Effectiveness of feed-in tariff and renewable portfolio standard under strategic pricing in network access

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Overview

Although some policy schemes are intended to promote production from renewable energy sources (RES-E), strategic pricing in network access possibly offsets the effectiveness of these policies. Ropenus and Jensen (2009) theoretically showed that strategic manipulation of access charge by the monopolist partially offsets the effectiveness of fixed-price feed-in tariff for promoting renewable power production, and unbundling with perfect regulation on access charge eliminates the possibility of manipulation, consequently makes it possible to the fixed-price feed-in tariff works entirely.

This study compares the effectiveness of fixed-price and premium price feed-in tariffs (FIT) and renewable portfolio standard (RPS) for promoting production from RES-E, explicitly considering strategic pricing in network access. Impacts of vertical structure, i.e., vertical integration and separation, are also investigated.

Methods

Consider a market structure with a monopolist and a competitive fringe, where the monopolist produces electricity from non-renewable energy sources, while the competitive fringe produces from renewable energy sources. The fringe firm sells electricity to the monopolist in the renewable electricity market. The monopolist sells total electricity generated by the fringe and its own to the consumer in a retail market. Both firm needs to access a transmission network sector in order to sell electricity they produce.

Under vertical integration, the vertically integrated monopolist is able to set access price incurred by the fringe in addition to its own output. Under vertical separation, on the other hand, the access price is set by an independent operator in network sector. The monopolist is obliged to purchase renewable electricity from the fringe firm under policy scheme of a) fixed-price feed-in tariff, b) premium-price feed-in tariff, c) renewable portfolio standard (RPS). We also consider a benchmark situation in which no policy regime for promoting renewable energy sources is implemented. Under the benchmark case, the dominant firm is able to set a price for renewable electricity as a monopsony in the renewable electricity market. The fringe firm decides production from RES q_F so as to maximize its profit,

$$\pi_F = P_R q_F - C_F(q_F) - a q_F,$$

taking a price for renewable electricity P_R and an access price a as given, where $C_F(\cdot)$ is a production cost function. The first order condition of profit maximization for the fringe firm yields a supply function of renewable electricity $q_F(a, P_R)$, and an inverse supply function $P_R(a, q_F) = C_F' + a$.

Under vertical integration the monopolist is able to set access price incurred by the fringe and its own production level so as to maximize its profit. The price for renewable electricity under fixed-price feed-in tariff is fixed at $P_R = \overline{P}_R$ which is set by the policy maker. Under premium-price feed-in tariff the price for renewable electricity is set at $P_R = P + t$, where P is a equilibrium price in the retail market, and t is a premium set by the policy maker. The profit maximization problem of the monopolist under these FIT policy schemes can be represented as follows,

$$\max_{a, q_M} PQ - C_M(q_M) - (P_R - a) q_F(a, P_R) - F_T,$$

where $C_M(\cdot)$ is a production cost function, F_T is a fixed cost at the network sector. RPS policy scheme mandates the monopolist to purchase a certain proportion of renewable electricity to its own production. The profit maximization problem of the monopolist under RPS can be represented as follows using the inverse supply function;

$$\max_{a, q_M} PQ - C_M(q_M) - (P_R(a, \beta q_M) - a) \cdot \beta q_M - F_T \tag{1}$$

where β is the proportional purchase obligation set by the policy maker ($\beta \equiv q_F / q_M$).

Under vertical separation an independent operator in network sector sets an access price so as to maximize its own profit π_T:

$$\max_{a} \pi_T = aQ - F_T$$

where Q is the total output ($Q \equiv q_M + q_F$).

In contrast to the case of vertical integration the monopolist need to absorb the access price in order to access the network. The profit-maximization problem of the monopolist under fixed-price and premium-price feed-in tariff policy schemes can be represented as follows,

$$\max_{q_M} \pi_M = PQ - C_M(q_M) - P_R q_F - a q_M.$$

In the case of RPS the profit-maximization problem of the monopolist can be represented using inverse supply function of renewable electricity;

$$\max_{q_M} \pi_M = PQ - C_M(q_M) - P_R(\beta q_M; a) \cdot \beta q_M - a q_M.$$

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Results

It is shown that under vertical integration, market equilibria of fixed-price and premium price feed-in tariff policy schemes are same with that of the benchmark case. This means that the effectiveness of both FIT policy schemes is fully offset by strategic pricing in network access under vertical integration. This result indicates that under these policy schemes the monopolist practically faces the same decision making with the benchmark case; it is able to set a price for renewable electricity as a monopsony through manipulating access price. In contrast to the FIT policy schemes, RPS does not create incentive for the manipulation. This is because higher access price shifts the inverse supply function upward, which in turn induces higher cost for the vertically integrated monopolist to meet purchase obligation. This can be seen from the first-order condition of eq. (1) with respect to access price: $-(\partial P_R(a, q_F)/\partial a - 1)q_F = 0$. Consequently RPS is potentially more effective than FIT policy schemes under vertical integration.

It is also shown that vertical separation improves effectiveness of both FIT policies, but adversely reduces that of RPS. RPS under vertical separation gives the independent network operator room to increase its profit by raising access price, while RPS under vertical integration does not create incentive for access price manipulation. In the case of fixed-price and premium-price feed-in tariff policies, the unbundling increases renewable electricity production, because it makes impossible for the monopolist to set a renewable electricity price as a monopsony.

Conclusions

The results obtained in this study indicate that effectiveness of feed-in tariff and renewable portfolio standanrd depend on ability of the regulatory authority. That is, in the case of vertical integration effective access charge regulation is essential for feed-in tariff policy schemes to produce positive effects on promoting renewable electricity, while RPS does not necessarily require strict regulation.

References

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