On the role of financial investors in carbon markets: Insights from commitment reports and carbon literature

Maria Mansanet-Bataller* and Ángel Pardo**

Version 29 March 2023

*Maria Mansanet-Bataller, maria.mansanet_bataller@univ-fcomte.fr. Université de Franche-Comté, CRESE, F-25000 Besançon, France

**Corresponding author: Ángel Pardo, angel.pardo@uv.es, Department of Financial Economics, Faculty of Economics, University of Valencia, Avenida de los Naranjos s/n, 46022 Valencia, Spain, Tel.: +34 963 828 369, Fax: +34 963 828 370

Abstract

Several papers by academics and various reports by financial analysts suggest that non-compliance traders, mostly investment funds and firms, are manipulating the EU ETS and causing EUA prices to rise. In response, the European Commission has mandated the European Securities and Markets Authority (ESMA) to investigate whether "certain trading behaviours would require further regulatory actions" (ESMA, 2021). The objective of this paper is (i) to analyse the participation of non-compliance traders in the EU ETS and their role in the financialisation of the scheme, and (ii) to contribute to the debate on price manipulation by the non-compliance sector in the EU ETS. Both our analysis of the EUA Commitments of Traders reports and our review of the main findings of the empirical papers on portfolio management with EUAs suggest that non-compliance traders mainly take short positions in the European carbon futures market in order to arbitrage the spot market. Only a small portion of the long positions are used by financial investors to diversify or hedge risks coming from financial markets. Therefore, in both situations, non-compliance traders would be acting as long-term liquidity providers rather than speculators.

Keywords: arbitrage, diversify, EUA, financialisation, hedge, speculate

JEL Classification: G15, G20

Acknowledgements: We are grateful to Simon Quemin and Michael Pahle for providing us the missing data on the ESMA database. We also thank Neil Larsen for his linguistic support. The contents of this paper are the authors' sole responsibility.

1. Introduction

A typical topic in the literature on commodity markets is the influence of the trading activity of financial players in derivatives markets on the prices and volatility of the underlying asset. When non-commercial trading activity becomes a significant part of derivatives trading, concerns about the well-functioning of the derivatives market and its impact on the spot market are often raised in the media, regulatory reports and academic papers. The European Carbon Futures Market (ECFM) has also been affected by this issue. The recent increase in ECFM trading volumes and the vertiginous rise in carbon prices observed since 2021 have reignited the debate about the role of financial institutions in the European Union Emissions Trading Scheme (EU ETS) and the impact of their trading activities on carbon prices and volatility.

Some recent studies have raised concerns about the financialisation of the ECFM. Berta et al. (2017) provided an estimate of the allowance transfer needs of installations to achieve compliance and showed that as market activity increased, compliance transactions became increasingly marginal and eventually drowned in a vortex of speculation. They concluded that the compliance market has been overshadowed by the hedging-speculative derivatives market. In the same vein, Bua et al. (2021) said that the surge in carbon prices may reflect speculation by some market participants who are taking long positions in the EU ETS market in anticipation of further price increases in the coming months. In addition, Refinitiv's Carbon Market Report (2022) states that "some stakeholders argue financials' speculative activity constitutes market manipulation and causes the higher EUA prices". Finally, Quemin and Pahle (2022) indicate that while financials perform several necessary market functions, excessive speculation in the ECFM can undermine market functioning through increased price volatility, price bubbles or manipulation. Furthermore, they point out that these

concerns are even more pertinent in a politically created market such as the carbon allowance market.

Recently, the European Securities and Markets Authority (ESMA) indicated in a preliminary report on emission allowances and their derivatives (ESMA, 2021) that the number of position holders in EUA futures increased more rapidly in the category of investment firms than in the category of compliance entities and other non-financial entities between 2018 to 2021. In light of this evidence, the European Commission asked ESMA to assess whether certain trading behaviours would require further regulatory measures. In its final report on emission allowances and their derivatives, ESMA (2022) concluded that the analysis of the data had not unearthed any major abnormality or fundamental problem in the functioning of the EU carbon market from a financial supervisory perspective.

This paper examines the trading strategies of financial investors in the ECFM and contributes to the debate on the role of financial investors in the EU ETS. Specifically, we investigate the financialisation of the carbon market from a new perspective, not only analysing the evolution of trading and counterparties in the EU carbon markets through the study of weekly Commitments of Traders (COT) reports, but also reviewing the main findings of the carbon finance literature focused on the investment strategies of non-compliance traders in the ECFM. Both analyses suggest that non-compliance traders mainly take short positions in order to arbitrage the spot market. Only a small proportion of the long positions are used by financial investors to diversify or hedge risks arising from financial markets. In such situations, non-compliance traders are acting as long-term liquidity providers rather than speculators. These findings are of great interest not only to researchers and market participants, but also to policymakers and regulators.

We proceed as follows. Section 2 describes the main features of the EU ETS, focusing on the major regulatory changes that the system has undergone since its inception. This section also outlines the ESMA reporting system that has been used to collect data on the positions of carbon traders and analyses their evolution. Section 3 summarises and discusses the main findings of the papers in relation to possible strategies followed by financial players in the ECFM. In particular, financial participants may use the European Union Allowance (EUA) as a speculative asset, an inflation hedge, a diversifier, a hedge, a safe-haven asset and to realise arbitrage opportunities. Section 4 concludes.

2. EU ETS specificities and the role of non-compliance entities

2.1. Regulatory changes

Since its inception in 2005, the EU ETS has attracted the attention of the media as well as many academics, traders and other stakeholders. The carbon market was born with the goal of dying. If the European Union is able to meet its greenhouse gas reduction targets (carbon neutrality by 2050), the carbon market should disappear. Putting a price on the right to emit one tonne of CO_2 equivalent into the atmosphere is a challenging and engaging task in itself. But there are other reasons why the EU ETS is attracting so much interest.[1]

First, the EU ETS is a politically created market where supply is predetermined and therefore completely inelastic. It depends on political decisions, leading to significant regulatory uncertainty that has affected EUA prices (see Mansanet-Bataller and Pardo (2009), Koch et al. (2016) and Fan et al. (2017), among others). Specifically, according

[1] For complete information on the EU ETS, see https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en. (Last accessed in February 2023).

to Bua et al. (2021), the main regulatory changes generated during the four phases of its operation are related to the following issues: (i) the scope and sectors of application; (ii) the way allowances are distributed (auctions or free distribution); (iii) the supply of allowances (cap) of the emissions system; and (iv) the creation of the Market Stability Reserve (MSR).[2] It is important to underline that the objective of each regulatory change introduced by the European Commission has been to strengthen the European Union's main policy against climate change by providing the EU ETS with the necessary tools to achieve its objectives, which can be summarised in three ideas: (i) reducing CO_2 emissions, (ii) promoting clean technologies, and (iii) developing energy efficiency, by setting an appropriately high price on carbon emissions. It should be noted that until 2018, prices were considered too low to tackle climate change, and this situation led to the introduction of the MSR at the end of Phase III.

In line with this, the cap of the emissions system has also been tightened since the start of the scheme: in Phase III, a reduction path for annual European emissions was established at a rate of 1.74%, which was increased to 2.2% in Phase IV. In July 2021, a revision of the EU ETS was proposed as part of the ambitious "Fit for 55" initiative, which, together with other policy measures, aims to reduce total GHG emissions by 55% below 1990 levels by 2030.[3]

[2] The objective of the MSR is to deal with the surplus of allowances and it is used as a supply adjustment mechanism to increase the system's resilience to major shocks. The system operates according to pre-defined rules that adjust auction volumes, thereby changing the total number of allowances in circulation. The MSR is a rule-based mechanism that seeks to address market imbalances by making the supply of allowances flexible in relation to the number of unused allowances banked in the system. The idea is to remove or reintroduce EUAs into the market, taking into account the total number of allowances in circulation. Arguably, the MSR is the main driver of the huge increase in carbon prices since its introduction in 2019. Specifically, the MSR (i) reduces annual auction volumes by 12% (24% over 2019-23) by drawing allowances into the MSR if the cumulative surplus exceeds 833 million allowances; (ii) increases auction volumes by 100 million allowances by injecting allowances from the MSR if the surplus falls below 400 million allowances or if allowance prices over a six-month period are three times higher than the average of the preceding two years; and (iii) from 2023 onwards, invalidates allowances in the MSR in excess of the previous year's auction volumes.

[3] See COM (2021) 551: Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757.

Second, although EUAs were freely distributed during Phase I, they are now mainly distributed through auctions. The consequence of this important change is that, as explained in the next section, the EU ETS is organised into a primary market, in which Member States sell EUAs through auctions, and a secondary market, in which EUAs are traded through organised platforms.

Third, MiFID II establishes emission allowances as a specific category of financial instruments under point (11) of Section C of Annex I of the Directive 2014/65/EU, and lists derivatives of emission allowances under point (4) of Section C of the said Annex.[4] It should be noted that the classification of the EUA as a financial asset on the spot market seems contradictory at first sight, since it behaves like a commodity in the sense that it can be considered as an input in the production process of other goods or services. In fact, some of the key characteristics of EUAs make them a special asset class. Unlike physical commodities, the cost of storing allowances is low and there is no obvious benefit to holding allowances. Also, unlike other financial assets, the real underpinning of the scheme, namely the needs of compliance entities, can be estimated (see Berta et al. (2017)).

Finally, emission allowance derivatives do not fall within the definition of commodity derivatives under MiFID II and, therefore, although they are subject to weekly position reporting of commitments of EUA traders to ESMA, they are not required to maintain position limits. A position limit is defined as the maximum position in futures contracts that a trader can hold on one side of the market. These limits are usually imposed by regulators to prevent trading irregularities. In the case of physically settled futures

[4] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0065 for the consolidated version. (Last accessed in February 2023) and see the legal point of view of the EU ETS at https://www.emissions-euets.com/. (Last accessed in May 2022).

contracts, such as in the ECFM, a common form of market power manipulation is to corner the market, which involves accumulating a significant number of long futures positions until the contract expires, with the intention of demanding delivery of more assets than are available in the spot market. This manipulative practice is difficult to extrapolate to the ECFM given that, as we will show, most of the long futures positions open to expiration are held by compliance entities that want to buy EUAs to comply with the regulation.

As the introduction of position limits always reduces market liquidity, policymakers should confirm that trading by financial market participants actually affects volatility or price levels before imposing such limits. In this regard, ESMA (2022), in its final report, assesses the possibility of establishing position limits. On the one hand, it indicates that the introduction of position limits to prevent the build-up of large derivative positions would therefore be appropriate for derivatives on emissions allowances in order to limit the risks of manipulative behaviour. However, it also states that the introduction of position limits may reduce liquidity in the emissions derivatives market, thereby contributing to increased volatility and reduced market resilience. Therefore, ESMA's position on the imposition of position limits on EUA futures contracts is inconclusive.

2.2. Trading on the EU ETS

The EU ETS is organised into a primary and a secondary market for EUAs. On the one hand, the primary market for emission allowances mainly consists of auctions in which, in addition to compliance entities, most categories of market participants can participate (e.g., credit institutions, investment firms, investment funds, commodity trading firms without compliance requirements, among others). Most Member States

have jointly chosen the German regulated market European Energy Exchange (EEX) as the common platform for auctioning allowances under the EU ETS. The EEX organises the auctioning of two types of allowances: EUAs and EU Aviation Allowances (EUAA).[5] The auctions take place on a daily basis according to a fixed calendar, the contract size is one allowance, and the minimum lot size is 500 EUAs.

On the other hand, the secondary market for emissions allowances consists of (i) contracts with a daily expiry, called "daily futures" or "spot"; (ii) futures with various maturities; and (iii) options on EUA futures. All derivatives have a standardised contract size of 1,000 allowances (i.e. 1,000 tonnes of CO_2) rather than the 500 EUA contract size in the auctions. Secondary markets play an important role by allowing compliance buyers to acquire allowances without having to take part in the primary auction. It is important to note that the EUA secondary market may have the same type of market participants as the primary market. As mentioned in Section 2.1, the EUA and its derivatives are subject to the regulation of ESMA. Therefore, it would not be surprising to find that market participants in both the primary and secondary markets include not only compliance entities, but also credit institutions, investment firms, investment funds and trading firms without compliance requirements.

Three European trading venues provide a secondary market for the EU carbon market: EEX in Germany, ICE Endex in the Netherlands and Nasdaq Oslo in Norway.[6] Following Brexit, the EU carbon secondary market on ICE completely migrated from the UK's trading venue ICE Futures Europe to the Dutch entity ICE Endex in June 2021. Since then, UK ETS allowances have been available for trading on ICE Futures

[5] The EU Aviation Allowances are the right to emit one tonne of CO_2 equivalent by the aviation sector.
[6] The full specifications about the EUA-related contracts traded in these venues can be seen at https://www.eex.com/en/markets/environmental-markets/eu-ets-spot-futures-options; https://www.theice.com/products/?filter=eua; and https://www.nasdaq.com/solutions/eua-carbon-emission-futures-options. (Last accessed in May 2022).

Europe. It is important to note that the ICE December futures contracts concentrate most of the ECFM negotiations and, as a result, the price of the futures contracts expiring in that month is widely regarded as the European carbon price benchmark.

In Fig. 1, we show the evolution of EUA futures prices for the four phases until the end of 2022. Focusing on the last five years, we see that EUA prices have increased from €8 per tonne at the beginning of 2018 to around €85 in December 2022. This period is characterised by (i) the price drop in March 2020 due to COVID-19 lockdowns; (ii) the price rally observed in 2021, during which around forty price records were recorded, fuelled by the "Fit for 55" target; and (iii) the all-time high of nearly €100 at which the December 2022 futures contract settled on 4 February 2022.

(Please, insert Fig. 1)

According to Bua et al. (2021), the price increases observed in 2020 and 2021 may reflect a rise in energy demand due to weather conditions and the reopening of the economy after the lifting of the COVID-19 pandemic-related restrictions, as well as speculation by some market participants who anticipated further price increases in the following months. However, Refinitiv's Carbon Market Report (2023) argues that prices in 2022 were mainly influenced by the policy drivers of the EU ETS, which were strongly linked to energy fundamentals.

2.3. Report of Commitments of EUA traders

Since January 2018, ESMA has published weekly commitments of trader reports in accordance with Article 58(1)(a) of Directive 2014/65/EU (MiFID II), which states that Member States shall ensure that an investment firm or a market operator operating a trading venue that trades commodity derivatives or emission allowances or derivatives

thereof make public a weekly report. This report, known as the weekly Commitments of Traders (COT), must indicate the aggregate positions held by the different categories of participants, specifying the number of long and short positions by such categories, changes with regard to the previous report, the percentage of the total open interest represented by each category and the number of persons in each category.

Specifically, following Article 58(4), participants holding positions in an emission allowance or derivative thereof shall be classified by the investment firm or market operator operating that trading venue according to the nature of their main business as: (a) investment firms or credit institutions; (b) investment funds; (c) other financial institutions, including insurance undertakings and reinsurance undertakings; (d) commercial undertakings, and (e) operators with compliance obligations under Directive 2003/87/EC. Note that the first three categories (a, b and c) are financial institutions.

Furthermore, Commission Implementing Regulation (EU) 2017/1093 specifies that the reports shall differentiate between positions (identified as (i) positions which in an objectively measurable way reduce risks directly relating to commercial activities, (ii) other and (iii) total positions), in order to provide transparency on the split between financial and non-financial related activities. It is important to note that financial institutions cannot hold positions deemed risk reducing, and the corresponding trading venues will reject records that attempt to report the positions of any financial investor as risk-reducing.[7]

[7] Article 83 of Commission Delegated Regulation (EU) 2017/565 of 25 April 2016 on position reporting indicates that the obligation for a trading venue to make public such a report shall apply when 20 open position holders exist in a given contract on a given trading venue. This threshold is applied in aggregate on the basis of all of the categories of persons regardless of the numbers of position holders in any single category of persons. For contracts where there are less than five position holders active in a given category of persons, the number of position holders in that category shall not be published. ESMA shall proceed to a centralised publication of the information included in those reports. See https://registers.esma.europa.eu/publication/searchRegister?core=esma_registers_coder58 to get the weekly Commitment of Traders reports from Endex and EEX. (Last accessed in February 2023).

2.4. Evolution of holder positions

In order to perform our analysis, we have used the weekly position data reported by ICE Endex to ESMA. Specifically, weekly position reports are available for EUA futures traded on ICE Futures Europe, from January 2018 until the beginning of June 2021, and for EUA futures traded on ICE Endex since 25 June 2021. Note that the reports for 11 and 18 June 2021 are missing from the ESMA databases.

We will first focus on the open positions for each type of market participant. As mentioned earlier, the weekly reports provide information on five categories; however, following the ESMA report, the five categories mentioned above have been grouped into three categories for the sake of clarity. These categories are (i) investment firms or credit institutions, (ii) investment funds and other financial institutions, (iii) commercial undertakings and operators with compliance obligations under Directive 2003/87/EC.

Table 1 shows the number of participants in each of the three categories of carbon market players mentioned above. The number of participants in each category has been calculated for each calendar year as the average number of people holding a position in each category for that year. There are three things to note in this table. First, the total number of participants has risen by 91% in five years (from 384 to 736). Second, the number of financial players and commercial traders has increased from 2018 to 2022, although the increase is much higher in the category of financial investors (103% versus 71%), confirming the trend observed by ESMA (2021). Third, the position of the holders in 2022 again shows that there are more investment firms and funds (51.9% and 15.5%, respectively) than compliance entities (32.6%).

(Please, insert Table 1)

The weekly COT reports also provide information on the long and short positions by categories of participants. Fig. 2 shows this information in percentages by category for the ICE Endex and for the last date of our sample data, 30 December 2022.

(Please, insert Fig. 2)

We observe that long positions are largely dominated by commercial undertakings and operators with compliance obligations (76% of total long positions), while short positions are held by investment funds/credit institutions (90% of total short positions). When both long and short positions are aggregated, the breakdown of open positions in EUA futures is broadly dichotomous: 45% of the open positions are held by non-financial counterparties (both compliance entities and other non-financials) and 55% are held by financial counterparties (investment firms, investment funds and other financials).

The evolution of the long and short positions by categories of participants is shown in Fig. 3. The darkest lines indicate long positions while the lightest lines represent the short positions.

(Please, insert Fig. 3)

As in Fig. 2, it can be seen in Fig. 3 that most of the long positions are taken by non-financial entities, while most of the short positions are held by financial players. Furthermore, the high number of long positions taken by non-financial entities throughout each year suggests that the compliance entities do not participate in auctions, but regularly buy allowances on the futures market until the end of December of each compliance year.

We also observe in Fig. 3 that both the long positions of compliance firms and the short positions of some financial investors follow a similar pattern over time. This could be explained by the fact that non-financial counterparties build a long hedging position in the futures market, thereby saving the capital costs that would otherwise be incurred by purchasing the allowances directly on the spot market. To allow compliance counterparties to build this long hedging position, both investment firms and credit institutions buy allowances in the auctions and open short positions in the futures market until the final settlement of the EUA futures contract. It is interesting to note that these strategies raise the question of whether financial players are speculating and provoking an increase in EUA futures prices; however, if this were the case, they should be taking long positions on EUA futures contracts instead of short ones.

3. Strategies of non-compliance traders

Therefore, the relevant research question we would like to answer at this point is: what are financial investors (really) doing in the carbon markets? If financial entities are speculating with EUA futures and provoking an overresponse of EUA prices, the supervisory authority should consider whether any regulatory measures need to be introduced in the EU ETS, as proposed by ESMA (2021). Our hypothesis is that non-compliance entities may be implementing other trading strategies in the EU ETS that are not necessarily speculative. This is in line with the ESMA (2022) Final Report on Emissions allowances and associated derivatives, which states that “the data analysis has not unearthed any major abnormality or fundamental issue in the functioning of the EU carbon market from a financial supervisory perspective”. More specifically, as noted in the empirical literature, financial participants can use EUAs as a speculative asset, but also as an inflation hedge, a diversifier, a hedge, a haven asset, and for

arbitrage opportunities. In this section, we detail why these counterparties are not necessarily speculating with EUA futures.

3.1. EUAs as a speculative asset

There has been little research on speculation strategies in the EU ETS. To the best of our knowledge, only three studies have investigated the presence of speculation strategies in the ECFM. At first glance, this paucity of studies may seem surprising given that the existence of excessive speculation in derivatives markets is one of the main concerns of policymakers. Lucia et al. (2015) examined the dynamics of the speculative activity in the ECFM from 2005 to 2013. They used speculation ratios based on volume and open interest (see Garcia et al. (1986) and Lucia and Pardo (2010)) and observed that Phase II of the EU ETS appears to be the most speculative, with the highest level of speculative activity observed when contracts are listed. Ampudia et al. (2022) also studied the role of speculation during the increase in EU emissions allowance prices in 2021-2022. They used a speculation index, calculated as the ratio between weekly trading volume and the open interest at the end of the week, and found that although the index has gradually increased over the last two years, it remains largely below the levels observed by Lucia et al. (2015) in Phase II. Note that the level of speculation was higher in Phase II than in Phase IV, despite the fact that EUA prices in the former were significantly lower, around €20, than those observed in the latter (see Fig. 1). Finally, Quemin and Pahle (2022), using the ICE COT reports, calculated the Working (1960) T-index by using short, long, hedging and "other" positions both for all market actors, as well as for financial institutions only. The evolution of the T-index suggests a steady increase in excessive speculation between 2018 and 2020.

The study of speculation in futures markets is a difficult subject for several reasons. First, speculation, along with arbitrage and hedging, are necessary strategies in any derivatives market. The problem is not the existence of speculation, but an excess amount of it. The Commodity Futures Trading Commission states that excessive speculation in a commodity traded for future delivery may cause "sudden or unreasonable fluctuations or unwarranted changes in the price of such commodity". Although this concept is clear, it is very difficult to quantify.[8] Second, speculator indices assume that most speculators prefer to enter and exit the market in a short period of time, but in addition to the intraday positions of day-traders, there are other trades that can account for a significant portion of the traded volume and are not reflected in the open interest, such as the work of market makers. Finally, as pointed out by Quemin and Pahle (2022), the correlation between the T-index and price changes or volatility is usually low, if not negligible, which casts doubt on its use as a speculation metric. In addition, the reporting system identified all the positions reported by financial investors as non-risk-reducing, ignoring other uses that financial investors may give to EUAs, both in arbitrage activities and for hedging, diversification and refuge purposes. Therefore, the study of speculation in carbon markets would require data with a high level of granularity in order to analyse the strategies directly and not through proxies.

3.2. EUA and arbitrage opportunities

Theoretical models of commodity futures pricing have focused on the role of futures as a hedging instrument for commercial traders with physical positions. In this way, commercial traders would take short futures positions to hedge their long positions in

[8] See https://www.govinfo.gov/app/details/USCODE-2021-title7/USCODE-2021-title7-chap1-sec6a/context. (Last accessed in March 2023).

the spot market, while the long futures positions taken by financial players acting as speculators would be in exchange for a positive expected return. This return comes from the difference between the expected spot price at the maturity contract and the price of the futures contract when the long position is open and would be the rationale behind the theory of *normal backwardation* (see Keynes (1930) and Hicks (1946)).

The above situation implies a positive convenience yield and cannot be applied at all to the ECFM. In fact, unlike other commodity futures markets, the ECFM is characterised by being in a permanent contango situation since its creation in 2005. Furthermore, several papers, such as Bredin and Parsons (2016), Trück and Weron (2016) and Palao and Pardo (2021), among others, have documented this situation in recent years. As is well known, a market is in a *contango* situation when the forward price of a futures contract is higher than the spot price. If the difference between these prices is greater than the sum of the risk-free interest rate plus the storage costs, the convenience yield becomes negative, and the market is said to be in a normal *contango* situation.

According to Tilton et al. (2011), a *contango* that exceeds the cost of storage and interest will encourage some carbon traders to buy EUAs in the spot market to sell them in the futures market in order to profit from the arbitrage opportunity. This means that there has been a negative convenience yield in the European carbon futures and spot markets in recent years, which has allowed financial investors to exploit systematic profitable arbitrage opportunities. Performing both operations would raise the spot price and lower the futures price simultaneously, and thus the work of the arbitrageurs would tend to stabilise prices between the futures and the spot prices.

It is important to note that all of the above empirical papers point to a clear financialisation of the ECFM. Specifically, their findings support the idea that portfolio managers and passive investing by investment firms and funds may be responsible for the high number of short positions taken in EUA carbon futures (see Fig. 3).

3.3. EUAs as an inflation hedge

An inflation hedge is an investment that is considered to provide protection against a decline in purchasing power. The effectiveness of the EUA as an inflation hedge is of interest to EUA financial players, who could invest in them while protecting themselves against inflation-related losses in purchasing power. The question of whether EUAs act as an inflation hedge was first addressed by Medina and Pardo (2013). They used the one-month Euribor rate as the expected inflation, with unexpected inflation being the difference between observed inflation, measured by the European Union Harmonised Index of Consumer Prices, and expected inflation. They obtained a positive Spearman's contemporaneous cross-correlation coefficient between nominal EUA returns and the monthly unexpected inflation rates for the 2008, 2009 and 2010 EUA futures contracts, which was interpreted as meaning that EUA assets can help to hedge against inflation in the euro zone. Pardo (2021) extended the previous study by applying the Extended Fisher Hypothesis, proposed by Fama and Schwert (1977), to investigate the relationship between EUA nominal returns and expected and unexpected inflation rates. Pardo (2021) used eight Harmonised Indices of Consumer Prices (HIPC) to investigate whether EUAs can serve as an investment asset to hedge against inflation risk for two economic areas and six countries with a sample period going from January 2008 to April 2019. The results show a positive and significant relationship between EUA nominal returns and unanticipated changes in purchasing

power, suggesting that portfolio managers can use EUAs to shield their portfolios from the ravages of unexpected inflation in all regions and countries except the US.

Therefore, the scarce literature confirms the role of the EUA as an inflation hedge in Phases II, III and IV, indicating that financial players should engage in buying carbon allowances if they want to hedge against unexpected inflation.

3.4. EUAs as a diversifier or a hedge

Following the definitions in the seminal papers by Baur and Lucey (2010) and Baur and McDermott (2010), a diversifier is defined as an asset that is positively (but not perfectly) correlated on average with another asset or portfolio, whereas a strong (weak) hedge is defined as an asset that is negatively correlated (uncorrelated) on average with another asset or portfolio. In our context, a significant positive non-perfect correlation between an asset and the EUA can be used not only for portfolio diversification by taking long positions in EUA futures contracts, but also for hedging purposes by taking short ones.

A large number of papers have analysed the diversification benefits of carbon assets in combination with traditional assets. Alberola et al. (2008), Mansanet-Bataller and Pardo (2011), Lutz et al. (2013), Rickels et al. (2015), Azlen et al. (2022), and Demiralay et al. (2022), among others, found that EUA returns are positively but not perfectly correlated with stock indices returns, making the EUA a potentially good risk diversifier in traditional portfolios. Similarly, another strand of the carbon literature has examined the attractiveness of the EUA market for investors seeking to avoid market risk in energy markets. Chevallier (2009) proposed a mean-variance optimisation and portfolio frontier analysis of energy risk management with carbon assets. His results reveal that carbon, gas, coal and bond assets have the best characteristics for

composing an optimal portfolio. Reboredo (2013) examined the dependence structure between EUAs and crude oil markets during Phase II of the EU ETS, using a number of copula specifications. His results indicate that EUAs can be classified as an asset that can improve the risk-adjusted performance of a well-diversified portfolio so as to hedge crude oil risk and reduce downside risk. Zhang and Sun (2016) and Uddin et al. (2018) observed diversification benefits of the EUA for high-emission commodities, such as coal and crude oil. Finally, Zhou et al. (2022) investigated the multidimensional risk spillover effects between carbon, energy and non-ferrous metals markets, and also examined portfolio diversification. They concluded that EUA positions should be short in order to hedge a non-ferrous metals portfolio.

Finally, some studies have investigated the role of carbon in combination with cryptocurrencies. Palao and Pardo (2021) found that the EUA behaves as a weak hedge with bitcoin, gold and US government bonds, and as a strong hedge with corporate bonds, German sovereign bonds and volatility indices. Similarly, Yang and Hamori (2021) showed that the European carbon market is a hedge against cryptocurrency risk, especially before the COVID-19 pandemic and during the crash period in the cryptocurrency market. In addition, Pham et al. (2022) studied the tail dependence between carbon prices and cryptocurrencies and observed a low level of spillovers between carbon and cryptocurrencies during periods of low volatility, suggesting that carbon prices can provide diversification benefits for cryptocurrencies during these periods.[9]

[9] See Zhou et al. (2022) for a comprehensive literature review of studies related to spillovers between carbon and other financial markets, and Demiralay et al. (2022) for a summary of papers that analyse the links between carbon and stock markets and/or the hedging/diversification benefits of carbon allowances.

Therefore, all the previous studies have provided empirical evidence, for different sample periods and assets, that supports the purchase or sale of EUAs for diversification or hedging purposes, which allows financial investors to manage the risks of their investments and is far from being considered a speculative practice.

3.5. EUAs as a safe-haven asset

Applying the definitions from the seminal paper by Baur and McDermott (2010), a strong (weak) safe haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio only in certain periods, for example during periods of falling stock markets. Therefore, if the target market suffers extreme declines and the EUA price rises or stays the same, the EUA behaves as a safe haven for the target market.

As far as we know, only two papers have studied the role of EUAs as a safe haven. Yang and Hamori (2021) analysed the role of the European and Chinese carbon markets as safe havens in relation to the cryptocurrency market. They employed a generalised autoregressive score-dynamic model to conclude that the ECFM provides a refuge against the cryptocurrency market, while the Chinese carbon market does not. Palao and Pardo (2022), in the same line of research, investigated whether the EUA can be considered a safe haven for 12 daily benchmarks from six markets (carbon, oil, stocks, bonds, precious metals and cryptocurrencies). Using a quantile regression model, they found that EUAs can help to limit losses in falling markets in conjunction with corporate bonds or gold. Furthermore, they detected that carbon allowances can also act as a safe haven when volatility in Europe or North America is too low or too high. Therefore, they concluded that EUAs can be considered as a

refuge investment when corporate bonds, gold or volatility-related assets experience market turbulence.

In summary, these two studies explain the purchase of EUA futures contracts by those financial traders who consider the EUA to be a refuge asset. These traders would only intervene in the ECFM in order to manage the risks arising from their investments in the event of a severe financial crisis. In this line of research, Palao and Pardo (2022) have also investigated whether carbon volatility and trading volumes are driven by demand pressure from investors who rely on carbon assets as an alternative asset that provides shelter from turbulent markets. In particular, they found evidence of larger trading volumes and higher than normal intraday volatility in the ECFM on days coinciding with extreme fluctuations in some financial markets. This could be avoided by exchanges and/or supervisory authorities by applying some circuit breakers, such as trading halts, volatility auctions or price collars, only in the event of financial market turbulence.

4. Conclusions

The European objectives of reducing emissions, promoting clean technologies and developing energy efficiency are achieved in part by putting a price on greenhouse gas emissions through the EU ETS. However, since its inception and until 2018, carbon prices were too low to achieve the above objectives. This started to change with the approval of the Market Stability Reserve in 2018 and the new emissions reduction path approved by the European Union in the context of the “fit for 55”, which aims to achieve carbon neutrality by 2050. Both decisions led to a spectacular rise in EUA prices, reaching almost €100 in February 2022.

In the context of increasing concerns about climate change, high energy prices and high carbon prices, there is a great controversy about the role of financial institutions in the EU ETS and about the impact of their activities on the EUA price and volatility. This paper investigates the financialisation of the EU ETS by (i) analysing the trading positions of EUA holders by studying their weekly Commitments of Traders (COT) reports and (ii) reviewing the main findings of the carbon finance literature focused on the investment strategies of non-compliance traders in the ECFM.

Our analysis of the COT reports confirms the important role played by financial participants in the ECFM. We observe that a large proportion of long positions (76%) are mainly taken by compliance entities and not by financial players, who only account for the remainder of all long positions (24%). Furthermore, the majority of short positions (93%) belong to financial players. These systematic patterns observed over the last five years seem to be at odds with the idea that financial players are driving up carbon futures prices and thus hindering the compliance of entities under Directive 2003/87/EC. If financial players were speculating and provoking an increase in EUA futures prices, they would be taking long positions instead of short ones. Thus, most of the players putting upward pressure on EUA prices are compliance entities taking long positions to cover their real emissions in an increasingly restrictive system.

Both the analysis of the EUA COT reports and the review of the main findings of the empirical papers on portfolio management with EUAs suggest that non-compliance traders are mainly taking short positions in the European carbon futures market in order to arbitrage the positions they have taken in the primary market. Only a small portion of the long positions are used by financial investors to diversify or hedge risks coming from financial markets. In both situations, therefore, non-compliance traders appear to be acting as long-term liquidity providers rather than speculators.

Although it might be worthwhile to apply some circuit breakers, such as trading halts, volatility auctions or price collars, in the event of extreme turbulence in the financial markets, neither the COT reports nor the empirical work on the trading behaviour of carbon financial players would suggest that EUA futures markets should be subject to further regulatory measures to deal with excessive speculation, such as position limits and position management controls.

REFERENCES

Alberola, E., Chevallier, J., Chèze, B., 2008. Price drivers and structural breaks in European carbon prices 2005–2007. Energy Policy. 36(2), 787-797.

Ampudia, M., Bua, G., Kapp, D., Salakhova, D., 2022. The role of speculation during the recent increase in EU emissions allowance prices. ECB Economic Bulletin, Issue 3/2022. https://www.ecb.europa.eu/pub/economic-bulletin/focus/2022/html/ecb.ebbox202203_06~ca1e9ea13e.en.html

Azlen, M., Gostlow, G., Child, A., 2022. The Carbon Risk Premium. J Altern Invest. 25(1), 33-64.

Baur, D.G., Lucey, B.M., 2010. Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. Financial Rev. 45(2), 217-229.

Baur, D.G., McDermott, T.K., 2010. Is gold a safe haven? International evidence. J Bank Financ. 34(8), 1886-1898.

Berta, N., Gautherat, E., Gun, O., 2017. Transactions in the European carbon market: a bubble of compliance in a whirlpool of speculation. Camb J Econ. 41(2), 575-593.

Bredin, D., Parsons, J., 2016. Why is spot carbon so cheap and future carbon so dear? The term structure of carbon prices. Energy J. 37 (3), 83–107.

Bua, G., Kapp, D., Kuik, F., Lis, E. (2021). EU emissions allowance prices in the context of the ECB's climate change action plan. ECB Economic Bulletin, Issue 6/2021. https://www.ecb.europa.eu/pub/economic-bulletin/focus/2021/html/ecb.ebbox202106_05~ef8ce0bc70.en.html

Chevallier, J., 2009. Energy risk management with carbon assets. Int J Global Energy. 32(4), 328-349.

Demiralay, S., Gencer, H. G., Bayraci, S., 2022. Carbon credit futures as an emerging asset: Hedging, diversification and downside risks. Energ Econ. 113, 106196.

ESMA, 2021. Emission Allowances and Derivatives Thereof. Paris, Preliminary Report, 15 November 2021. https://www.esma.europa.eu/sites/default/files/library/esma70-445-7_preliminary_report_on_emission_allowances.pdf

ESMA, 2022. Emission allowances and associated derivatives. Final Report, 28 March 2022. https://www.esma.europa.eu/sites/default/files/library/esma70-445-38_final_report_on_emission_allowances_and_associated_derivatives.pdf

Fama, E.F., Schwert, G.W., 1977. Asset returns and inflation. J Financ Econ. 5, 115–146.

Fan, Y., Jia, J. J., Wang, X., Xu, J. H., 2017. What policy adjustments in the EU ETS truly affected the carbon prices? Energy Policy. 103, 145-164.

Garcia, P., Leuthold, R.M., Zapata, H., 1986. Lead-lag relationships between trading volume and price variability: new evidence. J Futures Mark. 6,1–10.

Hicks, J. R., 1946. An inquiry into some fundamental principles of economic theory. Value and Capital, Clarendon Press Oxford.

Keynes, J. M., 1930. Treatise on money. Vol.2. MacMillan & Co, London.

Koch, N., Grosjean, G., Fuss, S., Edenhofer, O., 2016. Politics matters: Regulatory events as catalysts for price formation under cap-and-trade. J Environ Econ Manag. 78, 121-139.

Lucia, J. J., Mansanet-Bataller, M., Pardo, A., 2015. Speculative and hedging activities in the European carbon market. Energy Policy. 82, 342-351.

Lucia, J.J., Pardo., A., 2010. On measuring speculative and hedging activities in futures markets from volume and open interest data. Appl Econ. 42,1549–1557.

Lutz, B. J., Pigorsch, U., Rotfuß, W., 2013. Nonlinearity in cap-and-trade systems: The EUA price and its fundamentals. Energ Econ. 40, 222-232.

Medina, V., Pardo, A., 2013. Is the EUA a new asset class? Quant Financ. 13, 637–653.

Mansanet-Bataller, M., Pardo, A., 2009. Impacts of regulatory announcements on CO2 prices. J Energy Mark. 2(2), 1-33.

Mansanet-Bataller, M., Pardo, A., 2011. CO_2 prices and portfolio management. Int J Global Energy. 35(2-4), 158-177.

Palao, F., Pardo, A., 2021. The inconvenience yield of carbon futures. Energ Econ. 101, 105461.

Palao, F., Pardo, A., 2022. Carbon and safe-haven flows. Green Finance. 4(4), 474-491.

Pardo, A., 2021. Carbon and inflation. Financ Res Lett 38: 101519.

Pham, L., Karim, S., Naeem, M. A., Long, C., 2022. A tale of two tails among carbon prices, green and non-green cryptocurrencies. Int Rev Financ Anal. 82, 102139.

Quemin, S., Pahle, M., 2022. Financials threaten to undermine the functioning of emissions markets. Nat Clim Change. 1-10.

Reboredo, J.C., 2013. Modeling EU allowances and oil market interdependence. Implications for portfolio management. Energ Econ. 36, 471-480.

REFINITIV, 2022. Carbon Market Year in Review 2021. https://www.refinitiv.com/content/dam/marketing/en_us/documents/gated/reports/carbon-market-year-in-review-2021.pdf

REFINITIV, 2023. Carbon Market Year in Review 2022. https://www.refinitiv.com/content/dam/marketing/en_us/documents/gated/reports/carbon-market-year-in-review-2022.pdf

Rickels, W., Görlich, D., Peterson, S., 2015. Explaining European emission allowance price dynamics: Evidence from phase II. Ger Econ Rev. 16(2), 181-202.

Tilton, J. E., Humphreys, D., Radetzki, M., 2011. Investor demand and spot commodity prices. Resour Policy. 36(3), 187-195.

Trück, S., Weron, R., 2016. Convenience yields and risk premiums in the EU-ETS—Evidence from the Kyoto commitment period. J Futures Mark. 36 (6), 587–611.

Uddin, G.S., Hernandez, J.A., Shahzad, S.J.H., Hedström, A., 2018. Multivariate dependence and spillover effects across energy commodities and diversification potentials of carbon assets. Energ Econ. 71, 35-46.

Working, H., 1960. Speculation on hedging markets. Food Research Institute Studies. 1, 185-220.

Yang, L., Hamori, S., 2021. The role of the carbon market in relation to the cryptocurrency market: Only diversification or more? Int Rev Financ Anal. 77, 101864.

Zhang, Y., Sun, Y.F., 2016. The dynamic volatility spillover between European carbon trading market and fossil energy market. J Clean Prod. 112, 2654-2663.

Zhou, Y., Wu, S., Zhang, Z., 2022. Multidimensional risk spillovers among carbon, energy and nonferrous metals markets: Evidence from the quantile VAR network. Energ Econ. 114, 106319.

Table 1. Participants by category in the European Carbon Futures Market

This table shows the number (Num.) and percentage (%) of participants in each category of carbon market players in the three categories defined by ESMA: (i) Investment Firms or Credit Institutions, (ii) Investment Funds and Other Financial Institutions, and (iii) Commercial Undertakings and Operators with compliance obligations under Directive 2003/87/EC. The number of participants in each category is calculated for each calendar year as the average number of people holding a position in each category for that year. The percentage (%) of each category for each year is also shown. Source: Prepared by authors from ESMA data. Note that the reports of 11 and 18 June 2021 are not available.

	Investment Firms or Credit Institutions		Investment Funds and Other Financial Institutions		Commercial Undertakings and Operators with compliance obligations under Directive 2008/87/ECs		Total
Year	Num.	%	Num.	%	Num.	%	Num.
2018	38	0.099	206	0.537	140	0.364	384
2019	41	0.093	248	0.560	154	0.347	443
2020	42	0.088	278	0.575	163	0.337	483
2021	105	0.136	366	0.472	303	0.392	774
2022	114	0.155	382	0.519	240	0.326	736

Fig. 1. EUA Price evolution

This figure shows the evolution of EUA prices by phase. Phase I (2005-2007), Phase II (2008-2012), Phase III (2013-2020), Phase IV (2021-2030). The figure shows the evolution of the settlement prices in €/tCO2 for the EUA December futures front contract from 22 April 2005 to 19 December 2022. Source: Prepared by authors based on Refinitiv (Reuters) databases.

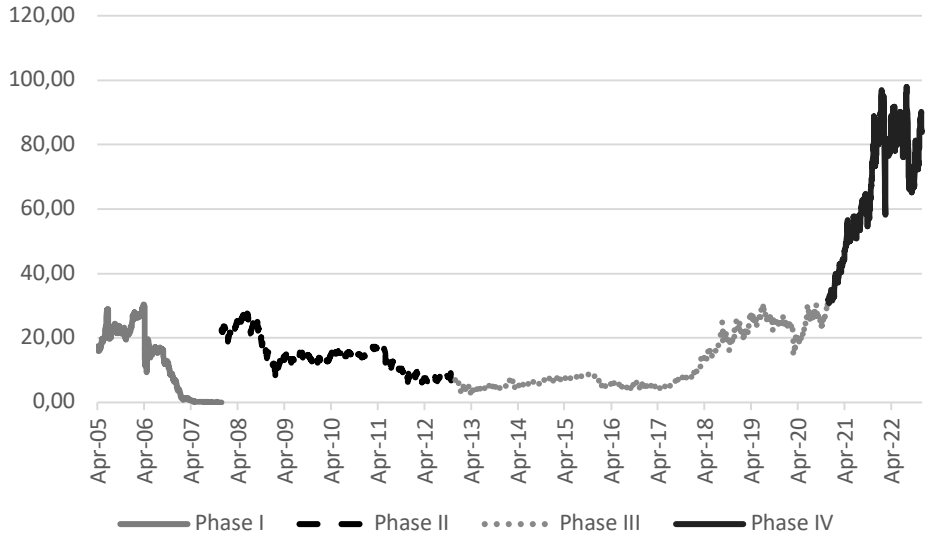

Fig. 2. Long, Short and Total positions by category

These figures show the percentage of long and short positions represented by category of the carbon market players in ICE Endex, divided into the three categories defined by ESMA: (i) Investment Firms or Credit Institutions, (ii) Investment Funds and Other Financial Institutions, (iii) Commercial Undertakings and Operators with compliance obligations under Directive 2003/87/EC. Data refer to the last day of the sample period (30 December 2022). The three categories are depicted from the darkest to the lightest colour in the order above-mentioned. Source: Prepared by authors from ESMA data. Note that the reports of 11 and 18 June 2021 are not available.

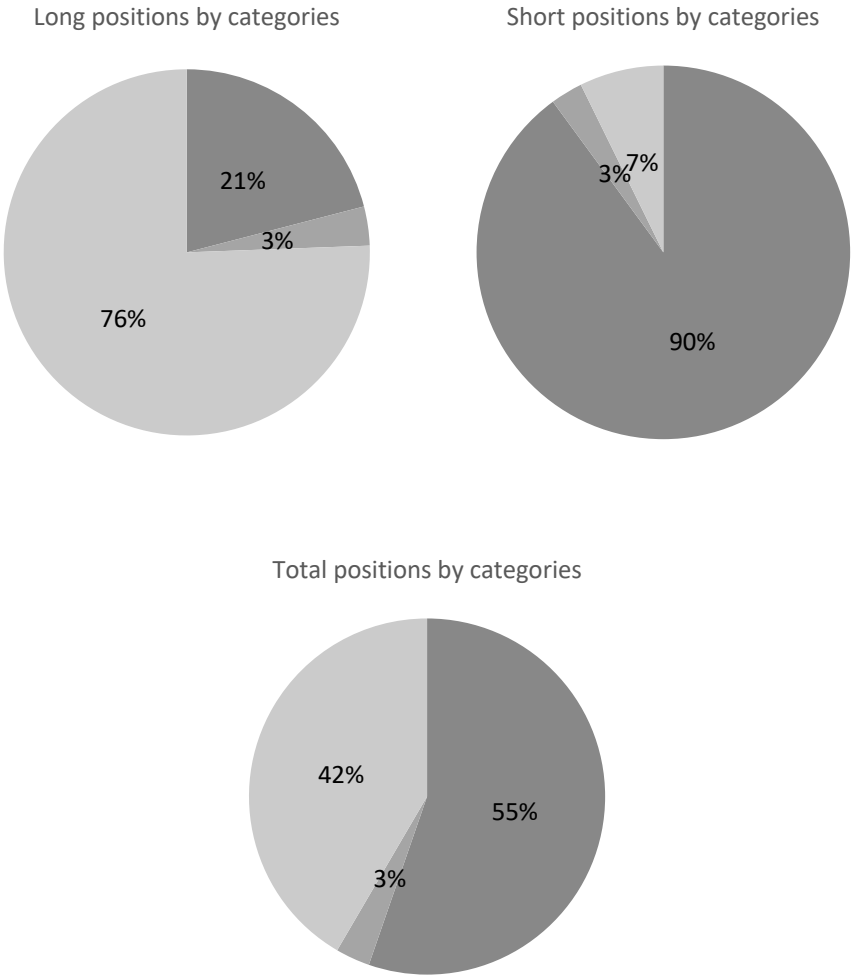

Fig. 3. Evolution of Open positions

This figure shows the evolution of long and short open positions per category of counterparty for EUA futures, broken down into the three categories defined by the ESMA: (i) Investment Firms or Credit Institutions, (ii) Investment Funds and Other Financial Institutions, (iii) Commercial Undertakings and Operators with compliance obligations under Directive 2003/87/EC. The long and short open positions are shown in the positive and negative axes, respectively. Source: Prepared by authors from ESMA data. Note that the reports of 11 and 18 June 2021 are missing.