Influences from the European Parliament on EU Emissions Prices

Abstract

The decisions of the European Parliament (EP) are shown to influence both EU emission allowance (EUA) prices and volatility. Reductions in price and increases in volatility are observed when EP decisions are (i) not "party-political" in origin, (ii) made during times of low market sentiment, or (iii) made during times of low market attention. Daily EUA prices from 2007 to 2014 are used in the study, with decisions analysed using an event study approach for price impact, and a GARCH specification for volatility impact. Our findings suggest the need for policymakers to improve communication of long-term strategies for the EUA market. This aims to reduce the evident ongoing uncertainty experienced by traders around each decision made by the EP. The finding that sentiment and market attention at the time of an EP decision influences the market's reaction indicates a need to consider market dynamics in terms of decision timing, so that market turbulence is not an unintended by-product of an EP decision. Indeed some form of medium term forward guidance may be called for.

JEL: Q58, G14, C12

Keywords: EU emission allowances, market sentiment, market attention, European Parliament

1 Introduction

In April 2013 the European Parliament was expected to pass a European Commission legislative proposal to fix the recognized oversupply issue in the EU Emissions Trading Scheme (EU ETS) (Koch et al., 2014). The Commission's proposal [1] involved postponing until 2019-2020 the release of 900 million EU emissions allowances (EUAs) - each allowance granting permission to a regulated installation to emit one tonne of CO_2 equivalent - that were originally due to be released into the market in 2013-15. The hope of the Commission was that this would support the declining price of allowances already trading in the emissions market and thus act as an incentive towards meeting the overall goals of the EU ETS, namely: encouraging investment in and consumption of cleaner energy production, incentivising more efficient energy use and production processes, and reducing emissions across the EU. On 16th April 2013, however, the European Parliament narrowly voted against the proposal. There was an immediate impact on EUA prices, which dropped by over a third. The futures price of an EUA permitting the emission of one tonne of CO_2, which had cost €4.76 at close of business on 15th April, fell to €3.09 on 16th April.

This is one example where legislation passed by the European Parliament (EP), which holds legislative authority over the EU ETS, impacted on EUA prices. Prior research supports a wider argument that EUA prices are

[1] European Commission Press Release accessed on 9th June 2015 at http://europa.eu/rapid/press-release_MEMO-13-343_en.htm

influenced by regulatory actions (Daskalakis et al., 2009; Koch et al., 2014; Kossoy and Guigon, 2012). Missing from prior studies though is a systematic investigation of the overall impact of emissions market specific and related legislation and resolutions passed by the EP, thus leaving a number of open questions. Do the legislative efforts of the EP move the EUA market? Are particular types of legislation and resolutions more influential? Are there conditional effects under which legislation and resolutions have a greater market impact? These are important questions. It is clear from Blyth et al. (2007), Fuss et al. (2008) and Yang et al. (2008) that there is considerable regulatory risk in the EU ETS and the resulting uncertainty in the price of carbon, has major implications for investment decisions in the power sector. Indeed the uncertainty regarding the implementation of measures to combat climate change makes possible the contradictory opinions regarding the existence of a carbon bubble and a projected higher demand for fossil fuels[2].

Our study addresses these issues by tracking 29 relevant decisions made by the EP over Phase II and Phase III (to date) of the EU ETS, and examining how the origin of each decision, the level of market sentiment and the level of market attention all have an influence on EUA price behaviour. The decisions made by the EP act, on average, to reduce emission allowance prices.

[2]The Telegraph, The Guardian and Carbon Tracker accessed on 6th June 2015 display differing perspectives on the prospect of a carbon bubble. http://www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/11615079/Shell-CEO-carbon-bubble-campaigners-ignores-reality.html

http://www.theguardian.com/environment/2013/apr/19/carbon-bubble-financial-crash-crisis

http://www.carbontracker.org/resources/

This is quite striking given that the success of the trading scheme requires prices of emission allowances to be at a sufficiently high level so as to act as a disincentive to traditional high emission energy production and energy-intensive business practices. We contrast "party-political" decisions brought to the EP by the seven political groups of MEPs[3], with "non-party-political" decisions brought from other sources. The other sources are the committees of the European Parliament, the European Commission and the European Council; these are official bureaucratic organizations rather the seven political groups of MEPs that respond to voters' concerns. The classification of each decision is carried out by the EP itself. An example of a non-party-political decision would be that brought forward by the EP Committee on Transport and Tourism on 11^{th}March 2008 concerning the inclusion of airlines in the EU ETS. An example of a party-political decision would be that brought before the parliament by five of the political groups[4] on 5^{th} June 2008 concerning US emissions and climate change policy. When we analyse resolutions categorised as "non-party-political" and those termed "party-political", we find that it is the non-party-political initiatives which are the particular

[3]The groups of MEPs for the present 8th European Parliament are, the European People's Party (EPP), the Progressive Alliance of Socialists and Democrats (S&D) containing the Party of European Socialists (PES), the Alliance of Liberals and Democrats for Europe (ALDE), the European Conservatives and Reformists, the European United Left – Nordic Green Left, the Greens / European Free Alliance (Greens-EFA) or the Europe of Freedom and Direct Democracy. Accessed on 6th June 2015 at http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00010/Organisation

[4]The groups were EPP, PES, ALDE, Greens-EFA and the UEN.The Union for Europe of the Nations (UEN) was an active political group in the European Parliament from 1999 to 2009.

drivers of these negative returns. We also find there is heightened volatility around key legislative decision dates when we incorporate this information in an appropriately designed GARCH volatility model, indicating that market uncertainty is a feature of prices around these dates. It may be the case that some form of *forward guidance* such as is used by central banks, would be beneficial in communicating, in advance, the nature of complex legislative decisions to the market . This action might reduce volatility in the market, as has been found to be the case by Campbell et al. (2012) and Kool and Thornton (2012) who analyse the macroeconomic effects of Federal Reserve forward guidance.[5] The main challenge though with this policy solution is that the EP is subject to many competing influences, and does not have the independence and targeted focus of a central bank.

A possible explanation for the strong effect of EP decisions on EUA prices during times of low media exposure can be found in the Investor Attention Hypothesis (Barber and Odean, 2008; Da et al., 2011; Hirshleifer et al. 2009, 2013; Vozlyublennaia, 2014). In an equity context this proposes that since attention is a limited resource, investors will make decisions about firms to which their attention has first been drawn, and that until their attention is drawn to a stock its price will only slowly reflect new information due to lack of trading interest. We draw on this line of argument and adopt the theory for emissions markets. The amount of attention given to emissions trading is normally small as it is only a very small part of the energy market. To

[5]The authors would like to thank an anonymous referee for this helpful comment.

illustrate this point from 2010 to 2014 the value of the trades of the most liquid EUA futures contracts (prompt December) was 0.88% of the value of trades of the most liquid futures contracts of Brent oil (prompt month); in 2012 the value of the trades in EUAs was $73 billion while the total value of the world's oil production that year was $3.27 trillion[6]. When attention is focused on emissions by the media or by the actions of MEPs, the market in turn pays attention and anticipates the decisions made by the European Parliament. When the European Parliament makes decisions about the emissions market when there is low media coverage or when the decision arises from non-party-political sources within the EU (namely, the European Parliament committees, the European Commission or the European Council), then market inattention will lead to a lagged corrective price adjustment and increase in volatility.

We also test for differences in behaviour when sentiment is relatively high compared with times when it is low. We find that EP decisions made when sentiment is low have a negative impact on returns and are associated with an increase in volatility. The impact on returns is determined by an event study which shows that on days on which the EP makes a decision there are, on average, significant negative returns, and these negative returns become cumulatively greater in the following week. An explanation for the cumu-

[6]Data from Bloomberg, EU ETS Factsheet at
http://ec.europa.eu/clima/publications/docs/factsheet_ets_en.pdf,
and the Energy Information Administration EIA at http://www.eia.gov/ all accessed on 9th June 2015

lative reduction in prices is that this may be similar to the post earnings announcement drift (Bernard and Thomas, 1989; Hirshleifer et al., 2009). After an earnings announcement it is common to find that the price of the stock continues moving in the same direction due to a lack of investor attention. This effect is more pronounced when news affecting the price of the stock is difficult to interpret (Song and Schwarz, 2010). We find that there is a similar continued movement of EUA prices after the announcement of an EP regulatory decision. We posit that this is due to similar investor inattention in the emissions markets. The implications of many of these decisions are more difficult to interpret than straightforward messages like earnings announcements and so the effect is extended. This offers an explanation for the continued slow movement of prices after an EP announcement..

This study is similar in intent to a recent investigation by Lin and Tamvakis (2010) which examined the impact of OPEC output decisions on crude oil prices. Based on an argument, in part, that OPEC had the ability to affect the volume of oil produced and was thus a major actor in the market, a systematic investigation was carried out of each OPEC meeting where a quota decision was made. In the case of the EUA market the major player, the EP, has even greater power as it can alter the structure of the market's operation, affect supply through adjusting allowances available in the market, and even boost demand through an ability to determine which institutions must partake in the scheme. This suggests a need to formally investigate the influence of the EP on the prices at which EUAs trade in the market.

In a further contribution, extending work done independently by Koch et al. (2014), we examine the potential conditional determinants of market reaction to EP legislation. In particular we develop innovative measures of market sentiment and market attention, which are known in other markets to influence reaction to new information. An emissions market sentiment index is constructed by adapting the principal component analysis approach of Baker and Wurgler (2006) in equity markets, and particularly based on the oil sentiment index proposed in Deeney et al. (2015). The components of this index draw on volatility and speculative measures from the EUA market, while also drawing pertinent information from the wider energy markets, and wider financial markets.

Sentiment has been found to be a significant influence in equities markets (e.g. Baker and Wurgler, 2006; Schmeling, 2009) and more recently in the energy and commodity markets (Deeney et al., 2015; Sliverio and Szklo, 2012). Sentiment has been found to be particularly effective at predicting the prices of stocks with greater inherent uncertainty; these have been characterized by Baker and Wurgler (2006) as being young, small, unprofitable, non-dividend-paying, with high volatility, capable of extreme growth or becoming distressed. It can be argued that the European emissions market contains some of these same characteristics, albeit from different sources. For example, there is the already discussed dependency on uncertain political events; a history of extreme movements (Koch et al., 2014); and strong crossover influences and volatilities from other energy markets (Bredin and

Muckley, 2011; Chevallier, 2011; Mansanet-Bataller, 2011). The sentiment state of market participants at the time that new information arrives is also known to be important. Mian and Sankaraguruswamy (2012) show that sentiment mediates how investors react to news, with high sentiment periods related to a positive reaction to news and the opposite for low sentiment periods. Investors tend to choose good news to focus on in high sentiment times and bad news to focus on in times of low sentiment. We thus expect that whether the market is in a time of high or low sentiment will mediate the reaction of prices to new legislation.

Fang and Peress (2009) show that news exposure has an influence on the returns of stocks in the US market. We thus construct a market attention variable based on news stories about the EUA market and emissions trading. We propose this variable as measuring market attention. We argue that market attention both informs market participants (Tetlock, 2007) and is informed by market participants (Oberlechner and Hocking, 2004), and therefore acts as a guide to the level of market interest in upcoming news events. Following from this, we find that low market attention of issues relevant to the EU ETS in advance of a legislative decision is associated with greater "price shock", and we find there is a significant cumulative negative price reaction in the days after a low market attention decision.

The methodology is detailed in Section 2, followed by the findings and analysis in Section 3, and we conclude with further discussion of the implications for policy makers and market participants in Section 4. Our policy implications centre on the general importance of understanding the reaction of market participants to legislative decisions and the need to improve communication with market participants as to the long-term policy goals for the EUA market and greater signposting of the intermediate steps that will be adopted to achieve these goals. There also needs to be greater understanding of the factors affecting the market at a given point in time, as shown particularly by the sentiment and media coverage findings. This conditional understanding is argued to be of potential benefit to policy makers across a variety of regulated markets.

2 Methodology

Prior research suggests that EUA prices are influenced by regulatory actions (Daskalakis and Markellos, 2009; Koch et al., 2014; Kossoy and Guigon, 2012). We add to prior studies by a systematic investigation of the overall impact of emissions market specific and related legislation passed by the EP. We contribute to the existing literature on the EU ETS by testing whether policy decisions of the EP influence the price and volatility of EUAs. We provide a distinction by means of examining whether there is a differential effect to the impact of EP policy decisions depending on: (i) the origin of EP policy decisions, i.e. whether non-party-political or party-political; (ii) the level of market sentiment (high or low); and (iii) the level of market attention (high or low) which we measure in terms of emissions market news exposure.

The origin of EP policy decisions influences the impact of those decisions on the price and volatility of emission allowance prices. The EP itself classifies the origin of each decision. We divide these into "non-party-political" resolutions brought by a combination of the parliament's own committees, the European Council and the European Commission, and "party-political" resolutions brought by a combination of the political groups in the parliament. A full explanation is given in Section 2.2. This allows us to understand which sources of legislation and which parts of the European political system have the greatest impact on emissions markets. The investigation based on market sentiment provides policy makers with insights into the timing of policy decisions and to what extent the prevailing market dynamics impact. For this analysis, we uniquely develop an EUA market sentiment index based on financial proxy information relating to the emissions market and the wider energy markets, and wider financial markets. A decision is considered to be high sentiment if it takes place on a day on which the market sentiment index is higher than the median sentiment for all the decision dates under consideration. Construction of the market sentiment index follows the method of Baker and Wurgler (2006) - a detailed explanation is given in Section 2.3. Finally, the analysis based on emission market attention provides insights again into the the timing of policy decisions and to what extent the level of market attention to climate change and emissions issues impacts. The analysis allows us to consider how the level of public awareness of these issues influences the tendency of MEPs to vote in a way which the market expects. This has implications for policy makers who simultaneously must plan to avoid damage to the environment, give clear signals to the market and must attempt to carry out the wishes of their electorate. A policy decision is considered to be high news if its news exposure measure is higher than the median for all the decision dates under consideration. The news exposure measure is based on Fang and Peress (2009) and is detailed in section 2.4.

We use event study and GARCH methods to test changes in the price returns and volatility at the times of EP decisions, following Lin and Tamvakis (2010) and Lu and Chen (2011). The remainder of this section is organized as follows. We firstly describe the EUA price data considered for our analysis, and then, to support the objectives above, we describe the method used to identify the dates for the EP policy decisions and how these break down as either party-political or non-party-political. The method used to build an appropriate market sentiment index for the emissions and energy markets is then given, followed by the method used to measure market attention. Finally, the testing specifications for the price-based event study and the GARCH-based volatility analysis are provided.

2.1 EUA Prices

We use the prices of prompt December futures in our anlaysis; these are the futures contracts with an expiry of the next December. A futures contract for a commodity, such as an emission allowance, is an agreement to buy or sell an agreed quantity of that commodity at a specific time in future. The contract may be settled in cash rather than in delivery of the commodity itself. These contracts are traded in much higher volumes than EUAs on the spot market (Zhu et al., 2015), while also being the most liquid of the futures contracts available. Futures contracts for Phase II (2008 - 2012) and Phase III (2013 - 2020) allowances are examined using daily data beginning on 2nd October 2007 and ending on 5th February 2014. Phase I allowances (2005 - 2007) are not examined as they were not permitted to be used after Phase I finished in 2007, whereas Phase II allowances could be banked and used during Phase III. The data before 1st January 2008 refers to the December 2008 futures contract. Table 1 presents descriptive statistics for the log returns of the prompt December EUA futures contract over the sample period and Fig. 1 shows the time series. A discussion of the outlier on 16th April 2013 follows at the end of section 2.2.

<< Insert Figure 1: Log Returns of EU Emission Allowance Prices 2007-2014 >>

2.2 EP Policy Decision Selection and Classification

The overall objective of our study is to test what impact policy decisions of the EP have on the level of EUA prices and their volatility. Therefore, identifying the dates of EP policy decisions relating to the EU ETS is fundamental to our objective. During the course of legislation making its way through the EP, there are many stages before the date of the actual decision,

Statistic	Log Return EUA
# daily observations	1,625
min	-0.43208
max	0.24525
mean	-0.000815
median	0.00000
standard deviation	0.03294
skewness	-0.90640
excess kurtosis	23.305
5% percentile	-0.051038
95% percentile	0.045303
ADF (p value)	4.84 x 10^{-24}
Jaque Beara (p value)	0.00000

The table presents descriptive statistics for the log returns of the prompt December EUA futures contract from 3rd October 2007 to 5th February 2014.

Table 1: Descriptive statistics of EUA futures returns

Figure 1:

including debates in the council, votes by relevant committees, and debates in the parliament. We select the "Decision by Parliament" date for each policy decision as given in the European Parliament Legislative Observatory.[7] This source provides a list of key stages of a resolution as it makes its way through the EP and gives the origin of each resolution.

The EP itself classifies resolutions brought to it. Thus we may objectively distinguish resolutions originating from the political groups of the MEPs (which we term "party-political"), from resolutions brought by the EP's committees, the European Council, or the European Commission (termed by us as "non-party-political"). To find all the relevant decisions, we search for the terms: "EU ETS", "emissions trading" and "carbon trading" in the European Parliament Legislative Observatory. We do not use the term "climate change" as this was found to be too broad and would have found EP policy decisions which concern climate change mitigation, adaptation and other matters only loosely related to the EU ETS. A list of the dates and classifications of the EP decisions, obtained from our search, is given in Tables 2 and 3, along with brief explanations of their connection and potential influence on the EU ETS. Thirty seven policy decisions were identified over our sample period of 2nd October 2007 to 5th February 2014. In order to ensure a reasonable period for the calculation of the parameters needed in the event study described in Section 2.5.1, we choose 20 days for the length of the estimation

[7] Accessed on 20th November 2014 at http://www.europarl.europa.eu/oeil/home/home.do.

window and five days on either side of the event day as the event window. This is shorter than similar studies such as Lin and Tamvakis (2010), but we must compromise between having a reasonable number of events and adequate lengths for each of the estimation and event windows. Having chosen a 20 day estimation window and five days on either side of the event as the event window we are compelled to omit 8 of the 37 identified events. This is because we cannot have an event occurring in the estimation window of another event as the estimation window is used to calculate the parameters of normal behaviour. This means that two events must be closer than 5 days apart or farther than 25 days, therefore we chose 29 of the 37 events. It can be seen that there are 10 events classified as party-political, with 19 events classified as being non-party-political. A list of the EP decisions and the totals for each category are found in Tables 2, 3 and 5.

The 16th April 2013 requires special consideration for the reasons outlined in the introduction. On this date there was a very close vote of the EP rejecting backloading.[8] As noted earlier, backloading was the proposal to delay the release of 900 million EUAs until 2019-2020, which were originally due to be released into the market in 2013-15. On this date the price of EUAs fell from €4.76 to €3.09 on the futures market, a collapse of approximately 35%. This was the largest percentage drop in a single day observed in the

[8]On the same day there was also a resolution to delay the imposition of penalties arising from the failure of aircraft operators to abide by an earlier directive on emissions, but this would not have had the same importance as the rejection of backloading as it affects penalties applied in one sector of the market and whereas backloading is looking to address on a system-wide basis the recognized oversupply of allowances in the market.

EUA futures market. This can be clearly seen in the EUA log returns series provided in Figure 1. The EP backloading rejection date may therefore be deemed an extreme event. While this anecdotally illustrates the ability of an EP decision to move EUA prices, it presents the problem that inclusion of this one day's data may drive the conclusions on its own. For robustness, we therefore conduct our statistical analysis with and without the inclusion of 16th April 2013 - which we will herein refer to as the backloading rejection date - for both the event study and the GARCH analyses.

2.3 Measurement of Market Sentiment

The second important question in our analysis, as earlier set out, is whether the impact of policy decisions depends in any way on the level of market sentiment. Towards answering this question, we uniquely develop an emissions market sentiment index following a similar index constructed for the oil markets in Deeney et al. (2015). For our purposes, we use financial proxy information relating to the emissions markets and wider energy markets, and wider financial markets.

A decision of the EP is characterized as being high sentiment if it occurs on a day when the market sentiment index is above the median for the set of decisions under consideration. A daily market sentiment index is constructed for the emissions market using principal component analysis (PCA) of appropriately chosen financial proxies, in line with Baker and Wurgler (2006), Lemmon and Portniaguina (2006), and Deeney et al. (2015). This approach

Date	Classification	Category	Sentiment	News	Relevance of Decision
11/10/2007	INI	EP-led	High	High	Support for EU ETS to include air transport
11/03/2008	INI	EP-led	High	Low	Air transport to be included in EU ETS
24/04/2008	INI, RSP	TOP	High	High	Increasing the ambit of the EU ETS and support for the poluter pays principle
05/06/2008	RSP	TOP	High	High	Expresses hope that US will trade emissions with EU ETS
08/07/2008	COD	EP-led	High	High	Air transport to be included in EU ETS
09/07/2008	INI	EP-led	High	High	Support for low carbon energy efficient technologies
04/09/2008	INI	EP-led	High	Low	Policy to curb CO_2 emissions
21/10/2008	INI	EP-led	High	High	Commitment to Global Climate Change Alliance and plans for spending EU ETS income.
17/12/2008	COD	EP-led	High	High	Resolution to extend EU ETS to include maritime, shipping and aviation
03/02/2009	INI	EP-led	High	Low	Secondăstrategic energy review aiming to reduce GHG by 80% by 2050
11/03/2009	RSP	TOP	High	High	Resolution on an EU strategy for a comprehensive climate change agreement in Copenhagen and the adequate provision of financing for climate change policy
23/04/2009	RSP	TOP	High	High	Proposal of a Global Forest Carbon Mechanism and committements to spend EU ETS income
22/10/2009	RSP	TOP	Low	High	Resolution on the upcoming EU-US Summit calling for stronger cooperation in energy efficiency and bio-fuels.
25/11/2009	RSP	TOP	Low	High	Resolution on the EU strategy for the Copenhagen Conference on Climate Change (COPă15)

The table shows the European Parliament (EP) decisions under consideration from 2007 to 2009. Decisions are either less than 5 trading days or more than 25 days apart. The classifications are assigned by the EP itself and indicate the following types of decisions: resolution on topical subjects (RSP, 10), own initiative procedure (INI, 11), ordinary legislative procedure (COD, 6) and consultation procedure directive (CNS, 1). We categorize RSP as topical and denote it "TOP" and categorize all other decisions as "EP-led". Two decisions were taken on 24th April 2008 and since a topical decisions was taken this date has been categorized as topical. Decisions for 2010 - 2013 are in Tab.3.

Table 2: List of selected Dates of European Parliament Decisions 2007 - 2009

Date	**Classification**	**Cate-gory**	**Senti-ment**	**News**	**Decision**
11/03/2010	RSP	TOP	Low	Low	Commitment to meet GHG targets and the use of the European Investment Bank to support low carbon targets
06/05/2010	INI	EP-led	Low	Low	Adapting to climate change: towards a European framework for action. Possible changes of electricity generation using renewable and fossil fuels.
17/06/2010	RSP	TOP	Low	Low	Resolution on the EU-US disagreement on air transport in EU ETS
25/11/2010	INI	EP-led	Low	High	Inclusion of maritime transport in the EU ETS
08/03/2011	INI	EP-led	Low	Low	Financial Transaction Tax and strengthening of EU ETS
05/07/2011	INI	EP-led	Low	Low	Options to move beyond 20% GHG emission reductions and assessing the risk of carbon leakage
14/09/2011	COD	EP-led	Low	Low	Wholesale energy market integrity and transparency
17/11/2011	RSP	TOP	Low	Low	Resolution on the EU-US disagreement on air transport inclusion in EU ETS
15/03/2012	INI	EP-led	Low	Low	Roadmap for moving to a competitive low carbon economy in 2050
19/04/2012	CNS	EP-led	Low	Low	Proposal to tax electricity generation using GHG output as one component
22/11/2012	RSP	TOP	Low	Low	Resolution on the Climate Change Conference in Doha, Qatar
12/03/2013	COD	EP-led	Low	Low	Greenhouse gas emissions, climate change: mechanism for monitoring and reporting
16/04/2013	COD	EP-led	Low	Low	* (Backloading rejected) Scheme for greenhouse gas emission allowance trading:ătemporary derogation from theăEU ETS
23/10/2013	RSP	TOP	Low	Low	Resolution on the climate change conference in Warsaw, Poland (COP 19)
10/12/2013	COD	EP-led	Low	Low	Greenhouse gas emission allowance trading: timing of auctions

The table shows the European Parliament (EP) decisions from 2010 to 2013. For an explanation of the EP classification of decisions see Table 2. The decision * on 16th April 2013, the backloading rejection day, caused the largest drop in EUA prices during the period of the investigation. The EP narrowly rejected a plan to delay the release of EUAs known as backloading. All statistical tests were repeated omitting this date so as to ensure the robust nature of our conclusions.

Table 3: List of selected Dates of European Parliament Decisions 2010 - 2014

has most popularly been applied to the equities markets, where there are abundant data available and levels of market liquidity are for the most part high. By contrast, in the emissions market liquidity is lower, with the volume of options traded for instance being particularly low. This makes the use of emissions market specific financial information less reliable on a stand-alone basis than we would desire. To overcome this weakness, we construct an index which includes additional financial information from the wider energy markets not just the emissions market. This aligns with Bredin and Muckley (2011), Chevallier (2011), and Mansanet-Bataler et al. (2011), who find the emissions market to be intrinsically linked with the energy markets. We choose the coal and gas markets because they have an established connection to the prices of EUAs, as shown by Alberola et al. (2008) and Chevallier (2011). For coal prices, we use the API2 grade for Amsterdam-Rotterdam-Antwerp (ARA) prompt month futures contract, following Chevallier (2011). For gas prices, we use the UK's National Balance Point (NBP) prompt month futures price, following Creti et al. (2012) and Aatola et al. (2013). For oil prices, we use the benchmark Brent prompt month futures contract, providing us with a key oil market indicator and proxy measure of economic activity (Zhu et al., 2015). To capture a measure of "market fear" in the European economy, we use the implied volatility index associated with the FTSE index, termed VFTSE. This follows Whaley (2000) who associates index volatility and market fear. (As a robustness check the sentiment index calculations were repeated using the Euro Stoxx 50's volatility index instead of the VFTSE. The classification of the 29 days was identical.)

The specific financial proxies used in the construction of the market sentiment index comprise volume, open interest and volatility measures and are as follows:

1. The volume of trades of the prompt December EUA futures contract
2. The aggregate total of all EUA futures contracts of all expiry dates excluding the prompt December contract
3. The 20-day volatility of the prompt December EUA futures contract
4. The 20-day volatility of the prompt month Brent crude oil futures contract
5. The 20-day volatility of the prompt month NBP natural gas futures contract
6. The 20-day volatility of the prompt month ARA coal futures contract
7. The open interest of Brent crude oil futures contracts
8. The open interest of NBP natural gas futures contracts
9. The implied volatility of the FTSE index, i.e. VFTSE

For our first two proxies we use the volume of EUA futures contracts. Baker and Stein (2004), Baker and Wurgler (2007), Canbas and Kandir (2009) and Scheinkman and Xiong (2003) use the volume of trades as a proxy for investor sentiment across equity markets. The volume of trades is a natural measure of market activity and as shown by this literature it is also an indicator of market sentiment.

The volatility of futures prices is also a recognized indicator of market sentiment (Whaley, 2000) as it indicates rapid changes in price. For our analysis we calculate twenty-day historical volatility for emissions, oil, gas and coal futures prices; a period of 20 trading days corresponds approximately to one calendar month. The twenty-day time frame is chosen as a reasonable balance between a sufficiently long period for the accurate calculation of volatility and a short enough period for the volatility information to be current, this choice follows the monthly time scale used by Baker and Wurgler (2006) in their seminal paper on sentiment indices.

The level of open interest of futures contracts is an indicator of the level of speculation and market activity in the oil and gas markets. It is the quantity of futures contracts which are not closed, liquidated or delivered. Open interest data for coal and EUA futures was not available for the period under examination and so we include just information from the oil and natural gas markets.

The volatility of a large stock index has commonly been used as a measure of market fear in the literature. Simon and Wiggins (2001), Whaley (2000) and Whaley (2009) have used the VIX implied volatility index as a proxy of market sentiment, specifically fear. The VFTSE is used here as a European equivalent to the US-centred VIX. The VFTSE is calculated from the implied volatility of FTSE 100 index options covering out-of-the-money strike prices for the near and next term maturities. An alternative choice would be the volatility of the Euro Stoxx 50 but the VFTSE is chosen as the FTSE 100 has a greater weighting of large energy firms (including BG Group, BP, Petrofac, Royal Dutch Shell, Tullow Oil and Wood Group) with a total market capitalization of Stg£286 billion (389 billion) compared with the Euro Stoxx 50 (including ENI, Repsol and Total) which have a total market capitalization of 194 billion[9]. This is shown to be a robust choice because when the sentiment index calculations were repeated using the volatility of the Euro Stoxx 50 (V2X) the new sentiment index produced the same categorization of high or low sentiment for each of the 29 EP decisions. The Euro Stoxx 50 is the index of the top 50 firms of the Euro zone by capitalization, its volatility index is calculated similarly to the VFTSE. The two are very highly correlated and so it is not surprising that the substitution of the V2X and VFTSE did not change the designation of high and low sentiment.

To take into account the possibility that some of the proxies may be more strongly leading indicators of market sentiment than others, we follow the method of Baker and Wurgler (2006). A first stage index F_t is prepared by entering the current values of the nine proxies and their first lags in a principal component analysis (PCA). The first principal component of this PCA of

[9]Data accessed on 9th June 2015 from http://www.londonstockexchange.com/exchange/prices-and-markets/stocks/indices/summary/summary-indices-constituents.html?index=UKX , and

http://www.londonstockexchange.com/exchange/prices-and-markets/international-markets/indices/home/eurostoxx-50.html

Energy and Emissions Sentiment Index	Current or First Lag	Loading
Volume of Prompt Dec EUA Futures	Lag	-0.36
Volume of non Prompt Dec EUA Futures	Current	-0.40
20 Day EUA Volatility	Current	-0.17
20 Day Brent Oil Volatility	Current	0.38
20 Day NBP Gas Volatility	Lag	0.32
20 Day ARA Coal Volatility	Lag	0.35
Open Interest of Brent Futures	Current	-0.26
Open Interest of NBP Futures	Lag	-0.32
Volatility of the FTSE	Lag	0.38

The table shows the choices of current or first lag of the listed financial proxies and the PCA-derived weights for the linear combination of these proxies to produce the emissions and energy market sentiment index. The first principal component explains 27% of the variance.

Table 4: Loadings for the emissions and energy market sentiment index

the 18 series is the first stage index, F_t . For each individual proxy P_t the correlation between the current value and the first stage index, Corr(P_t,F_t), and the correlation between its first lag and the first stage index Corr(P_{t-1},F_t) are calculated. For each individual proxy the larger of these two values determines whether to use the current or first lag for each proxy; these are entered into a second PCA which produces the sentiment index as its first principal component.

2.4 Measurement of Media Coverage

For the third part of our analysis, we consider to what extent the level of market attention on issues pertinent to the emissions market at the time of policy decisions impacts on price and volatility. Fang and Peress (2009) show that news exposure has an influence on the returns of stocks in the US market. This is in line with the Investor Attention Hypothesis (Barber and Odean, 2008; Da et al., 2011; Vozlyublennaia, 2014) which posits that since attention is a scarce commodity, that investors are more likely to trade stocks to which their attention has already been drawn. Motivated by this work, we thus construct a media exposure variable based on news stories about the EUA market and emissions trading, a variable we propose as measuring "market attention". Media coverage both informs market participants (Tetlock, 2007) and is informed by market participants (Oberlechner and Hocking, 2004), and therefore acts as a guide to the level of market interest in upcoming news events.

A policy decision of the EP is categorized as being of high news importance if the news exposure on the day of the decision is above the median for the set of decisions under consideration. Fang and Peress (2009) defined the news exposure of a particular stock as a count of stories which appeared in either the Dow Jones Newswire service, or in any of four US newspapers: The New York Times, USA Today, The Wall Street Journal or The Washington Post (which together accounted for 11% of daily circulation of newspapers in US at that time). Motivated by this approach, we consider the following sources of news: the news wire services Agence France Presse (APF), The Associated Press (AP), Thomson Reuters ONE and Thomson Reuters Financial News Super Focus; and the UK broadsheets The Daily Telegraph, The Financial Times, The Times, The Independent and The Guardian (which account for 18% of daily circulation of newspapers in the UK[10]). The list of broadsheets is taken from Lexis Nexis and excludes Sunday papers as these would give a biased result for that one day of the week which is not a trading day.

We search the Lexis Nexis database for the following terms: “EU ETS”, “climate change”, “carbon emission”, and “CO2”. When the search term “EU ETS” was used on its own very low counts were made so that such data was too sparse, hence a wider selection of search terms were used. For an article to be counted at least one of these four search terms must have occurred three times in the article. This provides an objective way to ensure that the article is actually about the EU emissions market and not merely referring to it while discussing other emissions related topics, such as the Chinese emissions trading schemes for instance. We therefore define the following time series:

$Newspaper_t =$ the number of stories on day t in any of the newspapers listed, with each story containing at least three occurrences of at least one of the search terms listed;

$NewsWire_t =$ the number of stories on day t in any of the news wires listed, with each story containing at least three occurrences of at least one of the search terms listed.

In order to measure the effect of the media on EP decisions, we construct

[10]Source: Audit Bureau Circulations (ABC). Site accessed on 2nd February 2015 at http://www.abc.org.uk/

Origin	
Topical (TOP)	10
European Parliament Led (EP- led)	19

Sentiment	
High	14
Low	15

News Exposure	
High	13
Low	16

The table records the number of decisions of the European Parliament in each of the categories tested.

Table 5: Distribution of the decisions across origin, sentiment and news exposure

a time series which captures the level of coverage of the EU ETS and related issues over the previous three days. We therefore define $News_t$ for the time period under consideration as follows

$$News_t = \sum_{i=t-3}^{t-1} (Newspaper_i + Newswire_i)\,,\ t = 4, 5, .., 1626$$

This time series is calculated and the median for the 29 days under consideration is calculated. High news coverage is considered to happen on days when the news is higher than the median.

To summarise the classification set out in this section and that of Sections 2.3 and 2.4, Table 5 provides a breakdown of the 29 events dates by origin, sentiment and news exposure.

2.5 Testing Methodology

In this section we set out the technical details of the event study employed to examine price effects and follow this with the specification of the GARCH modelling used to examine volatility effects.

2.5.1 Event Study Specification

Following the method of Kothari and Warner (2007), MacKinlay (1997) and, Lin and Tamvakis (2010) we use an event study on the 29 identified dates of EP policy decisions. In addition to this, we perform separate event studies using the categorizations based on (i) the EP policy decision origin, (ii) the level of market sentiment and (iii) the level of news market attention. An event study is chosen as it is ideally suited to test for the presence of changes in the mean of time series where the date of the change is known approximately. It will allow us to see when the event is reflected by a change in the mean log returns.

We use an estimation window of 20 days and an event window of 11 days, comprising the 5 days before the event, the event day itself and the 5 days after the event. Lin and Tamvakis (2010) used lengths of 40 days for the estimation window and 20 days for the event window to examine quarterly OPEC meetings. Here we retain the approximate ratio of 2:1 for the estimation window and event window lengths by choosing a 20 day estimation window and 11 day event window. There is an inherent limitation of an investigation of EP decisions, as they do not occur at a constant frequency. The selection for the estimation and event window lengths are chosen as a compromise between obtaining a reasonably accurate estimation for the parameters for normal behaviour away from events (during the estimation window periods), keeping the event window short to detect events more effectively (Kothari and Warner, 2007) and selecting a reasonably large number of decisions to test. At the same time it is necessary to keep an event window long enough to test for price movements before EP decisions (possibly due to information leakage) and the possibility of price movements after the event day itself. Akin to the phenomenon of post earnings announcement drift (Hirshleifer et al., 2009) the effect of an EP decision on EUA prices may not end on the day of the decision itself, but may continue for a short period after. Therefore we select 11 days in keeping with the ratio of Lin and Tamvakis (2010). Setting longer periods for the estimation window will improve the accuracy of the parameter estimates for the statistical testing (Kothari and Warner, 2007) however in this application the cost of this increased accuracy is the loss of the number of EP decisions which can be analysed.

The abnormal returns are calculated as the difference between the day's return and the expected return using two models of normal behaviour: a zero log return model; and a constant rate of return model. MacKinlay (1997) states that although a constant return model is a very simple, it is surprisingly useful at identifying changes in price behaviour compared with more sophisticated models. In particular we follow Lin and Tamvakis (2010) by using both a zero log return and a constant log return model for the behaviour of EUA prices during normal periods. The conclusions drawn from these two models are the same giving practically the same p-values; the results presented in Table 6 are for the simpler zero log return model (results for the constant rate of return model are available upon request). We define $r_{i,\tau}$ as the observed EUA log return, with i being an index for the particular event and τ being an index for time during this particular event. In this case $i = 1, 2, .., N$, where $N = 29$ for all of the events under consideration. When we examine only a subset of these, such as days when decisions are party-political in origin, or days with high sentiment or high news then $N = 10$ or $N = 14$ respectively. We set the event time $\tau = 0$ on the day of event, τ then takes values between -25 and 5. $K_{i,\tau}$ is defined to be the expected return based on a model calibrated during the estimation window, which are the 20 days when $-25 \leqslant \tau \leqslant -6$. We therefore define the residual $\epsilon_{i,\tau} = r_{i.\tau} - K_{i,\tau}$. In this application of the event study, as is the case in Lin and Tamvakis (2010) we assume $K_{i,\tau} = 0$. Very similar results and identical conclusions are obtained when using a constant return model for $K_{i,\tau}$, calculated as the mean during the estimation windows. Following the standard approach, the average abnormal return AR_τ at event time τ is defined as

$$AR_\tau = \frac{1}{N}\sum_{i=1}^{N}\epsilon_{i,\tau}. \tag{1}$$

The cumulative average abnormal return between two days τ_1 and τ_2, $CAR(\tau_1, \tau_2)$, is therefore defined as

$$CAR(\tau_1, \tau_2) = \sum_{t=\tau_2}^{\tau_2} AR_\tau \ .$$

This is calculated for all 29 events and for the different categories of events, party-political, non-party-political, and high and low sentiment and news. We calculate an associated test statistic

$$T = \frac{CAR(\tau_1, \tau_2)}{\sqrt{\sigma^2(\tau_1, \tau_2)}} \sim N(0, 1)$$

where $\sigma^2(\tau_1, \tau_2) = L\sigma^2$, σ^2 is the variance of the AR_τ calculated during the estimation window, and $L = \tau_2 - \tau_1 + 1$. In our application the value of τ_1 is fixed at $\tau_1 = -5$ while τ_2 varies from $-5, -4, ..., 5$; we present results labelled in the form $CAR\,\tau_2$. The results of the event studies are presented in Table 6 both with and without the extreme event of the backloading rejection date, 16th April 2013. Repeating the event studies in this way provides a robustness check for our analysis.

2.5.2 GARCH Model Specification

In addition to the impact on returns, we are also particularly interested in the effect of EP policy decisions on the volatility of the EUA emissions market. To test this we use a GARCH model with dummy variables in the variance equation, following Lu and Chen (2011). In line with Chevallier (2011) and, Engle and Ng (1993) the standard GARCH(1,1) model for EUA prices is specified as follows:

$$r_t = \mu + \rho r_{t-1} + \varepsilon_t,\ \varepsilon_t \sim i.i.d.(0, \sigma_t^2),$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

where r_t is the log return for day t;ρ is the coefficient of first order auto-correlation; μ, $\alpha_0, \alpha_1$and β are constants, and ε_t is the error term process with mean zero and conditional variance σ_t^2. We test whether there is an effect on the event days by introducing a dummy variable d_t in the variance specification. We test the period before the event day, by setting $d_t = 1$ on each of five days before each event and zero on all other days. We test the period of and after the event by setting $d_t = 1$ on the day of each event and on the following five days. These periods are chosen so that we may make compare the event study results and the GARCH results. That is, we specify

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \gamma d_t$$

where d_t is the value of the dummy variable on day t. We use Marquardt's method in Eviews and present the results before the event in Table 7 with the results on and after the event in Table 8. Again, as a robustness check we repeat the GARCH modelling while excluding the extreme event of the backloading rejection date, 16th April 2013.

3 Empirical Results

Following the method set out in the previous section, Table 6 (Panel A) presents the results of the event studies while Tables 7 and 8 (Panel A) present the results of the GARCH modelling before and after the same events. Our principal finding is that EP policy decisions taken as a whole have a significant effect on EUA prices. From the event study analysis, this effect starts on the day of the policy decision itself and results in a reduction of EUA prices, while from the GARCH modelling we see an increase in volatility before and after the decision. The decrease in the EUA price is strongly statistically significant, as evidenced for the cumulative abnormal returns over event dates $\tau = 0, \ldots, 5$. These event study results were found to be robust to a change in the model used to calculate the abnormal returns in Eqn. 1, where instead of a zero log returns model we use a constant log returns model to calculate the abnormal returns (calculated as the mean during the estimation windows). From the GARCH modelling, an increase in volatility clustering is evidenced after the event dates with a smaller effect before. There is a very strong result after event days as seen in the higher value of the γ parameter.

As set out in the previous section, (Section 2), given the influence and hence potential source of bias from the backloading vote event, we check the robustness of our findings by means of repeating the testing but removing from the data set the extreme event date of the 16th April 2013, i.e. the date of the backloading rejection by the EP. Panel B of Table 6 presents the results of the event studies in this case. As this date falls into the classifications of "non-party-political", "low sentiment" and "low news", we report the updated results for these categories only. When the effect of the vote on backloading is removed from the analysis the statistical significance of the results is less striking, although the results remain statistically significant at the conventional levels. So our findings hold after accounting for the potential bias of the extreme backloading event. In a similar manner, Panel B of Tables 7 and 8 present the results of the GARCH modelling when the backloading rejection date is removed. When we re-examine the all-decisions grouping we notice that before the event the size of the coefficient for the dummy variable, γ, is lower without the outlier and has lost statistical significance, but the volatility dummy variable on and after the event is practically the same and remains strongly significant. This indicates that the backloading rejection date was an important part of the overall pattern in the data but was not responsible on its own for the pattern.

A drop in EUA prices is seen not only on the event day itself but for several more days after the EP decision. We may conclude that the emissions market is taken by surprise when EP decisions are made. Then similarly to the post earnings announcement drift (Barber and Odean, 2008; Da et al., 2011; Vozlyublennaia, 2014) the change in price continues for several days.

Our second key finding is that when the EP is dealing with a policy decision which is non-party-political, i.e. legislation which originated from the

European Parliament's committees, the European council or the European commission, there is on average a large reduction in the price of EUAs and an observable increase in the volatility of the EUA price. These effects are not seen for decisions brought forward by the party-political groups of MEPs, decisions made in these cases tend not to move the price significantly and there is some evidence that volatility decreases after such decisions. The results are seen to hold when the backloading rejection vote is excluded. This would indicate that if the political groups of the MEPs are themselves the source of the discussion, then the resulting decisions of the EP do not take the market by surprise. This may be caused by the political groups' willingness to publicise their activities. The market is more strongly affected by the non-party-political decisions from more bureaucratic sources which are less likely to seek publicity and so these decisions are less anticipated by the market. This finding has an important implication for policy makers as it shows that non-party-political legislation has the greatest impact on the emissions markets, and these on average cause market shocks.

Our third main finding is that the EP policy decisions are associated with a decrease in the level of EUA price and an increase in volatility after the decision during times of low market sentiment but not in times of high sentiment. This suggests a particular effect of EP policy decisions during times of low market sentiment. A similar pattern is seen without the backloading event date. These sentiment findings indicate a need for policy makers to consider market dynamics in terms of policy decision timing.

Our fourth and final finding is that when there are low levels of emissions market attention (as measured by media coverage), the EP decisions again move the price of EUAs significantly downwards after the event and significantly increase volatility both before and after the event. In contrast, when there are high levels of emissions market related news, the EP decisions do not, on average, have an effect on the level of EUA prices but actually lower the volatility after the decision takes place. This suggests that policy decisions that directly or indirectly relate to the structure and functioning of the EUA market impact on price and volatility when general market attention is low. These findings indicate a need to inform market participants more effectively as to upcoming EP decisions that might impact on the market.

There are some weaknesses in the testing method used here which would prompt future investigations. Firstly the media analysed is only in the English language. While it is certainly the case that the chosen newspapers and newswires have international respect it would be interesting to test the exposure in other languages. Another weakness is that we only test 29 decisions, while this is a much larger sample size than Koch et al. (2014) it is always desirable to have more datapoints. This selection was a compromise between the length of the estimation window and the number of decisions used for the event study, because an increased estimation window size would reduce the number of decisions available for the event study.

Panel A Event Study using all data

	All Decisions	Topical	EP-led	High Sentiment	Low Sentiment	High News	Low News
CAR -5	-0.004	-0.002	-0.005	0.001	-0.009	-0.006	-0.003
CAR -4	-0.013	-0.010	-0.014*	-0.005	-0.020*	-0.014	-0.012
CAR -3	-0.016	-0.022	-0.013	-0.010	-0.022*	-0.021*	-0.012
CAR -2	-0.012	-0.021	-0.007	0.000	-0.023	-0.009	-0.015
CAR -1	-0.013	-0.018	-0.010	-0.003	-0.022	-0.010	-0.015
CAR 0	-0.036***	-0.028	-0.041**	-0.020	-0.051**	-0.020	-0.049**
CAR 1	-0.045***	-0.019	-0.059***	-0.019	-0.070***	-0.009	-0.074***
CAR 2	-0.039***	-0.013	-0.052***	-0.012	-0.064***	0.000	-0.070***
CAR 3	-0.047***	-0.020	-0.062***	-0.020	-0.073***	0.001	-0.086***
CAR 4	-0.056***	-0.014	-0.078***	-0.018	-0.082***	-0.000	-0.101***
CAR 5	-0.060***	-0.024	-0.079***	-0.036*	-0.083***	-0.006	-0.105***
N =	29	10	19	14	15	13	16

Panel B Event Study omitting the backloading rejection day

	All Decisions	EP-led	Low Sentiment	Low News
CAR -5	-0.001	-0.001	-0.004	0.003
CAR -4	-0.007	-0.005	-0.008	0.000
CAR -3	-0.011	-0.004	-0.011	-0.001
CAR -2	-0.009	-0.003	-0.018	-0.010
CAR -1	-0.010	-0.006	-0.018	-0.010
CAR 0	-0.019 *	-0.014	-0.018	-0.018
CAR 1	-0.024 **	-0.027 *	-0.029	-0.037 *
CAR 2	-0.021 *	-0.026 *	-0.031	-0.040 *
CAR 3	-0.031 **	-0.038 **	-0.043 *	-0.059 **
CAR 4	-0.037 **	-0.050 **	-0.046 *	-0.068 ***
CAR 5	-0.044 ***	-0.055 **	-0.051 **	-0.077 ***
N =	28	18	14	15

Panel A shows results of tests comparing the effect of European Parliament decisions on the mean of log returns of EUA prices on the five days before, the day itself and the five days after the decision. Panel B repeats these tests without the outlier on the backloading rejection day, 16th April 2013. Topical refers to EP decisions originating from the political groups of MEPs, EP-led refers to all other sources of EP decisions. High sentiment refers to levels of sentiment above the median. The EUA sentiment index uses only data from the EUA and Energy markets, and the volatility of the Stoxx 50 to construct a sentiment index. News is a measure of the exposure of the EU ETS in broadsheet and newswire stories. The event study measures changes in the cumulative abnormal returns for an event window of 11 days. These tests are repeated with a constant level of change model to calculate the abnormal returns. These results yield very similar results and identical conclusions; they are omitted for brevity and are available from the authors. N indicates the number of events in each test. The usual */**/*** indicates 10%, 5% and 1% p-values for the coefficient significance test.

Table 6: Event study results

Panel A GARCH before the Event days

	Base Model	All Decisions	Topical	EP-led	High Sentiment	Low Sentiment	High News	Low News
α_0 (x 10^{-5})	1.54 ***	1.28***	1.54***	1.24***	1.44***	1.41***	1.56***	1.23***
α_1	0.160 ***	0.157***	0.160***	0.156***	0.159 ***	0.157***	0.160***	0.151***
β_1	0.839 ***	0.843***	0.839***	0.845***	0.840***	0.842***	0.839***	0.846***
γ(x 10^{-5})	-	1.99*	-0.53	3.06*	1.27	2.57	-0.29	8.7***
N	-	29	10	19	14	15	13	16

Panel B GARCH before the Event Days omitting the backloading rejection day

	Base Model	All Decisions	EP-led	Low Sentiment	Low News
α_0 (x 10^{-5})	1.54 ***	1.33***	1.28***	1.45***	1.22***
α_1	0.160 ***	0.157***	0.157 ***	0.158***	0.153***
β_1	0.839 ***	0.843***	0.844 ***	0.841***	0.846***
γ(x 10^{-5})	-	1.47	2.11*	1.15	5.90***
N	-	28	18	14	15

The table shows the results of GARCH models for the 1,625 daily log returns of EUA prices. Panel A uses all 29 decisions of the European Parliament (EP) selected according to origin, sentiment and news exposure. Panel B repeats these tests, omitting an outlier on the backloading rejection day, 16th April 2013. The base model is the standard GARCH model without the dummy variables around the times of EP decisions, and this model is shown for comparison purposes. Topical refers to a categorization of each decision by the EP itself where the decision originates from the political groups of the EP. High sentiment refers to levels of sentiment above the median. The sentiment index uses only data from the EUA and Energy markets, and the volatility of the Stoxx 50 to construct a sentiment index. News is a measure of the exposure of the EU ETS in broadsheet and newswire stories. The change of variance is based on the addition of a dummy variable d_t to the variance equation in a GARCH model $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2 + \gamma d_t$. The dummy variable d_t takes the value 1 on the 5 days before the European Parliament decision and zero otherwise. N refers to the number of events (EP decisions) in each model. The usual */**/*** indicates 10%, 5% and 1% p-values for the coefficient significance test. For brevity the mean equation results are not included but are available from the authors.

Table 7: GARCH results for the five day period before European Parliament decisions

Panel A GARCH on and after the Event Days

	Base Model	All Decisions	Topical	EP-led l	High Sentiment	Low Sentiment	High News	Low News
α_0 (x 10^{-5})	1.54 ***	1.33***	1.56***	1.32***	1.51***	1.41***	1.75***	1.35***
α_1	0.160 ***	0.164***	0.159***	0.166***	0.161***	0.162***	0.161***	0.166***
β_1	0.839 ***	0.836***	0.841***	0.834***	0.839***	0.837***	0.837***	0.832***
γ(x 10^{-5})	-	2.35**	-2.69*	3.93***	0.56	3.55**	-2.88**	9.39***
N	-	29	10	19	14	15	13	16

Panel B GARCH on and after the Event Days omitting the backloading rejection day

	Base Model	All Decisions	EP-led	Low Sentiment	Low News
α_0 (x 10^{-5})	1.54 ***	1.33***	1.31***	1.40***	1.32***
α_1	0.160 ***	0.163***	0.166***	0.162***	0.165***
β_1	0.839 ***	0.836***	0.835***	0.838***	0.833***
γ(x 10^{-5})	-	2.23**	3.70***	3.25**	8.60***
N	-	28	18	14	15

The table shows the results of GARCH models for the same tests as in Table 7 with the change that the dummy variable d_t takes the value 1 on the day of the decision and on the following 5 days, and is zero otherwise. This tests for a change of variance after an event.

Table 8: GARCH results for the day of the European Parliament decisions and the following five days

4 Conclusions and Policy Implications

Koch et al. (2014) are clear that there is much yet to be discovered about the drivers of EUA prices beyond the fundamentals. It is not surprising that policy maker decisions from the European Parliament have a direct effect on the volatility and level of EUA prices. This study shows that EP influence is changed by the type of decision, the sentiment of the emissions markets, and the level of market attention (as measured by news coverage) in advance of the decision.

The emissions market has some insight into the likely outcome of decisions made by the European Parliament in three circumstances, (i) when it is the party-political groups in the parliament who propose the legislation, (ii) when market sentiment is high and (iii) when the level of market awareness is high, that is when there are high levels of media coverage. The decisions made under these circumstances seem to be anticipated correctly by the market and there is little price movement.

Of greater interest are the occasions when EUA market prices systematically react as if it has just been surprised. The decisions that we have termed non-party-political in this study; those decisions originating from one of the EP committees, the European Council or the European Commission, significantly lower EUA prices and are associated with heightened price volatility. The GARCH volatility findings indicate a high level of trader uncertainty around the outcome of these decisions and their potential impact on prices.

Better communication by policy makers would help reduce this. Clearly setting out a timeline of planned legislative decisions over the medium-term and what these policies will broadly aim to achieve can help provide some improved certainty to market participants. Ideally some form of forward guidance might be given. A benefit of this is that current prices would be a more accurate reflection of true value and thus organizations that must buy allowances will be paying an appropriate price. Reducing uncertainty will also encourage the market to move from being a short-term speculative market to one where institutions interested in long-term participation will be attracted, thus helping to add depth to the market.

With regard to the sentiment and media findings, these offer some additional important implications. Firstly the finding that sentiment and media coverage might influence price reaction is of interest in terms of informing the timing of decisions. Political decisions are often timed based on judgements of public receptiveness, and perhaps this needs to be considered for EP decisions on the EUA market. EUAs are not like normal commodities; the supply of EUAs is under political control and the demand for them is caused by regulation. Hence they have a high level of regulatory uncertainty attached to their valuation. The sentiment literature in equity markets, starting with Baker and Wurgler (2006), has consistently recognized that more uncertain assets are more prone to sentiment influence. The presence of high uncertainty in the pricing of EUAs (and not just for the EUA market, but also other highly regulated markets subject to political influence), suggests a greater need for awareness of these behavioural drivers of price.

It is clear that EP decisions have a significant and important influence on EUA price levels and volatility. We have provided a systematic investigation of this influence in this study. Providing greater certainty to market participants, possibly through forward guidance, would enhance market participation, while improved awareness of behavioural influences regarding the market's reaction to EP decisions, can help strengthen the operation of the EUA market. A next step is to delve more qualitatively into the nature of individual EP decisions and ascertain particular facets of those decisions that might be driving market reactions. There is also strong scope for integrating market sentiment deeper into our understanding of emissions markets pricing.

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