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Title	Development of automotive industry in developing countries during the last two decades.		
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<p>Abstract</p> <p>In recent century, globalization has appeared as one of the fundamental and powerful drivers forming the world economies. The automobile industry is one of the key industries which determines the economic power of different countries. During the last two decades the Global Value Chains (GVCs) in automotive industry have faced with considerable transformations. The economic crisis 2008- 2009 has shifted the automotive industry to developing countries and increased the significance of some large growing economies such as China and India.</p> <p>This master thesis was conducted in order to investigate the circumstances of automotive industry from the past to present especially during the last two decades.</p> <p>The literature review highlights the globalization and its substantial effects to the car industry in developing countries. Literature review has proven that the Foreign Direct Investment (FDI) plays a significant role in the development of the automotive industry in developing countries. Also, the literature review highlights the significance of developing countries in mitigation of greenhouse emissions by presentation of electric vehicles (EVs) to their people and creation of consumption patterns for this production.</p> <p>To answer the research question author used secondary data from different secondary data resources. These data analysis helped the author to determine the trend of automobile industry development in developing countries.</p> <p>Results from this study showed the positive effects of globalization to the automotive industry in developing countries. The transformation of global value chains and globalization resulted in considerable development to the automotive industry in developing countries.</p>			
Key words	Electric vehicles, Foreign Direct Investment, Global Value Chains		
Further information			





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DEVELOPMENT OF AUTOMOTIVE INDUSTRY IN DEVELOPING COUNTRIES DURING THE LAST TWO DECADES

Master's Thesis
In International Business

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The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Tuition Originality Check service.

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1 INTRODUCTION

1.1 Background

The standard car is a four wheel vehicle for transportation of people and goods by usage of fossil fuel internal combustion engine. The last century has been considered as a century of modernization with global production. (Wad 2010, 1.) The first car with an internal combustion engine that was fueled by hydrogen was designed by Francois Isaac de Rivaz in 1808, meanwhile engineers tried to improve the invention till the year 1885, in this year the first modern gasoline or petrol fueled engine was progressed in Europe by Karl Benz. (Automotive Service Technician 2019, 9-11.)

The production process of the car industry in both Europe and USA initiated in the late 19th century. All key automotive manufacturing developing countries represented import- substitution industrialization (ISI). ISI policies imposed quantitative restrictions or complete ban on import CBUs from developed countries. (Wad 2010, 3.) According to Jan&Hsiao (2004, 1145) developing economies after raise the automotive industry as a route to economic and technological development once achieve a certain GDP per capita level. The automotive industry has fundamental effects on related industries. This industry is capable for creation of numerous job opportunities and increasing per capita GDP in developing countries.

According to Vanconcellos (1996, 246) in the recent decades, in developing countries the rapid growth of large cities occurred by a considerable increase in automobile ownership. In developed societies the concept of the automobile has multidimensional influence on the life style of the people. We cannot find a single aspect that can discuss why this specific technology has so deeply influenced our lives.

Many researchers believe that the automobile industry is an outstanding part of the manufacturing sector and also recognized as one of the most substantial indicator of an economic development. As a result of this, the automotive industry plays a vital role in the country's fast economic and industrial boost. (Singh 2017, 6.) Moreover, The automotive industry plays a significant role in global economic activity with expanded connection to many diverse industries and sectors, it is necessary to mention that automotive industry is a capital intensive and knowledge intensive industry which plays a significant role in economic development of country. The car industry uses Iron, plastic, steel, aluminum, glass, computer chips, rubber and etc. With respect to the statistics the automotive

industry consumes half of the world's oil and rubber, about 25% of the glass product and also car industry consumes 1/6 of the steel output. These statistics show that the automotive industry is the second industry after aircraft industry which consumes the highest volume of consumed outputs of the other industries. (Saber 2018, 179.) According to Orsato&Wells (2006, 995) except the fact that automobile is a physical production of technology, also it plays a significant role in economic, environment, social, cultural and political dimensions of societies. Innovative activities which exert vehicle design and development of automotive industry are costly and difficult to master. Also the process needs high amount of tacit knowledge. The automotive industry also requires infrastructure-related technologies such as highways, roads, bridges and tunnels.

According to Amadeo (2019, 3) in 2018 the automotive industry in USA dedicated the 2.7% of the country's GDP to itself. From the total GDP of \$20.5 trillion the share of automotive industry was about \$545.4 billion. \$327.1 billion was dedicated to auto manufacturing and \$218.3 billion was the share of vehicle retail sales. According to the Saber (2018, 179) 1% growth in automotive industry causes a GDP growth of 1.5% for the economies of developed countries. With respect to different statistics, the country with more developed automobile industry allocate the higher share of world's GDP to itself. Hence the automotive industry has between 5 to 10% of the share of developed country's GDP.

According to different market research, in the previous years the global electric vehicle market faced flourishing of 22% a year. In 2017, this number was \$19 billion and it is anticipated to reach to its peak about \$567 billion by 2025. The statistics show that electric vehicles produce 54% less CO₂ emissions than the average new gas powered vehicle. This research showed that nowadays there are 1.2 million electric vehicles are moving in the roads while this number will reach to 18.7 million by 2030. (Amadeo 2019, 5.)

Globalization is the extension of technology, products, information and job opportunities across the different nations with different cultures. In recent century, globalization has appeared as one of the substantial and powerful forces forming the world economies. The central hypothesis is that globalization shifts the source of competitive pressure from developed countries with the excellence of the point of automobile production to developing countries with comparative advantages in spatially diffused networks of automobile plants, suppliers and affiliates. From the last decades, new assembly and supplier plant has been constructed in developing countries such as China, India, Brazil, Mexico, Vietnam, Thailand and East Europe. The reason behind that transformation was the rise

of competition and market saturation in developing countries. (Sturgeon & Florida 2000, 9.)

According to Buckley, Clegg, Zheng, and Siler & Giorgioni (2007, 712) total impact of FDI on receiving countries productivities is often encompassed into two specific types of effects: direct and indirect effects. The direct effect of FDI refers to its significant impact on the productivity of FDI-receiving countries. On the other hand, indirect effect of FDI is about the effect of foreign firms with their presence on the productivity of domestic firms.

Since the late 1980, large multinational companies had increased their foreign direct investment (FDI) in developing countries. Moreover, in developing countries in the first stage, these investments mainly designed for export back to the developed countries but in the recent years the concentration has changed to progress of local markets. Furthermore in addition to the shift of markets for motor vehicles to the developing countries, the more advancement in the technology and design work will transfer the car industry to the developing countries. (Van Biesbroeck & Sturgeon 2010, 1.)

Some emerging economies play a significant role in the automotive industry because of their economic growth and ability in global market. Since the late 1980, the foreign direct investment and trade has speeded up considerably in many industries such as automotive industry. Huge surplus of low-cost and high skilled workers in the largest countries of developing world such as China, India and Brazil caused attention of investment for both process of supplying in flourishing local industrial sectors and for export back to developed countries. (Sturgeon & Van Biesbroeck 2011, 185.)

It has proven that the FDI in automotive industry plays a leading role in the economy of host countries. Literature reviews determines that FDI is the substantial power and the fundamental phenomenon in many developing countries such as Turkey. (Günsen 2015, 21.) Many studies show that the foreign direct investment (FDI) has a fundamental effect on the host country's productivity. With respect to many studies the automotive industry is one of the key industries in China. This industry dedicated large and increasing share of industrial output, production and employment. (Buckley et al. 2007, 709.),

Global Value Chains (GVCs) refers to the international circulation of goods and services. Also GVCs identifies different methods which people all around the world use to correlate with international production networks. As a result of this, this concept evaluates the country's degree of competitiveness and the effect of economic policies. (Amador & Dimauro 2011, page 13.). According to (Gereffi & Fernandez 2011, 2) Global value

chains clarifies that how firms, producers and workers are integrated in the global economy. In this era, global value chains (GVCs) became the core of global economy. Global value chains has a positive effect for global GDP, increasing share of international trade and work opportunities. The evolution of GVCs in different sectors such as commodities apparel, electronics, tourism and business services outsourcing has brought substantial implications in terms of global trade.

In this era, global climate change and global warming is one of the most important issues for our planet. For reduction of global climate change we need distribution of a large number of different technologies. The global challenge of climate change reduction has caused innovation of new technologies that persuade the progress and adoption of new technologies. In recent decades, fast economic growth in some developing countries such as china, India and Brazil has shifted policy attention to simplify the use of clean technologies. (Hall & Helmers 2010, 5.).

The emission of greenhouse gases cause different negative consequences such as rises in the average global temperature, more differences in temperature across time, sharpens the severity of maximum weather related events and in-creases an average sea- level rise. It is necessary to mention that developing countries are more dependent on the agricultural sectors which are more vulnerable to climate change, as a result of this, the potential damages of climate change for developing countries is manifold. (Hall & Helmers 2010, 3.)

International technology transfer focuses to the debate that how to restrict that carbon emissions from rapid economic growth in two most populous developing countries China and India Rapid economic growth in both China and India has started from more than a decade ago and it is anticipated to continue in the future. Both of these countries produce high amount of world's goods and services. It shows that the global economic power will shift from the west to the east. Furthermore, the development is not only in terms of production, this economic power also has a positive effect on technology advancement and innovation. (Rasuma Lema & Adrian Lema 2012, 24.)

1.2 Research gap and research question

Many studies are conducted on particular aspects of the automotive industry. Many studies are focused on global production. For instance (Winroth & Bennett 2017) focused on international production networks in the automotive industry. In this study the authors

discussed the internationalization of automotive industry during the early 1900s. For instance Canbolat et al. (2007) concentrates on new transformations in value chain dynamics eventuating from globalization. Noorbakhsh et al. (2001) concentrates on the structural changes in the supply chain of the industry. Studies conducted by Osterman and Neal (2009) is concentrated on the structural changes in the supply chain of the industry. The Majority of the studies focused on the regional or national aspects of automobile industry. The gap in this field is that only a few studies conducted to look at the automobile industry in developing countries as a group. However, some studies such as Sturgeon and Van Biesebroeck (2010) and wad (2010) analyze the effects of the global economic crisis on the automotive industry sector in developing countries. (Gastrow 2012, 5899.)

This study investigates the circumstances of automotive industry in developing countries. This study is conducted to highlight the past and present state of the car industry in developing countries.

In this era, the automotive industry's center will continue to shift from west to east. The China is already the world's biggest automobile manufacturer. China reached to its peak in 2012 with 19 million vehicles sold. One of the most substantial opportunities is the ability to produce smaller vehicles such as subcompacts, micro cars and superminis. These already calculated for more than 30 percent of global sales and have this opportunity to reach more than 30 million vehicles in 2020. (Sha, Huang & Gabardi 2013. Page 4.)

Sub- questions were formed in three field of interests. Thus the main research question was designed as below:

RQ: How the automotive industry has developed in developing countries?

In order to answer the main research question of study, sub questions were formed:

SQ1: How have the globalization and FDIs influenced the car industry in developing countries?

SQ2: How the global value chain in automotive industry changed during the last two decades?

SQ3: How car industry in developing countries has adopted to green technology?

2 GLOBALIZATION AND ITS EFFECTS TO THE CAR INDUSTRY IN DEVELOPING COUNTRIES

2.1 Globalization in automotive industry

In this part of study, the author tries to describe recent global automotive industry especially in developing countries.

Globalization in automotive industry is a fundamental factor in several trends. It causes shift from west to east in case of consumption and production, and furthermore, continuing globalization is increased foreign direct investment (FDI) in growing economies. In many populous developing countries such as Brazil, China and India have attracted substantial raw materials for production and local product adaptation. (Gastrow 2012, 5900.)

Globalization has appeared as one of the most substantial and considerable severity shaping domestic world economies. It has been a movement of new assembly and supplier sectors in developing countries such as China, India, Thailand, Vietnam, Brazil, Mexico and East Europe. This movement has driven because of increased competition and market saturation at developed countries such as USA, Japan and EU countries. (Sturgeon and Florida 2000, 1.) According to Sturgeon & Florida (2000, 10) during the past ten years the quality of jobs in developed world has stabilized while the job quality has decreased especially in the United States. In sharp contrast, the employment rate in automotive industry in developing countries have been moderate while the job quality compliance with extremely high quality by local standards is considerable issue.

The automotive industry shares common features with other globalized industries such as: apparel, electronics and consumer goods. The general characteristic refers to the fact that in all of these industries encompassing automotive industry, Foreign Direct Investment (FDI), cross-border trade and global production have speeded up considerably since the late 1980. Potential market growth and huge amount of low-cost but high skilled workers in some growing economies such as China and India played a significant role for attraction of Foreign Direct Investment (FDI). They attract FDI from developed countries and deliver it to supply local markets and finally export back to the developed countries. (Sturgeon, Memedovich, Van Biesebroeck & Gereffi 2009, 9.) According to Sturgeon & Florida (2000, 44) in a competition to grasp more market share in developing countries where populations are large and the car owners are not so much, the automakers try to build new assembly plants. They try to fulfil this plan in countries which are open to

foreign investments such as Vietnam, China, India and East Europe. Except market saturation in developed countries, slow growth and increased competition at home country have convinced the auto makers to invest in developing countries with largest population and labor force such as Brazil, China and India.

The “automotive industry is human capital intensive and technologically advanced”. The statistics show that the globalization in automotive industry have considerable effect on employment and wages in this industry. In this industry low- skilled workers and labor intensive sectors of the developed countries encounter with decreasing wage and employment because of the existence of low income and high- skilled workers in developing countries. During the last decades multinational companies have started to invest in low income countries and resulted in the emergence of new automobile producers and exporters. (Spatz& Nunnenkmp 2002, 1, 8.) According to the Sturgeon et al. (2009, 10-11) there were some substantial trends to affect the automotive industry until the economic crisis in 2008. Firstly the boom in automobile production that occurred more than last few decades increased automobile production significantly. Between 1975 and 2007 automobile production more than doubled in this period. The reason behind this growth was emersion of new markets in two populous developing countries India and China. This venture has transferred the process of worldwide production from west to east.

During the 1990s, the rapid growth of car industry was considerable in a small number of developing countries. During this period the growth of the emerging markets started. These countries included Latin American countries such as Brazil and Mexico which emerged from the slack of the 1980s, the ASEAN countries, Eastern Europe, China and India. With respect to the statistics these group of countries raised vehicle sales by 80% and production by 93%. One of the considerable characteristics of car industry in the 1990s was the passion of vehicle manufacturers for extension of their operations in developing countries. (Humphrey&Memedovich 2003, 2-5.)

Wad (2010,5) highlights that the market met a stable average annual growth above 3.5% from 2001 to 2007, while during this period North America and Western Europe encountered with negative growth in both production and demand. In contrary, developed Asian countries such as Japan, Australia and New Zealand met 5% growth for their sales and 22% growth in their production process. According to the Sturgeon et al. (2009, 12) most of this global growth was the result of industry growth in the emerging market such as China, Republic of Korea and India.

“A global industry

Automakers and global suppliers” create buyer- supplier connections

“On a global scale. Inter- regional vehicle and parts trade is” fundamental

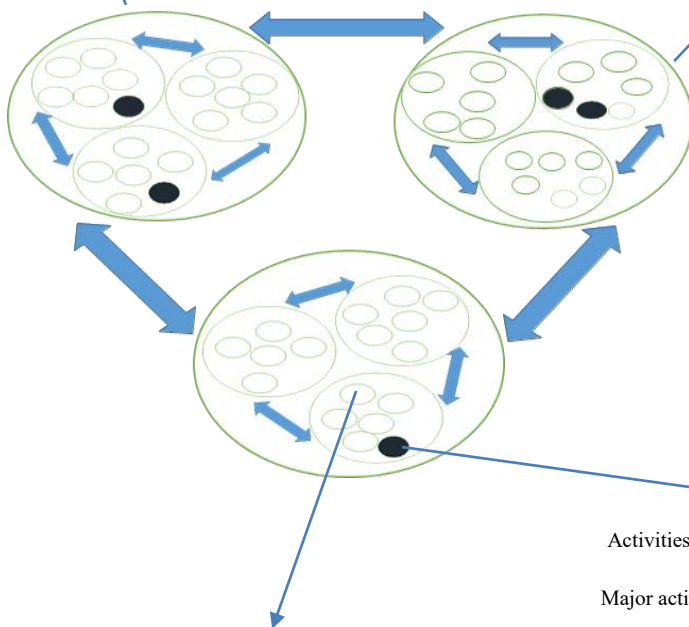
But covered by political an operational consideration

Regional production system

the domination of inter- regional finished

vehicle and part flows as an operational pattern in this

In this industry is fundamental



Local clusters

Activities desire to be focused among clusters of
Major activity such as design and O assembly

National production system

Still domestic production plays a crucial role “in this
Industry and dominates many national markets”

Figure 1 : The nested geographic and organizational structure of the automotive industry (Sturgeon et al. 2008, 8)

The manufacturers recognized that the developing countries in rapid growing markets had potential for spreading vehicle development costs, considerable potential for establishment of cheap production sites and finally these countries provide access to new markets for produced vehicles. (Humphrey& Memedovich 2003, 2-5.)

Increasing globalization does not affect the importance of regional and local markets. Local adaptations to the global trend plays a significant role for the success of globalization. Some local conditions such as road and driving conditions, industry regulations and standards, labor market and public policies such as tariffs and taxations. (Gastrow 2012, 5897.)

2.2 The trend of automotive industry in developing countries

1950s was the turning point for different developing countries. They imitated industrialization policies for improvement of auto industry in their home countries. As a result of this, by the early 1990s in some developing regions such Latin America, the ASEAN region, India and China started to produce their automotive products with a few imported components from developed countries. Many tariff regulations decreased in developing countries and they were shifting and integrating to the global production to sales strategies of major multinational automotive industry. These changes have transformed the structure and the features of the automotive industry in growing economies. (Humphrey & Memedovich 2003, 25-28.) Before the 1990s, the automotive industry was one of the most fundamental industries in all around the world which was dominated by couple of companies such as GM, Ford, Chrysler and Toyota which were located in developed countries. However, the expansion of automotive production in emerging countries faced with a boom in the end of 1990s (Humphrey & Memedovich 2003, 30.)

In the 1990s, the auto industry in developing countries was affected not only by changes in investment and trade policies and the globalization strategies of powerful companies in developed countries, but also the automotive industries' value chains themselves faced with transformation. (Humphrey & Memedovich 2003, 11.) According to the analyzed statistics by Humphrey & Memedovich (2003,36), between 1990 and 1997 the global vehicle production soared by a little less than 7 million units while the global vehicle production in the same period was nearly the half of this number.

In the 1990s, the changes in the nature of global assembly sector had a considerable effect for developing countries. For these countries one of the key reasons for advancement of the automotive industry was to motivate domestic industries for more development. These developments are not only for creation of job opportunities for domestic markets and reduction of costs of imported vehicle parts but also for motivation of domestic workforce to achieve more technological capabilities. (Humphrey & Memedovich

2003, 29.) According to Humphrey & Memedovich (2003,26) Couple of developing countries played a significant role for this rapid growth in global production such as Republic of Korea .It is necessary to highlight that the most substantial feature of the 1990s was the emersion of emerging markets such as Latin America (especially Brazil and Mexico), Eastern Europe, ASEAN countries, China and India. Furthermore, in the 1990s major automotive manufacturers exported their operations especially assembly sectors in developing countries. The reason behind this decision was for decreasing and spreading vehicle production costs.

According to Wad (2010, 4-5) there are four key trends in developing countries, firstly the change of Import substitution Industrialization because of the “collapse of the Union of Soviet Socialist Republics (USSR) in the early1990s”. After 1990s liberalization and globalization played a significant role for the formation of the automotive industry until the financial crisis of 2008. Secondly, for achieving economies of scales both assemblers and large suppliers in developed countries tried to create alliances with their colleagues in developing countries. Thirdly, local (national) suppliers lost their dependency through the acquisition with foreign partners. Fourthly, the TNCs (Transnational companies) have chased the specific strategy of ‘build- where- you-sell in compliance with potential of local market for achieving the best level of economies of scales. Sturgeon & Van Biesbroeck (2010, 10-11) categorized the developing countries into four dynamics developing countries. The first category was very large and populated countries such as China, India and Brazil. These countries have potential markets and hence, it stimulated the assemblers to either produce cars especially for their market consumption either to adopt their existing car models for consumption in these markets. Second category was mid-sized advanced developing countries, these countries had sufficient large market to authenticate local assembly, however, they were not large enough to create motivation for local adaptation or market- particular products. Countries such as South Africa, Thailand and Turkey are categorized in this group. These countries desire to be assembly center for their regions, also they can create opportunities for their suppliers, and some of these countries such as “South Africa has a mature assembly sector that” has the capability to assemble fully imported kits for their national consumption and global export. Furthermore, it has a component sector that uses country’s comparative advantages for integration of the primary kits, comparative advantages such as high skilled but low cost workers “(for harnesses), heavy components (for wheel hubs and engine blocks)”, leather (for car seats), platinum (for catalytic converters). Third category are developing countries which

are near to large developed- country markets, these countries because of their low cost workers have labor- intensive orientation. If they can increase their work force capabilities they can be optimistic about the production of luxury and expensive parts. A fourth dynamic is identified a “nascent”, these countries apply their maximum capability to supply the new and global supply- base products for becoming more competitive in global markets.

Chery brand in China obtained a production scales in a short time by using a wide scope of capabilities. This company has its own R&D capabilities. They founded their own R&D sector with more than 1000 expertise. Chery has flexibility and entrepreneurial spirit for running businesses. They provide a good technological environment which grounded on the appropriate level of education and recruitment of high skilled workers. They accessed to the numerous global suppliers for design production process, engineering and components. These efforts resulted in some developments for the Chery along the other assemblers from China and India. However, in comparison with giant producers such as Ford, GM, Toyota and Nissan has less influence and brand's effective image. Furthermore, this partnership with experts and experienced firms from automotive industry in developed

Countries did not give them the capability to compete with developed country producers. (Junjie& Xiajing 2013, 177-179.)

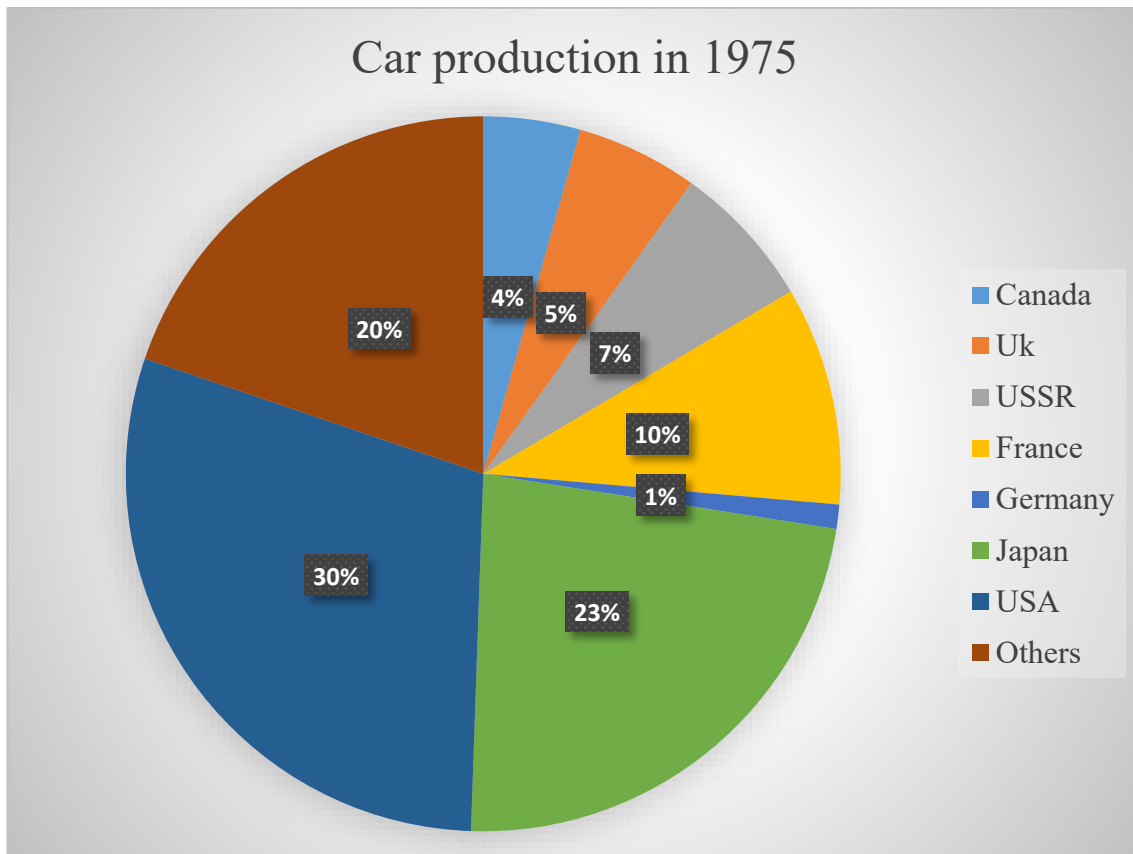


Figure 2:Car production in 1975 (Sturgeon et al. 2009, 11)

This pie chart (Figure 2 Automotive industry in 1975 (Sturgeon et al. 2009, 11) illustrates the automotive production share in 1975. In this year with respect to the statistics, there are 7 major producers which allocated 80% of production to themselves. Among these major producers there are 6 developed countries such as USA, Japan, Germany,

France, UK and Canada. In sharp contrast, there is not any developing countries among major producers in this year.

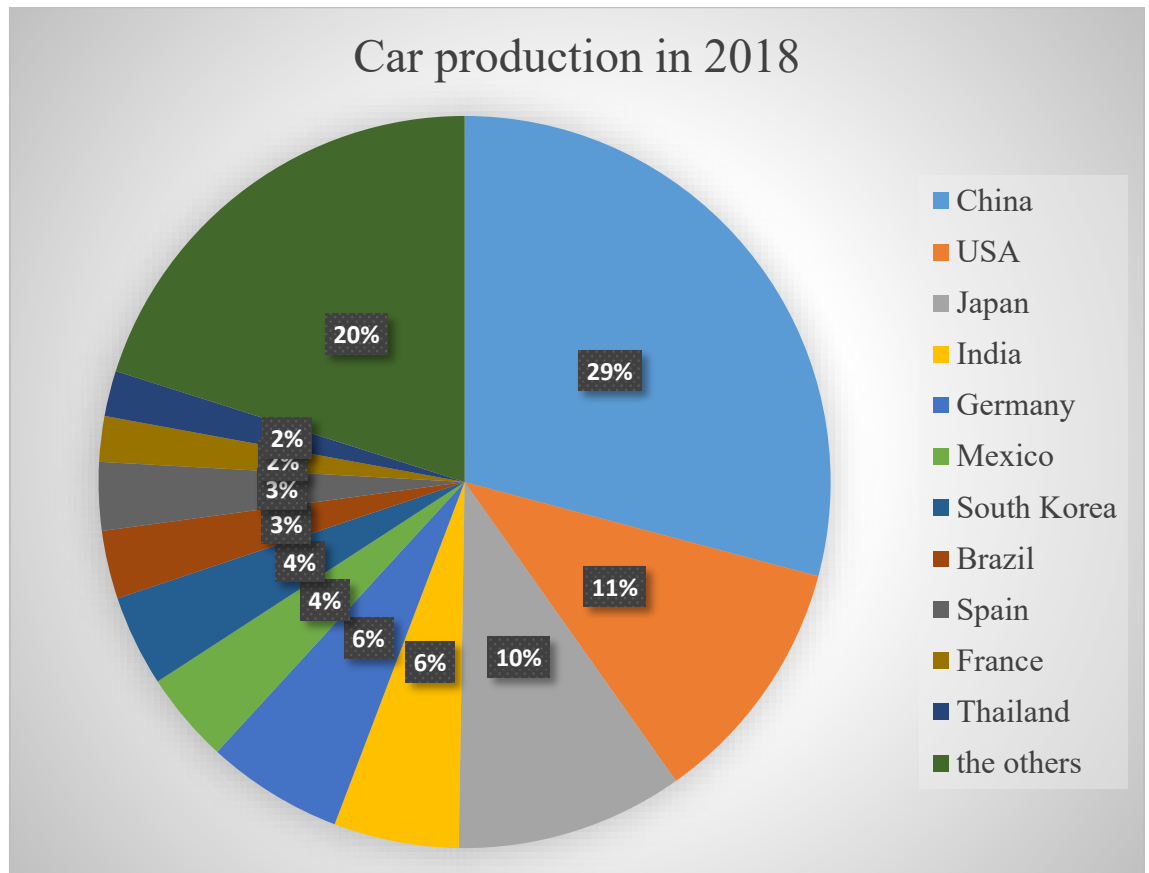


Figure 3 :Car production in 2018 (Source: OICA)

This pie chart (Car production in 2018, OICA) illustrates the car production share in 2018. With respect to the statistics, in this year there are 12 countries produced 80% of the total production in all around the world. Among major producers in automotive industry we can see China, India, Mexico, South Korea, Brazil and Thailand which are developing countries and produced 48% of total world's production. One of the most considerable issues is that the China allocated highest share of market production to itself. China produced 29% of total market production and placed in the 1st ranking of the world's car producers.

Analyzing these two pie chart proves that during this more than 4 decades, 5 develop- and populous countries: China, India, Brazil, Mexico and Thailand are introduced as major producers in the automotive industry and entered to the global market.

2.3 Financial crisis to car industry in developing countries

The global financial crisis during 2008- 2009 affected automotive industry more than any other industry, the pressure financial crisis on the automotive industry had devastating impacts. Three American automakers which played a significant role in GVCs faced a sharp drop in their market Share. (Van Biesbroeck &Sturgeon 2009, 213.)According to Sturgeon& Van Biesbroeck (2010, 6) the global economic crisis 2008-2009 had a very deep and devastating impact on the automotive industry after housing and finance sectors. There are several reasons for this issue which some of them are very considerable. Firstly before financial crisis the automotive industry especially 3 American giant car manufacturers (GM, Ford and Chrysler) were in a critical conditions. The critical situation of the value chains conducted by these three super power automakers. Different challenges such as huge debt loads, high fixed capital costs, unpaid supplier invoices speeded up the devastation for the companies. Secondly the financial crisis decreased car purchases by consumers because of many reasons such as market uncertainty and lack of credibility.

The global financial crisis started in October 2008 and affected automobile sales in both USA and Europe where automobile production plunged in both region dramatically as a result of this occurrence. The sign of global economic deficit started from 2007 to 2008, except USA and Europe also Japanese automotive producers met a deficit in their production. Albeit global automotive production dropped by 3.7% from 2007 to 2008 in all developed countries such as USA and Japan, developing countries faced an increase in their production. (Wad 2010, 13.) The concentration on the automotive industry is extremely high, the pioneers and strong firms are very large and handful. The importance of GVCs in the automotive industry for all governments especially US government is clear, as a result of this the US government believed that they can help the industry effectively. However, the financial crisis in automotive industry in developing countries had different consequences. (Sturgeon & Van Biesebroeck 2010, 9.)

On the other hand, the financial crisis had different effects for developing countries. As a result of this circumstance, shift of automobile production from developed world to developing countries speeded up. With respect to the statistics, between 2007 and 2009, for developing countries the share of global production sharply increased, in 2007 the share of global production for developing countries was 1.9% while it reached to its peak in 2009 which was 7.5%, the main reason for this issue was the growth in China. (Gastrow 2012, 5901.) There are few studies which are especially focus on the automotive industry

in the developing countries. For instance, Canbolat et al. (2007) concentrates on current changes in value chain dynamics as an outcome of globalization. Another example is Noorbakhsh et al. (2001) concentrates on the relationship between workforce “capital and FDI inflows in developing countries”. However, there are two significant studies which carried out comprehensive analysis. One study is Wad (2010) and second is Sturgeon and Van Biesbroeck (2010). These studies investigate the effects of the global economic crisis on the automotive industry in developing countries. (Gastrow 2012, 5899.)

There are studies that analyzed the automotive industry in developing countries post economic crisis in 2008 and its financial effects. Many researchers believe that the financial crisis had less negative effects for automotive industry in developing countries. For instance Wad (2010) mentions that the financial crisis had less negative effects for automotive industry in developing countries. Firstly, less integration of financial system into the global financial system resulted in less exposure to the complicated financial situation that played a significant role in occurring the crisis. As a result of this, the restriction of the access to the consumer credits for automobile purchases were less than purchasers were less than the same extent as in developed countries. Moreover, while in the USA consumer bought 80% of vehicles through credits, the customers in China purchased 80% of vehicles by cash. (Gastrow 2012, 5902.) The global financial crisis affected the automotive industry especially in developed countries. However, the effects of this occurrence for developing countries was less considerable. The initial effect of this occurrence for developing countries was the velocity of global market shift to their countries. Also they faced with the faster stabilization of the supply chain. (Gastrow 2012, 5895.) According to Sturgeon & Van Biesbroeck (2011, 188) the 2008- 2009 economic crisis shifted the automobile industry from developed countries to developing countries. However, the industry’s growth in developing countries has been restricted to a specific group of countries such as China, India, Brazil and Thailand.

3 GLOBAL VALUE CHAIN IN AUTOMOTIVE INDUSTRY

3.1 Global integration and regional production

The sophisticated economic geography of the automotive industry speeded up the global integration of automotive industry in the last decades. Global integration has developed at the design stage. In recent years, industry suppliers play a central role in system design, as a result of this they try to establish their own design centers near to their major customers because of better collaboration with them. (Van Biesebroeck & Sturgeon, 2010, 3.)

Since the late 1980, the Foreign Direct Investment (FDI) and commerce have been increased dramatically in many industries, huge increases of low- cost but high skilled workers in the largest developing countries such as China, India and Brazil has motivated investors for more investments. Recently developing countries play a significant role in production functions while the responsibility of innovation and design actions remain in developed countries. (Van Biesebroeck & Sturgeon 2010, 210.) According to Sturgeon, Van Biesbroeck & Gereffi (2008, 8) automotive industry is in the significant transmission. Since the mid- 1980s it has been starting a profound shift from a series of distinct dominant countries to a more integrated global industry. Many drivers such as market saturation in developed countries, high level of motorization and different political pressures on automobile manufacturers encouraged the diffusion of final assembly centers which nowadays take “place in many more countries than it did 30 years ago”.

Recently, automakers try to establish final assembly plants in new locations and try to establish final assembly plants in new locations and try to produce multiple products in multiple markets, they force their suppliers for moving to abroad with them. The capability to produce in different major production regions is one of the most substantial preconditions for automakers to start a project. (Sturgeon & Van Biesebroeck 2011, 184.)

According to Van Biesebroeck & Sturgeon (2010,209) because of political pressure for local production, the automakers have been obliged to establish their final assembly in many of developed automotive industry regions such as the United States and Europe, also in the largest developing countries such as China, India and Brazil. Lower operation costs in some regions stimulated investors to change their investment locations, for instance, Mexico and the southern United States in North America, Spain and Eastern Europe in Europe and Southeast Asia and China in Asia have been targeted by the investors

for the long term investments because of their low operation costs. This proves that the restriction of the automotive industry and its production process in a cluster of developed countries is impossible.

In terms of GVCs in automotive industry, developed countries are responsible for innovative activities and designing operations while production and assembly functions take place in developed countries. (Van Biesebroeck & Sturgeon 2010, 210.)

3.2 Green technology and its effect on automotive industry

3.2.1 Climate change and green technology

In this era, extension of new technologies helps to reduce the global climate change and greenhouse gases emissions. Negative effects of the climate change motivated the development of new technologies and procedures particularly in some developing countries which experience recent rapid economic growth. In this era, the policy makers concentrate on the countries that are not effectively participating in the use of clean technologies seriously. (Hall & Helmers 2010, 3)

Rapid economic growth in two populous developing countries (India and China) has stabilized for more than a decade and it is anticipated for continuous economic growth in the future. This economic growth prepared this opportunity for these countries to progress in innovative activities and considerable advancements in green technologies industries (Rasmus Lema & Adrian Lema 2012, 23.)

The emission of greenhouse gases will have different adverse consequences such as rise in the average global temperature, rise variation temperatures in specific period of time and rise of the average sea- level. Moreover, in particular the adverse effects of climate change for developing countries which are dependent to agricultural sectors are more visible. Furthermore, the climate change has a negative impact on public health in developing countries, for instance, increasing the temperature has a direct relation to the spread of Malaria disease and its mortality. Another most substantial consequences of climate change are the natural disasters which will be increased especially in coastal area of tropical developing countries. As a result of this discussion, developing countries are more interested in mitigating climate change and its adverse consequences by development and distribution of green technologies in their region. (Hall & Helmers 2010, 3.)

According to Hall & Helmers (2010, 3) improving the quality of life in these countries in similar level in western developed countries with ignorance of energy consumption deals of innovative environmental solutions would have adverse effects for global warming. Moreover, with respect to the forecasts, the countries which are the most responsible for occurrence of this phenomenon, are not those countries that will be influenced by the adverse consequences of this phenomenon.

According to the Rasmus Lema & Adrian Lema (2012, 28), “National Champions” described as the companies that have technological capabilities and prevailing market or export shares in their home countries. National Champions play a significant role in the climate change alleviation through dissemination of green technologies in China and India.

3.2.2 *Green technology pioneers in Asia*

In the mid-1980s Chinese power technology began with imports of terrible amount of wind power turbines from Europe while nowadays there are more than 40 domestic manufacturers to produce 44 Giga watt electricity and famous producers as the world’s largest wind power market. The national champion firms have started to play a significant role in the global market in a very short period from 2006. China faces with high growth market and accessibility to imperative 70% local content requirements. As a result of this, most of major global wind power firms initiated their production lines in China. (Rasmus Lema& Adrian Lema 2012, 29.)

Establishment of global green economy will need technology transfer in both developing and developed countries. Among developing countries some emerging economies have started to establish considerable technological capabilities in terms of related fields to the green economy. During the last decades, some of developing countries especially China and India have played a significant role in some of green technology industries such as wind turbines, Solar Polar Voltaic (PV) panels and electric and hybrid electric vehicles. (Fu& Zhang 2011, 329.) According to Fu&Zhang (2011, 329) innovation is risky, costly and unpredictable. As a result of this it is logical for poor and developing countries to rely on foreign technology attainment from developed countries for their technological development. Technology can be spread through different transmission systems such as licensing, movement of capital through the FDI and OFDI (Outward Foreign Direct Investment), circulation of commodities through international trade, movement of

people because of different reasons such as travel, migration and foreign education of students and workers and other various transition systems.

Concentration on indigenous R&D is resulted in the development model of the solar PV industry in China. On the other hand, the Indian solar PV sector is a combination of three main producers including joint ventures, patent licensing, acquisition and in house R&D. In the case of solar PV sector both China and India had a rapid development for building national sector PV but China plays a significant role in global market with developed technological capabilities. (Fu& Zhang 2011, 333-335.) China's PV industry started from assembly of components while nowadays they produce the complete panels and became the world's largest producer of solar PV panels with a 98% export share. By 2009 three national champions ranked between 10 top global manufacturers. (Rasmus Lema & Adrian Lema 2012, 3.)

Since the introduction of the electric vehicles (EV) and its benefits for environment protection, many countries have focused on the promotion of electric vehicle (EV) in their future plans. China produces the world's largest amount of carbon dioxide, the Chinese government has planned different acts to decrease emissions. (Tan, Wang, Deng, Yang, Rao & Zhang 2014, 5493.)

The transport sector in China has consumed petroleum- based fuels, particularly diesel and gasoline. This type of energy resources provided cheap and reliable transport services for Chinese citizens, also they helped for improvement of socio- economic development. However, the transport sector plays a significant role for emission of greenhouse gases (GHG). With respect to the statistics, between 1990 and 2013, for instance GHG emissions in transport sector soared more than 7times. As a result of this, the policy makers in China tried to decrease the countries GHG emissions from the transport sector. After researching among different options there is a strong consensus between the policy makers that electric vehicle (EV) is one of the most suitable options for reaching to their goals. (LI, Yang & Sandu 2018, 2.)

Electric vehicles (EVs) are valuable in three different aspects: environment protection, grid construction and economic efficiency. In January 2009, in order to alleviate climate changes and reduction of "emissions the ministry of finance and ministry of science and technology" cooperatively issued the notification of Energy- Saving and electric vehicle promotion in pilot demonstration areas which was the first especial policy to introduce EV as a solution. From then, the target of Chinese government is to produce 5 million battery electric vehicles (BEVs) and hybrid electric vehicles (HEVs) by 2020. (Tan et al.

2014, 5494.) Introduction of “Ten Cities with thousands of EVs” program has a significant effect in progress and popularization of electric vehicles comprising battery BEV, HEV, and fuel cell electric vehicle (FCEV). (Tan et al. 2014, 5496.)

Increasing global environment crisis and reduction of natural resources highlights the importance of environmentally- friendly economic growth. With respect to the statistics from the IPCC (intergovernmental panel on climate change) announced that the global average temperature has raised about 0.6 C during the last century. From 2000 to 2010 some indicators of environmental and recourse productivity increased in South Korea. For instance, the Korea’s greenhouse gas emissions productivity face 19.5% increase from 2000 to 2009. It is anticipated by imposed national policies to decrease GHG in Korea, GHG emissions will be decreased by 30% in 2020. With respect to the statistics, in Korea energy efficiency soared by 10.2% between 2000 and 2010. (Ki-Jong 2012, 1, 12-13.)

In the last decade, India has faced with a quick increase in motorization and consumption of automotive industry productions. Congestion and air pollution are the most considerable challenges in metropolitan cities and town in this countries. India highly dependent on other countries in terms of petroleum products. Approximately 70% of needed petroleum consumption is imported from abroad. As a result of this, Indian government is making considerable efforts to substitute an alternative vehicle technology instead of fossil fuel based technology. They recognized that electric vehicle (EV) can be one of the best solutions to overcome the mentioned crisis. (Digalwar 2015, 40.)

Indian government tries to speed up the adaptation and manufacturing of Hybrid and Electric Vehicle (FAME) to prepare better subsidies for EV purchase. In India the transport sector which is based on petroleum and fossil fuel technology produce high share of country’s green gas emissions (GHGs). 87% of India’s CO₂ is produced by movement of vehicles in road transport. Diesel exhaust contains adverse pollutant which cause different diseases such as respiratory irritation, lung cancer and heart diseases. To solve these health issues the best procedure is to transfer from traditional fossil fuel based technology to clean electric vehicles. As a result of this, Indian government commenced the 2020 plan to establish a potential demand for 5 to 7 million EVs comprising light commercial vehicles, buses, two- wheelers and three- wheelers. (Kumar, Anmol & Akhil 2015, 552.)

India entered to the global automobile market as a late comer in the early 1990s. In sharp contrast, over the last decades automotive industry in this country has faced with

tremendous progress because of the attainment of technological capabilities and emersion of urban middle class customers. India has appeared the world's second biggest two-wheelers market just behind the China. Many domestic Indian automotive companies such as Tata motors, TVS motors and Bajaj have tried to change their role from being importer of foreign technology to being product developers. With respect to the shift to electro mobility, India face with some disincentives such as critical electricity short supply, the low purchasing power of urban consumers and shifting to electro mobility and also shifting to electro mobility would increase Carbon emissions because of inappropriate Indian setting. Contrary to these disincentives, the Indian government established a subsidy for procurement of electric two and three wheelers in 2010. Following this proceeding the Indian government established a national mission for electric mobility in early 2011 which included duty exemptions, promising purchase subsidies, government fleet procurements and R&D support for EV projects. (Altenburg, Schamp & Chaudhary 2015, 469-470.)

South Korea sustains the lack of natural resources. Energy security is one of the most fundamental concerns of the Korean government, with respect to the statistics, recently South Korea is the 10th largest country in terms of energy consumption in the world. As a result of this, on 2009 the Korean government declared the green new deal which motivates utilization of green technology by investment in environmental industries to overcome the global financial crisis. This policy entered \$43.5 billion in nine fundamental projects and 27 dependent projects with a goal for creation of 960,000 new job opportunities. In compliance with climate change matters, the Korean government announced its cooperation to Low- Carbon green growth by confirmation a short term target of 30% decrease of GHG by 2020. (Seung- Lee& Min Yu 2012, 7-10.)

During the next two decades, Thailand like the other South- East Asian countries will face with increase in its energy sector because of the population and economic growth. Thailand will rely on energy imports for more than 50% of country's energy supply from abroad. Thailand was among the first pioneers in Asia to introduce incentive policies for the generation of electricity from renewable energy (RE). Thailand has this plan to produce 30% of its total final energy consumption with renewable energy resources by 2030 with respect to "its Alternative Energy Development Plan (AEDP) 2015". Thailand is the member "of the Association of South-East Asian Nations (ASEAN)" together with Indonesia, Malaysia, the Philippines and Singapore. Recently ASEAN has become the sixth

powerful economy in the world with respect to (ASEAN Stats, 2017). (Kanjanaarat&Amin 2017, 11, 17.)

According to Kanjanaarat&Amin (2017, 71, 75) Thailand has considerable energy potential in East Asian countries. In RE map will provide 37% of country's total fuel energy consumption which is more than the government's current target of 30%. Moreover, during the last decade, the automobile industry in Thailand has faced with the considerable development and progress. The government has regulated unique targets encouraging the consumption of biofuels in AEDP 2015 and production of 1.2 million EVs (including BEVs and PHEVs).

3.2.3 *Green technology pioneer in South America*

Brazil is among the most successful growing economies in the world. Brazil one of the countries which are called BRICS (Brazil, Russia, India, China and South Africa). These countries are considered as the recently industrialized countries and they are famous with their large and growing economies and substantial effect on regional and global issues. (Emodio, Bayaraa & Yusuf 2015, 264.)

According to Emodi et al. (2015, 264-265) Brazil is the largest country in the South America both by population and geographical area. Brazil is the world's fifth largest country and the world's ninth most powerful economies by GDP \$1.847 trillion and Purchasing Power Parity (PPP= \$3.456 trillion) in 2019 (World Bank 2020). According to Emodi et al. (2015, 265) for the production of electricity Brazil is highly dependent on hydroelectricity and has access to the highest water resources in the world. During the 2001-2008 the Brazil faced with energy crisis and shortage in power supply because of drought in this period. As a result of this, the Brazilian government established a program to substitute alternative source of electricity power (PROINFA) in 2002. This program targeted to increase the cooperation "of wind power sources and small hydropower systems" which are autonomous independent producers (PIA) for better proficiency in their electricity production process. The prospect of this program was the production of 15% of the annual market growth.

Brazil placed between one of the world's cleanest energy producers. Recently Brazil's energy sectors focus on "sustainable energy" resources that emanate from low-carbon and renewable sources. Brazil is one of the most populous countries by nearly 200 million and country's land area is approximately 2 times bigger than European Union. Unlike the

confrontation with the quick rate of energy demand, Brazil has placed among one of world's cleanest energy mixes. (Luomi 2014, 3.)

Environmental challenges and depletion of natural resources have forced United States, India, China and several European countries such as Norway, Sweden, Netherlands, Germany and UK turn to substitute electric cars as an appropriate alternative to fossil fuel driven automobiles. Brazil is a developing economy in South America which its economic growth has affected the demand for energy. With respect to the statistics, in 2010 Brazil consumed 226 million tons of oil. Brazil is the fifth biggest producer of automobiles in the world. The electric car in Brazil has not given necessary consideration in comparison with countries such as USA, China and India. (Baran & Legey 2012, 908.)

During the last four decades, in Brazil energy sectors and automotive industry have faced with significant with significant innovative advances. One of the most considerable advantages in this country is the observation of the raise of the electric vehicles in the roads. Many different electric vehicles are already produced and commercialized in Brazil. Different types of electric vehicles such as bicycles, small scooters, forklifts, wheel chairs, hybrid electric buses and different types of electric vehicles are allocated for usage in restricted areas. (Nunes 2007, 7-8.)

3.2.4 Green technology pioneer in Africa

South Africa is the seventh coal producer in the world. 77% of South Africa's electricity is produced from coal which causes high level of environmental pollution. South Africa produces highest per capita greenhouse emissions on the continent of Africa (Shilpi Jain&P.K. Jain 2017, 721.). According to Assaff (2014, 80) coal plays a significant role in South Africa's economy. Still the conventional fossil fuel- based energy sources is fundamental source of energy supply. To transform the energy sector in this country in the future the authorities should promote green technologies such as renewable energy technologies, energy efficient technology as well as technologies targeted at producing clean coal.

In early 2008, the South African's government announced the convergence of mass electrification with economic growth in industrial sectors and inadequate estimation about the necessary demand for power in industrial sector. As a result of this, South African's authorities recognized that the lack of concentration on a "structural change" for the en-

ergy policies and substitution of innovative energy sector in South Africa is a considerable challenge in this country. In 2009, Greenpeace and the European Renewable Energy Sector conducted many studies about the potential of South Africa in renewable energy resources. These studies showed that South Africa owns different renewable energy resources such as solar energy, wind energy and wave. (Krupa & Burch 2011, 6255, 6256.)

It is anticipated that South Africa has about 280 TW of solar energy. South Africa ranked among the best solar energy resources in the world. Concentrated Solar Power (CSP) is a simple technology in which solar collectors are applied for storage of solar radiation to gain high temperatures in a heat transfer fluid. In comparison with fossil fuel-based plants, Concentrated Solar Power (CSP) is costly and needs different motivations to make it cost-efficient. However, South Africa has this potential to introduce itself as a prominent global player in Concentrated Solar Power in the future. (Assaf 2014, 82.) According to Shilpi Jain & P.K. Jain (2017, 723-725) the promotion of Renewable Energy (RE) technology by the South African's government goes back to the post-apartheid era. There are number of policy documents which reflect governments commitment to RE technologies for sustainable development such as the 1998 white paper on Renewable Energy (WPRE), 2011 white paper on national climate change response policy (WPNCCRP) and 2011 National Development Plan (NDP). In 2011, according to percentage of GDP South Africa was the fourth largest investor in Renewable Energy in the world. In 2012, renewable energy resources produced 16.9% of total energy consumption which formerly was from the combustion of traditional fossil fuel sources for heating and cooking. South Africa has immense solar energy potential. This country receives high amount of sunshine. In South Africa most areas receive an average 8-10 hours of sunshine per day. The country receives average of 2500 hours per year and 4.5 to 6.6 kWh/m² radiation level. Solar Energy Technology Roadmap (SETRM) tries to produce precise guide to expand the green technologies industry for the local consumption. This program will create manufacturing capabilities and capacity, create job opportunities and elevate expansion of local industry. This program assesses that the country will produce 40 GW of solar PV and 30 GW of CSP (Concentrated Solar Power) by the end of 2050.

Investigating for electrical vehicles (EVs) in South Africa commenced in the early 1970s (during the first oil crisis) at the council for scientific and industrial research (CSIR) where researchers produced LI-Ion and ZEBRA battery technology. Interest in electric vehicles decreased when the fuel crisis diminished. In the 1980s interest was re-

newed again. In 2008, South African electricity public utility (ESKOM) program expanded a number of electric vehicles ranging from e- bikes to a 20- sector game viewing vehicle. The success of automotive industry in South Africa was the motive behind endeavors to develop an e- mobility industry in the country. The South Africa's government started to support the development of electric vehicles industry by containing the commercialization of this type of vehicles in its second industrial policy action plan (IPAP2). This program contained key action programs in the automotive products and medium and heavy commercial vehicles sector. (Dane 2013, 19.)

4 METHODOLOGY

The fourth chapter was conducted to explain the practical procedures to answer the research questions. Firstly author discussed the research approach in this study. Followed by data collection subsection and clarification about the type of data was utilized for reaching to the aim of study. Followed by data analysis subsection and the utilization of different statistical tools for data analysis process. Finally in the last subsection the trustworthiness of secondary data was discussed by author.

4.1 Research approach

Before the start of every scientific research, the aims of research and research question must be finalized. A research approach aims to link the collected data to the research questions. The research method should be considerate and strong enough to sustain critique. Furthermore, the research method should be rational, systematic and compatible with research questions. As a result of this, methodology mentions to the best procedure of research design which applies logical, systematic and consistent research decisions for achievement of valid and reliable findings. (Symeou & Lamprianou 2008, 2.)

Secondary data is every data set which is not collected by the author or the analysis of data collected by the other researcher. In more detailed approach secondary data may include the data that has been previously collected and has been classified in different data banks for the reuse of the other researchers. (Martins&Serra 2018, 2.) There are a lot of secondary data are being gathered and classified by different researchers all around the world for research objectives. The researchers with limited time and resources for their research processes can utilize the secondary data. The most substantial advantage of secondary data analysis are the cost efficiency and tranquility it provides. When reliable secondary data resources are available, researchers are capable to use them for outstanding empirical researches. (Haradhan 2017, 5, 6.)

In conducting study, the area of research and research questions ascertain the utilization of appropriate method for researcher. Secondary data analysis method is a normative method with a procedural and estimation steps. The underlying structure to secondary data analysis method is to apply theoretical knowledge and perceptual competencies to apply available secondary data to reach the research aims. (Johnston 2014, 620.)

This research tries to investigate the trend and development of automobile industry in developing countries from the past to present especially during the last two decades. In detail this study was conducted to analyze the development of automobile industry in developing countries during the last two decades. With respect to the aim of the study and research questions the secondary data analysis method was chosen which is based on numerical or statistical methods. In more detail, in this research author tries to clarify the growth of automobile industry in developing countries such as China, India, Brazil, Mexico, South Korea and Thailand by utilization of analytical approach according to numerical or statistical secondary data resources.

4.2 Data collection

In recent decades, technological advances in all around the world simplified the access of researchers to high amount of data. Nowadays applying existing data for research purposes is becoming wide spread. Analyzing secondary data is flexible and researchers have this ability to maneuver in several ways for the best data analysis. (Johnston 2014, 624.) To reach the objectives of the research the following methodology was conducted. In this study author tries to collect data from different secondary data resources such as OECD Bank, CEIC, World Bank, International Organization of Motor Vehicle Manufacturers. (OICA) and etc.

To determine the trend of automobile industry development in developing countries, access to the different economic indicators which plays a significant role in automobile production is important. In this study author tries to access to the production volume of car industry between 1999 and 2019. In developing countries such as china, India, Brazil, South Korea, Mexico and Thailand. International Organization of Motor Vehicle Manufacturers (OICA) provides world motor vehicle production. OICA provides production statistics by country/region and type of vehicle. Analyzing available data determines the trend of automobile production in different countries especially developing countries which are considered in the study. Different secondary data resources such as OECD bank, CEIC and World Bank provides different economic indicators in various countries such as FDI which enables the researcher to analyze the effect of economic indicators in automobile production in developing countries.

4.3 Data analysis

In This study author tried to analyze the data with the help of statistical tools such as average, percentage, CAGR (Compound Annual Growth Rate), AAGR (Average Annual Growth Rate), correlation coefficient, trend analysis by the help of line charts, bar charts, Pie charts, graphs and etc. following paragraphs justify utilization of each method

CAGR (Compound Annual Growth Rate): compound annual growth rate or CAGR is the mean annual growth rate of an investment or production volume in a specific time period more than one year. It is one of the most precise ways to calculate and determine returns for individual assets, investment portfolios, production volume and anything that can rise or fall in amount in specific time. On the other words, CAGR is a business and investing particular term for the numeral succession that determines a constant rate of return over the specific time period. The most substantial advantages of CAGR over the other arithmetical methods is the consideration of the fluctuations and rate in the specific time period. Compound annual growth rate (Wayman 2019)

AAGR (Average Annual Growth Rate): AAGR is a useful arithmetic tool for determining trends. It can be used in any various financial resources including: revenue profit, production volume, expenses and cash flow to give investors an opinion of which direction is headed for that specific measure. Average Annual Growth Rate (Hayes 2019)

Correlation Coefficient: the correlation coefficient is a statistical measurement which shows the strength of the connection between the relative movements of two variables. The values range between -1.0 and 1.0. An accounted number greater than 1.0 or less than -1.0 means that there is a mistake in the correlation measurement. A correlation of -1.0 illustrates a perfect negative correlation. In sharp contrast, a correlation of 1.0 illustrates a perfect positive correlation. Finally a correlation of 0.0 shows no linear relationship between the movements of two variables. Correlation Coefficient (Ganti& Westfall 2020)

4.4 Trustworthiness

There are many reasons for choosing secondary analysis of an existing data measures rather than plan a new research to gain original data. The most obvious logical reason behind that is the easy access to the data which have been already collected. There is an emerging consensus between researchers that the sharing and analysis of secondary data resources is a substantial strategy for promoting a cumulative and collaborative science. Moreover, analysis of secondary data sets have provided the opportunity for developmental scientists to effectively undertake substantial and challenging research questions that reinterpret, replicate or extend on key findings in the field. (Greenhoot&Dowsett 2012, 4-5.)

Data reliability (DR) is an assumption which every resources especially in management, business, social sciences and basic sciences must be aware of. For increasing data reliability internally a researcher must use as many repeat sample groups as possible to reduce the chance of the existence of an eccentric sample group which distorts the outcomes of study. It means that the researchers with repetition of data analysis process can identify the eccentric sample among their several samples. As a result of this, researchers can increase the reliability of their research process by repeatability and increasing its internal stability. Many researchers such as Shuttleworth highlight that data reliability is the stability, ability and repeatability of results (Shuttleworth 2009.1). For instance, the result of a study can be reliable if consistent results have been achieved by the researcher in different circumstances. Furthermore, researchers have this opportunity to evaluate secondary data reliability by different procedures such as reviewing existing information about the data, which may entail interviewing officials of audited organization, fulfilling simple analysis on the sample of data and reviewing selected system controls. (Oluwaseun, Ibrahim & Abayomi 2019, 30-32.)

5 RESULTS

In this chapter, the data analysis results of the study would be illustrated. Sub- chapter 5-1 tries to answer to the first and second sub- questions of the study. Sub- chapter 5.2 tried to illustrate the data analysis results related to sub- question of the study.

5.1 Data analysis related to first and second sub- questions

In this sub- chapter author tried to analyze the data related to two sub- questions of the study.

SQ1: How have the globalization and FDIs influenced the car industry in developing countries?

SQ2: How the global value chain in automotive industry changed during the last two decades?

As it mentioned in literature review after financial crisis 2008- 2009, the globalization in automobile industry occurred and global integration of automotive industry shifted from couple of specific developed countries to developing countries. In 2018, China produced 29% of total world's production and nominated as the world's super power producer in the world. India produced 6% of total share market in this year and ranked in second place of major automobile producers among developing countries. As a result of this discussion author decided to analyze the data related to these two countries.

First of all, author tried to analyze the data in China as the world's largest automobile producer in the world.

The total volume of automobile industry in China reached more than 25 million units (25,720,625) in 2019. Around 21 million units out of China's automobile production which were passenger cars (21,360,193) units. In this year the Sedan among the passenger vehicles were the most popular passenger car type in China as 2018 with 87.5% of market share. In 2019 only ten percent of passenger vehicles bought were luxury vehicles in China. This percentage has increased from a few years ago. The leading car manufacturer in China was SAIC Motor Corporation with around 29.5 million units production in 2018. Changan Automobile Corporation allocated second place of market share to itself with about 1.5 million unit production and Dongfeng Motor Corporation occupied third place of production share with 1.2 million units produced in 2018. Automotive sales industry in China- Statistics & facts (Wang, 2020)

According to the automotive sales industry in China- statistics&facts (Wong, 2020) the consumption of passenger cars in comparison with mature developed countries is still low. China except the possession of the world's biggest new car market, the used car market is growing rapidly in China with the trade value of used cars more than 953 billion Yuan in 2019. With respect to the statistics, in terms of international car trade the car imports from abroad reached to its peak in 2010 which was about 93 percent after the global financial crisis of 2008- 2009.

.Foreign invested enterprise (FIE) is a very popular method of establishing an operation in Asian countries especially in China. In China each one of legal entities can be noticed FIEs comprising equity joint ventures. In China an equity joint venture is a legal person with restricted liability. In this country this organization is created between Chinese and foreign parties following the ministry of commerce ("MOFCOM"). The law of the People's Republic of China implement regulation for Chinese- Foreign equity joint ventures. Recently China commenced a new plan on January 2017 to simplify its economic system and more adjustment to international standards. Foreign Invested Enterprise (FIE) (Wang, 2018)

In this dissertation author tried to collect the data for analyzing FIE and find out whether the FIE has a correlation with automobile production volume or not. Unfortunately access to the data for last four years was not possible. As a result of this I author decided to analyze the data between 2008 and 2015.

Table 1: Automobile production trends in China (number of vehicles)

cat year	Passenger cars	Annual growth rate %	Light commercial vehicles	Annual growth rate %	Heavy Trucks	Annual growth rate %	Buses and coaches	Annual growth rate %	Grand total	Annual growth rate %
1999	565366	-	1218870	-	38000	-	7717	-	1829953	-
2000	604677	7%	1374489	13%	31000	-18%	7953	3%	2018119	10.2%
2001	703521	16%	1459886	6%	157073	507%	11496	45%	2331976	15.6%
2002	1090820	55%	1661640	14%	416894	265%	81871	712%	3251225	39.4%
2003	2018875	85%	1871111	13%	487000	16.8%	66700	-19%	4443686	36.7%
2004	2316262	15%	2133740	14%	544813	11.3%	78712	18%	5070527	14.1%
2005	3078153	33%	1988912	-7%	563486	4%	77138	-2%	5707689	12.6%
2006	5233132	70%	1380712	-31%	702870	24.7%	195333	253%	7512047	31.6%
2007	6381116	22%	1094097	-21%	878608	25%	242022	24%	8595843	14.4%
2008	6737745	6%	1216747	11%	1066110	213%	447149	185%	9467751	10.1%
2009	10383831	54%	1573546	29%	1704407	60%	129210	-346%	13790994	-346%
2010	13897083	34%	1946820	24%	2259161	32.5%	161697	25%	18264764	32.4%
2011	14485326	4%	1845372	-5%	1923839	-15%	164339	106%	18418776	0.8%
2012	15523658	7%	1874738	2%	1704319	-11.5%	169093	2.9%	19271808	4.6%
2013	18085213	17%	1976279	5%	1882185	10.4%	173148	2.4%	22116825	14.8%
2014	19919795	10%	1870694	-5%	1770109	-6%	162292	-6.3%	23722890	7.3%
2015	21079427	6%	1792788	-4%	1467217	-17%	163894	1%	24503326	3.3%
2016	24420744	16%	1751991	-2%	1756888	19.7%	189171	1504%	28118794	14.8%
2017	24806687	5%	1772800	1%	2251562	28.5%	178385	-5.7%	29015434	3.2%
2018	23529423	-5%	1995776	13%	2130880	-5.4%	153717	-14.2%	27809196	-4.2%
2019	21360193	-9%	2002284	0	2217847	4%	140344	-8.3%	25720665	-7.5%
AAGR	22.4%		3.5%		47.9%		44.3%		15%	
CAGR	19.9%		2.5%		22.5%		15.6%		14.1%	

Source: OICA (compiled by researcher)

The table 1 shows that the Chinese automobile industry produced around 1.83 million vehicles in FY (Financial Year) 1999. During the FY 2019 automotive industry in China produced around 25.72 million vehicles. This comparison shows that automotive production process in China between 1999- 2019 has faced with a very considerable production growth (about 1400%). The automotive industry sector shows AAGR (Average Annual Growth Rate) of 15% and CAGR (Compound Annual Growth Rate) of 14.1% over FY 1999-2019. Heavy trucks vehicle segment was the fastest growing segment indicating CAGR of 22.5% followed by passenger vehicle segment with a CAGR of 19.9 percent, Buses and Coaches segment with a CAGR 15.6% and light commercial segment with a CAGR 2.5% respectively. Passenger vehicles segment calculates for about 83% of the total automobile production in China. In sharp contrast, buses and coaches segment accounts only for 0.5% of the total automobile production in the country. With respect to the OICA (International Organization Of Motor Vehicle Manufacturers) China is the world's first largest producer of automobiles in terms of volume include passenger cars, light commercial vehicles, mini buses, trucks, buses and coaches.

Table 2: FIE and Automobile industry production between 2008 and 2015

FIE		Production			
Year	USD	Passenger cars	Light commercial vehicles	Heavy trucks	Buses and coaches
2008	2,270,375,745	6,737,745	1,216,747	1,066,110	447,149
2009	3,031,782,600	10,383,831	1,573,546	1,704,407	129,210
2010	3,975,685,3000	13,897,083	1,946,820	2,259,161	161,697
2011	4,791,483,200	14,485,326	1,845,327	1,923,839	164,339
2012	5,169,028,200	15,523,658	1,874,738	1,704,319	169,093
2013	4,790,216,200	18,085,213	1,976,297	1,882,185	173,148
2014	5,111,162,000	19,919,795	1,870,694	1,770,109	162,292
2015	16,578,256,800	21,079,427	1,792,788	1,467,217	163,894

Sources: CEIC&OICA

Table 2 represents the FIE in USD and production of automobile (Passenger cars, light commercial vehicles, Heavy trucks and Buses and coaches) in China between 2008 and 2015. These provided data will be analyzed in the following tables

Table 3: Correlation coefficient between FIE and production year to year (2008-2015)

	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8
Row 1	1							
Row 2	1	1						
Row 3	1	1	1					
Row 4	1	1	1	1				
Row 5	1	1	1	1	1			
Row 6	1	1	1	1	1	1		
Row 7	0.999	1	1	1	1	1	1	
Row 8	0.999	0.999	0.999	0.999	0.999	0.999	0.999	1

Row 1 is FIE and production of vehicles (Passenger cars, Light commercial vehicles, Heavy trucks and Buses and coaches) in 2008

Row 2 is FIE and production of vehicles (Passenger cars, Light commercial vehicles, Heavy trucks and Buses and coaches) in 2009

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Row 8 is FIE and production of vehicles (Passenger cars, Light commercial vehicles, Heavy trucks and Buses and coaches) in 2015

With respect to the table 3, we observe that there is a strong positive correlation between the FIE and production (passenger cars, commercial vehicles, heavy trucks & Buses and coaches) of automobile industry from year to year. The analyze of this table, proves that for all the years there is a strong correlation which infers that the previous year figures is the basis for the growth of these aspects in the production of the automobile industry in China.

Table 4:Correlation coefficient between FIE and production (2008-2015)

	Column 1	Column 2	Column 3	Column 4	Column 5
Column 1	1				
Column 2	0.679	1			
Column 3	0.250	0.773	1		
Column 4	-0.158	0.338	0.822	1	
Column 5	-0.275	-0.627	-0.808	-0.740	1

Column 1 is FIE in USD between 2008 and 2015, Column 2 is production of passenger cars between 2008 and 2015, column 3 is production of light commercial vehicles between 2008 and 2015, column 4 is production of Heavy trucks between 2008 and 2015 and finally column 5 is production of Buses and coaches between 2008 and 2015.

Table 4 illustrates that there is positively moderate correlation between the two variables FIE and production of passenger cars 0.679 and there is positively weak correlation between FIE and production of light commercial vehicles 0.250 of automobile industry in China. This table illustrates that there is negative weak correlation coefficient between the two variables FEI, production of heavy trucks -0.158 and production of buses and coaches -0.275 and there is negatively strong correlation between FIE and production of light commercial vehicles – 0.808. In sharp contrast, there is positively strong correlation between two variables, production of heavy trucks and production of light commercial vehicles 0.822 which is a very considerable issue in automobile production in China. Another data analysis proves that production of buses and coaches has a negative correlation with all variables. There is a negative correlation between production of buses and coaches and the other four variables. There is negatively weak correlation between production of buses and coaches, FIE -0.275. There is negatively moderate correlation between production of buses and coaches, production of passenger cars -0.627. Finally there is a negatively strong correlation between production of buses and coaches, production of light commercial vehicles -0.808 and production of buses and coaches, production of heavy trucks -0.740. totally this data analysis proves that the highest FIE in China related to production of passenger cars.

Table 5: correlation analysis between FDI net inflows and total vehicle production

Year	FDI net inflows (USD) X	Total vehicle production (NO of vehicles) Y	Coefficient of correlation between X and Y
2000	42,095,000,000	2,018,119	r= 0.781
2001	47,053,000,000	2,331,976	
2002	53,074,000,000	3,251,225	
2003	57,901,000,000	4,443,686	
2004	68,117,000,000	5,070,527	
2005	104,109,000,000	5,707,689	
2006	124,082,000,000	7,512,047	
2007	156,249,000,000	8,595,843	
2008	171,535,000,000	9,467,751	
2009	131,057,000,000	13,790,994	
2010	243,703,000,000	18,264,764	
2011	280,072,000,000	18,418,776	
2012	241,214,000,000	19,271,808	
2013	290,928,000,000	22,116,825	
2014	268,097,000,000	23,722,890	
2015	242,489,000,000	24,503,326	
2016	174,750,000,000	28,118,794	
2017	166,084,000,000	29,015,434	
2018	203,492,000,000	27,809,196	

Sources: World Bank&OICA

In table 5 FDI net flows taken as “X” and total production by automobile industry is taken as “Y”. Table 3 illustrates that during 2000-2018, “r” is the coefficient or correlation between X and Y which is 0.781. This number shows a high degree of positive correlation between the two variables.

With respect to the statistics, during the last two decades especially after the economic crisis 2008- 2009 in USA, China met a considerable development in automobile production. In this part author tries to compare total car production in China with two major producers include USA and Japan.

Table 6: car production in China, USA and Japan between 2007 and 2019

Year	China	USA	Japan
2007	9,882,456	10,780,729	11,596,327
2008	9,299,180	8,672,144	11,575,644
2009	13,790,994	5,709,431	7,934,057
2010	18,264,761	7,743,093	9,628,920
2011	18,418,776	8,661,535	8,398,630
2012	19,271,808	10,335,765	9,943,773
2013	22,116,825	11,066,432	9,630,181
2014	23,731,600	11,660,702	9,774,665
2015	24,503,326	12,100,095	9,278,238
2016	28,118,794	12,198,337	9,204,590
2017	29,015,434	11,189,985	9,693,796
2018	27,879,809	11,314,705	9,728,528
2019	25,720,665	10,880,019	9,684,298

Source: OICA

Table 6 shows the total car production in China, USA and Japan between 2007 and 2019. With respect to the statistics from the table, in 2007 which was before the economic crisis 2008- 2009 both USA and Japan produced more than China as an emerging producer in automobile industry. In 2008 Chinese automobile producers surpassed USA by production of 9,299,180 approximately 627,000 vehicles more than USA. 2009 was the turn point for the automobile industry in China. In 2009 Chinese automobile producers produced 13,790,994 vehicles which was approximately 240% more than USA automobile producers by production of 5,709,431 vehicles and 174% more than Japanese producers by total car production of 7,934,057 vehicles. 2009 was the end of sovereignty of USA and Japan in automotive industry and emersion of China as a new superpower in automobile industry.

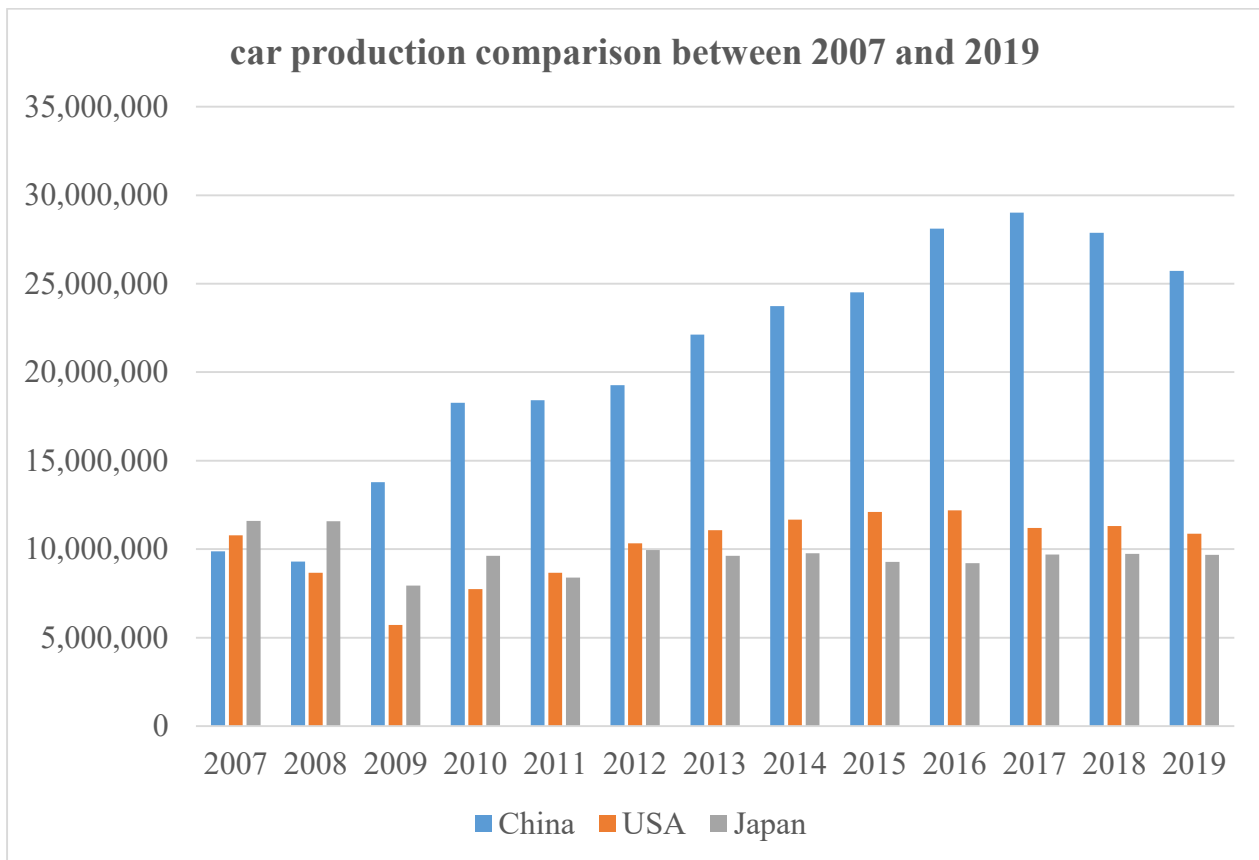


Figure 4: Car production comparison between 2007 and 2019 (source: OICA)

This bar chart (car comparison production between 2007 and 2019, OICA) illustrates the comparison of total car production in USA, Japan and China between 2007 and 2009. The statistics represent that the total car production in USA in 2009 because of financial crisis dropped to its lowest amount (total car production of 5,709,431). On the other hand, total car production in China between 2007 and 2019 slightly increased where it reached to its peak in 2017 (total production of 29,015,434 vehicles). In comparison with China and USA, Japan faced with less ups and down in their production volume.

Table 7: automobile sale trend in China (number of vehicles)

Category Year	Passenger cars	Annual growth rate %	Commercial vehicles	Annual growth rate %	All vehicles	Annual growth rate %
2005	3,971,101	-	1,787,088	-	5,758,189	-
2006	5,175,961	30%	2,040,011	14.2%	7,215,972	25.3%
2007	6,297,538	21.7%	2,493,990	22.3%	8,791,528	21.8%
2008	6,755,609	7.3%	2,624,893	5.2%	9,380,502	6.7%
2009	10,331,315	52.9%	3,313,479	26.2%	13,644,794	45.5%
2010	13,757,794	33.2%	4,304,142	29.9%	18,061,936	32.4%
2011	14,472,416	5.2%	4,032,698	-6.3%	18,505,114	2.5%
2012	15,495,240	7%	3,811,195	-5.5%	19,306,435	4.3%
2013	17,927,730	15.7%	4,056,349	6.4%	21,984,079	13.9%
2014	19,707,677	9.9%	3,791,324	-6.5%	23,499,001	6.9%
2015	21,210,339	7.6%	3,451,263	-9%	24,661,602	4.9%
2016	24,376,902	14.9%	3,651,273	5.8%	28,028,175	13.6%
2017	24,718,321	1.4%	4,160,583	14%	28,878,904	3%
2018	23,709,782	-4.1%	4,370,795	5%	28,080,577	-2.8%
2019	21,444,180	-9.6%	4,324,497	1.1%	25,768,677	-8.2%
AAGR	13.79%		7.3%		12.1%	
CAGR	12.8%		6.5%		11.3%	

Source: OICA (Compiled by researcher)

The table 7 represents that the Chinese automobile industry around 5.7 vehicles in FY (Financial Year) 2005. During the FY 2019 automotive industry in China sold around 25.7 million vehicles. This comparison proves that the automotive sales process during this period met a considerable growth rate (about 448% growth rate). The automotive sales sector shows AAGR (Average Annual Growth Rate of 12.1% and CAGR (Compound Annual Growth Rate) of 11.3% over FY 2005-2019.

Table 8: FIE and automobile industry sale in China between 2008 and 2015

FIE		Sale	
Year	USD	Passenger cars	Commercial vehicles
2008	2,270,375,745	6,755,609	2,624,893
2009	3,031,782,600	10,331,315	3,313,479
2010	3,975,685,300	13,757,794	4,304,142
2011	4,791,483,200	14,472,416	4,032,698
2012	5,169,028,200	15,495,240	3,811,195
2013	4,790,216,200	17,927,730	4,056,349
2014	5,111,162,000	19,707,677	3,791,324
2015	16,578,256,800	21,210,339	3,451,263

Source: CEIC&OICA (compiled by researcher)

Table 8 represents the FIE in USD and automobile industry sale includes (passenger cars and commercial vehicles) between 2008 and 2015. This provided data will be analyzed in the following table.

Table 9: Correlation coefficient between FIE and Sale (2008-2015)

	Column 1	Column 2	Column 3
Column 1	1		
Column 2	0.694	1	
Column 3	0.013	0.543	1

Column 1 is FIE in USD between 2008 and 2015, column 2 is sale of passenger cars between 2008 and 2015 and finally column 3 is sale of commercial vehicles between 2008 and 2015.

Table above illustrates that there is moderately positive correlation between two variables FIE, sale of passenger cars 0.694. This table also shows there is a positively weak correlation between two variables FIE, sale of commercial vehicles 0.013 while there is a moderately positive correlation between two variables sale of passenger cars, sale of commercial vehicles 0.543

Table 10 : Correlation analysis between FDI net inflows and total vehicle sale

Year	FDI net outflows X	Total vehicle sale (NO of vehicle) Y	Coefficient of correlation between X and Y
2005	13,730,000,000	5,758,189	r=0.828
2006	23,932,000,000	7,215,972	
2007	17,155,000,000	8,791,528	
2008	56,742,000,000	9,380,502	
2009	43,890,000,000	13,644,794	
2010	57,954,000,000	18,061,936	
2011	48,421,000,000	18,505,114	
2012	64,963,000,000	19,306,435	
2013	72,971,000,000	21,984,079	
2014	123,130,000,000	23,499,001	
2015	174,391,000,000	24,661,602	
2016	216,424,000,000	28,028,175	
2017	138,293,000,000	28,878,904	
2018	96,472,000,000	28,080,577	

Sources: world Bank & OICA (compiled by researcher)

In table 10 FDI net outflows taken as “X” and total sale by automobile industry in China as “Y”. Table 7 represents that during 2005-2018, “r” is the coefficient of correlation between X and Y which is 0.828. This figure proves that there is positively strong correlation between two variables.

In recent years, many countries such as USA and EU countries have identified India as a suitable location for FDI. “Rapidly growing economy, low wages, and educated workforce in the services” sectors and production lines convinced investors for more investment in this growing market and more FDI by investors from different developed countries. Foreign inflows (FDI) is highly expected to carry on growing market and more FDI by investors from different developed countries. This is because the faster economic of India at a faster speed in comparison with most emerging economies. Manly global automobile manufacturers are searching for locations with lower operation costs. As a result of this, India has this potential and attract more FDI because a lot of automobile

producers are using Indian operations to fulfill global desires. (Lavanya, Kumar & Reddy 2017, 31.)

1940's was the turn point for emersion of automobile industry in India. After a decade Indian government and local entrepreneurs have increased endeavors to create a production industry. The partial liberalization of 1980s and enactment of new economic policy in 1991 guided the industry on the fast track of development. Following this many international producers initiated joint ventures with Indian companies. Many foreign companies such as GM (General Motors), Ford and Daewoo started local operations in India. In 2002, the Indian government regulated an automobile policy that targeted at production of Indian automotive industry with higher financial motivations for R&D (Research and Development). The top Indian automotive manufacturers are Tata motors, Maruti Suzuki, Hyundai, General Motors India, Toyota Kirlaskar Motors, Skoda Auto India, Ashok Leyland, Mahindra&Mahindra, Eicher, Bajaj, Honda, Ford Indian, and Fiat Indian. The largest target market of India's automobile comprise United Kingdom, followed by Italy, Germany, Netherlands and South Africa. (Singh 2017, 6.)

Table 11: automobile production in India (source: OICA)

Cat Year	Passen- ger cars	Annual growth rate %	Light com- mercial vehi- cles	Annual growth rate %	Heavy trucks	Annual growth rate %	Buses and coaches	Annual growth rate %	Grand total	Annual growth rate %
2007	1,713,479	-	249,834	-	245,996	-	44,420	-	2,253,729	-
2008	1,829,677	6.8%	239,702	-4%	201,182	-18.2%	44,101	-0.7%	2,314,662	-2.7%
2009	2,175,220	18.9%	269,450	12.4%	154,878	-23.1%	42,002	-4.8%	2,641,550	14.1%
2010	2,831,542	30.2%	395,253	46.7%	275,662	78%	54,616	30%	3,557,073	34.7%
2011	3,053,871	7.9%	510,217	29%	325,775	18.2%	50,328	-7.9%	3,940,191	10.8%
2012	3,296,240	7.9%	553,048	8.4%	270,519	-17%	54,906	9%	4,174,713	6%
2013	3,138,988	-4.8%	515,708	-6.8%	182,601	-32.5%	43,641	-21.5%	3,880,938	-7%
2014	3,158,215	0.6%	433,310	-16%	204,578	12%	44,057	0.9%	3,840,160	-1%
2015	3,378,068	7%	427,234	-1.4%	267,224	30.6%	53,223	20.8%	4,125,749	7.4%
2016	3,677,605	8.9%	465,597	9%	293,657	9.9%	52,106	-2.1%	4,488,965	8.8%
2017	3,952,550	7.5%	504,116	8.2%	283,838	-3.4%	42,392	-18.6%	4,782,896	6.5%
2018	4,064,774	2.8%	663,193	31.5%	407,056	43.4%	39,662	-6.5%	5,174,685	8.2%
2019	3,623,336	-11%	571,428	-14%	276,921	-32%	44,332	11.8%	4,516,017	-22.7%
AAGR	6.9%		8.6%		-1.8%		0.9%		5.3%	
CAGR	6.4%		7.1%		0.01%		0		6%	

Table 11 illustrates that the Indian automobile industry produced around 2.25 million vehicles in FY (Financial Year) 2007. During the FY 2019 Indian automobile industry produced around 4.5 million vehicles. The data analysis shows that automobile production process in India during 2007- 2019 has faced with a very considerable production growth (about 200%).

The automobile industry sector in India shows AAGR (Average Annual Growth Rate) of 5.3% and CAGR (Compound Annual Growth Rate) of 6% over financial year 2007-2019. Light commercial vehicle segment was the fastest growing segment indicating CAGR 7.1% followed by passenger cars segment with a CAGR of 6.4%. In sharp contrast, heavy trucks segment, Buses and coaches segment faced with very slow (CAGR 0.01%) and CAGR 0% respectively. India's automotive industry is the world's sixth largest producer of automobile in terms of volume and value, also with 6% the world's automobile production in 2018 is ranked in second place among developing countries after China.

Table 12: FDI net inflows in automotive industry and production in India (2007-2018)

FDI net inflows in automotive industry		Production			
Year	USD	Passenger cars	Light commercial vehicles	Heavy trucks	Buses and coaches
2007	178,740,000	1,713,479	249,834	245,996	44,420
2008	577,139,040	1,829,677	239,702	201,182	44,101
2009	776,420,160	2,175,220	269,450	154,878	42,002
2010	689,698,080	2,831,542	395,253	275,662	54,616
2011	471,200,280	3,053,871	510,217	325,775	50,328
2012	717,572,040	3,296,240	553,048	270,519	54,906
2013	1,080,243,360	3,138,988	515,708	182,601	43,641
2014	1,636,194,000	3,158,215	433,310	204,578	44,057
2015	2,222,491,320	3,378,068	427,234	267,224	53,223
2016	1,777,044,360	3,677,605	465,597	293,657	52,106
2017	1,470,606,720	3,952,550	504,116	283,838	42,392
2018	2,011,522,920	4,064,774	663,193	407,056	39,662

Source: CEIC&OICA (compiled by researcher)

Table 12 represents FDI net inflows in automotive industry and production of automotive industry includes (passenger cars, light commercial vehicles, Heavy trucks and Buses and coaches in India between 2007 and 2018. These data will be analyzed in the next table.

Table 13: Correlation coefficient between FDI and production (2007-2018)

	Column 1	Column 2	Column 3	Column 4	Column 5
Column 1	1				
Column 2	0.755	1			
Column 3	0.517	0.898	1		
Column 4	0.340	0.625	0.684	1	
Column 5	-0.055	0.101	0.076	0.146	1

Column 1 is FDI net inflows in automotive industry in India between 2007 and 2018, column 2 is production of passenger cars in India between 2007 and 2018, column 3 is production of light commercial vehicles in India between 2007 and 2018, column 4 is production of Heavy trucks in India between 2007 and 2018 and finally column 5 is production of Buses and coaches in India between 2007 and 2018.

Table 13 illustrates that there is a positively strong correlation between the two variables FDI, production of passenger cars 0.755. It means that FDI has a positive effect on production of passenger cars in India. Also there is a positively strong correlation between the two variables production of passenger cars, production of light commercial vehicles 0.898. There is positively moderate correlation between two variables FDI, production of light commercial vehicles 0.517 and production of heavy trucks 0.340.

There is positively moderate correlation between two variables production of heavy trucks, production of passenger cars 0.625 and production of light commercial vehicles 0.684. The production of buses and coaches has a weak correlation with all different variables which is one of the significant findings of the section's data analysis. Totally the data analysis of this part highlights that there is a strong positive correlation between FDI inflows and production of passenger cars.

Table 14: FDI net inflows and production coefficient correlation in India

Year	FDI net inflows in automotive industry (USD) X	Total vehicle production (number of vehicles) Y	Coefficient of correlation between X and Y
2007	178,740,000	2,253,729	r=0.719
2008	577,139,040	2,314,662	
2009	776,420,160	2,641,550	
2010	689,698,080	3,557,073	
2011	471,200,280	3,940,191	
2012	717,572,040	4,174,713	
2013	1,080,243,360	3,880,938	
2014	1,636,194,000	3,840,160	
2015	2,222,491,320	4,125,749	
2016	1,777,044,360	4,488,965	
2017	1,470,606,720	4,782,896	
2018	2,011,522,920	5,174,685	

Source: OICA&CEIC (compiled by researcher)

In table 14 FDI net inflows in automotive industry taken as “X” and total production by automobile industry in India is taken as “Y”. Table 10 represents that during 2007-2018, “r” is the coefficient of correlation between X and Y which is 0.719. This figure proves that there is positively strong correlation between two variables. In the other words, Foreign Direct investment net inflows in automotive industry in India has a positive effect on automobile production process in India.

Table 15: Total car production in USA, Japan and Germany between 2007 and 2019

Year	USA	Japan	Germany	Total Production
2007	10,780,729	11,596,327	5,709,139	28,086,195
2008	8,672,144	11,575,644	5,532,030	25,779,818
2009	5,709,431	7,934,057	4,964,523	18,608,011
2010	7,743,093	9,628,920	5,552,409	22,924,422
2011	8,661,535	8,398,630	5,871,918	22,932,083
2012	10,335,765	9,943,773	5,388,459	25,667,997
2013	11,066,432	9,630,181	5,439,904	26,136,517
2014	11,660,702	9,774,665	5,604,028	27,039,395
2015	12,100,095	9,278,238	5,707,938	27,086,271
2016	12,198,337	9,204,590	5,764,808	27,167,735
2017	11,189,985	9,693,796	5,645,581	26,529,362
2018	11,314,705	9,728,528	5,120,409	26,163,642
2019	10,880,019	9,684,298	4,661,328	25,225,645

Source: OICA (compiled by researcher)

Table 15 illustrates the total production of three major automobile producers in developed countries include USA, Japan and Germany. The data analysis from this table proves that the total production of these three countries was in its peak in 2007 (28,086,195 vehicles). After 2007 the total production of these three developed producers slightly decreased while it never surpassed their production volume in 2007 and even reached to this volume of vehicle production. It proves that financial crisis 2008-2009 had a significant negative effect for major automobile producers in developed countries.

Table 16: Total car production in China, India and South Korea between 2007 and 2019

Year	China	India	South Korea	Total production
2007	9,882,456	2,253,729	3,723,482	15,859,667
2008	9,299,180	2,314,662	3,450,478	15,064,320
2009	13,790,994	2,641,550	3,158,417	19,590,961
2010	18,264,761	3,557,073	3,866,206	25,688,040
2011	18,418,776	3,940,191	4,221,617	26,580,584
2012	19,271,808	4,174,713	4,167,089	27,613,610
2013	22,116,825	3,880,938	4,122,604	30,120,367
2014	23,731,600	3,840,160	4,124,116	31,695,876
2015	24,503,326	4,125,749	4,135,108	32,764,183
2016	28,118,794	4,488,965	3,859,994	36,467,753
2017	29,015,434	4,782,896	3,735,399	37,533,729
2018	27,879,809	5,174,685	3,661,730	36,716,224
2019	25,720,665	4,516,017	3,612,587	33,849,269

Source OICA (compiled by researcher)

Table 16 represents the total production of three major automobile producers in developing countries include China, India and South Korea. In 2007 these three countries produced about 15.86 million vehicles. After 2007 and specifically 2008 the total production of vehicles in these three major producers in emerging economies sharply increased while it reached to its peak in 2017 (approximately 37.53 million vehicles). This data analysis proves that financial crisis 2008-2009 increased the volume of automobile production in developing countries and showed its positive effects to automotive industry in developing countries.

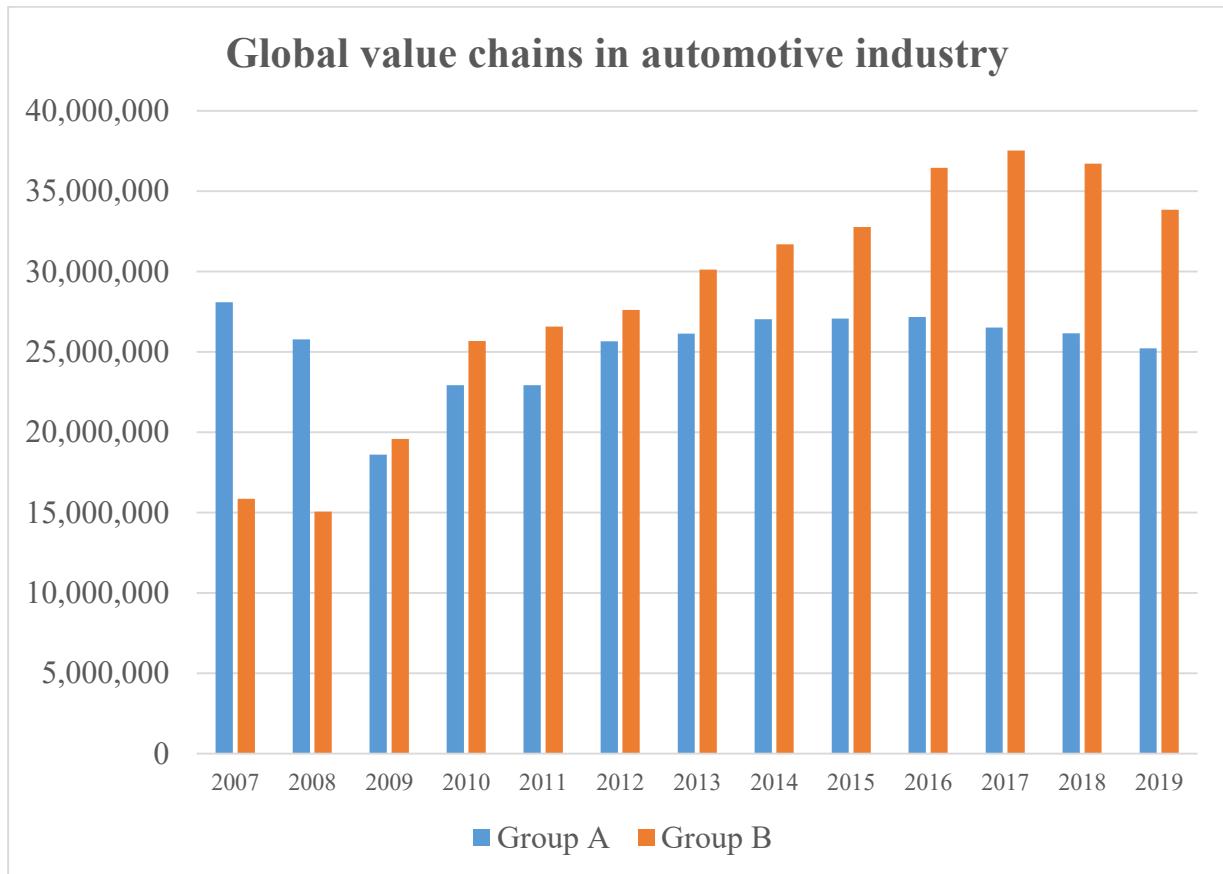


Figure 5: changes to global value chains in automotive industry (sources OICA)

In figure 5 total production of car industry in three major developed car producer in developed countries include USA, Japan and Germany taken as "Group A" and total production of car industry in three major car producer among developing countries include China, India and South Korea taken as "group B". This line chart illustrates that in 2007 and 2008 Group A produced more than group B. 2009 was a turn point for the production process of car industry in group B and they surpassed the Group A. This data analysis proves that the economic crisis 2008-2009 played a significant role in changes of global value chains in automotive industry and created opportunities for developing countries such as China and India to introduce themselves as a major global producer in in automotive industry.

5.2 Electric vehicles sale growth in developing countries

As it is highlighted in the literature review section that progress of new technologies and innovations in some of developing countries help to decrease the global climate change and greenhouse gases emissions. In this section author tries to analyze the available data related to developing countries. As it is mentioned in literature review China produces the world's largest amount of Carbon dioxide. As a result of this in 2010, the Chinese authorities tried to promote the consumption of electric vehicles (EVs) as a beneficial substitution instead of fossil fuel vehicles.

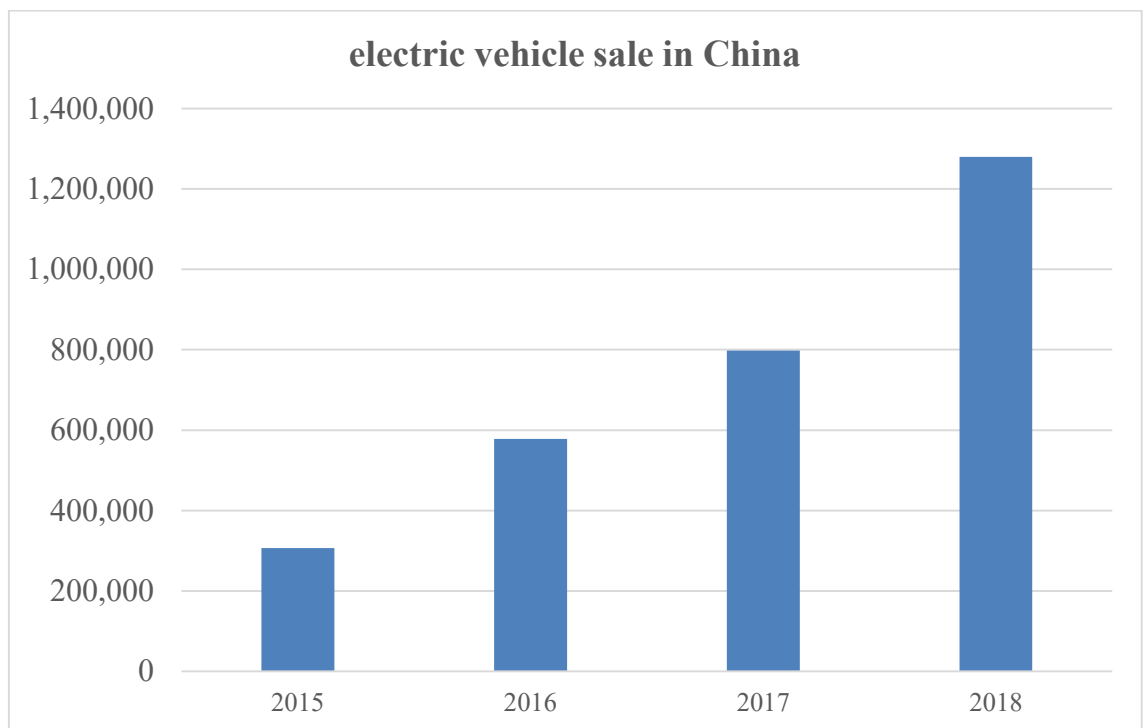


Figure 6: Electric vehicle sale in China (source: Mordor intelligence)

Figure 6 (bar chart) illustrates the volume of electric vehicles (Evs) sale in China between 2015 and 2018. With respect to the data, in 2015 the Chinese electric vehicle manufacturers sold about 307,000 vehicles while this number reached to its peak in 2018 about 1,280,000 electric vehicles. Comparison between these two figures determines that between 2015 and 2018 sale of electric vehicles in China faced with a very considerable growth (about 416%).

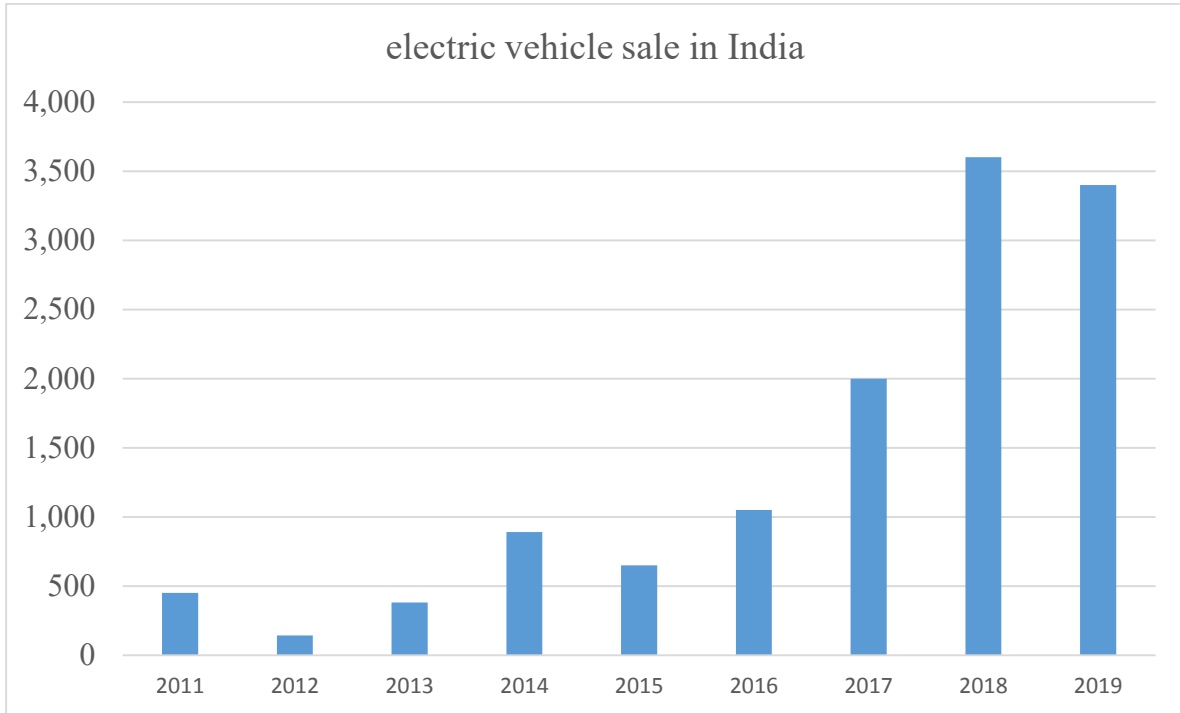


Figure 7: Electric vehicle sale in India between 2011 and 2019 (source: BNEF)

Figure 7 (bar chart) illustrates the amount of electric vehicle sale between 2011 and 2019. The data analysis shows the fluctuation in process sale of electric vehicles in India between 2011 and 2019. Despite these fluctuations the total sale of electric vehicles in 2011 was about 450 vehicles while it reached to its peak in 2018 about 3600 vehicles (approximately 800% growth). The data analysis of electric vehicles between 2011 and 2019 proves the trend of electric vehicles consumption in India shifts to the considerable growth.

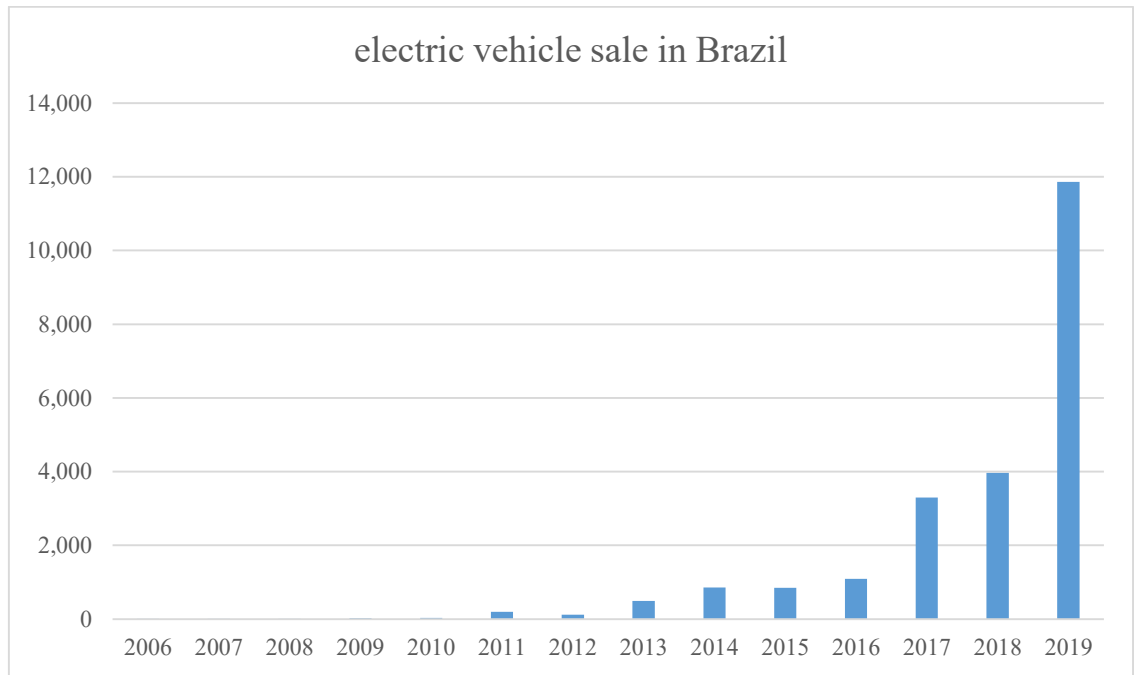


Figure 8: electric vehicle sale in Brazil between 2006 and 2019 (source: Statista)

Figure 8 (Bar chart) illustrates the sale of electric vehicles in Brazil between 2006 and 2019. During this period the sale of electric vehicle in Brazil sharply increased. In 2006 the automobile manufacturers only sold 3 vehicles while this figure reached to its peak in 2019 (about 11,858 vehicles). The comparison between these two figures proves that the sale of electric vehicles during this period faced with a considerable growth and the people in Brazil

6 CONCLUSION

This study tried to investigate the trend and development of automobile industry from the past to present. With respect to the aim of the study and research questions, the literature review conducted to obtain necessary information about the automotive industry background during this period. One of the most effective economic occurrence which had a significant effect in the automotive industry in all around the world was economic crisis 2008-2009. The global financial crisis during 2008- 2009 affected automotive industry more than any other industry. The global financial crisis negatively affected automobile sales in both USA and Europe where automobile production plummeted in both region dramatically.

In sharp contrast, the financial crisis had a different effects for developing countries. As a result of this circumstance, the shift of production from developed countries to developing countries speeded up. Since the late 1980, large multinational had increased their Foreign Direct Investment (FDI) in developing countries. The FDI refers to its significant effect on the productivity of receiving countries.

As a result of this discussion, after financial crisis 2008-2009 the stream of FDI by developed countries into developing countries increased. In this era, development of new technologies and producers, particularly in some developing countries which having experience rapid economic growth.

In the following of discussion, to determine the trend of automotive industry development in developing countries author decided to analyze the data with the help of statistical tools such as average, percentage, CAGR (Compound Annual Growth Rate), AAGR (Average Annual Growth Rate), correlation coefficient, trend analysis with the help of line charts, bar charts, pie charts, graphs and etc.

In data analyze section author tried to analyze the data related to the most powerful automobile producers among developing countries, China and India. The findings of this data analysis were very considerable. The automotive production process in China between 1999 and 2019 has faced with a very considerable production growth (about 1400%). With respect to the OICA (International Organization of Motor Vehicle Manufacturers) China is the world's first largest producer of automobiles in terms of volume. With respect to the data analysis Foreign Direct Investment net inflows had a high degree of positive correlation with total vehicle production in this country.

As it was mentioned before the financial crisis 2008-2009 transformed the Global Value Chains (GVCs) in the automobile industry. With respect to the data analysis from 2009 to present major automobile producers in developing countries such as China, India and South Korea surpassed the major car producers in developed countries such as USA, Japan and Germany in terms of total automobile production. Finally data analysis related to the electric vehicles (EVs) sale in developing countries proves that this process faced with a considerable growth during the last two decades.

For future studies in this field, researchers may concentrate more on job opportunities which can create this industry as one of the robust industries for the people of populous developing countries such as China, India, Brazil and Thailand. Moreover, automotive industry may be seen as a stimulus industry for development and growth of the other industries which are tightly related to the automotive industry.

7 SUMMARY

To sum up, the automotive industry is a major industry which plays a significant role for development and economic growth of different countries in all around the world. With respect to different statistics, the country with more developed automobile industry allocate the higher share of the world's GDP to itself. The automotive industry is human capital intensive and technologically advanced.

The purpose of the study was to investigate the development of automotive industry in developing countries during the last two decades. To achieve the study aim, three different sub-questions were designed. One revealing the role of globalization and FDI in growth of automotive industry in developing countries. One to reveal the change of global value chain in the automotive industry during the last two decades and finally to investigate the adaptation of the automotive industry to green technology in developing countries.

The initial framework of the study was constructed from the existing literature in the field. Globalization in automotive industry is a fundamental factor in several trend. Globalization in automotive industry increased Foreign Direct Investment (FDI) in developing countries. Global automakers try to build new assembly plants in countries which are open to foreign direct investment such as China, India, Brazil, South Korea and etc.

The automotive manufacturers identified that the populous developing countries with rapid growing market have potential for establishment of automotive factories with high skilled workforce and cheap production lines which will result in qualified products.

During the last two decades, the Global Value Chains (GVCs) in automotive industry faced with a considerable transformation. The global financial crisis during 2008- 2009 affected automotive industry more than any other industry. Financial crisis 2008-2009 had a positive effect in the automotive industry in developing countries. This occurrence shifted the automotive industry from a couple of major automobile producers among developed countries such as USA and EU countries to populous developing countries with a high skilled workforce and notable industrial potential such as China and India.

This transformation in the Global Value Chains (GVCs) in automobile industry resulted in the introduction of some developing countries such as India and South Korea as major producers and especially China as a most powerful car producer in the universe.

In 2019, China is nominated as the most powerful automobile producer in the world with more than 25 million total vehicle production.

In this era, rapid economic growth in some populous developing countries such as China, India, Brazil Mexico and Thailand provided this opportunity for these countries to progress in innovative activities and considerable advancement in the green technologies industries.

Global climate change has devastating effects for the world especially in coastal and tropical region of developing countries. As a result of this, developing countries are more passionate to mitigate climate change and its negative effects by development of different green technologies in their countries.

In this study, the secondary data analysis method was applied which is based on numerical or statistical methods. In this research data was collected from different secondary data resources such as OECD Bank, CEIC, World Bank, International Organization of Motor Vehicle Manufacturers (OICA), Statista and etc.

In this study, the author tried to analyze the data with the help of statistical tools such as average, percentage, CAGR (Compound Annual Growth Rate) AAGR (Average Annual Growth Rate), correlation coefficient, trend analysis with the help of line charts, pie charts and graphs.

Results from data analysis showed that automotive production process in developing countries faced with a substantial growth. For instance, China in Financial Year (FY) 1999 produced around 1.83 million vehicles which produced around 25.72 million vehicles. The comparison between two figures illustrates that automotive production process in China between 1999 and 2019 has faced with a very considerable production growth (about 1400%). The automotive industry sector in China shows AAGR (Average Annual Growth Rate) of 15% and CAGR (Compound Annual Growth Rate) of 14.1% over FY 1999-2019. These figures prove a considerable production growth in automotive industry in China during the last two decades.

The automobile industry analysis in India shows the similar situation in China. The automobile industry in this country produced around 2.25 million vehicles in FY (Financial Year) 2007 while during the FY 2019 Indian automobile industry produced around 4.5 million vehicles. The data analysis shows that automobile production process in India during 2007-2019 has faced with a very considerable production growth (about 200%)

Data analysis illustrates that Foreign Direct Investment (FDI) net inflows have a positive correlation coefficient with production of automobile industries in developing countries. In more details, FDI has a positive effect for the production of automotive industry especially passenger cars.

Economic crisis 2008- 2009 played a substantial role in changes of global value chains (GVCs) in the automotive industry and created opportunities for developing countries such as China and India to introduce themselves as a major global producer in the automotive industry.

The introduction of new technologies and innovations in some of developing countries help to decrease the global climate change and greenhouse gas emissions. As a result of this, the consumption and sale of electric vehicles (EVs) in growing economies such as Brazil, India and China sharply increased especially during the last decade.

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APPENDIX