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Effectiveness and efficiency of auctions for supporting renewable electricity – What can we learn from recent experiences?

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ABSTRACT

The current debate about using auctions to support electricity from renewable sources is very polarised. While their proponents imply that auctions are the universal remedy, their opponents consider them a major threat to other formerly successful policies for renewables. In theory, auctions can improve the effectiveness and efficiency of support. However, the empirical effects of auctions on renewable support have not yet been fully analysed. Here, we use empirical data from Brazil, France, Italy, the Netherlands and South Africa to compare the effectiveness and efficiency of auction-based schemes with previous support schemes. Comparisons with countries that did not switch to an auction scheme in the time period assessed complement the study. The analysis shows mixed results. While auctions can indeed improve efficiency and effectiveness, this cannot be identified as a generic trend. The evidence based on existing data is neither sufficient to recommend the introduction of auctions as a generic instrument, nor does it show that previous support schemes were typically superior. Therefore, policy makers in countries which already have effective and efficient support schemes of any kind need to be very careful when designing auctions in order to achieve the targeted improvements.

1. Introduction

Policies supporting electricity from renewable sources have been in place for more than 20 years in many countries. While in the past, most countries used either fixed feed-in tariffs or quota systems to support renewables, recently more and more countries have introduced auctions[1] as part of their support system [1]. In the European Union (EU), this development will most certainly continue due to the current Guidelines on State aid for environmental protection and energy [2], which prescribe the use of auctions to support renewable electricity with only a few exceptions. Auctions fulfil two main functions in the support system: First, they define support levels[2] in a competitive and market-based way. Second, they serve as a mechanism to control the capacity expansion of renewables as well as the cost of support by setting either a budget, capacity or generation cap.[3] As a consequence, auctions influence both the effectiveness and efficiency of support systems [3–6].

Efficiency and effectiveness are often used as criteria to assess the performance of renewable support schemes [7]. This paper contributes to answering the question of whether recent experiences with auctions support the assumption that auctions outperform other systems in terms of the effectiveness and efficiency of support. The analysis is based on comparing recent auction schemes to other support systems previously used in the analysed countries.

In many countries, the current discussion about auctions is very controversial. Whereas their proponents believe auctions to be the universal remedy [2], their opponents consider them a major threat to formerly successful policies for renewables [8–10]. This paper aims to discover whether it can provide evidence to support either of these extreme positions.

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[1] In the context of renewable policies, the terms tenders and auctions are often used as synonyms. Strictly speaking, tenders are multi-criteria auctions. Throughout this paper only the term auction is used. See Ref. [49] for a more detailed definition.

[2] Throughout the paper, 'support level' corresponds to unit cost subsidy and not to overall support expenditures.

[3] In some countries auctions are also used for other purposes. In Germany, for example, actor diversity is cited as a third objective alongside effectiveness and efficiency [87]. Some countries also use auction mechanisms to increase local economic activity (e.g. France or South Africa, see Section 4.1.2).

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The remainder of this paper is structured as follows. Section 2 describes the criteria in more detail and summarises existing results from the literature regarding auction performance. Section 3 explains the methodology used to assess recent auctions. The results are presented and interpreted in Section 4. Section 5 summarises, concludes and discusses policy implications.

2. Effects of auctions on effectiveness and efficiency

Effectiveness corresponds to the degree to which an objective is reached. In the context of renewables, effectiveness refers to the renewable capacity installed or renewable electricity generated in a given period (e.g. one year) because of the support instrument in place [11]. Effectiveness is assessed positively if extension targets[4] are either reached or over-achieved [11]. However, since 2008, unexpectedly high growth rates of solar photovoltaics in a number of countries such as Germany, Italy and Spain resulted in high costs and were one of the reasons in Spain for the moratorium of renewable energy support [12]. Therefore, in this paper, support schemes are deemed effective if the resulting renewable extension does not substantially deviate from the set targets, i.e. there is no or only modest over- or underachievement of these targets.

Auctions influence the effectiveness of support schemes by setting a cap on renewables' extension. Thus, in contrast to support systems without caps, auctions in theory avoid overachieving renewables' extension targets. When compared to the simple capacity or cost caps that can be introduced in systems with administratively set feed-in tariffs or feed-in premiums, auctions have the advantage of allocating scarce funds more efficiently. While simple caps usually distribute support on a first-come-first-served basis, well designed auctions select the projects with the lowest levelised costs of electricity generation (LCOE) [13,14]. However, in order to reach a high level of effectiveness, auctions need to be designed accordingly. First, auction volumes and awarded capacities need to be aligned to extension targets. Second, the auction design must incentivise successful auction participants to realise their projects as awarded. Support scheme effectiveness is high if the renewable extension or generation realised is close to the planned extension (e.g. based on extension targets).

Efficiency is reached when a given target is achieved at lowest cost. In the context of renewable electricity generation, the term efficiency is used in different ways. One definition is the minimization of the overall costs of installing a certain renewable capacity or producing a certain amount of electricity at a given point in time [11]. This kind of efficiency is also called static or macroeconomic efficiency [11,14]. Dynamic efficiency is another aspect. This concept involves the future costs of renewables' extension. It is argued that support schemes incentivizing currently expensive technologies at an early stage contribute to static efficiency in the longer term [11,15]. Efficiency in the context of supporting renewable energy can however also focus on the support costs for renewables and aim at minimizing support costs [14]. In this context, the distribution effects of support schemes play an important role in addition to overall generation costs. Support costs are influenced mainly by the choice of technology, but also by the support levels and risks involved in support systems [16].

Auctions impact the macroeconomic efficiency of support schemes mainly through the chosen technologies and the choice of selection criteria. Additional selection criteria apart from prices tend to decrease macroeconomic efficiency. Otherwise, there are no systematic differences between support systems with and without auctions regarding macroeconomic efficiency. The same is true for the auctions' impact on dynamic and static support efficiency. As for other support schemes, technology-neutral auctions focus on static efficiency, while technology-specific auctions include considerations regarding dynamic efficiency. However, the introduction of auctions can substantially influence the development of support costs. On the one hand, when compared to a system with administratively set support, auctions introduce a competitive, market-based procedure to determine support levels [8,17]. Given sufficient competition on the market, this can reduce support costs. On the other hand, the introduction of auctions also modifies the projects' risk structure because additional risks (especially the risk of penalties for non-realization or delays) are transferred to the plant operator. This involves higher costs as a consequence [6]. Due to these opposing effects of auctions on support costs, their theoretic impact is unclear.

However, the risks caused by auctions are usually lower than those under quota schemes where plant operators need to handle the twofold price risk on both the regular electricity and the certificates market [8]. Both price components are uncertain and depend on future market developments whereas, under auction schemes, income is usually fixed over the plant's lifetime [8,11,18–22].

So far, a number of authors have assessed the performance of auctions as an element of support schemes for electricity generation from renewables in a qualitative manner [4,6,23–26]. There are also some more detailed analyses of individual countries [8,10,27–30]. In general, these assessments show a mixed picture of the success of past experiences with auctions regarding both effectiveness and efficiency. Particularly, in some countries where low support levels were reached, many projects were not realised [30].

A comparative data-based assessment of different countries concerning the performance of auctions has been missing to date. This paper contributes to filling this gap by assessing the auction systems of five selected countries. The assessment compares them to both the system previously in placein each country before the tender scheme was introduced, and to three countries that retained the same non-auction support system over the entire evaluation period.

3. Methodology

Adequate support levels for renewable energy vary between countries and over time. There are cost differences between countries due to differing resource endowments, but also due to planning procedures, land availability and financing conditions. Over time, the costs of renewables tend to decrease due to technological learning, but changes in the prices for raw materials or in global demand also influence the costs of renewable energy projects.

A panel analysis is the most appropriate methodology to analyse the effects of auctions on the effectiveness and efficiency of renewable energy support. Panel analysis is a statistical method used to analyse two dimensional data, typically cross sectional and longitudinal. The support scheme performance in countries with and without auctions could be analysed and compared using panel analysis, regarding both the effectiveness of auction schemes and their efficiency.

However, such a panel analysis requires a relatively large sample size to obtain significant results. Currently, there are only a few countries that have switched to an auction scheme and whose auctions' effectiveness can be evaluated.[5]

[4] By extension targets, we mean the targets for deploying renewables. These can be formulated as installed capacities, electricity generated or percentage shares of total energy consumption or electricity generation.

[5] To assess the scheme's effectiveness, the realization period needs to be completed to enable an evaluation of realization rates.