

INTERNATIONAL ELECTRICITY TRADE - ECONOMIC CONSIDERATIONS

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International electricity trade has grown significantly over the last decades. The European countries with synchronised networks traded 11.5% of their consumption internationally in 1999 up from 6% in 1975. To explain the increase advantages of international electricity trade are presented and costs associated with international electricity trade indicated. Prices can guide dispatch and trade decisions in the electricity sector. Therefore differences between competitive prices, monopolistic prices, oligopolistic prices and shadow prices are illustrated. Advantages of liberalisation and competition prices are contrasted with limitations due to price distortions from market power. Pricing of transmission capacity between competitive as well as monopolistic/state owned entities is explained based on traditional bargaining rules. The presentation ends with summary of financing options and a list of advantages of international electricity trade.

International exchange of electricity brings four advantageous. Trade allows countries to make better use of complementary resources, for example to use flexible hydro generation to export peak power and import thermal power during off peak hours. Secondly international interconnections allow balancing of annual demand variations, for example if little rain reduced hydro reserves and thermal output in a specific year. Thirdly international electricity trade allows countries to balance historically grown generation with current needs. In Italy demand growth was underestimated but could be balanced by imports. A fourth advantage of international trade is that it allows the pooling of reserve capacity thereby reducing costs for extra power stations and limiting inefficient dispatch of power stations required for provision of spinning reserve.

To allow international trade power systems can be interconnected by AC or DC links. For distances of more than 700 km or under water transmissions DC lines are currently more cost efficient than AC lines. If technical aspects inhibit synchronisation of the systems and require DC coupling then DC lines might be more economic already over shorter distances.

Economic charging of uncongested transmission lines should be based on marginal costs. Any market participant can reduce system costs by the system marginal costs when rescheduling transmissions. By charging transmission based on marginal costs decentralised decisions of individual generators and consumers are coordinated such that the overall system is managed efficiently. Due to quadratic increase of losses with transmitted energy marginal costs multiplied with the amount of scheduled transactions equals twice the total amount of losses. Marginal pricing results in over-recovery of variable costs. The additional revenue can be used to cover fixed costs of investment.

The idea of prices to guide dispatch decisions was introduced to the electricity sector in 1982 by Schweppes. Prices offer a unifying framework for communication, aggregating information in complex systems, and keeping the overall system efficient whilst allowing for decentralisation of individual decisions. In the energy market prices can be introduced as shadow prices to guide decisions, as audited prices to pay generators based on calculated costs or as market prices. In a perfectly competitive market assuming an infinite amount of buyers and sellers market prices equal variable costs of the most expensive generator required to match demand. If few electricity generators have major market shares then they can execute market power and push prices above competitive levels. Transmission constraints and short-term price inelastic demand increase market power. In European countries other than the Nordic countries market power seems to be

so high that threat of entry of new generators and threat of regulatory intervention rather than trading in the spot market determines average prices. Mediation of market power is therefore the major concern in the process of liberalisation and might inhibit a total liberalisation in certain situations.

When two electricity systems are interconnected energy will be transmitted from the low price zone to the high price zone. In the exporting zone prices increase because additional more expensive generators are required whereas in the importing zone prices decrease. In equilibrium transmission will increase until transmission costs equal the price difference between zones. If transmission capacity is constrained then scarce capacity is auctioned. The regulator should capture the auction revenues because if transmission owners keep the revenues they will increase congestion if that serves to maximise revenue. Transmission is a natural monopoly therefore a regulator is required to achieve welfare maximisation.

If a monopolist generates electricity on one side of the interconnection then auction revenues will be zero. The monopolist will never ask for more transmission capacity than is available but rather keep the economic rent of the transmission line. If a monopolist exchanges electricity with a competitive market then the monopolist will choose the price observed in the competitive market and add transmission costs. The monopolist can keep the gains from trade.

If two monopolists trade with each other general bargaining theory only shows that the price of electricity will be somewhere between the costs of generation in the exporting country and the value of the electricity for the importing country. Nash bargaining theory suggests that the parties will agree on a price in the middle. Only if both sides profit from the trade the technical hurdles can be overcome. If one party does not profit from trade then system security, demand uncertainty or deliberately chosen dispatch patterns provide sufficient excuses to limit transmissions.

If the electricity exporter is a monopoly long term contracting is crucial. In short run the importing country can not construct new generation capacity pushing its threat point to high prices. European gas imports prove that potential conflicts can be avoided by long-term contracting based on reference prices.

Electricity interconnections can be funded by private ownership, but as was illustrated above the result will not be socially optimal. A second alternative is Public Private Partnerships allowing for privately funded, constructed and maintained transmission lines. The state signs a long term contract specifying the annual rental payments, quality requirements and incentive terms. The assumption is that competition for projects will reduce the costs and find the most economic solution. The third option of public ownership requires state funding, which is usually cheaper than private equity. Public ownership allows preserving flexibility for future organisational changes to the electricity sector. Such changes might be advantageous in the light of new technological, economical or political developments. The most appropriate of these options has to be chosen based on the characteristics of each project.

Successful international electricity exchange can be a win- win game. The achievable gains motivate and require close co-operation of the administrative, technical and political levels.