TRANSMISSION TARIFF DESIGN: IMPLICATION OF INTER-TSO COMPENSATION ON CROSS-BORDER INVESTMENT

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(1) Overview

Ensuring competitiveness of the electricity sector in an interconnected national networks operated by national Transmission System Operators (TSOs) requires a sound mechanism to compensate TSOs hosting transit flows. In Europe, a voluntary inter-TSO compensation mechanism was introduced in 2002 in response to the 1990 directive by the EU parliament. The mechanism is supposed to enhance the competitiveness pillar of the European energy policy objective towards the development of internal electricity market (IEM). It aims to remove the CB and transit charges as they result in network tariff pancaking which discourages trade. The current binding guideline is EC regulation 833/2010 [1] which is an improvement to the previous EU regulation No. 714/2009 [2].

Recently, ACER has undertaken a union-wide assessment of the infrastructure of electricity transmission associated with facilitating cross-border flows of electricity based on a forward looking long run average incremental cost (FL-LRAIC). In the end, the Agency concluded that the LRAIC methodology is only of limited suitability in the context of the current ITC mechanism and that new regulatory framework should be developed in relation to ITC (ACER, 2013a, 2013b).

Similarly, many authors [5–9] have criticized the mechanism for its imprecision and limited scope. Moreover, it is not obvious whether such a non-market based mechanism can have any implication for investment to facilitate the realization of the single European electricity market [8] and how it interacts with other CB instruments like congestion management [10].

The ITC mechanism is not originally designed to give incentive for cross-border investment; however, as it leads to redistribution of costs and benefits, it can influence the cross-border investment decision of participating TSOs. In a system where ITC is not applicable, the investment decisions are guided by the common market based parameters such as the consumer surplus (CS), producer surplus (PS) and congestion revenue (CR). This study incorporates ITC in a transmission planning model as one of the benefit parameters to see its effect on the resulting cross-border investment level. Moreover, it sets out to study how market parameters and the ITC fund size can affect the resulting investment outcome.

(2) Methods

In this study, three investment planning scenarios are considered. These scenarios include: a supranational scenario where there is a single planner and two national scenarios with multiple national TSOs, assuming a system with and without ITC. The objective of the TSOs under all scenarios is assumed to be social welfare maximization.

A mathematical optimization method of transmission planning is used to model supranational case with an objective of simultaneously minimizing the operating and investment costs. Since we assume a perfectly inelastic demand function, this formulation is equivalent to a social welfare maximization problem.

Determining the cross-border capacity in a national planning setting requires an interactive decision process between adjacent TSOs. The common way to model such problems is to use a heuristic approach where investments are made on a step by step basis [11], [12]. In this study, the investments which lead to negative benefit index at least to one TSO are excluded and among the remaining lines the one with the highest sum of benefit index is upgraded in each iteration. This process is carried out until the algorithm is not able to find any better plan considering the assessment criteria that were settled down. This approach is applied for a system with and without ITC. Where ITC is applicable, the TSOs include their compensation or payment to ITC as a benefit or cost of the additional investment.

Furthermore, to identify the key techno-economic parameters that influence the investment decision of TSOs, sensitivity analysis are performed with respect to the ITC fund size and the supply functions of participating national markets.

These models have been implemented in GAMS and solved using KNITRO.

(3) Results

Base case results show that ITC could have an impact on cross-border investment level. Moreover, the significance of the impact depends on the relative size of the ITC payment or compensation with respect to the changes in CS, PS and CR. The two main factors that can alter this balance are the ITC fund size and the each national market's supply function.

Figure 1 shows the relationship between investment and ITC fund size. As can be seen, the cross-border investment level and pattern is sensitive to ITC and the size of the fund. If we increase the original fund size between 2 and 6 fold, the investment on line AB and BC increases whereas the investment on line AC decreases. Setting the ITC fund at 8 times the original size leads to a sharp drop in the capacity of line AB and AC from 4.75 and 3.25 GW to 2.4 and 1.2 GW, respectively. The capacity of line BC also decreases but less drastically. This investment level is maintained until the original fund size is increased by 14 folds. Beyond this level, investment keeps decreasing farther from the supranational optimal.

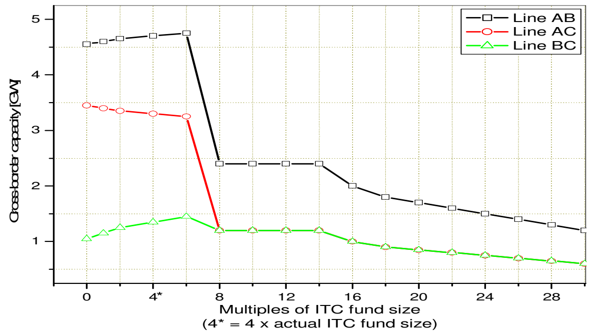

Figure 1: ITC fund size and cross-border investment

Furthermore, our results show that the sensitivity of cross-border investment to ITC is influenced by the supply function of participating countries. Wider price differences leads to less significant deviation as this would mainly increase the size of the CR.

(4) Conclusions

This paper proposes a modeling approach to integrate the current European ITC mechanism into a decentralized transmission planning model to see its impact on cross-border investment. The results indicate that introducing ITC could have an impact on the cross-border investment. However, this depends on two major factors: the ITC fund size and supply function of market in which the TSO operates. It was evident that keeping the original size the fund has a less significant impact. Increasing the fund size, however, can change the volume and pattern of investment. Similarly, price difference between national markets due to different supply functions and demand levels can affect the extent to which ITC affects investment decision.

Therefore, policy makers should be aware of the possible impact of ITC on cross-border investment, particularly in setting the ITC fund size. The proposed model can be applied in a more realistic network to study possible impacts of ITC and other cross-boder cost allocation mechanisms.

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