Influences from the European Parliament on EU Emissions Prices

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April 12, 2015

Abstract

The decisions of the European Parliament (EP) are shown to influence both EU emission allowance (EUA) prices and volatility. This is not a universal influence though, only the decisions which are either (i) parliament-led, as opposed to topical decisions originating from the political groups, (ii) made during times of low market sentiment or (iii) made during times of low market awareness, reduce the price and increase the volatility. 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 in order to reduce the evident ongoing uncertainty experienced by traders around each decision made by the EP. The sentiment findings indicate 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.
**JEL:** Q58, G14, C12

**Keywords:** EU emission allowances, market sentiment, media exposure, European Parliament

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**Acknowledgements**

This material is based upon works supported by Dublin City University under the Daniel O’Hare Research Scholarship scheme awarded to Peter Deeney. Peter Deeney, Mark Cummins and Michael Dowling are members of the Dublin City University Business School (DCUBS), Ireland. Alan Smeaton of The Insight Centre for Data Analytics is supported by Science Foundation Ireland under Grant Number SFI/12/RC/2289. Alan Smeaton is a professor in the Dublin City University School of Computing, Ireland. The authors would like to thank participants at the meeting of the Euro Working Group on Commodities and Financial Modelling (2014) held in Chania, Greece, the Research Seminar Series and Doctoral Colloquium in DCUBS 2015, the Irish Accounting and Finance Association in Belfast 2014 and the Irish Society for New Economists in Galway 2014.

## 1 Introduction

In April 2013 the European Parliament was expected to pass a European Commission legislative proposal to fix the recognised oversupply issue in the EU Emissions Trading Scheme (EU ETS). The Commission’s proposal involved postponing until 2019-2020 the release of 900 million EU emissions allowances
(EUAs) - each allowance granting permission to a regulated installation in the EU to emit one tonne of CO₂ 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 from €4.76 to €3.09.

Legislation passed by the European Parliament (EP), which holds primary legislative authority over the EU ETS, thus can clearly impact on EUA prices. Prior research supports a wider argument that EUA prices are 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?

Our study addresses these issues by tracking 29 relevant resolutions passed by the EP over Phase II and Phase III (to date) of the EU ETS. We show a strong overall impact from these decisions on market returns. The impact on returns is determined through an event study approach which shows that the day a legislation or resolution is passed is on average associated with significantly negative returns, and these negative returns become cumulatively greater in the week following the decision day. Thus, the resolutions passed by the EP
act, on average, as a driver of price falls. This is quite striking given that the success of the trading scheme requires prices of emission allowances to be sufficiently high, and indeed to exceed the cost of abatement, so as to act as a disincentive to traditional high emission energy production and energy-intensive business practices. When we further divide resolutions into those that are EP-led and those termed ‘topical’ (generally legislation introduced by EP political parties as it is deemed currently topical or urgent), we find that it is the EP-led initiatives which are the particular 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.

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 they can alter the structure of the markets 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 re-
action 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. We show market sentiment to be important.

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; Silverio 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 Muckle, 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 which is similar to that for sentiment. We thus construct a media coverage variable based on news stories about the EUA market and emissions trading. We propose this variable as measuring 'market attention'. We argue that 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. Following from this, we find that low media exposure of issues relevant to the EU ETS in advance of a legislative decision is associated with greater 'price shock'; there is a significant cumulative negative price reaction in the days after a low media exposure 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; Kosoy 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 EP-led or topical; (ii) the level of market sentiment (high or low); and (iii) the level of emissions market related news media exposure (high or low) or what we refer to as ‘market attention’.

Examining the origin of EP policy decisions provides insights into the impact of resolutions brought forward by the EP. The EP itself classifies the origin of each resolution. We divide these into ‘EP-led’ resolutions brought by a combination of the parliament itself, the European Council and the parliamentary committees, and ‘topical’ 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 better understand which forms 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 related news media exposure 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 price volatility at the times of EP decisions, following Lin and Tamvakis (2010) and Lu and Chen (2011). The remainder of this section is organised 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 topical or EP-led. 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 news media exposure or 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 analysis. 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 on 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 Table 1: Descriptive Statistics >>
<< 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 market 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, 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.\footnote{Accessed on 20th November 2014 at http://www.europarl.europa.eu/oeff/home/home.do.} This source provides a list of key stages of a resolution as it makes its way through the EP.

The EP itself classifies resolutions according to their origin and so we may easily identify resolutions originating from the EP itself, the European Council, the Commission or the parliamentary committees (termed by us as ‘EP-led’). Resolutions brought forward by the political groups within the EP are described by the EP as being ‘topical’; we designate these with the term ‘TOP’. We use the European Parliament Legislative Observatory because it has an exhaustive record of all EP policy decisions. To find all the relevant decisions, we search
for the terms: “EU ETS”, “emissions trading” and “carbon trading”. We do not use the term “climate change” as this was deemed 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 window and five days on either side of the event day as the event window. This is quite short compared with similar studies such as Lin and Tamvakis (2010), but we must compromise between having a reasonable sample of events and an adequate period for each of the estimation and event windows. We avoid having an event, i.e. an EP policy decision, within the estimation window of another event. Therefore events must be fewer than 5 days apart or more than 25. This means that our initial list of 37 identified events reduces to 29 events. It can be seen that there are 10 events classified as topical, with 19 events classified as being EP-led. 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.\(^2\) 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

\(^2\) 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 recognised oversupply of allowances in the market.
€3.09 on the futures market, a collapse of approximately 35%. This was the largest percentage drop in a single day observed in the 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

Another 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 method 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 therefore construct an index which includes additional financial information from the wider energy markets in particular. This aligns with Bredin and Muckley (2011), Chevallier (2011), and Mansanet-Bataller 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); coal of course being the largest emitter of the fossil fuels and gas, as the lowest emitter, being recognised as the transition fuel to a low carbon economy. 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). The use of NBP is most suitable as this market is recognised as the largest and most liquid of the European gas markets. 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.

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 recognised 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. The twenty-day time frame is chosen 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. 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 used as an alternative to the volume of trades. 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. 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.

The sentiment index is defined as a linear combination of the proxies where the weights are selected by principal component analysis (PCA). To take into account the possibility that some of the indices are more strongly leading indices than the others (following Baker and Wurgler, 2006), a first stage index is constructed to determine whether to use each proxy’s current value or its first lag. The first stage index is the first principal component of the eighteen time series comprised of the current values and the first lags of all nine proxies. For each proxy, the correlation between the first stage index and the proxy time series is calculated as well as the correlation between the first stage index and the proxy’s first lag. Whichever of the current or first lag has the higher correlation goes forward to the second stage PCA. The first principal component of this second stage PCA is then deemed the sentiment index for the emissions and energy market. The weightings and the choices of either current or first lags of the proxies are presented in Table 4.

<< Insert Table 4: PCA Loadings >>

2.4 Measurement of Media Coverage

For the third part of our analysis, we consider to what extent the level of news media exposure 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 which is similar to that for sentiment. Motivated by this work, we thus construct a media coverage 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: New York Times, USA Today, Wall Street Journal or the Washington Post (which accounted for 11% of daily circulation of newspapers in US at that time of writing). 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 accounts for 18% of daily circulation of newspapers in the UK\(^3\)). 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.

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

\(^3\)Source: Audit Bureau Circulations (ABC). Data was collected on 2nd February 2015 at http://www.abc.org.uk/
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:

\[ \text{Newspaper}_t = \text{the number of stories on day } t \text{ in any of the newspapers listed, with each story containing at least three occurrences of at least one of the search terms listed;} \]

\[ \text{NewsWire}_t = \text{the number of stories on day } t \text{ in any of the news wires listed, with each story containing at least three occurrences of at least one of the search terms listed.} \]

In order to measure the effect of the media on EP decisions, we construct a time series which captures the level of coverage of the EU ETS and related issues over the previous three days. We therefore define \( \text{News}_t \) for the time period under consideration as follows

\[ \text{News}_t = \sum_{i=t-3}^{t-1} (\text{Newspaper}_i + \text{NewsWire}_i), \ t = 4, 5, \ldots, 1626 \]

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 for all decision days.

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.

<< Insert Table 5: Distribution of Decisions >>
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 Tanvakis (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 media exposure. 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. The abnormal returns are calculated as the difference between the day's return and the expected return using two models: 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. We therefore use two models, a zero log return and constant log return. We define \( r_{i,\tau} \) as the observed EUA log return, with \( i \) being an index for the events and \( \tau \) being an index for time during each 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 with high sentiment or days with high news then \( N = 14 \) or \( N = 13 \) respectively. We set the event time \( \tau = 0 \) on the day of
event, $\tau$ 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 $-25 \leq \tau \leq -6$. 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 $AR_{\tau}$ at event time $\tau$ is defined as

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

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

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

This is calculated for all 29 events and for the different categories of events, EP-led, TOP, 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 $\sigma^2(\tau_1, \tau_2) = Ls^2$, $s^2$ is the variance of the $AR_{\tau}$ calculated during the estimation window, and $L = \tau_2 - \tau_1 + 1$. In our application the value of $\tau_1$ is fixed at $\tau_1 = -5$ while $\tau_2$ 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:

\[ r_t = \mu + \rho_1 r_{t-1} + \varepsilon_t, \varepsilon_t \sim i.i.d.(0, \sigma_t^2), \]

\[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \]

where \( r_t \) is the log return for day \( t \), \( \mu \) is constant and \( \varepsilon_t \) is the error term process with mean zero and conditional variance \( \sigma_t^2 \). 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

\[ \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \gamma d_t \]

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. 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 significant result after event days as seen in the higher value of the $\gamma$ parameter.

As set out in the previous section, 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 ‘EP-led’, ‘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 there is less statistical significance in the results, although the results remain statistically significant at conventional levels. 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, $\gamma$, is lower without the outlier and has lost statistical significance, but the volatility on and after the event is practically the same and is 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.

Our second key finding is that when the EP is dealing with a policy decision which is EP-led, i.e. legislation which is originated within the EP, the council, the commission or the EP committees, 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 topical policy decisions brought forward by the 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 when there is a public awareness of a need to legislate that the result of the decisions of the EP is not a surprise to the market but that the market is perhaps more fundamentally affected by the EP-led decisions and these are less anticipated by the market. This finding has an important implication for policy makers as it shows that EP-led 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 related 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 better inform market participants and media coverage as to upcoming EP decisions that might impact on the market.

<< Insert Table 6: Event Study Findings >>
<< Insert Table 7: GARCH (before decision) Findings >>
<< Insert Table 8: GARCH (on or after decision) Findings >>

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 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 political groups in the parliament who propose the legislation (topical decisions), (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 in
these events seem to be anticipated correctly by the market and thus there is little price movement.

Of greater interest are the occasions when EUA market prices systematically react as if 'surprised'. The decisions that we have termed EP-led in this study; those decisions originating from the EP itself, the European Council, the Commission or the parliamentary committees, 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. A benefit of this is that current prices would be a more accurate reflection of true value and thus organisations 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 uncertainty attached to their valuation. The sentiment literature in equity markets, starting with Baker and Wurgler (2006), has
consistently recognised 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 and improved awareness of behavioural influences on the market reaction to 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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