Influence on Carbon Emission Price in Europe

Danning Zhao[(✉)]

School of Social Science, University of Manchester, Manchester M13 9PL, UK
2016150260@jou.edu.cn

Abstract. To achieve carbon neutralization, a carbon price is applied to encourage reducing carbon emissions and pollution. Yet the existing literature rarely considers the influence of investors' attitudes, exchange rate, and day-of-the-week effects on carbon emission prices. This paper investigated the impacts of the mentioned influences using a regression model from January 2020 to January 2022. We employed the CBOE VIX index as a measurement for investors' attitudes and sourced the price of EUA MO1 to represent the carbon emission price. Also, we analyzed the daily ratio of Euro to US Dollars as the impact of interest rate. We find that investors' attitude and the exchange rate has a positive relation to carbon emission prices, whereas day-of-week effects have a significantly negative impact on carbon emission prices.

Keywords: Carbon emission price · EUA · VIX index · Interest rate · Day-of-the-week effect

1 Introduction

Ever since the Industrial Revolution in the 19th century, economic growth has boosted massive carbon emissions- which leads to climate change and global warming. Brought by climate change, the sea level will go up because of the melting of glaciers, desert areas will become unbearable to live and so many on. In order to keep the global temperature from rising, 195 signatories joined the Paris Agreement. To reduce carbon emission, which is the main reason for global warming, economists consider introducing a carbon price as the most effective way to control carbon emissions. A carbon price not only reduces emissions but also raises funds to finance the clean-up activities.

The current study introduced the relation between carbon emission prices and fuel energy or policy-related. Yet there are few pieces of research concentrating on the financial market only, thus our analysis is strict on market and investor performance. Nowadays, there exists massive research on carbon emission prices around the globe, yet mainly focuses on the trading scheme and its influence. Despite the research on theoretical solutions to consummate carbon trading schemes, many researchers evaluate carbon emission prices using various pricing models. For example, Yuezhao Zhu and Hongxi Chen employed Black-Scholes model to analyze the EUADEC-11 prices [1].

As for the factors that influence the carbon emission prices, some scholars cut to the point through the relation between supply and demand. Mansanet-Bataller et al., Alberola et al., and Alberola and Chevallier document that the determinants of the emission market

are: institutional events, energy prices, weather events, and macroeconomic variables [2–4]. Other scholars directly analyze how the influencing parameters can affect carbon emission prices. Convery and Redmond reveal that the changes in energy prices impact the development of EUA prices the most [5]. Wenjun Guo claimed interest rate is also a key factor in carbon emission prices [6]. In the financial literature, the interest rate is widely debated when analyzing prices and returns. Manganelli and Wolswijk study the spreads between Euro area governments' bond yields and find that it is related to short-term interest rates [7]. Thus, we think the interest rate is an influencing component in our model.

2   Data Introduction

To investigate what influences carbon emission prices in Europe, we selected the data VIX, EURUSD BGN Curncy, as well as EUA MO1 price. Here, we specify our date range from January 1st 2020 to January 1st 2022. All data are collected from Bloomberg Database.

The dependent variable is set to be the returns of EUA MO1 closing daily price. Generic 1st Carbon Future Contract, "MO1 Commodity." data is collected from Bloomberg Commodity Pricing. By setting the ratio of the difference of two consecutive year and previous prices to be the return of carbon emission prices, we then move on to test the relations. To correspond with emission prices, all other factors are collected from the database in Euro.

Figure 1 shows the carbon emission prices-EUA MO1- between January 2020 to January 2022. Overall, the price continues to go up despite there are some small fluctuations. The lowest price is on March 18th 2020, whilst the highest price occurs on 8th December 2022.
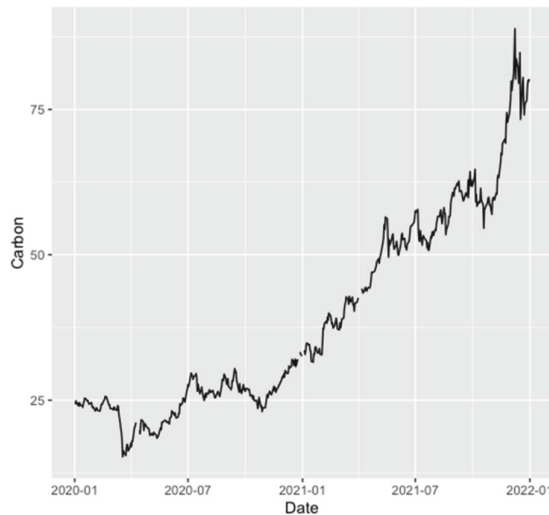

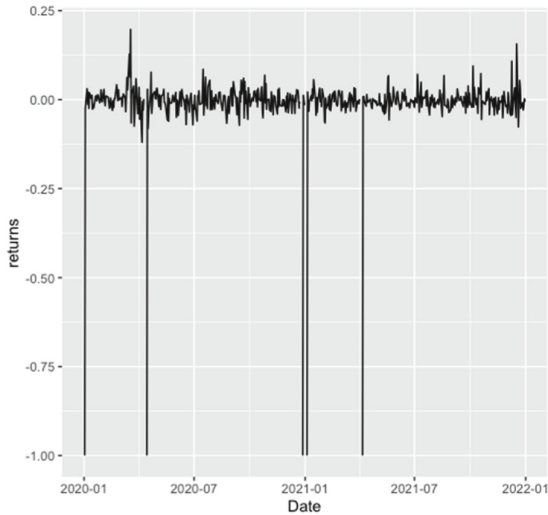**Fig. 1.** EUA MO1 price between 2020 and 2022

Fig. 2. Daily price returns of EUA MO1 prices

Figure 2 states the returns of daily prices. We can see that there has been some time with negative returns within the time period. In following testing, we use prices returns to do regressions.

VIX, which is known as the Chicago Board Options Exchange's CBOE Volatility Index, measures market's expectation of volatility based on S&P500 index over the coming 30 days [8]. Investors also use VIX to measure the level of risk, fear, or stress when making investment decisions. The more dramatic the price changes in VIX, the higher the level of volatility- which also emphasizes higher risk and uncertainty there is in the market. VIX normally affects options' prices and premiums: a higher VIX means a higher price for options. Hence, here we would like to testify whether VIX has impact on carbon emission prices [9].

Figure 3 shows the VIX price surged to its highest until 16th March 2020. And VIX fluctuated from February to May 2020 and continued to remain high until June 2020. The VIX index price gradually stabilized after January 2021.

Currencies are correlated to some commodity prices since exports and economic growth are directly related to the domestic industry. Thus, knowing the relationship between currencies and commodities helps investors understand and predict market movements. Thus, in this paper, we analyze the relationship between carbon emission prices and exchange rates. Here to simplify the process, we chose the ratio of Euro to US Dollar to represent the movement of the foreign exchange rate in the given time series.

Figure 4 shows the exchange rate of Euro to US Dollar from 2020 to 2022. Euro devaluated during the outbreak of the pandemic in January 2020, and fluctuated from March 2020 to July 2020. The ratio of Euro to US Dollar increased from July 2020 to January 2021. And the ratio then roar after a short decrease between January 2021 to May 2021. Then the exchange rate continuously plummeted.
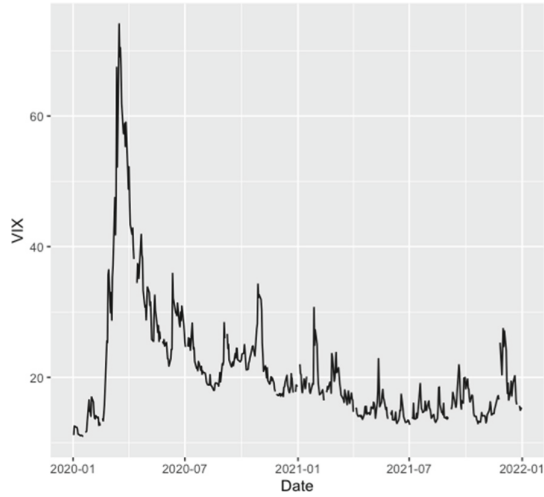
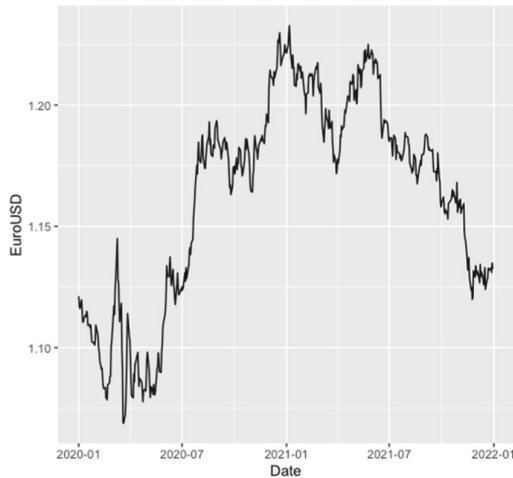**Fig. 3.** VIX index price from 2020 to 2022

Fig. 4. Exchange rate of Euro to US Dollar

As the Monday Effect suggested, the returns of stocks and the market on Monday are basically like that on the previous Friday. Yet the Weekend Effect states the returns usually reduce more when the market opens on Monday because of the negative and disappointing news that happened throughout the weekend. Furthermore, some studies have examined the dependency of different days in a week on the prices of certain stocks and instruments. Jaffe et al. found significant negative returns on Monday in the US, Canada, and the UK [10]. Here we would like to extend the examination of Monday returns- to see if the prices on Mondays are significantly higher than those on other days [11].

3   Methodology

This section will describe the models applied to test the multiple factors' influence on carbon emission prices. The effects can be explored by using the regression model, firstly we would employ the standard OLS regression model.

In order to perform a regression analysis, we made the following hypothesis:

Hypothesis 1: VIX index will influence carbon emission price.

Hypothesis 2: Exchange rate between Euro and US Dollar will influence carbon emission price.

Hypothesis 3: It's better to transact on Monday than other day in a week.

For each source of factor, a multiple linear regression model is employed:

$$Y_t = \sum_{m=1}^{i} \beta_m X_m + \varepsilon = \beta_0 + \beta_1 VIX + \beta_2 EuroUSD + \beta_3 Monday + \varepsilon \tag{1}$$

where, Y_t is the return of carbon emission prices (EUA MO1).

4   Empirical results

Table 1 Represents the output of standard OLS regression.

Based on the output of the OLS regression, we can see that VIX has a positive relation to the carbon emission price- which corresponds that the higher the VIX leads the higher price. So, when there is more risk and uncertainty in the market, a higher price emerges. Also, the exchange rate between Euro and US Dollar has a positive impact on the price: the higher the ratio of Euro to US Dollar, the higher the price will be. The carbon emission price has a negative Monday effect, which means the transactions that

Table 1. Output of standard OLS regression

		Intercept	VIX	EuroUSD	Monday
Coefficients		−0.0329290 (0.1509064)	0.0005888 (0.0005501)	0.0108575 (0.1246751)	−0.0200094 (0.0119188)
t-value		−0.218	1.070	0.087	−1.679
p-value		0.8274	0.2850	0.9306	0.0938
Adjusted R^2	0.002244				

Table 2. Result of linear hypothesis test

	RSS	Sum of square	F test	p-value associated with F test
Restricted Model	5.4018			
Regression Model	5.3574	0.044395	1.3756	0.2494

happen on Mondays have a lower price than on other days in the week. The F-test is statistically significant, which means at least one variable in the model is significantly different than zero.

Also, we obtained the fitted values and residuals to be -5.786681 and $7.359564e-16$ respectively. And we have reached the conclusion that the residuals are uncorrelated with all the explanatory variables, as well as the fitted values and residuals are uncorrelated.

It has long been debated that the homoscedasticity assumption of OLS is likely to be violated in the context of finance literature or to say stock returns. If the assumption is not satisfied, the standard errors and thus conclusions inferred from the model could be wrong (Brooks, 2002) [12]. Thus, we have performed the Breush-Pagan test. The test statistics is 1.623 with the corresponding p-value to be 0.6542. Since the p-value is significantly high and is not less than 0.05, we fail to reject our null hypothesis as a result. We do not have sufficient evidence to claim there exists heteroscedasticity in this model.

Table 2 shows the result of linear hypothesis test. Here we fix our null hypothesis to be the coefficients of all three parameters- VIX, EuroUSD, Monday- to be zero. The p-value of our OLS model 0.2494 is statistically significant, hence we do not reject our null hypothesis.

5 Conclusion

The findings of the analysis lead to the positive influence of investor fear as volatility and exchange rate between currencies, and the negative influence of different days of the transaction within the week. The higher the volatility that VIX has shown, the higher the carbon emission price is. Also, the higher the exchange rate of domestic currency to foreign currency is, the higher the carbon emission price will be. Yet Mondays tend to have relatively lower carbon emission prices than other weekdays.

The main limitation of this research is that the present study is not conducted through the comparison of different models, as each model have its own strengths and weakness. Future analysis will fill such a gap. Moreover, future analysis will extend the data chosen within the longer time period and different representative data for each source.

References

1. Y. Zhu, H. Chen, Z. Zhao, Analysis on Carbon Emissions Trading using B-S pricing model, The Science& Technology Progress and Policy, 2013, 30 (5),:27–30
2. M. Mansanet-Bataller, A. Pardo, and E. Valor, 2007, CO_2 Prices Energy and Weather ,The Energy Journal, 28 (3), pp. 67-86
3. E. Alberola, J. Chevallier, and B. Chèze, 2008, Price Drivers and Structural Breaks in European Carbon Prices 2005-07, Energy Policy, 36 (2) , pp. 787-797
4. E. Alberola, and J. Chevallier, 2009, European Carbon Prices and Banking Restrictions: Evidence from Phase I (2005-2007) ,The Energy Journal, 30 (3) , pp. 51-80
5. F.J. Convery, L. Redmond, 2007, Market and price developments in the European union emissions trading scheme. Review of Environmental Economies and Policy 1, pp.88-111

6. Wenjun Guo, 2015, Research on the influencing parameters on carbon emission prices in China- Based on Lasso Analysis. Chinese Journal of Population, Resources, and Environment, 25(5)
7. S. Manganelli, and G. Wolswijk, 2009, Economic Policy, 24 (58) , pp. 191-240
8. Cboe, "VIX Volatility Suite, https://www.cboe.com/tradable_products/vix/."
9. Robert E. Whaley, 2009, Understanding the VIX. The Journal of Portfolio Management Spring, 35 (3) 98-105
10. J. Jaffe, and R. Westerfield, 1985, The Weekend Effect in Common Stock Returns: The International Evidence. Journal of Finance, vol. 40, pp.433-454
11. Le Long, Hau., 2010, Day-Of-The-Week Effects in Different Stock Markets: New Evidence on Model-Dependency in Testing Seasonalities in Stock Returns. Development and Policies Research Center (DEPOCEN), Vietnam, Working Papers.
12. C. Brooks, 2002, Introductory Econometrics for Finance. Cambridge, New York: Cambridge University Press.