RENEWABLE ELECTRICITY SUBSIDIES AND WINDFALL PROFITS: AN EMPIRICAL ANALYSIS OF THE DUTCH SUPPORT SCHEME

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Overview

Many governments aim to promote the generation of renewable electricity, typically with the aim to reduce greenhouse gas emissions in the power sector. Due to the higher costs of renewable electrcity, electricity markets will generally not induce large-scale investments in renewables without government support.[1] Therefore, many governments have introduced subsidy schemes for renewable electricity.

A critical feature in the design of the subsidy scheme is the level of the subsidy. The literature usually differentiates between two types of support schemes corresponding to price and quantity based methods, respectively. The first method, based on prices, entails setting the subsidy equal to an estimate of the LCOE of renewable electricity (feed-in-tariff or FIT) or the difference between the LCOE estimate and market value of electricity (feed-in-premium or FIP). The second method, based on quantities, entails setting a fixed total subsidy budget which is tendered to renewable electricity producers. Another quantity-based support method is the renewable energy obligation, which is beyond the scope of this paper because the (implicit) subsidy with this type of scheme does not have to be determined by the government but is determined in the market. In practice, support schemes may combine the characteristics of these two types of support schemes. For example, in case of a FIT or FIP, there may be a quantity feature in the fo\rm of a cap on the total subsidy budget, or a specific renewable energy target. In the case of quatity based methods, the tendering process may involve inviting renewable energy producers to make a bid in terms of their required FIT or FIP.

Given that governments face uncertainty about the actual LCOE and (future) electricity prices, their estimates of these factors determine (i) the effectiveness of the scheme in promoting investment in renewable electricity and (ii) the amount of windfall profits for investors. While microeconomic theory typically does not guide the optimal distribution of rents or wealth, point (ii) is becoming increasingly relevant. Considering that large scale displacement of fossil-fuelled generation for renewable generation is expected to require very considerable subsidy amounts, very generous support schemes may put an unnecessarily large burden on the government budget and therefore on taxpayers (or electricity consumers if the subsidy burden falls on them), which may be perceived as unfair and potentially erode public support for subsidies. For example, in Germany, typically considered as highly successful in promoting renewable electricity generation (i.e. in meeting point [i]), the share of renewable electricity in total generation in 2015 reached 31.5%. To finance the scheme, the average German household paid €218 in extra levies on their annual energy bill. In the Netherlands, the support scheme is also financed through a per-unit levy on gas and electricity, amounting to €27.30 per MWh for the latter.[2] This increases the yearly average household energy bill by €183. Also, given that the public's willingness to contribute to (policies for) climate change mitigation is not without limits, it is desirable to minimise the costs of the government support scheme. Another reason for limiting windfall profits as much as possible is that raising additional taxes to fund a generous support scheme exacerbates the inefficiencies from taxation.

This paper investigates to what extent support schemes for renewable electricity result in windfall profits for subsidised investors. We focus on the Dutch renewable electricity support scheme because the Dutch government has set relatively ambitious targets for renewable electricity and has implemented several adaptations to the scheme over the past decades which aim to limit windfall profits from renewable electricity subsidies. These adaptations include a switch from a FIT to a FIP and the tendering of a limited subsidy budget over multiple rounds in which the subsidy becomes more generous. The central contribution of this paper is the empirical analysis of the degree to which existing support schemes for renewable electricity provide windfall profits. This empirical analysis appears to be a novelty in the scientific literature.

Methods

We use Monte Carlo simulations to estimate the cumulative distribution function of the *required* subsidy, and compare this with the *actually granted* subsidy for various renewable energy technologies. To calculate the actual subsidy amounts, the Dutch government makes a large number of assumptions, such as regarding the load factor, electricity

[1] Apart from countries with favourable environmental conditions for hydro power, such as Canada and Norway.
[2] The levy varies per electricity consumer type and lies between €0.40 and €37.50 per MWh.

price, interest rate and required return on equity. The government considers these factors to be constant across projects, while many of these factors are stochastic in practice. We aim to identify the most important factors that are stochastic in practice, such as the factors mentioned above. Consequently, we estimate the distributions for these variables. In turn, these distributions are used to estimate the cumulative distribution function of the actually required subsidy levels the various technologies. Hence, we calculate the actually required subsidy on the basis of the same calculation method as the government, but incorporate the stochastic nature of a number of critical factors. We then compare the actual subsidy with the distribution of the required subsidy in order to investigate the degree to which the subsidy scheme provides windfall profits to subsidised investors. Figure 1 provides an illustration of this comparison, which comes from Mulder et al. (2007), a technical report which is authored, amongst others, by one of the current authors. This technical report applies a very similar methodology to investigate the windfall profits of investors that received a subsidy between 2003 and 2006.

The analysis incorporates all years during which the Dutch government operated a support scheme. This means that the analysis includes three versions of the support scheme, the MEP which is a FIT that was in place from 2003-2006, the SDE which is a FIP that was in place from 2008-2010 and the SDE+ which is an improved FIP aimed at economic efficiency and reduction of windfall profits that has been in place since 2011. For each year, we estimate the cumulative distribution function of the required subsidy and compare it with the actual subsidy. The comparison over time provides insight into the development of the degree of windfall profits, and is indicative for how succesfull the support scheme design changes have been in reducing the degree of windfall profits.

The data for the analysis comes from a mixture of public and private sources. Electricity prices and interest rates are obtained from Bloomberg. Project-specific factors, particularly the realised load factor of subsidised wind turbines, may be derived from by the government body that executes the support scheme, the RVO.

Results

The primary results from the analysis will be the estimated cumulative distribution function of the required subsidy which is compared with the actual subsidy. This exercise is performed for each year for which a subsidy for renewable electricity was in place since 2003 to illustrate the development over time. We will compare our results with the results for the period 2003-2006 documented in Mulder et al. (2007), which showed that most subsidised investors earned considerable windfall profits in that period.

Conclusions

The paper will conclude with providing an answer to what extent the Dutch support scheme resulted in windfall profits. In addition, the paper draws overall conclusions about the success of the Dutch government in reducing windfall profits over time though the adaptations to the design of the scheme. From these findings, we formulate a number of lessons for the design of support schemes.

References

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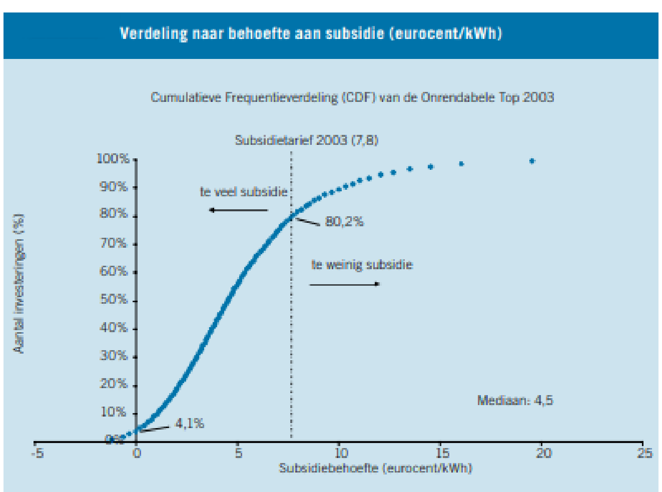

Figure 1: Cumulative distribution function of the required subsidy in 2003, compared with the actual subsidy. Source: Mulder et al. (2007).