SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 240

EU ETS – AN EMPIRICAL STUDY OF MARKET DYNAMICS AND CORPORATE STRATEGIES IN THE SECOND AND THIRD TRADING PERIODS (2008-2020)

Paweł WITKOWSKI

University of Szczecin, Department of Finance and Banking; pawel.witkowski@usz.edu.pl,
ORCID: 0000-0003-0080-3893

Purpose: The research aims to identify how enterprises adjusted their trading strategies, participation intensity, and risk management approaches in response to evolving EU regulations and changing market conditions. The study also seeks to examine the structural differences between small and large enterprises and their approaches to trading emission allowances and derivatives.
Design/methodology/approach: The research combining quantitative and qualitative analyses. The study is based on secondary data from official reports published by relevant institutions. The theoretical scope of the paper covers the intersection of environmental economics and financial market behavior, emphasizing the transformation of emission allowances into fully recognized financial instruments within the EU legal framework.
Findings: The analysis revealed that during the second trading period, market activity was relatively low due to a substantial free allocation of allowances and an oversupply in the market. Most small and medium-sized enterprises engaged minimally, often purchasing allowances only to meet compliance obligations. In contrast, large utilities and industrial entities demonstrated more active behavior, particularly in the third trading period, employing strategies such as hedging, banking, and cost minimization. Rising EUA prices after 2018 encouraged a shift toward more strategic, long-term management of allowances and increased interest in emission-reduction investments.
Research limitations/implications: The study's main limitation lies in its reliance on aggregated data, with a focus primarily on the German market and EU-level statistics. Consequently, the results may not fully reflect the diversity of behaviors in smaller or less-regulated markets.
Practical implications: The findings provide valuable insights for policymakers, regulators, and corporate decision-makers involved in emission trading and environmental management.
Originality/value: This paper provides an original, comprehensive analysis of the behavioral evolution of EU ETS participants over two key trading periods. The study contributes to the understanding of how regulatory changes influence corporate decision-making and market development. Its value lies in offering both academic insight and practical guidance for policymakers, environmental economists, and corporate sustainability managers.
Keywords: Carbon finance, Carbon market, Corporate finance, ESG.
Category of the paper: General review, Viewpoint.

1. Introduction

The European Emissions Trading Scheme (hereinafter referred to as the EU ETS) is the main tool for implementing the commitments undertaken by the EU and its members in the Kyoto Protocol to the UNFCCC (UN, 2015). The system was established on 13 October 2003 and became operational in January 2005 (EU, 2003). The EU ETS operates on a cap-and-trade basis with partially free allocation. In the initial clearing periods (2005-2012), most allowances (EUA – European Union Allowance) were allocated to installations for free ("grandfathering"). In 2013, it was around 80% but in 2020 companies already received only 30% of allowances for free.

From its introduction, it was clear that the system would operate on a "learning by doing" basis. As a result, the EU ETS has undergone many changes, some of the most important of which are:

- developing rules to limit emissions leakage,
- developing details of the transition to an auction system (including the pace of transition, differentiated by sector),
- regulating the legal nature of emission allowances,
- withdrawing surplus allowances created after the financial crisis (backloading),
- establishing a Market Stability Reserve (MSR).

All these changes had an impact on the price of allowances and the behavior of companies covered by the system. Ultimately, it is the response of companies that will determine whether the targets for greenhouse gas emission reductions and the economic efficiency of these efforts are achieved. This raises the question of the strategies used by companies, whether they have adapted to the changing regulations, and what tools they are using.

This study synthesises findings from official reports, published surveys, and academic literature to examine participant behaviour in the EU ETS across the second and third trading periods (2008-2020). Key primary sources include reports from the European Commission, national authorities (DEHSt, KfW/ZEW), and industry analyses (Thomson Reuters/Point Carbon).

2. The Legal Nature of Emission Allowances

The analysis of EU ETS participants' behaviour should begin with determining the legal nature of emission allowances. According to Article 3(a) of the EU ETS Act (EU, 2003), an emission allowance is defined as the entitlement to emit an equivalent amount of CO_2 into the atmosphere, which may be freely traded (Article 12). This includes, among other actions, the transfer, sale, or cancellation of such units.

It is worth noting that the legal classification of emission allowances has varied across EU Member States. Most commonly, allowances have been described as financial instruments, intangible assets and property rights, or as commodities. In September 2016, following a recommendation by the European Court of Auditors, the European Commission initiated an investigation into the legal nature of emission allowances (European Commission, 2017a, p. 30). Since 3 January 2018, pursuant to MiFID II Directive, greenhouse gas emission allowances have been formally classified as financial instruments that are not securities (EU, 2014a, Section C). Consequently, they are also subject to the provisions of EMIR Regulation (EU, 2012) and MAR Regulation (EU, 2014b), which regulate OTC derivatives, central counterparties, trade repositories and market abuse respectively.

3. Market Structure and Corporate Strategies

3.1. Market Structure

The fact that emission allowances constitute a financial instrument and may be freely disposed of creates extensive possibilities for managing these units. Allowances can be traded on regulated exchanges and over the counter (OTC) markets and serve as the underlying asset for derivatives (futures, forwards, swaps, options). Accessible instruments based on emission allowances or related units (CERs and ERUs) on the most important exchanges are presented in Table 1.

Table 1.
Selected exchanges and financial instruments related to the EU ETS available on them

Exchange / Instrument	EUA	CER	ERU
ICE/ECX	spot (daily futures), auctions (UK), futures, options	spot (daily futures), futures, options	none (previously futures and options)
EEX	spot, auctions (PL, GER, EU), futures (monthly, quarterly, annual), options (European)	spot, futures	none (previously futures)
CME NYMEX	options (monthly), futures (monthly)	none (previously futures and options)	none (previously futures and options)
BLUENEXT	none (previously spot, futures, CER/EUA spread)	none (previously spot, auctions, futures, CER/EUA spread, Green CER)	none (previously auctions and spot)
NASDAQ OMX	none, but OTC offer includes: spot transactions (daily futures), futures (quarterly), spread contracts, swap, strip	none (previously spot, futures, forward and options)	none

Source: own elaboration based on nasdaq.com; cmegroup.com; theice.com; eex.com; bluenext.it.

Over time, many exchanges withdrew certain EUA, CER, and ERU instruments. On the one hand, this was due to regulatory changes (including those concerning the legal classification of allowances, the possibility of transferring allowances between periods, the reduction in the number of allowances from the auction and creating a Market Stability Reserve), as well as shifts in interest in particular instruments. On the other hand, trading became concentrated on ICE and EEX.

An analysis of the exchanges' offerings confirms that companies actively use exchange services and probably employing more sophisticated strategies for managing their positions in the emissions trading market. Companies are likely to use EUA, CER, and ERU units, as well as derivatives based on these units. However, the use of individual financial instruments has changed over the years (see Figure 1).

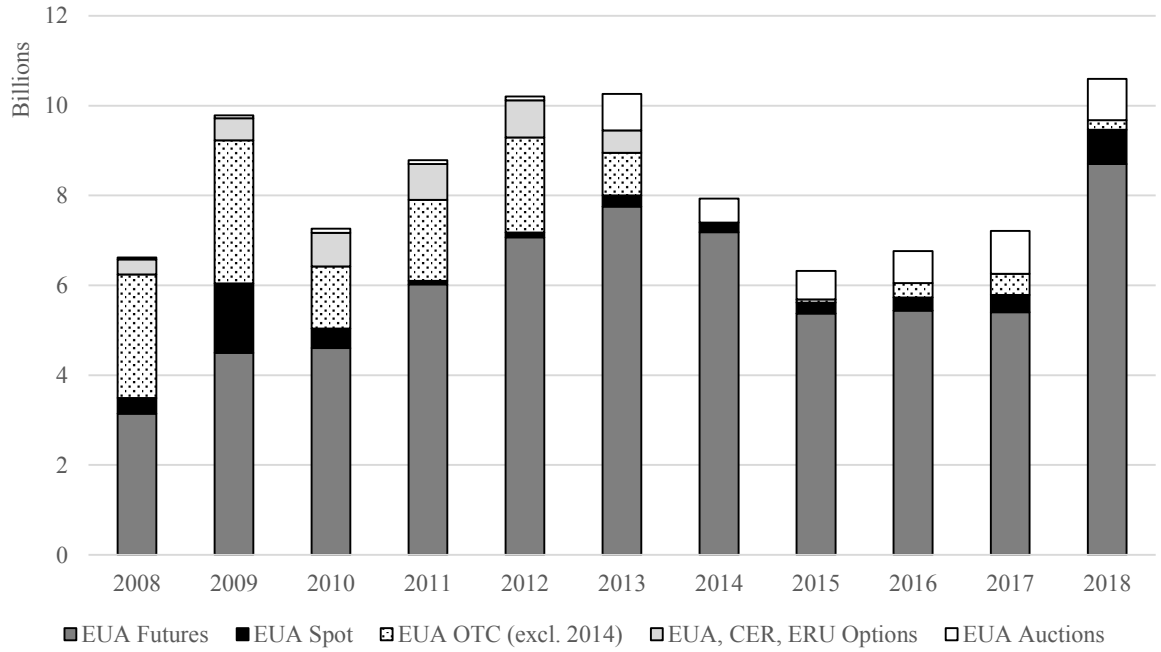


Figure 1. Volume of transactions conducted on exchange and over-the-counter markets, divided by contract type (auctions, spot, futures, options) in 2008-2018.

Source: own elaboration based on DEHST (2013, 2014a, 2015, 2016, 2017, 2018); Walner et al. (2014); European Commission (2015, 2017b, 2018, 2019).

In the early years of the second period, most emissions trading took place on the futures exchange market and the OTC market. Auctions and spot market transactions accounted for a marginal share of emissions trading (except for 2009). In subsequent years, the importance of the OTC market declined, and since the beginning of the third trading period, this market has completely lost its significance. The decline in the importance of the secondary market after 2009 was due to a loss of confidence among participants because of cases of VAT fraud (so-called VAT carousels) and theft of rights from user accounts in the register (so-called phishing) in previous years. As the free allocation of allowances (grandfathering) began to be phased out (since 2013), auctions began to gain in importance. However, the largest trading in allowances continues to take place through futures contracts. Importantly, the purchase of

a derivative instrument entails the physical delivery of the underlying asset. The relatively small share of spot market transactions in the total trading volume indicates active position management by participants in the emissions trading market.

3.2. Enterprise involvement in emissions trading during the Second and Third Trading Period

Survey data collected among German enterprises indicate that in 56% of cases emissions trading activities are managed by a single individual, while 29% of firms have a dedicated, permanent team for this purpose (KfW/ZEW, 2011, p. 34). Over the years the proportion of companies showing no inclination to engage in emissions trading has declined: in 2009, 87% either did not participate or traded only once a year, whereas by 2015 this figure had fallen to 69% (see Figure 2). At the same time, the number of companies trading daily increased. It is also worth noting that among companies that do not engage in trading at all, there are more small enterprises than large ones (KfW/ZEW, 2011, p. 24).

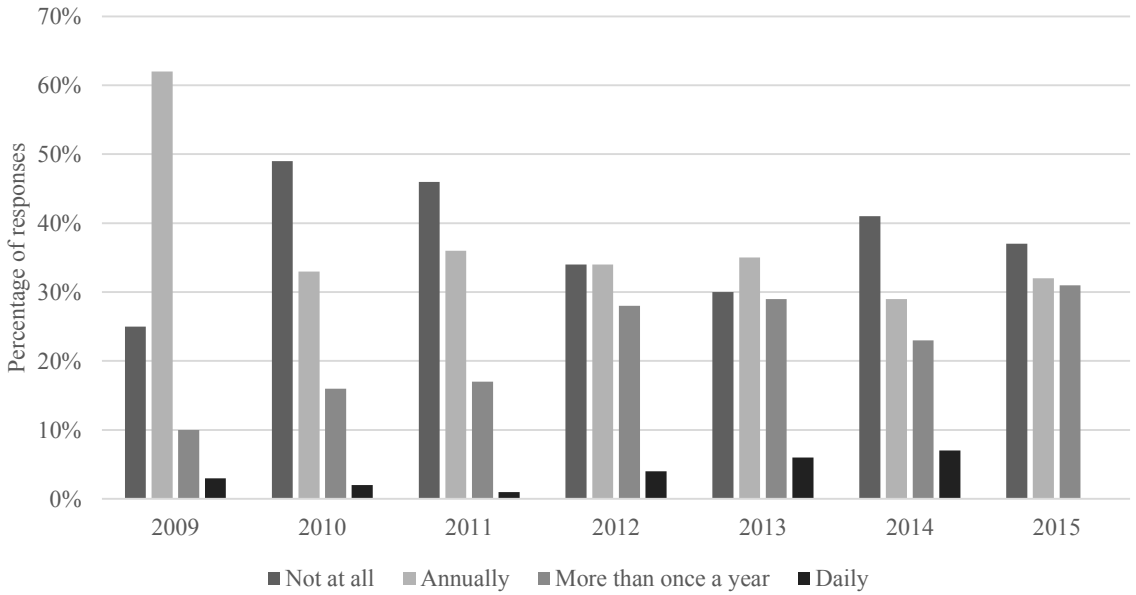


Figure 2. Frequency of Emissions Trading among Surveyed Enterprises, 2009–2015.

Source: Author's own elaboration based on KfW/ZEW (2010-2016).

Among reasons for non-participation the most frequently cited was "sufficient free allocation" (approximately 50%) (see Figure 3). Since 2013, fewer companies have cited this reason for not participating in emissions trading.

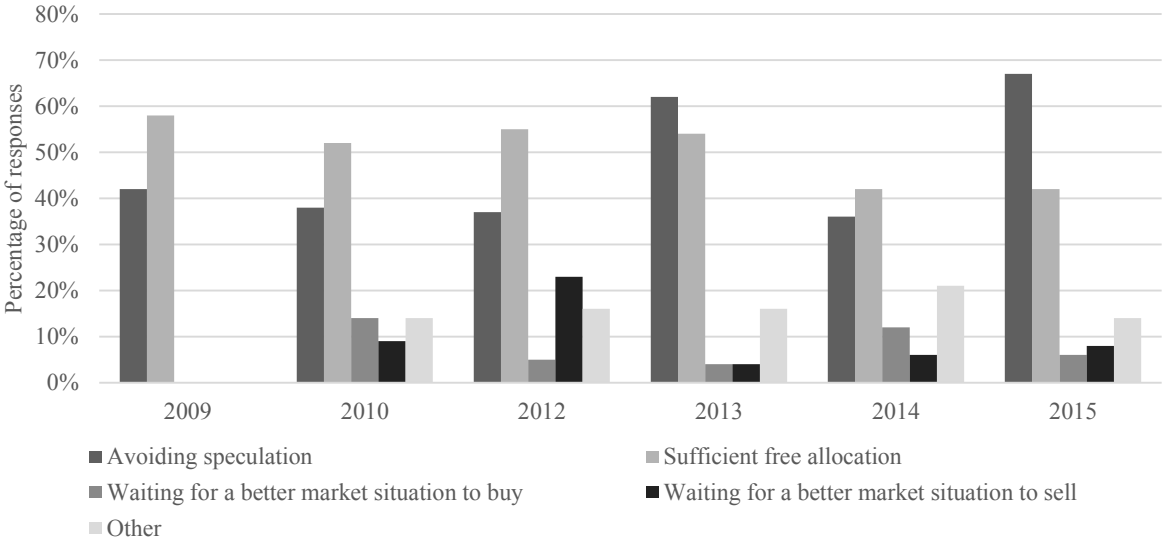


Figure 3. Reasons for Lack of Corporate Engagement in Emissions Trading (multiple answers possible).

Source: Author's own elaboration based on KfW/ZEW (2010-2016).

This is understandable when one analyzes the supply and demand for allowances in the second trading period (Figure 4). Between 2009 and 2012 free allocation exceeded actual emissions, amplifying the surplus in the market (see Figure 4). This confirms the reasons for non-participation indicated by companies during this period (sufficient free allocation). The allocation principles (≈90% free allocation) and reduced output during the 2007-2010 crisis produced a sustained oversupply of units. The effect of this surplus was a drop in allowance prices, which explains the increase in the share of responses "Waiting for a better market situation to sell".

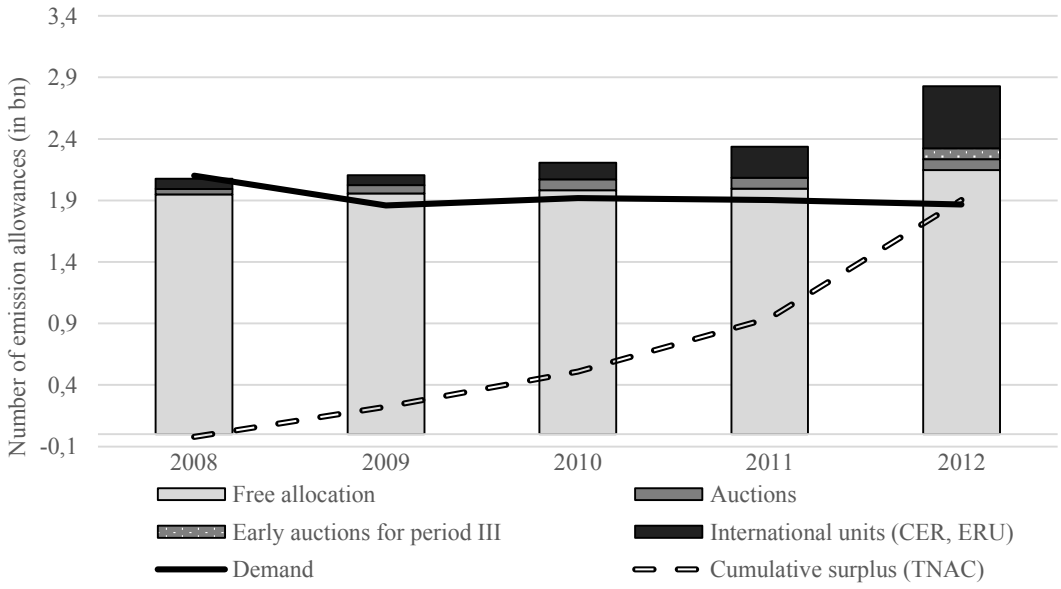


Figure 4. Structure of Supply and Demand for Emission Allowances (EUA, CER, ERU) during the Second Trading Period, 2008-2012 (approximate values).

Source: Author's own elaboration based on European Commission (2012a, 2012b, 2017a).

Furthermore, research shows 80% of firms used a single acquisition channel and 17% used two (DEHST, 2014b). The most common channel by number of firms in the second period was within-group transfers (38%), but this represented only 5% of cumulative volume—used for minor shortfalls (Tabel 2). The OTC market accounted for the largest share of traded volume. Intermediaries (brokers, dealers, banks) played a major role in facilitating transactions.

Table 2.
Significance of EUA Acquisition Channels in the Second Trading Period (by number of companies and transaction volume, in %)

Acquisition Channel	Number of Companies	Transaction Volume
Auctions	3	12
Exchange (Secondary Market)	6	14
Intermediaries	37	26
Intra-company	38	5
OTC	16	43

Source: Author's own elaboration based on DEHSt (2014b).

SMEs typically used a single channel, relying on OTC or intermediaries for large purchases (see Table 3). Large firms were active across all segments and often used multiple channels. In the second settlement period, small enterprises did not participate in auctions at all. Large enterprises, on the other hand, were active in every market segment, clearly dominating the auction market. In addition, they more often used several purchase channels.

Table 3.
Structure of EUA Acquisition Channels in the Second Trading Period by Company Size (in %)

Category	Purchase <100,000 t SMEs	Purchase <100,000 t Large	Purchase >100,000 t SMEs	Purchase >100,000 t Large
Auctions	0	4	0	13
Exchange (Secondary Market)	13	8	0	33
Intra-group	20	24	0	13
Intermediaries	67	60	100	40
OTC	13	20	100	73

Note. Multiple responses possible.

Source: DEHSt (2014b).

There is a belief that companies are more willing to purchase allowances from other entities in the same country (*home bias*). Research shows that this is probably related to transaction costs. By using existing trade links (purchasing from current contractors), companies can minimize transaction costs. Existing trade links account for as much as two-thirds of future trade links (Hinterman, Ludwig, 2019, pp. 18-19). Importantly, this phenomenon varies between companies. This variation is partly explained by the size of the companies (smaller companies are more likely to buy from local contractors) and their location – country (Hinterman, Ludwig, 2019, p. 3). Large companies generally incur lower transaction costs than small ones (Jaraite-Kažukauske, Kažukauskas, 2015, pp. 597-599; Hinterman, Ludwig, 2019, p. 17).

3.3. Corporate Strategies in Emissions Trading during the Third Trading Period

Expenditure on missing emission allowances became significant in the third trading period. In 2012 and 2013 more than half of surveyed companies used a banking strategy, but the importance of this strategy declined in subsequent years.

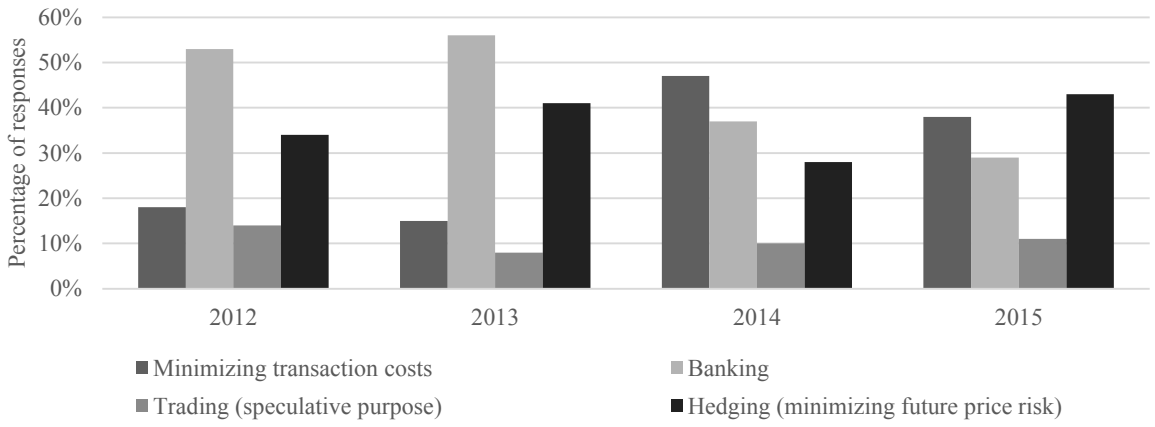
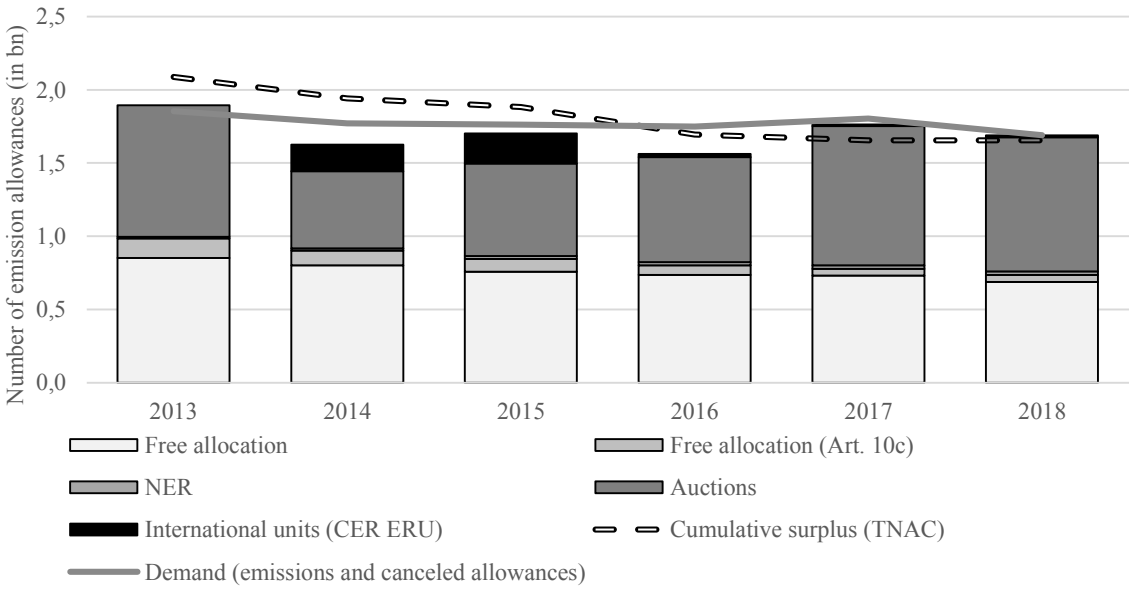


Figure 7. Strategies Used by Companies in Emissions Trading, 2012-2015.

Source: Author's own elaboration based on KfW/ZEW (2013-2016).

The importance of the banking strategy in 2012 and 2013 stemmed from the fact that companies had large surpluses of allowances. The carryover of allowances (banking) from the second to the third period contributed to a cumulative surplus of approximately 2.1 billion units in 2013 (see Figure 5).



Note. NER – new entrants' reserve. The cumulative surplus of approximately 2.1 billion units in 2013 resulted from the banking of 1,749,540,826 units from the second period and the transfer of 300 million units to the EIB for investment in demonstration projects. TNAC- total number of allowances in circulation.

Figure 5. Structure of Supply and Demand for Emission Allowances (EUA, CER, ERU) during the Third Trading Period, 2013-2018.

Source: Author's own elaboration based on European Commission (2015, 2017b, 2018, 2019) and DG CLIMA press releases.

From 2014 the strategy of minimising transaction costs gained importance: 47% of firms reported using it in 2014 compared with 15% in 2013. Many companies required only minor purchases (42%), while 21% required larger volumes – likely power and CHP plants. The frequency of cost-minimisation strategies depends on the ratio of transaction costs to allowance costs and the share of free allocation.

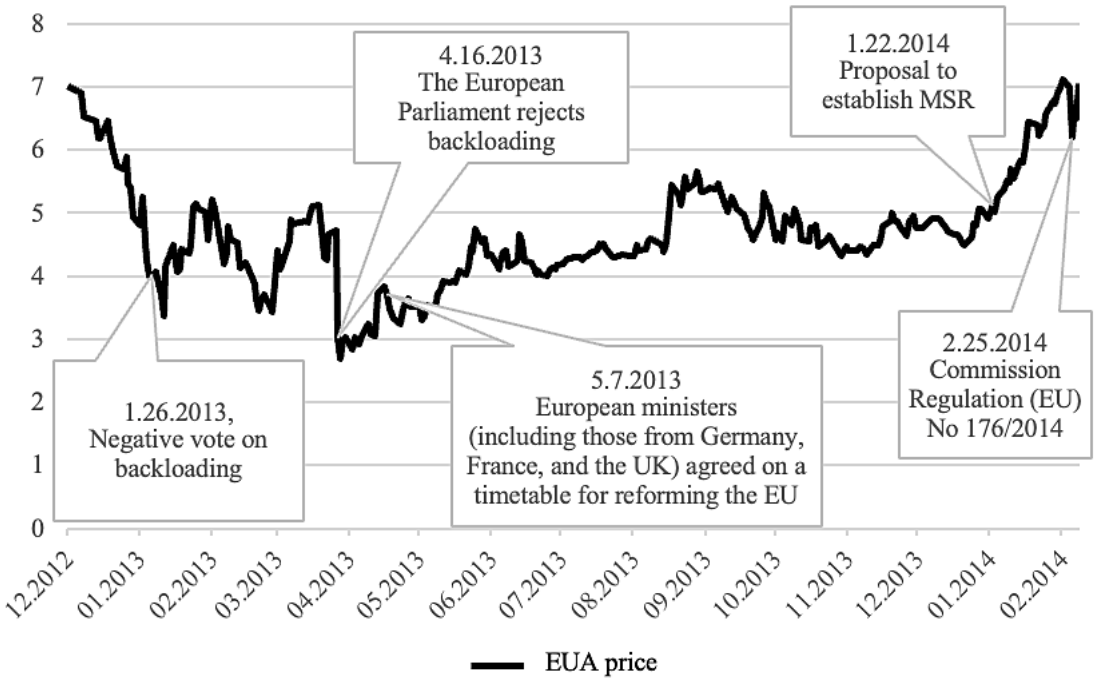


Figure 8. Impact of Backloading Developments on EUA Prices (in euros).

Source: Author's own elaboration based on European Commission press releases (ec.europa.eu/clima/news).

In the third period the percentage of companies trading for speculative purposes and engaging in hedging increased significantly. The reasons for this can be found in the uncertainty surrounding regulatory changes. Between 2014 and 2016 the EU withdrew 900 million allowances from future auctions (backloading) and later introduced the Market Stability Reserve. Following the European Parliament's final approval and Commission Regulation (EU) No 176/2014, EUA prices rose from €3 to €6.20. The impact of decisions concerning backloading and MSR on EUA prices is presented in the chart. Utilities (power and CHP plants) are primary hedgers (Melum et al., 2018; Nordeng et al., 2016).

4. Conclusion

During the second trading period, market activity was relatively low due to an oversupply in the market. Emissions management became significant from 2013 onwards. Initially, it was particularly relevant for power plants, CHP units and large industrial enterprises. As free

allocation declined and EUA prices rose, a broader set of firms became active in the market and started to use derivatives.

Using the results of the analyses described above, it is possible to characterise the behaviour of participants in the market for greenhouse gas emission allowances. At one end of the spectrum are small enterprises that adopt transaction-cost-minimisation strategies. They are generally inactive, rely on intermediaries and typically make spot purchases once a year for regulatory compliance. Trading is usually handled by a single individual. These entities show low demand and supply for EUAs, and they buy more often than they sell.

At the other end are very large entities, particularly utilities, which actively manage allowances, trade frequently across spot and derivatives markets, and often operate trading departments. They tend to hedge and occasionally act as intermediaries for subsidiaries. Large industrial firms supply a significant share of allowances due to surpluses accumulated during the crisis period.

The entities that supply a significant portion of allowances are large and very large industrial companies that saved many units during the financial crisis and economic slowdown (Melum et al., 2018, p. 14). Like very large public utility companies, they are characterized by a significant imbalance between supply and demand, although some entities have a surplus of allowances and others have a shortage. Their main strategy is acquisition, often carried out through an intermediary, unlike large companies in the public service sector.

The last group of participants consists of investors, banks, and intermediaries. Investors and banks actively participate in both futures and spot markets. They do so on the stock exchange and over-the-counter markets. In this group of entities, trading is handled by the trading department. Intermediaries also participate in all possible markets, although their mode of operation is rather passive and consists of executing client orders.

It is also reasonable to assume that since 2018, companies have been more actively seeking opportunities to reduce emissions, including relevant investments, as the price of EUAs exceeded €20 this year. According to research, at this price level, reducing EU ETS costs has become an important reason for investments resulting in emission reductions (KfW, 2014, p. 22).

The study is constrained by the availability and comparability of data. Differences in survey methodologies across sources may affect direct comparability. Future research could use transaction-level datasets to examine trading networks or extend the analysis to the fourth trading phase (2021-2030) and evaluate the effects of newer instruments and policies (e.g. CBAM). There is also potential for further study on the relationship between allowance price volatility and corporate investment in low-carbon technologies.

References

1. DEHST (2013). *Deutsche Versteigerungen von Emissionsberechtigungen, Periodischer Bericht: Jahresbericht 2013*. Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt, April 2014, ISSN: 2366-6560.
2. DEHST (2014a). *Deutsche Versteigerungen von Emissionsberechtigungen, Periodischer Bericht: Jahresbericht 2014*. Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt, Februar 2015, ISSN: 2366-6560.
3. DEHST (2014b). *Zukaufkanäle deutscher Anlagenbetreiber im EU-Emissionshandel. Auswertung einer Umfrage unter allen deutschen Anlagenbetreibern zu ihren Zukaufstrategien in der zweiten und dritten Handelsperiode*. Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt, Januar 2014.
4. DEHST (2015). *Deutsche Versteigerungen von Emissionsberechtigungen, Periodischer Bericht: Jahresbericht 2015*. Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt, Januar 2016, ISSN: 2366-6560.
5. DEHST (2016). *Deutsche Versteigerungen von Emissionsberechtigungen, Periodischer Bericht: Jahresbericht 2016*. Deutsche Emissionshandelsstelle (DEHSt) im Umweltbundesamt, März 2017, ISSN: 2366-6560.
6. DEHST (2017). *German Auctioning of Emission Allowances, Periodical Report: Annual Report 2017*. German Emissions Trading Authority (DEHSt) at the German Environment Agency, February 2018, ISSN: 2366-6560.
7. DEHST (2018). *German Auctioning of Emission Allowances, Periodical Report: Annual Report 2018*. German Emissions Trading Authority (DEHSt) at the German Environment Agency, July 2019, ISSN: 2366-6560.
8. EU (2003). Directive2003/87/ec of the European parliament and of the council of 13 October 2003 establishing a scheme for greenhouse 579 gas emission allowance trading within the community and amending council directive96/61/ec (text with eea relevance). Official Journal of the European Union L 275/32. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0087
9. EU (2012). Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories Text with EEA relevance. Official Journal of the European Union L 201/1. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0648
10. EU (2014a). Directive 2014/65/eu of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending directive 2002/92/ec and directive 2011/61/eu(recast) text with eea relevance. Official Journal of the European Union L 173/349. http://data.europa.eu/eli/dir/2014/65/oj

11. EU (2014b). Regulation (EU) No 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse (market abuse regulation) and repealing Directive 2003/6/EC of the European Parliament and of the Council and Commission Directives 2003/124/EC, 2003/125/EC and 2004/72/EC Text with EEA relevance. Official Journal of the European Union L 173/1. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0596
12. European Commission (2012a). *Report from the Commission to the European Parliament and the Council. The state of the European carbon market in 2012 (text with EEA relevance)*. COM(2012) 652 final. Brussels, 14.11.2012. https://eur-lex.europa.eu/legal-content/eng/TXT/PDF/?uri=CELEX:52012DC0652
13. European Commission (2012b). *Commission staff working document. Information provided on the functioning of the EU Emissions Trading System, the volumes of greenhouse gas emission allowances auctioned and freely allocated and the impact on the surplus of allowances in the period up to 2020*. SWD (2012) 234 final. Brussels, 25.7.2012. https://climate.ec.europa.eu/system/files/2016-11/swd_2012_234_en.pdf
14. European Commission (2014). *Report from the commission to the European Parliament and the Council. Report on the functioning of the European carbon market*. COM/2017/0693 final, Document 52017DC0693. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52017DC0693qid=1749061244208
15. European Commission (2015). *Annex Report on the functioning of the European carbon market. Accompanying the document: Report from the Commission to the European Parliament and the Council. Climate action progress report, including the report on the functioning of the European carbon market and the report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide {SWD(2015) 246 final}*.
16. European Commission (2015). *Report from the commission to the European Parliament and the Council. Climate action progress report, including the report on the functioning of the European carbon market and the report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide*. Brussels, 18.11.2015. COM(2015) 576 final. https://climate.ec.europa.eu/document/download/10ed7776-d6e8-40b5-9a95-90927740ade0_en?filename=com_2015_576_en.pdf
17. European Commission (2017a). *Report from the commission to the European Parliament and the Council. Report on the functioning of the European carbon market*. Brussels 23.11.2017 r., COM(2017) 693 final.
18. European Commission (2017b). *Communication from the Commission. Publication of the total number of allowances in circulation for the purposes of the Market Stability Reserve under the EU Emissions Trading System established by Directive 2003/87/EC. C(2017) 3228 final*. Brussels, 12.05.2017.
19. European Commission (2018). *Communication from the Commission. Publication of the total number of allowances in circulation in 2017 for the purposes of the Market Stability*

Reserve under the EU Emissions Trading System established by Directive 2003/87/EC. C(2018) 2801 final. Brussels, 15.05.2018.

20. European Commission (2019). *Communication from the Commission. Publication of the total number of allowances in circulation in 2018 for the purposes of the Market Stability Reserve under the EU Emis ions Trading System established by Directive 2003/87/EC. C(2019) 3288 final*. Brussels, 14.05.2019.
21. Hintermann, B., Ludwig, M. (2019). Home Bias in the EU ETS: Evidence from Transaction Data. *Journal of Environmental Economics and Management*, *93*, 17-32. https://doi.org/10.1016/j.jeem.2018.12.002
22. Jaraite-Kažukauske, K., Kažukauskas, A. (2015). Do Transaction Costs Influence Firm Trading Behaviour in the European Carbon Market? *Energy Economics*, *52*, 594-604. https://doi.org/10.1016/j.eneco.2015.01.022
23. KfW/ZEW (2009). *CO2 Barometer 2009: Leaving the Trial Phase behind – Preferences & Strategies of German Companies under the EU ETS*. https://www.econstor.eu/bitstream/10419/109793/1/CO2-Barometer-2009.pdf
24. KfW/ZEW (2010). *CO2 Barometer 2010: Effizienzpotenziale des Emissionshandels noch nicht ausgeschöpft – Strategien und Management deutscher Unternehmen*. https://www.econstor.eu/bitstream/10419/109794/1/CO2-Barometer-2010.pdf
25. KfW/ZEW (2011). *CO2 Barometer 2011. Hoher anpassungsbedarf im EU-Emissionshandel ab 2013 – deutliche Defizite bei der Vorbereitung in den Unternehmen. KfW Bankengruppe*. https://www.econstor.eu/bitstream/10419/109795/1/CO2-Barometer-2011.pdf
26. KfW/ZEW (2012). *CO2 Barometer 2012: Anreizwirkung des EU-Emissionshandels auf Unternehmen gering – Klimapolitische Regulierung wenig relevant für Standortentscheidungen*. https://www.econstor.eu/bitstream/10419/109796/1/CO2-Barometer-2012.pdf
27. KfW/ZEW (2013). *CO2 Barometer 2013 – Carbon Edition: The EU Emissions Trading Scheme: Firm Behaviour During the Crisis*. https://www.econstor.eu/bitstream/10419/109797/1/CO2-Barometer-2013-Carbon-Edition.pdf
28. KfW/ZEW (2014). *CO2 Barometer 2014 – Carbon Edition: New Phase, Old Problems.* https://www.econstor.eu/bitstream/10419/109799/1/CO2-Barometer-2014-Carbon-Edition.pdf
29. KfW/ZEW (2015). *CO2 Barometer 2015 – Carbon Edition: Ten years of emission trading: strategies of German companies*. https://www.econstor.eu/bitstream/10419/121848/1/836098110.pdf
30. KfW/ZEW (2016). *CO2 Barometer 2016 – Carbon Edition. How the EU ETS can contribute to meeting the ambitious targets of the Paris Agreement*. https://www.econstor.eu/bitstream/10419/146924/1/86830185X.pdf

31. Melum, F., Nordeng, A., Hongliang, Ch., Zelljadt, L., Kolos, M. (2018). *Thomson Reuters Carbon Market Survey, 2018. Price boost and increased confidence*. Thomson Reuters. https://images.marketing.refinitiv.com/Web/ThomsonReutersFinancialRisk/%7Bbbc58606-737e-4186-b7e4-019a2b31a0fd%7D_Carbon_Marke_Survey_2018.pdf
32. Nordeng, A., Schjolset, S., Ferdinand, M., Dimantchev, E., Marcello T., Chia, H., Lee, G., Kolos, M. (2016). *Thomson Reuters Carbon Market Survey, 2016. Will Paris be a catalyst for more emission trading.* Thomson Reuters. https://www.yumpu.com/en/document/read/55689140/carbon-market-survey-2016-will-paris-be-a-catalyst-for-more-emission-trading
33. UN (2015). United nations framework convention on climate change. S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107. https://unfccc.int/resource/docs/convkp/conveng.pdf
34. Walner, M., Glock, A., Runge, C., Tschach, I., Ruf, P. (2014). *The Role of Traders in the EU ETS*. German Emissions Trading Authority, 57.