Study the Influencing Factors of New Energy Vehicle Industry Stocks Based on Linear Regression Model

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ABSTRACT: The new energy vehicle industry has become the focus of the investment community. The development of new energy vehicles cannot be separated from policy support, public awareness of environmental protection and the inevitability of sustainable social development. In this paper, we analyze the factors influencing the share price of new energy vehicles in terms of policy, technology, and general environment. This paper uses a multiple linear regression model to analyze the reasons for the changes in the share prices of new energy vehicles by analyzing the average monthly closing prices of Tesla and BYD, the exchange rate of the people against the U.S. dollar, and the changes in the CPI indices of China and the U.S. The data analysis revealed that the products produced by Chinese new energy vehicle companies tend to be domestic products due to the rising exchange rate in China. Due to the low price of domestic new energy vehicles, people tend to buy Chinese new energy vehicle brands under the background of inflation.

1. Introduction

China has progressively released a series of regulations to assist the development of new energy vehicles in response to COVID-19, the worldwide chip scarcity, and the rise in the price of bulk commodities. The implementation plan for encouraging green consumption was released on January 21, 2022, by China's National Development and Reform Commission and the other seven agencies, and it calls for a significant increase in the use of green transportation. The government would promote the exemption of traffic restrictions, encourage the development of new energy cars, gradually remove restrictions on the purchase of new energy vehicles in various locations, and increase the building of charging stations and supporting infrastructure. Based on the data above, the new energy vehicle sector can be upbeat.

New energy vehicles have the advantages of being economical and sustainable. As China has progressively released all-encompassing incentive policies, including extending the duration of the subsidy policy, building charging or replacement power stations, setting preferences, etc., it has also increased subsidies in addition to exempting vehicle purchase tax and vehicle and vessel use tax. This enables customers to purchase new energy vehicles with greater flexibility. Customers' time and money costs can also be greatly reduced when dealing with client groups in Beijing and Shanghai where it is difficult to obtain car registration plates. In addition, as China's economy has grown quickly, the majority of people's material standards of living have improved, and the number of cars on the road has gradually increased, urban exhaust pollution is becoming an increasingly critical problem. When using electric power resources, no waste gas or liquid will be produced. Therefore, using electric-drive vehicles will not emit pollutants that degrade the environment and can significantly reduce carbon dioxide emissions in the air. As a result, new energy vehicles are important for preserving the environment.

However, the issues with mileage and charging remain to be resolved for new energy vehicles. The majority of modern energy vehicles can only sustain an endurance of 600–700 kilometers, however a handful of them can travel more than 1000 kilometers. Perhaps new energy vehicles can provide a better driving experience in urban areas, but when faced with self-driving trips, new energy vehicles are less practical than conventional automobiles. On China's national day in 2021, more than 500 million people traveled, 10% of them traveled more than 300 kilometers. This information causes many visitors who are traveling long distances in new energy cars to experience

the inconvenience of “charging for 2 hours and queuing for 6 hours.” Evidently, the charging issue has posed significant obstacles for the growth of the new energy vehicle sector. Fast charging should take around 1.5 hours, and slow charging should take 6–7 hours. Families of average means can purchase or utilize household charging piles. The process is more complicated for residential charging piles since they need permission from the local property and power providers, while public charging piles are less common because most of them are found in city regions and frequently have long lines. The market acceptance of new energy cars may be lessened if the government and pertinent businesses are unable to effectively address the issues of sluggish charging and problematic charging.

In 2009, China launched the plan of “Tens of thousands of Vehicles”, which aims to launch 1,000 new energy vehicles in each municipality every year for about three years through national financial subsidies, and its application scope is mainly urban operation vehicles, such as buses, taxis, postal services and other businesses. However, due to the backward development of new energy vehicle technology in China, only a few cities have actually implemented the proposal. In 2012, China timely modified the development plan for new energy vehicles. The State Council issued the Development Plan for Energy Conservation and New Energy Vehicle Industry (2012-2020). In this document, pure electric vehicles and plug-in hybrid electric vehicles became China's key strategic development objects. Due to the epidemic of China's indigenous industrialization development, the long-term haze threatens the health and daily life of the people, and the effective way to resolve the environmental problem is to promote the use of new energy to replace the fossil energy. After the establishment of the heavy air pollution early warning system in 2013, Beijing first issued no limitations on the license plate of new energy vehicles and offered preferential subsidies. At the same time, the purchase tax was slashed and the comparatively low price made consumers progressively embrace new energy vehicles. Relevant data show that from 2015 to 2020, the proportion of passenger vehicles for new energy vehicles has steadily increased from 60% to 90%, which indicates that China's consumer end is gradually widening the market demand for new energy vehicles. Due to China's excessive subsidies and lax supervision of new energy vehicles in the early stage, the cheating of subsidies was further fermented in 2016, and people expressed concerns about the future development prospects of the new energy vehicle industry. Accordingly, Chinese policymakers decided to reform the new energy vehicle industry, regulate the industry system, lower the subsidy intensity year by year, and provide targeted subsidies to new energy vehicle enterprises that can truly achieve higher driving range and lower energy consumption, so as to stimulate the healthy development of China's new energy vehicle industry. In September 2017, the double integral policy was officially launched, aimed at enforcing the dual objective assessment of fuel consumption and the integral ratio requirement of new energy vehicles. The policy strengthens the energy-saving management system and guides China to coordinate the development of energy-efficient orthodox and new energy vehicles. Influenced by the double points policy, many enterprises have established joint ventures to accomplish technology sharing of new energy vehicles, such as BAIC Group and Daimler, Ford and Zotye, and Volkswagen and JAC. This move also promotes the realization of complementary advantages between enterprises, increases industrial concentration, and improves the delivery process of new energy vehicles. In 2018, China announced the lifting of restrictions on foreign investment in the auto manufacturing sector, particularly in the manufacturing of new energy vehicles. A month later, Tesla declared a gigafactory in Shanghai free trade zone. The entry of foreign automobile enterprises has driven the development of China's new energy automobile industry. Unqualified enterprises have been eliminated and new forces are rising. Nio was successfully listed on the New York Stock Exchange, and BYD and Xiaopeng Auto steadily became the world's top 10 Chinese companies by market capitalization.

2. Literature Review

In the mid-19th century, the world's first oil well was uncovered in 1854, thanks to Polish pharmacist Lukasiewicz, who discovered an easier way to make kerosene from petroleum. Due to

the better economic value of oil, energy shortly entered the oil age, and the automobile industry also entered the stage of fuel vehicles. In 1900, the automobile industry entered the hybrid phase, where various energy sources could be used to their advantage in order to better control the vehicle's powertrain. The first hybrid car, the Semper Vivus, was developed by Fernando Porsche, but at the time not many people actually used hybrids, so the development of hybrid cars entered a period of bondage. But after 1973, attitudes to hybrid cars changed fairly differently. Gasoline prices soared in the United States as a result of the Arab oil ban. At that time, American consumers were very concerned about gas prices because most Americans drove to work. This situation has forced automobile manufacturers to enter the research and development of new energy vehicle technology for decades, but it has not achieved good results in the short term. In 1977, Toyota did not choose to directly achieve pure electric vehicles but chose the direction of gas-electric hybrid. The combination of gasoline and electric motors does not require customers to change their preferences, and existing gas stations can help provide convenience for hybrid cars. In the same year, Toyota released the first-generation hybrid electric car Prius in Japan and realized mass production. Environmental protection and low price characteristics, alleviating the impact of the oil crisis on hybrid cars. Simultaneously, little was known about hybrid cars in China. It was not until 2004, when the Prius II came out, that the innovation notably diminished fuel consumption and exhaust emissions. Two years later, it was officially launched in China and locally manufactured, and at this time, China had a deep understanding of hybrid cars. In fact, as early as 1870, pure electric vehicles won the recognition of the European and American markets with their low price, quiet and straightforward operation. Nevertheless, in the early 1920s, the progress of oil extraction technology and the development of battery entered the bottleneck period, which led to the temporary decline of pure electric vehicles. At this time, the market preferred fuel vehicles.

With the continuous innovation of technology over the years, pure electric vehicles have entered a period of rapid development in the 21st century. For example, metal oxide semiconductors, micro controllers, single chip computers and power converters have enhanced the power utilization rate and reduced the cost. In addition, commercial lithium batteries have replaced lead-acid batteries because of their higher energy density, lighter weight, longer cycle life and faster charging. At this time, many emerging electric vehicle companies are performing very well. For example, Tesla launched the world's first mass-produced pure electric sports car, the Roadster with a range of 320km using lithium-ion batteries in 2006, and the pure electric Model S with a range of 610km in 2012. In 2010, BYD launched the pure electric vehicle E6 using lithium iron phosphate battery, with a range of 300km, which was the longest range in the world at that time and the first pure electric passenger car for the public in large quantities. So far, the United States, the Netherlands, Norway, Germany, France, the United Kingdom and other countries have publicly proposed to prohibit the sale of traditional fuel vehicles in the market after 2030. Such messages all indicate that the future will be the era of new energy vehicles, and traditional car enterprises will be compelled to transform. If we desire to reach this goal, high-voltage fast charging may be the best solution in the next stage, to upgrade the charging power and battery charge-discharge ratio, ensure safe and effective battery thermal management and broaden the application scenarios of new energy vehicles.

2.1 Battery Technology at Different Stages

The initial use of electric vehicles is lead-acid batteries. The low cost of lead-acid batteries is its biggest advantage. However, due to the small density and large volume of lead acid, it can not satisfy the consumption of a vehicle, and even the service life of an average of 10,000 kilometers per year, so lead acid battery can not be used on a large scale, and ultimately was eliminated by automobile manufacturers.

Similarly, nickel-metal hydride batteries, which are closer to our daily lives, have been removed from the vehicle market due to low charging efficiency and the inability to use high-voltage fast charging. At the present stage, lithium battery is the mainstream choice of new energy vehicles, lithium compounds (lithium manganate, lithium iron phosphate, etc.) as electrode materials,

graphite as anode materials. Its advantages are high energy density, small size, light weight, and high charging efficiency. The main factor that determines the type or performance of lithium batteries lies in the materials at the two poles of the battery, among which the material at the positive pole is the key at the present stage, such as the mainstream lithium iron phosphate, lithium cobalt acid in ternary materials, nickel cobalt manganese, etc. There are differences in capacity, cost, low temperature charge and discharge, safety and other dimensions. Nonetheless, lithium batteries are greatly affected by temperature. In winter, the range of lithium batteries can only reach 60 or 70% of the standard range, which is severely limited. Although the corresponding measures have been taken, the effect is not as good as the ideal.

Hydrogen is also used as an ideal clean energy in batteries. Hydrogen itself, for combustion, can release a lot of energy, good low temperature performance. The most important hydrogenation efficiency is high, the hydrogenation just 5 minutes to drive more than 600 kilometers, and the data there is room for improvement, considerably are far superior to the existing lithium battery. However, hydrogen fuel cells cannot be commonly applied because obtaining hydrogen requires a large amount of electricity to electrolyze water, which is too costly.

At present, graphene batteries are considered as an important technology to improve battery charging speed and promote the progress of power battery technology due to their ultra-light weight, ultra-high strength and ultra-high conductivity. In 2017, the Ministry of Industry and Information Technology of China articulated the “13th Five-Year Plan for Scientific and Technological Innovation in the Field of Materials”, classifying graphene material technology as a key development area. It is reported that the “super fast charging battery” developed based on GAC 3D structural graphene (3DG) material has completed the test of cell, module and battery pack samples, and carried out high-power charging test with the vehicle. The battery life and safety have reached the standard for use. The ultimate development direction of lithium battery is solid battery, which uses solid electrolyte, and its capacity density is considerably higher than the current mainstream lithium battery, which means that pure electric models are higher and even reach the range of energy-saving gasoline vehicles, and the charging efficiency has a qualitative leap compared with the present stage. Among the listed companies, Del Stock has started to lay out the R&D of solid-state battery since 2018. At present, it has achieved the R&D target of key nodes. The all-solid-state battery development project has completed the sample and is in the process of client testing. On August 2, 2022, Ganfeng Lithium announced that Ganfeng New type lithium Battery Science and Technology Industrial Park and Advanced Battery Research Institute project officially started, planning to form 10GWh battery capacity and 10GWh Pack project, planning to construct the largest solid-state battery production base in China.

2.2 Domestic and Foreign Comparison

Sales of new energy cars climbed gradually in April 2022 both domestically and abroad, and they remained strong overall. The overall number of international new energy vehicle sales, as reported by Marklines, was 264,300 units, a +38.9% year over year and -27.0% month over month change. Among them, BEV sold 172,300 units, up 59.9% annually but down 1.1% monthly. Sales of PHEVs were 92,000 units, up 11.5% annually and down 15.5% monthly. The total number of new energy vehicle sales in Asia (outside of China) in April 2022 was 19,000 units, up +125.9% year and down -17.2% monthly.

The total number of new energy vehicle sales in Europe in April 2022 was 151,300 units, an increase of 11.7% year over year and a decrease of 37.6% month over month. The total number of new energy vehicle sales in North America in April 2022 were 93,100 units, an increase of 102.4% over the previous year and 3.7% over the previous month. The China Academy of Information and Communications Technology (CAICT) reports that in June 2022, China's new-energy vehicle production and sales both reached record highs of 590,000 and 596,000 units, respectively. This continued the pattern of the industry's rapid expansion. Production and sales of new energy vehicles reached 2.661 million and 2.6 million in the first half of the year, an increase of 1.2 times year over year. New energy vehicles were sold in rural areas, and a number of consumption-related initiatives

were implemented to encourage the release of new energy vehicle supply and demand. As a result, the demand for new energy vehicles worldwide is increasing, and China's new energy vehicle competitiveness is gradually improving.

2.3 Policies

From the policy perspective, recently, China has formulated a series of favorable policies to promote the development of the new energy vehicle industry. In 2020, The General Office of the State Council issued the new energy vehicle industry Development Plan (2021-2035) notice, the future to implement new energy vehicle basic technology improvement project, breakthrough car gauge chip and other key technologies, support basic components, key production equipment, high-end experimental instruments and other basic generic technology research and development innovation. In 2021, the CPC Central Committee and The State Council issued guidelines on the complete, accurate, and comprehensive implementation of the new development concept and achieving peak carbon neutrality. The policy clearly states that we should vigorously develop green and low-carbon industries, including information technology, new materials, new energy vehicles, and other strategic emerging industries. In 2022, The State Council will continue to issue the 14th Five-Year Plan for Energy conservation and emission reduction, taking the lead in purchasing energy-saving and new energy vehicles. New and existing parking lots should be equipped with charging facilities for electric vehicles or reserve installation conditions for charging facilities to provide convenient conditions for citizens using new energy vehicles.

2.4 The Environment

In 2020, China clearly set the goal of achieving “carbon peak” by 2030 and “carbon neutrality” by 2060. China will continue to promote the adjustment of industrial structure and energy structure. China's transportation sector accounts for about 9.6% of carbon emissions, but the number of cars in China continues to grow, which means that carbon emissions from the transportation sector will continue to increase, and the most effective way to achieve “emission reduction” is to go electric. As oil is a non-renewable resource, its price is constantly rising, and the oil cost occupies a part of the consumption of car holders, which will become one of the main considerations for customers when they buy cars. The sustained high oil price may give the new energy vehicle industry a valuable opportunity for development.

3. The Research Methods

Linear regression analysis is to describe a dependent variable Y and one or more linear dependence relation between the independent variable X, use certain linear fitting of the dependent variable and independent variables, the relationship between model parameters for the regression equation, using the regression equation to predict the changing trend of the dependent variable, using the regression analysis method can reflect the quantitative relationship between the specific model, The regression model. A phenomenon is usually associated with multiple factors, and the optimal combination of multiple variables to predict or estimate the dependent variable is more effective and realistic than that of only one independent variable. Independent variables are mainly determined by the actual influencing factors. The equation is as follows:

$$Yi=\beta0+\beta1X1+\beta2X2+\ldots+\beta nXn+e$$

n is the number of explanatory variables; βi is a constant term; β1 ~ βn are regression coefficients; e is the random variable value of the error term, which is the random error after removing the influence of n independent variables on Yi. The least square method is used to estimate the regression coefficients β0, β1..., βn can be estimated, β value can be obtained, then the multiple linear regression model can be used for prediction.

The multiple linear regression model can study the stock influencing factors of the new energy automobile industry, among which X1, X2, and X3 influencing factors can be selected for qualitative analysis. As the head company has a major leading role and influence in the new energy vehicle industry, the public data of Tesla and BYD can be collected and analyzed in the following

quantitative verification, and then SPSS regression analysis can be conducted to obtain the corresponding beta coefficient. According to the linear law obtained by the beta coefficient, the policy forecast of the industry and the future stock price forecast can be carried out.

4. Research on Current Situation of New Energy Automobile Industry

4.1 Current Situation Analysis of New Energy Vehicles

From China to the US, all countries are expanding their own battery supply chains. This is undoubtedly good news for the new energy automobile industry.

4.2 Compare the Current Situation of the New Energy Automobile Industry in China and the United States

Tesla, USA

Tesla's Q3 2022 revenue was slightly below market expectations and its automotive gross margin was 27.9%, flat year over year, according to a related earnings release. It can be found that the rise in raw material prices and exchange rate fluctuations have a relatively large impact on Tesla

Byd of China

According to relevant financial statements, BYD continued to launch new models in the Q3 of 2022, such as the pure electric version of Denza D9 and Song MAX DM-i, which optimized the model configuration and is expected to usher in performance growth. In the third quarter of this year, the net profit reached 5.5 billion yuan, a year-on-year growth of 365%. Sales of pure electric passenger cars reached 95,000 units in September, up 214.5 percent year on year.

5. Data Collection and Analysis

5.1 Collection of Data

The paper collected BYD and Tesla closing prices from March 2017 to July 2022, as well as the exchange rate of the Chinese yuan against the US dollar. The data involved are from the Investing.com, China's National Bureau of Statistics, Sina Finance.

5.2 Analysis of Data

Table 1 Bata Coefficient Of Tesla

CPI	-0.612
Exchange rate (USD/RMB)	-0.244

Table 2 Bata Coefficient Of BYD

CPI	-0.173
Exchange rate (RMB/USD)	0.503

For China, a rising exchange rate means it is harder to export its goods and the value of the yuan rises. When the wealth of Chinese people rises, take BYD as an example and many other Chinese new energy vehicles are mainly consumed by Chinese people, which is a domestic product, leading to the rise of BYD's share price.

According to the data analysis shown in Table 1 and Table 2, a rise in the CPI means a rise in the inflation rate. But because people's wages change with a lag, they tend to buy necessities rather than cars. By comparing the beta coefficient of CPI in China and the United States, we can find that whenever the CPI changes by one unit, the reduction value of Tesla is smaller than that of BYD. Therefore, when the CPI rises and people's purchasing power declines but they have to buy an energy car, they will prefer to buy BYD rather than Tesla, which explains why the stock price of Tesla drops faster than that of BYD.

6. Conclusion

This paper argues that in order to improve the competitiveness of China's new energy vehicles, Chinese enterprises need to increase investment in technology, constantly attract talents, and break through technological bottlenecks such as batteries and chips. Due to the rising price of raw materials and the shortage of chips, the development momentum of new energy vehicles in Europe and the United States is slightly tired, but this phenomenon will not last, so China's new energy vehicle industry can not relax. At the same time, enterprises should intensify publicity efforts to make consumers aware that they can enjoy preferential policies when buying new energy vehicles, so as to improve public awareness and goodwill. As oil prices continue to rise and inflation continues, government subsidies can lower the price of new energy vehicles, thus attracting people who have bought or want to buy cars to choose new energy vehicles over traditional fuel cars.

References

[1] association, goods (2020) [Tomorrow's Theme Preview] Disruptive use experience, graphene battery “on board”, which companies have the related technology?, Investing.com. Investing.com. Available at: https://cn.investing.com/news/stock-market-news/article-1940804.

[2] association, goods (2022) Tomorrow theme foresight - the ultimate development direction of lithium battery, the largest solid-state battery production base in China has been put into production, Investing.com. Investing.com. Available at: https://cn.investing.com/news/stock-market-news/article-2122324.

[3] blue, plus (2017) A brief history of the development of hybrid vehicles, baidu library. Available at: https://wenku.baidu.com/view/cdc9e791bad528ea81c758f5f61fb7360b4c2bc6.html.

[4] da, da (2020) Development history of pure electric vehicles, zhihu . Available at: https://zhuanlan.zhihu.com/p/241477874?ivk_sa=1024320u.

[5] dongfang, bubai (2021) Understand the history of the development of the new energy vehicle, Zhihu column. Available at: https://zhuanlan.zhihu.com/p/348114846.

[6] International security, anxin (2022) Byd -01211.HK- Q3 results beat expectations _ sales and performancedoubleharvest,xiayanbao.com.Availableat:http://share.xiayanbao.com/info/9iiTAdE4MwZswJPJUSCXk6?refuid=noref.

[7] ren, huanhuan (2018) orientation, impact and anticipation of china CAFC&NEV credit regulation,Baidulibrary.Availableat:https://wenku.baidu.com/view/d6cecf3e7e1cfad6195f312b3169a4517723e5be.html.

[8] ruo, shansang (2018) The History of Automotive Fuel: The End of the 100-Year Fuel Era, baidu library.Availableat:https://wenku.baidu.com/view/eac3b52aecf9aef8941ea76e58fafab068dc4471.html.

[9] tan, che (2022) Domestic and foreign new energy vehicle development status, baidu article. Available at: https://baijiahao.baidu.com/s?id=1737110192370030974&wfr=spider&for=pc.

[10] securities, shouchuang (2022) Passenger car sales in September rose steadily from the previous month _ BYD _ Chery led the year-on-year growth, xiayanbao.com. Available at: http://share.xiayanbao.com/info/JgjYrRpEedJ8s6kCffrddJ?refuid=noref.

[11] zhao, jinyuan (2020) comparison of BP Neural Network and Multiple Linear regression Model for Carbon Emissions prediction. thesis.