

DERISKING ELECTRICITY PRICES FOR DECARBONISATION: A NOVEL PERSPECTIVE ON MARKET INCOMPLETENESS THROUGH IRREVERSIBILITY

Louis Soumoy, Climate Economics Chair, +33 7 89 48 59 10, louis.soumoy@chaireeconomieduclimat.org
Jules Welgryn, Climate Economics Chair, +33 6 47 04 86 42, jules.welgryn@chaireeconomieduclimat.org

Overview

Long-term electricity contracting has remained an unresolved issue in European markets, with growing implications for decarbonising industries. This 'missing market' failure indeed let investors exposed to the long-term electricity market volatility, increasing the cost of capital, and hence reducing investments in both new generation and electrification of usages. In this paper, we argue that industrial decarbonisation investments stand apart due to their unique characteristics: they are subject to strong ambiguity - rather than risk -, and are irreversible by design. Building on these insights, we develop a bilateral contracting model that accounts for ambiguity aversion and investment irreversibility, tailored to the dynamics between energy producers and industrial consumers. Using the real-world case of ArcelorMittal and EdF, we demonstrate that the current market design prevents parties from reaching a mutually advantageous agreement. Finally, we discuss policy measures to overcome these barriers and stimulate low-carbon investment across both sectors.

Methods

Investment Models, Contracting, Ambiguity, Risk, Real Options, Stochastic Discount Factors, Empirical Case Study

Results

We first derive theoretical results from our Bilateral Contracting model, that allow us to study the intricate relationship between two opposing effects: risk aversion (pushing the agents to sign) and irreversibility considerations (pushing agents to delay decisions). This analysis allows us to characterise the different states of the market that allow for the contractualisation between two symmetric agents looking to hedge risks. We are then able to offer insights on how irreversible investment decisions are made under uncertainty.

We then fit our model to the electricity market, taking the example of currently undergoing Power Purchase Agreement (PPA) negotiations between EdF and ArcelorMittal in Dunkerque, France. By fitting our model to the investment decisions of both agent, we are able to put forward key factors explaining the complexity of this negotiation. We determine the price at which each agent should negotiate, and find that our results close align with those reported in official documents and press sources. We conclude that current electricity market fundamentals prevent agents from signing PPA contracts, and derive policy implications from this observation.

Conclusions

Our findings suggest several key policy insights. Firstly, we remind that market incompleteness is symptomatic of deeper market failures. These failures cannot always be resolved simply by introducing new financial derivatives; instead, it is crucial to understand and address the frictions causing this incompleteness. A case in point is the failure of new energy derivatives to gain traction on platforms like EPEX Spot. While many theoretical arguments for market incompleteness apply to various sectors, they do not fully explain why the electricity markets remain incomplete. We propose a new theoretical explanation : the irreversible nature of long-term investments in these markets creates a unique barrier to market completion. Secondly, they confirm that traditional Carbon Contracts for Difference, which only hedge against carbon price risks, might be an insufficient tool when looking to incentivise industrials to pursue a decarbonisation pathway. This has significant implications for any country considering a CCfD programme alongside the implementation of an Emissions Trading Scheme. We then argue that the continuation of CfD programmes is necessary to keep developing new low-carbon electricity generation in the current market setting. Alternatively, Public entities should be designing policies aiming to reduce the volatility of electricity market and improve foresight, which would allow for more contractualization between private agents and

reduce the need for public investment in the electricity market. This could be achieved through targeted policies, or through market reforms. In conclusion, to push industrials towards a decarbonisation pathway while preventing carbon leakage, governments must employ tools that enable them hedge against very volatile electricity prices (in addition to pure carbon risk).

References

Jacco J. J. Thijssen. Incomplete markets, ambiguity, and irreversible investment. *Journal of Economic Dynamics and Control*, 35(6):909–921, June 2011. ISSN 0165-1889. doi:10.1016/j.jedc.2010.12.001. URL <https://www.sciencedirect.com/science/article/pii/S0165188910002575>

Avinash K. Dixit and Robert S. Pindyck. *Investment Under Uncertainty*. Princeton University Press, 1994. ISBN 978-0-691-03410-2. Google-Books-ID: VahsELa qC8C. Frank H. Knight. *Risk, Uncertainty and Profit*. Social Science Research Network, Rochester, NY, 1921. URL <https://papers.ssrn.com/abstract=1496192>.

Itzhak Gilboa and David Schmeidler. Maxmin expected utility with non-unique prior. *Journal of Mathematical Economics*, 18(2):141–153, January 1989. ISSN 0304-4068. doi:10.1016/0304-4068(89)90018-9. URL <https://www.sciencedirect.com/science/article/pii/0304406889900189>

John Cochrane. *Asset Pricing*, Revised Edition. Princeton university press edition, January 2005. ISBN 978-0-69112137-6. URL <https://urlr.me/6cG8CY>

Nils May and Karsten Neuhoff. Financing Power: Impacts of Energy Policies in Changing Regulatory Environments. *The Energy Journal*, 42(4):131–152, July 2021. ISSN 0195-6574. doi:10.5547/01956574.42.4.nmay. URL <https://doi.org/10.5547/01956574.42.4.nmay>. Publisher: SAGE Publications

Gauthier de Maere d’Aertrycke, Andreas Ehrenmann, and Yves Smeers. Investment with incomplete markets for risk: The need for long-term contracts. *Energy Policy*, 105:571–583, June 2017. ISSN 0301-4215. doi:10.1016/j.enpol.2017.01.029. URL <https://www.sciencedirect.com/science/article/pii/S0301421517300411>

Ibrahim Abada, Gauthier De Maere D’Aertrycke, Andreas Ehrenmann, and Yves Smeers. What Models Tell us about Long-term Contracts in Times of the Energy Transition. *Economics of Energy & Environmental Policy*, 8(1):163–182, 2019. ISSN 2160-5882. URL <https://www.jstor.org/stable/27030649>. Publisher: International Association for Energy Economics.

Paul L. Joskow. From hierarchies to markets and partially back again in electricity: responding to decarbonization and security of supply goals. *Journal of Institutional Economics*, 18(2):313329, April 2022. ISSN 1744-1374, 1744 1382. doi: 10.1017/S1744137421000400. URL <https://urlr.me/tAMZcs>