

The Role of Carbon Credit Markets in a Sustainable Energy Future: Fact or Fiction?

An Econometric Analysis

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Overview

As carbon markets gain traction globally, understanding the mechanisms driving their price dynamics is critical for informed decision-making and policy development. This study focuses on the Australian Carbon Credit Units (ACCU) market, a vital component of Australia's voluntary carbon offset framework. The ACCUs are tradable financial instruments designed to incentivize carbon abatement activities and contribute to the country's emissions reduction targets. While existing literature primarily examines mandatory emissions trading systems (ETS) in mature markets, this research shifts the focus to voluntary carbon markets (VCMs), which remain underexplored. Through a rigorous econometric analysis, we identify the key drivers of ACCU price fluctuations, including regulatory events, macroeconomic indicators, financial variables, and market-specific factors. Our findings offer crucial insights for stakeholders including policymakers, businesses, and households on the evolving role of carbon credit markets in achieving sustainable energy futures. The analysis reveals a nuanced interplay between environmental policies, political events, and macroeconomic conditions, as well as a negative correlation between ACCU returns and European Union Allowances (EUA). Notably, our study finds no significant relationship between ACCU prices and other financial assets, reinforcing the distinct behaviour of voluntary carbon markets. This research contributes to the growing understanding of carbon markets by illustrating how ACCUs respond to regulatory frameworks, economic shifts, and market-specific variables. By addressing the challenges of price volatility, market transparency, and policy uncertainty, our study underscores the potential of voluntary carbon markets to drive sustainability efforts while highlighting the barriers that must be overcome.

Methods

The literature on carbon markets has primarily focused on mandatory emissions trading schemes like the EU ETS, where price dynamics are heavily influenced by compliance regulations. In contrast, voluntary carbon markets such as the ACCU market are driven by diverse participants, project-specific characteristics, and evolving regulatory frameworks. This study pioneers an empirical investigation into the price behaviour of the ACCU market, offering a novel contribution to the field.

Our analysis spans a robust dataset of daily ACCU spot prices from February 1, 2020, to December 1, 2024, capturing both the short-term fluctuations and long-term trends in this emerging market. The research adopts a multi-stage econometric approach to identify and quantify the factors influencing ACCU price dynamics. In the first step, we examine the statistical properties of ACCU returns by comparing the empirical distribution to fitted Gaussian, Student-t, and location-scale t-distributions. This allows us to evaluate the suitability of conventional financial models for the ACCU market, particularly given its observed price volatility. To further uncover the key drivers of ACCU prices, we develop a series of econometric models as outlined below:

Model (1) focuses on policy events and regulatory variables, identifying specific policies and political milestones that significantly impact ACCU returns.

Model (2) incorporates macroeconomic indicators such as interest rates, GDP growth, and the Australian Industrial Production Index (API).

Model (3) adds financial market variables, including ASX 200 returns, oil, coal, gas prices, and EUA returns, to examine potential cross-market relationships.

Model (4) introduces ACCU-specific variables, such as transaction volumes, new issuances, and cancellations (both voluntary and compliance-driven).

Model (5) employs a stepwise forward regression approach ($\alpha=0.10$) to construct the most parsimonious and robust model, integrating significant variables from all categories.

By combining distributional analysis with comprehensive econometric modelling, we capture the complex and evolving nature of the ACCU market while isolating the unique factors influencing its price behaviour.

Results

Our analysis reveals several critical insights into the behaviour of the ACCU market. The distributional properties analysis suggests that conventional Gaussian models fail to capture the extreme observations in ACCU returns, which exhibit significantly heavier tails than other financial assets. This indicates a higher likelihood of extreme price swings, raising questions about the market's maturity and stability.

Our regression models highlight the dominant role of regulatory interventions and political milestones in shaping ACCU price dynamics. For example, policies such as the *Trans Exit* resulted in negative price shocks, while the Labor Party's 2022 election victory generated a positive market response. Amendments to mechanisms like the

safeguard mechanism also exerted downward pressure on returns, underscoring the ACCU market's sensitivity to policy changes.

Furthermore, ACCU returns show a positive relationship with economic growth, suggesting that periods of economic expansion stimulate carbon offset demand. In contrast, rising interest rates place downward pressure on prices.

While no significant relationship is found between ACCU prices and traditional financial assets (e.g., ASX 200), we observe a negative correlation between ACCU and EUA returns. This divergence reflects key structural differences: the mature EU ETS operates under standardized regulations, whereas the ACCU market remains voluntary, fragmented, and subject to evolving rules and varying perceptions of credit quality.

Lastly, voluntary and compliance cancellations exhibit distinct effects on ACCU returns. Voluntary cancellations, often driven by corporate social responsibility initiatives, support market stability and returns, while compliance-driven cancellations introduce downward pressure on prices.

Overall, these results underscore the unique characteristics of the ACCU market and its heightened sensitivity to policy interventions, setting it apart from conventional financial markets.

Conclusions

This study provides the first econometric exploration of price dynamics in the Australian Carbon Credit Units market, offering valuable insights for policymakers, investors, and researchers. Our findings emphasize the critical role of regulatory frameworks, macroeconomic conditions, and market-specific factors in influencing ACCU prices. The distinct behaviour of the ACCU market—characterized by heavy-tailed distributions, policy-driven volatility, and limited correlation with other financial assets—highlights both its potential and its challenges. Issues such as price instability, transparency gaps, and weaknesses in Monitoring, Reporting, and Verification (MRV) processes remain significant barriers to market maturity and scalability.

To foster a sustainable and credible carbon market, we recommend several key policy directions. Strengthening MRV standards is crucial to enhancing market transparency, reducing price uncertainty, and building investor confidence. Additionally, stabilizing regulatory frameworks by ensuring a consistent policy environment can help mitigate volatility and encourage sustained investment in the market.

We also recommend promoting voluntary cancellations as part of corporate sustainability strategies. Such incentives not only support market stability and returns but also advance broader environmental objectives. Finally, aligning the ACCU market with global markets, such as the EU ETS, could improve liquidity, attract a wider range of investors, and amplify the market's environmental impact. These policy measures collectively could strengthen the ACCU market's credibility, stability, and long-term effectiveness.

In conclusion, the success of the ACCU market in supporting Australia's emissions reduction targets will depend on collaborative efforts between regulators, industry participants, and policymakers. By addressing the challenges of volatility, transparency, and policy uncertainty, the ACCU market can play a pivotal role in the transition to a low-carbon economy and contribute to global climate change mitigation efforts.

References

- Ahonen, H. M., Kessler, J., Michaelowa, A., Espelage, A., Hoch, S., 2022. Governance of fragmented compliance and voluntary carbon markets under the Paris Agreement. *Politics and Governance*, 10(1), 235–245.
- Australian Government Clean Energy Regulator. (2023, September 27). *About the ACCU Scheme*. Retrieved from Emissions Reduction Fund: <https://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund>.
- Betz, R., Michaelowa, A., Castro, P., Kotsch, R., Mehling, M., Michaelowa, K., & Baranzini, A. (2022). An Introduction to Carbon Markets. In *The Carbon Market Challenge: Preventing Abuse Through Effective Governance*. Cambridge: Cambridge University Press.
- Chubb, I., Bennett, A., Gorrington, A., & Hatfield-Dodds, S. (2022). *Independent Review of Australian Carbon Credit Units*. Canberra: Department of Climate Change, Energy, the Environment and Water.
- Clean Energy Regulator, 2023. [Emissions Reduction Fund ACCU Scheme \(cleanenergyregulator.gov.au\)](https://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund).
- European Commission, 2023. EU Emissions trading System (ETS). https://ec.europa.eu/clima/policies/ets_en.
- Haya B, Cullenward D, Strong AL, Grubert E, Heilmayr R, Sivas DA, & Wara M, 2020. *Managing Uncertainty in Carbon Offsets: Insights from California's Standardized Approach*. *Climate Policy*. DOI: 10.1080/14693062.2020.1781035.