Impact of the Latest Trends in Automotive Engineering on Micro and Macroeconomics

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ABSTRACT:

The automotive engineering sector has often been dubbed as the powerhouse of economic development in the world. Not only does this sector make significant contributions to a nation's gross domestic product, but it also channelizes related changes in every other miscellaneous sector even remotely related to it. The history of automotive engineering so far has seen progressive growth over the years. Certain latest trends are in process and are likely to change this industry's face in the next ten years. All such factors and related case studies are explored in this paper.

KEYWORDS:

Automotive, Economics, GDP, Electric, Autonomous, Industry

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INTRODUCTION:

Automotive engineering forms a massive branch of applied science that deals with the design, development, and manufacture of vehicles plying the ground. It is one of the required engineering fields that play a significant role in the nation's GDP besides affecting international economics on a vast scale.

Therefore, vehicle development follows stringent regulations, and it is the interdisciplinary optimization phase that is subject to multiple design criteria. Often, such design criteria can conflict with others as well. The development of a new vehicle or modification of an existing model is subject to standards such as:[1]

- Safety
- Fuel consumption
- Durability
- Crashworthiness
- Ergonomics
- Handling
- Aerodynamics
- NVH concepts

With progressive advancement in terms of technology and attention towards environmental compliance, one can observe newer developments in the automotive engineering segment. Several revolutionary vehicle concepts have now seen reality, and these include hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV), and full electric vehicle (FEV), all having a different powertrain and battery charging system.

It is safe to say that automobile engineering and manufacturing giants play a significant role in the nation and the world's economy.

- ✓ The automotive industry churns out approximately 60 million cars and trucks each year.
- ✓ The automotive industry employs roughly 4 million people directly and several others indirectly.

The automotive engineering industry found its roots in Germany and France, and later, mass production also started in the USA. The segment has been growing ever since, providing employment to millions and making for a sizable portion of the economy.

A good example would be that of Volkswagen. As per a 2015 report, VW made the following contributions to America's economy:

- It contributed $2.4 billion to taxes (federal, state, and local).

[1] Behzad Saberi, May 2018, The role of the automobile industry in the economy of developed countries.

- The automotive company also provided more than $7.1 billion in employee compensation, resulting in a $24.8 billion US economic gross output.

Therefore, in such a scenario, the automotive engineering industry's latest developments can further economic growth if implemented correctly, a flawless management and supply chain.[2]

TABLE 1: The contribution of macroeconomic parameters to the GDP of the leading countries in 2017

PARAMETERS	USA	JAPAN	GERMANY	SOUTH KOREA
Share of GDP in the world economy	24.42	5.6	4.57	1.85
Percentage of the automotive industry in the world population	12.3	10	6	4.9
% share of the automotive industry in GDP	12	12	14	10
Country's % share in the export of goods	9.1	3.8	8.1	3.1
Commodity exports (in billions)	1504,9	624,9	1329,5	526,8
The volume of exports and machinery and transport equipment (billions)	666,9	400,6	729,6	315,1
The volume of export of cars (billions)	53,8	91,9	151,9	37,5
Number of employees in the automotive	870	803	807	320

[2] Behzad Saberi, May 2018, The role of the automobile industry in the economy of developed countries.

industry (in thousands)				
%Share of industry in GDP	19.9	26.6	32.5	39.7

Automobile Engineering Industry: An Evolving Sector

The automobile industry has been rightfully cited as the most remarkable economy engine in the entire world. In the span of 1995 to 2005, the industry was growing at a rate of 30% each year. Hence, it plays a significant role in the economy and can considerably alter the dynamics of micro and macroeconomics.

Auto and auto parts engineering is such a sought-after field because it has a direct impact on multiple other sectors, thereby contributing to a sizable portion of the economy.

Considering that an average of 60 million cars is manufactured each year, this means that over 9 million people are employed in the process directly to manufacture. This corresponds to around 5% of the total world employment.

However, there are several routes of indirect employment too. As per data, each direct job in the automotive industry is connected to 5 other indirect jobs. Hence, a chain reaction analogy can be brought here, leading to an overall 50 million jobs alone in the auto sector.

A simple way to understand this concept would be to consider some of the raw materials needed to manufacture a car. These are:

- Steel[3]
- Iron
- Aluminium
- Glass
- Plastic
- Carpeting
- Computer chips
- Engine control unit
- Software
- Textiles
- Rubber
- Battery etc.

[3] Bojan Georgievski, Anas Alqudah, Jan, 2016, The Effect of the Volkswagen Scandal: A Comparative Case Study

Thus, the manufacture of one car is direct and indirect engagement of several industries, thus keeping healthy cash flow and liquidity in the world economy.

Case Studies to Highlight the Impact of Automotive Engineering Industries on the Economy:

In the United States of America, the retail of auto and auto parts form a sizeable chunk of the total retail sales. In fact, this number is as high as 20%. In the year 2018, the automotive engineering industry was responsible for about 2.7% contribution to the USA's GDP. In numbers, this accounts for $545 billion out of the total $20.5 trillion that was produced that year.

Out of that $545 billion, nearly $327 billion was contributed by auto and auto parts manufacturing while the rest stemmed from retail vehicle sales. Thus, one can understand how this industry plays an indispensable role in sustaining and fuel the nation's economic and overall development. The following case studies and statistics will further provide a clearer vision of the said fact.

Case Study 1: Sale of electric vehicles (EVs)

Although electronic vehicles or EVs were initially demanded, mainly by consumers concerned about the environment and wanted an eco-friendly alternative, the demand has gradually grown over the years. EVs are of those inventions in the automotive industry that reflect green energy and the green economy at the same time. Several countries in the world had signed the much-publicized Paris Climate Agreement with the vision to reduce carbon emissions.

Also, EVs or PHEVs function entirely differently than an internal combustion engine. EVs are run by chargeable batteries. This will again play a crucial role in affecting the economy positively. In addition to the concept of public EV charging stations, people are now gradually moving towards home-based charging solutions too. Countries like the UK also provide government grants to eligible people for setting up charging stations in their houses.

As per a report published by the Allied Market Research, the electronic vehicle sector is growing by a whopping 22% every year. As of 2017, the EV sales in the USA clocked at $119 billion. It has been projected that the sales will possibly cross $567 billion by the year 2025.

These numbers yet again showcase the importance of the automotive engineering and manufacturing industries to the nation's economic growth. There have also been cases wherein a setback in the automotive sector also caused a significant dip in the economy. The next case study will explore this idea.

Case Study 2: Impact of the 2015 Volkswagen Scandal on German Economy

The 2015 emissions scandal of Volkswagen took the world by a not-so-pleasant surprise. Worse, it was a major hit for the German economy. Volkswagen happens to be Germany's

biggest exporter, employing over 800,000 people. In that year, 2015, Germany was already facing an all-time terrible diesel crisis. This incident further crumpled the economy, but only to a slight extent.

Volkswagen contributes over 2.7% to Germany's GDP. The main reason why the scandal did not have a significant or massive impact on the economy is that the company holds about 22% of the total car exports. So, even a 10% drop in demand for VW cars post-scandal reflected only a 0.4% impact on Germany's economy.

This is the scope of automotive engineering, wherein even scandals are not seemingly powerful enough. It might tarnish the company's image for a while but cannot have damaging large-scale economic consequences.

Case Study 3: Auto Industry Bailout 2008

The top 3 distributors in the USA, General Motors, Chrysler and Ford requested Congress to provide financial[4] aid in the year 2008. It was established that General Motors and Chrysler were facing bankruptcy and subject to the risk of laying off 1 million employees. On the other hand, Ford did not face such financial trouble, but it was still a part of the bailout.

This resulted in an $80.7 billion bailout for the US government that lasted seven years from December 2008 to December 2014. This had a devastating impact on the economy as the Department of Treasury was compelled to utilize funds from the Troubled Asset Relief Program, thereby losing $10.2 billion for taxpayers.

Case Study 4: Impact of NAFTA on the Economy and the Automotive Industry

The US President Donald Trump had approved the new NAFTA agreement in 2016, which suggested changes in 6 different domains. The automotive industry, particularly auto and auto parts manufacturing, was one of them.

According to the new NAFTA, it was mandated to manufacture at least 75% of all car components in Canada, Mexico, or the United States. This was hugely disruptive as the original agreement required only about 12.5% of the car components manufactured in these countries.

It was also stated in the new agreement that 30% of the cars must be mandatorily manufactured by employees who earn at least $16 an hour. This number is expected to increase to 40% by 2025.

Worse, if auto manufacturing does not meet these standards, tariffs might get imposed on those. The impact will mainly be seen in the market of small cars in the North American

[4] Business News, Aug, 2017, Emission scandal is a risk to German economy

market, which, in turn, might slow down the economy, even if transiently or on a short-term basis.

These case studies paint a picture that automotive engineering and manufacturing industries have a massive impact on the economy. Specific latest trends in customer behaviour, as well as innovative approaches in the automobile industry itself, are likely to have a significant effect on the economy.

Latest Trends to Transform the Automotive Industry:

The automotive industry is immensely grueling with several world players with a steely focus to reach and stay at the top of the leader board. Research says that there are five latest trends that are likely to impact the automotive engineering [5]and manufacturing market of America, China, and Europe by 2030. These trends indicate how the industry needs to modify itself in terms of volume, scale, and complexity to meet the changing threshold.

Trend 1: The Users' Mobility Behaviour

As per a PwC (PricewaterhouseCoopers) forecast, the user mobility will change dramatically, affecting the automotive sector by and large. As technologies advance, operations of all types are gradually moving towards autonomy. According to estimates and predictions, by 2030, 40% of Europe's total driving experience will be autonomous. It is also expected that such changes might occur parallel in Europe and China.

The percentage of autonomous driving might increase to 50% in China and 36% in America by 2030.

Such a massive transformation of the automotive engineering industry will automatically affect every other sector even remotely related to it, such as:

- Insurance
- Manufacturing
- Financial services providers
- Legislation
- After-sales
- Trade
- Suppliers, etc.

Such a change will also cause a drop in car inventory. However, car sales are going to be unaffected and can rise as well. All world leaders in this sector are expected to decide on this change between 2020 and 2025.

Trend 2: Increase in Personal Mileage

[5] Mark Alfred, June, 2019, Automotive Industry Trends 2020

Reports also indicate that by the year 2030, personal mileage in the USA will increase by 24%. China is expected to see an increase in private mileage in the same timeline by about 183%. The reason is that with the concept of autonomous driving getting commercialized, everyone who was previously deprived of the pleasures of driving is also likely to be a part. This includes those belonging to the physically disabled or specially-abled categories.

The forecasts also predict that cars are expected to be used intensively and subjected to frequent replacements in the future. This means production will perpetually be on a roll, thereby significantly enhancing the nation's and the world's economy. [6]

Trend 3: Reduction in Automobile Inventory

PwC Autocast also predicts, based on current trends, that the vehicle inventory in Europe might drop from 280 million to only 200 million cars by the year 2030. However, the drop in stock does not necessarily mean a fall in vehicle sales. If anything, vehicles' sale is expected to grow sharply as more and more consumers will begin to seek autonomous driving options.

As per estimates, the automotive sales will shoot up by 34% across the European market during the transformation period. In numbers, this indicates a rise from 18 million to 24 million units in production. A nearly similar 30% growth is expected in China's case, with over 35 million units expected to be sold in 2030.

Trend 4: The domination of electrified and connected cars

By 2030, a massive portion of the world automotive market will be dominated by electric vehicles, fitted with the concept of connected driving. As per estimates, a whopping 55% of the car sales are expected to be electric cars by 2030.

CONCLUSION:

These trends can transform not only the automotive engineering and manufacturing industries but also increase the yield per vehicle as well as total profits made over a vehicle's lifetime or service life.

One of the factors that can ideally change the industry's future and the world economy is the extensive use of all-electric cars. Although fuel costs will decrease simultaneously, GDP might remain unaffected due to the increase in electronic and connected car production and installation of their charging ports, public or private, or both. Nonetheless, it is entirely the user behavior and consumer demands that will drive these changes.

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[6] Mark Alfred, June, 2019, Automotive Industry Trends 2020

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Data Availability Statement:

The data that support the findings of this study are openly available in [repository name e.g "figshare"] at http://doi.org/[doi], reference number [reference number].