Developing financial market instruments to protect against what could be dramatically escalating costs, should certain possible future climate change scenarios be realised

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ABSTRACT

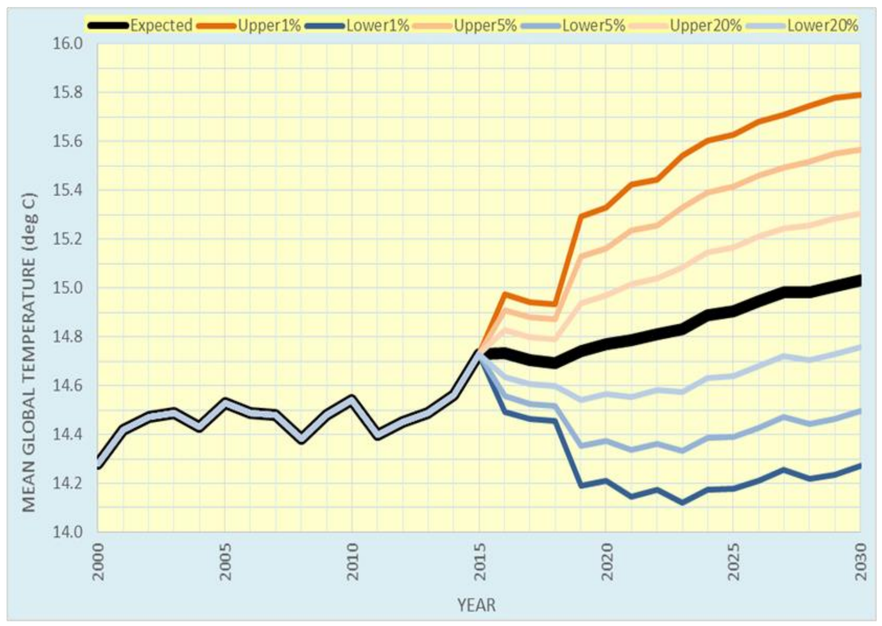
The cost of protecting against global climate change may be established by applying financial market mathematics to data associated with drivers of that change. This approach is used to derive a risk management model that evaluates the cost of protection. Data employed to develop the model include long-term time series of measures associated with such drivers.

The data are statistically analysed to establish their relative importance. It is found that Atmospheric Carbon Dioxide is of profound importance, but that other drivers do have an influence.

The findings are then applied to derive the statistical distribution of possible future trends out to 2030 of the Global Mean Temperature, based upon a set of Monte-Carlo-generated scenarios. These scenarios show that it is much more likely for the Global Mean Temperature in 2030 to be higher than that in 2015.

The statistical distribution is then interrogated to provide estimates of what are the 'fair value' prices of put and call options on Global Mean Temperature futures contracts set to expire on Dec-31 in each year out to 2030. The options considered include European style options (exercise only on expiry date) and Bermudan style options (exercise on any Dec-31 prior to expiry date) with the 'fair value' prices of the call options with particular expiry dates shown to be higher than those of the corresponding put options.

To summarise, the paper demonstrates how to evaluate the cost of hedging and speculative instruments related to climate change. Whilst their development allows those who wish to place 'bets' on their views as to the likely future climate, the real value of the foregoing to those involved in disaster and emergency management lies in the instruments providing the opportunity to protect against what could be dramatically escalating costs, should certain possible future climate change scenarios be realised.



The fluctuations in global mean temperature from 2000 to 2015 and the 1%, 5%, 10% and 20% upper and lower bounds for the expected global mean temperature in each year from 2016 to 2030.

BACKGROUND

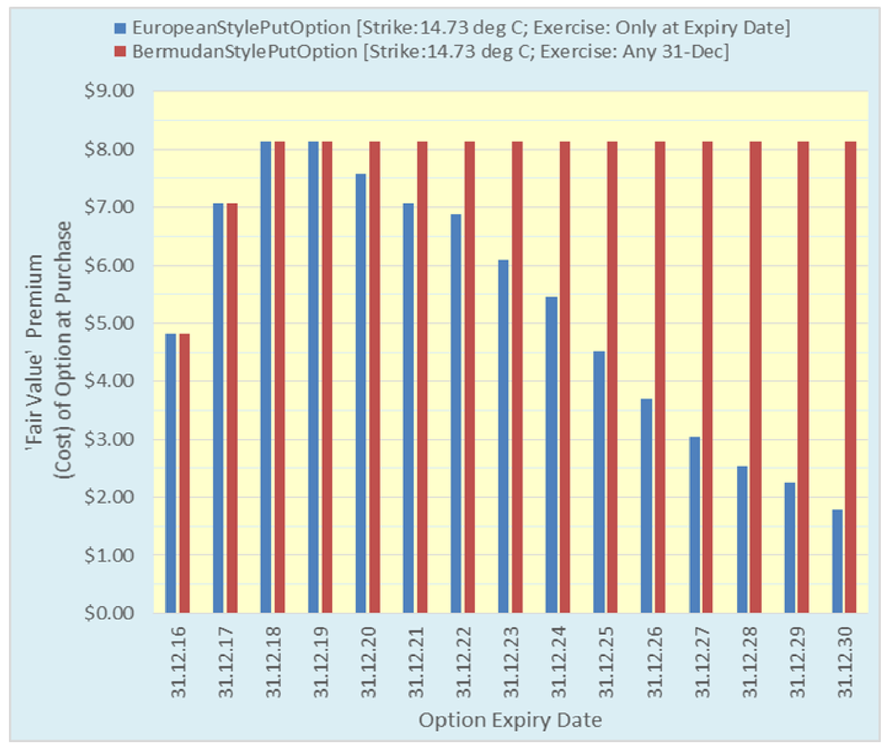
McGregor (2006) places the material that follows in a broad context, when he writes: *"The science of meteorology is deeply intertwined with the process of emergency management. Weather phenomena are the cause of many disaster events such as tornadoes and hurricanes and a factor in many others. Weather can also affect the way assistance is provided during or after an emergency. Since time to prepare is vital, much of meteorology is concerned with forecasting ... (but) the future poses its own special brand of weather hazards due to the uncertainties and scale of global warming and consequent changes in global climate patterns".*

DISCUSSION

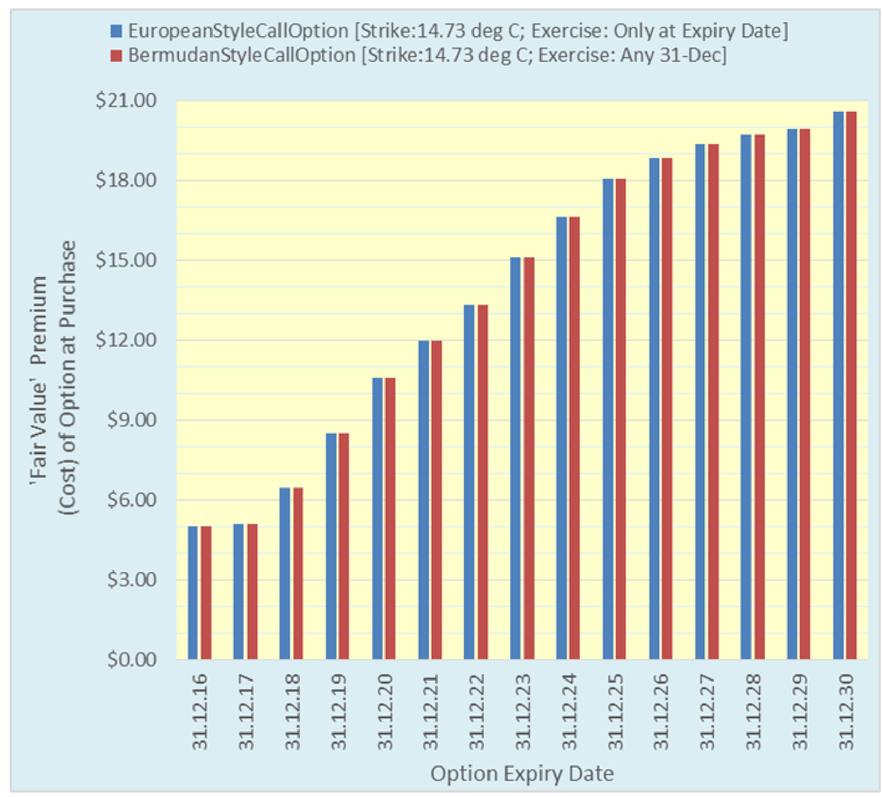
The primary purpose of the paper is, in demonstrating how one may evaluate a "fair value" price for hedging and speculative instruments related to climate change, to propose that such products may be applied as an "insurance policy" to ameliorate, from a long-term perspective, the potentially escalating costs of managing the consequences of disasters and emergencies that may arise from climate change.

Labadie (2011) puts the issue of addressing difficulties from such a perspective thus: *"Emergency managers will have to deal with the impending, uncertain, and possibly extreme effects of climate change. Yet, many emergency managers ... are unsure of their place in the effort to plan for, adapt to, and cope with those effects. This ... mostly is due to (a not unexpected) ... focus on ... a shorter event horizon (5 years vs. 75–100 years); and a shorter planning and operational cycle".*

The National Climate Change Adaptation Research Facility (2013) notes that: *"Recent unprecedented climate-related extreme events have ... brought the (Australian) nation's vulnerability to such disasters into sharp focus and placed a significant financial ... emotional and social burden on governments and affected communities".* It is the aforementioned financial burden that, through application of the market instruments whose development are discussed in this paper, one hopes to ameliorate.



'Fair value' *premiums (costs)* of a set of put options purchased on 31-Dec-2015 all with a *strike* of 14.73°C (the 2015 Global Mean Temperature) and a *premium (value)* of $100 per °C at expiry.



'Fair value' *premiums (costs)* of a set of call options purchased on 31-Dec-2015 all with a *strike* of 14.73°C (the 2015 Global Mean Temperature) and a *premium (value)* of $100 per °C at expiry.

CONCLUDING REMARKS

The paper demonstrates how to evaluate the cost of hedging and speculative instruments related to climate change. Whilst their development allows those who wish to place 'bets' on their views as to the likely future climate, the real value of the foregoing to those involved in disaster and emergency management lies in the instruments providing the opportunity to protect against what could be dramatically escalating costs, should certain possible future climate change scenarios be realised. From the paper's analysis of the economics data, there emerges a strategy to ameliorate the financial burden arising from managing disasters that arise from climate-change-related extreme events.