Paper Title: The Value of Better Wind Information

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Overview

Unlike the uncertainties pertaining to commodities such as electricity, natural gas, and oil, those related to renewable energy (RE) projects are less well understood (Green and Yatchew, 2012). Paxson and Pinto (2005) model price and production uncertainty for a RE project via a geometric Brownian motion, while Howell *et al.*, (2009) model wind forecast uncertainty using Brownian motion. In the same line of work, various other models have been developed in order to analyse the impact of wind uncertainty on the decision to invest, yet the value of improved wind information and its impact on the windfarm investment decision remain open questions.

We depart from a frequently invoked assumption that reduced uncertainty will result in reduced costs of finance, and, thus, for a given investment, a different distribution of returns, and rather study uncertainty reductions that may influence the investment decision itself. Typically, price and production uncertainty create a value of waiting, and the investment decision is deferred as long as the value of the option to invest is greater than the value of the project (Dixit and Pindyck, 1994). A value of improved wind information - you can envisage a "wind geologist" getting some money, some measurement installations, and some time - is, in this framework, that reduced uncertainty brings the project value and the option value closer together. Then, if assessment of the windfarm is eventually positive, the windfarm investment will have happened at an earlier point in time, and information has earned a rent by not letting so many good–wind days (or bad ones) go before the investment decision is taken.

Methods

We develop an analytical framework in which wind and power price uncertainty are modelled via two, possibly correlated, geometric Brownian motions and capture the value of better wind information by assuming that, prior to investment, a survey is conducted in order to obtain more information about the wind resource at a particular location. As Figure 1 illustrates, the survey has a deterministic length and introduces an investment lag feature in the analysis similar to that of Bar–Ilan and Strange (1996) and Heydari and Siddiqui (2010). However, we also assume that the survey results in a potential reduction (deterministic or stochastic) of wind resource uncertainty. Depending on the expected price and power production values upon completion of the survey, investment can be deferred or take place or immediately.

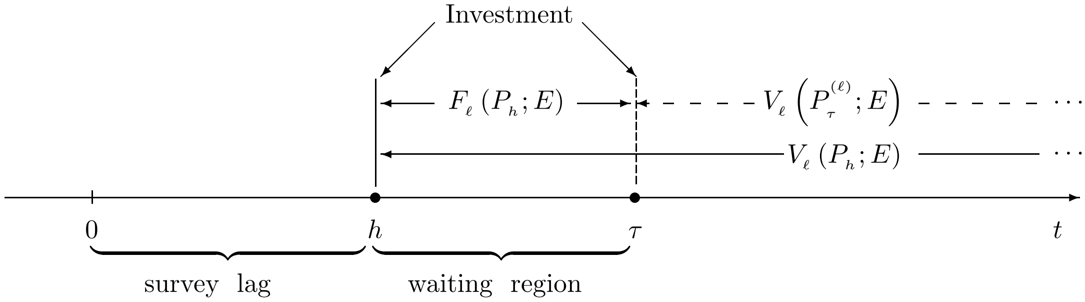

Figure 1: Investment under wind uncertainty in the presence of survey lags

Within this framework, we not only determine the value of the option to invest, the value of the project, and the required investment threshold, but by linking the duration of the survey to wind resource uncertainty, we are also able to capture the value of better wind information. Consequently, we propose a way to analyse how to optimise information acquisition in an investment analysis. The framework is different from what is more frequently used on problems of variable wind, that have more to do with knowing when it is blowing and when it is valuable. Ours is meant for the problem of which windfarm locations are worth building on, in terms of expected wind over the farm's expected lifetime, and, thus, the methods we apply abstract from problems related to portfolio characteristics of farms in a portfolio of farms.

Results

An investment in improved wind information reduces the variance in the wind estimate, thus bringing closer together the value of the option to invest and the value of the project itself. The left panel in Figure 2 illustrates the different ways in which the variance in the wind estimate may be reduced. As the right panel illustrates for the case of linear and zero survey cost, the survey you invest in to learn more and more quickly about wind conditions at the site you are considering, draws an important part of its value from reducing the threshold value of wind intensity that you need to see before you invest. This means that a good windfarm will be realized earlier, and this has the benefit of letting fewer good wind days go to waste and of bringing a positive discounted cash flow to you at an earlier point in time. In addition, better wind information will allow you earlier to walk away without having invested in a poor windfarm location.

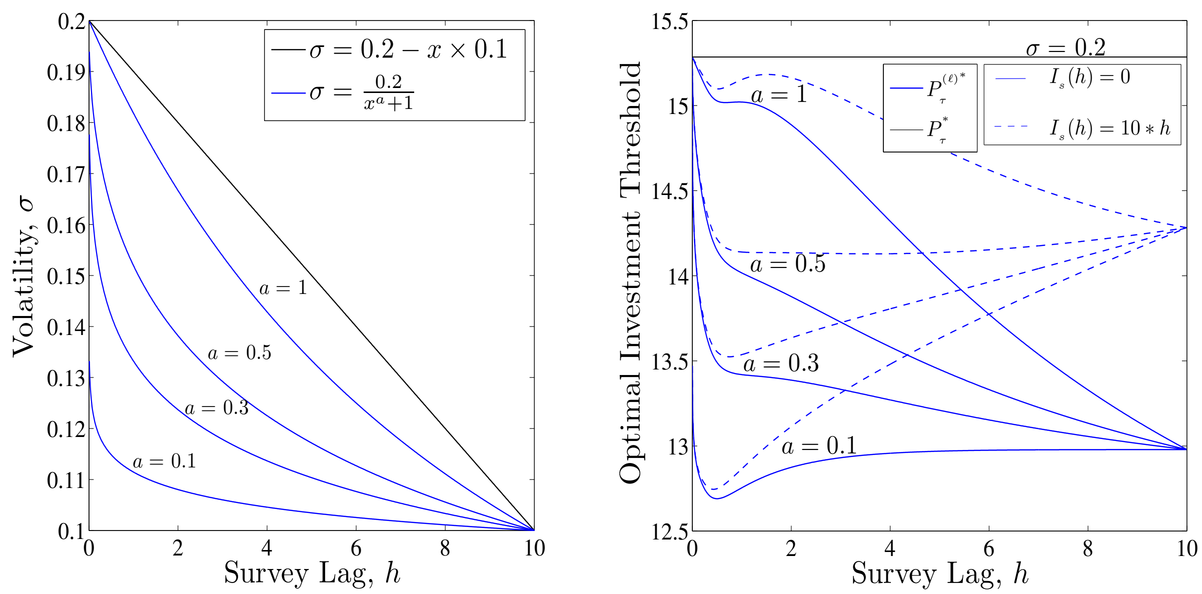

Figure 2: Volatility versus h (left) and optimal investment threshold versus h (right)

Conclusions

Our framework is suited to value the services of "wind geologists" in a more real sense than merely by suggesting that a windfarm's positive yield will reward equity more and debt less if the investment prospect comes with a qualified wind analysis report. Our idea is that better wind information may actually change investment decisions, and draws its value, i.e., its justification, from the probability that it will actually influence these decisions. Much remains in terms of making this analysis more realistic, but we are working with wind analysis firms to see how this can be further developed. Research support from Norwegian Research Council , CenSES project, is gratefully acknowledged.

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