The Stock Price Response of Major Electric Vehicle Companies to the Changes of Electric Vehicle Tax Credits

Minh Nguyen, Ethan Yuen

Abstract This research paper investigates the impact of tax credit changes on electric vehicle (EV) sales and the stock prices of automobile companies with a stake in the EV market. The study focuses on the announcement and implementation of increased tax credit qualifications in the United States. The primary companies analyzed are Tesla, Rivian, Nissan, and Ford, which account for a significant portion of the U.S. EV market. The research explores two possible responses by EV market leaders to the tax credit changes: reducing prices or making changes in production to accommodate the tax credit. The hypothesis suggests that tighter restrictions on EV tax credits will result in a drop in stock prices for affected automobile companies. The study utilizes the Capital Asset Pricing Model (CAPM) and cumulative abnormal returns (CARs) to analyze the data. The results show fluctuations in abnormal returns around the announcement and implementation events, with Tesla and Rivian experiencing more significant negative impacts. The average CARs around the events are not statistically significant, but the downward trend in CARs supports the hypothesis. The research provides insights into the effects of EV tax credit changes on stock prices and highlights the varying impacts on different EV manufacturers.

Introduction

Does tax credit positively impact EV sales? The majority view on this question appears to be that tax credit (in which tax credit is applicable to more people) will increase the number who consume or invest into Electric Vehicles (EVs). In lieu of Biden's '50% by 2030' proposal, researchers believe that these goals are likely to be exceeded, with the IRA and technology driving down manufacturing costs [1]. Driving down manufacturing costs would allow EV companies to produce more cars or reinvest into cleaner/more efficient energy vehicles. Furthermore, a 2015 study from Norway showed that incentives are "extremely influential" towards new vehicle buyers [2]. By providing a tax credit, the consumer of EVs can only benefit from such. Additionally, costs to 'refill' an electric vehicle are significantly cheaper than gas-powered cars largely due to the limited supply of gasoline and crude oil. Contrary to the studies, the changes we are observing will negatively impact cars that qualify for the tax credit, which may hurt sales. An assumption can be made that if people are not buying EVs, then they are buying gas-powered cars. Cheaper than clean EVs, gas-powered cars are the only current alternative. This could negatively impact the timeline of the projected 50% of new vehicle sales being electric by 2030.

In August of 2022, the United States Government amended the Inflation Reduction Act of 2022 to allow certain Electric Vehicles to qualify for a tax credit - also known as Clean Vehicle Credit [3]. Designed to curb inflation and promote clean energy, the Inflation Reduction act has made similar tax credits to provide incentives for clean energy, such as home tax credits, efficient home credits, clean vehicle credits, and more. Throughout 2022, the Clean Vehicle Credit qualifications have adjusted to reduce the number of qualified EVs. The most recent change was an increase in requirements, negatively affecting future EVs that can qualify for tax credit. On March 31, 2023, the U.S. Government announced more regulations to deny certain EVs tax credits. Both rules concern the battery: at least 50% of battery components must be assembled within North America, and at least 40% of all minerals must be from the US (or countries with trade agreements) [4]; these effects will continuously compound until 2027, where at least 80% of all minerals must be from the US or trade-agreed countries, and in 2029, where 100% of the battery components must be assembled within North America. Following, we see that April 17, 2023, was the implementation date for the tax credit modification [5]. From this there have been reductions, or complete disqualifications, of electric vehicles that qualify for the tax credit [6]. In this project, we will study how the stock prices of vehicle companies with a larger stake in the United States Electric Vehicle market have responded to the announcement and the implementation of increased tax credit qualifications.

Theory & Hypothesis

The EV tax credit changes provide an opportunity to examine how firms respond to immediate changes in relative price for shareholders. The restriction of EV tax credits will decrease incentives for consumers to buy electric vehicles, as they feel relatively more expensive [7]. In the following, we discuss two possible alterations to production that EV market leaders may implement in order to further provide incentives to buyers. First, the EV companies may reduce prices on cars depending on the amount of credit lost. By lowering the prices of the cars, the consumers will feel that the car is relatively cheaper than the original, and thus will return to consuming/buying these cars. The consequence of this would be the EV companies having lower profit margins. Second, EV companies may accommodate the tax credit by making changes in production. Accommodating the tax credit would imply changing mineral sources and production locations. By moving locations they must acquire a plant/production building, machinery, etc. Additionally, they would need to hire overseers, workers, and change sourcing. The consequence of this would be incurring costs in the short and long-term, increasing

costs and reducing the profit margin. On top of that, companies must continually change production and mineral in order to qualify for tax credits year-over-year; unless a company decides to comply with the maximum requirements of minerals and components set for 2027 and 2029 (respectively), the EV company must change sources and increase locations within the United States to compensate. This would lower future profit margins even further.

The companies we will observe are Tesla (TSLA), Rivian (RIVN), Nissan (NSANY), and Ford (F). These four companies account for over 60% of the United States EV market [8]. Furthermore, they were all impacted by the tax credit change, the most notable being Rivian, who saw all models drop qualifications down to half tax-credit, indicating that they satisfied either the component or mineral qualifications, but not both [9]. Conversely, Tesla, Ford, and Nissan had several models fully disqualified [**?**][10]. Tesla and Rivian are the only fully-EV companies, and so we should find that the EV tax changes will impact them the most in the long run. Ford, and Nissan have set goals to increase EV sales to 40-50% of all sales by 2030, and thus we can imply that tax credit changes will impact them more in the future.

From these possibilities, our hypothesis is that if restrictions on EV tax credits are tightened, then stock prices of automobile companies with a stake in EVs will drop upon the initial announcement and the publication of qualifying vehicles, assuming the companies' EVs are affected by the changes. To reflect public information, we should see all stock prices decrease. Either option - changes in production or changes in price - will result in current and/or future costs. Stock prices are assumed to be equal to the net present value of all future cash flows. By realizing less profit/incurring more costs, EV companies will have smaller profit margins, resulting in lower cash flows. This will lower the share prices of electric vehicle companies' stocks. Furthermore, the more a company relies on EV sales, we should expect a more negative impact on their stock price. We anticipate observing significant negative trend in abnormal returns for Tesla and Rivian following the announcement and implementation, indicating the sensitivity of their stock prices to EV policy changes. Ford and Nissan, as more diversified automobile manufacturers, will be less affected by the tax credit changes, leading to comparatively higher returns than Tesla and Rivian.

Data & Methodology

Our primary dates of focus are March 31st, 2023, and April 17th, 2023, representing the dates of announcement and implementation to the EV tax credit changes. Prior to performing data analysis, we will use Yahoo! Finance in order to gather stock data regarding Tesla, Nissan, Ford, and Rivian. For the market return, we will use the S&P 500 as our baseline. To perform the analysis, we use the CAPM Model,

$$r = r_f + \beta(r_m - r_f),$$

to predict returns in the ±10-day windows around the initial announcement and the publication of qualifying vehicles. Usage of the CAPM over the Fama French 3 Factor Model (FF3FM) is largely caused by the lack of data. The events happened less than a month prior to the paper, and thus we use the CAPM. We estimate the CAPM model in the 100 days prior to the event windows. By using 100-days rather than the typical 200-day window, we worsen our beta but improve the relevancy of the data. Once we obtain the returns of all stocks and market return, we calculate the abnormal returns for a stock by subtracting the stock return by the market return.

$$r_{abnormal} = r_{stock} - r_{market}$$

After obtaining the returns of all stocks, we can determine the market return; from there, abnormal returns for a stock are obtained by subtracting the stock return by the market return.

$$CAR_{i,-t,+t} = \sum_{j=-t}^{+t} AR_{ij}$$

We construct 3, 5, and 11-day CARs centered around both events and then test whether these

returns are statistically significant from zero by performing a regression. Should p-values be less than 5%, we can conclude that the data is statistically significant at a 95% confidence level, indicating that the events significantly impacted EV companies' stock prices. To calculate average CARs we take the average of the CARs. Following, we will graph several of these data points and compare the visual representation of them. We use Stata to perform analyses and generate graphs.

Analysis & Results

Abnormal returns seem to fluctuate without any clear trend around both the announcement (*Figure 1*) and implementation (*Figure 2*) of the tax credit tightening. However, there are big drops in abnormal returns of Tesla and Rivian, the EV-only manufacturers, from positive to negative right after each event. Especially, after the implementation and the information of eligible EVs was made public, the downward trend applies to all companies and lasts for at least two days, supporting our hypothesis. One thing to note is that Tesla has a significant drop in abnormal return three days after the implementation. This is because of Tesla's disappointing first-quarter earnings report released on that day [11]. Overall, Tesla and Rivian see higher fluctuations than Ford and Nissan, further supporting our predictions. We will now observe average CARs with different window lengths around the events to determine if there is a general trend for abnormal stock price changes.

Figure 1. Abnormal Returns by Brand Around the Announcement

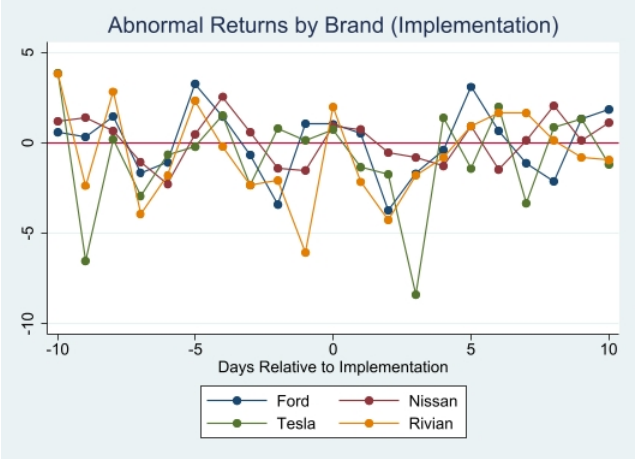

Figure 2. Abnormal Returns by Brand Around the Implementation

Contradicting with our hypothesis, the average CARs are positive around the announcement (*Table 1*). We can attribute those surprisingly positive average CARS to the contamination of the companies' first-quarter sales releases and future outlook reports [12] [13] [14] [15] [16]. The spike in the 5-day average CAR relative to others is most likely caused by the releases of those positive reports a day after the announcement. For the implementation, we see increasingly negative average CARs in window lengths (*Table 2*), suggesting a clear negative impact of the publicity of the new EV tax credit list on stock prices of EV companies. However, the average CARs for the announcement and implementation are statistically insignificant. Because we do not expect Ford and Nissan to be largely impacted by the tax credit changes, we will isolate Tesla and Rivian to determine

if they were statistically impacted by the announcement and implementation.

	(1) 3-day CAR	(2) 5-day CAR	(3) 11-day CAR
Average	1.308	4.799	0.650
	(1.01)	(1.79)	(0.20)
Observations	4	4	4

t statistics in parentheses
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 1. Average CARs with Alternate Event Windows of the Announcement

	(1) 3-day CAR	(2) 5-day CAR	(3) 11-day CAR
Average	-1.003	-5.119	-6.132
	(-0.53)	(-1.97)	(-1.57)
Observations	4	4	4

t statistics in parentheses
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 2. Average CARs with Alternate Event Windows of the Implementation

Similar to before, there is no statistically significant average CAR around the announcement (*Table 3*) or implementation (*Table 4*) even after isolating Tesla and Rivian. However, we can see the changes in magnitude and sign of the average CARs. The average CARs around the announcement are lower than before, except for the 5-day average CAR, suggesting Tesla and Rivian are more negatively affected by the changes by the tax credit tightening announcement. The 11-day CAR even changes its sign from positive to negative. The more positive 5-day average CAR can be attributed to the bigger impact of positive reports on stock prices of young companies like Tesla and Rivian. For the implementation, all average CARs are more negative when isolating Tesla and Rivian. This implies that the CARs of Ford and Nissan are higher than Tesla and Rivian around the implementation, suggesting Ford and Nissan are not as much affected by the publicity of new EV tax credits list. The next steps will be to observe the trend in CARs over time and determine whether Ford and Nissan have significantly higher returns relative to the fully-EV Tesla and Rivian.

	(1) 3-day CAR	(2) 5-day CAR	(3) 11-day CAR
Average	0.493	5.876	-0.111
	(0.24)	(0.91)	(-0.02)
Observations	2	2	2

t statistics in parentheses
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 3. Average CARs with Alternate Event Windows of the Announcement, Tesla and Rivian

	(1) 3-day CAR	(2) 5-day CAR	(3) 11-day CAR
Average	-2.645	-5.837	-10.10
	(-0.91)	(-1.04)	(-5.64)
Observations	2	2	2

t statistics in parentheses
$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 4. Average CARs with Alternate Event Windows of the Implementation, Tesla and Rivian

At first, it seems like the CARs fluctuate without any trend around the announcement in general (*Figure 3*). However, we can see a clear downward trend for Tesla and Rivian after the announcement, while there is no trend for Ford and Nissan. This also applies to the implementation (*Figure 4*). We can even see a more obvious declining pattern in CARs of Rivian and Tesla starting prior to the implementation, while Nissan and Ford maintain their CARs around zero. We can once again see a big drop in Tesla's CAR three days after the implementation as the result of its disappointing first-quarter earnings report released on that day.

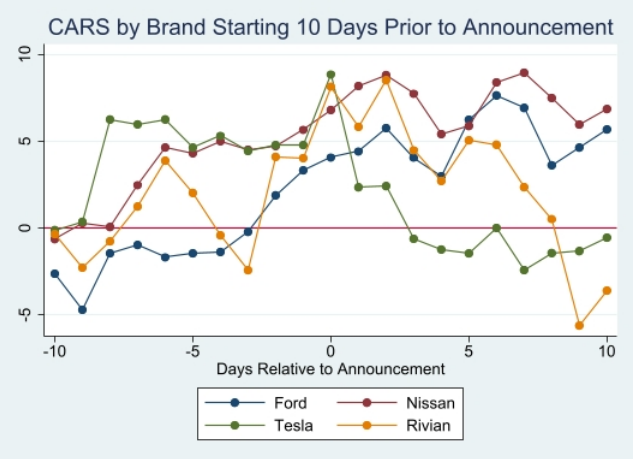

Figure 3. CARs by Brand, Starting 10 Days Prior to the Announcement

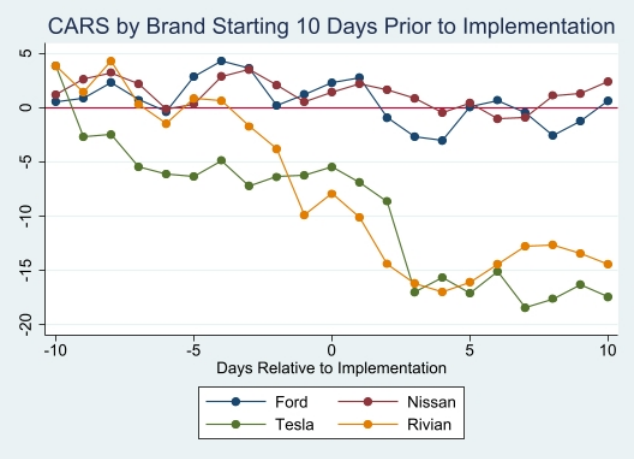

Figure 4. CARs by Brand, Starting 10 Days Prior to the Implementation

Around the announcement, the average CAR is almost always positive (*Figure 5*). The average CARs near the announcement date are even significantly positive, suggesting the dominating impact of the release of the first-quarter reports. Around the implementation, we see a downward trend in the average CAR (*Figure 6*). Especially, after the implementation, the average CAR declines and stays significantly negative, showing the impact of the public information of new EV tax credits.

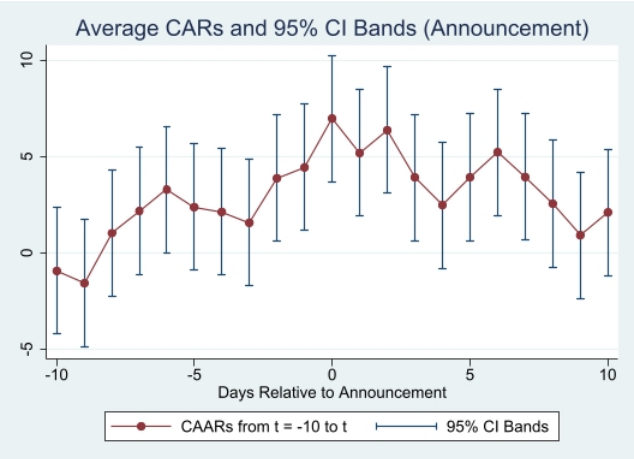

Figure 5. Average CARs Starting 10 Days Prior to the Announcement and 95% Confidence Interval Bands

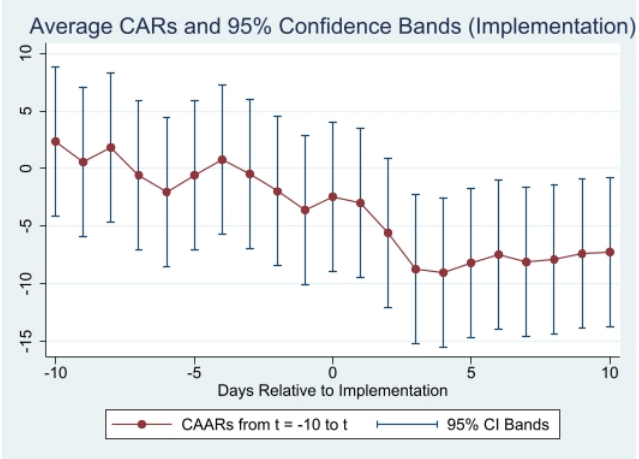

Figure 6. Average CARs Starting 10 Days Prior to the Implementation and 95% Confidence Interval Bands

To further examine whether Ford and Nissan have significantly higher returns relative to the fully-EV Tesla and Rivian, we will compare Ford and Nissan relative to Rivian. We choose Rivian rather than Tesla because Tesla's negative downturn after the implementation was contaminated with its earnings report as mentioned. We can see that Ford and Nissan have increasingly higher returns relative to Rivian after the announcement (*Figure 7*), but not significant until nine days after the announcement. For the implementation, the difference is more obvious (*Figure 8*). This supports our hypothesis that the more a company rely on EV sales, the more volatile their stock is to EV policy changes.

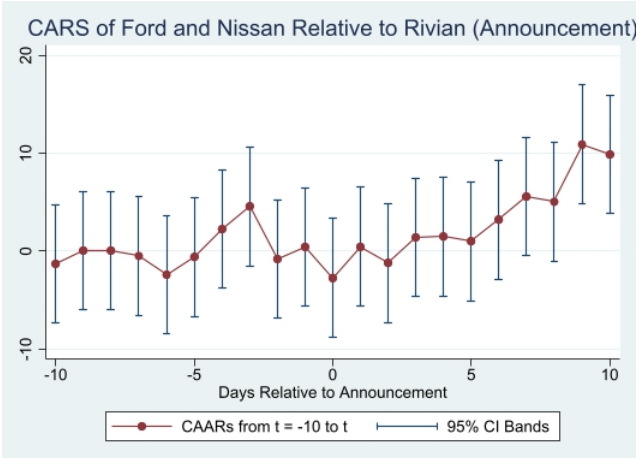

Figure 7. CARs of Ford and Nissan Relative to Rivian Around the Announcement

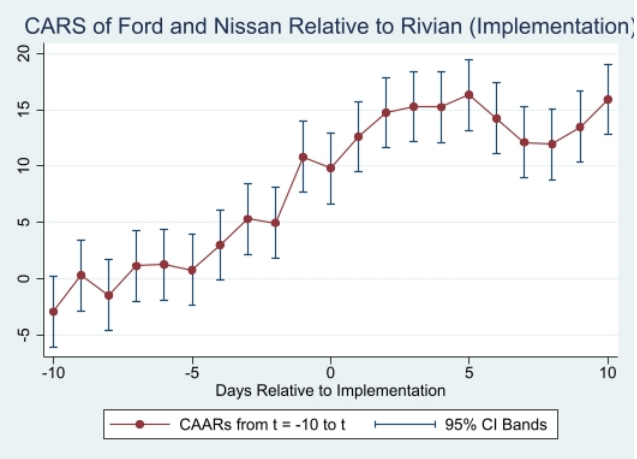

Figure 8. CARs of Ford and Nissan Relative to Rivian Around the Implementation

Conclusion

The findings of this research suggest that the tightening of tax credits for electric vehicles can have a negative impact on the stock prices of automobile companies involved in the EV market. While the average cumulative abnormal returns around the announcement and implementation events were not statistically significant, there was a clear downward trend in CARs for Tesla and Rivian, indicating the sensitivity of their stock prices to EV policy changes. On the other hand, Ford and Nissan, as more diversified automobile manufacturers, were less affected by the tax credit changes, leading to comparatively higher returns. These results support the hypothesis that tighter restrictions on EV tax credits can result in decreased stock prices for affected companies.

The study also highlights the potential responses by EV market leaders to tax credit changes, including price reductions and changes in production to accommodate the tax credit. Both options entail costs and potential reductions in profit margins. The findings underscore the importance of considering the impact of policy changes on the financial performance of EV companies and the need for strategic decision-making to navigate evolving regulations.

Overall, this research provides valuable insights into the relationship between tax credits, EV sales, and stock prices in the context of the United States EV market. The results contribute to the understanding of the effects of policy changes on the financial dynamics of the industry and can inform decision-making for both investors and EV manufacturers. Further research can explore additional factors and events that may influence the relationship between tax credits and stock prices, as well as the long-term implications of EV policy changes on the industry.

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