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"THE EVOLUTION OF CHINA'S AUTOMOTIVE MARKET: OPPORTUNITIES AND CHALLENGES FOR A GREENER FUTURE"

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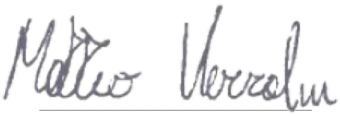

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INTRODUCTION

In honour of the 40th anniversary of the "gaige kaifang", the open policy that in 1978 revolutionized China and consequently the global economy, this work will analyse how the automotive market was affected, how it had, and will, cope with the technological and environmental challenges and consequently how it will evolve in the near future.

The automotive industry has been chosen as a subject because it is undergoing a relevant transition from internal combustion engines to electric ones. This disruptive innovation in the power train of vehicles represents a huge step forward for technology and for the future of mankind. The widespread adoption of electric vehicles will enhance the quality of air in urban areas. Furthermore, if combined with an energy structure strongly reliant on renewable energy, it will help curb the emission of green-house gasses, in particular CO2, with great benefits for the environment, limiting the drastic consequences of climate change.

The evolution of China's automotive market was chosen as the topic of this thesis because of the strong impact that it will have on the global economy of the future. Understanding how this market reached the current situation is relevant to comprehend the major opportunities and challenges that it will face in order to become a greener economy, reliant on electric transportation.

The first chapter will provide an overview of the different phases that the automotive industry underwent after World War 2, from being an infant industry protected by the government, with a couple of thousand vehicles produced each year, to being the most important automotive market in the world, with millions of passenger cars manufactured; going through an economic liberalization phase during which joint ventures with multinational companies allowed the local automakers to acquire the necessary technology and knowhow. The major players in this market will be addressed, highlighting the objectives that the central government had planned to achieve in the automotive industry.

The second chapter will concentrate on the actual automakers in China, describing how they reached their current position within the market, distinguishing between state-owned and private companies, with a further focus on the relevance of the joint ventures. Moreover, the overall importance within the worldwide automotive market of the Chinese market will be defined.

Chapter three will capture the more relevant than ever issue of pollution and how it is strictly related to the automotive industry. In doing so, there will be an evaluation of the evolution and the current energy structure in China, understanding the importance of it when a future characterized by "new energy vehicles" is foreseen. The two most probable forecasts by the

International Energy Agency will be reported, in order to comprehend the possible future of the energy structure and the automotive industry in China, and how this will reflect on the CO2 emissions of the country.

The final chapter will concentrate on this future. Firstly, analysing how China has been able to lead the electric vehicle market through strong state intervention. Then trying to highlight the most important opportunities and challenges that the Chinese “new energy vehicle” market will face in the near future.

Finally, the conclusion will sum up all the findings of the paper, giving an insight into how the Chinese automotive market will evolve and how this evolution could affect the rest of the world.

1. CHAPTER I:
CHINA'S AUTOMOTIVE MARKET: HISTORY

China's transition, from a global manufacturing hub to one of the most influential superpowers in the world, can also be seen in how the automotive market evolved within the country. This market has been enormously affected by the national policies and the relationships between China and the rest of the world. Because of this, it is possible to segment the past 70 years in three different phases, during which the automotive industry was created and has developed, from being an infant industry to a global competitor[1].

1.1. The three stages

During the first half of the twentieth century the automotive market in China was nearly inexistent, with a low number of manufacturers which mainly produced trucks. The lack of this industry during this period is due to the political climate that deterred potential buyers from owning a car because of the risk of it being confiscated. Furthermore, the presence of paved roads was extremely rare and the low standard of living made it unaffordable for most of the population.

1.1.1. State centric 1949 - 1978

After World War 2, China was trying to recover from the devastating occupation of the Japanese army. Albeit all the destruction, there were not only ruins and blood left behind by their Asian enemies. The Japanese had abandoned in the Manchurian territories, located in the northeast of China, industrial bases. The Chinese, although they had these factories and hardware, lacked the knowledge and soft skills necessary to exploit them. So, in 1950, thanks to the Sino-Soviet alliance, the People's Republic of China obtained the help of USSR to modernize its industry. The soviets sent their engineers to train their Chinese colleagues in order to optimize the production of several machineries.

The automotive market at the time was not developed and the main demand was for taxis in the main cities and personal cars for Chinese leaders. Because of this, the units yearly

[1] Christoff, A. (2009). *THE CHINESE AUTOMOBILE INDUSTRY AND THE WORLD TRADE ORGANIZATION: CHINA'S NON-COMPLIANCE WITH WTO REGULATIONS THROUGH ITS SUBSIDIZING OF AUTOMOBILE MANUFACTURERS*. [online] Mckinneylaw.iu.edu. Available at: https://mckinneylaw.iu.edu/iiclr/pdf/vol19p137.pdf .

produced did not exceed a couple of thousand and most of them were produced in the First Automobile Works (FAW), a joint project, which was founded in 1953 where trucks and the Hongqi limousine were produced. This slow advancement reached a halt in 1960, when there was a clash in the Sino-Soviet agreement, which led to the repatriation of the soviet engineers. Moreover, this downturn was worsened by the cultural revolution, which struck China for a decade, from 1966 till 1976[2].

1.1.2. Global partnering 1978 - 2001

The growth of this industry took a huge leap forward in 1978, when Deng Xiaoping reformed the system with the famous policy "gaige kaifang" (literally: reform and opening up), in order to open up the economy[3]. This "open door policy" modified the economic landscape.

Before the reform, China monopolized international trade through state trade corporations, which had the duty of intermediating between the global and the internal markets, dictating prices in the Chinese market, which often did not reflect the world market price.

The "open door policy" decentralized to local and regional governments the decision-making regarding imports and exports, replacing the administrative restrictions with tariffs, quotas and licensing, and creating in 1979 the Special Economic Zones (SEZs), which were initially four: Shenzhen, Zhuhai, Shantou and Xiamen. These territories enjoyed fewer restrictions on cross-border trade and foreign investments, allowing exporting sectors to import goods outside the normal custom duty regime. In 2014 the number of areas with a predisposition for foreign trade was much higher, with 6 SEZs, 14 open coastal cities, 4 pilot free trade areas and 5 financial reform pilot areas[4].

These structural changes to the economy favoured Foreign Direct Investments (FDIs), trade expansion and consequently an increased exposure to international managerial and technological standards and knowhow, plus an introduction of foreign capital in the country.

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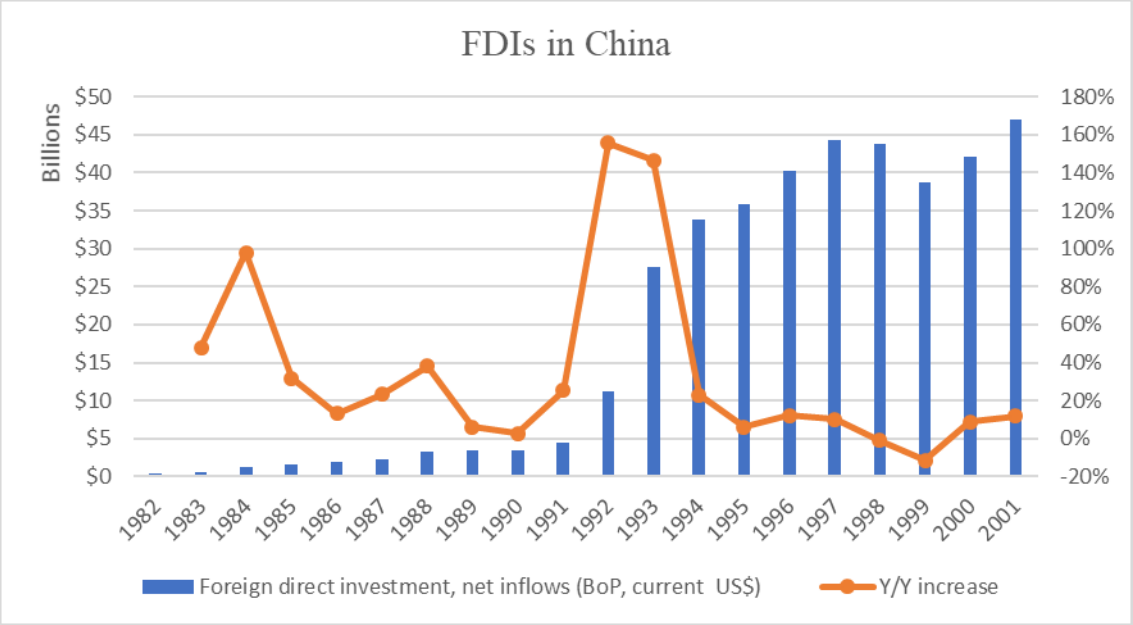
[2] China automotive industry handbook strategic information and contacts. (2013). Washington: International Business Publications, USA, pp.45-46.
HISTORY. (2009). *USSR and PRC sign mutual defense treaty*. [online] Available at: https://www.history.com/this-day-in-history/ussr-and-prc-sign-mutual-defense-treaty.
Holweg, M., Oliver, N. and Luo, J. (2005). *The Past, Present and Future of China's Automotive Industry: A Value Chain Perspective*. [online] Researchgate. Available at: https://www.researchgate.net/publication/276909020_The_Past_Present_and_Future_of_China's_Automotive_Industry_A_Value_Chain_Perspective.

[3] Huenemann, R. (2013). *Economic Reforms, 1978-Present - Chinese Studies - Oxford Bibliographies - obo*. [online] Oxfordbibliographies.com. Available at: http://www.oxfordbibliographies.com/view/document/obo-9780199920082/obo-9780199920082-0008.xml.

[4] Worldbank.org. (n.d.). *China's Special Economic Zones*. [online] Available at: https://www.worldbank.org/content/dam/Worldbank/Event/Africa/Investing%20in%20Africa%20Forum/2015/investing-in-africa-forum-chinas-special-economic-zone.pdf.

This had an enormous impact on the Chinese economy, which experienced an overwhelming export-led growth in the following decades. [5]

This openness towards FDIs, however, had been selective in specific industry, encouraging investments, through preferential treatments such as tariff exemptions and fiscal reductions. These restrictions were slowly dismantled, broadening the access to new sectors.

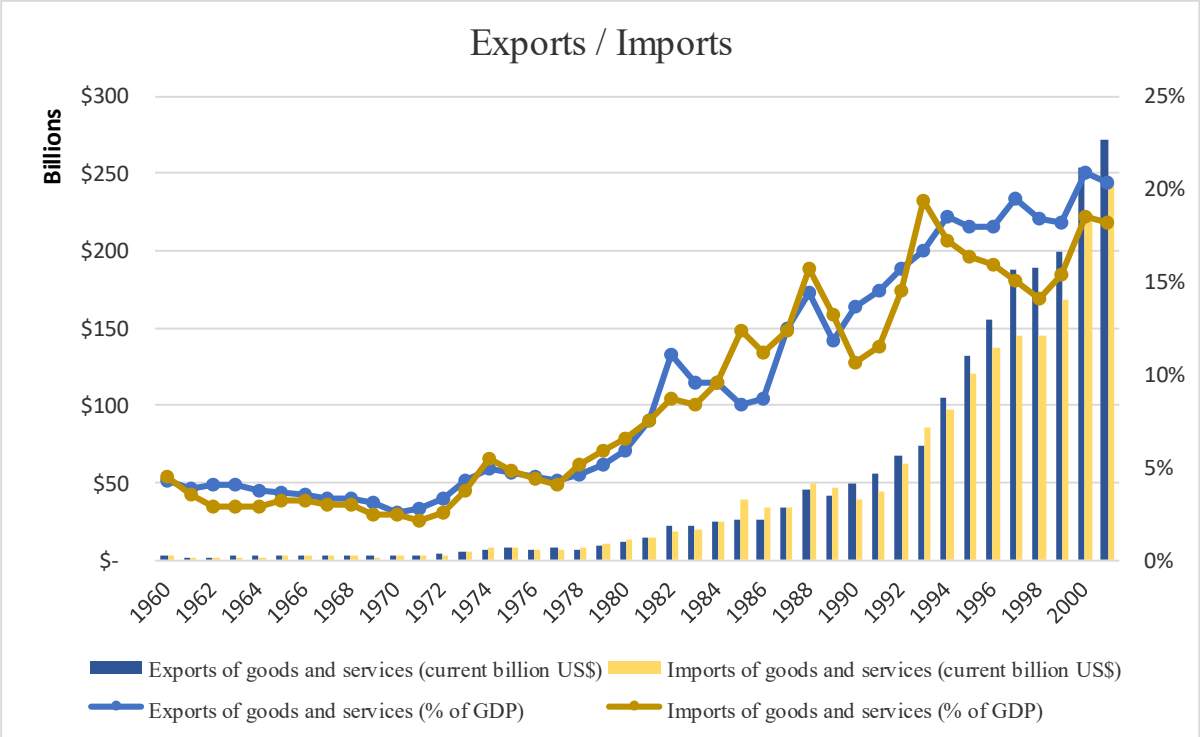


Source: https://data.worldbank.org/

Unfortunately, it was not possible to retrieve data prior to 1982, but it can be seen how from that date on, FDIs have increased exponentially, with a CAGR of 34%. The first decade shows a moderate increase in pace, due to the aforementioned restrictions and a lack of confidence of foreign investors; but, in 1992, FDIs soared thanks to a further economic liberalization of new sectors and of the internal market, and, additionally, of a global momentum of growth, which slowly faded during the mid-90's. An aspect to take into consideration regarding this data is that, among all the foreign investments directed to China, 60% of them during these two decades came from Hong Kong and Taiwan, which underlines one of the aims of these liberal policies that was the repatriation of Chinese capitals. However, foreign invested enterprises (FIEs) have immensely contributed to the building up

[5] Wei, S. (1995). The Open Door Policy and China's Rapid Growth: Evidence from City-Level Data. *National Bureau of Economic Research*, 4, pp.73 - 104.
News.bbc.co.uk. (n.d.). *Open Door Policy*. [online] Available at: http://news.bbc.co.uk/2/shared/spl/hi/in_depth/china_politics/key_people_events/html/8.stm .
Silk, L. (1985). *Economic Scene; The Open Door Policy in China*. [online] Nytimes.com. Available at: https://www.nytimes.com/1985/09/27/business/economic-scene-the-open-door-policy-in-china.html.

of the modern capabilities of the domestic market in several industries, such as the automotive industry through numerous joint ventures[6].



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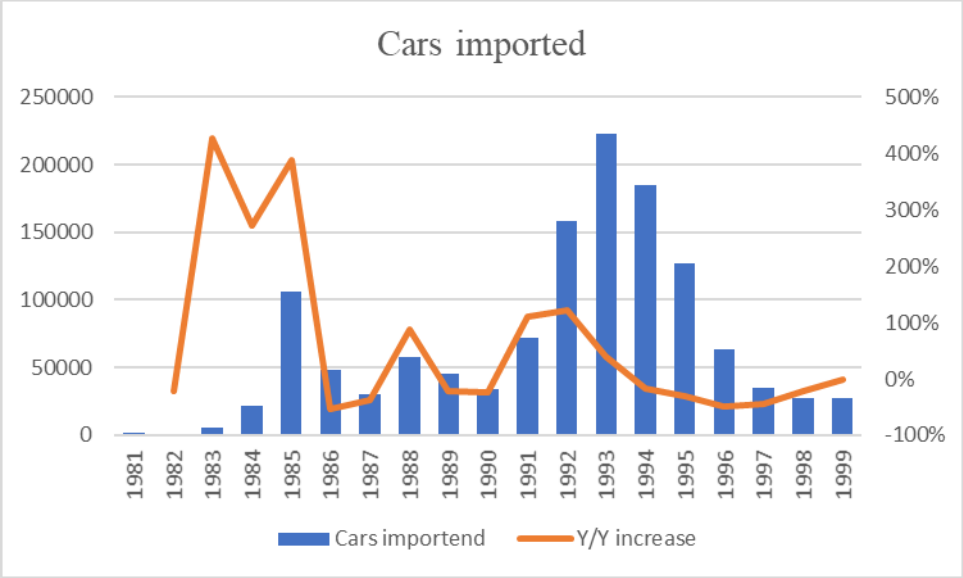
Furthermore, looking at the graphic of imports and exports, it is possible to notice how the opening policy strongly affected the influence of the global market in the domestic economy, with a relative steady increase in terms of billions and as a percentage of the nation's GDP. Focusing on the topic of this thesis, that will be later analysed more in depth, we can see how the automotive industry was greatly influenced by this opening to the global market as well. In fact, since 1978, dialogues began between Chinese and foreign automakers to form alliances in order to enter the Chinese market. These alliances took the form of joint ventures and were finalized from 1983 on. This is because the government, understanding the potential of its customer base, exploited this resource requiring the major international automotive players to partner with local industries to allow the latter to gain the knowledge and the ability to fill the technological and managerial gap that they had between them, and create firms that would be able to compete globally in the future. Under this aspect, it can be considered as an infant industry which is protected from international competition and at the same time helped and trained by their foreign counterparties. An enormous stimulus for this industry came

[6] Lemoine, F. (2000). FDI and the Opening Up of China's Economy. *CEPII Centre d'Entudes Prospectives et d'Informations Internationales*.

from the economic growth and the increase in tourism after the "gaige kaifang", which led to an explosion of demand for new cars.



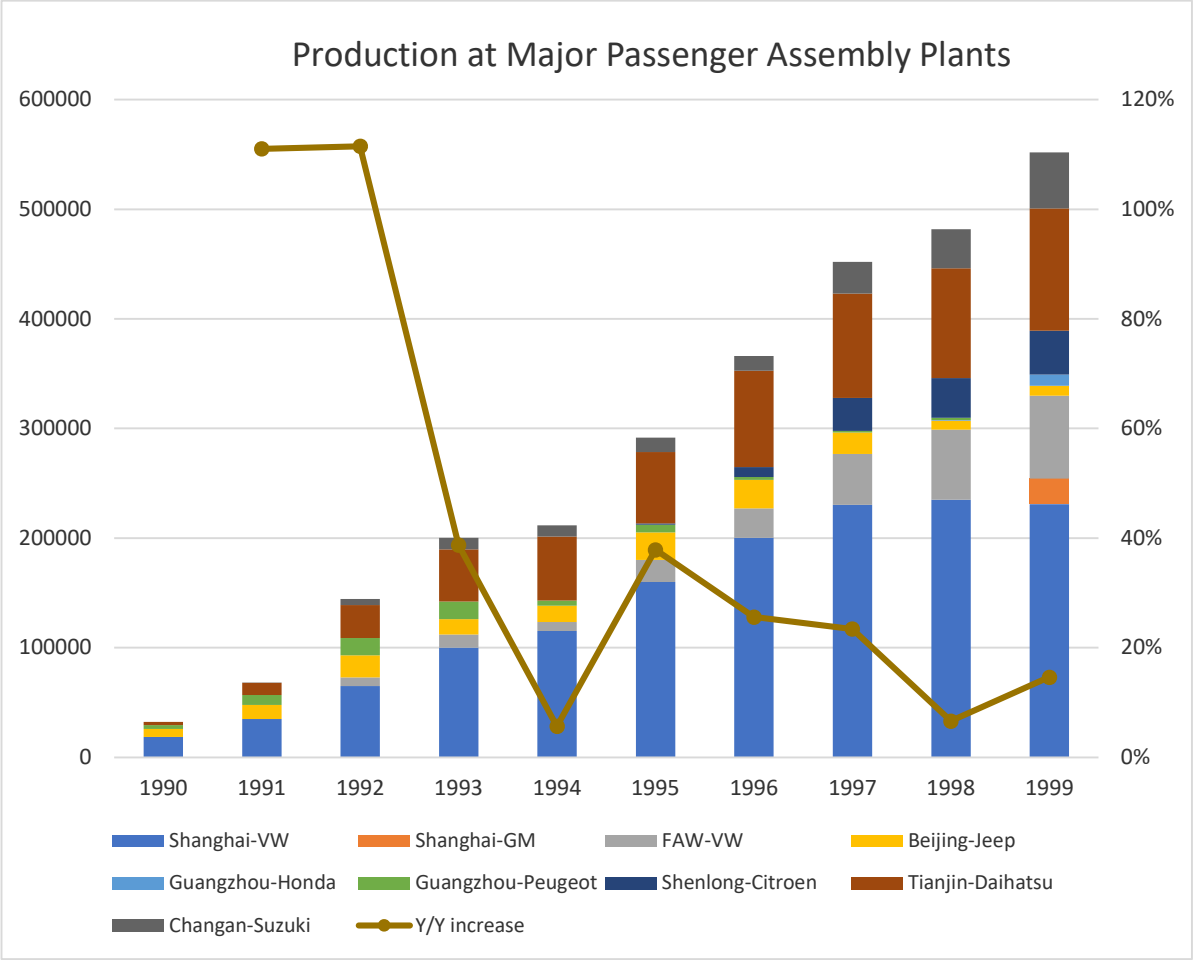
Source: Harwit, E. (2001). The Impact of WTO Membership on the Automobile Industry in China

This demand was largely satisfied by imports, which reached 105 thousand units in 1985[7], even though import taxes were as high as 260 per cent.

After some years of downturn for imports of new vehicles, the surge of the economy and domestic production, combined with a reduction on import tariffs during the first years of the 90's, caused a further rise in foreign car imports which reached their maximum in 1993, with more than 220 thousand units.

This trend towards favouring imported vehicles faded during the second half of the 90s even if the national demand was increasing. This happened because the demand moved towards nationally produced cars, which were manufactured mainly by the joint ventures that, after a decade, had reached a level of quality that satisfied the Chinese customer, making less attractive the more expensive foreign substitutes. This shift in the market was also one of the objectives of the central government, which was concerned about the loss of foreign exchange that characterized the automotive industry.

[7] Harwit, E. (2001). The Impact of WTO Membership on the Automobile Industry in China. *The China Quarterly*, 167.



Source: Harwit, E. (2001). The Impact of WTO Membership on the Automobile Industry in China

As it is possible to see from the graph, the production steadily increased during the last decade of the twentieth century, with a CAGR of 42 percent. These joint ventures, which were at the time the most relevant ones in China, produced cars that were then commercialized through the foreign brand. During this period, on the one side the major Chinese OEM was SAIC, with VW and, later on, GM as partners; while, on the other, the foreign automaker with the most important presence in the Chinese market was Volkswagen which, through its joint ventures with SAIC and FAW, produced more than 300 thousand passenger vehicles in 1999, more than all the other commercial agreements taken here in consideration.

During this period, the opening by the government of the Shanghai and Shenzhen Stock Exchange in 1990 gave a further boost towards a liberal market, with less control of the government and more free movement of capitals across the industries in order to modernize the economy[8].

[8] Amadeo, K. (2018). *Why China's Stock Market Is Like a Casino*. [online] The Balance. Available at: https://www.thebalance.com/china-stock-market-shanghai-shenzhen-hong-kong-3305480.

The free convertibility of the yuan, or renminbi, the local Chinese currency, established in 1996, eased foreign investments as well. This new connection to the international financial market was further implemented through the withdraw from the currency's peg on the dollar, which had caused till then some friction with the US and Europe.

1.1.3. Creation of indigenous brands and NEVs 2001 -

From 2001, the application to join the WTO affected enormously the presence, relevance and credibility of the Chinese economy worldwide[9]. The talks with the international organization began in 1986, but due to the resistance of the industries and local governments that feared the overwhelming superiority of the developed nations in key industries which would have caused the loss of millions of jobs, the final agreement was signed in November 10, 2001. China's accession to the World Trade Organization had a huge impact on the relevance of import and export for its local and the global economy, since import tariffs would have to decrease and market protection policies would have to be reduced. At the same time, this signing bounded China to disclosure and transparency regulations which had to be implemented in order to allow fair trade among the members of the organization. Among this point there have been some issues related to subsidies to the specific automotive industry which under the WTO rules are considered actionable or prohibited as a result of their adverse effect on the industry's competitiveness of the other Member States. These are difficult to spot because of the limited information provided by the Chinese firms and moreover as long as they can be covered as funds aimed at research and development or environmental improvement, they are categorized as non-actionable. This resulted in a partial ineffectiveness of the guidelines of the international organization, which additionally, if sanctions were applied, they did not discourage such behaviour because they implied that other Member States had to take action and could be compensated in the limit of the damage they had suffered. This allowed the central government to continue to support its firms and protect them from global competition during the first years after the signing[10].

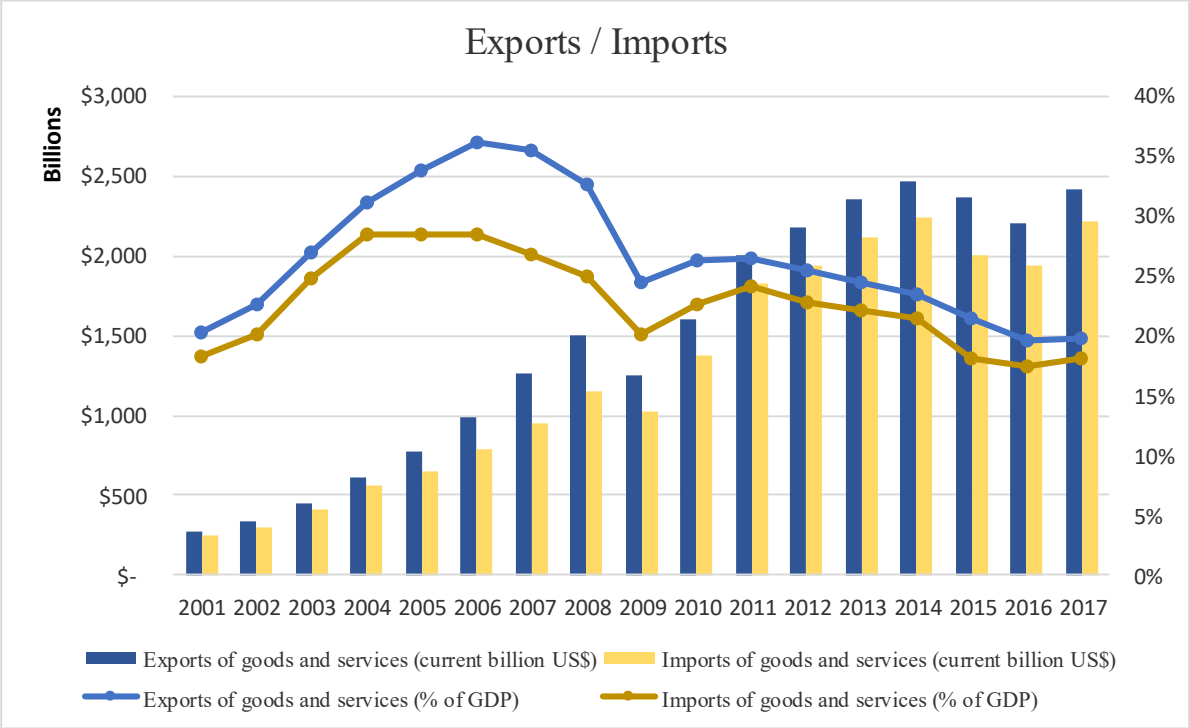
A further tactic through which China did not follow the rules of the WTO is related to the transfer of technology that the country required the foreign firms who wanted to enter its

[9] Bloomberg.com. (2017). *China's Path Toward Opening Up its Financial System*. [online] Available at: https://www.bloomberg.com/news/articles/2017-11-10/china-s-path-toward-opening-up-its-financial-system-a-timeline.

[10] Christoff, A. (2009). The Chinese Automobile Industry and the World Trade Organization: China's Non-Compliance With WTO Regulations Through Its Subsidizing of Automobile Manufacturers. *Indiana International & Comparative Law Review*, 19(1).

market through joint ventures. This request by the central government would be considered illegal under the international agreement, but it was bypassed thanks to long administrative procedures which led the MNCs to spontaneously offer such transfer in order to speed up the procedure and obtain the support of the local government.

In line with this questionable behaviour towards the global economy, the renminbi was repegged by the Bank of China in the summer of 2008 till 2015, since when it started referring to a basket of reference currencies[11]. This latter action was also due to the recognition by the International Monetary Fund (IMF) of the yuan as a currency with Special Drawing Fund in 2015.



Source: https://data.worldbank.org/

Looking at the economic side, this period continued the trend that characterized the previous decade, with imports and exports growing in absolute value with the exception of 2009, year marked by the international crisis. If compared to the Chinese GDP, it can be seen how these increasing values have settled in the last five years around 20-25 percent of it, with a constant trade surplus.

The central government designated this period as fundamental for the growth and global competitiveness of the Chinese brands, defined as indigenous. Furthermore, the focus of the party leaders captured a future development of the automotive world, the NEVs, new energy

[11] Balding, C. (2018). *China's Not Feeling the Yuan Market Love*. [online] Bloomberg.com. Available at: https://www.bloomberg.com/opinion/articles/2018-06-04/china-s-not-feeling-the-yuan-market-love .

vehicles, in order to gain a technological advantage in the industry. These topics will be further discussed in this work.

1.2. China's main players in the automotive sector

Since the 1980s China has steadily developed at an astonishing pace, such as other Eastern Asian countries did previously, most famously Japan and South Korea. Focusing on the automotive market, it is possible to notice how this growth has differed from its Asian counterparts. China began this process far later and, because of this, the gap with the developed countries was huge. Furthermore, with its vastity, China was, and still is, an enormous potential market with a great appeal for any multinational company. Due to this, after the policy change, it welcomed vast amounts of foreign direct investments and tried to induce technology transfers via joint-ventures between MNCs and mainly state-owned enterprises.

This approach towards developing an industry that since then was nearly non-existing, meant a change in the economic infrastructure, which led to dismantling part of the highly inefficient social industry structure, while ensuring the continuity of the Communist Party rule. Overall it enabled to ramp up in a brief period the production of passenger cars to accommodate the growing domestic demand driven by the increase in average household incomes.

China's huge size and its degree of decentralization meant that this process could not be overseen in its entirety, leading the central government to concentrate only on just a few major state-owned firms, to enable them to enter this market and achieve economies of scale in order to become national champions. Meanwhile, some local governments saw the opportunities that a carmaker could offer to its citizens, with new employment, and its overall economic growth. This led to a flourishment of locally state-owned enterprises (LSOEs) and private firms.

From this panoramic of the industry, we can see how this complex system has five major players, each of them with their own objectives and incentives, most of them incompatible with one and another. These players are: the central government, local governments, state-owned automakers, private automakers and foreign multinational automakers.

1.2.1. Central government

This entity is represented by the Chinese Communist Party, which has led the country for several decades. Its general main aim, in order to keep the power and rule the country, is social stability, which is achieved through the control of inflation and unemployment.

Focusing on the auto industry, which was defined in the Seventh Five-Year plan[12] as a "pillar" industry in 1986, the State's goal was, and still is, to create a globally competitive automotive industry, dominant internally and abroad. The objectives, in order to achieve such an ambitious goal, have evolved during time. Initially the main concern was to obtain the foreign technology necessary to advance such an archaic industry. According to the leaders, the enterprises involved in the industry were supposed to make use of exports to get foreign exchange and utilize the imports to get the necessary technology. Then, once exports increased in other major industries, reducing the necessity for foreign cash, the efforts moved towards the development of Chinese brands, consolidation of the industry and the establishment of R&D centers, where the research for alternative fuels and propulsion systems could be conducted to have an advantage in the new generation of vehicles, the so-called "new energy vehicles" (NEVs).

1.2.1.1. Consolidation

Consolidation is nowadays, as in the past, an important topic. Back in 1978 there were 55 auto assemblers, by 2008 there were 117 and in 2016 there were 184[13]. The government, over the course of the years, has achieved its objective of consolidating at the top of the industry, through forced mergers and financial benefits. But at the bottom it is still very fragmented, even though attempts were made during the years, such as preventing the creation of new automakers. The tolerance towards this situation can be traced back to the main goal, social stability, which impedes the closure of small manufacturers which are big employers in small districts.

The attempts to achieve such a challenging objective began at the end of the 1980's, when the leaders focused their attention on establishing a few relevant players that were supposed to rule the market, naming them "big three, small three". The big ones where obviously state-owned enterprises: FAW, Shenlong and SAIC; while the small where JVs: Beijing-Jeep, Guangzhou-Peugeot and Tianjin Auto[14]. This structure of the industry was furtherly

[12] China.org.cn. (n.d.). *The 7th Five Year Plan (1986-1990) -- china.org.cn*. [online] Available at: http://www.china.org.cn/english/MATERIAL/157620.htm.

[13] Cox, M. (2017). *The Chinese Automotive Market – Much more than just large - MMTA*. [online] MMTA. Available at: https://mmta.co.uk/2017/06/22/chinese-automotive-market-much-just-large/.

[14] Lee, C., Chen, J. and Fujimoto, T. (1996). *Different Strategies of Localization in the Chinese Auto Industry: The Cases of Shanghai Volkswagen and Tianjin Daihatsu*. [online] Dspace.mit.edu. Available at: https://dspace.mit.edu/bitstream/handle/1721.1/1607/China.pdf.

developed in the "8th Five Year Plan", in which there were also limitations for local governments to create new automakers.

A relevant step towards reducing fragmentation was taken through a policy in 2004, which stated that the bankrupted automakers would no longer be allowed to sell their permission to produce cars. In fact, two of the most important private companies nowadays, BYD and Geely, as many others, obtained such a certification one year before in that exact way.

In 2009, when the "Auto Industry Adjustment and Stimulus Plan" was drafted, the objective of consolidation was still a top priority. The policy resumed the "big four, small four" policy. This time it captured two more enterprises, appointing FAW, which had merged with Tianjin in 2002[15], Dongfeng, SAIC and Changan as the "big four", and BAIC, GAC, Chery and Sinotruk as the "small four". These eight are state-owned enterprises and they were encouraged to conduct national and regional mergers.

This consolidation process, even though it enabled China to create and support several large manufacturers that have a relevant market share in the Chinese market, has not yet managed to push out of the market small and inefficient locally state-owned enterprises.

1.2.1.2. Technology acquisition

Technology acquisition was strongly dependent on foreign automakers and was a slow process that can be segmented in different stages. Initially the Chinese industries were responsible to assemble "complete knock-down kits" (CKDs), which required low skills. It then started producing some parts for their foreign counterparts, localizing production within the country. The further step was to create the whole supply chain within China and the last stages, recently reached, were to create joint-ventures for R&D purposes and furthermore, establish their own R&D centers. These stages have been followed by the state-owned enterprises, while the private automakers, who still exploited the possibility of agreements with foreign counterparts to accelerate their development, sometimes utilized the "shanzhai" mentality, which literally means "mountain village", but it stands for the art of copying applying incremental innovations. The use of this tactic was in part halted by China's membership in the WTO. Nowadays, the technological level reached by the Chinese constructors can be comparable to most of the major foreign automakers. This is also thanks to the efforts and investments by the private firms.

[15] Cnn.com. (2002). *CNN.com - China FAW absorbs small-car company - June 17, 2002*. [online] Available at: http://www.cnn.com/2002/BUSINESS/asia/06/16/china.carmerger/index.html .

1.2.1.3. Chinese brands

The necessity of creating Chinese brands was put in the spotlight when China entered the WTO. During the first years, ninety percent of the passenger cars produced within the country came from JVs and this meant that most of the profits obtained in this industry were being repatriated by the foreign automakers. Slowly through the years, the market share captured by Chinese brands increased, reaching 29 percent in 2009[16] and approximately 43 percent in 2017, thanks to continuous improvements in quality and brand equity that allowed these brands to compete with the foreign rivals in the internal market[17]. Such a relatively low market share, especially if we take into consideration the first years of the new millennium, can be traced back to how the SOEs relied upon the JVs to sell their cars, applying the foreign brand or a JV one. Meanwhile, private automakers, which had to rely on their own strength without much support from the central government, have been crucial for the latter in order to reach the objective of creating and developing Chinese brands. This is because, while the SOEs relied on the financial support of the state, with short-term views that focused on the profits that JVs gave to the managers, the private firms had to adopt a more long-term approach, investing in their own brands to achieve economies of scale and recognition from the market in order to be profitable and survive. This trend can also be seen when we analyse the "new energy vehicles" market, because, in order to be a pioneer in this new disruptive technology, there has to be a lot of R&D to back it up. This implies a long-term view that, as previously underlined, was an approach that mainly private firms had.

The latest move of the central government to obtain strong indigenous brands is the announcement, made in 2018 but hinted for the past years, that it is going to lift the 50 percent cap on the stakes that foreign automakers can own in a joint venture by 2022. This is considered a good stimulus for the state-owned enterprises to furtherly increase their efforts in building solid value-propositions with their brands, approach that has been taken only in part by some public automotive manufacturers. Such a change implies that China thinks its automotive industry is ready to compete against MNCs in its own market, even though the transition will be gradual since there will be many contracts still in place[18].

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[16] Roberto, M., Guo, G. and Jiang, C. (2011). Chang'an Automobile and the Chinese automotive industry. *Emerald Emerging Markets Case Studies*, 1(4), pp.1-17.

[17] Www2.deloitte.com. (2011). *Gaining momentum: recent trends in China's automobile parts market*. [online] Available at: https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/manufacturing/deloitte-cn-mfg-gaining-momentum-en-161111.pdf.

[18] Bloomberg.com. (2018). *Chinese Carmakers Under Pressure as Joint-Venture Caps Erased*. [online] Available at: https://www.bloomberg.com/news/articles/2018-04-18/tesla-bmw-unshackled-from-jv-era-puts-china-carmakers-on-notice.

1.2.2. Local governments

Creating locally state-owned enterprises was a task that fascinated local leaders of the different municipalities in China. These individuals are valued by the central government and by their voters based on the economic performance and employment level reached, and this type of industry ensures a big advantage in both areas. That is the reason why, since the beginning of the development of the automotive industry, many vehicle assemblers were created all over the country, sometimes without Beijing even knowing of their existence, such as Chery.

A further aspect regarding local governments and their involvement in this industry is that, once a joint-venture with a foreign manufacturer was established, most of them required localization of the suppliers within their territory, so that they could develop not only the automotive industry, but all the related ones, boosting the economy and employment of the region. This strategy has proven to be applied successfully only in certain districts, where there already were advanced firms which could supply parts that could meet the required quality standards. An example of this is the Shanghai district, home of the LSOE SAIC. This OEM successfully established long-lasting joint ventures with Volkswagen, and later GM, relying on a well-developed local supply chain that boosted production.

1.2.3. State-owned automakers

The leaders of these automakers can be compared to the local leaders, in the sense that their evaluation is based on the size of their firm and their aim is to obtain important roles within the government. That leads them to focus on increasing production capacity, especially in the short term, abandoning the usual aim of profitability, but be settled without losing money. This is why SOEs, once they reached an agreement with a foreign partner, were satisfied to exploit their partner's know-how and brand equity to exponentially increase the number of vehicles sold, without dedicating any financial resources to the development of their own brand or in R&D, which would have meant a focus, and consequently financial returns, only in the long-term. This attitude has slowly changed in the past decade, but as we will be able to appreciate later on in this work, most of them are still behind the private automakers.

1.2.4. Private automakers

The definition of "pillar" industry implies a strong commitment and involvement by the State. This makes the creation of a private firm in such an environment a difficult challenge, since it has to achieve economies of scale, produce products that are considered attractive by the customers and obtain financial and managerial resources that the State will not provide; in one word it has to be able to "survive". Despite this adverse scenario, there are several companies that, over the years, successfully entered the automotive market, with results that often overshadowed the performance of their state-owned competitors. This is because these private firms were forced to have a long-term view, in order to have a competitive advantage in the future. Furthermore, they have successfully achieved goals set by the central government, such as creation of indigenous brands, technological innovation, a relevant share of exports and, more recently, a leading position in the NEVs market. This has led Beijing in the past years to devote more attention and resources to these industries which in the previous decades were considered underdogs.

1.2.5. Foreign multinational companies

After the opening of the Chinese market, all the automotive MNCs, sooner or later, entered the Chinese market. This is because the customer base was immense and so were the opportunities of growth, while the high tariffs made it costly to import cars into the country. The approach to this market has some shady aspects about it too. As a starter, a foreign automotive firm could enter it only through joint-ventures with local firms and with a participation stake of maximum 50 percent. This meant that there were issues related to the protection of the brand and other intellectual property. Furthermore, the initial investments to update the machinery and the plants was considerable, plus there was the necessity to train the local employees.

The first pioneers in this market began with small steps, sending complete knock-down kits, but from the 90s, the requirements for a local supply chain were high and this meant putting at risk the image of the brand with quality that was not completely under the control of the multinational companies. Despite these and other issues, such as cultural clashes and being obliged to transfer technology to their local partners, many foreign automakers obtained huge profits and market share in China, and for some of them this now represent the biggest market.

1.2.5.1. Joint ventures

As previously stated, the aim of joint ventures for the Chinese government was mainly transfer of technology, in order to develop the automotive industry, which, compared to the level reached in the developed countries, was very low and decades behind. This goal was the basis of a broader objective, which was to obtain as soon as possible Chinese automakers that were able to compete in the global market. This is why the People's Republic of China did not allow foreign firms to establish a wholly owned subsidiary when entering the market, but it forced them to establish joint ventures with a non-controlling stake.

This process of interaction between local firms and multinational companies began after 1978, when the "open door policy" had taken place. The first two automotive industries which exploited this new opportunity were Beijing Auto Works (BAW) and Shanghai Tractor Automobile Corporation (STAC, later denominated Shanghai Automotive Industry Corporation, SAIC).

BAW, an SOE, had its first contacts with American Motors (AMC), owner of the brand Jeep, in 1978. After several years and evaluations of other possible partners, the 20-year contract between the two companies was signed in 1983, with the American firm obtaining a stake of 31% in the newly formed company paid in cash and intellectual property. The contract stated that after an initial stage the Chinese had to assemble imported "complete knock-down" kits (CKDs), the production would have to be localized within the country. In 1987, AMC was acquired by Chrysler Corporation, which lost interest in the Chinese market, underinvesting in the partnership. In 1999, Chrysler was bought by Daimler Corporation, which understood the potential of the Chinese market and in 2001 decided to produce the new model, the Grand Cherokee, in the Chinese factories for the local market and localized 90 percent of the production of the parts within the country. Furthermore, that same year, the German company created another joint venture with the parent company of BAW, BAIC (Beijing Automotive Industry Corp.). The BAW-Jeep joint venture ended in 2007, but it is admired by the Chinese society as a successful technology transfer, which allowed the SOE to gain important knowledge and know-how in order to produce its own cars based on the foreign ones.

Another crucial agreement, that showed the way to the Chinese enterprises, was the joint venture between SAIC and Volkswagen. The initial approach between the two parties happened in 1978 and in the following years the Germans, after seeing the outdated conditions of the Chinese factory, decided to test and modernize it, sending CKDs to be assembled and training the local engineers. Finally, the agreement was signed in 1984, with a 50/50 split of the ownership and a provision for Volkswagen to transfer technology to their

counterparts. To address a relevant concern of the authorities regarding foreign exchange, the Germans agreed upon producing 100.000 engines in China that would then be exported. The prosperity of this JV can be traced to the fact that, thanks to the pressure of the Shanghai authorities, the production of the parts was localized nearby, permitting a favourable supply chain and a full integration within the territory and its community. For this reason, it is not surprising that it is still operating, producing Volkswagen and Skodas in its big five production bases, with a sixth under construction[19]. Furthermore, it recently reached an agreement to produce Audis, which initially will be sold online, due to the possible conflicts that could arise with the other Chinese counterpart which produces the German brand, FAW[20].

This FAW-Volkswagen joint venture goes back to 1991, and since then it has grown enormously with seven specialized production plants where cars under the Audi and Volkswagen brands are made.

The two Sino-German JVs have increased their production capabilities and expertise, since they were first established, and now Volkswagen, exploiting the environmental concerns of the government, is aiming at producing a range of all-electric vehicles with both of its partners, SAIC and FAW[21].

SAIC's previous experience with Volkswagen helped it for further JVs. The locally state-owned enterprise established several agreements with GM since 1997 to date. Among them, 3 joint ventures are the most relevant: the SAIC-GM one, with the aim of producing a large range of vehicles under the American's brands; a research and development one, named PATAC, Pan Asia Technical Automotive Center; and SGMW one, in which Wuling motors (now Guangxi Automobile Group Co. Ltd.) holds a minority stake (5.9 percent.). The latter two are very relevant for the Chinese industry: the PATAC is the first joint venture of its kind, which focuses on R&D, allowing China to not only rely on imported and sometimes outdated technology, but to produce it in-house; the second one fulfils the desires of the local government and a long-term perspective, because it produces minivans and mini-trucks under the Wuling brands, and passenger vehicles under the Baojun brand, which was created in 2010[22]. This Sino-American relationship is strong even under the financial point of view since

[19] *Volkswagen Group China*. [online] Available at: http://www.volkswagengroupchina.com.cn/content/vgc/content/en/partnership/shanghai_volkswagen.html.
[20] Fusheng, L. (2018). *SAIC Volkswagen to become second JV to produce Audi cars*. [online] Chinadaily.com.cn. Available at: http://www.chinadaily.com.cn/a/201807/30/WS5b5ea29ea31031a351e90f57.html.
[21] Harman, A. (2018). *VW's China JV Building EV Factory*. [online] WardsAuto. Available at: https://www.wardsauto.com/industry/vw-s-china-jv-building-ev-factory.
[22] www.gmchina.com. (n.d.). *About GM China | Our Company | GM China*. [online] Available at: https://www.gmchina.com/company/cn/en/gm/company/about-gm-china.html.

the Chinese firm participated with a 10% stake within the newly formed company when GM acquired Daewoo in 2002 for $1.2bn[23].

More recently, the first joint venture that will only focus on the fast-growing market of all-electric vehicles has been formed between BYD and Daimler AG. This agreement, established in 2010, created Shenzhen BYD Daimler New Technology Co., Ltd. (BDNT), which is a 50-50 R&D technology joint venture with the aim of developing electric vehicles in and for China under its own new brand, "Denza". This marriage obtains the engineering expertise of the Germans as leaders in safety, technology and quality excellence and the Chinese leadership in battery technology[24]. Since its creation, the company has produced two pure electric sedans, the Denza 400 and 500, which have reached 4685 units sold in 2017, more than doubling from the previous year[25].

[23] Fox News. (2002). *GM Acquires Daewoo Units for $1.2B*. [online] Available at: https://www.foxnews.com/story/gm-acquires-daewoo-units-for-1-2b .

[24] Mitchell, T. (2014). *China's BYD develops new electric car with Daimler*. [online] Ft.com. Available at: https://www.ft.com/content/1a457b6c-2d2d-11e4-911b-00144feabdc0.

Daimler. (n.d.). *Beijing, Shenzhen BYD Daimler New Technology Co., Ltd.*. [online] Available at: https://www.daimler.com/career/about-us/locations/location-detail-page-5167.html.

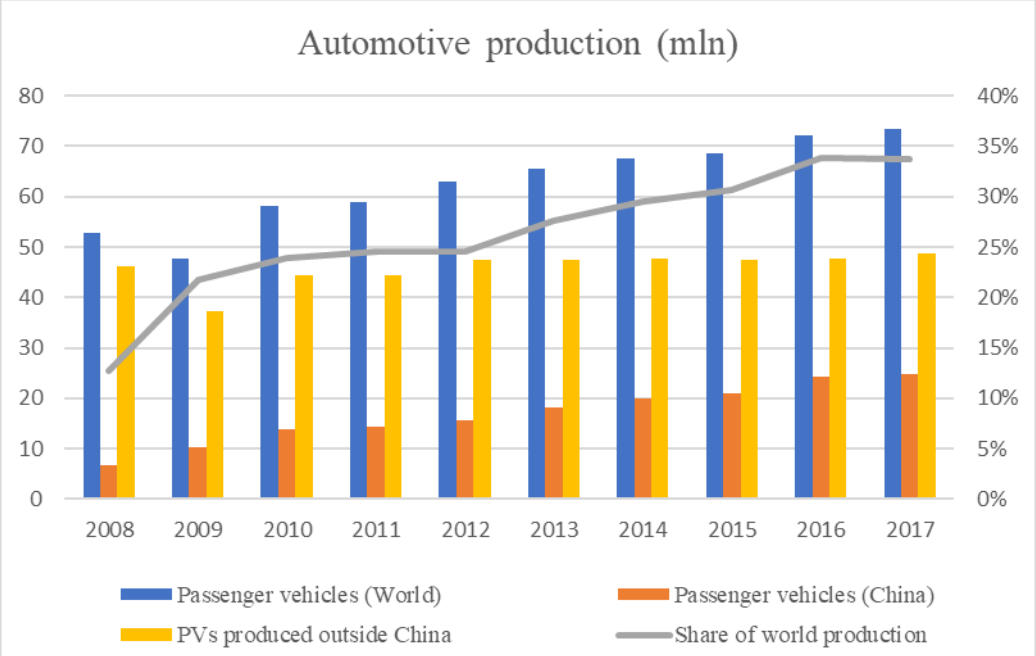
[25] carsalesbase.com. (2018). *Denza China auto sales figures*. [online] Available at: http://carsalesbase.com/china-car-sales-data/denza/.

2. CHAPTER II:

THE IMPORTANCE OF THE CHINESE MARKET[26]

As underlined in the previous chapter, the automotive industry in China is characterized by the presence of SOEs, private automakers and joint ventures with multinational companies, each of which with a market share and a growth in annual output that evolved during the last decade and that will be analysed within this chapter.

Before focusing on the specific firms, it is important to understand the global importance of the Chinese market.



Source: https://www.statista.com/statistics/233743/vehicle-sales-in-china/ [27]

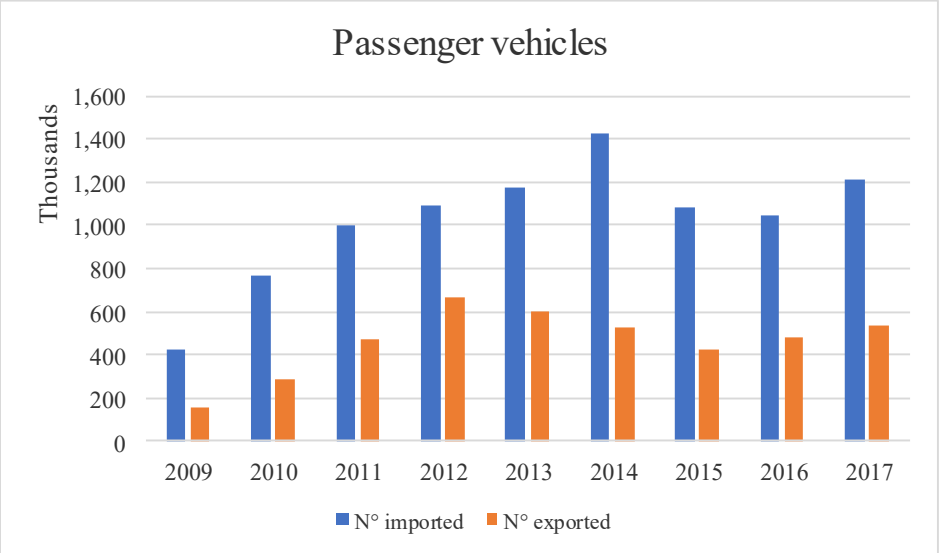
The data shows us how the global market has increased the overall output in the decade between 2008 and 2017. This 39 percent increase in production was not generated by the production facilities outside China, which had, without taking into account the bias in 2009 caused by the financial crisis, an average output between 45 and 50 million units. The global hike can be traced back to the astonishing expansion of the Chinese production capacity. The automotive industries in China went from an annual output of less than 7 million vehicles in 2008, to more than 24 million in 2017, a 268 percent increase in a decade. This data, that is incredible if considered by itself, is even more amazing when compared to the global market. The share of world production that is held by China is slightly less than 34 percent, which

[26] If not otherwise mentioned, the data for this chapter comes from: carsalesbase.com. (2018). *Chinese Car Sales Data - Left-Lane.com*. [online] Available at: http://carsalesbase.com/china-car-sales-data/.

[27] Statista. (2018). *China: car sales 2008-2018 | Statista*. [online] Available at: https://www.statista.com/statistics/233743/vehicle-sales-in-china/.

means that one third of all the passenger vehicles sold in the world are made in the Asian country.

This boost in production was not meant to satisfy the foreign demand, but the increasing internal demand, that grew steadily in the years thanks to an economic development that created a large middle class.



Source: https://www.statista.com/statistics/233743/vehicle-sales-in-china/

The number of imported cars increased during the first period of the decade due to the lowering of import tariffs caused by the entry in the WTO of China, but they still do not represent a relevant market share, around 5 percent of the total vehicles sold. Furthermore, also exports have increased in the automotive sector, showing the quality and recognition that Chinese production has achieved during the various development stages.

In order to understand who satisfied this growing internal demand and how it was done, we will focus our attention on the SOEs, private automakers and joint ventures that are considered the major producers in this market.

2.1. Major producers in the Chinese market

The major producers have approached the market in different ways, some of them nurturing on the consolidate position obtained in the market thanks to well-organized partnerships with foreign allies, others heavily investing on the advancement of the company through organic growth and also through external one, via acquisitions made in China and overseas. As it will later be highlighted, the former method was preferred by the state-owned enterprises, while the private automakers took the more challenging and forward-looking route.

We will not consider the enormous amount of small SOEs that are present throughout China, since their output is very limited and not relevant to explain who the dominant producers are in this market. In fact, the brands taken into consideration account for 93-96 percent of the total sales.

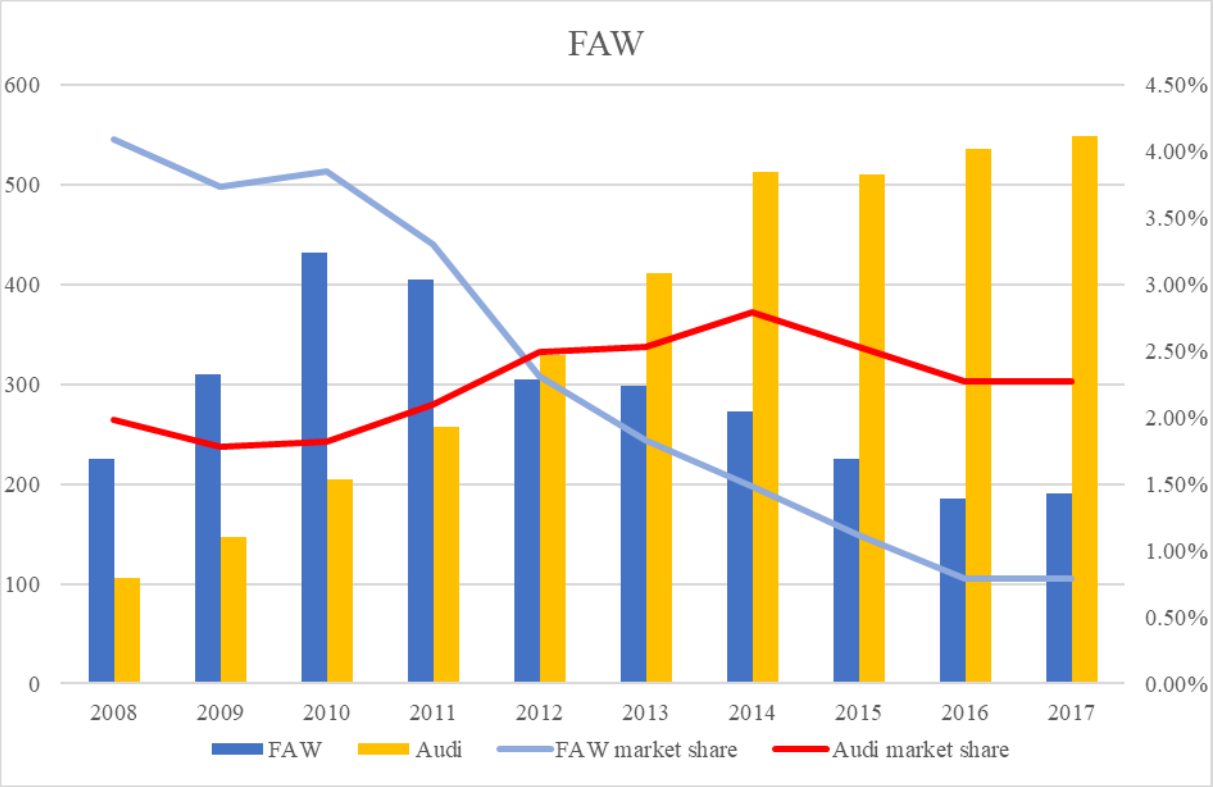
2.1.1. State-owned enterprises

In this part of the chapter we will analyse how the unit sales and the market share of the state-owned enterprises has evolved in the last decade. When evaluated individually, the joint ventures taken into consideration will only be the brands that have only one Chinese partner, since in some cases it is not possible to separate the output between one SOE and another for a specific foreign MNC. The unit sales will be separated between the ones sold with an indigenous brand and the ones with the foreign one. This is because the former enables us to better understand how the automaker has structured its strategy and how much they rely on their partners for their sales.

2.1.1.1. First Automotive Works, FAW

FAW, namely "First Automotive Works", now known as "FAW Group Co., Ltd.", was, as the name suggests, the first automotive company in China. The company was, and still is, a state-owned enterprise, which was established in 1953. Under the initial guidance of the Russians, it was able to start production of its first cars in 1956, the Hongqi, a limousine, and the Dongfeng, a sedan, along with different truck models[28]. Its development in the last decades has been fuelled by its many joint-ventures with foreign firms, such as the already cited VW, but also Audi, Toyota and Mazda[29]. Its important local and international presence with a vast range of vehicles, which include cars, truck, buses and minivans, is testified by the recognition obtained by the Fortune 500, which has placed China FAW Group in 125th position, even if its annual output of locally branded cars shrank since 2011, not reaching the 200 thousand units in the last two years.

[28] FAW. (n.d.). *About FAW*. [online] Available at: http://www.faw.com/fawen/gyjt36/fzlc/index.html.
[29] Fisita.com. (n.d.). *China FAW Group Corporation - FISITA*. [online] Available at: https://www.fisita.com/about/corporate/china-faw-group-corporation.

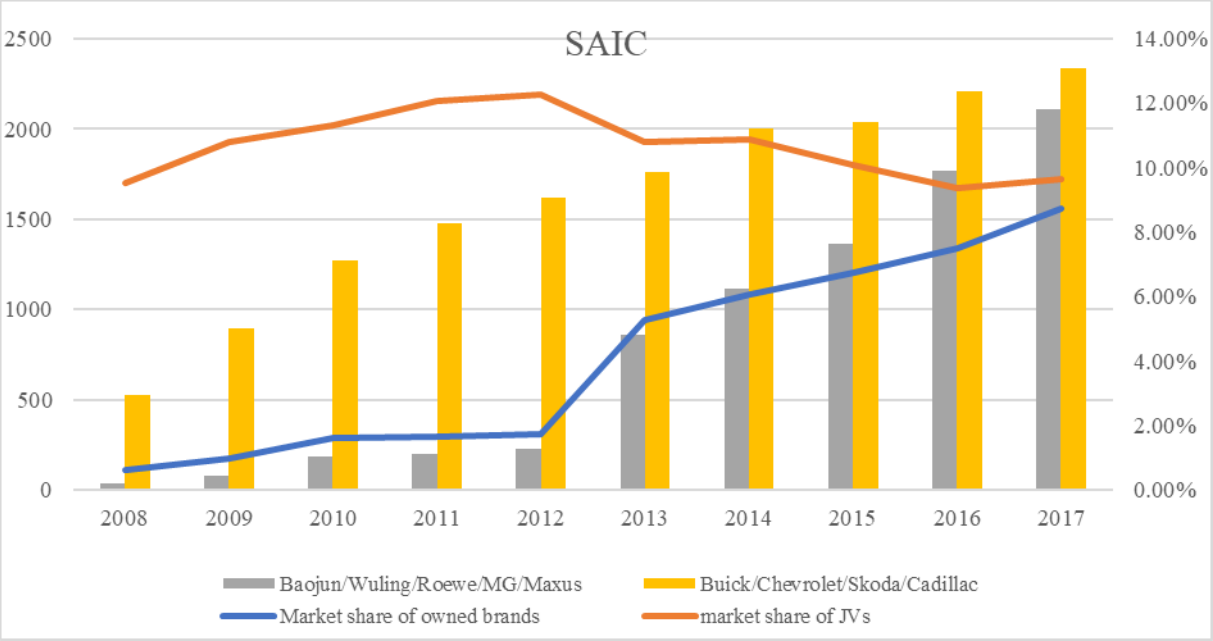


Source: http://carsalesbase.com/china-car-sales-data/

2.1.1.2. SAIC Motor Company Ltd.

SAIC, a locally state-owned enterprise, was first created in 1955 and in 2007, after several name changes, it has become SAIC Motor Company Ltd.. Established in Shanghai and one of the oldest car manufacturers in China, it has received worldwide acknowledgement from the Fortune 500 since 2012, rising to 36th position in 2018[30]. It is best known for its healthy and long-lasting joint venture with VW, and later with GM. In 2007 it merged with Nanjing, a Chinese automotive firm, through which it obtained the brand MG, a historic English car manufacturer. At the moment, SAIC, thanks also to the units produced with the JVs, is the leader in China's automotive market[31].

[30] Fortune. (2019). *Fortune Global 500 List 2018: See Who Made It*. [online] Available at: http://fortune.com/global500/.
[31] Saicmotor.com. (n.d.). *SAIC MOTOR*. [online] Available at: http://www.saicmotor.com/english/company_profile/about_us/index.shtml.



Source: http://carsalesbase.com/china-car-sales-data/

Without considering Volkswagen, which is a commercial partner that is shared with FAW, SAIC still has an impressive leading position in the Chinese market, with a market share nearly reaching 20 percent. This SOE, admired at the beginning of the opening up of the market because it was able to integrate and localize in the nearby territories the supply chain, still nowadays shows the right path to follow, relying on the foreign partners to maintain a high output and exploit their know-how with a shared R&D project with GM, while consolidating its own brands. These indigenous brands, that also have foreign origins such as MG and Roewe (which was once called Rover), have seen a steady rise in production and market share.

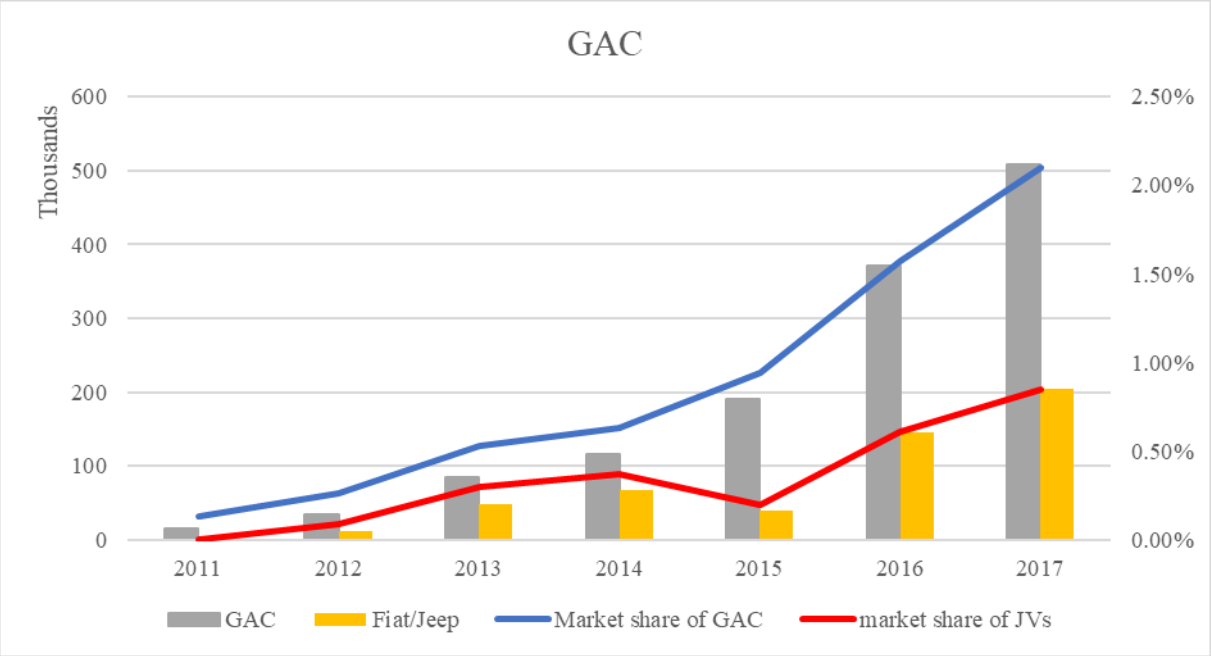
Furthermore, SAIC represents a model to follow for all the other SOEs, because it has been adopting a forward-looking approach, already introducing NEVs and investing in future opportunities, such as an artificial intelligence laboratory, the first one in the Chinese automotive industry, and the first mass-produced 5G internet vehicle[32].

2.1.1.3. Guangzhou Automobile Group Co., Ltd., GAC

GAC is a subsidiary of GAIC, a Chinese state-owned joint stock holding company. Although its history dates back to the 50s, the company began producing passenger vehicles only in 1985, when the Guangzhou province, after several years of discussions, established a joint venture with Peugeot creating Guangzhou Peugeot Automobile Corp. (GPAC). This Sino-

[32] Saicmotor.com. (n.d.). *SAIC MOTOR*. [online] Available at: http://www.saicmotor.com/english/latest_news/saic_motor/.

French agreement did not last long, due to poor quality of the local suppliers and a lack of investments by the local authorities and the foreign firm, which led to the withdrawal by Peugeot from the joint venture in 1997. From then on, GAC was formed[33]. Since then, it has established several joint ventures, with foreign companies such as Honda, Toyota, Mitsubishi and Fiat. Furthermore, it increased its production capabilities in the late 2000's, when, due to the "big four, small four" policy, it was forced to merger with Changfeng[34]. Another relevant aspect is that the company introduced in 2010 its own brand, the Trumpchi, with the first models based on the platform of the 166 Alfa Romeo, which were acquired from the Italian Automotive company[35].



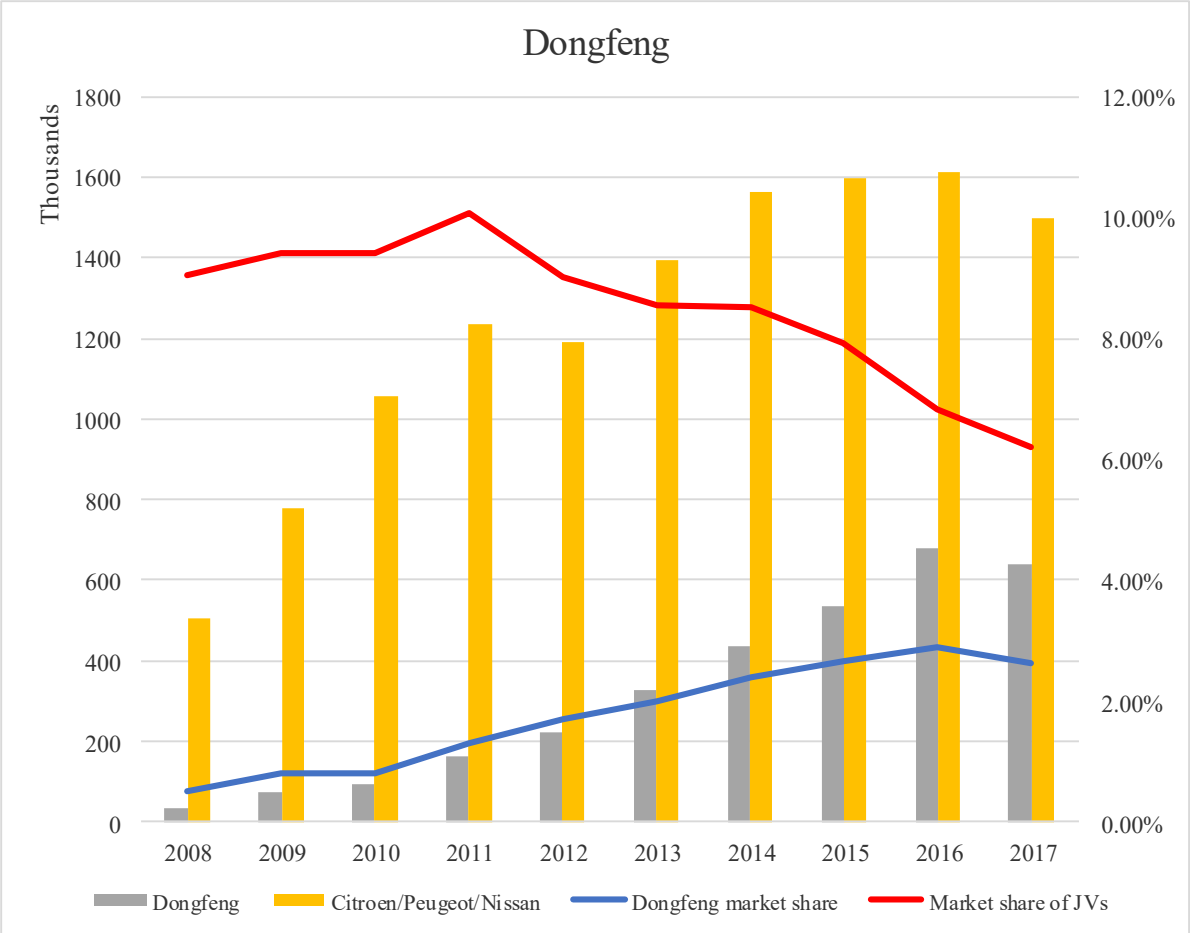
Source: http://carsalesbase.com/china-car-sales-data/

The investment in an indigenous brand, following the wishes of the central government, has been successful and it has led to an increase in output that reached the half a million units in 2017. Also Fiat has found a valuable partner, after a failed partnership with Nanjing ended in 2008 because of the acquisition of the Chinese company by SAIC, which had no interest in continuing the relationship.

[33] Luo, Y. (2001). *Strategy, structure, and performance of MNCs in China*. Westport, Conn.: Quorum Books.
Luo, Y. (2000). *How to enter China: Choices and Lessons*. The University of Michigan Press.
[34] Anderson, G. (2010). *China's Merger Fever?*. [online] Forbes.com. Available at: https://www.forbes.com/sites/china/2010/09/14/chinas-merger-fever/#12651722798d.
[35] Alvolante.it. (2011). *L'Alfa Romeo 166 "rinasce" in Cina come crossover*. [online] Available at: https://www.alvolante.it/news/alfa_romeo_166_cina_crossover-429211044.
Nikkei Asian Review. (n.d.). *Guangzhou Automobile Group Co., Ltd.*. [online] Available at: https://asia.nikkei.com/Companies/Guangzhou-Automobile-Group-Co.-Ltd2.

2.1.1.4. Dongfeng Motor Corporation (DFMC)

Dongfeng Motor Corporation is another state-owned enterprise which has a relevant role in the Chinese automotive market. It was founded in 1969, as the Second Automobile Works Co., and since then it has developed enormously. Initially thanks to the government support and then, after the reform era of Deng Xiaoping, through several joint ventures with numerous international partners, such as Kia, Honda and Nissan[36]. Moreover, its Sino-French partnership with Peugeot-Citroen has proven to be more fortunate than the previous French agreement with GAC. Even in this case it is possible to notice how the focus has shifted towards incrementing the importance of a local brand.



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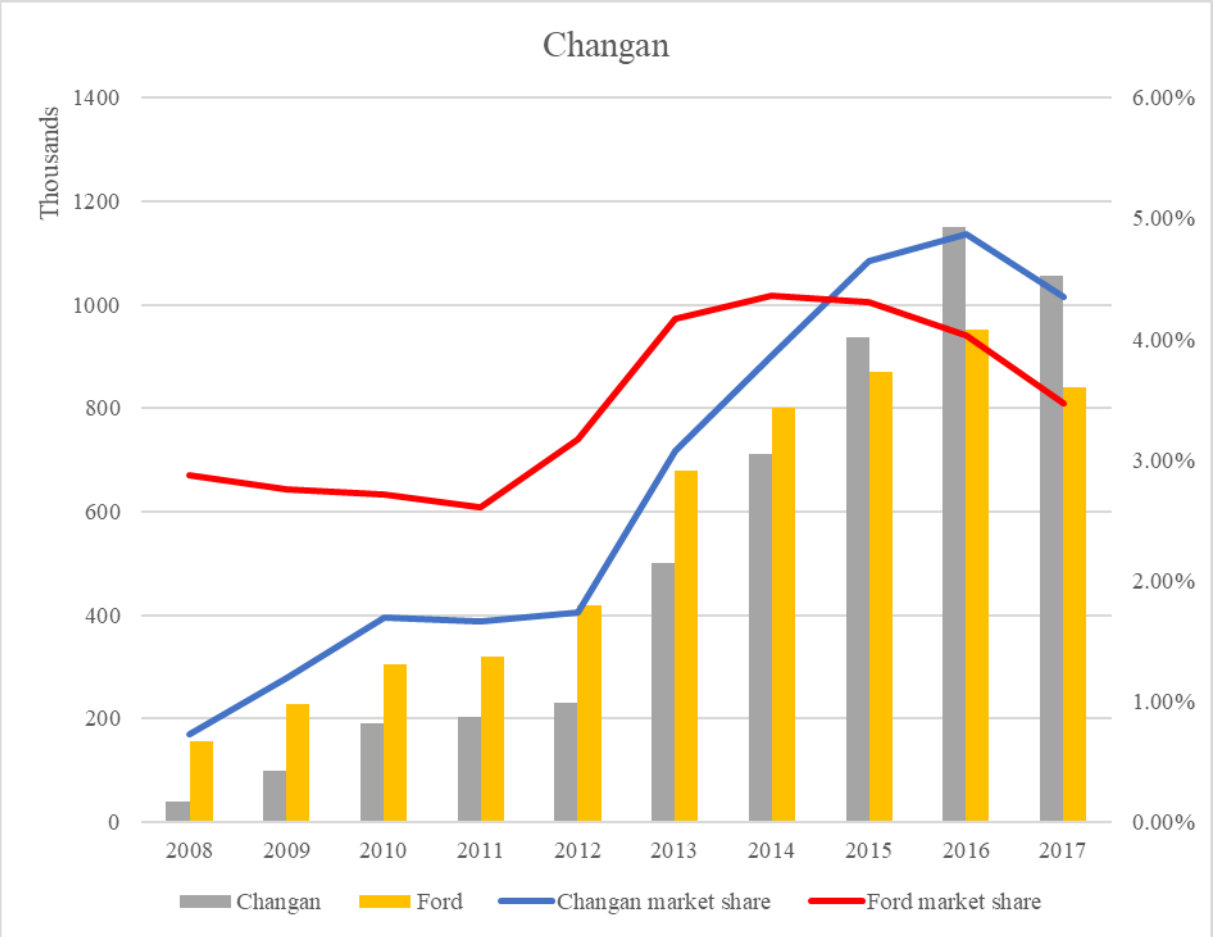
2.1.1.5. Changan Auto

Changan Auto is a state-owned enterprise with origins dating back to 1862. In the 1950s it released its first production vehicle, but since then till a decade ago it mostly concentrated in commercial vehicles. After acquiring two domestic automakers, Hafei and Changhe, its

[36] Zhang, W. and Alon, I. (2010). *A guide to the top 100 companies in China*. Singapore: World Scientific.

production of passenger vehicles increased steadily year after year, allowing it to become the fourth most important Chinese automakers in its internal market, also thanks to its joint ventures with Ford, Mazda and Suzuki[37].



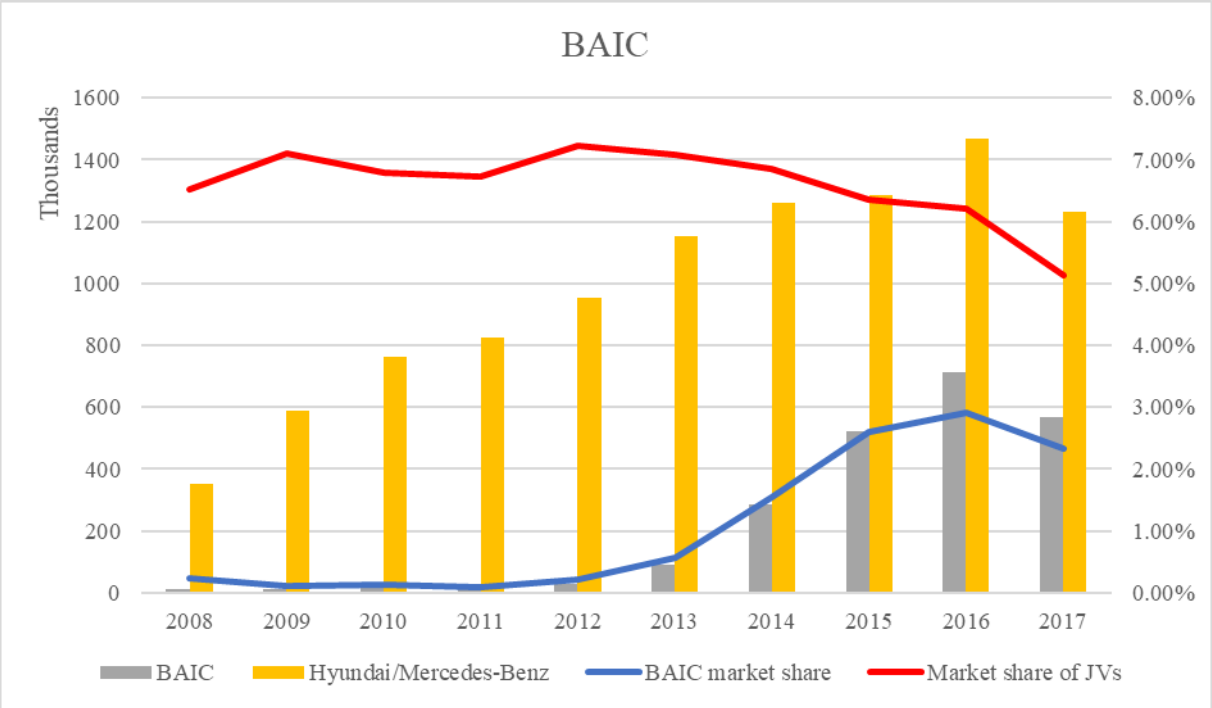
Source: http://carsalesbase.com/china-car-sales-data/

The importance of this company goes beyond its market share. Its international ambitions led it to establish in Torino, Italy, a design center where the new models are developed[38]. Moreover, it is partnering with the technology Chinese giant Tencent to develop the internet of vehicles (IoV)[39], and it will be one of the first automakers that will abandon the production of fossil fuel engines, an aim that is forecasted to be accomplished by 2025[40].

[37] Companies History - The biggest companies in the world. (n.d.). *Chongqing Changan Auto*. [online] Available at: http://www.companieshistory.com/chongqing-changan-auto/.
[38] Magni, M. (2017). *Changan - Nel 2018 nuove assunzioni a Torino*. [online] Quattroruote.it. Available at: https://www.quattroruote.it/news/news-lavoro/2017/10/30/changan_quando_la_cina_delocalizza_in_italia.html.
[39] Xinhuanet.com. (2018). *Changan Auto teams up with Tencent in auto intelligence*. [online] Available at: http://www.xinhuanet.com/english/2018-04/12/c_137106306.htm.
[40] Grasso, R. (2018). *Changan sarà uno dei primi produttori a interrompere la vendita di auto a combustibile fossile*. [online] Hardware Upgrade. Available at: https://auto.hwupgrade.it/news/tecnologia/changan-sara-uno-dei-primi-produttori-a-interrompere-la-vendita-di-auto-a-combustibile-fossile_74128.html.

2.1.1.6. Beijing Automotive Group Co Ltd, BAIC

Also know as Beijing Auto Works (BAW), BAIC is one of the oldest automotive manufacturers in China, since it was created in 1958[41].



Source: http://carsalesbase.com/china-car-sales-data/

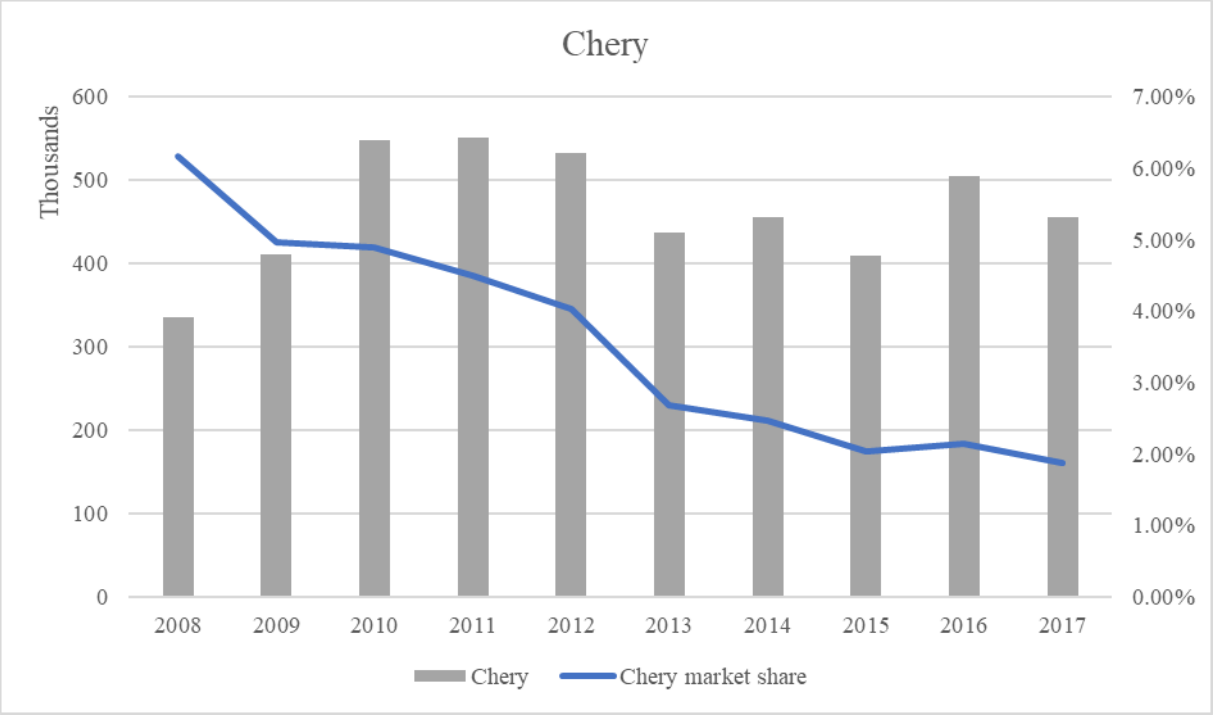
Besides from its prestigious partnership with Mercedes-Benz and with Hyundai which account for two thirds of the unit sales, BAIC is strongly investing in NEVs. It recently announced that, as Changan, it will abandon fossil fuels by 2025[42]. In addition to the electric vehicles branded with the company's name, it created in 2017 Arcfox, a luxury brand that will only market pure electric vehicles and that is gaining momentum in China[43].

2.1.1.7. Chery

A peculiar SOE is Chery. After being established in the 1960s and having a turbulent beginning due to claims of intellectual property infringement from Fiat and GM, Chery has focused on its internal market developing its own brand. Contrary to the other state-owned automakers, the company did not rely strongly on foreign partners. At the moment, its only

[41] BAIC. (2019). *History*. [online] Available at: http://en.baicgroup.com.cn/index.php?r=index/default/cate&id=133&tid=104.
[42] Croce, P. (2017). *Baic venderà solo auto elettriche in Cina entro il 2025*. [online] Autoblog.it. Available at: http://www.autoblog.it/post/901892/baic-vendera-solo-auto-elettriche-in-cina-entro-il-2025.
[43] Xin, Z. (2018). *BAIC Group bets big on new energy*. [online] Chinadaily.com.cn. Available at: http://www.chinadaily.com.cn/a/201809/06/WS5b908e6ca31033b4f46548c2.html.

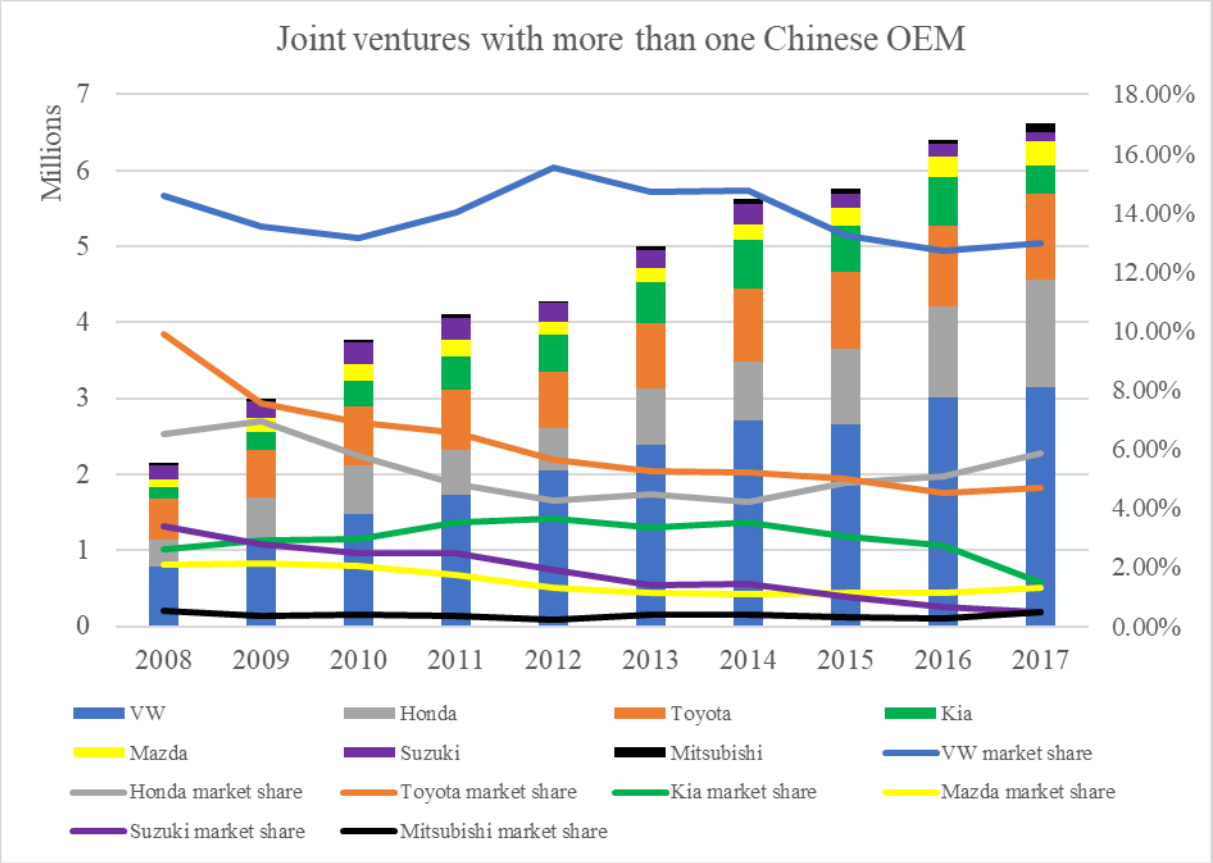
joint venture is with Jaguar – Land Rover, with an annual production of less than 100 thousand units.



Source: http://carsalesbase.com/china-car-sales-data/

2.1.1.8. Joint ventures with more than one Chinese OEM

The foreign automakers can only enter the Chinese market through joint ventures, but this does not limit them to sign agreements only with one local original equipment manufacturer. Some of the most important automotive MNCs have decided to establish relationships with two Chinese manufacturers, in order to better exploit their unique competences, reach more potential customers and enhance their production capabilities.



Source: http://carsalesbase.com/china-car-sales-data/

An example of this approach is the Volkswagen Group, which was one of the first foreign companies to enter the Chinese market in 1983. As explained in the first chapter, they did not limit themselves to their first partnership with SAIC, but they signed several deals with another state-owned company, FAW. These two allies enabled Volkswagen to exponentially increase their presence and market share within the country, which reached nearly 13 percent in 2017, with a total production of more than three million units, while the overall VW Group sold over 4 million units[44].

The importance of this market and of the potentials of numerous partners in it was further highlighted by the German company in 2017, when it signed another joint venture with JAC, a state-owned company exclusively dedicated to the production of e-vehicles[45]. The Volkswagen China CEO, Jochem Heizmann, stated: "The Chinese market plays a key role in the success of the Volkswagen Group. That is why in 2018 we launched our SUV and electric mobility campaign in China, which will be strengthened by our new plants". He later said: "We want to make a significant contribution to electrifying the Chinese passenger car market.

[44] To put this number into perspective, the total sales of vehicles in Italy in 2017 was half of that Statista. (n.d.). *Vehicle sales: Italy 2017 | Statistic*. [online] Available at: https://www.statista.com/statistics/265952/vehicle-sales-in-italy/.

[45] Volkswagenag.com. (n.d.). *Volkswagen: 40 years in China*. [online] Available at: https://www.volkswagenag.com/en/news/stories/2018/10/at-home-in-china.html.

Around 40 different electric vehicle models are to be produced in China by 2025". As of August 2018, the Volkswagen group holds an 18.3% share of the Chinese passenger car market and these investments show that the aim of the MNC is to consolidate this leading position in the future, when this growing market will move towards more ecological solutions[46].

Also Honda, which, through its joint ventures with GAC and Dongfeng, produced nearly one and a half million vehicles in China, is strongly investing in the future of this market. It has planned to build with GAC a new plant with the specific aim of producing NEVs[47]. Moreover, due to Sino-American trade war concerns, it moved its production of its luxury brand Acura to China[48].

A shift from America to China is slowly taking place in Toyota as well. The company, which has suffered in the last years in the Chinese market, has plans to triplicate its production in China in the next decade thanks to its support from their local partners, FAW and GAC[49].

Mazda and Mitsubishi are also aiming at increasing their presence in the market thanks to their partners, respectively Changan and FAW, and GAC and Soueast, with a focus on the growing NEVs market[50]. Two other automakers, who have suffered in recent years and do not see a prosperous future in the Chinese market, are Kia and Suzuki. The former, whose allies are Dongfeng and Yueda, has seen its sales halved in the last year; while the latter was forced to abandon the market, as Chinese consumers shifted their demand towards larger sedans and SUVs[51].

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[46] Volkswagenag.com. (n.d.). *Volkswagen expands production in China*. [online] Available at: https://www.volkswagenag.com/en/news/2018/09/Volkswagen_expands_production_in_China.html.

[47] Shirouzu, N. and Sun, Y. (2018). *Honda and GAC Group to build $430 million Chinese plant for....* [online] U.S. Available at: https://www.reuters.com/article/us-honda-china/honda-and-gac-group-to-build-430-million-chinese-plant-for-new-energy-cars-idUSKCN1N51JC.

[48] Furukawa, K. (2018). *Honda to shift production of SUV to China from US amid trade war*. [online] Nikkei Asian Review. Available at: https://asia.nikkei.com/Business/Companies/Honda-to-shift-production-of-SUV-to-China-from-US-amid-trade-war.

[49] Sano, N., Inoue, K. and Buckland, K. (2018). *Toyota to Target Tripling China Production Over Next Decade*. [online] Bloomberg.com. Available at: https://www.bloomberg.com/news/articles/2018-08-28/toyota-said-to-target-tripling-china-production-over-next-decade.

[50] Automotive World. (2018). *GAC Mitsubishi Motors to start production of all new EV in China*. [online] Available at: https://www.automotiveworld.com/news-releases/gac-mitsubishi-motors-to-start-production-of-all-new-ev-in-china/.

Yuzawa, M. (2018). *Mazda to roll out China-only electric vehicles by 2020*. [online] Nikkei Asian Review. Available at: https://asia.nikkei.com/Business/Companies/Mazda-to-roll-out-China-only-electric-vehicles-by-2020.

[51] Buckland, K., Zhang, Y. and Tian, Y. (2018). *Suzuki Forced Out of China as Buyers Continue to Favor SUVs*. [online] Bloomberg.com. Available at: https://www.bloomberg.com/news/articles/2018-09-04/suzuki-exits-china-after-dissolving-partnership-with-changan.

2.1.2. Private automakers

2.1.2.1. Geely

One of the major Chinese privately owned carmakers is Zhejiang Geely Holding Group, simply named Geely. This firm was created in 1997 and rolled out its first car a year later. During its first period, this car company could have been considered as one of the many that crowded China, but in the last decade things have changed. Thanks to its charismatic owner, Li Shufu, Geely has been able to increase its output by nearly 500%, becoming the most important private Chinese automaker. Furthermore, this company is especially relevant because in 2010 it was the first Chinese automotive firm to acquire 100 percent of a foreign rival, Volvo Cars, which was bought from Ford for $1.5bn. This acquisition gives a strong signal of the growing importance of the Chinese automotive companies in the global competition, showing how they are expanding beyond their market and the ones of developing countries. Volvo will allow Geely to expand in new markets in the developed world and gain valuable knowhow and technology from a company which can be considered a world excellence in safety, with a competitive edge in technology, R&D, design and operations. Furthermore, the Chinese company will be able to exploit its established logistics and supplier base, in addition to the knowledge of the customers in its local market to increase enormously the sales in China of the Swedish company[52]. This has been proven a successful move, with sales that have tripled for both companies from 2010 to 2017, reaching for Volvo more than 90 thousand units, making China the biggest market for the Swedish company.

A recent announcement made by Volvo and strongly influenced by the ecological path taken by the main industrialized countries, in which we also find China with its environmental policies, is that all the models launched after 2019 will be either fully electric or hybrid. This decision makes Volvo the first major brand to end production of pure combustion engines. Moreover, with the aim of entering the segment of high-performance electric cars, the Swedish firm with its parent company have invested heavily, nearly $1bn, into Polestar[53].

Another move by the Chinese automaker with the aim of extending its global presence took place in 2013, when it acquired “London Taxi Company”. Since then it has invested in its factory in Coventry and designed a new hybrid taxi cab, the TX5, which rolled out the

[52] Arnott, S. (2010). *China's Geely buys Volvo for $1.5bn*. [online] The Independent. Available at: https://www.independent.co.uk/news/business/news/chinas-geely-buys-volvo-for-15bn-2041772.html. Nicholson, C. (2010). *Geely of China Completes Acquisition of Volvo*. [online] Nytimes.com. Available at: https://www.nytimes.com/2010/08/03/business/global/03volvo.html.

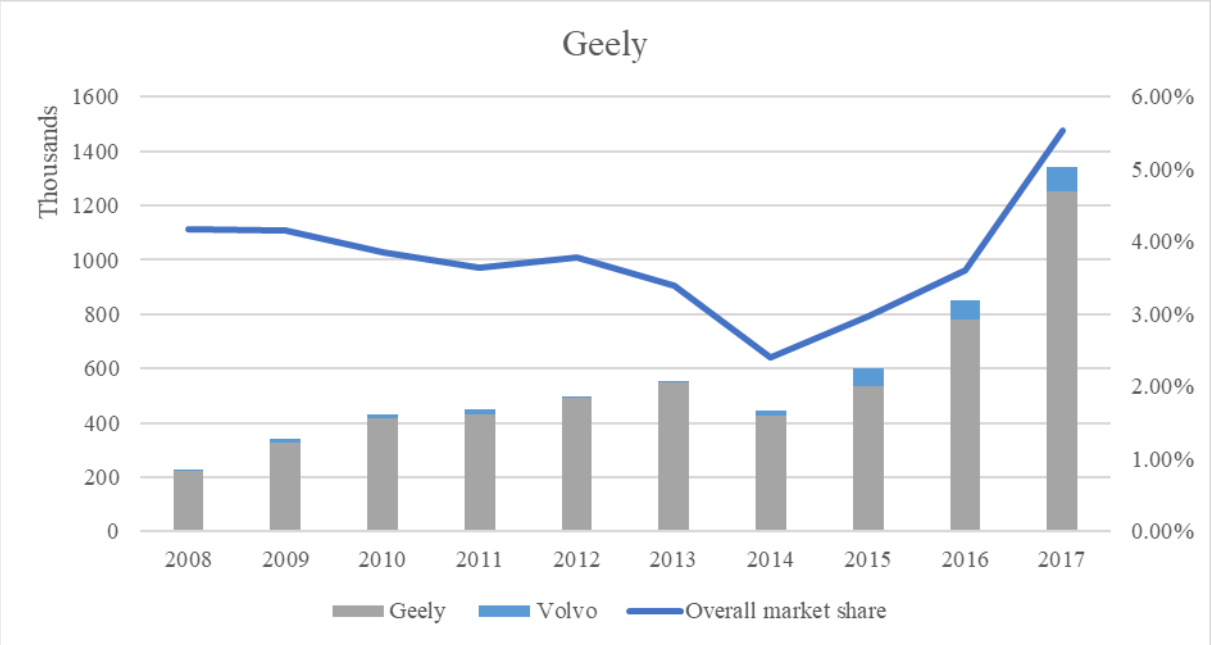
[53] Ambler, P. (2018). *Volvo & Geely: The Unlikely Marriage Of Swedish Tech And Chinese Manufacturing Might That Earned Record Profits*. [online] Forbes.com. Available at: https://www.forbes.com/sites/pamelaambler/2018/01/23/volvo-geely-the-unlikely-marriage-of-swedish-tech-and-chinese-manufacturing-might-that-earned-record-profits/#79e1a7e34ecc.

production line in 2017 for London and will be also produced in China to satisfy the growing demand for greener taxis[54].

All these acquisitions, to which have to be added the 51 percent stake in Lotus Cars, 9.7 in Daimler AG (which makes it the major single shareholder) and 49.9 percent in Malaysia's Proton, combined with an investment of $3.3bn in the truckmaker Volvo AB, show how determined Li Shufu is to build China's first global automotive company[55].

Li, in a statement released to Bloomberg, said: "Geely's dream is to become a globalized company. To do that, we must get out of the country". To follow this ambitious goal, the Chinese Group created an upmarket brand, Lynk & Co, which, after being produced and sold in China since 2017, will be produced in Belgium and will be marketed in Europe and then in the US[56].

The global ambitions of the company and its owner have not undermined their presence in China, where its increasing sales have reached the 1.3 million units in 2017, with a market share of more than 5%.



Source: http://carsalesbase.com/china-car-sales-data/

[54] De Feijter, T. (2016). *London's Iconic Black Cab To Be Replaced With Hybrid By Chinese Automaker Geely*. [online] Forbes.com. Available at: https://www.forbes.com/sites/tychodefeijter/2016/08/17/geely-to-replace-londons-iconic-black-cab-with-a-hybrid/#28833e27396c.

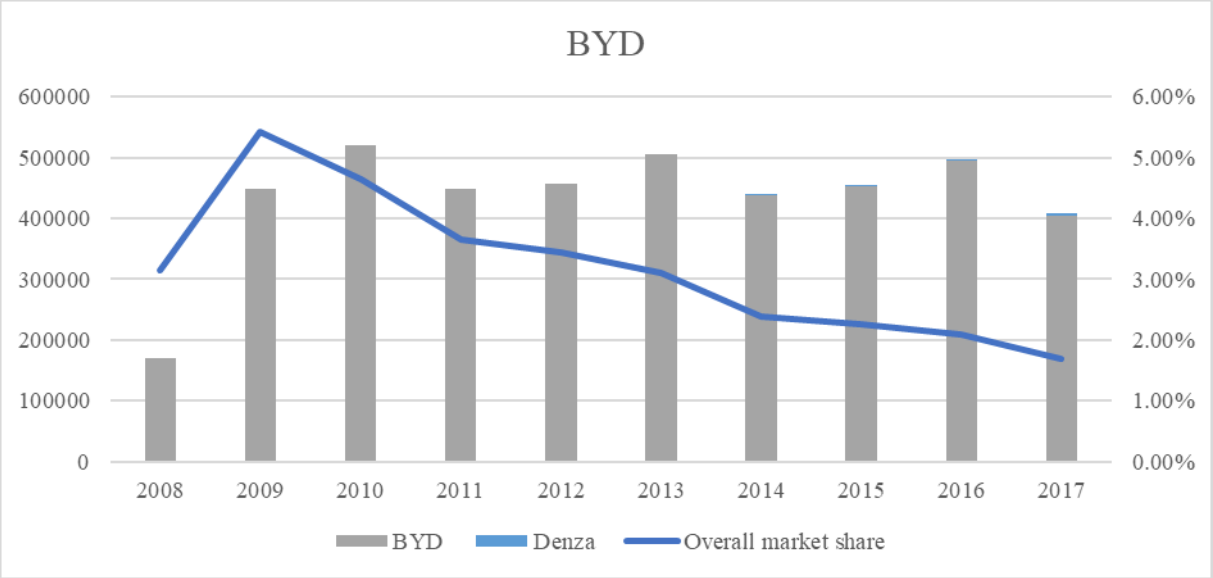
[55] Gruley, B. and Butters, J. (2018). *How China's 36th-Best Car Company Saved Volvo*. [online] Bloomberg.com. Available at: https://www.bloomberg.com/news/features/2018-05-24/volvo-is-better-than-ever-thanks-to-this-chinese-billionaire.

[56] Bloomberg.com. (2018). *China's Car Revolution Is Going Global*. [online] Available at: https://www.bloomberg.com/news/features/2018-04-23/china-s-carmakers-want-to-dominate-world-s-next-era-of-driving.

2.1.2.2. BYD

Another excellence in the Chinese automotive world is BYD. This company, as many other ones in China, has a peculiar story. It was established in 1995 by Wang Chuanfu as a manufacturer of batteries. Relying on low labour cost, it soon reached global competitiveness, becoming in 2000 the world's largest manufacturer of mobile phone batteries. It entered the automotive market only in 2003, acquiring a locally state-owned firm, Qinchuan, which was in financial distress, and renaming it BYD Auto. The acquisition was the only way to obtain the license to produce cars, circumventing the governmental restrictions. Wang was convinced that its expertise in batteries would allow him to produce a competitive electric car[57]. His dreams captured the attention of Warren Buffett who, through his company Berkshire Hathaway Inc. acquired 8% of BYD Co. on the Hong Kong stock exchange, where the company was listed in 2002, for $232 million. Now those shares are worth roughly $1.6 billion, an increase of more than 500% in a decade. But how has this company been able to grow so much in just 10 years?[58] BYD was, back in 2008, the first company world-wide to start mass-production and commercialization of a plug-in electric car[59]. Since then, they have focused on the electrification of transport vehicles for the mass market, with a particular attention to buses and taxis, that, according to Wang, are the vehicles that mostly affect the quality of the air in major cities. This business strategy, that is completely different from the one of the most popular electric vehicle producer nowadays, Tesla, has allowed BYD to become the world largest maker of electric vehicles, with a market share in China of 20%, and with great potential future opportunities overseas. These have already started to be exploited. For example, in California, where the company's largest US facility is, BYD buses are in service in Long Beach. It has also entered the UK, upgrading the iconic double decker buses in London. Now the challenges faced outside its native country are to demonstrate how the preconceptions regarding the poor quality of Chinese products are so very wrong[60].

[57] Anderson, G. (2012). *Designated drivers*. Singapore: John Wiley et Sons.
[58] Fortune. (2018). *Warren Buffett Has Made a Killing Off China's Biggest Electric Car Maker*. [online] Available at: http://fortune.com/2018/09/26/warren-buffett-berkshire-hathaway-byd-china-electric-cars/.
[59] Pasternack, A. (2008). *World's First Plug-In Electric Car Goes On Sale Next Month -- in China*. [online] TreeHugger. Available at: https://www.treehugger.com/cars/worlds-first-plug-in-electric-car-goes-on-sale-next-month-in-china.html.
[60] Bateman, J. (2018). *The Biggest Electric Vehicle Company You've Never Heard Of*. [online] Fast Company. Available at: https://www.fastcompany.com/40517240/the-biggest-electric-vehicle-company-youve-never-heard-of.



Source: http://carsalesbase.com/china-car-sales-data/

This international strategy allowed BYD to maintain a quite regular output in China, but this led its market share to collapse during the years. A recent move towards gaining a major presence in its local country, without neglecting its global ambitions, involves Daimler AG, which has become its partner in a joint venture established in 2010. These companies have allied to produce and commercialize, initially in China, pure electric cars under the brand Denza. To date, this move has to still show its profitability, since it sold less than 5 thousand units in 2017[61].

2.1.2.3. Great Wall Motor Company

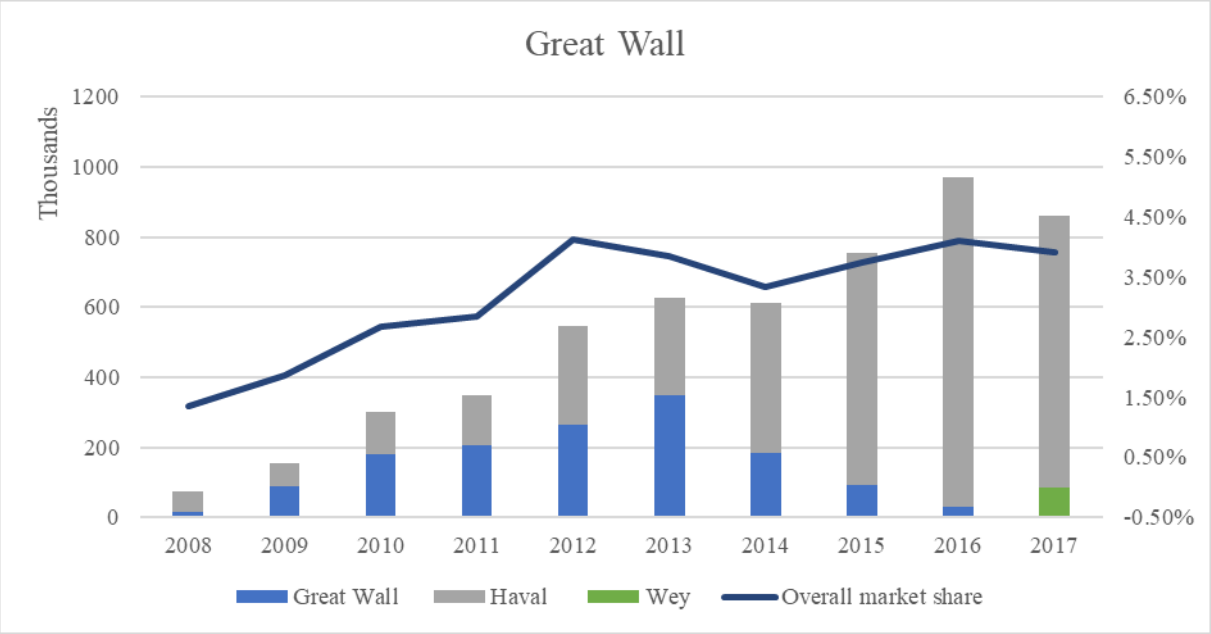
Great Wall Motor Company is another distinctive story since it began its life in 1976 as a collective enterprise and only later, in 2003, was listed in the Hong Kong stock exchange and became a private company, with only a fourth of the shares still controlled by the local government. As many other companies, Great Wall began producing cars years after its creation. In the second half of the 90's Wei Jianjun, its CEO at the time, noticed a niche of the automotive market that was not served by the current players and so, in 1996, it introduced its first pick-up truck, the "Deer", and after only two years it became the national leader in this segment. After a couple of years, it focused its efforts also on another underestimated Chinese market, the SUV one, launching its first vehicle of that category in 2002 and soon becoming China's largest exporter of vehicles.

[61] Rctom.hbs.org. (2015). *When BYD Meets Mercedes-Benz: a Joint-Venture in China – Technology and Operations Management*. [online] Available at: https://rctom.hbs.org/submission/when-byd-meets-mercedes-benz-a-joint-venture-in-china/.

This worldwide success can be explained by the understanding of Great Wall that it had to implement strict security and emission tests in order to have its vehicles accepted under the foreign standards in other countries, especially the most developed ones[62].

Great Wall Motors in an attempt to capture all the niches of the SUV market, created the Haval. After a decade from the creation of this brand, in 2013 it became an independent badge, allowing it to structure its own marketing and sales network aimed at a higher customer segment, slowly capturing the Great Wall customers[63]. Furthermore, in 2016, it created a new luxury brand named Wey, which recalls the name of the founder, Wei Jianjun, and, even though it is only sold in the Chinese market, it certainly has global ambitions[64].

The global aims are strongly stated by the founder, who, during a reception at its headquarter, said: "By 2020, we hope Haval can become the world's biggest specialty SUV brand"[65].



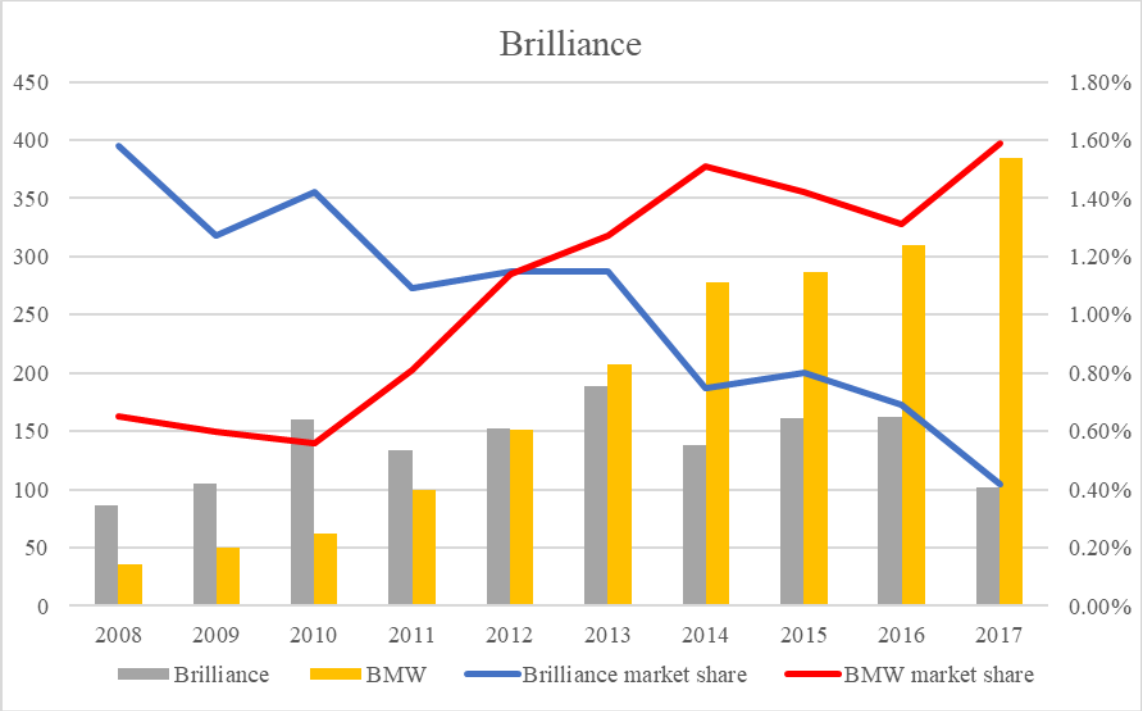
Source: http://carsalesbase.com/china-car-sales-data/

2.1.2.4. Brilliance Auto Group

The history of Brilliance dates back to the late 1950s, when it was a state-owned auto factory and in the 90s it became the leading Chinese maker of minibuses. It became a private

[62] Anderson, G. (2012). *Designated drivers*. Singapore: John Wiley et Sons.
[63] Wang, J. (2013). *Great Wall's Haval sub-brand to become independent in China - CarNewsChina.com*. [online] CarNewsChina.com. Available at: https://carnewschina.com/2013/02/18/great-walls-haval-sub-brand-to-become-independent-in-china/.
[64] Vijayenthiran, V. (2017). *Great Wall launches luxury SUV brand Wey*. [online] Motor Authority. Available at: https://www.motorauthority.com/news/1112854_great-wall-launches-luxury-suv-brand-wey
_Alvolante.it. (2017). *Wey: lusso "made in China"*. [online] Available at: https://www.alvolante.it/news/wey-il-lusso-made-china-353733.
[65] McDonald, J. (n.d.). *China's thriving SUV-only automaker looks to global growth*. [online] HAVAL MOTORS. Available at: https://www.haval.com.au/chinas-thriving-suv-automaker-looks-global-growth/.

company when Yang Rong invested in it, changing its name to Brilliance Auto Group in 2002. In 2003 it established a joint venture with BMW with the aim of producing and commercializing the German vehicles in China.



Source: http://carsalesbase.com/china-car-sales-data/

The growth of sales of the foreign brand increased substantially, while the Chinese partner saw an opposite trend. This joint venture has seen a fundamental evolvement in 2018, when BMW announced it will increase its stake in it, rising it to 75%. The repercussions on Brilliance have been negative, since most of its profits derive from this agreement, and its shares fell 30 percent in the Hong Kong stock[66]. This move can be considered as fundamental when the future of the Chinese automotive market is taken into consideration. BMW is the first foreign automaker to take advantage of the new regulation, which will eliminate restriction on the foreign-invested shares in passenger vehicle manufacturer in 2022.

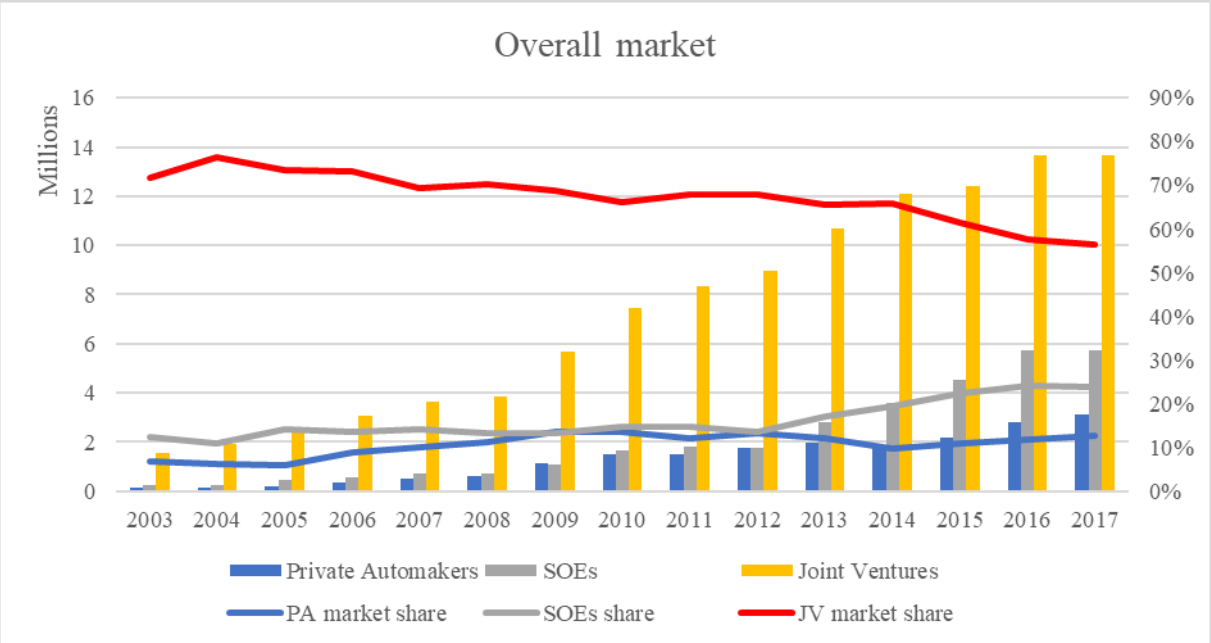
2.2. Conclusions

As we have shown in this chapter, there are numerous automakers that have a relevant stake in the Chinese automotive market. This market has immensely evolved in the last decades, with indigenous brands slowly gaining the confidence of customers and consequently market

[66] Thestar.com.my. (2018). *Brilliance China Auto plunges 30% after BMW takes over JV - Business News | The Star Online*. [online] Available at: https://www.thestar.com.my/business/business-news/2018/10/12/brilliance-china-auto-plunges-30pct-after-bmw-takes-over-jv/.

share. This is the case of not only private automakers, which account for 13% of the total vehicles sold, but also for SOEs, that have followed the desires of the central government and have reached an output of nearly 6 million units and a market share of 24%.

The presence and market share of the foreign manufacturers that have to rely on joint venture to conveniently commercialize their products in China is still overwhelming, but has been steadily decreasing, reaching approximately 56% in 2017.



Source: http://carsalesbase.com/china-car-sales-data/

The new regulations enacted by the central government will surely have a strong effect on these figures, and in part this has already happened. The step taken by BMW that wants to obtain a majority stake in its JV, will be the first one of many to come, now that the foreign automakers will have a much easier access to the Chinese market. These independence aims of MNCs can be even stronger if we take into account the ecological path that Chinese officials are following, in which "new electric vehicles" are crucial. When the requirement to have a Chinese partner is absent, there will not be many foreign manufacturers that will be willing to share their knowledge and possible competitive edge in electric vehicles technology, also considering that this type of technology mostly differs from the traditional combustion engine. This will lead these companies to establish wholly owned foreign enterprises in China, slashing the profits and technology acquisition that many Chinese manufacturers, mostly state-owned, have relied on for the past decades[67].

[67] Porkowski, J. (2018). *What The BMW Deal Means For The Future Of Auto Joint Ventures In China*. [online] Forbes.com. Available at: https://www.forbes.com/sites/jackperkowski/2018/11/02/what-the-bmw-deal-means-for-the-future-of-auto-joint-ventures-in-china/#75baee81cf67.

3. CHAPTER III: POLLUTION

The challenge for the future of the automotive market worldwide, and especially in China, is strictly related to pollution. The global aim is to reduce the green-house gasses in the atmosphere in the following years to avoid a surge in temperatures with disastrous consequences on the ecosystem and on the habitability of the earth. China is the largest emitter of pollutant substances, but at the same time it is the biggest exploiter of renewable energy. Furthermore, it is leading the negotiations for the Paris agreement, now that the U.S., because of Donald Trump, has dropped out from the discussions[68]. China has committed to reduce its carbon footprint over the years, and one of the paths that has to be followed in order to reduce it is to make its automotive market much more environmentally friendly. This involves increasing the market share of new energy vehicles, which obviously are strongly reliant on the energy sector and how this is structured.

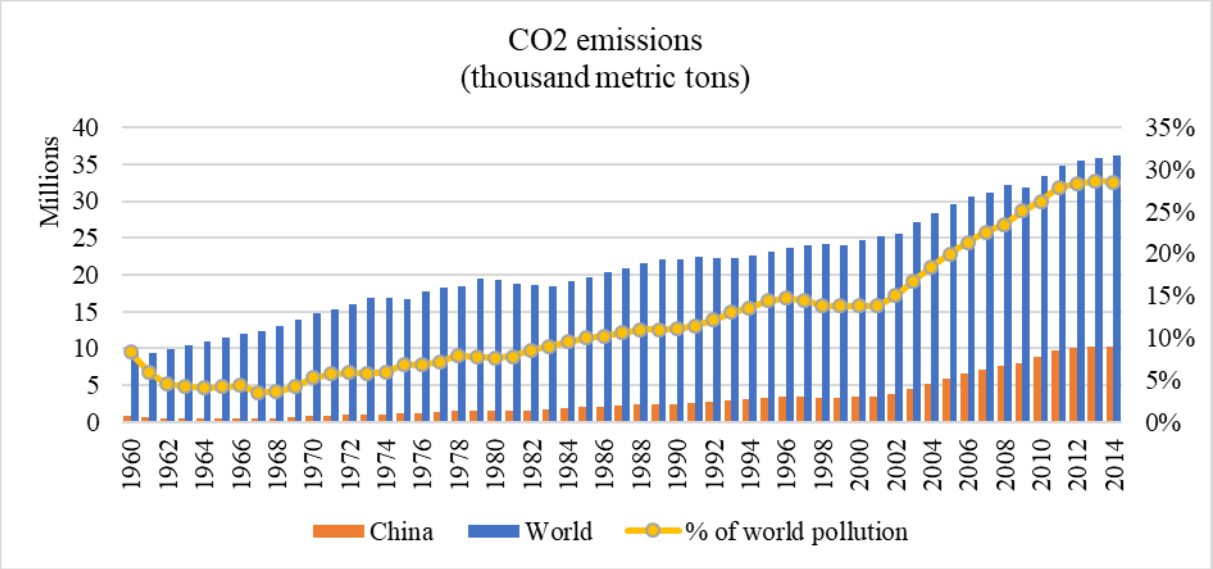
3.1. The energy sector

The rapid evolution of China had relevant consequences on the country's ecosystem. In order to catch up with the developed countries, the Chinese economy during the mid-twentieth century chose a planned economic system which exploited the relatively abundant productive factors that the country had to offer, such as labour and coal. Furthermore, the system was characterized by state control and suppressed prices of natural resources. This led to an economy based on heavy industries with smaller capital needs, high labour intensity and energy use. This strategy allowed China in the following decades to gain pace and to slowly become one of the relevant players worldwide. This economic development brought a subsequent structural transformation characterized by a modernization of the economic system, with a shift from heavy industries towards the steady growth of light industries and the service sectors, and consequently a rapid urbanization process.

The main issue related to this economic transformation is the revolution of the energy sector, which should be the basis of a green growth. This challenge originates back to the initial phases of the rapid growth, during which small mills provided cheap energy and the heavy industries had relaxed pollution requirements, which resulted in the near present in China being responsible for 25 percent of the total annual world emissions of CO2 in 2010 and

[68] Ayed, N. (2018). *China seen as both problem and solution in fight against climate change | CBC News*. [online] CBC. Available at: https://www.cbc.ca/news/world/china-complicated-role-fight-climate-change-1.4945974.

nearly 29 percent in 2014, with more than 10 million thousand metric tons of CO2 emitted during the year.



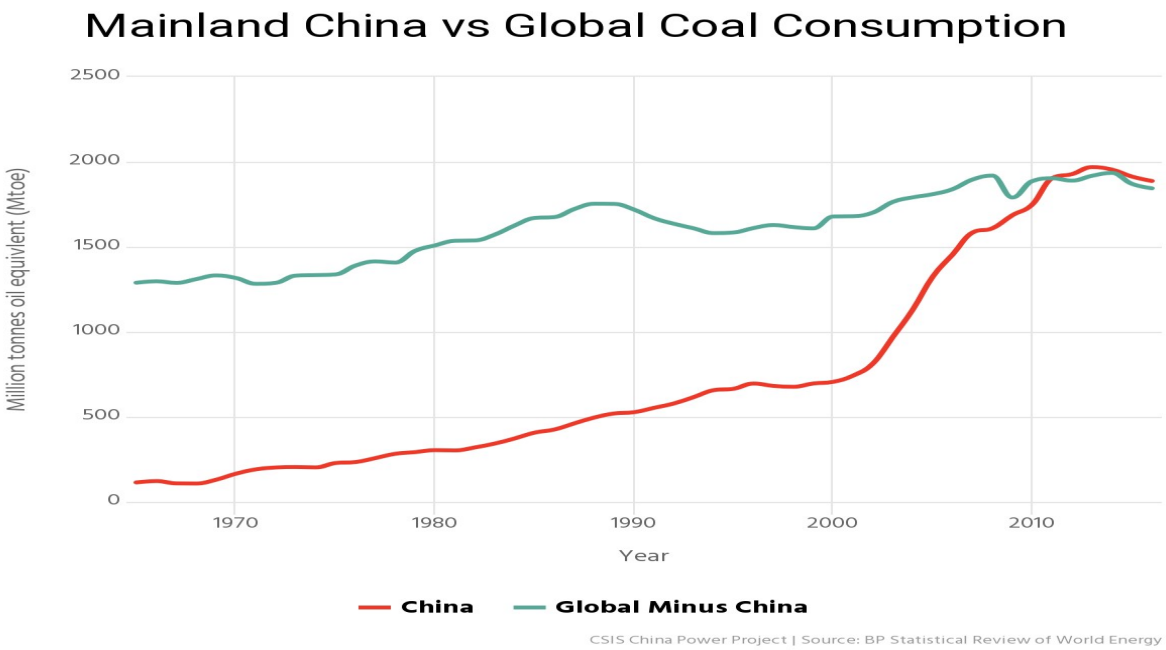
Source: https://data.worldbank.org/[69]

To have a green structural transformation it is necessary to overcome the social barriers that affect social stability, the main goal of the central government. These barriers are mainly due to the social costs and political resistance of local governments, which rely on these types of industries, where hundreds of thousands of citizens are employed. Furthermore, this green transition has to be nationally organized, since, as it happened in Beijing during the Olympics, air pollution measures limited to a single area are not effective if the neighbouring areas compensate with more polluting industries due to lower environmental standards, causing a "carbon leakage" which affects the whole region. This is also why only three out of 74 Chinese cities subjected to air quality monitoring met air quality standards in 2013.[70]

3.1.1. The energy structure

China's energy structure reflects the trend of its overall economy, relying since the initial development phase, decades ago, on the abundant natural resources that its territory had to offer. That meant that the growing energy needs of the large manufacturing-based economy was mainly fuelled by coal. Since then, the energy structure has not changed much till the twenty-first century.

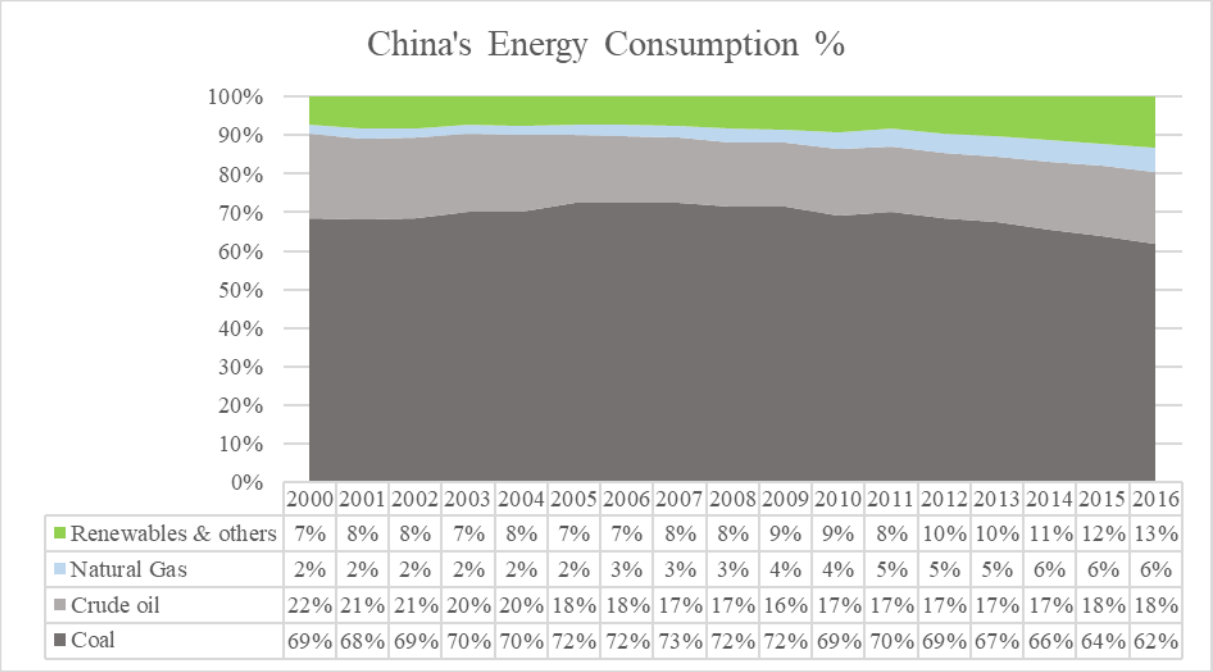
[69] Data.worldbank.org. (n.d.). *World Bank Open Data | Data*. [online] Available at: https://data.worldbank.org/.
[70] Lin, J. and Xu, J. (2014). The potential for green growth and structural transformation in China. *Oxford Review of Economic Policy*, 30(3), pp.550-568.



Source: China Power Project. (n.d.). *How is China's energy footprint changing?*

This development has led China to become the largest producer and consumer of coal, consuming more coal than the rest of the world combined since 2011, making up 62 percent of its domestic energy use in 2016. In order to satisfy this growing demand for this natural resource, China had to depend on imports coming from its regional neighbours. This has had important environmental repercussions due to the widespread problem of dirty and inefficient coal plants. The use of coal to produce energy contributed to 71 percent of China's air pollution in 2014, according to World Bank data.

To tackle this unsustainable energy structure, China has committed to exploit renewable resources, such as hydroelectric, nuclear, solar and wind, that will enable it to have a healthier and sustainable energy structure in the future. This commitment drove many investments in renewable energy, which have surged during the last years, reaching almost half of the global ones in this energy sector in 2017, totalling $126 billion. An analysis of China's energy consumption will enable us to better understand how this structure has evolved during the last years and which have been the effects of these enormous investments.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Renewables & others	7%	8%	8%	7%	8%	7%	7%	8%	8%	9%	9%	8%	10%	10%	11%	12%	13%
Natural Gas	2%	2%	2%	2%	2%	2%	3%	3%	3%	4%	4%	5%	5%	5%	6%	6%	6%
Crude oil	22%	21%	21%	20%	20%	18%	18%	17%	17%	16%	17%	17%	17%	17%	17%	18%	18%
Coal	69%	68%	69%	70%	70%	72%	72%	73%	72%	72%	69%	70%	69%	67%	66%	64%	62%

Source: China Power Project. (n.d.). *How is China's energy footprint changing?*

Within the "Renewable & others" data, we find China's energy consumption deriving from hydroelectric, solar, wind and nuclear. Among them, hydroelectric has become the main source. The investments in this type of energy production have been impressive, with four out of the ten largest energy-producing hydroelectric dams in the world located in China, with the biggest one, the "Three Gorges Dam", completed in 2012 with an overall cost of $37 billion. As a result, China has become the world leader in hydropower since 2014. This primacy has also been achieved in wind-energy capacity, in which the country accounts for a third of the global capacity. The solar photovoltaic energy generation is another Chinese excellence, in which the country is both the leading supplier and consumer, thanks to several investments and policy incentives from the government, that made it become home of two-thirds of the global capacity. Nuclear power is a further energy source exploited to reduce the reliance on fossil fuels, with 41 nuclear power reactors currently operating and 40 more on the way by 2020. That year represents a milestone also for the use of natural gas, when it is forecasted it is going to satisfy 10 percent of the domestic energy demands.

As it is possible to see, the reliance on coal is still huge, with the energy source satisfying 62 percent of the overall consumption. It can be noticed a trend towards more sustainable alternatives, but this is a long procedure and, during this phase, the implementation of modernization strategies for this side of the energy industry is essential to reduce its polluting impact.

Crude oil is another polluting energy source with an important market share in China, slightly lower than 20 percent. Mainly derived from the automotive market demand, this natural

resource is not abundant in China, forcing the country to import 70 percent of its supply in 2018 and creating a large trade deficit and a strong reliance on foreign countries, most of them troubled by political instability. This made China take two approaches to tackle the problem: reducing the demand by implementing policies that favoured new energy vehicles that did not rely on this fuel, and diversifying its portfolio of suppliers. The latter approach was carried out by investing heavily in Africa, trying to gain access to untapped resources and guaranteeing a steady flow to the domestic market offering in exchange economic development loans to the African states[71].

3.2. The automotive pollution

The data previously shown highlights how reducing the environmental impact of its economic structure is necessary for the future of China. One of the sectors targeted to reduce the pollution is the automotive one. Transportation produced approximately 23 percent of the global CO2 emissions and, with the rapid urbanization and increasing ownership, this percentage is growing.

The strategy of upgrading and electrifying the automotive industry in China dates back to 2009, when the "Eleventh Five-Year Plan" encouraged the development and adoption of "new energy vehicles" (NEVs), which are primarily represented by electric vehicles (EVs). This policy was a consequence of the first step taken in 2001 with the 863 Program, through which the Ministry of Science and Technology financially promoted strategic R&D, supporting the research efforts of Chinese car manufacturers, universities and research institutes. This national path towards vehicle electrification has further aims than just tackling global climate change; it allows China to increase its energy security, urban air quality and develop its automotive industry[72].

As previously underlined, coal as an energy resource is abundant in China, however the same cannot be said for crude oil. Nearly two thirds of the oil supply are being imported, making the fuel-powered automotive sector strongly dependent on foreign countries. Furthermore, internal combustion engines (ICEs) will not enable China to meet its international agreements on pollution reduction of greenhouse gases (GHG).

[71] China Power Project. (n.d.). *How is China's energy footprint changing? | ChinaPower Project*. [online] Available at: https://chinapower.csis.org/energy-footprint/#f586d500-2faa-cl.

[72] Siteresources.worldbank.org. (2011). *The China New Energy Vehicles Program*. [online] Available at: http://siteresources.worldbank.org/EXTNEWSCHINESE/Resources/3196537-1202098669693/EV_Report_en.pdf.

The adoption of NEVs is a solution to many economic and environmental problems, but they still face numerous barriers. Some of them are internationally widespread, such as high initial costs, low range, rare charging infrastructures, unsafe and unreliable batteries, issues on waste management and consumer preferences; others are specifically Chinese, such as local protectionism of the industries and consequently difficulties in installing charging facilities that can serve different vehicles and not only the ones produced by the local manufacturers.

3.2.1. The change of energy structure to reduce pollution of NEVs

New energy vehicles include a vast range of vehicles, but mainly plug-in and pure electric vehicles. Since the former typology serves as a step between the old internal combustion engine vehicles and the pure electric ones, we will focus our attention on the latter ones, which represent the real future of the automotive industry.

The pure electric vehicles utilize electricity to fuel their power system. This means that taken by themselves these vehicles do not cause any environmental pollution. However, the overall picture can differ. They rely on the electricity infrastructure from which they charge their batteries, this means that in order to be environmentally friendly, the power generation process upstream has to be based on renewable energy. Studies have shown that the environmental impact of pure electric vehicles is higher than normal vehicles in some parts of China, due to an energy structure strongly reliant on coal.

Although the rural area where the power generating sector is located has stronger self-purification abilities compared to the central urban area where most of the vehicles are, the "carbon leakage" problem, which identifies the transportation of pollutant substances from one area to another, can still affect the air quality of the urban areas. This is why it is fundamental not only to invest in the development of the automotive market, adopting electric vehicles, but it is also necessary to simultaneously advance the energy sector, with more ecological alternatives, to reduce the green-house emissions and prevent climate change[73].

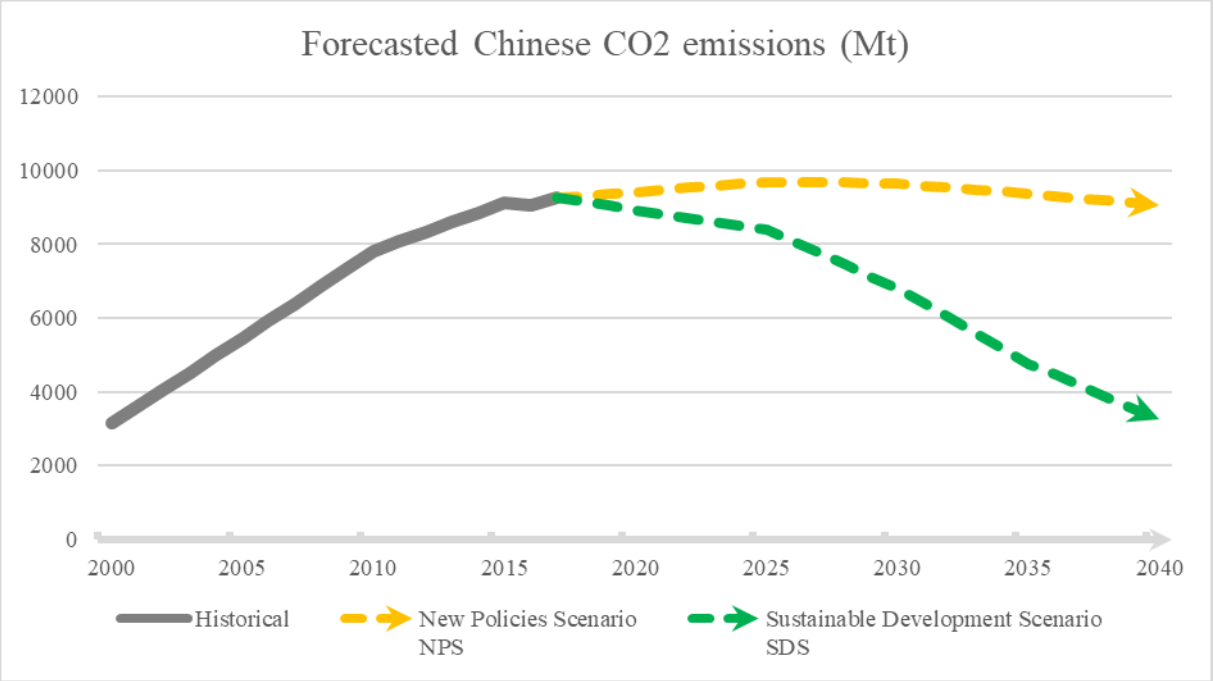
3.3. The International Energy Agency forecast

The International Energy Agency, in its "Global EV Outlook 2018", forecasts the future of the electric automotive market and the energy structure, with its repercussions on the environment, considering two possible scenarios: the New Policies Scenario (NPS) and the Sustainable Development Scenario (SDS).

[73] Yu, A., Wei, Y., Chen, W., Peng, N. and Peng, L. (2018). Life cycle environmental impacts and carbon emissions: A case study of electric and gasoline vehicles in China. *Transportation Research Part D: Transport and Environment*, 65, pp.409-420.

The NPS incorporates the effects of all the policies and measures that governments worldwide have put into place as well as all the announced ones. It can be considered as a more conservative view of the decades to come, with the near future not withstanding radical transformations. According to this forecast, the amount of coal utilized by China to produce energy would remain in absolute terms equal to the current one, with the renewable energies satisfying all the new electricity demand created by the development of the country and accounting for approximately 50 percent of the total Chinese energy production in 2040. The increase in energy demand will be partially due to the enlargement of the electric vehicle's market share, that, according to the "New Policies Scenario", should reach 13 percent in 2030.

The Sustainable Development Scenario, which also incorporates the "EV30@30 Scenario", foresees a much more optimistic 30 percent market share for electric passenger vehicles by 2030, accompanied by a reduction of power generation from fossil fuels exceeding 50 percent by the same year. The latter goal is in line with the Paris Agreement, which has the aim to reduce the CO2 emitted in order to halt the increase of global temperatures and minimize the consequent adverse effects of climate change. According to the SDS, the use of coal as an energy source will be a quarter of the current one in 2040. Demand will be mainly satisfied by nuclear, hydro, wind and solar power, each of them individually producing more electricity than coal. Within this scenario we have the EV30@30 campaign. Launched in 2017 at the Eight Clean Energy Ministerial, it has the main aim of promoting the widespread adoption of electric vehicles through supporting policies, developed infrastructures, financed research and commitment by the private and public sector to create a fleet of EVs. The ambition pledged by the "Electric Vehicle initiative" (EVI) is to obtain a 30 percent market share for electric vehicles by 2030, with the total fleet on the road reaching 220 million units.



Source: Global EV Outlook 2018. (2018). [S.l.]: International Energy Agency.

According to the two future scenarios elaborated by the International Energy Agency, there are different forecasted levels of CO2 emissions. These are obviously influenced by the evolution of the automotive industry and by the structure of the energy sector. As it is possible to see, on the one hand we have the New Policies Scenario, with cautious projections on the widespread adoption of electric vehicles and of the reduction of coal as a source of energy, which projects constant emissions for the next two decades, with slight variations compared to the current ones. On the other, we have the Sustainable Development Scenario that foresees a much larger market share of electric vehicles and a revolution of the energy structure that leads to a strong diminishment of CO2 emissions, reduced to a third of today's ones.

Since China is nowadays responsible for nearly a third of the worldwide pollution, it would be desirable that the SDS came true. The premises regarding the electric market, the governmental policies and the investments are promising, but the effort towards a greener future have to be consistent and constantly monitored and improved in order to obtain these ecological results[74].

[74] Global EV Outlook 2018. (2018). [S.l.]: International Energy Agency.

4. CHAPTER IV:
THE FUTURE OF CHINA'S AUTOMOTIVE MARKET

The automotive market is living a huge transformation due to a disruptive innovation that will continue for the next decades, with a steady shift from internal combustion engines to battery-powered electric vehicles. This trend is somehow forced by the environment. The crude oil supply is limited and the pollution created by fuel and diesel engines is contributing to the rise of global temperatures. Nowadays, nearly all the global leaders are trying to fight this climate change to avoid the enormous impact that it will have on the environment and on the economy of most of the countries. New electric vehicles are one of the solutions to tackle these issues and they are on the rise. According to "Bloomberg New Energy Finance", their share of new car sales will be around 55 percent in 2040, with 33 percent of the global automotive fleet being electric.

The market share of electric vehicles has been increasing over the past years, but it still represents a small niche of the automotive market, with less than 2 percent in 2017, and unit sales of approximately 1.1 million. These figures will steadily raise. Bloomberg forecasted that they will grow up to 11 million in 2025 and 30 million in 2030, representing 39 percent of global sales.

China, which is the biggest automotive market in the world, accounting for a third of the overall global sales, is leading this market evolution. It represents the largest market for NEVs at the moment, with half a million of units sold in 2017, and it targets to reach the 2 million benchmark by 2020. In 2025, the forecasted market share of new energy vehicles is estimated at 20 percent, which translates in 7 million electric passenger vehicles[75]. By 2040, 60 percent of passenger vehicles sold in China will be electric[76]. The initial phase of this transition has been led and fostered by the Chinese government with several policies and state control to help it gain pace, in order to obtain a leading global position in this market segment. The future phases of this automotive development are characterized by many opportunities and challenges, that, if well handled, will allow China to establish itself as a global superpower in this industry.

[75] Jourdan, A. (2017). *China targets 35 million vehicle sales by 2025, NEVs to make up....* [online] U.S. Available at: https://www.reuters.com/article/us-china-autos-electric/china-targets-35-million-vehicle-sales-by-2025-nevs-to-make-up-one-fifth-idUSKBN17R086.

[76] Bloomberg NEF. (n.d.). *Electric Vehicle Outlook 2018 | Bloomberg New Energy Finance*. [online] Available at: https://about.bnef.com/electric-vehicle-outlook/.

4.1. The policies to favour NEVs adoption

It is clear that pure market forces cannot drive a shift towards new energy alternatives, when the price gap is still large and it favours the traditional propulsion system. The development of sustainable energy, which is not only limited to the automotive industry, but spreads out to the energy sector as well, is strategically important for China. This country, despite the enormous internal growth, still lags behind developed international superpowers in many technological sectors, and this new market could give it a global lead for the future of new energy vehicles. That is why China, as a rising star on advanced manufactures, sets NEV as one of ten key industries in the core policy "Made in China 2025".

The People's Republic of China's NEV policies are promulgated and connected to three major goals that have been previously highlighted, which are to reduce the dependence on fossil fuel oil energy, to transform, develop and revitalize the automotive industry and to improve air quality by reducing vehicle pollutant emissions.

The typical new energy vehicle promotional policies are: license plate policies, subsidies and purchase-tax exemptions. While the latter two are financial incentives, which ensure a reasonable return on the initial investment for the manufacturers and the early adopters, the former one is the most relevant push towards NEVs in the major cities, due to road restrictions and lottery purchase quota policies that make the obtainment of the permission to drive on the road a new combustion engine car a long and expensive procedure. These Chinese policies can be also categorized in three layers: the first one defines the most basic requirements, which qualify the vehicle to be eligible for road benefits, such as the license plate; the second grants purchase-tax exemption whenever the technologies utilized are in line with the governmental registered components standards; and finally the automotive producers have to source their batteries from governmental approved domestic battery suppliers in order to obtain the NEV subsidy.

Because of this strong central government financial incentives towards developing the mass-market adoption of electric vehicles, the evolution of this market is somewhat counterintuitive compared to normal new markets. Usually in newly formed markets, premium automakers should have a large market penetration, due to their focus on R&D, their technology intensive products and their customer base which is less sensible towards price premiums. In the early phases of Chinese NEV industrial development this did not happen; the high subsidies and financial benefits for the final consumer led domestic automakers, such as BYD, to market low-end ecological vehicles to meet the policy requirements and engaged in price wars, since the customer segment is highly price sensitive. This made China become not only the major

market for passenger vehicles, but also the biggest NEV market in the world, with more than one and a half million units in use and half a million sold in 2017[77]. To prevent the overwhelming presence of the state and the dependency of the domestic NEV industry development on the subsidies, the national government decided to slowly phase out the financial support to promote a market-oriented development. "The Circular on Financial Support Policies for the Promotion and Application of New Energy Vehicles (2016-2020)" specifies that the subsidies shall gradually be reduced every two years through 2017-2020 at a rate of 20 and 40% based on the 2016 level, respectively, from an initial starting point established with the "Notice on Subsidies for Private Purchases of New Energy Vehicles" that ranges from RMB 20,000 to RMB 44,000 per vehicle, with the possibly for local governments to add between 15 percent to 50 percent to that amount. The amount of the subsidy depends on the performance and range of the vehicle, with the more efficient and the ones with the longest range receiving a larger incentive[78]. This subsidy strategy involved a great investment by the government, which spent 7.7 billion dollars in subsidies in 2017 alone[79].

To furtherly promote the introduction of new energy vehicles in the market, the Ministry of Industry and Information Technology promulgated a cap-and-trade emission rule that will start in 2019. This new rule, that was delayed one year further because of the pressure of the automotive industry, will force automakers with sales of more than 30,000 vehicles, to meet a quota of 10 percent of them being all-electric battery vehicles or plug-ins, with this threshold reaching 12 percent in 2020. The automakers that will miss these quotas, will be forced by the government to purchase these "credits" from NEV producers and if they are not able to buy enough, they will face government fines or, in the worst case, the factory shutdown. The benchmark does not represent the true percentage on sales; NEV sales are accounted as much as six times, depending on their technological level and range, which reduces the overall threshold that manufacturers have to achieve[80].

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[77] Hu, Z. and Yuan, J. (2018). China's NEV market development and its capability of enabling premium NEV: Referencing from the NEV market performance of BMW and Mercedes in China. *Transportation Research Part A: Policy and Practice*, 118, pp.545-555.

[78] Zhang, X. and Bai, X. (2017). Incentive policies from 2006 to 2016 and new energy vehicle adoption in 2010–2020 in China. *Renewable and Sustainable Energy Reviews*, 70, pp.24-43.
Liu, Y. and Kokko, A. (2013). Who does what in China's new energy vehicle industry?. *Energy Policy*, 57, pp.21-29.

[79] Porkowski, J. (2018). *What China's Shifting Subsidies Could Mean For Its Electric Vehicle Industry*. [online] Forbes.com. Available at: https://www.forbes.com/sites/jackperkowski/2018/07/13/china-shifts-subsidies-for-electric-vehicles/.

[80] DW.COM. (n.d.). *China sets new deadline for electric car quota | DW | 28.09.2017*. [online] Available at: https://www.dw.com/en/china-sets-new-deadline-for-electric-car-quota/a-40719095.

4.2. Opportunities

The opportunities that the evolution of the automotive market creates for China are immense. As previously underlined, the country is already leading in the new energy vehicles market, but it is important to continue this development in order to capture its great economic potential. The growth of electric vehicles will enable China to achieve one of its main goals, the creation of national champions, that through indigenous brands are not only capable of occupying a dominant position in the domestic market, but are able to spread across the markets of the other developed countries, gaining relevant market share slices. Furthermore, the electric vehicles' power systems rely on batteries, market in which China is considered the global manufacturer, and this means that the country will have the chance to satisfy the surging demand in the following decades. Finally, the adoption of new energy vehicles is not only limited to the automotive sector, even public transport is shifting towards the ecological alternative and e-buses represent a huge opportunity for the future.

4.2.1. The establishment of national champions

This is a crucial chance for China to exploit the development of this disruptive innovation which has its epicentre in its domestic market. Its own indigenous firms with their own brands have to take advantage of this favourable moment and be aware of the threats represented by foreign automakers, that will be able to operate in China by themselves without any restrictions on foreign-invested shares in passenger vehicle manufacturers from 2022. The domestic champions will have to face the burden of increasing their market without relying anymore on the support of the government's subsidies and the protection from the other international players. They will have to be competitive in a market-oriented industry.

The beginning of 2018, even though still partially biased by the subsidies, seems promising for indigenous brands and overall Chinese manufacturers that operate in the new energy vehicle market. From January to June, sales rose 130 percent compared to the previous year, with about 350,000 passenger cars sold in the period. BYD was the main player, with a 20 percent market share and 70,000 electric cars sold. BAIC and SAIC, the two state-owned automakers, occupy the rest of the podium, with respectively 60 and 44 thousand vehicles sold. Other indigenous brands with a relevant presence in the market are Geely and JAC

motors. Also joint-ventures are trying to capture a share of this market, with SAIC-GM-Wuling and BMW Brilliance Automotive selling well[81].

One of the threats nowadays comes from the most famous electric car manufacturer, Tesla, which imported 15,000 in 2017 and is planning to build a wholly owned plant in Shanghai, with a final production capacity of half a million units a year[82]. Another one could be represented by Volkswagen that, through its joint ventures, already dominates the Chinese automotive market. The German group is planning to introduce 40 locally produced new energy vehicle models in the country within the next decade, to try to maintain the leading position that it has in the internal combustion engine market[83].

As seen in the previous chapters, the Chinese automotive industry can be distinguished in private and state-controlled manufacturers. If we take into account the future opportunities in the electric passenger vehicle market, we have a few automakers that are a step ahead compared to others.

BYD can be considered the most promising manufacturer to become one of the leading global producers of electric passenger vehicles, taking into account its volume of sales in China and its worldwide relevant presence in the e-buses market. The data can be a little bit misleading, due to the fact that the sales in China have been strongly influenced by subsidies, causing a growth of low-end electric vehicles with low standards in order to obtain the financial incentives, thing that would not have happened in an economy led by market forces. Nevertheless, it can still be acknowledged as one of the Chinese excellences and, with the Denza brand created through the joint-venture with Daimler, its opportunities for the future are very promising.

A further contender is Geely, maybe the most well-known Chinese manufacturer outside its national borders because of its acquisition of Volvo. Its Swedish subsidiary has stated that it will launch only hybrid or full-electric vehicles from now on, showing a great commitment and optimism towards the electrification of the automotive market, a bet that will probably pay off. Furthermore, Lynk & Co, the newly created luxury brand of Geely, has constructed a new Tesla-like factory that will have a capacity of 200 thousand “new energy vehicles” a

[81] Tabeta, S. (2018). *With quotas looming, China's 'new energy' car sales take off*. [online] Nikkei Asian Review. Available at: https://asia.nikkei.com/Spotlight/Electric-cars-in-China/With-quotas-looming-China-s-new-energy-car-sales-take-off.

[82] Matsuda, N. (2018). *Tesla establishes electric vehicle outpost in China*. [online] Nikkei Asian Review. Available at: https://asia.nikkei.com/Spotlight/Electric-cars-in-China/Tesla-establishes-electric-vehicle-outpost-in-China.

[83] Bloomberg.com. (2018). *China Is Leading the World to an Electric Car Future*. [online] Available at: https://www.bloomberg.com/news/articles/2018-11-14/china-is-leading-the-world-to-an-electric-car-future.

year, that could satisfy the growing Chinese demand and also be exported[84]. The portfolio of Geely and its future potential in the electric vehicle market is much larger than this. It is also the owner of "London Electric Vehicle Company" and Polestar. The former is the maker of the famous black cabs, that has undergone a disruptive change towards all-electric vehicles and now it aims to tap the demand for taxis also in the major Chinese cities and in other developed countries[85]. The latter is a newly created brand that has the aim to compete head-to-head with Tesla in 2019, with its highly positioned fully electric vehicles[86].

We find some promising players in the "new energy vehicle" market also within the state-owned Chinese automakers. First of this list is BAIC, the Beijing headquartered automaker that in the first quarter of 2018 had the best-selling electric model worldwide, the BAIC EC, even though the sales where concentrated only in China. To achieve such a goal it relied on subsidies, but for the future it is renewing its products, to be able to obtain figures of nearly a quarter of a million of electric passenger vehicles sold in 2019[87]. Furthermore, it has committed to abandon internal combustion engine vehicle production by 2025.

Another important locally state-owned player for the future of China's automotive market is SAIC. Nowadays, it is the leading producer and exporter of passenger vehicles in the Chinese market, and its global ambitions lead the company to forecast over a million oversee sales within 2025. It is also focused on the innovations that are changing the automotive market. It is one of the few worldwide companies that is testing self-driving vehicles[88]. Furthermore, it is exploiting its joint venture with GM, the "Pan Asia Technical Center" (PATAC), leveraging on the American's electric motor expertise, to capture important slices of the electric vehicle market through its numerous indigenous brands, such as Roewe and Baojun[89],

It has to be seen if BYD and BAIC will be able to disentangle themselves from their native automotive market and succeed in the foreign developed countries with valuable products that can compete with the worldwide excellences of the sector. Geely, thanks to its diversified

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[84] electrive.com. (2018). *Geely's Lynk&Co doubles shifts at Tesla-like PEV factory - electrive.com*. [online] Available at: https://www.electrive.com/2018/05/07/geelys-lynkco-doubles-shifts-at-tesla-like-pev-factory/.

[85] Autovistagroup.com. (2017). *New London taxi to bring zero-emission travel to city streets around the world | Autovista Group*. [online] Available at: https://autovistagroup.com/news-and-insights/new-london-taxi-bring-zero-emission-travel-city-streets-around-world.

[86] Bright, J. (2018). *Polestar unveils first production EV with aim to overtake Tesla*. [online] TechCrunch. Available at: https://techcrunch.com/2018/09/21/polestar-unveils-first-production-ev-with-aim-to-overtake-tesla/?guccounter=2.

[87] Fung, D. (2018). *BAIC EC is the top-selling electric car worldwide | CarAdvice*. [online] CarAdvice.com. Available at: https://www.caradvice.com.au/649827/baic-ec-number-one-ev-q1-2018/.

Inside EVs. (2018). *BAIC Aims To Sell 220,000 Electric Cars In China Next Year*. [online] Available at: https://insideevs.com/baic-sell-220000-electric-cars-china/.

[88] Zhang, M. (2018). *China's biggest carmaker sets million-unit goal for overseas sales*. [online] South China Morning Post. Available at: https://www.scmp.com/business/companies/article/2136178/chinas-biggest-carmaker-saic-motor-aiming-overseas-sales-top.

[89] Cable, J. (2011). *GM and SAIC Agree to Develop Electric Vehicles in China*. [online] IndustryWeek. Available at: https://www.industryweek.com/environment/gm-and-saic-agree-develop-electric-vehicles-china.

portfolio and its ownership of foreign brands with strong brand equity is a step ahead, with less market share compared to its local competitors but with a healthy business model and a future strategy very promising. Finally, SAIC is an established automaker in China and also overseas, but it has to be seen if it will be able to innovate and maintain its market share without relying on its joint ventures to develop future technologies.

4.2.2. The automotive battery market

Obviously the most important difference between internal combustion engine (ICE) vehicles and electric ones is represented by the disruptive innovation, the power train. While the former ones rely on fuel which is combusted in the engine to provide power to the vehicle, the latter ones utilize batteries, which store electricity that then is used to power the motor. This distinction is currently one of the main obstacles towards mass adoption of electric vehicles. For ICE vehicles, the price of the powertrain accounts for 16 percent of the overall cost of the final product, while for the electric vehicles, the propulsion system represents half of the overall value of the final product, all of the other part of the vehicle considered equal. This leads to a price gap that is not closed within the lifecycle of the vehicle by lower maintenance costs and lower price of electricity compared to fuel.

This is why the main challenge towards mass adoption without relying on favourable state interventions is a reduction in price of the electric powertrain utilized by these "new energy vehicles". It is forecasted that demand will grow from 70 gigawatt hours nowadays to 900 gigawatt hours in 2030. This increasing demand will allow many new industries to enter the market and achieve economies of scale, reducing cell production costs. Boston Consulting Group has estimated that by 2021 the cost per kWh will be down from $195 to $153, with further reductions in the following years.[90]

Today the typical batteries used in electric vehicles have a capacity range of 25-70 kWh and are based on lithium-ion technology, the same used in smartphones and laptops, which has developed to a level that enables it to compete evenly with internal combustion engines in terms of performance. The main producers of these types of batteries are predominantly located in China, with BYD being the biggest manufacturer in the world, with 8 gigawatt hour (GWh) of capacity a year.

The technology on which the batteries are based nowadays, Lithium-ion, will obtain further improvements in the following years and soon could be overtaken by alternatives with higher

[90] Kupper, D., Kuhlmann, K., Wolf, S., Pieper, C., Xu, G. and Ahmad, J. (2018). *The Future of Battery Production for Electric Vehicles*. [online] https://www.bcg.com. Available at: https://www.bcg.com/publications/2018/future-battery-production-electric-vehicles.aspx.

energy densities and lower theoretical costs, such as Li-air and Li-sulphur; but their technology readiness is very low and it will take time to bring these options to a competitive level. At the moment, the best chance to lower the cost of batteries, and consequently the price of electric vehicles, is exploiting economies of scale by building enormous plants that will be able to satisfy the growing demand, increase the battery capacities and evolve the battery chemistries, allowing a higher energy density and a lower reliance on expensive raw materials, such as cobalt[91].

In 2018, the Lithium-ion battery manufacturing capacity for the automotive market was approximately 130 GWh per year. The main battery maker was Panasonic, with nearly 30 percent of the market share, followed by LG Chem and then, with approximately 10 percent market share each, BYD and CATL (Contemporary Amperex Technology Ltd.), both Chinese. During the next years the growing request for more electric vehicles will mean that this capacity will have to surge to satisfy this demand. This is an enormous opportunity for China, which already has the advantage of being the main global manufacturer of this product and could confirm this leadership in this growing market in the future, with great gains for the nation and for the most important electric vehicle market in the world, the Chinese one. This supremacy of the Chinese industry is stunning also taking into account that the manufacturing of batteries is not strongly reliant on manual labour, an abundant and cheap factor in China, and so it does not have a competitive price advantage compared to other developed nations. The backing of strong government policies and subsidies fuelled this market, tightening the control of four key components of these types of batteries, with a global market share between 50 and 77 percent of anode and cathode materials, electrolyte solutions and separators.

Based on the plants under construction and on the ones planned to be built, the worldwide automotive battery capacity for 2021 is expected to reach 400 GWh, with 73 percent of it concentrated in China. So, it seems that this great opportunity has, for the moment, been captured by the Asian superpower, but it is still to be seen if this leadership will be long-lasting. By 2030, the battery demand will reach 1500 GWh, with prices forecasted to reduce by a third, to $100 KWh, thanks to many developments in chemistry and technology. This will be a testing ground for the Chinese industry, which will have to prove that it is able to be globally competitive in a continuously evolving market.

[91] Same as n° 74

4.2.3. E-buses

A market that is strongly related to the automotive one, that has been influenced by this disruptive innovation and that represents a substitute in many occasions to passenger vehicles, is the public urban transportation one. Air quality concerns in urban areas affects all motorized vehicles. Tailpipe emissions from internal combustion engines, such as nitrogen oxides and particulates, are one of the major pollutants. Busses, with their diesel engines and predominant presence in all the cities around the world, provide a strong contribution to the amount of these emissions. That is why the environmental shift towards electric vehicles is capturing also this market. Nowadays there are over 300 thousand e-buses around the world, with the overwhelming majority present in China, 99 percent of them. With nearly all charging and battery configurations that in 2019 outperform their diesel rivals when considering the total cost of ownership, it is not surprising that the forecast for the market of e-buses is optimistic. By 2030, "Bloomberg New Energy Finance" is expecting that 84% of all municipal buses sales globally will be electric, and by 2040, 80 percent of the worldwide fleet will rely on electricity[92]. The relevance of this market transformation has been highlighted by the C40 cities, which groups the world's greatest cities such as Paris, LA and London, that have pledged to adopt only zero-emission buses from 2025[93].

This represents a great future market for China. They have started this conversion towards electric years ago, and have done so by subsidizing their manufacturers and the local municipalities. But now these investments can pay off. China is home to two of the most important electric bus manufacturers in the world, Yutong and BYD. The former sold 90 thousand e-buses last year, with strong foreign demand from the EU. The latter, BYD, known also to be one of the most relevant manufacturers of electric cars, is the leader of the e-bus market. Its footprint is not only limited to the Chinese territory, but it extended its reach to all over the world. BYD just sold more than 600 buses in Europe, thanks to a strong demand from Scandinavia and support from its new manufacturing facilities in Hungary and later in France[94]. Moreover, America is an interesting market for the Chinese manufacturer, where it is already the maker of most of the 300 electric bus fleet, and it could increase its supply thanks to a 84 million dollar incentive from the government to promote low or no emission

[92] turtl.co. (n.d.). *Electric Vehicles*. [online] Available at: https://bnef.turtl.co/story/evo2018?teaser=true. Bloomberg NEF. (2018). *E-Buses to Surge Even Faster Than EVs as Conventional Vehicles Fade | Bloomberg NEF*. [online] Available at: https://about.bnef.com/blog/e-buses-surge-even-faster-evs-conventional-vehicles-fade/.

[93] C40.org. (n.d.). *C40 : Fossil-Fuel-Free Streets Declaration*. [online] Available at: https://www.c40.org/other/fossil-fuel-free-streets-declaration.

[94] Kane, M. (2018). *BYD Sold Over 600 Electric Buses In Europe*. [online] Inside EVs. Available at: https://insideevs.com/byd-sold-600-electric-buses-europe/.

transportation. To furtherly boost sales, it also offers lease options in order to reduce the burden for local municipalities of the high upfront cost of an e-bus[95].

The potential of this transition to help reduce the air pollution in big cities is shown by Shenzhen. At the end of the past decade, the growing Chinese city had enormous air pollution problems, with 20 percent of it coming from its diesel-engined bus fleet. Thanks to vast amounts of subsidies, the city adopted e-buses, soon changing all its 17 thousand fleet with electric substitutes produced by BYD, the global manufacturer headquartered in the Chinese city. This represents an example to the rest of the world, especially now that this product has become more affordable[96].

4.3. Challenges

Obviously, such an important transition in such a relevant industry is not without challenges, that have to be tackled in order to succeed. These involve different aspect of new energy vehicles and the main ones are: demand, utilization, production and pollution. It is necessary to change the state of mind of some people in order to convince them to shift their purchasing behaviour. Furthermore, the lack of charging points reduces the possibility of utilization. Finally, production of batteries for electric vehicles is reliant on scarce natural resources and the energy that powers them has to come from an ecological energy sector, in order to avoid the "carbon leakage" and make the whole transition from the internal combustion engine vehicles worthless.

4.3.1. Change in mentality to favour adoption

When a disruptive technology is introduced in a market, it takes time for it to gain market share and become the new reference point for the customers. Even electric passenger vehicles are affected by this customer behaviour. Nowadays, it can be stated that the main customers of this segment of the automotive market are the innovators and the early adopters, but the majority still has to become a consumer. This means that the challenge is to capture the mass market in order to reach higher volumes of sales and make electric vehicles the reference point of the future automotive market.

[95] Blanco, S. (2018). *The U.S. Just Spent $84M On Electric Buses*. [online] Forbes.com. Available at: https://www.forbes.com/sites/sebastianblanco/2018/08/31/84-million-electric-buses/#6d324bb75e40.

[96] Lu, L., Xue, L. and Zhou, W. (2018). *How Did Shenzhen, China Build World's Largest Electric Bus Fleet? | World Resources Institute*. [online] Wri.org. Available at: https://www.wri.org/blog/2018/04/how-did-shenzhen-china-build-world-s-largest-electric-bus-fleet.

This initial stage of the bell curve of adoption is characterized by a mentality of the majority of consumers that does not contemplate an electric vehicle in its most likely options when considering buying a new car. This can be traced to the fact that this market segment is viewed as a niche, that has higher up-front costs and goes against the long-held norms and practices on how the vehicle is used and fuelled. The latter is a source of further concerns, such as battery safety, range anxiety and lack of charging stations.

The challenge of changing this mentality is present in China, even though the grow of its electric vehicle market is staggering and one of the biggest in the world. The government initially tackled it by making it perceived not as a niche market, thanks to large subsidies and financial incentives that lowered the final price, and heavily investing in the charging infrastructure, to diminish the range anxiety associated with a fear of a flat battery. To favour future adoption there will have to be more investments and a change of mind-set of the consumers, who will have to modernize their long-held norms and practices[97].

4.3.2. Investments in charging points

The widespread presence in the territory of a charging infrastructure is fundamental in order to promote customer demand for electric vehicles and favour their daily utilization.

In China, the electricity system is organized as a state-owned, vertically integrated monopoly that has the power to drive the expansion of the charging infrastructure. Private companies can enter the charging business through licenses issued by the National Development and Reform Commission (NDRC), with the local administrations regulating the prices[98]. The country, at the end of 2017, had 450 thousand installed charging stations, with 210 thousand of them public. This means that the country is the first worldwide in number of public electric charging poles. This primacy is not enough to satisfy the growing demand, since the sales of electric vehicles outpaced the construction of new charging facilities. The supposed proportion between the two should be 1:1, but in the Chinese territory it is only 8.6:1.

The presence of these public charging infrastructures is necessary especially in large cities and on the main routes between cities, due to the low possibility of urban citizens to have a private charging facility and the necessity of recharge for long journeys.

The enormous investments needed to implement the charging infrastructure represent a challenge nowadays to support the "new energy vehicle" market growth in China. By 2020, the annual amount of sales in this market are forecasted to reach 2 million units. That is why,

[97] Linke, R. (2017). *The real barriers to electric vehicle adoption | MIT Sloan*. [online] MIT Sloan. Available at: https://mitsloan.mit.edu/ideas-made-to-matter/real-barriers-to-electric-vehicle-adoption.

[98] Same as n° 74

in its "13th Five Year Plan", the Chinese government has set the aim to build, by the beginning of the new decade, 4.8 million distributed charging piles. To promote the investments related to such a massive construction, national policies and subsidies have been planned. These will incentivize the construction of charging piles by allocating central fiscal funds to subsidize the provinces and enterprises that undertake this commitment. This is fundamental during this initial phase of mass adoption because of the low driving force of the current electric vehicle fleet, that causes a period of five years to recover the cost of each charging station [99].

Moreover, China, in order to not risk overinvesting to find itself with an infrastructure of outdated technology, teamed-up with Japan to create a single standard in faster car chargers. Currently five standards of charging are competing globally, and the Asian superpower, which is forecasted to maintain the role as biggest market also in the future, wants to set its own standard in its country. The final aim of the two countries is to develop next-generation chargers with outputs over 500kW, meaning a tenfold increase of the current standard. That will enable quick charging of multiple vehicles. Japan seemed the perfect partner to engage in this long-term project, due to its technology and know-how, which will enable the manufacturing of these high-capacity charging equipment with appropriate safety features[100].

4.3.3. The scarce natural resources

The increased production of electric vehicles will obviously affect, as previously mentioned, the demand for batteries. This surge will be an opportunity for the Chinese industry, with a possible leading position in this future strategic market; but it also represents a challenge when you consider the raw material that are used to produce the batteries, which are the basis of the powertrain of the electric vehicle. The materials that are mainly affected by the increasing demand for lithium-ion batteries are copper, nickel, cobalt and lithium. While for the former two, there is no issue related to shortages or other potential major risks; the latter two are subjected to a much more significant impact, since the electric vehicle industry

[99] Yuanyuan, L. (2018). *China Strives to Speed Up Development of EV Charging Stations*. [online] Renewableenergyworld.com. Available at: https://www.renewableenergyworld.com/articles/2018/06/china-strives-to-speed-up-development-of-ev-charging-stations.html.
Prnewswire.com. (2018). *China EV Charging Station and Charging Pile Market 2018-2025: 15 Global and Chinese Charging Operators & Operation and Development Strategies of 8 Chinese Ssuppliers*. [online] Available at: https://www.prnewswire.com/news-releases/china-ev-charging-station-and-charging-pile-market-2018-2025-15-global-and-chinese-charging-operators--operation-and-development-strategies-of-8-chinese-ssuppliers-300701521.html.

[100] Tanaka, A. (2018). *China taps Japan to create single standard in faster car chargers*. [online] Nikkei Asian Review. Available at: https://asia.nikkei.com/Business/Business-Trends/China-taps-Japan-to-create-single-standard-in-faster-car-chargers.

represents nowadays approximately 6 and 9 percent, respectively, of the total demand for these materials.

Cobalt is mined with nickel and copper, and it has till now been considered as a by-product of these extractions, due to its limited market size and price. More than half of this material is globally supplied by the Democratic Republic of Congo, which does not represent a stable source of supply due to political reasons and problems related to child labour. China has secured its supply in the near future of this silvery metal with agreements with the African leaders and with the largest producer of cobalt, Glencore[101]. Moreover, China has an edge compared to the other national players in the market because it has 90 percent of the refining capacity of raw cobalt worldwide. But the future of this commodity is highly uncertain. The skyrocketing demand, that is foreseen to be 47 times higher in 2030 without technological innovations, sets a global supply shortage in year 2025, or even in the early 2020s according to some analysts[102]. Cobalt is nowadays fundamental for batteries since, in its use as cathode, it prevents overheating and gives stability during charge and discharge, increasing the lifetime of the battery. To tackle this shortage challenge, battery manufacturers are trying to reduce up to 75 percent of the amount of cobalt present in the cathodes of the batteries, but this is a temporary solution. To be able to reduce it even more, or even eliminate the need of such a material, there will be the necessity to create solid-state batteries. These are still at an embryonic phase, and will not enter the market until 2025[103].

Lithium does not have such a great issue related to shortages in the near future, but it still is a scarce natural resource. That is why it is fundamental to secure agreements for this raw material in order to obtain a reliable supply chain. Because of this, Chinese companies, particularly car and car supply companies, have invested more than one billion dollars in 2017 in lithium mines[104].

[101] Mining Technology | Mining News and Views Updated Daily. (2018). *China set to claim cobalt supply as electric vehicle demand picks up*. [online] Available at: https://www.mining-technology.com/comment/china-set-claim-cobalt-supply-electric-vehicle-demand-picks/.

[102] News.bloombergenvironment.com. (2018). *Electric Car Revolution Could Stall on Cobalt Shortage*. [online] Available at: https://news.bloombergenvironment.com/environment-and-energy/electric-car-revolution-could-stall-on-cobalt-shortage.

[103] Ft.com. (n.d.). *Electric cars: the race to replace cobalt | Financial Times*. [online] Available at: https://www.ft.com/content/3b72645a-91cc-11e8-bb8f-a6a2f7bca546.

[104] Ft.com. (n.d.). *Global carmakers race to lock in lithium for electric vehicles | Financial Times*. [online] Available at: https://www.ft.com/content/e9b83834-155b-11e8-9376-4a6390addb44.

4.3.4. The evolution of the energy structure

The evolution of China's energy structure is fundamental to not undermine the efforts in spreading the adoption of electric vehicles in order to reduce the carbon footprint of the automotive market.

As shown in the previous chapter, the amount of air pollution is immensely affected by China's strong reliance on coal to satisfy its electricity demand. This represents one of the major challenges for a greener future. Coal utilization has been one of the foundations of China's huge development. This means that, in order to abandon this path and adopt ecological alternatives to replace the energy provided by it, there will be high social costs. These include the shut-down of the inefficient small mills, which employ thousands of rural migrants, causing risks to social stability and a danger for the poor local economies that rely on this type of industry. Furthermore, institutional inertia is a further obstacle to the transition, due to strong interests of local governments, which have a monopoly in their regional energy structure and are resilient towards a drastic change in this structure, for the fear of losing their control over the industry[105].

These socio-economic challenges have mitigated the transition, but this change has begun. The peak of coal utilization was reached in 2014, and since then it has slowly reduced its market share in electricity supply. This can be explained on one side by the slow-down of China's GDP growth and shift from a manufacturing-based economy to a more modern one which reduced the overall requirements of energy supply, and on the other one by the current policies which promote more ecological alternatives to favour the reduction of polluting substances in the air[106].

The latter explanation clarifies the leading global position that China has in most of the renewable energy industries, such as wind, solar and hydroelectric. They are the main supplier of the former two, and the main producers of all of them, but they have the necessity to fully exploit their potential and not leave unused capacity in order to allow a full transition towards these ecological alternatives.

This shift towards renewable energy sources is the challenge for the future, now that the projections of electric vehicles adoption in China implies a growing demand for electricity that will have to be satisfied with an ecological energy structure.

[105] Lin, J. and Xu, J. (2014). The potential for green growth and structural transformation in China. *Oxford Review of Economic Policy*, 30(3), pp.550-568.
[106] Yuan, J. (2018). The future of coal in China. *Resources, Conservation and Recycling*, 129, pp.290-292.

CONCLUSIONS

All things considered, it is possible to see how the future for the automotive market in China is challenging and has immense opportunities. The growth of the market share of electric vehicles and the adoption of fleets of electric buses, supported by a development of the energy structure, can immensely improve the air quality of China's enormous cities.

The initial objectives of the Chinese government of consolidation, technology acquisition and the affirmation of Chinese brands have partially been achieved. The creation of national champions has been successful, also thanks to the technology acquired mainly before the entry in the WTO, obtaining a handful of automakers, state-owned and private also recognized by the Fortune Global 500, that are able to compete in the internal market, with some of them already having an interesting position in developed countries. The ability to succeed in foreign markets will be an important step forwards for some automakers, due to the future difficulties that they will face caused by the abolition of the limit of foreign ownership in their homeland market. Furthermore, many investments in research and development will have to be made in order to keep up with the new energy vehicle technology. This is more relevant than in the past because foreign MNCs will be less eager to start partnerships, due to their unwillingness to share a competitive edge on the technology of electric powered vehicles that will assure substantial new sales in the near future.

The transition to the electrification of the automotive market has been strongly pushed by the central government and it is still in its initial phases. It has to be seen if the growth experienced by the Chinese market will continue in the future at a steady pace, capturing the whole market share. Moreover, this transition will have to affect the energy structure too, in which there is a necessity to abandon coal and other fossil fuels and substitute them with non-polluting renewable energy sources.

The battery market has the potential to furtherly enhance the importance of China in the world economy, with a dominant position in the transportation industry and its supply chain. It will be crucial to see if the Asian country will be able to stay ahead of the future innovations that will affect this industry and adopt new technologies to disentangle the battery composition from the scarce resources that it relies on at present and that will be affected by supply shortage in the near future.

The e-bus market represents a strictly correlated business in which Chinese manufacturers, especially BYD, are steps ahead compared to all the other competitors. This shows how the government can affect the evolution of a market and favour the creation of global champions.

Obviously, this monopoly will be short-lived, but it will be of extreme importance to maintain the advantages gained from the position of first mover.

One of the question marks for the future is the achievement of the goals regarding the number of sales of electric vehicles set in the near future and how the sales will be affected by the fading out of the subsidies. It has to be understood if the market forces, with a push by automakers due to the introduction of the quotas, will be sufficient to drive up the sales of electric vehicles and if the investments devoted to the enhancement of the charging point infrastructure to support such a growth will be sufficient.

To conclude, the world hopes that this Chinese green transition will continue with an uninterrupted growth of the "new energy vehicle" market and of the utilization of renewable sources in the energy sector, with an evolution that will hopefully follow the more optimistic forecast elaborated by the International Energy Agency in its Sustainable Development Scenario. This would mean a much more environment friendly Chinese economy that will surely have a widespread effect on other nations worldwide, with promising results in the fight against climate change.

Further studies will have to be made to analyse if these trends have not vanished and the overall effects they have had on the automotive industry and on the climate. Moreover, there will have to be a deeper evaluation of the technological alternatives that could substitute the current batteries, to allow the widespread electrification of all means of transport. Finally, an investigation is needed to understand if this green path has obtained a worldwide appeal, leading countries to adopt electrified transportation in order to reduce their carbon footprint.

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