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Swedish-Norwegian tradable green certificates: Scheme design flaws and perceived investment barriers

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ABSTRACT

The EU Commission recommends using market-based support schemes for renewable-electricity projects. One example is the Swedish-Norwegian tradable green certificate scheme. We examine whether design features in the Norwegian part of this scheme, specifically, the scheme's short duration and the way it is to be abruptly terminated, contribute to investors' perceptions of barriers. We apply econometric techniques on primary data collected in two surveys of Norwegian investors in hydropower, and we use real options theory to predict and interpret investors' responses. We show that: (1) immediately after the scheme was introduced, investors are eager to lock in future subsidies by investing immediately and concerned with factors that may delay the completion of their projects; (2) as the certificate deadline neared, investors have become increasingly pessimistic and concerned with economic and risk barriers. Investors in big hydropower plants with regulation reservoirs are particularly concerned with the risk of not completing their projects in time to gain the right to sell certificates. These findings are consistent with the predicted responses to the scheme design derived from real options theory. In contrast to earlier studies, we find no difference in responses to the scheme design across investor types.

1. Introduction

The Swedish-Norwegian tradable green certificate scheme is designed to achieve a given increase in annual renewable-electricity production capacity at the least cost to society and to provide incentives to producers to respond to market developments. Thus, the scheme satisfies many of the requirements in the European Commission guidance for renewable energy support schemes (Commission, 2013). It is also the first example of the use of cooperation mechanisms opened up by the EU in Directive 2009/28/EC on promoting use of energy from renewable sources (Directive, 2009).

We examine whether specific design features in the Norwegian part of the scheme contribute to or reinforce investors' perceptions of barriers, and thus may reduce the cost efficiency of the Swedish-Norwegian joint support scheme. We apply econometric techniques on primary data collected in two surveys of Norwegian investors in hydropower, and we use real options theory to predict and interpret investors' responses.

The Norwegian part of the certificate scheme is regulated by the Law on electricity certificates and a later amendment of this law (Stortinget, 2011, 2015). The scheme gives the producers of new (i.e., the added production under the scheme), renewable electricity the same support per MWh delivered on the electricity grid irrespective of which technology is used and regardless of whether the plant is located in Norway or Sweden or whether the additional production comes from a new plant or from updating and expanding an existing plant. Thus, the scheme contributes to short-term cost-efficiency. In the long run, it is of course an empirical question whether a technology-specific or a technology-neutral support scheme will be most efficient in minimising the production costs of electricity.

Moreover, the scheme is market-based. Most importantly, electricity is sold in the wholesale market for electricity. Thus, investors are exposed to changes in demand and supply conditions. This will influence decisions on which technology to choose, where to locate plants and when to produce, which is expected to contribute to a well-functioning electricity market. For example, investing in a hydropower plant with a costly regulation reservoir may be justified by the added project value that results from being flexible enough to adjust production to changes in electricity prices. In addition, with this scheme, certificates are sold in a market. Producers of new, renewable electricity have for 15 years the right to sell one certificate per MWh delivered on the electricity grid. Sellers of electricity to end consumers must buy a

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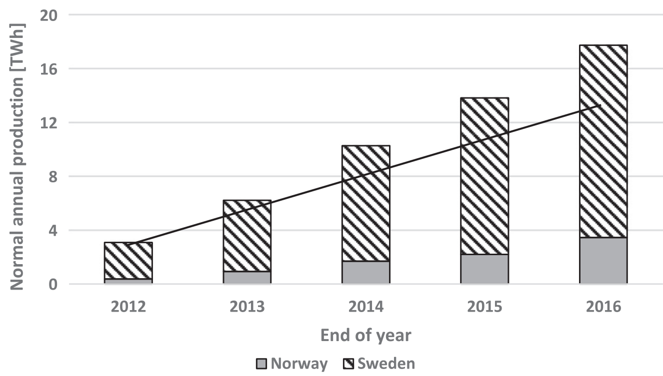

Fig. 1. Normal annual production for plants that are included in the joint green certificate target (TWh). The line illustrates a linear development towards the joint target of 28,4 TWh at the end of 2020.

fraction of a certificate, often referred to as a quota, for each MWh of electricity they sell. To balance supply of and demand for certificates, the sum of the electricity and certificate prices must at least equal the long-run marginal cost of the last producer to enter the market (Jensen and Skytte, 2002).

Finally, the scheme is quantity-driven. That is, the Swedish and Norwegian governments have determined national annual quotas. These quotas will increase through 2020 when the joint target is supposed to be met; thereafter, the quotas decline through 2035, when the last certificate is scheduled to be sold. To reach the Swedish-Norwegian target of additional 28.4 TWh annual production by the end of 2020, each country is obligated to adjust its annual quotas to accommodate changes in the forecasted demand for electricity.

In many ways, the Swedish-Norwegian tradable green certificate scheme is a success. Investments have so far increased steadily towards the target of 28.4 TWh additional annual production, and the sum of average electricity and certificate prices was only 312 NOK/MWh or 34 EUR/MWh in 2016 (Figs. 1 and 2). As of 1 January 2017, the scheme had contributed to 17.8 TWh in annual production in a normal year, divided by 10.6 TWh Swedish wind power, 2.8 TWh Swedish bio power, 3.0 TWh Norwegian hydropower, 0.8 TWh Swedish hydropower, 0.4 TWh Norwegian wind power, and 0,1 TWh Swedish solar power (NVE, 2017).

The relatively small share of Norwegian hydropower (17%) is surprising because the expected cost advantage of Norwegian hydropower was one of the reasons the first round of negotiations between Sweden and Norway failed in 2006. According to Gullberg and Bang (2015): “Sweden was concerned that the majority of the investments would be channelled into Norwegian hydropower because these projects were the least costly.” In Norway, hydropower projects have prior to the certificate scheme not been subsidised. Moreover, big hydropower plants are subject to a natural

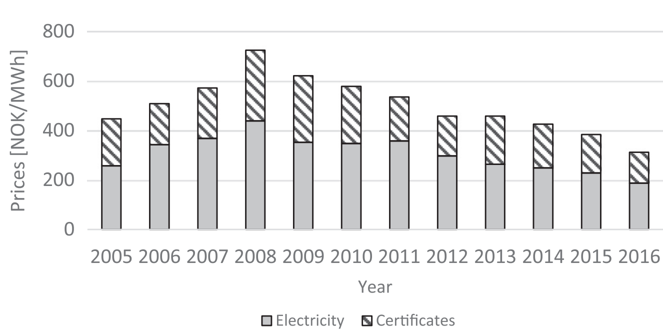

Fig. 2. The sum of electricity and certificate prices in Norwegian kroner. The electricity and certificate prices are annual averages of three-years forward contracts traded at the Nasdaq OMX Commodities (a Nordic power exchange) and by Svensk Kraftmakling (a brokerage firm), respectively.

resource tax in addition to the corporate tax, similar to oil and natural gas projects. Finally, some of the hydropower plants, particularly those with a total installed capacity above 10 MW, have regulation reservoirs, which gives them the added benefit of production flexibility. Thus, big hydropower plants with regulation reservoirs have historically been more profitable than other comparable renewable-electricity projects. We therefore suspect that some of the potentially most promising projects–large hydropower plants with regulation reservoirs–have not been realised under this scheme.

We examine whether design features in the Norwegian part of the scheme, specifically, the scheme's short duration and the way it is to be abruptly terminated, contribute to or reinforce investors' perceptions of barriers. Sweden had already implemented a national green certificate scheme in 2003, and it was only expanded to include Norway in 2012. Thus, Norwegian investors have at most 9 years to realise a project. Moreover, at the time of the two surveys, Sweden planned to gradually phase out the scheme, whereas Norway planned to end the scheme abruptly. That is, to gain the right to sell certificates, Norwegian investors had to deliver electricity to the electricity grid by the end of 2020. In contrast, Swedish investors completing their projects in 2021–2034 would still be entitled to sell certificates, but the selling period would gradually be reduced from 15 years to 1 year. These differences in scheme design are illustrated in Fig. 3.

We refer to real options theory (Dixit and Pindyck, 1994) to predict how the Norwegian scheme design will affect investor risk over time. These predictions are formulated as two hypotheses. Based on two surveys of Norwegian hydropower investors–one done immediately after the scheme was implemented (2012) and one from three years later (2015)–we examine whether the perceived barriers against and optimism for such projects have changed as predicted by real options theory. According to real options theory, the option to postpone an investment decision has a value when future cash flows are uncertain[1] and investment costs are partly or fully irreversible (Dixit and Pindyck, 1994). In general, the value of waiting increases with project risk and size of irreversible investment cost, as do the revenues required to invest, and therefore the required rate of return.

Our paper contributes to the academic research literature assessing the performance of tradable green certificates and equivalent support schemes, specifically to the studies on how investors respond to scheme design and policy risk. For an extensive review of this literature, see Darmani et al. (2016). However, for the purpose of this paper, we delimit our focus to a selection of recent contributions to real options theory that deal directly with the scheme design features we examine. These contributions, as well as selection of theoretical and empirical studies on investor heterogeneity in the renewable-electricity market, form the basis for our analysis.

In the next section, we describe the theoretical foundation for our analysis and derive hypotheses we will examine. In the third section, we present our survey methods, including the questionnaire, the data collection procedure and the econometric techniques. In the fourth and fifth sections, we present the results of the data analysis and explore their significance. Conclusions are offered in the sixth section.

2. Theory

According to the net present value investment rule, an investor should invest now if the discounted value of future net cash flows,

[1] The theory does not distinguish between risk and uncertainty. Both concepts refer to a situation where the possible consequences of decision or a process can be completely enumerated, and probabilities assigned to each possibility. In considering the implications of imperfect knowledge of the future, it is often useful to distinguish between risk and uncertainty. This distinction is originally due to Knight (1921) who defined situations involving risk as those where the possible consequences of a decision can be completely enumerated and probabilities can be assigned to each possibility. If this is not possible, we are dealing with uncertainty. This distinction is, however, not followed universally in the economics literature.