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Combining tariffs, investment subsidies and soft loans in a renewable electricity deployment policy

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HIGHLIGHTS

- Insight on the cost-effectiveness of combinations of deployment instruments for the same technology.
- A financial model is developed.
- Feed-in tariffs (FITs) are combined with investment subsidies and soft loans.
- The policy costs of combinations are the same as for the FITs-only option.
- Therefore, combining deployment measures is not a cost-containment strategy.

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ABSTRACT

Policy combinations and interactions have received a considerable attention in the climate and energy policy realm. However, virtually no attention has been paid to the analysis of the combination of different deployment instruments for the same renewable energy technology. This neglect is all the more striking given the existence in current policy practice of combinations of deployment instruments either across technologies or for the same technology, both in the EU and elsewhere. What renewable electricity support policies to use and, therefore, how to combine them in order to promote the deployment of renewable energy technologies cost-effectively is a main concern of governments. The aim of this paper is to provide insight on the cost-effectiveness of combinations of deployment instruments for the same technology. A financial model is developed for this purpose, whereby feed-in tariffs (FITs) are combined with investment subsidies and soft loans. The results show that the policy costs of combinations are the same as for the FITs-only option. Therefore, combining deployment instruments is not a cost-containment strategy. However, combinations may lead to different inter-temporal distributions of the same amount of policy costs and, thus, differently affect the social acceptability and political feasibility of renewable energy support.

1. Introduction

The analysis of policy combinations in the climate and energy policy realms has received widespread attention in the economics literature. Following the well-known principle in economics that a single market failure is best addressed with one instrument, while multiple market failures require multiple instruments (Tinbergen, 1952; Fischer and Preonas, 2010), the literature generally argues in favour of instrument combinations. These are a carbon price which internalises the CO_2 emissions externality resulting from fossil-fuel electricity generation, R&D support which addresses innovation spillovers resulting in a lower amount of innovation than is socially optimal and, finally, deployment support, which tackles the “deployment externality” in terms of learning effects (Fischer and Preonas, 2010; del Río, 2009; Stern, 2007; Edenhofer et al., 2009; IEA, 2008, 2011).

The scope of such combinations clearly depends on the externalities to be addressed and, in short, on the technical maturity and commercial competitiveness of the energy technologies in general and renewable energy technologies (RETs) in particular. While R&D support is critical in the first stages of the innovation process (basic and applied R&D), its relevance comparatively diminishes as we advance to the pre-commercial stages. It becomes relatively unimportant for fully commercial technologies characterised by a dominant design. In contrast, a carbon price

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is useful to internalize the negative environmental externality, which is the most relevant in the last stages of the innovation process.

Deployment support is therefore generally justified for intermediate stages. Although there is a wide agreement that combinations may be needed to tackle the aforementioned market failures, the interaction between instruments has been shown to lead to conflicts, resulting in inefficiencies, redundancies, double coverage or double counting (Sorrell and Sijm, 2003; del Río, 2007). This empirical finding has led many to be sceptical about instrument combinations (see del Río (in press)). This paper focuses on combinations of instruments to support the deployment of electricity from renewable energy sources (RES-E), analysing whether such combination is either redundant or cost-effective with respect to the use of a single instrument.

RES-E deployment instruments generally fall in two groups: primary instruments (feed-in tariffs (FITs), quotas with tradable green certificates (TGCs) and tendering schemes) and secondary instruments (investment subsidies, fiscal incentives and soft loans, among others) (see Section 2). However, the abundant literature comparing the primary instruments with each other (see, among others, Ragwitz et al. (2007), Del Río and Gual (2004) and Finon and Perez (2007)) contrasts with the scarce research on their interactions.

Indeed, virtually no attention has been paid to the combination of deployment instruments for the same technology, not even in recent, highly influential policy documents such as the policy chapter in the Intergovernmental Panel on Climate Change (IPPC) Report on Climate Change and Renewables (Mitchell et al., 2011) and the International Energy Agency (IEA) Report on Policies for Renewables (Müller et al., 2011)[1]. This neglect is all the more striking given that most countries with renewable energy policies around the world have more than one type of policy in place (Mitchell et al., 2011; REN21, 2013). In the EU, deployment instruments are combined either across technologies or for the same technology (see Section 2). What RES-E support policies to use and, therefore, how to combine them in order to promote the deployment of RES-E cost-effectively is a relevant issue for governments, at least in the EU, where ambitious targets for the penetration of renewable energy in energy consumption have been set for 2020 (Directive 28/2009/EC). In this paper, we focus on a traditional and widespread combination of instruments in the EU: FITs with investment subsidies or soft loans.

Two exceptions to the lack of studies on combinations of deployment instruments for the same technology are Huber et al. (2004) and Alrumaih and Hoffmann (2011). Huber et al. (2004) provide a brief, graphical analysis of the advantages of combining TGCs with FITs, TGCs with tenders and FITs with tenders. The results show that different combinations have different advantages according to different criteria, i.e., trade-offs exist. The authors argue that combining instruments for one technology does not lead to huge advantages and may lead to higher administration costs. In contrast, our study uses a financial model and focuses on combinations of FITs with investment subsidies and soft loans. In Alrumaih and Hoffmann (2011), an economic and a financial model is used to simulate the costs of the combination of FITs with investment subsidies and soft loans for the case of solar PV and CSP technologies in Saudi Arabia. They conclude that the support level (for the same amount of deployment) would be lowest under a tariff with investment subsidies, followed by the tariff and soft loan alternative. The tariff-only option would lead to the highest support level. Unfortunately, there is little information available on the model structure and assumptions.

Therefore, the question remains whether combining primary and secondary deployment instruments leads to better results in terms of cost-effectiveness compared to their separate use, i.e., whether the same amount of RES-E can be deployed at lower costs for consumers. We try to contribute to the extremely thin literature on the topic with the help of a financial model. The main aim of this paper is to test whether a combination of a primary instrument (FITs) with secondary instruments (investment subsidies and soft loans) leads to lower support costs compared to the use of FITs alone (for the same amount of RES-E deployment) and to test how FITs are modified if combined with those secondary instruments.

Accordingly, the paper is structured as follows. The next section provides a description of RES-E support schemes and identifies combinations of those deployment instruments, with a focus on the European context. The theoretical framework and the methodology to analyse the support costs of different instrument combinations is provided in Section 3. Sections 4 and 5 discuss the relationship between FITs and investment subsidies and FITs and soft loans when the net benefit for the investor is constant (Section 4) and when the net benefit and the discount rate are reduced (Section 5). The support costs of policy combinations are analysed in Section 6. Section 7 concludes.

2. Primary and secondary RES-E support schemes and their combinations

RES-E deployment promotion has traditionally been based on three main (primary) mechanisms, whose costs are usually borne by consumers: FITs, quotas with TGCs and tendering (see del Río and Gual (2004), Ragwitz et al. (2007) and Huber et al. (2004) for further details)[2]

- *Feed-in laws* provide for preferential prices per kW h (or MW h) generated, paid in the form of guaranteed premium prices and combined with a purchase obligation by the utilities. The most relevant distinction is between feed-in tariffs (FITs) and premium systems (FIPs). The former provides total payments per kW h of electricity of renewable origin while, in the later case, a payment per kW h on top of the electricity wholesale-market price is granted (Sijm, 2005). FITs (both types) are applied in 23 EU countries.
- *TGCs* are certificates that can be sold in the market, allowing RES-E generators to obtain revenue. This is additional to the revenue from their sales of electricity fed into the grid. Therefore, RES-E generators benefit from two streams of revenue from two different markets: the market price of electricity plus the market price of TGCs multiplied by the number of MW h of

[1] Indeed, Mitchell et al. (2011) note that further research is also needed to fully understand the effectiveness and efficiency of combinations of policy instruments designed to achieve a very high share of RES-E in the long term.

[2] The distinction between primary and secondary instruments is a widespread and classical one in the RES-E support literature, although with different names, "dominating instruments" in Ragwitz (2012), "main support schemes" in Klessmann and Lovinfosse (2012), Teckenburg et al. (2012) and IEA/IRENA (2013) and "primary" and "secondary" instruments in Ragwitz et al. (2012), Huber et al. (2004), Huber et al. (2004) and Del Río and Gual (2004). This distinction is made in order to differentiate instruments which are the basis (the main economic incentive) for RES-E support in some countries. Most RES-E investments in EU countries have been triggered by FITs or quotas with TGCs, whereas other instruments have played a minor role, with some exceptions. In contrast to primary instruments, which generally cover all RES-E installations and are set at the national level, secondary instruments are usually limited in scope and circumscribed to specific types of projects (small ones) and technologies (i.e., solar PV). Whereas main instruments are almost always applied at the national level, secondary ones are applied at both the national and lower government levels, that is, regional/provincial/municipal.