

## Executive Summary

Climate change regulation has notable economic and political implications that create uncertainty in financial markets. In this thesis, we investigate how carbon tax uncertainty is reflected in option prices. To do this, we construct an arbitrage-free volatility surface for S&P 500 companies using the stochastic volatility inspired surface during 2007 and 2021. We then compare the shape of the surface across firms with different carbon intensity.

Our analysis suggests that carbon tax uncertainty is priced in the option market. Specifically, the cost of protecting against downside tail and jump risks is higher for firms with high carbon emission consumption relative to their market value and those that do not report emissions. For firms in the upper quartile of carbon intensity, we find a 5% increase in standard deviation of the put-wing implied volatility slope (downside tail risk) and a 7% standard deviation increase in the negative implied volatility skew (jump risk), compared to firms in the lowest quartile. We also find that the value of option protection increases when carbon taxation receives more attention, as measured by the Google Search Volume Index.

When comparing our implied volatility surface to the OptionMetrics Surface File, we find that the latter has a lower ability to capture information for extreme strikes under constant extrapolation. While our key findings remain robust under the Surface File, there are some deviations from the original results.

Since firm carbon emission reporting is voluntary and not standardised, we test for sample selection bias in the cross-section. We do not find evidence that voluntary reporting leads to biased estimates in the model.

Our findings extend the work of Ilhan et al. (2021). They also demonstrate how the forward-looking nature of option contracts helps to disentangle the different aspects of downside, jump, price and variance risk under climate change uncertainty.

## Reference

E. Ilhan, Z. Sautner, and G. Vilkov. Carbon Tail Risk. *The Review of Financial Studies*, 34(3): 1540–1571, Mar. 2021. ISSN 0893-9454. doi: 10.1093/rfs/hhaa071