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### Analysis of Toyota and the Automobile Industry

Dylan Saltzman

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# **Analysis of Toyota and the Automobile Industry**

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# Introduction

## Overview

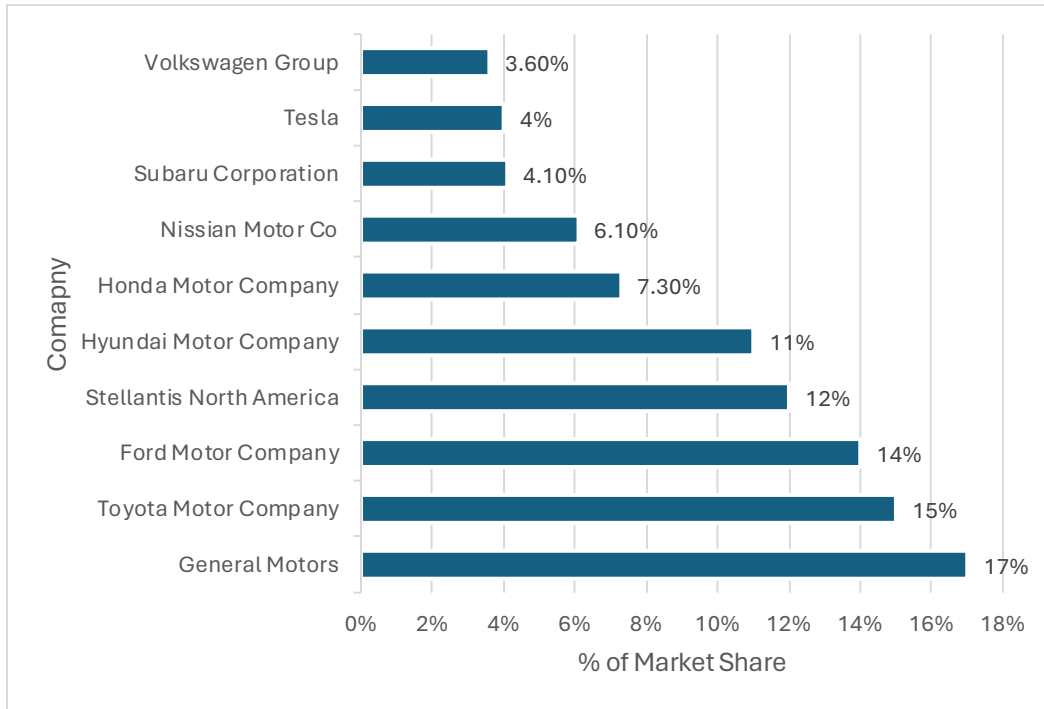
Toyota is an automobile company that has dominated the market for many recent years. The cars that we have today are a lot different than the ones we had two hundred years ago. Innovations in car technology were possible by entrepreneur's who wanted to make a difference in the world. Now, there are so many different options of cars to buy. This paper will outline the three main different types of fuel sources for cars, the pros and cons of each, and determine which consumers want the most. It will then go into what Toyota and its competitors have done, knowing this information. Then an analysis of Toyota's internal and external strengths will be conducted with a linear regression analysis and other analytical techniques. The mission, goals, organizational structure of Toyota will be highlighted and suggestions for improvements and aspirations will be made. The goal of this paper is to provide Toyota an analysis of their company structure, market industry, products, their consumer's preferences and competitors market share so that they are inspired to create the next innovative breakthrough for technology in cars making them more environmentally friendly, cost effective, and accessible to all.

## Background

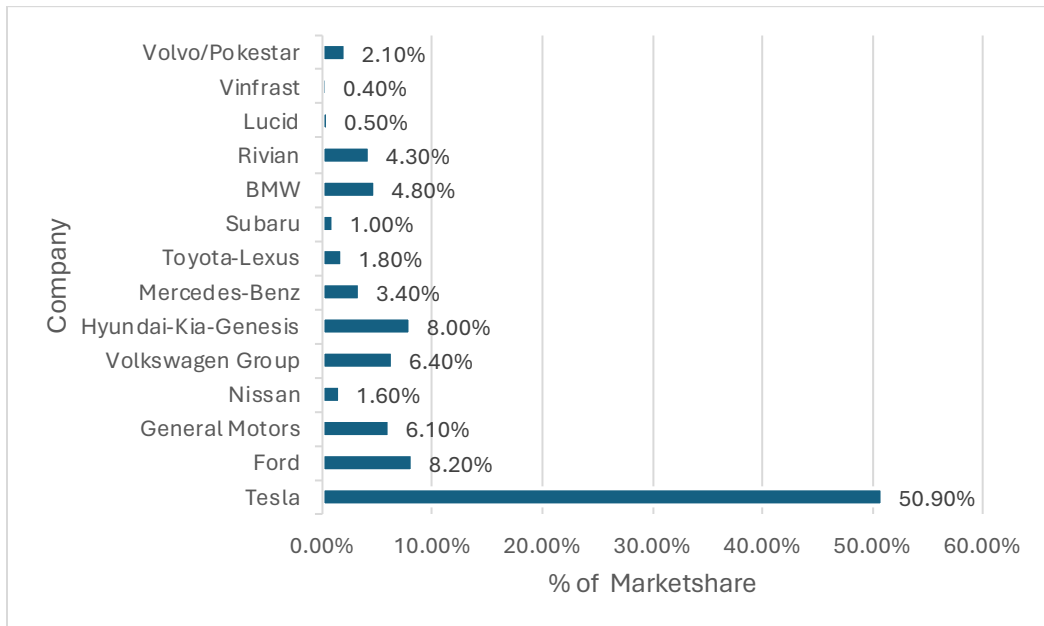
Motor transportation has evolved drastically in the past three centuries. The first self-powered road vehicle was invented by Nicolas Joesph Cugnot in 1769 using steam as fuel. At the beginning of the 20<sup>th</sup> century, forty percent of automobiles were powered by steam, while only thirty eight percent were electric, and twenty two percent were by gasoline. Nowadays, steam is not even considered a main source of fuel, rather now it is gas, electricity or both. In 1855, Karl Benz, a German mechanical engineer, designed and built the world's automobile powered by an internal-combustion engine. Then, in 1890, William Morrison built the first American battery

powered automobile. In 1898, Ferdinand Porsche built the world's first hybrid car, which uses gas and electricity to fuel the car. However, one of the biggest breakthroughs in the automobile industry occurred in 1908. Henry Ford introduced the assembly line, that mass produced his gasoline fueled car, the Model T. By 1912, an electric car had cost about \$1,750 while a gasoline car was about \$650. Unfortunately, in the late 1960s early 1970s, oil prices shot up drastically due to scarcity caused by the 1973 Arab Oil Embargo. The United States was too dependent on oil and needed to shift their research on developing new technologies that do not rely on gas as a fuel source. Congress passed the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976. This act led to the development of the Toyota Prius, which was the first mass produced hybrid vehicle. Toyota and their Prius revolutionized the automobile industry and has dominated the market since. At the moment, according to Figure 1, they own the second largest market share in the automobile industry at 16%. General Motors beats them at 18% because they produce more electric vehicles than Toyota, which can be seen in Figure 2. However, for Hybrids and gas fueled cars, Toyota has them beat.

**Figure 1: Market share of Automobile Industry**



**Figure 2: Market Share of Electronic Automobile Industry**



# Toyota

## The Prius

In 1997, Toyota launched the Prius. This first edition of Prius had a 1.5-liter VVT-I transversely mounted petrol engine that was mated to an electric motor. The unit could achieve above fifty miles per gallon, which is impressive for a hybrid engine. The Prius was then named Japan's New Car of the Year 1997 and Car of the Year and then again in 1998. In 2000, exports to places like the United States begun. It only took four years, and on only the second edition of the Prius, Toyota's hybrid vehicle sales surpassed one million. The hybrid model has now found its way into their luxury models too, Lexus. In 2009, the third edition of the Prius was launched, which had a new 1.8-liter hybrid engine that could reach seventy-two miles per gallon. Additionally, emissions decreased well below the 100g/km barrier, to an output of 89g/km. Toyota was and remains passionate about dominating the hybrid industry. In 2012 they released three more hybrid models, Yaris, Prius+ and Prius Plug-In.

## Market Trends

It is important for companies like Toyota to understand the market trend. According to Reuters (2024), "U.S. new vehicle sales, including retail and non-retail transactions, are estimated to reach 1,354,600 units in August, a 15.4% jump from a year earlier according to the joint report by J.D. Power and GlobalData." Additionally, retail inventories could potentially see an increase of 48.4% in August 2024. However, a pile up in inventory might lead to a decline in the dealer's profits. According to Reuters (2024), "Consumers are estimated to spend \$47.8 billion on new vehicles, the highest on record for the month of August, and 10.5% higher than last year."

Although consumers are spending more on vehicles, the transaction price for a new vehicle is

likely to decrease by 1.2% because of an increase of supply from competitors. Global sales are also expected to increase and reach eighty-six million units.

## Types of Cars

### Gasoline

The engine in a gas fueled car uses internal combustion engines. The engine generates power by burning the oil and uses the hot gases to drive the piston to move the car. When you turn your car on and push the gas pedal, the fuel pump moves the gas from your tank, through a filter, then into one of the engines cylinders. Pistons in the cylinder ignite the gas which then creates the mechanical energy needed to move the car wheels.

### Electric

As for electric cars, power is added to the lithium-ion battery pack through charging cables, just like your phone. The power is stored in the battery as a direct current (DC) electricity, but an electric car runs on alternating current (AC) power. Once you turn the car on, the inverter converts the stored energy to usable energy and then sends it to the induction motor. That energy in the induction motor creates a magnetic field that rotates in circles. This rotation is what spins the wheels. Whenever the wheels are moving faster than the engine, which occurs when you take your foot off the gas or brakes, the induction motor becomes a generator. It sends DC electricity back into the battery, recharging it without having to plug it back into a power source.

### Hybrid

Finally, hybrid cars combine both electric and gas-powered engines. At any moment, the gasoline engine could be in use, or the electric, or both at the same time. Hybrids use



regenerative braking to charge up the battery. In some scenarios, the gas engine is also used to charge the battery.

## Pros and Cons

Having three different types of fuel sources to choose from could be overwhelming for consumers because they do not know what the best option is. However, the “best option” varies from consumer to another due to preferences and lifestyles.

### Speed

As for speed, gas can reach a higher top speed than an electric vehicle. However, an electric vehicle can reach from point A to point B much faster than a gasoline vehicle. An electric vehicle can also generate more torque than a gasoline vehicle. Torque is the power that is generated to make the car accelerate. It takes less time for an electric vehicle to pick up to top speed than it does for a gasoline vehicle, especially at lower speeds.

### Cost

As for cost, the initial cost of a gasoline vehicle is inexpensive compared to the cost of an electric vehicle. However, as for cost over time, an electric vehicle becomes more economical due to the high costs to maintain gasoline vehicles, oil changes, transmission fluids and coolant, and worse fuel efficiency. Gasoline vehicles must fuel up more often than electric ones. To charge up an electric vehicle, on average, it costs less than seven dollars while a gasoline vehicle costs about forty dollars for a fuel tank. Along with the high initial cost of the electric car, charging the car can be a bit of a burden for long trips. There are not that many charging stations on the open road, and when you do have to charge, it takes about thirty minutes to fully charge

the car. That is a long time for a consumer to have to wait to continue their drive. To fuel up a gasoline car, it takes at most ten minutes.

## Environmental Friendliness

Electric vehicles are much safer for the environment than gasoline vehicles. Gasoline cars are powered by fossil fuels, which are limited resources that pollute the air when they are burned and released from the car. Carbon dioxide (Co2) is a gas released from the car, which is horrible for people to breathe in and harms the atmosphere. Plus, a lot of the leftovers and fluids from a gasoline car are not biodegradable, which means they do not naturally decompose. Powering a car with electricity eliminates fossil fuels, making it more environmentally friendly. However, the batteries in the electric car that power it is also not biodegradable or rechargeable. Once they die, which takes about twelve to fifteen years driving about 200,000 miles, they need to be thrown out and replaced. These batteries are horrible for the environment along with carbon dioxide from the gasoline vehicle.

## Summary

Overall, an electric vehicle is sustainable and environmentally friendly for a consumer, however, the initial cost of them and the burden to charge them makes gas vehicles more realistic for a typical consumer with an average income to purchase. As for hybrid vehicles, it is difficult to compare them to gas and electric cars because different models use different parts and features of a gas and electric vehicle. Hybrid vehicles are also expensive like electric vehicles, have fuel costs like gas vehicles, release Co2 emissions, and have parts that are not biodegradable.

## Production and Sales Analysis

Toyota is one of the largest automobile companies in the world. To maintain their market dominance, Toyota produces large quantities of vehicles. According to Figure 3, due to the 2020 pandemic, Toyota only produced 7,909,488 automobiles. The following year, Toyota produced about another 600,000 automobiles. In 2022, production ramped up due to restrictions being lifted. They were able to produce 902,266,713 automobiles. Then, in 2023, Toyota produced 110,033,171. Toyota can increase production level at such a high rate because of their business style. Toyota uses lean manufacturing which is a manufacturing methodology that emphasizes the ability to maximize efficiency of the firm while minimizing the amount of waste in the process. Toyota is notorious for allocating their time, materials, and costs as efficiently as possible. According to Liker, and Morgan (2006), “since 2009, Toyota has been the leader in lean production.” Due to their ability to produce mass amounts of cars and different types, Toyota can sell a large surplus of cars. Over the past four years, Toyota’s sales have increased by almost two million.

**Figure 3: Production for all of Toyota’s Vehicles**

<b>Production(Vehicles)</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
<b>All Vehicles</b>	7,909,488	8,583,258	902,266,713	110,033,171

As depicted in Figure 4, last year Toyota sold 11,233,039 units, worldwide. Their leading car in sales is gasoline cars with 6,729,150 units. Next is their hybrids with 3,575,258 units sold. Then lastly, is electric cars with only 104,018 units sold last year. However, if you look at the trend of

sales for each type of car, Hybrids and Electric cars are overall increasing in sales while Gasoline cars are slowly decreasing. From 2022 to 2023, sales in electric cars grew about 80,000 units and hybrids grew a little under 1,000,000 units while gasoline cars decreased by about 400,000 units. The reason for this shift in sales could be because of a few factors.

**Figure 4: Toyota’s Sales**

<b>Total Sales (Vehicles)</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
<b>Worldwide</b>	9,528,438	10,495,549	10,483,247	11,233,039
<b>All Electric</b>	1,959,570	2,621,925	2,726,263	3,679,631
<b>Electric (BEV)</b>	3,346	14,407	24,466	104,018
<b>Hybrids (HEV, MHEV, PHEV, and FCEV)</b>	1,956,224	2,607,518	2,701,797	3,575,613
<b>Lexus</b>	718,715	760,012	625,365	824,258
<b>Gasoline</b>	6,850,153	7,113,612	7,131,619	6,729,150

**Consumer Preferences**

First is the shift in consumer preferences. Consumers have become more environmentally friendly. They want cars that are not polluting the air with Carbon Dioxide as much and that are using less gas to slow down the use of fossil fuels. Consumers are also more willing to spend money on more expensive vehicles now, if it means they can spend less on fuel later in supply. One of Toyota’s goals is to become more environmentally friendly. Considering that their hybrid, the Toyota Prius, is one of their biggest sellers, they could be shifting production to produce more of those types of cars and less gas fueled cars. Having more hybrid and electric cars available gives more consumers the opportunity to buy one before, if they ever, sell out.

## Marketing

Lastly, Toyota has a shift in advertising. Instead of marketing the saturated gasoline cars, that most of their competitors produce, Toyota has been focusing on creating advertising for their new, innovative cars. To grab the consumers' attention, they are advertising new safety features that electric and hybrid cars have that typically would not be found in an ordinary gas car.

Consumers love to buy the latest and greatest innovations in technology, leading to the decrease in the old fuel source, gasoline, and hopping on the trend, electric and hybrid cars.

## External Analysis of Toyota

### Model

**Model:** Total sales of Toyota's gasoline cars =  $B_0 + B_1(\text{Gas price}) + B_2(\text{Price index}) + B_3(\text{Total sales of Toyota's electric cars}) + B_4(\text{real disposable income per capita}) + \epsilon_i$

For the first variable, gas prices, according to Duncan (1980), he suggested that as gas prices increase, the sales of larger gas fueled SUVs should decrease. Consumers would either not buy a car, buy a smaller sedan, or buy an alternative fueled car to prevent having to pay for gas. This reason also explains the use of electric powered cars in the model. If electric powered cars are a substitute to gas fueled cars for consumers, then if the sale of electric cars increases, then the sale of gas fueled cars should decrease. The next variable discussed was the price of the vehicles. According to Gavazza, Lizzeri, and Roketskiy (2014) if the price of a car increases, then the consumers' willingness to pay for that good will decrease, resulting in lower sales. Finally, the average amount of real American disposable GDP per capita was incorporated into the model because, stated by Chamon, Mauro, Okawa, Temple, and Schultz, (2008) as consumers obtain a

higher amount of disposable income, than their purchase of a particular good, if it is a normal good, will increase.

## Data

The data used in this research came from four different sources from 2011-2022. The reason this range of 11 years was chosen was to ensure that we would be able to view an accurate representation of how the explanatory variables impact the dependent variable.

**Figure 4: Raw Data from 2011 - 2022**

Year	Total Sales (End of Year Total) (thousand units)	Gas price (Avg for year)	Price Index of Toyota Car (Avg for year)	Sales (Electric) (End of Year total)	Real Disposable Personal Income per Capita (End of year)
2011	7,096,853	\$3.42	\$25,053.00	628,979	\$39,008.00
2012	6,717,314	\$3.44	\$23,489.00	1,219,307	\$41,192.00
2013	8,947,756	\$3.43	\$23,792.00	1,280,325	\$39,125.00
2014	9,147,342	\$3.34	\$22,940.00	1,267,260	\$40,991.00
2015	9,188,559	\$2.34	\$22,887.00	1,204,502	\$41,699.00
2016	9,223,727	\$2.15	\$22,301.00	1,402,693	\$42,013.00
2017	9,383,780	\$2.39	\$22,103.00	1,520,673	\$42,950.00
2018	9,541,748	\$2.74	\$21,734.00	1,633,198	\$44,814.00
2019	9,714,253	\$2.66	\$21,417.00	1,923,808	\$45,325.00
2020	8,692,168	\$2.12	\$22,970.00	1,959,570	\$46,790.00
2021	9,615,157	\$3.00	\$30,852.00	2,621,925	\$46,515.00
2022	9,566,961	\$3.79	\$28,907.00	2,726,263	\$45,915.00
<b>Average</b>	9,067,160	\$2.85	\$23,944.73	1,705,411	\$43,141.40
<b>S.D.</b>	837,654	\$0.58	\$3,049.83	546,378	\$2,777.00

## Results

Model: reg stend gasprice priceindex elecstend realdisp

source	SS	df	MS	Number of obs	=	12
Model	9344868.74	4	2336217.19	F(4, 7)	=	13.29
Residual	1230379.06	7	175768.437	Prob > F	=	0.0022
				R-squared	=	0.8837
				Adj R-squared	=	0.8172
Total	10575247.8	11	961386.164	Root MSE	=	419.25

stend	Coefficient	std. err.	t	P> t	[95% conf. interval]
gasprice	-406.4793	305.2049	-1.33	0.225	-1128.174 315.2157
priceindex	-.1910847	.0694011	-2.75	0.028	-.3551923 -.0269772
elecstend	2.689335	.4682652	5.74	0.001	1.582063 3.796606
realdisp	-.3190421	.1028442	-3.10	0.017	-.56223 -.0758542
_cons	24190.38	4489.006	5.39	0.001	13575.56 34805.19

In model 1, the  $R^2$  value is .8172 which means that there is a strong correlation between the explanatory variables and Toyota's total gas fueled car sales. Gas price and the price index have the correct expected symbols, however, electric cars and real disposable income per capita are incorrect, unless Toyota is viewed as an inferior good. When conducting the t - test, it was found that all the variables are significant, except gas prices. The insignificant impact of gas prices is logical if cars are a commodity. No matter what the price of gas is, consumers still need to buy a car to perform daily life responsibilities. While conducting the bias test, it was found that gas prices, price index, and real disposable income per capita were needed in the model. The total sales of Toyota's electric cars were not needed to be included in the model. Finally, the F-test was conducted and concluded that all the variables are jointly significant in the model.

## Summary

From our results, the variable that most significantly impacts the demand side of Toyota's total sales of gas fueled cars is the real disposable GDP per capita of a consumer. Even though gas prices and the price index of the cars were insignificant on their own, they had a jointly significant impact. The rise in insignificance of gas prices on the sales of Toyota's cars makes sense due to the shift in consumers preferences. As they have more disposable income available, they can purchase cars that initially cost more, electric and hybrid vehicles, so they can spend less on fueling their car.

The downside to conducting significance testing is that we cannot determine the level of significance, only if it is or is not significant. However, when devising strategies to increase sales, the first variables that should be planned around are the ones that reflect significant impact on sales, like real disposable GDP per capita.



# Internal Analysis of Toyota

## Customer Service

Toyota's lean manufacturing is not the only strength that has brought them previous success. Another one of these strengths is Toyota's Customer – Centric Approach. They become very involved with the customer before, during and after the purchase of any of their products. Toyota is passionate about listening to their customers' feedback. They conduct regular surveys and focus groups, personalize the experience for each customer by offering a wide variety of colors, styles, accessories and features, emphasize building strong personal relationships with customers, and overall going the extra mile for their customers. The dedication that Toyota has to their customers is founded deep within the company's values of Genchi Genbutsu and Kaizen. Genchi Genbutsu means “go and see yourself and Kaizen means “continuous improvement” in Japanese. Toyota encourages their employees to go that extra mile for their customers to go out and solve any problems or concerns they may have. Then, whatever issues the employee may identify, Toyota wants that fixed and improved right away.

## Human Capital

Toyota feels that their human capital is their most important asset. Having a quick, reliable customer service that genuinely cares about their customers will build relationships between the customer and Toyota, maintaining their loyalty to the brand. Employees are encouraged to take on new challenges to push themselves to be the best employee they can be to strengthen Toyota. By motivating employees to do their best, brings Toyota closer to fulfilling their corporate mission of “Producing Happiness for All”.

Due to the company's culture and motivation, Toyota has earned many awards and high ratings. They were given the Best Resale Value, Most Trusted Brand, 5-Year Cost to Own Award, and

Best Overall Truck Brand awards. Even with the downturn they have been facing recently, Toyota is still having success and winning awards.

## The Future for Toyota

### Goals

As for the future, Toyota has many plans to improve operations with new innovations. Their main focus is to optimize sustainability and maintain their competitive advantage in the evolving automobile industry. The first area they are going to target to achieve this goal is their carbon footprint. Toyota plans to reduce it through sustainable practices. They are working on producing a hydrogen fuel cell car that uses water instead of gas to make the car run. The plan is to continue the road map of hybrid technologies in their cars, like the Toyota Prius that is gas and electric, and in their manufacturing processes. The next area they want to invest in is the evolution of AI technology, specifically for autonomous driving. Toyota wants to create an integrated network where all the cars can communicate with each other using AI technology to enhance safety, efficiency, vehicle operations and maintenance. Once that is solved, the final goal is to make the car automated to mitigate the number of accidents that occur and target their next area of focus, mobility for all. The aim is to go beyond traditional transportation by providing service to everyone, regardless of physical or economic constraints. Vehicles will be compact and cost-effective and designed to cater to the customer's needs. Additionally, vehicles are going to be designed much safer. The Toyota safe sense (TSS) is a bundle of advanced safety features that are included in the car to prevent accidents, protect occupants and aid drivers. The last area Toyota plans to improve is their collaboration with other companies. They plan to form partnerships with tech giants like Apple and Google for integrated tech solutions and strategic alliances with innovative start-ups for fresh, cutting-edge technology. The last area Toyota plans

to focus on to optimize sustainability and maintain their competitive advantage is by globalizing more. Even though Toyota is popular in North America and Europe, they want to expand into untapped or undeveloped markets specifically in Africa and South America. The more markets that Toyota enters, the stronger their competitive advantage becomes due to brand recognition and loyalty by consumers.

## Conclusion

### Summary

Consumers have shifted their preferences for companies like Toyota for a few reasons. The trend on the importance of social status has grown tremendously over the years. Consumers want to drive the latest and greatest innovation in technology. Additionally, the hybrids and electric vehicles that Toyota produces are much better for the environment than the typical gasoline fueled car. Environmental friendliness is a huge trend now too. Buying a car, like a Toyota Prius, fulfills both the consumers need to have the newest and environmentally friendly vehicle. This increase in demand can be seen in Toyota's supply too. They are producing a lot less gasoline cars and are dramatically increasing the amount of hybrid and electric vehicles they produce.

Currently, Hybrid vehicles are the "best" vehicles to purchase. The initial purchase is cheaper than electric cars, fuel is cheaper than gas cars, and the carbon dioxide emissions and batteries waste is less than each respective vehicle. According to the results of the linear regression analysis, the change in gas prices is not significantly influencing the total sales of Toyota's vehicles. The price of vehicles and how much disposable income per capita for a consumer does. This result supports the statement that hybrid and electric vehicles are taking over the automobile industry.

## Relevance

It is important to identify changes in production, preferences and goals so that businesses can adapt to keep pushing innovation. If only one company was pushing technological breakthroughs, there would not be any motivation for them to keep innovating, which would slow our economy down. Competition drives economic growth. Without it, we would not have the cars that we drive today. Only two hundred years ago the first steam powered car was invented. The individuals and companies that noticed the opportunity drove the change for transportation that people would not have even thought was possible back then. Toyota has identified that the future of the automobile industry is hybrid vehicles. They increased production of these types of vehicles, and their sales increased too. The next step for them is to develop new innovations in technology for hybrid vehicles. Extensive research must be conducted to figure out what consumers need more out of a car, what is feasibly possible to do, how long it will take, how much it will cost, and what competitors are doing. The public has a high reputation for Toyota, and for them to continue their market dominance, they must change and innovate to meet new consumer needs.

## Aspirations

As for the future, cars need to be more accessible to people with all different types of disabilities, better safety controls, and more economic and environmentally friendly sources. One recommendation could be to create an AI auto pilot. This computer can see the road, traffic, lights signs and communicate with other AI drivers. By having an AI drive, it will diminish the amount of human error, which causes accidents, and allow for more people with disabilities to be able to drive around more often, instead of being limited to being driven by another person. Another recommendation is to expand to global markets and find methods to lower the cost of

production so that the price of the car can be lower. The aspiration is to allow these lower income countries to be able to afford a car so that they can grow their economy by importing and exporting goods faster.

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