

- Important level of pollution: Chinese economic improvement and development has led to catastrophic environmental impact, which has resulted in biodiversity losses, air and water pollution, deforestation, and industrial waste. It is true that in recent years the Chinese government has already started to take measures to address these environmental problems, such as public awareness programmes and promoting decentralisation. But these measures are far from comparable to those adopted in the West.

2.4 PESTA analysis Taiwan.

Political and legal factors:

Taiwan is an island under the name of the Republic of China, although it has tried to defend its sovereignty, but to no avail, as it is not recognised by the major world powers. Although not recognised in diplomatic terms, Taiwan enjoys US protection, with explicit bilateral commitments. Although it is not recognised in diplomatic terms, Taiwan enjoys US protection, with explicit bilateral commitments, as it is under Chinese pressure to

integrate it into its sovereignty, for all the potential it has in its ongoing struggle with the US to be the ruler of the world. This stalking by China is gaining momentum and there are fears of military intervention by China, as we are seeing in the current conflict over Russia's invasion of Ukraine.

Taiwan's legal system is based on civil law based on the German and Japanese legal systems. It is home to the world's largest semiconductor company, TSMC, with a market capitalisation of more than \$600 billion. That is why the government has proposed a new law to defend its intellectual property against encroachment by countries such as China, which wants to take away its position as the world's largest semiconductor producer. That is why the government wants to heavily punish any leaks, with new proposals for national security law.

Technological factors

Taiwan is one of the most research-intensive economies, but Taiwan's technological success has its own name: TSMC, the company that has already been mentioned many times, is responsible for the fact that we see Taiwan's name on a multitude of products, making the Asian country an example of public-private cooperation to improve innovation.

But Taiwan's link to technological success comes from its history. As a separate country from mainland China, it needed trade with the West to survive and evolve from what was a primary sector-based economy, taking measures with broad consensus among the population and the government such as investing in R&D, reforming the education system, encouraging international trade and the free market, an example of the island's commitment to innovation efforts is the Hsinchu Science Park, which has some 500 companies (including TSMC) and another example is the Taipei Free WIFI project.

Environmental factors

In addition to the industrial development of the island, problems associated with environmental care have arisen, as evidenced by the poor air quality in its cities, and tools such as the Airbox project have emerged to help mitigate the harmful effects of the air on the population.

The energy consumed by the Taiwanese comes largely from coal, with the associated pollution, with the Taichung thermal power plant being the most carbon dioxide-emitting power plant in the world.

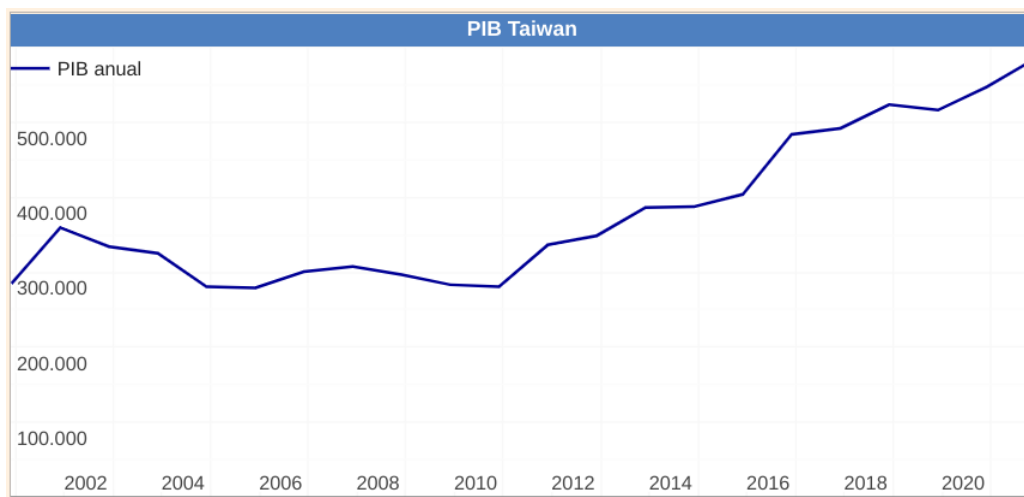
Currently both the government and TSMC have signed up to environmental commitments, including Taiwan's adherence to zero net carbon emissions by 2050 and a gradual shift from coal to natural gas, and the government has also invested in projects

such as Formosa 1, an offshore wind farm. TSMC is aware that climate change is having a severe impact on the environment and humanity," said TSMC. As the world's leading semiconductor company, TSMC must assume its corporate responsibility to address the challenges of climate change," concludes Mark Liu, president of the company, as an example acquired the production of a wind power plant located in Taiwan.

Economic factors:

Taiwan is a small country, but with a large economic presence in the markets, as we can see, since 2010 Taiwan has established itself as the 22nd largest economy in the world by GDP volume. Currently Taiwan has registered a 3.1% increase in GDP over the previous year, reaching a figure of 58,973 million euros.

FIGURE 2: Evolution of GDP Taiwan over the last two decades



Source: *datosmacro.com*

It is worth noting that during the pandemic Taiwan was able to record a growth rate of 2.5%, which is remarkable considering that it had a negative impact on the world's major economies. This was due to the swift action of the Taiwanese government, which closed all borders and applied a series of extremely strict measures in order to ensure internal well-being in the short and medium term. No wonder Taiwan was among the first to reopen all shops, as they managed to record zero cases of infection for 253 days since April.

As we have already mentioned, Taiwan is one of the world's leading producers of electronic products and components, and they took advantage of the enormous demand

for screens and the need for connectivity to manufacture these elements to meet this demand, which was driven by the need for teleworking and online teaching worldwide.

Social factors:

Taiwan is one of the most urbanised countries in Asia, with more than 60% of the population living in the big cities. In addition, the capital Taipei is home to about 13% of the country's total population, some 2.75 million people.

The Taiwanese have an education system that is geared towards acquiring important skills, such as mastering other languages like English and subjects related to technology and science. Taiwanese society is known for its passive and non-belligerent attitude, and in terms of the country's cities, the cities are very well developed, providing working conditions that are conducive to the creation and consolidation of new businesses.

3. ANALYSIS OF THE MARKET STRUCTURE AND SPAIN'S INVOLVEMENT.

The semiconductor market is totally globalised, which means that all countries depend to a greater or lesser extent on others, and Spain is no exception, with almost total dependence on foreign countries in almost all activities. An analysis of the supply chain, the value chain and the demand of this market will be carried out in order to understand the existing problems.

3.1 Global supply chain.

In this section we will analyse where the different activities of the supply chain are located, in order to see in which parts of the supply chain each of the countries involved is dependent. Based on the report by SIA⁸ and the Boston Consulting Group entitled "Strengthening the global semiconductor supply chain in an uncertain era", we can differentiate the different parts of the value chain by geographical location and even by intensity in the different R&D activities, which we will see in 3.1.4, the supply chain from the search for raw materials to the end consumer is concentrated on the continents of which the countries analysed above form part. In this way we can see the dependence of the global supply chain.

In terms of supply, the raw material par excellence needed for manufacturing is silicon, which is a tremendously abundant resource, and specifically silicon dioxide, however, not all countries have the capacity to purify it and be able to use it for purposes such as

⁸ SIA: Academic Information System of the Jaume I University.

computer chips, in a document called "Making of a Chip" by Intel: "In order to be used for computer chips, silicon must be purified so there is less than one alien atom per billion. It is pulled from a melted state to form a solid which is a single, continuous, and unbroken crystal lattice in the shape of a cylinder, known as an ingot". In this sense, the materials are distributed among the main players, representing 11% USA, 16% China, 22% Taiwan and 20% China. In this sense, the materials are distributed among the main actors, representing 11% USA, 16% China, 22% Taiwan, 16% South Korea, 19% Japan, 12% Europe and 3% the rest of the world, so in this case we can conclude that in terms of materials there is no dependence on the global supply chain.

Silicon has various uses in agriculture, ceramics, in metallurgy as a reducing agent, etc. Although silicon reserves are concentrated in China, this does not mean that the different countries depend on the Asian giant, as silicon for semiconductors accounts for only a small part of total use. Among the relevant countries is Spain according to the Mineral Commodity Summary 2021.

In terms of manufacturing, wafer fabrication is the next part of the process (together with materials, these are classified as "Capex intensive"), again distributed among the main players in a very similar way to that of materials, highlighting the fact that as the size of the chips decreases, the wafers are more usable, so their consumption does not tend to increase as much despite the increase in production.

On the other hand, the activities classified as "R&D intensive" necessary to conduct manufacturing are the activities where the US, Europe and Japan gain prominence, these activities are EDA & Core IP, Logic, DAO, Memory, and Manufacturing Equipment. Core IP", "Logic", "DAO", "Memory" and "Manufacturing Equipment" where China does not participate significantly in any of them, with the USA being the clear dominator except in memory where South Korea dominates, and as mentioned above Europe maintains some importance, Spain in this case has a few companies dedicated to microchip design (Wiyu, Imasenic, Kdpof and IC Malaga), as well as Japan in DAO and equipment manufacturing. These activities require many years of research and a lot of investment, which is why China has not yet entered them. However, in logic, the US, despite being the dominator, has not achieved chips of less than 10 nanometres, concentrated in Taiwan and South Korea, with the rest of the world dependent on the latest technologies where chips of up to three nanometres are used.

Finally, in assembly, packaging, and testing, which are labour- and capital-intensive activities, there is a clear dependence on "the two Chinese", mainland China with 38% and Taiwan with 27% completing the major players South Korea and Japan, Europe and

the United States hardly participate in these activities, thus depending on them. This is due to the fact that Western companies carry out the design, for example, but do not have the capacity to produce it (as in the case of Intel), delegating it to companies such as the Taiwanese TSMC. It is in these activities that manufacturing is completed, so distribution is from Asian ports, although more than 30% of semiconductor consumption remains in Asia.

3.2 Demand analysis.

At this point, an analysis of the demand in the microchip sector will be carried out, as this will allow us to understand the market and its importance at a global level.

Chips are widely used in electronic devices such as smartphones, computers, and other medical devices, as they perform key tasks to ensure the operation of these devices. These chips are made up of millions of transistors packed into a small piece of silicon and help devices become a smaller unit by removing or incorporating various components into the integrated circuit.

Microchips are a key element in realising the logic function of computer programs and memory, such as random-access memory (RAM), and are also used for special purposes, such as gateways, bit slicing and analogue-to-digital conversion. The increase in the enormous potential of the microchip market can be attributed to the availability of low-cost raw materials and huge production facilities in many developing countries in the Asian region, such as China and India.

3.2.1 Market drivers, constraints, trends, and opportunities

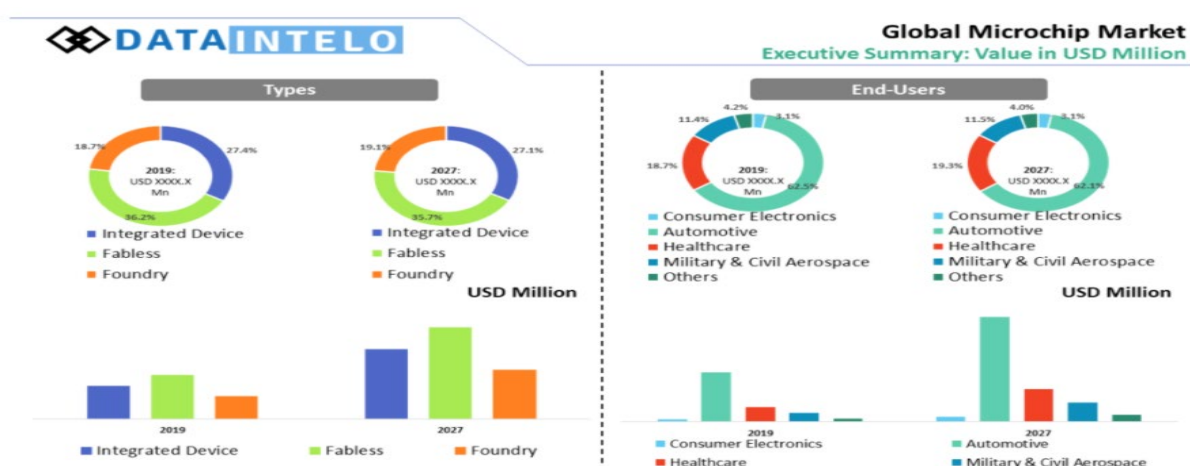
- The rapid growth of the electronics and medical industry due to the increasing demand for microchips in the assembly of a wide range of products, including computers and robotic devices, are the main driving factors.
- Easy access to the Internet of Things (IoT) and growing automation installations for various applications, such as home appliance products, represent other key factors helping to drive market expansion.
- However, the excessive cost of investment and growing concerns about children's addiction to gaming on phones and computers are the main restraining factors that may hamper market growth over the forecast period.
- Increasing applications of microchips in the automotive industry, especially due to increasing production of self-driving cars, are the current trends likely to drive the market expansion during the forecast period.

- Increasing innovative products and R&D investment by leading manufacturers in the field of microchip production and design are the key factors that can drive the long-term development of the market.

3.2.2 Who is the target audience?

In this case, the target public is quite diverse and broad, as there are several markets that require this type of products and semiconductors to function, such as computers, telecommunications, office automation, automobiles, etc. Although we could consider that the real target public would be large companies in sectors that require an elevated level of technology to manufacture their products.

FIGURE 3: EXECUTIVE SUMMARY OF THE GLOBAL MICROCHIP MARKET



SOURCE: Dataintel.com

The global microchips market is expected to register a robust CAGR during the forecast period, 2020-2027. The market growth is attributed to the increasing demand for consumer electronics items such as smartphones, computers, and smart TVs, as well as the widespread adoption of microchips in various applications in sectors such as healthcare and automotive. Meanwhile, market growth is expected to decline somewhat between 2019 and 2020 due to the negative impact of the COVID 19 pandemic on the global microchip market.

3.2.3 Global microchip market outlook

On the basis of product type, the global microchip market is segmented into embedded, fabless and foundry devices. The embedded segment is expected to register robust growth during the forecast period due to increasing demand for embedded and implanted

microchips for various applications, such as consumer electronics, medical, and automotive industry. Meanwhile, the fabless segment is expected to hold an impressive market share during the forecast years due to widespread adoption in various electronic devices such as computers.

On the basis of end users, the market is segmented into consumer electronics, automotive, healthcare, military and civil aerospace, and others. The consumer electronics segment contributes to the major share of the market and is expected to witness substantial growth over the analysis years due to increasing usage of mobile phones, laptops, and other electronic items across the globe and growing demand for new telecommunication services such as 5G networks. Meanwhile, the healthcare segment is expected to grow at the fastest rate during the aforementioned period due to increasing adoption of chips in medical devices, including surgical and treatment devices.

In terms of regions, the market is broadly classified into Asia Pacific, North America, Latin America, Europe, and Middle East & Africa. Among the regions, Asia Pacific currently holds the largest market share and is expected to witness strong expansion during the review period owing to the presence of major global players and establishment of huge production facilities in the region. Growing government initiatives in emerging economies such as China, India, South Korea, and Australia are key factors for the immense development of microchip production in the region. Meanwhile, North America is expected to register significant growth during the period due to its early technological advancement and high capital expenditure.

On a national level, we do not find ourselves in a somewhat exceptional case, as Spain is not a country like those mentioned above, as the microchip sector in Spain does not focus on manufacturing, but they do perform a design development function to subsequently commercialise them. Recently, there has been a business proposal to bring microchip production here in Spain (completely closed in 2001), specifically made by Carlos Pardo CEO of KDPOF.

3.2.4 Competitor analysis: Main producers and competitive environment

The main players competing in the global microchip market are Samsung Electronics, Intel Corporation, Texas Instruments, Cypress Semiconductor, Analog Devices, IBM, Qualcomm, Broadcom Ltd., Advanced Micro Devices (AMD), MediaTek, NVIDIA, TSMC,

United Microelectronics, STMicroelectronics, Semiconductor Manufacturing International Corporation and Taiwan Semiconductor Manufacturing Company.

Some of these companies have adopted various market strategies, such as merger and acquisition, collaboration, or partnership, launching new products, developing R&D activities, and expanding their units to improve their business portfolios and market competence.

Taiwan Semiconductor Manufacturing Co. is the world's largest contract chipmaker, and since the start of the pandemic it has raised chip prices by up to 20%. United Microelectronics (UMC) also issued a price increase of its own several months ago, raising prices for 28nm and 22nm processors. The price increases took place in September and November 2021 and are expected to be finalised in the first quarter of 2022.

A third China-based semiconductor manufacturer - Semiconductor Manufacturing International (SMIC) - has joined TSMC and UMC in raising its prices for 28nm and 40nm processes. The Chinese manufacturer will continue to prioritise order fulfilment from China and offer higher quotes to foreign-based companies: in particular, Taiwan-based companies, according to Digi Times Asia. **So why the rise in semiconductor prices?** If we are in the midst of a major supply shortage, why would manufacturers want to raise chip prices?

Well, the answer is a little more complex than we might imagine, as it is mainly due to an attempt to balance both supply and demand, or to balance the market between the short and the long term.

In the short term, price increases reduce demand from customers who do not urgently need chips and preserve capacity for customers who need them now. In the long term, higher prices create more net revenue for TSMC to spend on aggressive investments in new capacity.

3.2.6 Factors to be taken into account:

- Price of microchips and derived products: Unprecedented price increases are due to the time lag between technological development, the construction of manufacturing plants and the production of new chips, although this increase affects everyone, those who suffer the most in this case are the end consumers, as the prices of computers, smartphones and other electronic products have registered an increase of 2.5% per year, the highest price increase in the last 10 years. In addition to the increase in microchip prices of between 10 and 40%, the

prices of the materials needed to make them, such as aluminium, packaging materials, plastics, resins, and copper, have also risen.

- Production costs: Taking into account everything mentioned in the previous point, we can affirm that these increases in microchip prices, which can range between 10 and 40%, have also increased the prices of the materials needed to produce them, such as aluminium, packaging materials, plastics, resins, and copper. However, we must also take into account an important element such as the well-known Mur's law, which roughly speaking means that the microchip manufacturing process is becoming more and more complicated, given that approximately every two years the size of microchips is reduced, and as it becomes a more complex process with a greater need for resources, production costs finally end up increasing.
- Change in the availability of resources: In such a globalised sector and whose product is key to the operation of a wide variety of products, which are sold on a massive scale, such as automobiles, telephones, computers... to be more concise, all types of products that require electronic components. The availability of resources is the most key factor to be able to compete and operate in the market and in this case the manufacturers and suppliers of microchips have the upper hand as they have a huge advantage over the customers, since the negotiation capacity of these with the suppliers is minimal, almost non-existent.

3.3 Value chain. How the different activities are distributed.

The process of creating semiconductors adds a lot of value to the final product, as it is such a complex process and requires materials and technology that not all companies can afford. This complexity creates a barrier to entry into the semiconductor sector for other companies, which is why there are so few of them and why they are geographically concentrated in only a few countries. In addition, innovation is increasing the complexity of the architecture of these semiconductors, which is measured in nanometres.

The value chain of these semiconductors also requires skilled and well-managed human resources, as the final product depends on it. In terms of procurement, the microchip sector mainly relies on silicon as a raw material.

In the figure below we can see the main companies involved in distinct stages of the value chain, such as design or manufacturing.

FIGURE 4: MICROCHIP DESIGN AND MANUFACTURING COMPANIES



Source: Semiconductor Industry Association (SIA). 2021

4. ANALYSIS OF CONSOLES AND ELECTRONICS SECTOR.

4.1 Video game console sector

The game console industry is experiencing uncertainty due to a shortage of semiconductors, which has led to production delays and millions of dollars in losses for major companies in the sector. This production delay is due to a shortage of the semiconductors that run the internal circuits of game consoles. Justifying this shortage is somewhat complex, as several factors played a role, and a butterfly effect of events was formed that led to this semiconductor crisis.

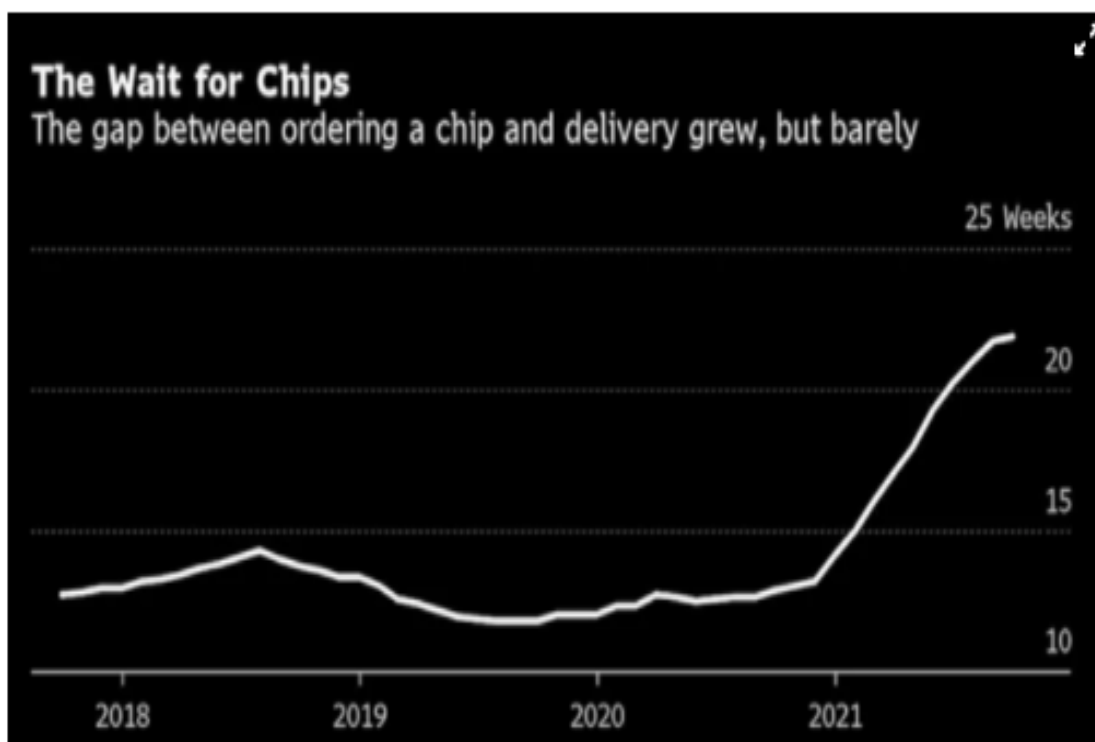
To put this in context, we must go back to the first wave of the COVID pandemic in 2020, when several semiconductor production plants were shut down, which then struggled to get back into operation after confinement and the opening of global economic activity, as it started with a very high demand that they were unable to cope with. To this add other factors that affected the most important semiconductor production companies such as TSMC (the world's largest producer of microchips), such as the drought that affected Taiwan in 2021, which made production even more difficult.

The trade war between the US and CHINA also played a role in this crisis, as tariffs were imposed by the US on Chinese foreign products, which hindered trade in semiconductors between these countries, where SMIC, one of the most important Chinese companies in semiconductor production, suffered. To all this, add one of the most crucial factors, the dependence of the major brands of video game consoles, automobiles, computers, and mobile phones on third-party subcontractors such as TSMC of Taiwan, which meant that

at a critical moment when the company could not keep up with demand, a domino effect was formed towards all the other companies.

Also, as this is a sector with barriers to entry because it requires large investments and a lot of intellectual R&D knowledge, there are very few companies, and as they are concentrated in a few countries such as China, South Korea and Taiwan, there is a strong dependence on these countries. To put this in context, figure 5 shows the average lead time for receiving a chip order from the fabs, which has gone from an average of 10 weeks to 25 weeks in just one year.

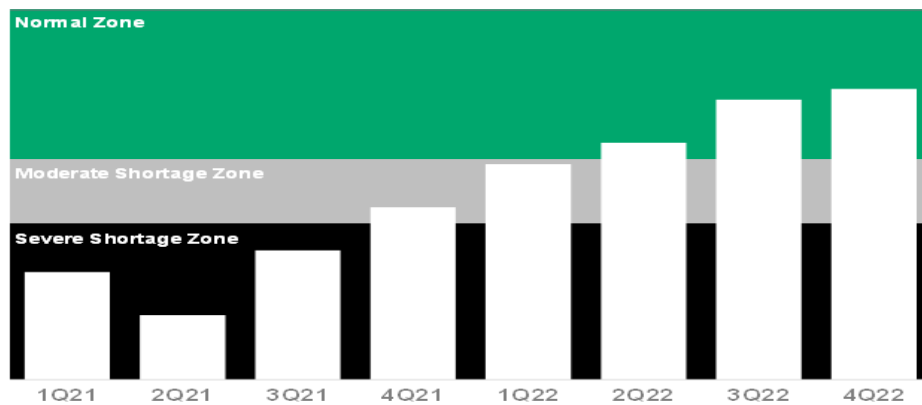
FIGURE 5: WAITING TIME FOR CHIP RECEPTION



Source: Bloomberg (2022)

This shortage is expected to last until the second quarter of 2022, according to a report by the leading business consultant, Gartner, which works with companies such as BBVA and Coca Cola. These forecasts can be seen in more detail in figure 6, which shows the inventory of the semiconductor supply chain on a chronological axis, showing three important zones: a severe zone, which was at the beginning of 2021 and one of the most critical points of the crisis. The moderate zone, which comprises the last quarter of 2021 and the first quarter of 2022. And the intimate zone, which is the normal inventory zone, that is, inventory levels to supply current production, which will occur according to these forecasts in the second quarter of 2022 and will increase.

FIGURE 6: GARTNER SEMICONDUCTOR INVENTORY FORECAST INDEX.



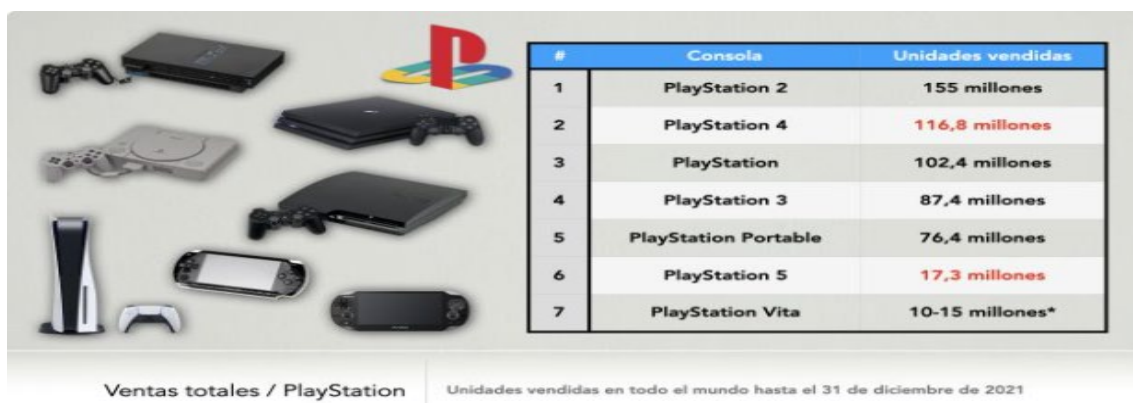
Source: Gartner (2021)

It is because of all these factors that the video console sector is experiencing a period of shortage of supply, which is damaging the companies and their sales forecasts, but which is also creating a second market of speculation with the new PS5 or Xbox consoles, which we will talk about later, involving the second-hand sale of these consoles at exorbitant prices. For this we will talk about the main companies affected, such as Sony and Microsoft, although we could also include Nintendo, but this company released more than ninety million units of its new console before the pandemic, which gave it a breathing space and room for manoeuvre, as opposed to the other two competing companies.

Sony

Sales of Sony's new flagship PlayStation 5 have been hit by this crisis, affecting its production and a shortage of supply, which has upset all its sales forecasts. This has caused sales to fall far short of its predecessor, the PlayStation 4, as shown in figure 7.

FIGURE 7: TOTAL PLAYSTATION UNITS SOLD AS OF 31/12/2021



Source: Meri station (2022)

Sony's initial forecast in November 2020 to 31 March 2022 was 22.6 million units sold, which has not been achieved due to chip shortages.

Sony closes the third quarter of 2021, 31 December 2021, with 17.3 million units sold, which is less than needed to meet its forecast of 3.9 million total units sold during that quarter. This forced Sony to apply a correction to its forecast, from 22.6 million PS5s to 19.3 million total since launch, with the goal of reaching that figure by 31 March. To achieve this, Sony must ship two million PS5 consoles between 1 January 2022 and 31 March 2022.

Sony has sold 9.5 million PS5 consoles from 1 April to 31 December; they initially expected to sell sixteen million this fiscal year. Achieving this will be an exceedingly challenging task, as they should sell another 6.5 million consoles between January and March alone.

Microsoft suffers from the same problem as Sony, as after the launch of its new Xbox X and S series consoles, it is involved in a reduction of its production forecasts.

Sony's reduction in supply has affected the market for the new PS5 consoles, creating a parallel market on the main C2C marketplaces⁹ such as eBay, Wallapop or Facebook market. In these marketplaces the price of the consoles far exceeds the RRP, creating a market with speculation. In figure 8, we can see the official selling prices of the new PS5, a challenging task to achieve since, when they are released in stock in any shop in the world, they are sold out in seconds, mainly due to the speculators' buying bots.¹⁰

FIGURE 8: OFFICIAL RETAIL PRICE OF THE PS5 IN ITS TWO VERSIONS



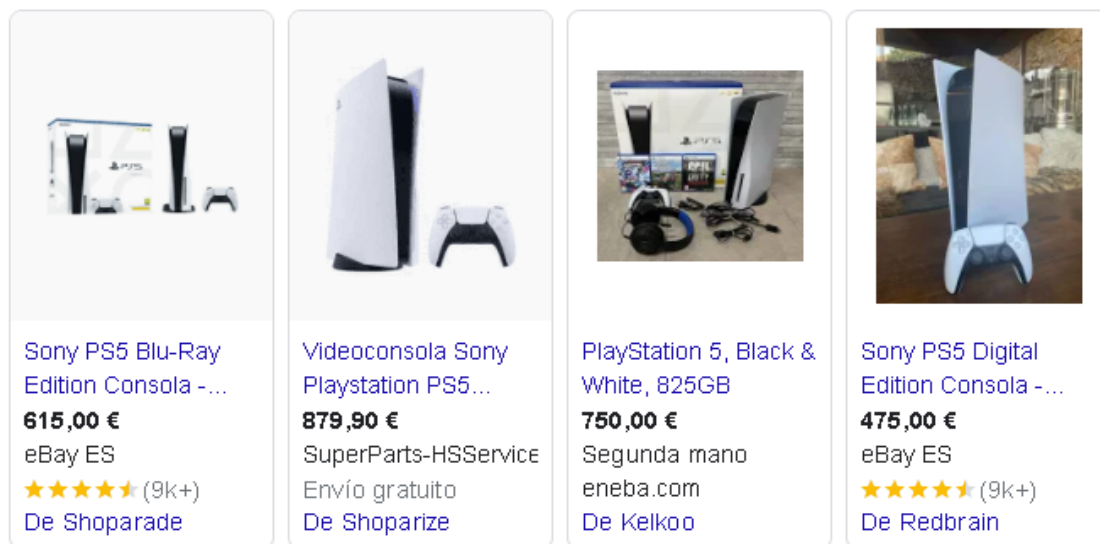
Source: El Español (2021)

⁹ C2C: market for the exchange of goods or services between private individuals.

¹⁰ A Bot is a computer programme programmed to perform specific tasks automatically and with a responsiveness far beyond human capabilities.

In Figure 9, we can see the abysmal difference between the RRP and the actual price at which they are sold on the second-hand markets. Sony and many console sales chains have therefore set out to fight against bots and speculators by limiting the number of units sold per customer, although this is often ineffective, as one customer with different profiles can buy several. In the physical shops, they have implemented another method to put an end to the abuse of speculators, which is to sell units by lottery, which is to say, awarding each customer who arrives with a number, and the winners get the console. Although these measures are not entirely effective because there are always new ways of evading them, so we can only hope for tougher measures on the part of the sellers and the manufacturer.

FIGURE 9: PS5 PRICE IN C2C MARKETS



Source: Google shopping (2022)

4.2 Electronics:

This crisis has been reflected in many sectors, such as in the field of biomedicine, such as the metastasis diagnosis device shown in figure 10, using nuclear medicine. It is valued at more than six million euros and represents a major breakthrough for science, but its production has been limited by the microchip crisis, which is causing a major headache for many industries. In Spain, it is only available at the Bellvitge clinical centre. Without this crisis that is plaguing the production of this advanced machinery, it could possibly be available in more centres, so we will have to wait for production to speed up and its availability to increase.

FIGURE 10: METASTATIC DIAGNOSIS APPARATUS AT BELLVITGE

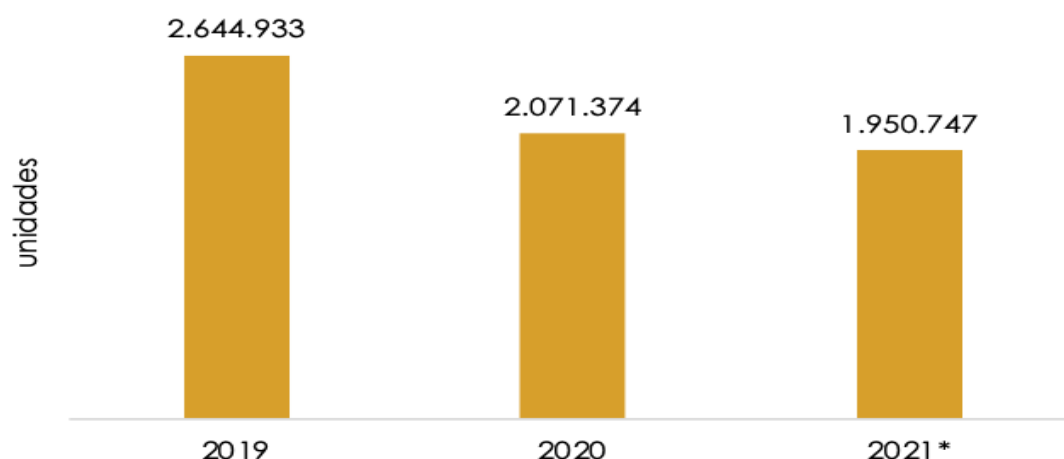


Source: La Vanguardia (2022)

And it is not the only case, as many household appliance companies are suffering the consequences, from current refrigerators that also make use of microchips, to an electric mixer, according to LG. Balay has also publicly denounced the problem, stating that its factory in Zaragoza had to stop production for two weeks due to the lack of these materials, with the economic cost that this entails.

We should also mention one of the most affected industries, the automotive industry, as we can see in the following figure, how its production has been affected, as most of its components are electronic.

FIGURE 11: VEHICLE PRODUCTION IN SPAIN IN 2019-2021.



Source: Equipoeconomico.com (2022)

5. CONCLUSION

Summing up this crisis, we must go back to the first wave of the COVID pandemic in 2020, when several semiconductor production plants were closed, which then had problems returning to activity after the confinement and the opening of global economic activity, as it started with an extremely high demand with which they could not cope. To this add other factors that affected the most important semiconductor production companies such as TSMC (the world's largest producer of microchips), such as the drought that affected Taiwan in 2021, which made production even more difficult.

It takes 3-4 months to turn a silicon board into a usable batch of chips, so increasing production speed is not easy, nor is increasing the capacity of the state-of-the-art plants used to make the latest generation of chips for game consoles, which cost tens of billions of dollars. At present there are only three major companies that excel in chip manufacturing - TSMC in Taiwan, Samsung in South Korea, and Intel in the US - but these manufacturers in turn rely on a Dutch company called ASML, which is the only manufacturer of the most advanced equipment used by these state-of-the-art chip companies. ASML is not the only manufacturer of photolithography machines, it competes also with the Japanese canon and Nikon, but ASML is, so to speak, the most advanced and on which Intel, TSMC and Samsung depend.

The trade war between the US and CHINA also played a role in this crisis, as tariffs were imposed by the US on Chinese foreign products, which hindered trade in semiconductors between these countries, where SMIC, one of the most important Chinese companies in semiconductor production, suffered. In addition to all this, one of the most important factors was the dependence of the major brands of video game consoles, automobiles, computers and mobile phones on third-party subcontractors such as TSMC of Taiwan, which meant that at a critical moment when the company could not keep up with demand, a domino effect was formed towards all the other companies. This affected video game console and electronics manufacturers, reducing their production and therefore their revenues.

In my opinion, this was to be expected, because after the severe slowdown caused by COVID, it was exceedingly difficult to return to pre-pandemic production rates so soon. I believe that, if another health crisis occurs again, or if factories are forced to close, such a crisis will happen again, so companies should be proactive, reconsidering their long-term material procurement policies, investing more money in maintaining working or safety stocks to deal with future inconveniences.

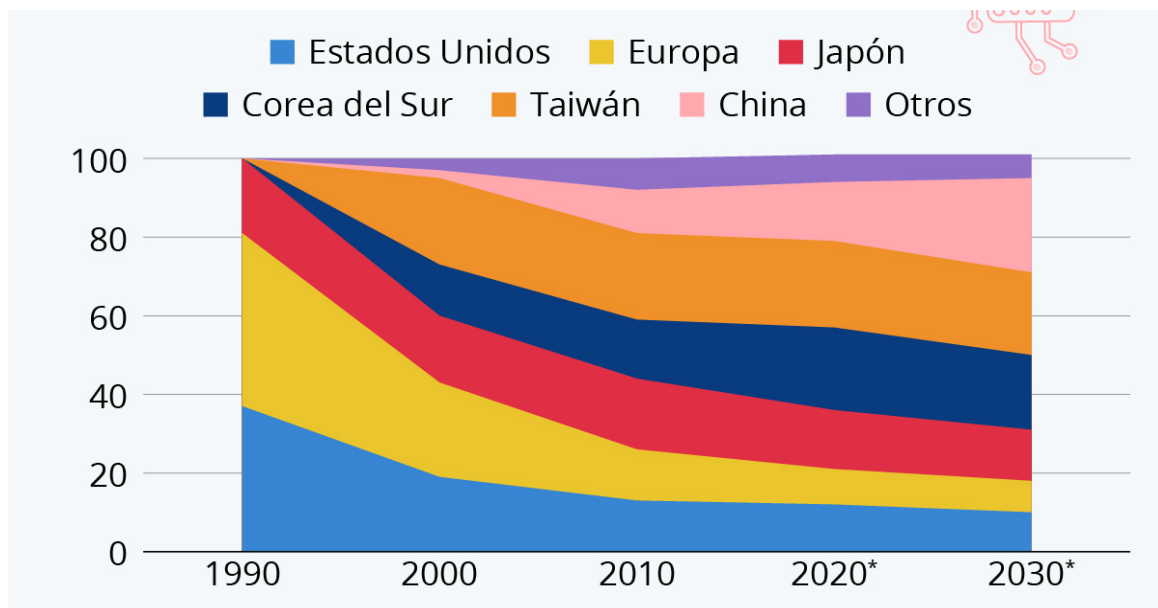
The producers affected by this crisis should come together and form associations, where investment is encouraged, i.e., cooperate with each other to find a win-win solution, as they all depend on these materials. These associations can also be used to share synergies, which would also encourage innovation in the sector.

Following the discussion of this problem, the conclusions drawn from this crisis are as follows:

Decrease dependence on suppliers concentrated in Asia:

The world's largest microchip manufacturers are concentrated in three countries, Taiwan, South Korea, and China. This is a big problem because the world depends on them, as they account for 83% of the world's production, so these countries act as a monopoly market.

FIGURE 12: CHIP MANUFACTURERS OVER THE LAST 40 YEARS



Source: Statista (2021)

As the US and Europe look to invest and create industries in other locations, the problem arises because of the intellectual property and innovative technology that companies in Taiwan, Korea or China have. The technology is so advanced, and the learning curve is so steep that it is almost impossible to compete with these countries. So, the conclusion would be to increase investment to create the necessary infrastructures to be able to produce in other countries, the creation of more suppliers would favour competitiveness and reduce dependence as there would be more suppliers, so it would be a great long-term investment.

Sony, one of the most affected by this crisis, especially in its video game division, is also looking for other alternatives to end its dependence on these suppliers, which gives it room for manoeuvre, since, with this crisis, Sony and most companies have realised that a butterfly effect of events such as COVID and the mismatch between supply and demand can make them lose unimaginable amounts of money, and in the midst of these crises, another problem arises. The problem is the priority given by the microchip manufacturers, depending on the agreements and the economic power of the companies, therefore, the big companies such as Apple will be favoured, for example, and the ones who will suffer the most are the small companies, therefore, the recommendation is to review the contractual supply agreements that the video game companies have with the suppliers and to have a guarantee or insurance, to cover their backs in case it happens again.

Investment in Europe

Europe is a great opportunity to end this semiconductor crisis, and for this reason, many companies have seen a great investment opportunity, one of them being one of the most important chip companies in the world, the US company Intel, which announced in September 2021 that it could invest around 95 billion dollars, which is a great ally to end the Asian hegemony in this industry.

Here in Spain, the company located in Madrid, KDPOF, is willing to manufacture chips in Spain, but this brings with it many difficulties, the main one being the advanced technology and the learning curve in Asian countries. Add to this the cost of setting up a factory, which ranges from one billion to manufacture simple microchips to eighteen billion to manufacture five nanometre microchips, which are currently manufactured in Asia. Add to this the lead time, with a lead time of at least 5 years to get them up and running. KDPOF, therefore, has a lot of work ahead of it to find the formula for implementing semiconductor production in Spain.

To this end, the Spanish government has launched an aid plan, PERTE¹¹, with an investment of 11,000 million euros. This is great news for Spanish companies like KDPOF, which are daring to take the plunge and compete against the microchip giants, with the aim of putting Spain at the forefront of semiconductor manufacturing.

The European Union has also made a move by mobilising forty-three billion euros to manufacture 20% of the semiconductor manufacturing market share in Europe by 2030, which currently stands at 10%. Through the European Chip Act, Europe wants to

¹¹ PERTE: Strategic Project for Economic Recovery and Transformation.

eliminate the high dependence on Asian countries and strengthen Europe's competitiveness. These funds will facilitate access to project finance and help start-ups to consolidate their projects, mature their innovations and attract investors.

This is a measure that the sectors that depend on Asian microchips were clamouring for, as Europe is one of the most important automotive industries in the world, and its production is highly conditioned by these chips. If this investment goes as planned, Europe will become one of the most important semiconductor manufacturing hubs in the world in the near future.

In-house microchip manufacturing

After seeing the negative consequences of this crisis, many companies have begun to look for alternatives, one of which is to open their own semiconductor factories and not depend so much on third party companies. That is why **Sony**, one of the companies most affected by this crisis, has not been able to meet its sales forecasts for its new star console, which has given it so many headaches. Sony is thinking of creating a factory in Japan in cooperation with the most important microchip company, TSMC, in cooperation with the Taiwanese company. Sony saw that its stock of ps5 is extremely limited and had a huge demand that it was not possible to cover in the estimated timeframe. With their own factory they would not be so dependent on others, and if they had any problems, it would not affect them as much, so it is an incredibly worthwhile investment to cover their backs. Finally, the recommendation is to further increase investment in R&D, with the aim of finding the key and sufficiently advanced technology to manufacture with the current quality standards, a task that will be exceedingly difficult, but which will be an incredibly good decision.

And with this series of conclusions on this final degree project, with implicit recommendations, we end this investigation into the microchip crisis in the video game console and electronics sector.

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