

Dynamic Changes in Exchange Rate Movements and Tesla Stock Yields

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ABSTRACT

From the perspective of globalization, the development of the new energy industry has become a key issue in the fields of economy and so on. Tesla Inc., one of the activists who intensively attempts to put new energy into car production, is increasingly dominating the market of the entire auto industry. However, it is difficult to manage its market share as there exist several economic uncertainties, especially exchange rate uncertainty which hinders the global economy from macroeconomic convergence. Therefore, unless can people accurately analyze the exchange rate, or it will be quite hard for them to make higher profits in the stock market. This paper mainly discusses the dynamic changes in EURUSD and CNYUSD and Tesla stock yields. Additionally, how the stock of the new energy industry fluctuates with exchange rates has also been considered. The result shows that CNYUSD has a more powerful influence on Tesla stock yields and marketers, therefore, should pay more attention to exports in China. It also concludes that exchange rates are highly correlated with the fluctuations in the new energy industry.

Keywords: Tesla, exchange rates, stock yields, new energy industry

1. INTRODUCTION

As global pollution becomes increasingly severe, the new energy industry will allow us to reduce industrial waste by replacing traditional energy with eco-friendly energy while ensuring the sustainable development of the energy industry. Accordingly, the application of new energy has become more sought-after worldwide. Tesla Inc., the world's first electric car company to use lithium-ion batteries, gradually plays a dominant role in the world automobile market. Currently, Tesla is leading the global car business to promise futurity with its emerging technology and competitive strategies. A recent study claimed that situations in the automobile industry have improved beyond all recognition after the emerge of Tesla Inc. [1]. Regarding pollution reduction and efficient use of energy as a business goal, Tesla formulates a detailed and feasible market strategy according to that goal and promptly translates it into action. Electric Vehicle (EV), a motor vehicle powered entirely by electricity, efficiently applies renewable energy into the production of automobiles [5]. This invention greatly facilitates the development of the global car business and minimizes car

emissions. Alternatively, the research showed that Tesla's consideration of its marketing strategy is also comprehensive [1]. Instead of continuing the traditional manufacturing business strategy, Elon Musk develops a more innovative business model. In general, Tesla hardly sees automobile production as a mechanized process. They tend to manufacture cars as software products. Resembling how Apple and Microsoft produce their products, Tesla automates its production by coding for specific software. To a large extent, this practice speeds up the pace of auto production and makes the purchase of vehicles an economical behavior. Tesla can somehow improve the car performance by merely updating its software capability, which is almost impossible for the other car business to do so. Furthermore, using software to advertise the products is beneficial. Not only can Tesla's labor cost and transaction cost be significantly reduced, but also can it simplify the buying process for customers. As a consequence, the research further proved that Tesla quickly surpassed numerous automobile industries with a market value of \$107 bn, in January 2020 and it becomes the world's second-largest automobile manufacturer, just behind Toyota [1].

Additionally, Tesla continues to expand its market globally by selling EVs in China and Europe, which gradually become two of the main export markets for Tesla.

However, this momentum creates two sides to Tesla's market value from the point of world economy and technology. As the advent of new technology is highly correlated with the fluctuation of the world economy, the market value of Tesla may be inflated by an uncertain change in both microeconomic and macroeconomic variables. To eliminate the negative effects arising from this uncertainty, Tesla should make an appropriate marketing strategy by considering several economic factors, such as exchange rates. According to the study presented by KABORO and MOSE in 2021, unpredictable price movements in the general economy are the major cause of exchange rate instability [2]. As a result, neither the domestic financial market nor the foreign financial market can avoid the relocation of resources and reversal of investment decisions derived from its instability. Particularly, cross-border companies will be subject to more restrictions under this circumstance while Tesla is one of the companies trading overseas. Cross-border companies mainly refer to set up branches or subsidiaries around the world by OFDI (outward foreign direct investment). The strategic goals of multinational companies are maximizing global profits. By setting up such companies, people can enjoy diversified services while paying lower transaction costs. Nevertheless, multinational companies' business could be seriously affected by fluctuations in exchange rates. Since one of the main functions of currency is the medium of exchange, therefore, exchange rate movements may have a straightforward effect on any transaction based on currency. One research mentioned that currency is frequently used when trading with foreign enterprises because it can be conveniently transacted in the financial market [3]. Consequently, there is a rather high possibility for cross-border trade settlement to be influenced by the exchange rate instability. In addition, the research also stated that many countries are considering creating another unified international monetary system as a solution to reduce the exchange rate risk [3]. After the 2007 subprime mortgage crisis, they realize that the dollar is incapable to protect them from unpredictable financial shocks.

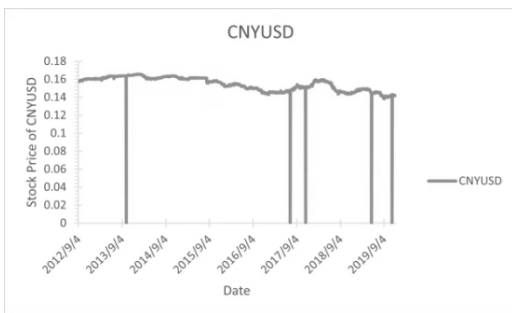


Figure 1 The trend of CNYUSD

The vertical lines in the graphs were caused by the missing value of the data



Figure 2 The trend of EURUSD

The vertical lines in the graphs were caused by the missing value of the data



Figure 3 The trend of Tesla stock price

The vertical lines in the graphs were caused by the missing value of the data

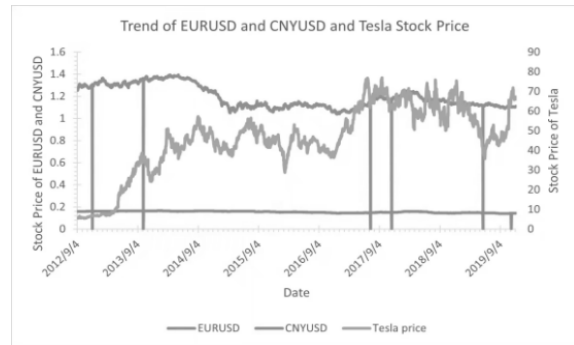


Figure 4 The trend of EURUSD and CNYUSD and Tesla Stock Price

Notes: EURUSD: Euro to Dollar
CNYUSD: CNY to Dollar

The graph (figure1, figure2, figure3, and figure4) above shows the trend of EURUSD and CNYUSD and Tesla stock price from September 2012 to December 2019. By ignoring the fluctuations which may generate from other economic variables, the graph generally indicates that both EURUSD and CNYUSD witnessed a downward trend from September 2012 to December 2019

whereas the stock price of Tesla saw an opposite trend during the same period. From this, the graph roughly shows that the stock price of Tesla increases in inverse proportion to the exchange rate. Therefore, accurate analysis of the exchange rate would benefit to achieve high profits in the stock market.

In this article, the relationship between EURUSD and USDCNY and Tesla stock yield will be studied since Europe and China are two main export markets for Tesla [1,4]. Moreover, the connection between exchange rate fluctuations and new energy industry market growth will also be included. The structure of this article is as follows: Part 2 describes the source of data and the use of the empirical model. Part 3 analyzes the results of the model. Part 4 provides the discussion related to the final output and a conclusion is made in part 5.

2. RESEARCH DESIGN

2.1 The source of the data

This thesis analyzes the effect between the exchange rate trend and Tesla price. EURUSD and CNYUSD are the two main exchange rates that are studied. All the daily data are collected from Yahoo Finance [6]. BplusSG states that Yahoo Finance is the number one financial website, providing the latest market information and

news daily, and is the largest financial news site in the United States on average monthly visits [7]. Hence, the Yahoo Finance database is significantly trustworthy. It is worth a mention that daily closing prices are the basic data that we used and studied in this research. Considering the effect of the novel coronavirus pandemic, this thesis studies the daily data(EURUSD、CNYUSD、Tesla price) from 4 Sept 2012 to 6 Dec 2019. During the long-term period, there does exist some deficiency in three main objectives. To ensure the accuracy of data-matching, we set date as the main consideration, and the existence of all three data(Tesla price、EURUSD、CNYUSD respectively) is indispensable. If not, the corresponding date would be ignored and not be studied.

2.2 The unit root test

To check whether the daily data of EURUSD、EURUSD return、CNYUSD、CNYUSD return、Tesla price、Tesla price return is stationary or not, this thesis does the test of the unit root to check them. Xia nan xing [8] put forward that we should determine whether there is a unit root in the time series before testing the time trend, and only after the unit root assumption is rejected, can a steady process with a trend be further studied. Table 1 shows all the results that all daily data are checked.

Table 1 ADF-test

	Test Statistics	1%Critical point	MacKinnon approximate p-value	Stationary or not
EURUSD	-7.108	-3.960	0.0000	stationary
EURUSD return	-31.253	-3.960	0.0000	stationary
CNYUSD	-13.217	-3.960	0.0000	stationary
CNYUSD return	-31.911	-3.960	0.0000	stationary
Tesla price	-30.186	-3.960	0.0000	stationary
Tesla price return	-30.213	-3.960	0.0000	stationary

Note: EURUSD return = ln(EURUSD,t)- ln(EURUSD, t-1); t=date
 CNYUSD return = ln(CNYUSD,t)- ln(CNYUSD,t-1); t=date
 Tesla price return = ln(CNYUSD,t)- ln(CNYUSD,t-1): t=date
 The output is statistic and the corresponding p-value, with no units.

From table 1, it is easy to check that all Test Statistics are smaller than 1% Critical points. The MacKinnon approximate p-value is all 0.0000. Hence, we could reject the null hypothesis and get the result that EURUSD、EURUSD returns 、CNYUSD、CNYUSD return、Tesla price、Tesla price return is stationary. The

examination of stock price and stock return is the guarantee of further research.

2.3 ARMAX model specification

ARMA model is used in financial analysis to predict the future by using past information and error terms.

When we introduce other explanatory variables into the ARMA model, we can get the ARMAX model which is used for predicting the future by using past information and error term and other exogenous variables which contributes to the changes of the future as well.

ARMAX model is composed basically of AR model and MA model. AR model is Autoregressive model which is used to deal with the time series. It uses the past information of variables to predict the variables. MA model is Moving Average Model. It is used to predict the variables by using the error term. By adding exogenous variables, AR model and MA model can be used to build ARMAX model.

The ARMAX model shows below:

$$x_t = \phi_0 + \sum_{i=1}^p \phi_i x_{t-i} + a_t - \sum_{i=1}^q \theta_i a_{t-i} + \gamma_{11}x_{1,t-1} + \dots + \gamma_{1q_1}x_{1,t-q_1} + \gamma_{K1}x_{K,t-1} + \dots + \gamma_{Kq_K}x_{K,t-q_K} \quad (1)$$

2.4 ARMA-GARCH model specification

GARCH model was used to analyze the volatility and it was more precise than the ARCH model which was also used to analyze the volatility of financial factors as well. The variance equation used in the ARMA-GARCH model showed below.

By adding the ARMA model into the GARCH model, we could predict the rate of return and volatility at the same time.

In our project, we used the exchange rate of EURUSD and CNYUSD as the exogenous variables of the ARMA-GARCH model. As the ARMA model was used in the ARMAX model as well, p and q in the ARMA-GARCH model were the same as the p and q in the ARMAX model.

3. EMPIRICAL RESULTS AND ANALYSIS

3.1 Results of ARMAX model

In this case, we used the exchange rate between CNY and USD and the exchange rate between EUR and USD to analyze the change of Tesla’s stock price. We used the exchange rate between EURUSD and CNYUSD as the exogenous variables and chose PACF and ACF to confirm p and q in ARMA (p, q), which was used to build the ARMAX model. Below showed the result of the PACF and ACF figures.

Below showed the results of the PACF and ACF

figures which were used to confirm p and q used in our modeling.

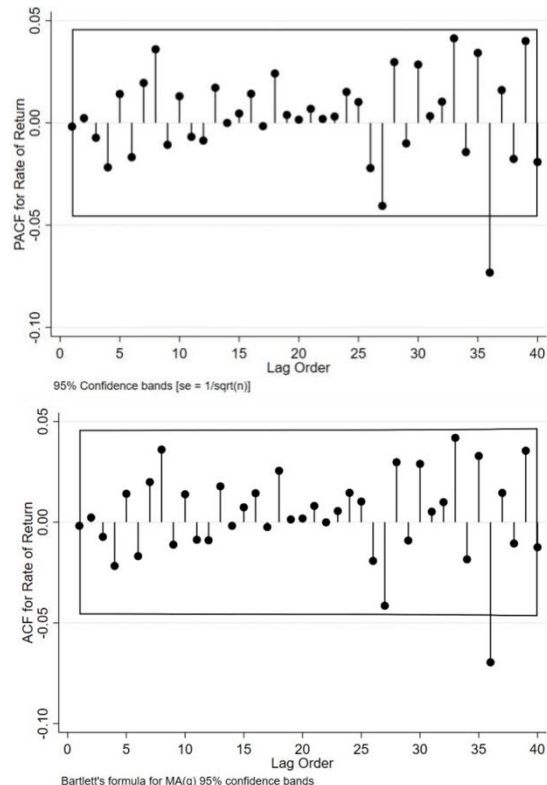


Figure 5 PACF and ACF test of ARMAX model.

Based on the PACF and ACF test above, p=36 and q=36.

Below showed the results of the ARMAX models.

Based on the results of the ARMAX model. The first three columns of results of the ARMAX model showed that the change of exchange rate between EUR and USD did not influence the stock price of Tesla significantly in the long run. And the last three columns of results of the ARMAX model showed that the upvaluation of CNY brings a significantly positive influence to Tesla’s stock price. In the fourth and fifth column of the ARMAX model’s result, the coefficient was 0.4945 and 0.5060, which were both remarkable on the 10% level.

Based on this result, CNY upvaluation would bring more influence to Tesla’s stock price compared with EUR. One possible reason for this situation might be Chinese consumers were more sensitive to the price of the products and this led to CNY influencing Tesla’s stock price more than EUR. However, the large volumes of the Chinese market could also cause this result.

Table 2 Empirical results, ARMAX model

	(1)	(2)	(3)	(4)	(5)	(6)
Rate of return, EURUSD						
T=0	-0.0872 (0.3558)	0.0087 (0.1486)	0.0067 (0.1503)			
T=-1		-0.0484 (0.1476)	-0.0353 (0.1485)			
T=-2			0.0643 (0.1510)			
Rate of return, CNYUSD						
T=0				0.4945* (0.2978)	0.5060* (0.3065)	0.4976 (0.3136)
T=-1					0.1495 (0.3487)	0.1531 (0.3506)
T=-2						-0.0148 (0.3434)
AR (-36)	-0.0872 (0.3558)	-0.1037 (0.3596)	-0.1027 (0.3395)	-0.0800 (0.3431)	-0.0921 (0.3481)	-0.0900 (0.3247)
MA (-36)	0.0198 (0.3599)	0.0364 (0.3639)	0.0313 (0.3436)	0.0098 (0.3478)	0.0226 (0.3531)	0.0153 (0.3294)
Constant	0.0014** (0.0007)	0.0014** (0.0007)	0.0014** (0.0007)	0.0014** (0.0007)	0.0014** (0.0007)	0.0014** (0.0007)

3.2 Results of ARMA-GARCH model and conclusions

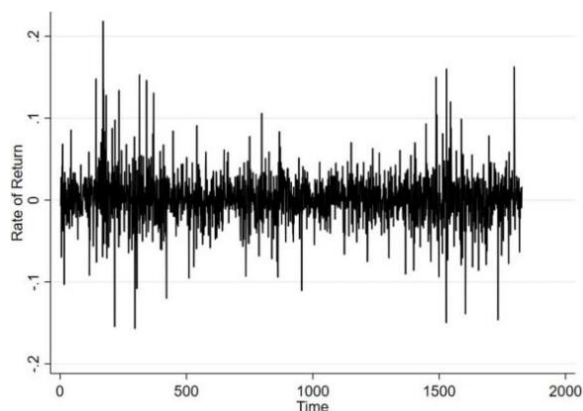


Figure 6 trend of rate of return of Tesla's stock

Note: This figure showed that the rate of return of Tesla's stock had heteroscedasticity.

By adding the exchange rate of EURUSD and CNYUSD into the variance equation, we found that from the order of magnitudes and significance, EUR and CNY influenced the rate of return of Tesla differently. The influence of the rate of return of Tesla caused by EUR was not significant while the change of CNY could cause a large influence on the rate of return of Tesla's price.

In this case, based on all the results above, on the background of the float exchange rate, it was a better choice for Tesla to concentrate more on China's market than the European market.

Table 3 Empirical results, ARMA-GARCH model

	(1)	(2)	(3)	(4)	(5)	(6)
Rate of return, EURUSD						
T=0	-12.1426 (111.2706)	-25.0291 (88.5206)	-29.9638 (165.1572)			
T=-1		22.4638 (114.5525)	56.9036 (64.8694)			
T=-2			-47.44315 (147.4761)			
Rate of return, CNYUSD						
T=0				224.8049*** (39.5522)	223.0493*** (21.7514)	-11.3414 (70.9484)
T=-1					-318.6449*** (26.2173)	215.5559*** (29.5974)
T=-2						-328.4546*** (32.9250)
ARCH	0.0247*** (0.0028)	0.2453*** (0.0030)	0.0245*** (0.0029)	0.0260*** (0.0030)	0.0133*** (0.0019)	0.0131*** (0.0019)
GARCH	0.9661*** (0.0046)	0.9663*** (0.0050)	0.9670*** (0.0048)	0.9640*** (0.0045)	0.9800*** (0.0026)	0.9801*** (0.0026)
Constant	-11.6437*** (0.3023)	-11.6684*** (0.3670)	-11.8270*** (0.3788)	-11.6883*** (0.2698)	-12.7662*** (0.3351)	-12.7964*** (0.3291)

The above showed the result of the ARMA-GARCH model. Similarly, after considering the influence of the exchange rate on to rate of return, we could consider the influence caused by the volatility of the stock price.

4. DISCUSSION

Indeed, the above contribution shows that both EURUSD and CNYUSD can affect the return of Tesla's stock. Yet, the impact of EURUSD on Tesla stock yield is in marked contrast to the CNYUSD. While EURUSD would only marginally affect the market return of Tesla, CNYUSD could considerably benefit its stock yield. This may imply that Chinese consumers are more sensitive to the change in commodity prices. According to the study showed by Cui in 1997, only a very small number of

Chinese can afford prohibitively high prices and most of them are successful entrepreneurs [9]. Therefore, the cost of living still is one important consideration for a large proportion of Chinese. This diversification simply makes Chinese consumers more susceptible when facing a price change. As a result, an increase in CNYUSD may have a significant positive impact on Tesla's profits. Turning to the analysis between exchange rate and volatility of stock price, it is obvious to find that they share a very slight difference from the former situation. EURUSD still plays an inconsequential role in determining the volatility of Tesla's stock price whereas CNYUSD can cause violent fluctuations in Tesla's stock price. Accordingly, the unpredictable movements of CNYUSD could bring a relatively larger shock to the stock market of Tesla.

As a consequence, a conclusion can be made that compared to Eurozone, focusing more on the Chinese mainland market is just an optimal choice for Tesla marketers. Keeping eyes on the trend of CNYUSD enables Tesla to develop a more effective and feasible market strategy and thus, gain an increasing profit by attracting more Chinese customers and extending its market scope locally. In addition, the fluctuations of Tesla's stock yield could maintain within a certain range if the marketers can accurately predict the future value of CNYUSD. This also makes it possible for Tesla to anticipate its market crisis and take corresponding avoidance measures.

Furthermore, it also can be concluded that the exchange rate undoubtedly affects the stock market. This impact includes the direction in which stock return changes and the degree to which stock yield fluctuates. However, this influence could be varied in different countries [10]. As people can see, CNYUSD has a correspondingly more significant impact on both Tesla's stock yield and the volatility of its stock price. If other exchange rates besides CNYUSD and EURUSD are introduced into the research, the results could be different. Moreover, as Tesla is the model of the new energy industry, the connection between its stock yield and exchange rates can indeed explain the overall effects of exchange rate instability on new energy industry market growth to some extent. Therefore, it could be beneficial for both new entrants and existing firms in the new energy industry to fairly consider the fluctuations of exchange rates in their target countries. For new entrants, they can deliberately decide which countries to join firstly. For existing firms, they can draw up a plan determining which markets to expand later and how to accommodate the preferences of residents.

5. CONCLUSION

This paper mainly focuses on the impacts of EURUSD and CNYUSD on Tesla's stock yield. The extended conclusion that how exchange rates' fluctuations connected with new energy industry market growth can also be summarized. The results from applying the empirical model, including the ARMAX model and ARMA-GARCH model, indicate that both Tesla's stock yield and volatility of its stock price have an inseparable relationship with EURUSD and CNYUSD. Among them, CNYUSD has a more powerful influence on the stock market of Tesla. Accordingly, considering more on the market in China could be a better choice for Tesla marketers.

A further conclusion can be drawn from this as Tesla is a typical example of a new energy industry.

Undoubtedly, the fluctuations of exchange rates are highly correlated with the market growth of the new energy industry. While it is worth noting that different exchange rates could have different degrees of impact on the firms existing in the new energy industry and also for those new entrants. Consequently, the market strategy should be formulated based on the firms' business goals.

People who are deciding whether to join the new energy industry could look at this article. This paper is just the case analyzing one of the most important factors which contribute to the success in the new energy industry. Investors who hold the shares in such types of firms can regard the exchange rate as an indicator to show whether there is an increase or a decrease in its market value and take precautions to hedge the risk in time.

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