Regulating Electricity Transmission in the European Union - How Many Agencies?

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National electric grids in Europe have been interconnected since the beginning of the twentieth century, a long time before the European Union (EU) was born and started building a single energy market. The primary reason for interconnections is security: the more national grids expand, the more national electric systems need to be interconnected to provide one another mutual assistance. Alongside the building of the EU, the European cross-border transmission sector has been organized through various national operators' associations. The evolution of the Union for the Coordination of Production and Transmission of Electricity (UCPTE) illustrates this process. Created in 1951, the UCPTE gathered all the electric operators of Western Europe to create a widely interconnected power grid. In 1999 the Czech Republic, Hungary, Poland, and the Slovak Republic became full members of the UCPTE. Meanwhile, in 1999 market liberalization prompted the separation of transmission activity from generation and retail operations. Consequently, the UCPTE became the Union for the Coordination of Transmission of Electricity (UCTE).

To guarantee the security of supply and networks, the EU added the objective of integrating national energy markets into one single energy market. Indeed, starting from 1996, the European authorities have published a series of directives and regulations aimed at instituting a free European electricity market in which consumers will be able to choose their favorite suppliers in a competitive setting.[1] To this end, the European authorities dismantled vertically integrated monopolies by separating production and supply, which are potentially competitive, from transmission and distribution, which are inherently natural monopolies. To guarantee free grid access to all suppliers in return for access tariffs, and to avoid cross-subsidies and distortions of competition, firms maintaining integrated ownership have to keep separated internal accounts and management for each transmission and distribution activity. Network activities have to be managed by independent entities: distribution system operators (DSOs) are now in charge of distribution transformers and lines while transmission system operators (TSOs) are responsible for the transmission network and the interconnections as well as the

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[1] In particular, directives 96/92/EC, 2003/54/EC and 2009/72/EC. See http://eur-lex.europa.eu/en/index.htm.

operation of the electric system. For instance, Réseau de Transport d'Electricité (RTE) is the TSO in France, National Grid is the main TSO in Great Britain, Red Eléctrica de España operates in Spain, and so on. Interconnections have a key role to play in favoring competition as they allow to benefit from the advantages of complementary generation mix as well as heterogeneous demand profiles. Second, to accompany the liberalization process and to keep the newly dismantled monopolies under close scrutiny, Directive 2003/54/EC[2] requires the setting up of independent national regulatory authorities (NRAs), such as the Commission de Régulation de l'Energie (CRE) in France, the Office of the Gas and Electricity Markets (OFGEM) in Great Britain, the Comisión Nacional de Energía (CNE) in Spain, and so on.

Despite the efforts of these regulatory bodies, several accidents and ongoing problems have shown that the common market is still far from being achieved and that the current organizational structure does not guarantee a reliable supply. A striking example is the blackout that occurred on November 4, 2006, when an overload of a German power network triggered chain reactions of outages across Western Europe, leaving 10 million Europeans without electricity. The German utility provider E.ON unexpectedly turned off the 380,000-volt line it operates over the river Ems to allow a ship to pass through safely.[3] The regulatory consequences of such an accident were summarized by Sir John Mogg, president of the Council of European Energy Regulators (CEER): "This recent blackout demonstrates the need, now more than ever, for an integrated European electricity grid subject to proper regulatory oversight. We need new legislation that formally mandates the TSOs to cooperate and we must have effective unbundling that would facilitate proper exchange of information."[4]

The Third Legislative Energy Package[5] adopted by the European authorities (2009), constitutes the EU's response to a lack of cooperation among TSOs in efforts to guarantee the security of supply and complete the European energy market. The package identifies interconnection as key to the creation of a common market. Consequently, the EU authorities aim at organizing an efficient cross-border transmission sector for Europe. To do so, the new legislation gives additional responsibilities to national TSOs and NRAs while creating a European regulator for interconnections, the Agency for the Cooperation of Energy Regulators (ACER),[6] as well as a European association of TSOs, the European Network of Transmission System Operators for Electricity (ENTSO-E).

The new regulatory framework for interconnection raises several economic issues that will be developed later on. As described above, both national and European regulators scrutinize the TSOs' activities. Each organization has powers that affect the TSOs' decisions on interconnection. The theory of multiprincipals[7] provides a useful tool-box when studying the interacting incentives designed by these

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[2] Directive 2003/54/EC concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.
[3] For details, see the UCTE's (2007) report at www.entsoe.eu/fileadmin/user_upload/_library/publications/ce/otherreports/Final-Report-20070130.pdf.
[4] CEER Press Release, "European Energy Regulators investigate blackout in Europe", 7 November 2006, www.cre.fr/fr/content/download/9898/168164/file/1162919250886.pdf
[5] The package consists of two directives on rules for the internal electricity and gas markets, two regulations on the conditions for access to those markets, and one regulation establishing the ACER.
[6] Regulation (EC) No 713/2009 of the European Parliament and of the Council of July 13, 2009, establishing an ACER; see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0713:EN:NOT.
[7] See Martimort (1992) and (1996).

different regulators. The subsidiarity principle,[8] according to which decentralization is desirable unless it entails too high coordination costs and too little internalization, is also helpful in assessing the proper level of decentralization.

In section 4.1 we analyze the hierarchical regulatory structure created by the Third Energy Package through a study of the powers attributed to each actor and a modeling of the actors' relationships (the analysis is based on an article by Caillaud, Jullien, and Picard, 1996). The main conclusion is that it is always optimal to decentralize part or all of the provision of incentive policies. In section 4.2, we consider the possibility of mergers between national TSOs and the subsequent likely development of international TSOs with stakes in several countries under separated regulation mechanisms. We discuss how the regulatory structure should evolve and how the relationships between an international TSO and its regulator(s) could be altered. Our analysis relies on an article by Laffont and Pouyet (2003), who discuss the role of shareholders and lobbyists in the regulation process. To conclude, we suggest some topics for further research.

4.1 The Regulatory Hierarchy of the European Cross-Border Transmission Sector

In this section, we assess the current regulatory hierarchy of the European cross-border transmission sector. We first look at the powers granted by the Third Energy Package to national and European regulators overseeing cross-border transmission activity. We then discuss the interactions between the incentives supplied by national and European regulators and their impacts on TSO decisions on interconnection. Finally, we sketch a model of how to design regulation mechanisms when the regulation authority faces moral hazard and potential capture.

4.1.1 National and International Regulators

This subsection consists in a presentation of the regulatory principals we examine later on. We first show how the Third Energy Package enhances the powers of national regulatory agencies to regulate interconnection. Then, we present the functions of the new European regulator for interconnection.

Enhanced powers for national regulation authorities

Through a directive on the internal rules for electricity markets, the Third Energy Package enhances NRAs' role in cross-border issues. For instance, NRAs, already in charge of monitoring TSO compliance with the guidelines for management of congestion and interconnection, also assess TSOs' investment plans and their consistency with the Europe-wide 10-year development plan elaborated by the ENTSO-E.

[8] See Laffont and Pouyet (2003).

Furthermore, the NRAs are explicitly required to cooperate more at the European level. Notice that the NRAs already cooperate, thanks to several structures such as the European Regulators Group for Electricity and Gas (ERGEG). The ERGEG was created in 2003 by the European Commission as an advisory body. It is composed of representatives of the NRAs. Through the ERGEG, the NRAs advise the Commission with the objective of consolidating the internal electricity market. Regardless of efforts that have led to a convergence of views,[9] the main weakness of the institution, which works on a voluntary basis, is that it follows a constrained decision-making process in which 27 regulators have to agree with one another.

Regulating Interconnection

After several years of debate about the appropriate regulatory structure to deal with cross-border issues, the European Commission has opted for an independent body. Till now, the regulation of interconnections was performed by the national regulators only. The Third Energy Package set up the ACER to complement and coordinate the regulatory tasks performed at the national level by the regulatory authorities.

The ACER supports NRAs in their efforts to cooperate. It also monitors and reviews the activities of the ENTSO-E. In particular, the ACER is involved in providing its opinion on the priorities of the TSOs' 10-year network development plan and in the preparation of technical and market codes. Furthermore, it has individual decision-making power over cross-border issues as well as a general advisory role in the European Commission, in continuity with the ERGEG's functions.

The role of ACER will probably evolve in the next few years, most likely gaining more power to the detriment of the NRAs. Is this a good thing or is decentralized regulation a better option? We now discuss this design problem.

4.1.2 Regulation Design of National TSOs

The question of choosing between a unique European agency and a set of national agencies, or a combination of both, to regulate a given economic sector was addressed in several fields before the problem arose in the electricity transport sector. For example, Caillaud, Jullien, and Picard (1996) ground the theoretical model we discuss in the following paragraphs in the organization of both the Common Agricultural Policy and European research and development (R&D) policy. The regulatory framework the authors work within is very similar to the one proposed in the Third Energy Package regarding cross-border issues. They address the question of how to balance the regulation process in a national-international hierarchical structure when the national entities are better informed than the international entity, and when the national firms create externalities out of the scope of the national regulators.

[9] See for example ERGEG (2008), "ERI Coherence and Convergence Report - An ERGEG Conclusions Paper", E08-ERI-12-04, www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_CONSULT/CLOSED%20PUBLIC%20CONSULTATIONS/ELECTRICITY/ERI%20Coherence%20and%20Convergence/CD/E08-ERI-12-04_CCR-CP_2008-02-15.pdf

Spillover Internalization vs. Informational Opportunism

The hierarchical structure

The regulatory pyramid analyzed by Caillaud, Jullien, and Picard (1996) is made up of one European regulatory agency (ERA) and a set of national regulation agencies, each of which in charge of controlling one national monopoly. This regulatory structure is quite representative of that current for the transport of electricity. Indeed, the European regulation agency can be associated with the ACER, the national sector regulators can be viewed as the NRAs, and the natural monopolies could be the TSOs. We may note that in countries where there are several TSOs, for example, in Germany, the operators have regional prerogatives and so behave like monopolies. As compared with the real world of electricity transport, several important actors are missing, in particular the national governments, the European Commission, and the ENTSO-E.

Externalities and spillover effects

The central question is whether TSOs' decision making has effects out of the scope of their profit function. Were private and social objectives positively related, there would be no reason to regulate firms (in this case, TSOs). That said, there is a general discrepancy between the private profit derived through the decisions of regulated TSOs and social welfare.

To explain the gap between the private and the social levels of effort in the industry we analyze, notice that all agents do not give the same value to the energy internationally transported, and they do not give the same value to interconnection capacities either. For instance, a vertically integrated firm that owns both transmission and generation assets has little interest in investing in cross-border infrastructure if it anticipates energy imports. Indeed, investing would make it easier for potential challengers to enter such a firm's home market. By contrast, national and European consumers value such investments because they increase the security of supply and make mutual assistance easier in case of domestic failure, even though interconnection makes electricity more expensive in the exporting countries.[10] Notice also that beside the European dimension of an integrated energy market, European foreign policy is at stake. For instance, the Mediterranean network project, which aims to link the European grid to the Mediterranean countries over a distance of 8,000 kilometers, is highly valued by some European actors.[11]

When there are several decision makers with the same objective but different levels of information, the only problem is how to pool the scattered information (Marshack and Radner, 1972). By contrast, in the context of electricity transport, divergent interests arise both from externalities (e.g. local congestion) and from spillover effects that are internalized neither by the NRAs nor by the TSOs (e.g. loop

[10] Building a line between two countries creates a large market with the effect of price convergence. In the high-price country, importing cheap energy drives the price down; in the low-price country exporting energy to demanders with high willingness-to-pay pushes the price up.

[11] For details on the Transgreen project, see http://transgreen.eu/topic/index.html

flows). The first type of discrepancy is rather common, whereas the second comes from international by-products of national decisions. For example, because of loop flows, the decision to reinforce a domestic transport line can adversely affect the electricity flows in interconnections and, consequently, modify welfare in the neighboring countries.

The informational structure

The basic assumption of the model discussed here is that some actions of the TSOs under scrutiny cannot be verified by the regulator(s), which is a matter of moral hazard. This means that regulation contracts cannot be based on these actions since the real decisions taken by the agent cannot be checked *ex post*.

On top of an informational asymmetry in favor of the TSOs, the model supposes that the national regulators have an informational advantage over the ERA. Several reasons can explain this information gap. Mere geographical location makes it more difficult for the ACER to observe the TSOs' actions. Moreover, the new legislation enables national regulators to keep the TSOs' activities under scrutiny. To limit market abuse, national regulators have access to the firms' operational decisions up to five years after such decisions are made. Meanwhile, national regulators have been working with TSOs since the year 2000, whereas the ACER is just starting out. Other similarities and divergences between the model and real life will be discussed later on.

As the actions of TSOs are hidden, the regulation mechanism can be based only on observable states of the world (for example the duration of blackouts) or signals (for example the number of complaints) that are partially generated by hidden actions and are publicly observable. The model we discuss here is based on the existence of signals. For instance, when a TSO increases its (unobservable) maintenance effort on the interconnections it manages, the NRAs and ERA can merely observe that the network users are more satisfied or that fewer complaints are received. Moreover, as the NRAs have an informational advantage over the ERA, each NRA receives an additional signal that is not correlated with the one received at the Community level (see our illustration in figure 4.1). The probability that each NRA receives a signal of good performance increases with the effort of the TSO under its jurisdiction.

Bargaining power

A more disputable assumption of the model when applied to electricity transport is the one concerning relative bargaining power: the ERA is supposed to have strong bargaining power against the TSOs since it proposes a system of subsidies that can only be accepted or rejected. National regulators, by contrast, have to negotiate their policy with the TSOs. Since the ACER is a new institution, this is obviously not (yet) the case. Nevertheless, the idea that Community decisions are easier to enforce than national decisions is increasingly true across the EU. Additionally, the modeling of the relationship between each NRA and the corresponding regulated TSO by means of a bargaining process can be interpreted as a modeling of the degree of capture of the national regulator, that is how much the NRA depends on the TSO's private

interest.[12] In other words, it is obviously more difficult for national TSOs to capture a European entity than to capture the national regulators.

Financial flows

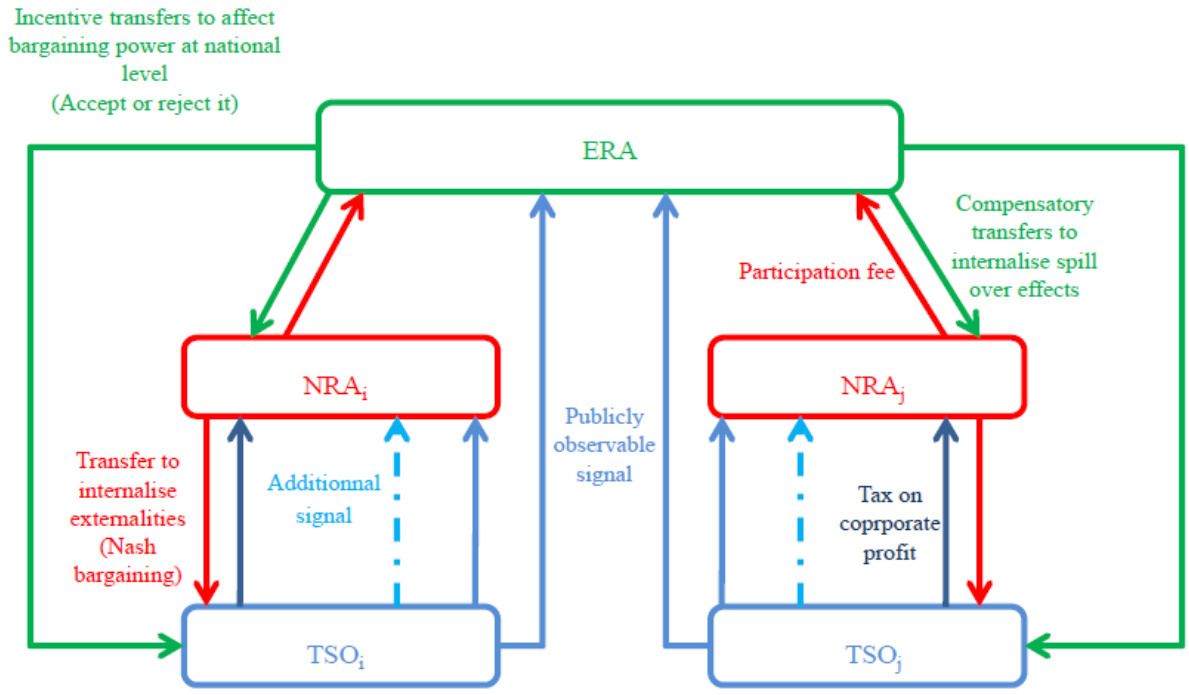
Consider now the financial flows under the control of the ERA. The ERA is entirely financed *ex ante* by member states' participation fees, and it must balance its budget. The regulatory instruments it controls are twofold: they consist of direct incentive transfers (subsidies from the ERA to the TSOs), and compensatory transfers between countries (transfers to the NRAs). Transfers from European institutions to the NRAs and TSOs to foster cross-border investments do exist—for example the inter-TSO compensation mechanism.[13] International transactions may be carried out by network operators in several member states. The TSOs concerned by energy flows resulting from the transactions incur extra costs on their networks. The inter-TSO compensation mechanism is an annual voluntary scheme aimed at compensating such extra costs. It has been operated since 2002 and is organized according to the EC Regulation 1228/2003: "It supports the development of the single electricity market by ensuring that decisions on cross-border trade and on plant location and retirement are not distorted and that the costs of the transmission infrastructure are recovered from those responsible for its use."

The Trans-European Energy Network (TEN-E) is another mechanism. The EU contributes to electricity transmission infrastructure projects of European interest. An annual budget of €25 million is spent for financing studies. The project between France and Spain is an example.[14]

Even though such schemes are not directly the responsibility of the ACER, we can imagine that the ERA would provide similar incentives to develop the interconnections. On the one hand, constrained by a balanced budget condition, the ERA modeled by Caillaud, Jullien, and Picard (1996) asks member states to contribute to financing transfers. On the other hand, the states receive compensatory transfers to internalize the spillover effects. This is quite representative of the budget of the ACER. The Agency's annual costs will be covered by Community grants. The Agency has limited revenues stemming from fees to be paid by third parties charged when the Agency takes certain decisions.[15]

[12] On the capture of regulators, see Faure-Grimaud, Laffont, and Martimort (2003).
[13] See Daxhelet and Smeers (2005) and Florence School of Regulation (2005).
[14] Estimated cost: €700 million funded 50% by RTE and 50% by REE, via their joint venture INELFE. European funding is being decided at the European Commission. It could reach € 225 million. source: http://www.liaison-france-espagne.org/index.php
[15] "The Agency should be mainly financed from the general budget of the European Union, by fees and by voluntary contributions. In particular, the resources currently pooled by regulatory authorities for their cooperation at Community level should continue to be available to the Agency". Regulation (EC) No 713/2009, whereas n°20.

Figure 4.1 Financial and informational flows in the national TSOs game



Note: NRA = national regulation agency; ERA = European regulation agency; TSO = transmission system operator.

As we already noted, in the regulation game with hidden action by the agent, the only feasible regulatory instruments are monetary transfers based on signals supposedly positively correlated with the intensity of the effort devoted to efficiency progress. At the national level, each NRA determines the transfer to the TSO it regulates. National transfers are financed through a tax on corporate profit (including a direct subsidy from the ERA). They are also financed by consumers paying their electricity bills, and this generates a dead-weight loss due to the cost of public funds.

Alternative scenarios

Given the assumptions and the institutional setting presented above, Caillaud *et al.* contrast the social effects of three possible scenarios:

- *Full decentralization* (that is, the green portions of figure 4.1 are not present): NRAs enjoy informational advantages but are constrained to bargain with the TSOs to implement their national policies, and do not take spillover effects into account .
- *Full centralization* (that is, the red portions of figure 4.1 are not present): the ERA is able to internalize the spillover effects but suffers from an informational disadvantage. In this scenario, the ACER would be endowed with all the powers of the NRAs. Note that this alternative is rejected by many governments, who fear losing their sovereignty. This rejection is in line with Caillaud *et al.* who show that "full centralization at the Community level is never optimal from the aggregate

point of view as soon as national regulators have an informational advantage" (*ibid*: 94).

- *Partial (de)centralization*. Because national and community policies are complementary, the partial decentralization scenario is generically the best solution, even though full decentralization may be optimal if the informational advantage of national regulators is large and they have sufficient bargaining power.

Moral Hazard and Risk of Capture

Several useful lessons can be derived from this analysis.

First, regarding informational rent, the optimal contracts signed by the ERA, followed by national negotiations, lead to suboptimal decisions by the TSOs. This is because the moral hazard problems faced by the ERA and the NRAs imply that a rent be left to the TSOs, which causes a social loss. The TSOs are able to extract some rent during the national negotiation process, since the NRAs do not have full bargaining power (that is, they are partially captured). To put it in other words, moral hazard and potential capture are the sources of TSO rents. The trade-off between full efficiency and rent minimization leads to a distortion in producers' decisions.[16]

Second, it is always optimal to allow for national policies, that is, to decentralize part or all of the provision of incentives. This ensures that the burden of providing incentives is shared among the different regulation entities. How it is shared depends on the size of the spillover effects and on the degree of national regulators' bargaining power, that is, their degree of capture. Two extreme cases can be distinguished:

- When the NRAs are totally independent from the regulated TSOs, they leave no rent during the bargaining process with the TSO they regulate. As the ERA suffers from an informational disadvantage to the NRAs, it cannot do better than the NRAs. The ERA only determines compensatory transfers between member states, so as to make them internalize the externalities their TSOs bring about. The task of inducing TSOs to take efficient decisions at the Community level is entirely left to the NRAs (this is not true, however, in case of partial capture).
- If the TSOs have some bargaining power, they are able to extract rents in the national negotiation framework. Once the Community and the national objectives are made compatible by transfers between member states, the ERA should influence the national negotiations so as to minimize the rent extracted by the TSOs. The capacity of the ERA to modify the status quo options in national negotiation processes is Pareto-improving for the Community. Then, full decentralization is not optimal despite the ERA's informational handicap.

Full decentralization can also be optimal as long as spillover effects are not too large, or more precisely as long as the TSOs' hidden actions that create spillover effects are below a certain threshold. Indeed, as long as the TSOs' decisions have

[16] Such results are standard in the literature on economic regulation. See, for example, Laffont and Martimort (2002).

small impacts on the welfare of neighboring countries, the subsidiarity considerations prevail. But in the case of large positive spillover effects, a supranational direct incentive policy will be desirable, complemented by the control of the better-informed NRAs.

Instead of a totally independent ERA, it is not uncommon for the electricity transport sector to be characterized by some degree of capture because the NRAs have to find compromises with both the TSOs and the national governments. This leads us to conclude that the Third Energy Package makes sense. First, the creation of the ACER will help to limit the bargaining power of the TSOs. Moreover, by enhancing the NRAs' powers, the Third Package will help mitigate capture, making efficiency reachable at a lower cost. This reinforcement of the NRAs is not in contradiction with the function of the ACER.

The future of the sector's complex regulatory structure depends on the capacity of the ERA to extract information from the NRAs. If the latter were obliged to transmit to the former all the information they have on the TSOs they regulate, the ACER would have all the advantages of a supranational entity (that is, the internalization of spillover effects and no risk of capture) without the informational gap that can impair its decision-making process.

4.2 The Regulation of International TSOs

In this section, we consider the possibility of mergers between national TSOs, which would lead to the creation of international TSOs. Then we discuss potential regulatory relationships between such international TSOs and international and national regulators.

4.2.1 International TSOs

Several new trends urge the contemplation of international TSOs. To begin, even though unbundling the ownership of production and transport assets is not yet compulsory after much debate during the elaboration of the Third Energy Package, European authorities continue to put pressure on vertically integrated national incumbents. Furthermore, the creation of a Europe-wide TSOs' association as well as the further development of regional initiatives can be seen as preliminary to the creation of international TSOs.

Unbundling

The proponents of unbundling maintain that when a handful of vertically integrated firms control the market, there are few incentives both to provide access to new entrants and to invest in network capacity. Unbundling would thus enable more competition and bring prices (and profits) down. To curtail the power of the energy giants, the European Council and the European Parliament encourage the effective

separation of generation and transmission assets as an efficient step toward promoting investment in infrastructure, fair access to the grid, and transparency.

The proposals for ownership unbundling faced strong opposition during the negotiations of the Third Energy Package. Eventually, the members of the European Parliament signed a deal that allows companies to choose among three alternative models: ownership unbundling (adopted by Italy, Spain and the UK among others), independent system operator (ISO) like for example in Scotland, California and Midwest, and independent transmission operator (ITO). In the ISO model, large vertically integrated companies are allowed to retain ownership of their electric grids under the condition that decisions regarding the system (ancillary services, investments…) are made by an independent entity. In the ITO model chosen by France and Germany, integrated companies keep making commercial and investment decisions but have to set up a framework to guarantee the independent operation of the electricity system as well as the transmission network.

Full unbundling still has powerful supporters, particularly among the members of the parliament and among commissioners.[17] Consequently, we can imagine that, sooner or later, ownership unbundling will become the rule all around the EU, so that most of the TSOs will operate as independent entities. Then, considering a case in which European neighboring TSOs are fully separated from energy producers on ownership grounds will no longer be just another academic exercise. As independent national monopolies emit and consume positive and negative externalities to and from their neighbors, they have some incentive to merge on a regional basis. Merging would increase the efficiency of the investment and operational decisions in those countries where energy externalities are at work, as well as allow them to benefit from economies of scope and scale, for example, in the management of maintenance teams. Some recent examples illustrate a new trend in cross-border mergers: in February 2010, the German operator E.ON sold about 10,700 kilometers of German transmission line to the Netherlander TENNET. In March 2010, the Swedish operator VATTENFALL announced its will to part with its East Germany network, eventually acquired by the Belgian ELIA. In July 2010 it was EDF's turn to part with its three British distribution grids, bought by a Hong Kong consortium.

ENTSO-E

In 1999 the European Transmission System Operators (ETSO) association was created. It aims to harmonize the disparate guidelines for grid access and use. On June 29, 2001, the ETSO gathered 32 independent TSO companies from the 15 countries of the EU plus Norway and Switzerland. Nevertheless, such voluntary cooperation has been proven limited by blackouts and other incidents resulting from either a lack of coordination or the absence of needed connections.

Consequently, the Third Energy Package created a Europe-wide TSO organization to harmonize access and operating rules, exchange information, and coordinate investment plans to build an integrated market. This organization is also

[17] For a discussion of the economic pros and cons, see Pollitt (2007)

in charge of elaborating the 10-year network development plan (TYNDP). Agreement did not have to wait until the new legislation was adopted. On December 28, 2008, the 40 European TSOs spontaneously signed an agreement establishing the new structure, and the ENTSO-E was born. Existing associations such as the ETSO have been dissolved and their tasks integrated into the new organization.

Regional Initiatives

In February 2006, the ERGEG launched the Electricity Regional Initiative (ERI). Seven regional electricity markets have been created in Europe: Baltic, Central East, Central South, Central West, Northern, South West, and France-UK-Ireland. With the ERI's launch operating and commercial standards will be further coordinated.

The Central Western ERI is the most advanced initiative thanks to the creation of CORESO and the Capacity Allocation Service System (CASC-CWE). CORESO provides real time and D-1 forecasts about the security of the Central Western networks to the TSOs in France, Belgium, Germany, the Netherlands, and Luxembourg. Furthermore, CORESO contributes to the building process of the CWE regional market coupling by supplying merged files representing two-day ahead forecasts. Meanwhile, the CASC is a joint cross-border service company in charge of services related to the auctioning of power transmission capacities on the common borders of France, Belgium, Germany, the Netherlands, and Luxembourg. Behaving as a single TSO on the European market, the CASC increases the liquidity within the five markets through the standardization of computer systems and procedures. As such, it is an important step toward the merger of the five markets into a common regional electricity market.

Given the observed momentum toward the creation of international TSOs or alliances of national TSOs, an unchanged regulatory framework would lead to big firms engaged in different activities, with cross-border transmission regulated by as many NRAs as the countries they are engaged in. Under which conditions would it be socially preferable to have one single supranational regulator entity facing international TSOs, rather than several NRAs? Given the social gains at stake, international TSOs and their regulatory framework deserve some attention.

4.2.2 The Regulation Design of International TSOs

We examine some of the potential problems created by the regulation of international TSOs using a model developed by Laffont and Pouyet (2003).

Modeling the Regulation of an International TSO

Hierarchical structure and informational gap

The alternative regulatory structures contemplated by Laffont and Pouyet (2003) bring to light some possible organizational features of the electricity transport sector in the near future. The players are (i) one international monopoly (an international

TSO) engaged in two countries. (ii) either one supranational regulator (ERA) for the two countries or two national independent regulators (NRAs), all facing asymmetrical information; and (iii) households living in the two countries who are simultaneously consumers, taxpayers, shareholders, and lobbyists. Notice that the supranational regulator could be the ACER as well as a joint assembly of the two national regulators.

The TSO incurs two costs, each associated with its activity in one of the two countries where it operates. Each cost has an intrinsic part perfectly known by the TSO but only known in probability by the regulator(s). Contrary to Caillaud, Jullien, and Picard (1996), for whom the NRAs had an informational advantage over the ERA, here, the national and supranational regulators bear the same informational asymmetry with respect to the TSO. The intrinsic cost of the TSO can be reduced by a specific effort that is not observable by the regulator(s). Nevertheless, the regulators can observe the resulting cost in each country, making this a case of "false moral hazard."[18] The regulator(s) actually face an adverse selection problem.

Costs, profits, and surplus

At the core of the analysis is the form of the cost function (or disutility function) of the two levels of effort incurred by the TSO. The authors assume that the cost-reducing efforts e_1 in country 1 and e_2 in country 2 create a disutility to the firm equal to $\psi(e_1, e_2) = \frac{1}{2}\left(e_1^2 + e_2^2\right) + \gamma e_1 e_2$. The marginal disutility of e_i, $\frac{\partial \psi(e_1, e_2)}{\partial e_i} = e_i + \gamma e_j$, increases (or decreases) with e_j if $\gamma > 0$ ($\gamma < 0$). Only the case where $\gamma > 0$ is analyzed. The authors focus on the case in which operating in country 1 or in country 2 are substitutable activities.[19] Applied to the cross-border transmission sector, such an assumption could be legitimated if the TSO had a limited common resource that could be dedicated to reducing the operation costs in the two countries.

The TSO's profit is equal to the sum of the transfers from either the two national regulators or from the ERA (including the reimbursement of costs), minus the disutility of the efforts.

In country *i*, the objective of the national regulator is made of the surplus created by the activity of the TSO in *i*, plus the share of the TSO's profit incurred to country *i*'s shareholders, minus the operating cost and the net transfer paid to the TSO, corrected by the cost of public funds. Two important ingredients of the NRAs'

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[18] See Laffont and Martimort (2002: 287). Specifically, if $C = \theta - e$, where θ stands for the intrinsic cost and e for the level of effort, the observation of C by the regulator allows us to treat the problem as a pure adverse selection model. Indeed, not observing the action *e* is the same as not observing the parameter θ.

[19] For a more general analysis of multiprincipals where the agent has either substitutable or complementary activities, see Martimort (1992: 14). The limitation to the case $\gamma > 0$ comes from the necessity to keep $\frac{\partial \psi(e_1, e_2)}{\partial e_i}$ positive for all e_j. Nevertheless, in the case of symmetrical effort $e_1 = e_2$, a weak complementarity condition $\gamma > -1$ is sufficient to meet both the condition of positive marginal disutility and the condition of convexity of the disutility.

objective functions are the cost of public funds and the proportion of the TSO's capital owned by households in the two countries.

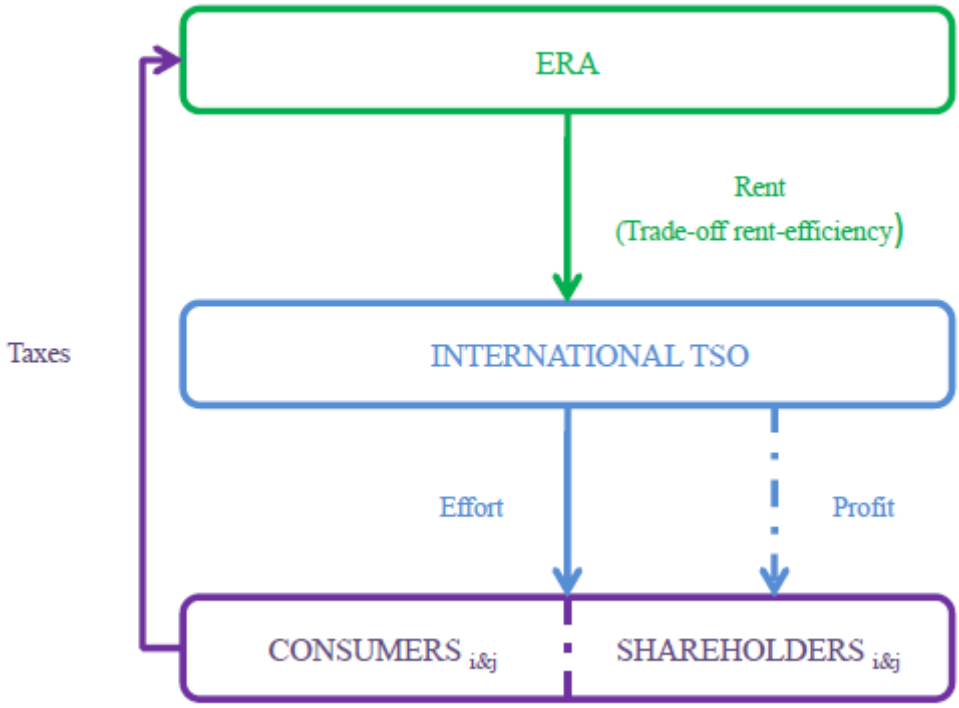
One or Two Regulation Agencies?

If information is spread evenly (that is, in the case of perfect information), it does not matter if we centralize the regulation mechanism or leave the two independent agencies to run it. This is because the only "externality" of the model appears in the disutility function, which is internalized by the TSO. When information is asymmetrical, political economy distortions are central to the regulation design. We first contrast the relative advantages and drawbacks of centralization and decentralization when economic regulation is not affected by political concerns. We then consider the case of a random majority creating political uncertainty.

Political stability and centralization

What can we expect under the centralization regime? With one single regulator only knowing the distribution of probabilities of cost the TSO keeps the control of its level of effort as we illustrate in figure 4.2.

Figure 4.2 Relationships among the players in the centralized regulation regime



Note: ERA = European regulation agency; TSO = transmission system operator.

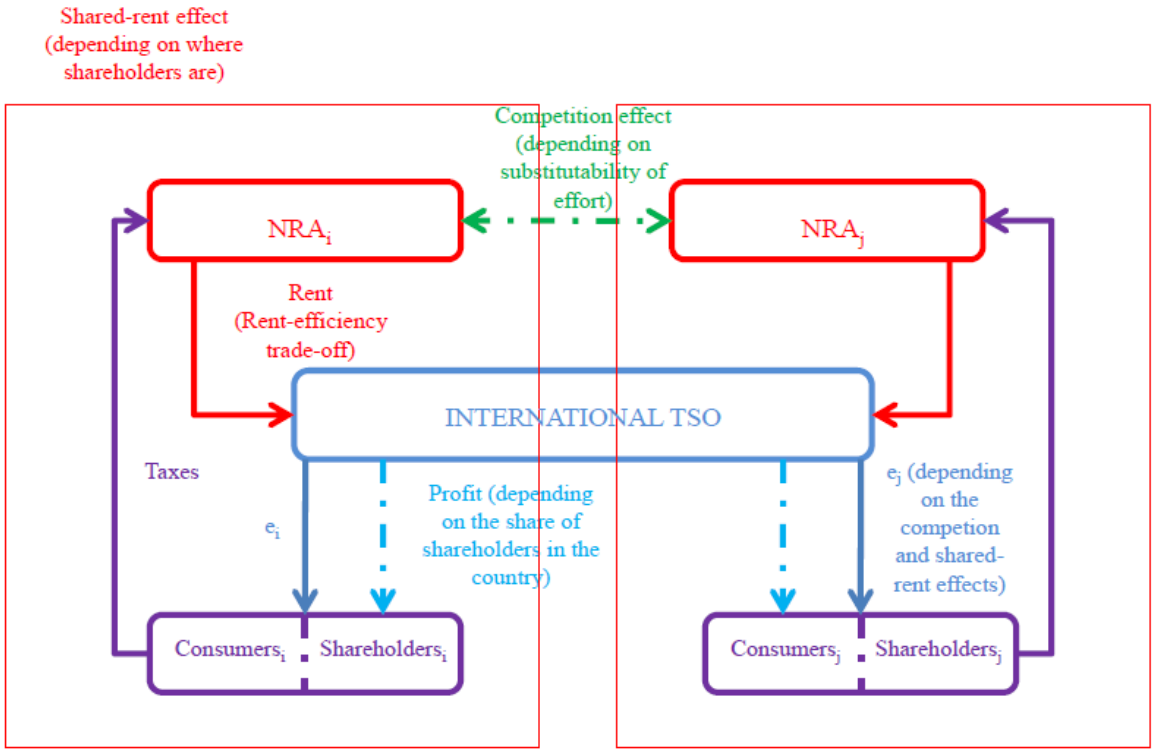
Then efforts are distorted downwards in comparison with the perfect information case. Indeed, facing a disadvantage in cost information relative to the TSO, the

regulator has to leave some rents to the TSO to induce cost-reducing efforts. As the rents are socially costly, the ERA faces the standard trade-off between rent and efficiency. All firms, except the most inefficient one, earn a positive rent.

Political stability and decentralization

We now consider the interactions between the NRAs' policies when regulation is decentralized. As we illustrate it in figure 4.3, each NRA knows, but cannot control, the fact that the other NRA's policy affects the relation it has with the TSO. It means that each NRA designs its regulation mechanism constrained not only by the informational opportunism of the TSO but also by the expected decision of the other NRA. To put it in a nutshell, regulators compete with one another to extract efficiency from a firm without leaving it too much rent.

Figure 4.3 Relationships among the players in the decentralized regulation regime



Note: NRA = national regulation agency; TSO = transmission system operator.

Two effects are at work: first, the "shared-rent effect," which is a consequence of the ownership structure of the TSO. In each country, some citizens hold shares of the firm. Consequently, the informational rent is split between the two countries, depending on where the shareholders are. Under decentralization, each NRA only takes into account the welfare of the agents belonging to its jurisdiction. Consequently, the NRAs undervalue the welfare induced by their policy, and they implement very low effort levels. Second, under decentralization, each NRA designs

its optimal incentive policy to make the monopoly behave in its national interest. It does not take into account the fact that each regulation also modifies the incentive relationships between the firm and the other regulator. As the efforts are substitutes, the NRAs propose high-powered incentive contracts, which lead to very high effort levels. This situation is the result of the "competition effect."

The level of effort in the decentralized framework can be larger or smaller than in the centralized one depending on the strength of each effect. Laffont and Pouyet (2003) show that the higher the substitution coefficient γ the more likely it is that the competition effect will overpass the shared-rent effect. Effort is distorted upward, and the rent abandoned to the TSO is ranked accordingly. The opposite occurs if γ is small, in particular if $\gamma = 0$. If the latter holds, there is no competition effect, and effort is distorted downward.

Political uncertainty

The level of effort is only one aspect of the performance of a regulation mechanism. A high level of effort can be too costly in terms of abandoned rents. Then, is centralization better than decentralization on welfare grounds? Using a model of random majority of shareholders, (the majority of shareholders might be either in one country or in the other) Laffont and Pouyet (2003) construct an example in which political economy distortions may favor decentralization. Random majority generates a fluctuation in the interest group that captures the regulatory decision, which leads to trade-offs between rent extraction and efficiency. The analysis is built on the following timing:

- The constitution decides which regulatory structure (centralized or decentralized) to set up in the two regions.
- In each country a random fraction of households become shareholders.
- The regulators in charge build a social objective function that depends on the majority in place.

The last hypothesis means that under decentralization, if there is a majority of shareholders among the households in country *i*, the NRA of *i* only takes into account the surplus of the shareholders in *i* and the part of the rent of the TSO that accrues to those shareholders. On the contrary, when the shareholders do not hold the majority in country *i*, the NRA in *i* only cares about the surplus of the nonshareholders. Under centralization, the unique regulator cares only about the majority in both countries.

A comparative analysis of welfare levels[20] shows that centralization suffers from policy fluctuations whereas competition between NRAs mitigates them, though at the cost of high-powered incentives. Consequently, centralization is preferred to decentralization if the shadow cost of public funds is larger than a given value. The converse is true when the shadow cost of public funds is below another value. Between these two thresholds, decentralization (centralization) is preferred to centralization (decentralization) when the size of the majority is small (large). The role of the cost of public funds is not surprising since, when this cost is high, it is

[20] This part of the analysis is based on the hypothesis that γ is large, which means, as seen above, that the competition effect is larger than the shared-rent effect.

socially costly to abandon a rent to the TSO. The role of the majority of shareholders is more surprising. The drawback of centralization is that the unique regulator cares only about the overall majority in both countries. When the size of the majority is small (larger than but close to 50 percent), the proportion of consumers disadvantaged by the centralized regulator tends to be relatively large, and decentralization becomes the preferred choice even though it provides the firm with too much rent. Decentralization serves to limit the discretionary power of the regulators.[21]

Economic and Political Lessons

Following Laffont and Pouyet (2003), we can conclude that the mere existence of an international TSO is not sufficient for installing an international regulator. The optimal regulatory regime depends on the cost of public funds, on the technology of the TSO (the degree of substitutability of efforts devoted to the various countries), and on the degree of political uncertainty. Indeed, when the NRAs are captured (that is, when the national agencies act in favor of the randomly determined majority in power), decentralization might be preferable as it reduces the discretionary power of the decision makers.

The model brings to light some of the economic problems that might arise if an ERA is installed with all the powers of the NRAs. It also provides important political lessons. In particular, it reminds us that the social utility function that traditionally gives equal weights to consumers and shareholders should be reconsidered in the context of international regulation. Indeed, consumers and shareholders do not necessarily live in the same country, so the NRAs do not fully internalize the effects of their domestic regulation. Additionally, the regulation institutions have been installed for a long time, while regulators are influenced by lobbyists who come and go with elections. Clearly, an ERA would be less sensitive to this form of capture, which means that its regulatory decisions would depart from the national interests.

4.3 Conclusion

The chapter has assessed the current regulatory structure of the cross-border transmission sector. Based on Caillaud, Jullien, and Picard (1996), we have seen that moral hazard and potential capture are sources of TSO rents. The trade-off between full efficiency and rent minimization leads to a distortion in TSO decisions. Furthermore, it is always optimal to allow national policies, that is, to decentralize part or all of the provision of incentives. This shares the burden of providing incentives among different regulation entities. The way it is shared depends on the size of the spillover effects and on the degree of national regulators' bargaining power, that is, the degree of capture of national regulators.

[21] This is in line with the results obtained by Martimort (1996).

Considering new trends such as the increasing number of unbundled incumbents and what could be viewed as preliminary steps toward the formation of international TSOs (for example, ENTSO-E and the development of regional initiatives), we have discussed how the relationships between international TSOs and national and European regulators could evolve. Based on Laffont and Pouyet (2003), we have seen that the optimal regulatory regime depends not only on the existence of an international TSO but on the cost of public funds, on the technology of the TSO (the degree of substitutability of efforts devoted to the different countries), and on the degree of political uncertainty. Indeed, when the NRAs may be captured (that is, when they act in favor of the randomly determined majority in power), decentralization might be preferable as it reduces the discretionary power of the decision makers.

It is possible to go still deeper into the issue of regulating cross-border electricity transmission. Indeed, our conclusions show that special attention has to be paid to the governance of the ACER to prevent the European regulator from being captured. Furthermore, the problem of "missing money" due to the presence of externalities is an issue that could be dealt with in future research. This problem can be summarized as follows: tariffs and congestion rents are not large enough to foster further investment in interconnections. The reason is that while cross-border infrastructure projects are mainly financed by the countries they interconnect, they generate positive externalities that benefit more countries. Consequently, the TSOs should be paid by all the agents who benefit from the network. The European Community has tried to tackle this problem through the Trans-European Energy Network and the ITC scheme. The measurement of the externalities generated by interconnections is at stake. Besides a lack of adequate financing schemes, the development of interconnections is slowed by heterogeneous national administrative and technical procedures. This hurdle could be lowered by a powerful international regulation entity.

Interconnections are fundamental for the development of electricity production from renewable sources. Indeed, renewables are not evenly available across the EU. Additionally, wind power and photovoltaic power are intermittent sources. Combined with the development of smart grids, stronger interconnections would allow more efficient and reliable dispatch at the international level. But renewable sources of electricity production are not yet mature and necessitate public subsidies. The multiprincipals theory and the subsidiarity principle could be applied in studying the interaction between national and European policies to subsidize green energy.[22]

[22] On this theme, see Eichner and Pethig (2010).

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