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Retail price effects of feed-in tariff regulation

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ABSTRACT

The feed-in tariff regulation is the widest spread instrument used to promote electricity generation from renewable energy sources in the EU, with the costs of resources devoted to this promotion usually being borne by final consumers. Two components of the electricity retail price are expected to be influenced by the feed-in tariff regulation: the incentive to those firms producing electricity from renewable energy sources and the wholesale price of electricity. In this study we analyze the effects that the feed-in tariff regulation has on the electricity retail price for industrial consumers. We estimate the relative intensity of the impact of the cost of support electricity generation under the feed-in tariff and the electricity wholesale price on the Spanish industrial retail price. Special attention is devoted to technology-specific considerations, as well as short and long run effects. The results show that there is not a strong link between the retail and wholesale market for Spanish industrial consumers. Moreover, the results indicate that an increase of solar generation leads to a higher increase in the industrial retail price than in the case of a proportional increase of wind generation. This suggests that, when evaluating the feed-in tariff regulation impact on the retail price, the cost of incentives effect prevails over the wholesale price effect, and this is stronger for solar than for wind generation.

1. Introduction

Within the European Union (EU) 2020 energy strategy, the Third Energy Package aimed to complete the liberalization process, and the Climate and Energy Package implemented the targets for 2020 (known as the "20-20-20" targets). One of the targets was to increase the share of EU energy consumption produced from renewable resources to 20% (Directive (2009/28/EC). The EU member states embraced this target promoting the production of electricity from renewable energy sources (RES-E), and the feed-in tariff (FIT) regulation is the wider spread promotion scheme used to encourage the take-up and development of generation from RES. Basically, under the FIT regulation, a specific remuneration level is guaranteed for electricity produced by generators of the targeted technologies to cover its long-term marginal costs and the access to grid is guaranteed through a dispatch priority for the generated RES-E.[1]

In most EU countries, the costs of resources devoted to promote the production of RES-E are borne by final consumers. The recent economic recession has raised the concerns of European governments, industry and consumers alike, worried by high energy prices. Some blame is attributed to climate policies in general and to FIT in particular. In Spain, around 8 Bn Euros a year, on average, have been devoted to promote RES-E production during the last four years. This amount of resources represents around 12% of the industry GDP. Electricity is a highly relevant economic factor and, thus, policy and regulatory decisions affecting its price should be deeply analyzed given the direct effect that energy prices have on the firms' production costs and, hence, on welfare. However, there is no empirical assessment of the actual impact that this scheme has on final consumer (retail) prices.

Two components of the electricity retail price are expected to be influenced by FIT regulation; the incentive to those firms producing RES-E and the wholesale price of electricity. On the one hand, from the characteristics of the electricity wholesale price (WP) formation (merit order) and the low marginal cost of renewable energy generation, the introduction of RES-E in the energy mix is expected to exert a downward pressure on the WP. This effect is represented on the *Wholesale Market* graph in Fig. 1. On the other hand, given the regulatory design of the incentive mechanisms, the FIT costs (FITC) are charged to the final electricity consumers. Hence, acting over the electricity retail price in opposite directions (see *Retail Market* graph in Fig. 1), both components are functions of the proportion of renewable sources in the energy mix but they have opposing influence on the retail price. However, the net effect cannot be predicted beforehand, and represents an empirical issue. Therefore, the aim of this paper is to analyze the relative intensity that these two components have on electricity retail prices.

With the exceptions of Finland and the Netherlands where the FITC are completely financed by general taxes, the costs of RES-E promotion

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[1] For a detailed review of several feed-in tariff schemes see Couture and Gagnon (2010).

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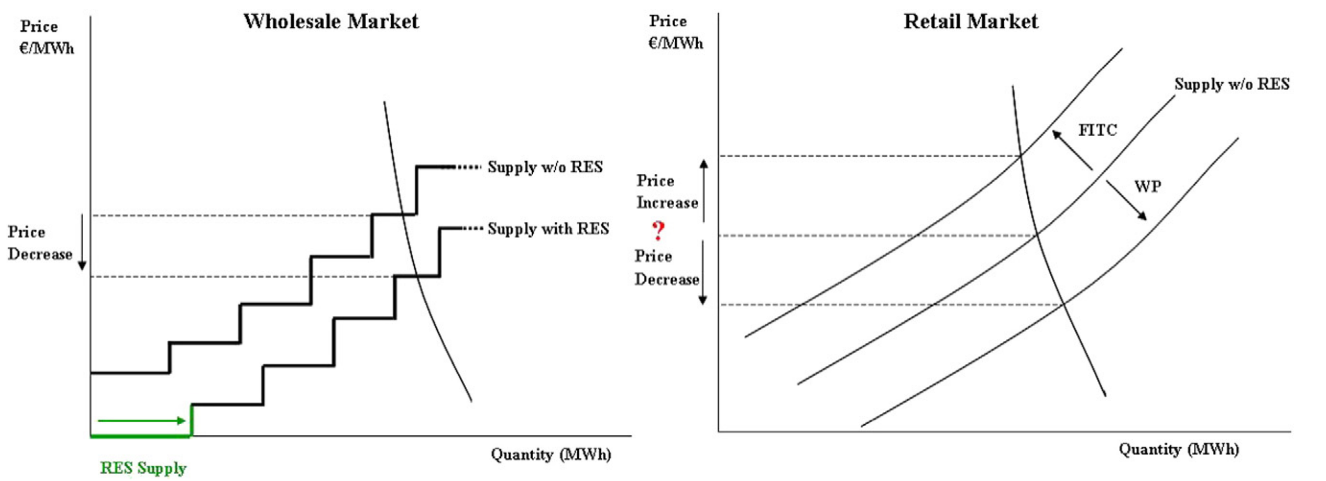

Fig. 1. FIT regulation effects.

in the EU member states are borne by final electricity consumers. Depending on the regulatory design, the FITC can be transferred into the electricity prices through two different channels; non-tax levies and pass down to end users of suppliers costs (CEER, 2013).[2] In both cases the FITC are transferred to the retail price after the wholesale price is set. Hence, the most common regulatory design is that in which the FITC are borne by end the consumer without having any impact on the wholesale price market formation mechanism.

In order to stimulate the development of certain technologies, the FIT guarantees generators of the targeted technologies a specific price per electricity produced. In Spain the FIT is granted to generation from RES and cogeneration plants with an installed capacity below 50 MW (the so-called Special Regime (SR)). The support is technology-specific granted and takes into account the fact that different technologies are at different levels of development and have different generation costs. Fig. 2 shows the yearly average FITC (in €/MWh) in Spain by technology over the last four years. While solar technology received an average of 375 €/MWh produced, the support level for wind and small hydro was, on average, 83 €/MWh, whereas for cogeneration (COG) and other renewable energy sources the average FITC was 110 €/MWh.

It should be stressed that wind and solar technologies make different contributions to the electricity system during the day, and that day times are characterized by different demand profiles. While the contribution of wind power is, in relative terms, higher during off-peak hours, the opposite is the case of solar power which is generated during daylight hours (peak hours). Moreover, the technologies within the FIT scheme provided different contributions to the energy consumed (see Fig. 3); while during the last years wind covered on average around 20% of the total load, solar covered 5% in the best case, small hydro only 3% or less, other renewable 2% or less, and COG (non-renewable) covered about 13% of the load. Hence, technology-specific considerations are important not only from the perspective of FITC but also from that of the WP, and this is carefully taken into account in the empirical study presented below.

To the best of our knowledge, none of the previous studies has assessed empirically from a disaggregated perspective the effect of both determinants (FITC and WP) on the retail price. Therefore, this paper seeks to contribute to the empirical analysis of the effect that the FIT regulation has on the electricity retail price for industrial consumers by quantifying the relative intensities of the FITC and the WP. This study is applied to Spain mainly because the more common regulatory design within the EU on RES-E promotion is applied, but also because of data availability and the fact that, within the EU, Spain has one of the highest renewable power capacities[3] (together with Germany and Italy), and one of the most significant wind power (together with Germany and Denmark) and solar power (together with Germany) generation penetrations. In what follows, special attention is devoted to technology-specific considerations, as well as to short- and long-run effects.

This article is organized as follows. Section 2 summarizes links to the existing literature. Section 3 describes the data and models used to estimate the retail price effects of the feed-in tariff regulation. Section 4 provides the estimation and results of our analysis. Finally, Section 5 discusses, interprets, and contextualizes our findings.

2. Links to the existing literature

Previous studies for different countries have analyzed (*ex-ante* and *ex-post*) the additional cost from supporting FIT, estimated the potential benefits from the merit of order effect, and compared aggregate figures for the potential cost savings from higher RES-E to direct FIT costs. Below we describe the main findings of these three closely related streams of the energy economics literature.

Numerous *ex-ante* studies calculate the additional cost from supporting schemes to electricity generated from renewable energy sources. Ragwitz et al. (2007) predicted that a steady rise of the average EU consumer price between 5.0 €/MWh and 7.7 €/MWh over the period 2005–2010 was required in order to finance RES-E deployment. In the German case, Frondel et al. (2010) calculated (dividing the overall amount of FIT by the overall electricity consumption) that in 2008 the price mark-up attributable to the FIT was about 7.5% of the average household electricity price. Using a quantitative electricity market model that accounts for factors such as oligopolistic behavior, emissions trading, and restricted cross-border transmission capacities, Traber and Kemfert (2009) also find an upward price effect of the German FIT. Relatively few *ex-post* studies have analyzed the price effects of FIT regulation. Del Rio and Gual (2007) assess the effect of the Spanish FIT between 1999 and 2003 in terms of the additional costs paid by consumers for renewables compared to conventional electricity (i.e. the share of RES-E promotion of the electricity bill). They found that the additional cost for the consumer increased annually by 23% during the period considered.

As discussed above, certain properties of RES-E generation can also potentially counter the upward-price effect associated with FIT

[2] To be more precise, while the non-tax levies are used in Austria, Belgium, France, Ireland, Italy, Lithuania, Luxembourg, Slovenia, and Spain, the pass through to end users of suppliers costs is used in Belgium, Czech Republic, Germany, Greece, Hungary, Norway, Poland, Portugal, Romania, Sweden, and UK.

[3] Excluding hydropower.