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The effect of political cycles on power investment decisions: Expectations over the repeal and reinstatement of carbon policy mechanisms in Australia

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HIGHLIGHTS

- Effect of political cycles quantified in power generation investments.
- Expected repeal and reinstatement of carbon policy modelled dynamically.
- A survey of experts informed the decision making model.
- Expectations over reinstatement of policy dampens the effect of expected repeal.

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ABSTRACT

Political uncertainty over global greenhouse gas (GHG) mitigation policy is likely to defer investment in cleaner technologies. It may also incentivise short-lived, high-cost interim investments while businesses wait for the uncertainty to subside. The range of possible policy responses to the issue has created uncertainty over the future of national mitigation pathways. Given that the electricity sector, globally, is a major emitter of GHGs, this represents a systematic risk to investment in electricity generation assets. This paper uses a real options analysis framework informed by a survey of experts conducted in Australia – used as a proxy to model the degree of the uncertainty – to investigate the optimal timing for investment in the conversion of a coal plant to a combined cycle gas turbine plant using the American-style option valuation method. The effect of market and political uncertainty is studied for the *Clean Energy Act 2011* in Australia. Political uncertainty is addressed bi-modally in terms of: (1) uncertainty over the repeal of the carbon pricing policy, and (2) if it is repealed, uncertainty over the reinstatement of the policy, to represent the effect of electoral cycles and the possibility of more stringent future global mitigation efforts. Results of the analysis show that although political uncertainty with respect to GHG mitigation policy may delay investment in the conversion of the coal plant, expectations over the reinstatement of the carbon pricing reduces the amount of option premium to defer the conversion decision.

1. Introduction

The risk of investment in contemporary energy supply has been magnified as a result of exposure to climate change policy risk in addition to traditional risk factors. However, given the aforementioned policy risk and its potential impact on carbon and energy prices, it is not only current policy settings that will influence current investment decisions in long-lived carbon price exposed assets, but also expectations over future policy settings.

The increasing reliance on coal for electricity generation in Australia makes it a high per-capita emitter of greenhouse gases (GHGs). A long period of political negotiations culminated in 2012 with a carbon pricing mechanism. This started with a fixed price of A$23/t$CO_2$, to be followed by an emission trading scheme (ETS) with a floating price and an emissions cap. However, lack of bipartisan support has threatened the policy's sustainability. In 2013, the recently elected Federal Government put before parliament a package of seven carbon tax repeal bills, all of which were

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rejected by the Senate. However, with the Senate make-up being unknown until mid-2014 these repeal bills could still be passed into law at some uncertain time in the future.

In this paper, a case study is developed to evaluate the timing of a hypothetical brown-field conversion to a combined cycle gas turbine (CCGT) plant or abandonment of an existing coal-fired steam turbine (CFST) plant in New South Wales, Australia that expands upon the real options analysis (ROA) model presented in Shahnazari et al. [1]. This expanded model provides a more realistic framework matched with expectations among investors about the future of carbon pricing, addressing some of the knowledge gaps in the existing literature. This is the first study, to our knowledge, that accounts for reinstatement of the policy to reflect the effect of electoral cycles and/or a more stringent global effort toward GHG mitigation. Our model also develops a more realistic simulation of uncertainty over repeal and reinstatement of the carbon policy over an expected time period. As such, probability distributions of repeal and reinstatement (derived by a survey of experts by Jotzo et al. [2] conducted in mid-2012) are allocated for each time stage to represent various expectations over respective carbon policy events in the future. Since the survey data was conducted in mid-2012 we take the perspective of decision makers with the information that was available prior to the repeal bills being put before parliament.

Real options theory has been employed to evaluate investment decisions in electricity markets mainly in the last two decades with a more recent uptake in green policy evaluation applications. Dixit and Pindyck [3] have shown by a simple example how ROA can support electricity planning decisions. A key element of risk management is to acknowledge the value of waiting to acquire more information about market and political conditions before committing to an investment, which will be referred to as the value of flexibility in this paper. Consequently, the notion of a 'now-or-never' investment in generation assets – as would be encapsulated by a traditional discounted cash flow (DCF) analysis – does not fully capture the temporal leeway at a potential investor's disposal. Other studies, such as Tseng and Barz [4], Deng and Oren [5], and Reuter et al. [6] have focused on short-term operational variability and flexibility and/or constraints on investment decisions. Reuter et al. [7] have compared greenfield investment in wind turbines with investment in coal plants.

Coinciding with increasing global concern regarding the anthropogenic causality of climate change, many studies have assessed the effect of uncertain forthcoming GHG mitigation regulations in terms of policy design and implementation timing on investment decisions, herein called pre-implementation studies [8–10]. These studies give considerable foresight into the effect of uncertainty and volatilities in the business environment. Numerous studies have shown that market and political uncertainty can affect investment in generation technologies both in terms of choice of technologies and timing of investments.

Concerns over relatively recent enacted carbon pricing regulations, among early adopters, has switched to presumptions about the continuation of the policies in light of the lack of cross-party support in the political spectrum at national and international levels. In contrast with pre-implementation studies, the literature on the effect of political uncertainty on investment decisions in the post-implementation phase, where carbon pricing policy is already in place, is limited. Hoffman [11] provides empirical evidence that the induced technological transition to cleaner technologies, targeted by the European Union emission trading scheme (EU ETS), is obstructed significantly by the lack of a long-term signal to decrease emission caps. Blyth et al. [12], Fuss et al. [10] and Shahnazari et al. [1] have shown that political uncertainty might limit the diffusion of less carbon-intensive technologies. Boomsma et al. [13] analyse investment timing and capacity choice for renewable energy projects in the presence of feed-in-tariffs and renewable energy certificate trading and find that uncertainty regarding the change of support scheme creates an incentive to defer investment in larger projects.

Numerous studies have attempted to assess the value associated with waiting to retrofit incumbent coal-fired generation with carbon capture and storage (CCS) technology in a pre-implementation mode [9,10,14–19]. To the best of our knowledge CCS technology has not been established at a commercial scale, and so there is an additional uncertainty as to whether or not it will ever leave the research and development stage, which may not have been accounted for in the literature above. Instead, this paper investigates an option that is ready to exercise immediately due to the fact that conversion from CFST to CCGT is a viable technology. This option represents a short-term response to carbon pricing that dampens its financial impact on the owner of a CFST asset. Given that a substantial proportion of the capital cost of incumbent CFST plants are sunk, brown-field augmentation of CFST with gas turbines, to benefit from a lower emission intensity and higher energy conversion efficiency, is potentially attractive as a means of preserving some of the asset value that was sunk into the original investment.

Political uncertainty has been modelled in various ways. Yang et al. [20], Fuss et al. [10], Blyth et al.[12] and Shahnazari et al. [1] have used a step function to simulate political uncertainty assuming that price shocks occur with a known probability at certain times in the future. In the Australian study by Reedman et al. [15], expectations over arrival of the carbon policy is limited to only once in a known 10 year period. In contrast, the model developed here is novel as it models political uncertainty through a range of expectations over carbon pricing policy repeal and reinstatement.

This study thus attempts to address the research question of how do expectations over repeal and reinstatement of carbon pricing policy influence investment in the electricity generation market. Using an ROA method, this paper presents a set of results and their implications stemming from the modelling of these uncertainties in the context of a case study of conversion from a coal plant to a CCGT plant. Moreover, price paths are informed by Treasury forecasts, assuming these data were the best available information for a decision maker to base an investment decision upon at the time the decision was made. This approach accounts for carbon price pass-through and technological changes with respect to the effect of expected carbon prices on the modelling of electricity price paths.

2. Model

It is assumed that a 400 MW CFST power plant has already been built and the remaining life of the plant is 40 years from the present time. Under anticipated increasing carbon prices, the investor has the option to invest in the conversion of the plant to a CCGT power plant in response to the looming cost, or abandon the plant under high future carbon prices. The options available to the investor are: (1) to invest in the plant conversion to CCGT, (2) to abandon the plant, or (3) to take no action. However, with uncertain carbon prices in the future due to either a policy regime change or volatility in prices in the liberalized emission trading market, the investor has the option to wait and acquire information about the future, to at least be partially informed about the commitment of the government to the current policies.

Climate change political uncertainty is modelled inclusively by carbon price. The model assumes a geometric random walk (GRW) process to simulate carbon price paths:

$$P_{c,t+1} = P_{c,t} e^{(\mu_c \cdot \Delta t + \sigma_c \cdot \bar{\varepsilon}_{t,c})} \quad (1)$$