Restructuring the European Energy Market through M&As – An Application of the Model of Economic Dominance

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Abstract

In 1998, the European Commission decided to deregulate the national electricity sector with the objective of creating a single energy market. This deregulation involved an important increase in M&As (Mergers & Acquisitions), leading to a large reorganization of the European electricity industry. Using the theory of economic dominance developed by R. Lantner in 1974 - a theory inspired by the graph theory - this article aims at gaining an insight into the M&A strategies of electricity firms in Europe between 1998 and 2003, and the way in which these strategies affected the industry at the European level. We found that European electricity firms increasingly used strategies of M&A to strengthen their economic dominance.

Key Words: Electricity industry, mergers, graph theory
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1 - Introduction

The liberalization of the energy industry has led to a major restructuring of the European energy sector. In fact, the opening of the European energy market has dramatically changed the strategies of energy firms, which have now been given the opportunity to expand their markets beyond their national borders. This development may lead to a concentrated energy market. The establishment of a new European market has given rise to possibilities for economies on a scale large enough to exert a major influence on the capital-intensive industries, such as the electricity and gas industries. Electricity and gas firms belong to network industries, which means that their values increase with the size of their commercial networks. Firms in the energy sector are presently engaged in a race aimed at acquiring a size that would give them the substantial competitive advantage they need to dominate the market. In today's market, the fastest way for a firm to expand is through M&A. Its effectiveness makes the M&A strategy one of the main mechanisms of market restructuring.

Since 1998, the European energy sector has experienced a significant increase in M&As, which still continues today. The liberalization process has led energy firms to merge and form large European energy groups which compete within an oligopoly. Mergers have a direct impact on both the market and the exchange structures, which could affect the free play of competition. They are therefore closely monitored by the market regulation authorities in charge of the implementation of the National Competition Policy. Whereas the energy firms are aimed at increasing their economic influence or dominance, the regulation authorities seek to guarantee a fair competition in both the local and regional markets in order to ensure the security of European energy in the long term. The regulation authorities have a difficult task in dealing with these diverging and sometimes conflicting goals.

In an effort to increase our insight into the logic behind the restructuring of the energy sector, a theoretical framework was used to study the M&A strategies of energy companies. This framework, stemming from regional and spatial economics, was developed by Lantner in 1974 and described in his theory on economic dominance. This theory combines the graph theory with the input-output theory developed by

Leontief. The idea behind this approach to M&A strategies is that since all electricity firms have to deliver their production through electricity networks, their position within the exchange structure plays an important role in their competitiveness.

First, we will introduce the economic dominance theory that we adapted to the analysis of mergers. Second, we will apply this model to the exchange of electricity between European countries. This will give us a clear picture of the exchange structure of the European electricity industry, enabling us to assess the relations of dependency and interdependency between the countries. Third, we will analyze a number of European M&As in the energy sector that took place between 1998 and 2003, the very beginning of the process of market liberalization. We will demonstrate that these M&As match with the exchange structure of the European electricity industry, suggesting that firms' M&A strategies are motivated by the ambition to either gain economic dominance in the upstream market or to reduce their dependency on the competitors in the downstream market.

2 - The theory of economic dominance

The model of economic dominance outlined below was developed by Professor Roland Lantner in 1974. It was inspired by the graphs theory and the work of W. Leontief on the various applications of the input-output technique in economics. We have applied this model to the study of M&A. No known previous publications exist using graph theory or regional economics to study the topic of M&A.

The modification of the structure of an industry influenced by M&A alters the balances of dominance, dependency, and interdependency between production and/or consumption nodes. The economic dominance theory developed by Lantner is a very useful tool for understanding the structural modifications of an economic system. The graphs of influence used in this study play an important role in this structural theory. These graphs depict the quantitative and topological aspects of the industry which determine the position, intensity, and importance of the links between the several players within the network of economic exchanges.

In his preface of the book of R. Lantner (1974), Claude Ponsard gives a clear explanation of Lantner's principle of economic dominance: *"The dominance of an element X over an element Y seems to be the combination of the direct influence and the multiple indirect influences that X exercise over Y."* Hence, it is more appropriate to study the dominance relations between two nodes at the level of the whole structure than at the local level. Through commercial flows, the model of economic dominance describes the existing dependency and interdependency relations between several nodes of activity, which could be firms or countries. According to the flows' capacity of diffusion within the exchange structure, the activity of one node directly or indirectly affects the activities of the other nodes. Some nodes can have a greater influence or impact than other nodes on their competitors or on the economic system itself. Consequently, the first occupy a more important place in the economic system than the latter. In this article we are interested in understanding how M&A could modify the nature of the relations between the firms within the industry. Therefore, we have analyzed the impacts of M&A on the spatial structure of the exchanges in the European energy sector. Our analysis is aimed at unraveling the logic underlying firms' M&A strategies and their choice of targets.

This new approach to M&A analysis is focused on the firm's behavior. As in the economic efficiency theory, agents are assumed to be fully rational and markets are considered to be efficient; in other words, neither information asymmetry nor agency problems exist between the top managers and the shareholders. The model of economic dominance provides us with a very useful theoretical framework to study recent M&As in the European energy sector. The hypothesis that we seek to validate in this article is that firms try to reinforce their influences on the other nodes within the structure, especially on their providers and/or clients, in order to strengthen their comparative advantages in the market. As for the regulation authorities, their responsibility is twofold: first: facilitating the free play within the European energy market by limiting firms' market powers, and second: guaranteeing the security of the European energy. Their aim is to avoid that some firms acquire a disproportionate degree of dominance over the other firms in the exchange structure. However, with respect to energy security, the regulation authorities are also focused on increasing the diffusion capacity of the flows within the structure, which again reinforces the dependency and dominance relationships between firms. In addition, European energy companies have to be sufficiently large to secure their independence from foreign (non-EU) firms and to increase their investment capacities. One of the main objectives of the liberalization of the European energy sector was to build a more homogenous and competitive internal energy market to guarantee the security of European energy. A second focal point in our article is therefore to demonstrate how the M&A process induced by the market liberalization could achieve this objective.

Next, we will describe the model of economic dominance in more detail, while leaving out the aspects that we did not use in our study. The presentation of the model will cover three aspects: the formalization of the exchange structure, the notion of influence, and the internal arrangement of the structure. After that, the usefulness of this model for the M&A analysis is demonstrated. Before introducing our model, however, we will provide a concise literature review on M&A, after which we will briefly deal with the “merger paradox”.

2.1 A brief literature review on M&A

The two most popular M&A theories are the efficiency theory and the monopoly theory. These theories argue that merger decisions stem from a rational choice made by managers aimed at maximizing their own utility.

According to the efficiency theory, firms merge in order to improve their economic efficiency resulting from the synergies between the merging firms. This theory is based on the principle of market efficiency, which is the cornerstone of neoclassic thinking. This view is especially in line with managers’ focus on establishing synergies as the motivation for initiating a merger. This opinion has been supported by Friedman and Gibson (1988), Maremont and Mitchell (1988), Porter (1987), and Lubatkin (1983). Three different types of synergies can be distinguished:

- *Financial synergies* are meant to reduce the merged firm’s cost of capital by decreasing the systematic risk, either through the diversification of the company’s investment portfolio, the enhancement of the allocation of capital resulting from improved information, or by increasing the firm's size, which should facilitate the access to capital markets.

- *Operational synergies* are the most frequently mentioned by managers when defending the economic viability of the merger. These synergies generally stem from the sharing of exploitation resources. There are four different sources of operational synergies, which may occur either simultaneously or separately. Scale and scope economies reduce the firms' average production costs as a result of the increase in the firms' size. [Baumol et al. (1982)]. This source is the most common form of synergy resulting from a merger. Foreign market penetration is a second source of operational synergy. When a firm operates on different national markets, it can, for instance, arbitrate between different countries with respect to production cost factors. The third source of synergy involves the acquisition of new technologies, new knowledge, or new competencies. And finally, the fourth source is related to a better control regarding the firm's supplies and its market.
- *Managerial synergies* refer to the use of the organizational and planning skills of the top managers of the absorbing firm to increase the performance of the absorbed firm. The « Management competition model » of Jensen (1986) gives a good illustration of this point.

Although popular, the theory of economic efficiency is also subject to criticism, while the results of the empirical studies testing its relevance have generally been poor. According to Kitching (1967) and Porter (1987), synergy is considered to be a concept surrounded by evasiveness, while it is only rarely realized. Porter (1987) concludes that more than half of the acquisitions made by major American companies have failed. And Ravenscraft and Scherer (1987) establish that the more a firm acquires, the less profitable it becomes. Hence, the synergies theory seems to be more consistent with the prices on the stock market than with firms' actual economic performance rates.

The monopoly theory is the second main theory on the merger issue. As its name suggests, this theory assumes that firms seek to strengthen their market power—that is their ability to alter the market price. It is based on the rationality of the participating agents rather than on the market efficiency principle. As opposed to the efficiency theory, the monopoly perspective states that merger gains are not the result of synergies but of the transfer of wealth from the consumers to the firm. In their theory of contestable markets, Baumol, Panzar, and Willig (1982) condemn market concentration on the ground that it creates barriers and consequently favors the market power of the incumbent firms. M&A can be a means to raise the market entry costs by increasing the absolute advantages of the incumbent firm. Four types of absolute advantages have been identified (Bain, 1956): technological advantage (licences, patents, or secret knowledge or know-how), a privileged access to the downstream and the upstream market (the exclusive control over the supply of inputs or a distribution network), the production cost advantage in the case of economies of scale, and finally, a the privileged access to the capital markets.

Finally, the "merger paradox" refers to the situation in which a firm enters into a merger which does not support its financial interests. Salant, Switzer, and Reynolds (1983) have shown that mergers are actually more advantageous to the competitors than to the merging firms. The authors based their model on a Nash-Cournot equilibrium (quantity game setting) in a non-cooperative game between firms. Their model indicates that when there are no synergies that reduce the costs, M&A increases the profitability of the competitors while decreasing that of the merging companies. In the same way, Farrell and Shapiro (1990) analyzed horizontal mergers in a Cournot oligopoly and found that mergers that do not entail synergies lead to price increases. Deneckere and Davidson (1985), however, obtained slightly different results by considering the same problem from a Bertrand equilibrium perspective (price game setting). Like SSR (1983), the authors found that although the competitors benefit more than the merging firms, the latter nevertheless remain profitable. According to these two models, firms should adopt an opportunistic approach and try to take advantage of the mergers initiated by their competitors. However, if all firms would take the same free-riding opportunistic perspective, there were no mergers at all.

2.2 The formalization of the exchange structure

We consider a network, or structure, to be consisting of a set of points, called *nodes*, and the connections between them, called *links*. In our context, each country is a node of the network while the trade flows are the links. The exchange structure is characterized by exchange flows among the various nodes of the economic system we seek to analyze. Hence, the inputs of the model are trade flows (in money or in quantity) taking place among the exchange structure nodes, which could be firms, sectors, or countries. For example, in the case of the electricity industry, with which we will deal in the second part of the article, we refer to electricity flows in GWh among the different countries. Each flow is defined by an orientation and a value.

Before introducing the model of economic dominance, we would like to set three conditions which, according to Lantner (1974), are necessary to its implementation. The first is the homogeneity of the activity of the nodes. The second is the stability of the entry/exit coefficients, that is, the proportionality of the nodes' inputs relative to their outputs. The third condition is that the final uses are exogenous: the internal nodes' consumption, investments, and exportations are independent variables of which the levels determine the levels of their production.

The valuation of the flows should be based on a formalization that provides a better homogeneity of the data than the simple comparisons of the absolute values. Such a valuation tells us in which way the flows are integrated into the general structure of transactions. To adopt a global approach to the exchange structure, we will perform our flows valuation by using technical and allocation coefficients as described in the graph theory.

Let our economic system be composed of *n* nodes. Using Miller and Blair's notation (1985), X_i represents the total production of node *I*, while Y_i represents the final demand for node *i*, which is the part of the production X_i that is consumed by node *i* itself. Z_{ij} represents the sales made by node *i* to the other nodes *j*, and Y_i represents the node's sales relative to its own final demand. We can then write:

$$X_i = \sum_{j=1}^{n} Z_{ij} + Y_i \quad (i = 1, 2, ..., n) \qquad (1)$$

The summation excludes the case of $i = j$, which is taken into account by Y_i.

We can also write:

$$X_j = \sum_{i=1}^{n} Z_{ij} + W_j \quad (j = 1, 2, ..., n) \qquad (2)$$

W_j represents the value added by node j, which is that part of the production of node j which is not imported from other nodes. The only difference between W_j and Y_i is the interpretation of the difference between the production of a given node and the flows with respect to the other nodes.

In order to perform an input-output analysis on our exchange structure, let us now follow Lantner (2001) who chose to use technical or allocation coefficients for the flows valuation.

- The allocation coefficient a_{ij} is equal to the ratio of the absolute value of flow $Z_{ij,}$ moving from node i to node j to the total output X_i of the initial node i:
  $$a_{ij} = Z_{ij} / X_i \qquad (3)$$
- The technical coefficient $t_{ij} = Z_{ij} / X_j$ is the ratio of the absolute value of flow $Z_{ij,}$ moving from node i to node j to the total output X_j of the terminal node j.

The actual difference between allocation and technical coefficients is that the latter allow us to consider the absolute value of a global effect (in quantities or in dollars), while the first let us consider the relative value of this global effect (in percentage).

Equations (1) and (2) could be rewritten by using allocation and technical coefficients. Let d_i be the proportion of the delivery of node *i* relative to the final demand, and let w_j be the proportion of imports of node *j* plus the value added.

$$d_i = \frac{Y_i}{X_i} \quad \text{and} \quad w_j = \frac{W_j}{X_j}$$

Then (1) could be written as:

$$\sum_{j=1}^{n} a_{ij} + d_i = 1 \quad (i = 1,2,...,n) \qquad (4)$$

In terms of variations, equation (1) could be written as:

$$\Delta X_i = \sum_{j=1}^{n} \Delta Z_{ij} + \Delta Y_i \quad (i = 1,2,...,n) \qquad (5)$$

The previous equation (5) describes the variation of the final demand Y_i according to the variation of the output X_i. It could then be rewritten as follows:

$$\sum_{j=1}^{n} a_{ij} + \frac{\Delta Y_i}{\Delta X_i} = 1 \quad (i = 1,2,...,n) \qquad (6)$$

And (2) could be written as:

$$\sum_{i=1}^{n} t_{ij} + w_j = 1 \quad (j = 1,2,...,n) \qquad (7)$$

The proportion of the sales of node i to itself a_{ii} (= t_{ii}) is a good measure of the degree of autarky; thus the proportion of the sales of node *i* to the other nodes (a_{ii} – 1) is a good measure of the degree of anti-autarky. Let $b_i = 1 - a_{ii} = 1 - t_{ii}$.

Equation (4) could be written by means of a matrix:

$$[I - A].\frac{\Delta X}{X} = \hat{d}.\frac{\Delta Y}{Y} \text{ with } \hat{d} = \begin{bmatrix} d_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & d_n \end{bmatrix} \qquad (8)$$

Proof: the matrix form of equation (6) is $[I - A] = \frac{\Delta Y}{\Delta X}$ and

$$\frac{\Delta Y}{\Delta X} = \frac{\frac{\Delta Y}{Y}}{\frac{\Delta X}{X}} \begin{bmatrix} d_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & d_n \end{bmatrix}$$

Equation (7) can also be written by means of a matrix:

$$[I - T].X = Y \qquad (9)$$

Proof: As $w_j = \frac{W_j}{X_j}$, equation (7) can be written by means of the matrix $[I - T].X = W$. Besides, the matrices *Y* and *W* of equation (1) $Y_i = X_i - \sum_{j=1}^{n} Z_{ij} \quad (i = 1,2,...,n)$ and (2) $W_j = X_j - \sum_{i=1}^{n} Z_{ij} \quad (j = 1,2,...,n)$, are equal (Y = W).

As *A* and *T* are the *n*x*n* matrices of the allocation coefficients a_{ij} and the technical coefficients t_{ij} respectively, matrix equation (8) deals with relative values whereas matrix equation (9) deals with absolute values. In our empirical study of M&As in the European electricity sector we will use the second approach.

[I – A] and [I - T] are what we call the matrices of exchanges. We will study the characteristics of these matrices to analyze the dependency relationships between the nodes and the concepts of influence, dominance, and hierarchy within the exchange structure.

Let Δ be the mathematical determinant of the matrices of exchanges: $\Delta = |I - A| = |I - T|$. It ranges between 0 and 1. The higher determinant Δ, the more important the global diffusion. Determinant Δ will later be useful in studying the internal arrangement of the "exchange structure" and in calculating global influences.

Although the matrix equations (8) and (9) clarify the relationships between the nodes quite well, they do not show the dominance and dependency relationships from a global perspective. Our model adopts a global approach to the diffusion of economic influence by taking into account the different paths it follows. This objective cannot be reached with the classical matrix methods for the resolution of equation systems. Hence, in the following paragraph we will add a fundamental notion to our model: global economic influence.

2.3 The internal arrangement of the exchange structure

We first present an overview of the main types of exchange structures, and then describe some interesting properties of their internal arrangement. Finally, we will introduce some indicators to describe the exchange structure and measure the level of dependency and interdependency between its nodes.

Let us start by proposing two hypotheses:

- The relations between the structure and the outer part of the structure are fixed: the coefficients d_i which we defined above ($d_i = Y_i/X_i$), are considered as exogenous data. Moreover, the production is entirely consumed: $(1-a_{ii}) - a_{i1} - \dots - a_{in} = d_i$ (or $(1-t_{ii}) - t_{i1} - \dots - t_{in} = w_i$)

- The links within the structure are mobile, so the position and the intensity of the relations between the nodes are variable.

2.3.1 The main types of exchange structures

There are three main types of structure. The first type is the one where the nodes are *perfectly autarchic*, that is, each node consumes only its own production. It is argued that there is no internal exportation within the exchange structure, i.e., no exchanges between the nodes. In addition, there is no diffusion of the perturbations of the nodes' production or demand. The second type is characterized by *global circularity*. Each node exclusively imports from and exports to another node: node *i* imports from node *i*-1 and exports to node *i*+1 (and node *n* exports to node 1). In this type of structure, the nodes are interdependent. Moreover, it facilitates the best possible diffusion of the nodes' perturbations. The third type of structure is *strictly triangular*. It is a hierarchical structure where the relations are characterized by a strict dependency between the nodes: the flows are directed in one unique way. Strictly triangular structures also allow an extensive degree of global diffusion. However, as the relationships between the nodes are directed in only one way, this diffusion is not perfect. The phenomenon of circularity is the opposite of the triangular arrangement. These three types are, however, purely theoretical; a structure is never fully circular or triangular. As most structures include both *autarkies* and *partial circularities,* they often occur simultaneously. It is argued that a structure is triangular when the triangulation characteristic is more dominant than the circular feature.

Some Properties of the global diffusion of a structure could be based on the characteristics of determinant Δ, which in itself is a good indicator of this phenomenon.

- <u>*Slowing down due to partial circularities.*</u>
  Partial circularities have a tendency to partially stop or slow down the global diffusion process, because the looping effect hinders the progression of the influence which consequently spreads to only a limited number of nodes.
- <u>*Blocking due to polar autarkies*</u>
  Similar to partial circularities, autarkies impede the global diffusion of influence on the structure.

- <u>*The cumulative absorption process*</u>
  "Determinant Δ of the whole structure is inferior or equal to the determinants of any of its substructures." This is because when a node is suppressed, the circuits (partial circularities or polar autarkies) that are linked to it are suppressed as well.
- <u>*The role of global circularities in the diffusion*</u>
  In contrast with partial circularities, global circularities tend to enhance the global diffusion of the influence on the structure because they make the communication between the nodes easier.

As we have previously shown, some configurations of the exchange structure enable a better global diffusion. This is why the regulation authorities seek to realize a configuration which best fits the objectives of their policy. Therefore they generally aim at reinforcing the fluidity of exchanges by favoring M&A, which strengthens the global diffusion (but also increases the dependency between the nodes). Alternatively, they may choose to guarantee the free play of the market by favoring M&A, which creates partial circularities and increases the level of interdependency among the nodes (but reduces the global diffusion of influence as we have just explained). To solve this dilemma, the regulation authorities need to base their decisions on an actual industrial policy. At present, however, such a policy does not exist yet at the European level. The liberalization of the energy sector in Europe should encourage the public authorities of the European countries to formulate and implement a common energy policy.

2.3.2 Measures of dependency and interdependency

To describe and analyze the exchange structures, we will use a set of indicators which was developed by Roland Lantner. These indicators define five intervals ranging between 0 and 1, which depict the percentages of the levels of dependency, interdependency, and autarky within the structure. These levels are determined by the importance of the related phenomenon. The first and last column in table 1 indicate the importance of what Lantner calls "heteroactivity," i.e., the fraction of the flows moving outside of the exchange structure. The "internal induction" (shown in the first column) corresponds with the flows moving toward final demand, i.e., final consumption. The "external diffusion" (shown in the last column) corresponds with the flows moving toward the nodes located outside the exchange structure. The second column describes the flows that are associated with dependency relations and the third concerns the flows related to interdependency relations. Together these flows represent the proportion of internal exportation, i.e., the level of exchanges between the nodes. This level could be interpreted as an anti-autarky indicator. The fourth column indicates the flows that represent the autarkies in the structure.

Table 1: Indicators for the description of an exchange structure.

$0 \rightarrow \sqrt[n]{\Delta_{\min}}$	$\sqrt[n]{\Delta_{\min}} \rightarrow \sqrt[n]{\Delta}$	$\sqrt[n]{\Delta} \rightarrow \sqrt[n]{\Delta^{a}_{\max}}$	$\sqrt[n]{\Delta^{a}_{\max}} \rightarrow \sqrt[n]{\Delta_{\max}}$	$\sqrt[n]{\Delta_{\max}} \rightarrow 1$
Heteroactivity : Internal Induction	Dependency due to the paths.	Inter-dependency due to the circuits.	Autarky due to the feedbacks.	Hetero-activity : External Diffusion

The minimum value of the determinant is $\Delta_{\min} = \Pi d_i$, and when taking into account the given relations with the outer dimension of the structure, its maximum is $\Delta_{\max} = 1 - \Pi(1 - \boldsymbol{d}_i)$. When, besides the relations with the outer dimension of the structure, we take the autarkies into account, the value that is higher than the determinant is $\Delta^{a}_{\max} = \Pi b_{ii} - \Pi(b_{ii} - d_i)$. In order to make the economic interpretation of these indicators easier, we used the n^{th} root of $\Delta_{\min}$, $\Delta^{a}_{\max}$ and $\Delta_{\max}$, where *n* represents the number of nodes in the structure. A demonstration of these indicators is intended to be published by R. Lantner in a forthcoming article.

2.4 The notion of influence

The Global Influence exerted by one node on another can be defined a measure of the global impact of the variation of the production of a node *j* on the production of another node *k*. It includes both the direct and indirect effects of an initial perturbation (depending on the other nodes of the structure). The direct influence exerted by allocation and technical coefficients involves only the direct impact between two nodes. In this article we assume that the model is supply-driven.

The absolute global influence $I^{G}_{(j)\to k}$ of the demand-node (*j*) on the productive node (*k)* is equal to the ratio of the induced absolute variation ΔX_k of the production of node *k* devided by the initial absolute variation ΔY_j of node (*j*)'s demand, which is its final demand:

$$I^{G}_{(j)\to k} = \frac{\Delta X_k}{\Delta Y_j} \tag{10}$$

The absolute global influences can also be obtained by inversing the matrix. Equation (7) is equivalent to

$$I^{G}_{(j)\to k} = B_{jk} / \left|T\right| = B_{jk} / \Delta \tag{11}$$

where B_{jk} is the (signed) cofactor of coefficient $-t_{jk}$ in the determinant of *T*. This co-factor is the value, signed by $(-1)^{j+k}$, of the determinant of the matrix [*I*-*T*] without line *j* and column *k*.

Economically speaking, absolute global influence refers to the global impact of a unit (currency or GWh) on the supply when the demand varies by one unit (currency or GWh). A more common term for economists would be "sensitivity."

The graphs of influence include all the global influences between the nodes of the whole structure. To better understand the idea behind these graphs of influence, let us assume that only the final demand Y_j addressed to node *j* changes. When the production of node *j* varies, the production of the other nodes (*n*-1) also varies in a concomitant way. The hypothesis of the proportionality of the inputs relative to the outputs mentioned above implies that the technical or allocation coefficients are constant. Generalizing the final demand of all nodes in a structure is not a problem. Because of the linearity of the model, the effects playing a role in the simultaneous variation of the several final demands can be added in a fairly simple manner. Hence, the model allows us to obtain all the global influences which the nodes of the structure have on one another simultaneously.

The graph of absolute influences depicts the global absolute influence of all nodes into one matrix. The linearity of the model allows us to derive the following relation from the definition of absolute influence: $\Delta X_k = \sum_{j=1}^{n} (I^G_{(j)\to k}).\Delta Y_j$ with *k*=1,…, *n*. This relation shows that an absolute variation ΔX_k is a linear combination of the absolute variations of the nodes' demand ΔY_j.

It is argued that node *j* has a direct dominance over node *k* if $I^D_{[j,k]} > I^D_{[k,j]}$, that is: $t_{kj} > t_{jk}$. It is argued that node *j* has a global dominance over node *k* if $I^G_{j\to k} > I^G_{k\to j}$.

The signifance of these graphs of influence lies in the separation of the direct and indirect effects of economic dominance. This model allows us to gain a subtle understanding of the global impact of an M&A on all the actors of a market. Through the influence exerted by the nodes, M&As indeed have a global consequence for the exchange structure as a whole.

The impact of a merger on this influence should depend on the variation of the co-factor B_{jk} (or C_{jk}) and the variation of determinant Δ. Hence, the impact on the merging firm's influence can be only assessed in relation to the corresponding impact on its competitors. The different cases are presented in the table below:

Table 2: The impact of M&As on the nodes' influences

Δ	$\mathbf{B_{jk}}$	$i^G_{(j)\to k}$
↗	↗	↗ If the increase of $\mathbf{B_{jk}}$ compensates the increase of **Δ** ↘ If the increase of $\mathbf{B_{jk}}$ does not compensate the increase of **Δ**
↗	↘	↘
↘	↗	↗
↘	↘	↗ If the decrease of **Δ** compensates the decrease of $\mathbf{B_{jk}}$ ↘ If the decrease of **Δ** does not compensate the decrease of $\mathbf{B_{jk}}$

Mergers generally cause the shrinkage of the exchange structure, thereby increasing determinant (Δ). Thus, the first two lines of the table represent the most common cases.

In this model firms are using M&A to reinforce the influence on one or several of their competitors. As for the regulation authorities, they favor an exchange structure that allows the free play of the market and at the same time focuses on maintaining the security of energy. They particularly pay attention to the impacts of M&A on the internal arrangement of the exchange structure. In the next section we will present the main properties of exchange structures and introduce some indicators (designed by Lantner) that describe their internal arrangement.

2.5 The hierarchy of the nodes

First, we will define the hierarchy of the structure's nodes according to their degree of dominance, and second, according to their degree of vulnerability (i.e., degree of dependency). We will use the global approach developed by R. Lantner (1974). This approach is based on multiplier coefficients (m_i) and "anti-multiplier" coefficients (am_i), allowing us to take both the direct and the indirect relations between the nodes into account.

2.5.1 The hierarchy of the nodes according to their dominance – the multipliers

When presenting the theory of the matrix multiplier in his book "The Theory of the Economic Dominance", Roland Lantner states that the "multiplier associated to the final demand of a node is a precious indicator of hierarchy". Indeed, the multiplier associated with a node indicates the node's capacity to stimulate global exchanges within the structure by taking into account both direct and indirect effects, amplification phenomena, and partial circularities.

We assume that a variation of the aggregated final demand moving toward productive node *i* involves a variation ΔX of the total production X. We define the multiplier m_i of a node as the ratio $m_i = \Delta X/\Delta D_i$. The total production X is then: $X = \sum_{j=1}^{n} X_j$.

Lantner has shown that these multipliers are the solutions to the following linear equations system, which is convenient since it is quick and easy to solve.

$$[I-\tilde{T}]\begin{bmatrix} m_1 \\ \dots \\ m_i \\ \dots \\ m_n \end{bmatrix} = \begin{bmatrix} 1 \\ \dots \\ \dots \\ \dots \\ 1 \end{bmatrix} \qquad (12)$$

$\tilde{T}$ being the transposed matrix of T.

Hence, there are two easier ways to obtain these multipliers:

- $m_i = |[I-T]^*|/\Delta$ where $[I-T]^*$ is the matrix [I-T], where the coefficients of the i^{th} column have been replaced by 1.
- Multiplier m_i could also be obtained by adding up the sensitivities (global influences) of node *i* in each column.

2.5.2 The hierarchy of nodes according to their vulnerability – the anti-multipliers

If the multipliers measure the total influence of a node on the other nodes in the exchange system, the “anti-multipliers” measure its vulnerability (total dependency). In order to determine a node’s vulnerability, we assume that when there is an increase ΔD_j in the demand of a node *j*, the productions of all other nodes uniformly move at a rate *k* with regard to the variation of their demand:

$$\Delta D_1 / X_1 = \dots = \Delta D_j / X_j = \dots = \Delta D_n / X_n = k \qquad (13)$$

The final effect of these demand variations on the production of each node can be measured by the relative production variations: $P_j = \Delta X_j / X_j$. The anti-multipliers are determined by the ratio $am_j = P_j / k$ measuring the degree of dependency of node *j* on the rest of the exchange structure. These anti-multipliers can be easily calculated with the coefficients of matrix [I-A].

We will later use these multipliers and anti-multipliers to establish a hierarchy of the European electricity industries according to their total dominance and their total dependency.

2.6 Application of the theory of economic dominance to M&A in the energy sector

Each theory on M&A focuses on one of the aspects of this phenomenon, leaving aside other aspects, which are considered to be of minor importance. Brouthers, Van Hastenburg, and Van den Ven (1998) have shown that in general the decision to conduct a merger is based on various reasons. Angwin (2001) argues that a merger decision is a complex process involving the interaction of different types of motives. Therefore, our adaptation of the economic dominance model is a significant additional part in the theoretical corpus on M&A. This corpus is based on a global approach to the exchange flows within the market and combines the concerns of both the firms and the regulator. The driving force behind mergers is the desire of firms to strengthen their economic dominance. Through their merger strategies, energy firms seek to increase their economic dominance over the industry, thereby enlarging the dependency of other firms on them. If they succeed in this, they can gradually shift from the status of price taker to that of price maker. In this way they can benefit from their increased market power. This approach is in contradistinction with the “merger paradox,” which refers to the notion that a merger is more beneficial to the incumbents than to the merging firms.

One of the objectives of commercial businesses is to increase their economic dominance over the system by obtaining a privileged position, which strengthens their influence on other firms. This would allow them to improve their import conditions in the downstream market and/or to acquire a better access to the upstream market. Consequently, their actions will tend to favor a triangular structure, which is characterized by strong relations of dependency. However, in a competitive free market this structure is always challenged by the forces of competition, which stimulate the dominated firms to try to reverse this balance of dominance. The regulation authority, on the other hand, is aimed at increasing the diffusion ratio and avoiding structures which are too triangular. This is why it actually faces a dilemma, consisting of choosing between the interdependency between the nodes and the diffusion of the flows within the exchange system. Reinforcing the interdependency between nodes is a way for the regulator to counteract market powers and stimulate the free competition within the market. The diffusion ratio is also important for the regulation authority because it enhances the accessibility of the flows to the nodes and makes the market more homogeneous. Therefore, with respect to the energy industries, this ratio improves the energy security. Generally, the diffusion ratio increases as the number of nodes (firms) decreases. It should be protected by eliminating intermediaries which cause major agency problems and by avoiding information asymmetry between the firms. In this way transaction costs could be reduced.

In their race for dominance, firms use their strategies to either create or suppress partial circularities and polar autarkies. Since diffusion and triangulation ratio generally evolve similarly, the regulator is often confronted with a dilemma when choosing between increasing the diffusion ratio and reducing the triangulation ratio, that is, choosing between dependency and interdependency or between energy security and a free competitive market. The regulator makes this choice on the basis of the strategic priorities as defined by the industrial and energy policy of the country.

This approach to M&A is in line with the phenomenon of merger waves**.** These waves are mainly stimulated by three factors: economic growth, clusters of technological innovation, and an evolving regulation and legislation. When one of these factors alters a firm's dominance, the other businesses react through mergers in order to adapt their strategic position. These mergers can be considered as a perturbation, modifying the exchange structure and its balances of dominance, and thereby causing a domino effect which again reinforces the phenomenon of M&A waves. As for the merger paradox presented by Salant, Switzer, and Reynolds (1983), it does not exist in our economic dominance approach. Firms do not seek to maximize their profits but to enhance their economic dominance in order to ensure the optimum continuation of their profits. By reinforcing its "topographic" position within the exchange structure, the newly merged firm follows a long-term strategy, the outcomes of which are difficult to assess. However, merging firms are clearly more focused on a long-term increase in their level of profits than their competitors. And because the non-merging firms may lose part of their economic dominance, the free rider phenomenon is not relevant here.

Our approach is also in line with the market efficiency principle. The reinforcement of the position of economic dominance resulting from a merger is clearly a reflection of the synergies between the merging firms. Therefore, these synergies have a direct impact (both in the short and in the long term) on the production flows and the balances of economic dominance. As for the notion of influence in our model, it is different from the notion of market power as postulated in the theory of monopoly power. Market power refers to the ability of a firm to alter the market prices, whereas influence refers to the ability of a firm to modify the supply and demand balances between all the firms belonging to the same economic system. As opposed to the notion of market power, here firms can be clients and/or suppliers of one another. Hence, this approach is based on a global analysis of the relation between a firm and the whole economic system to which it belongs.

2.7 M&A in the process of value creation

In the model we have used, the success of an M&A essentially depends on the synergies and influence that a firm can obtain from its position within the system. These two factors of success have a positive effect on the firm's value.

Mergers realized for the purpose of achieving economic dominance increase the value of the firms involved through the exploitation of the potential synergies. In addition to financial and managerial synergies, there are also operational synergies. The rationalization of the merging firms' activities facilitates scale and scope economies throughout the entire value chain. These cost reductions are more visible in national M&As, which are generally aimed at strengthening a firm's position on the home market by raising "natural" entry barriers to compensate for the suppression of legal and regulatory barriers. However, some other operational synergies are more perceptible in our adaptation of the model of economic dominance. For example, synergies resulting from market penetration allow the negotiation of prices throughout geographic areas. Synergies based on the acquisition of new technologies help reduce costs and production times, consequently enhancing the flexibility of the offer as compared to that of the competitors. Synergies arising from the control of the downstream and upstream market enable firms to reduce the market risks that are inherent to their activities. Moreover, mergers enable the merging firms to attain their target margins in both the downstream and the upstream market and to strengthen their presence within the chain value.

The influence of merging firms represents their ability to alter the offers and/or demands of all the other firms in the system and consequently affects the market in a favorable way. In addition, the quantitative increase in flows also improves their negotiation power. Negotiation power is even more important in the so-called network industries, such as the electricity and gas sector. This is because of the limited transport capacity of this sector, and the difficulty for companies to increase this capacity in a short period of time. Consequently, firms that initiate an M&A by using a strategy of economic dominance are likely to create value for themselves (as long as they do not pay too much). This value creation is based on the two factors of success we have just presented (synergies and influence). They indeed allow cost reductions and/or an increase in the profits. Both factors have a negative impact on the cost of capital by increasing the cash flows or reducing risks. Hence, economic dominance forms part of the process of a firm’s value creation.

To conclude this section, we can argue that our approach of M&A as based on the concept of economic dominance has the advantage of combining aspects of the monopoly power theory with elements of the economic efficiency theory.

3 - An empirical analysis of M&A in the European energy sector

This paragraph presents an empirical analysis of the M&A phenomenon as it occurred in Europe after the liberalization of the energy sector. First, we will apply the model of economic dominance to the European electricity industry. This empirical application is based on the European exchanges of electricity. Second, we will look at the M&As that took place in the European electricity industry between 1998 and 2003. We will try to show that in this type of industry M&A follows, to some extent, a pattern of economic dominance. We will seek to validate the theoretical approach that we developed in the previous paragraph. And finally, we will make a projection of the nature of the restructured European energy sector in the future and discuss the impacts on the energy security of the EU.

3.1 Empirical application of the model of economic dominance within the European electricity industry

We have applied the model of economic dominance to the inter-European exchanges of electricity (GWh). We used IEA/OECD data pertaining to the year 2004, covering 18 European countries. We classified these countries into four regions, according to the concentration of exchanges. So the region Southern Europe includes Spain, Portugal, Italy, and Greece; Western Europe Ireland, the United Kingdom, France, Belgium, and the Netherlands; Central and Northern Europe Germany, Austria, Sweden, Denmark, Finland, and Norway; and finally, Eastern Europe Hungary, the Czech Republic, and Poland. Data on the French exportation in 2004 were not available at the time when this article was written, so we used the most recent data available, which were from 2001. The exchange structure model was applicable to the production activity. We assumed that the third party was guaranteed access to the distribution and transport networks. Hence, the role of the distribution and transport activities was considered neutral in our approach.

We started from a supply-driven model, which means that the more a node produces, the more it consumes inputs from other nodes. Hence, economic dominance stems from the supply side. Practically, this model depicts the notion that the more a country produces to meet its internal demand, the lower its reserve capacities become. Consequently, this country has to import electricity to again restore its reserve capacities, which reduces the risks of having insufficient production capacities to meet the demand, and facilitates a better management of the market tensions inherent to the electricity demand hazard. Our analysis was based on absolute global influences, and thereby, on the technical coefficients t_{ij} of the matrix T.

Table 3: outputs and final demand of European countries

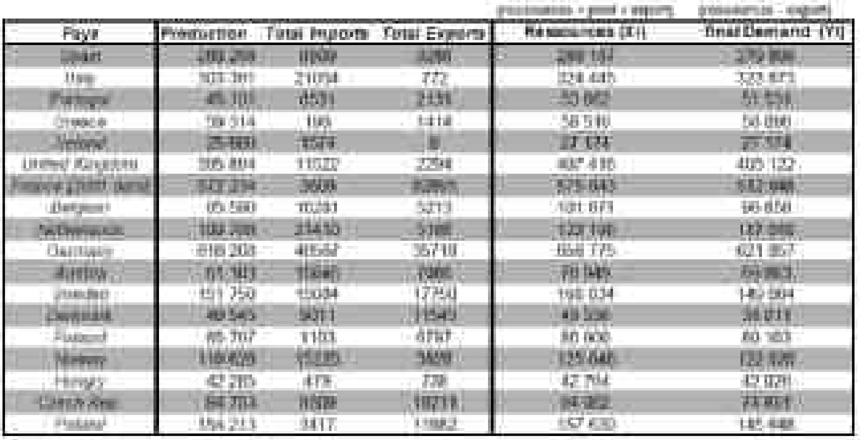
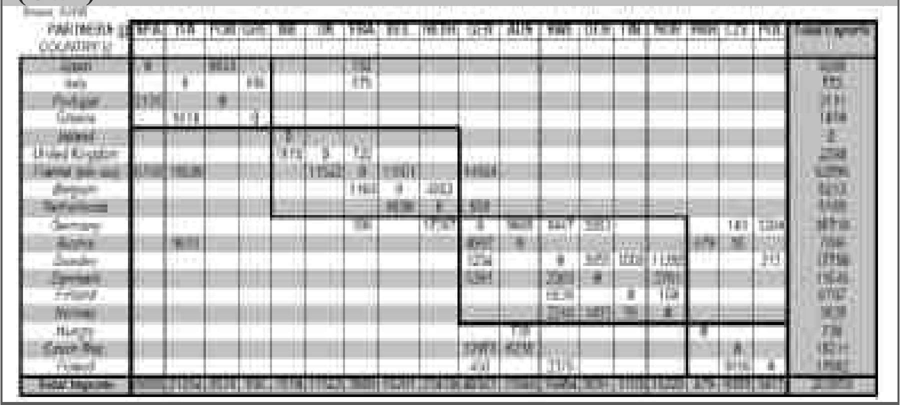


Table 3 shows that a very large proportion of the electricity production is intended for the national markets. In order to gain more insight into the economic dominance relations between the European countries with respect to the inter-European trades of electricity, we started from the assumption that there was no auto-consumption of electricity, which is why we reduced the coefficients of auto-consumption a_{ii} (= t_{ii}) to 0.

Table 4: The electricity exchanges flows within Europe in 2004 (Gwh)



Result 1:

> *The exchange structure of the European electricity market is strongly triangular, i.e., the relations between the different national electricity industries are mainly relations of dependency.*

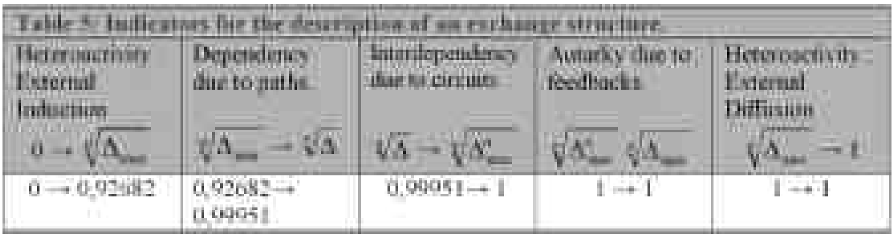


Table 5: Indicators for the description of an exchange structure

Heteroactivity External Induction $0 \to \sqrt[n]{\Delta_{max}}$	Dependency due to paths $\sqrt[n]{\Delta_{max}} \to \sqrt[n]{\Delta}$	Interdependency due to circuits $\sqrt[n]{\Delta} \to \sqrt[n]{\Delta'_{max}}$	Autarky due to feedbacks $\sqrt[n]{\Delta'_{max}}$ $\sqrt[n]{\Delta_{max}}$	Heteroactivity External Diffusion $\sqrt[n]{\Delta_{max}} \to 1$
0 → 0,92682	0,92682→ 0,99051	0,99051→ 1	1 → 1	1 → 1

Analyzing the indicators of the structure's internal arrangement first showed that heteroactivity represented 92.6% of the structure's influence. The influences resulting from inter-European trade represented only 7.4% of our exchange structure, indicating how small the flows of inter-European electricity were compared to the national flows. Nevertheless, given the particular characteristics of the electricity systems, of which the stability was guaranteed by a strict equilibrium between supply and demand, these exchanges were sufficient to apply the theory of economic dominance. During peak periods, prices are highly sensitive to the general level of supply. The analysis of the European electricity exchanges shows that the relationships between the countries were strongly characterized by dependency. Indeed, dependency due to paths represented 99.4% of the inter-European trade flows, whereas interdependency resulting from circuits represented only 0.6% of these flows. Even if they represented only a small proportion of the industry's production, the inter-European exchanges were mostly characterized by dependency relationships between the nodes. This was due to the small number of partial circuits. Hence, the European electricity industry structure was highly triangular and, as can be seen when comparing Matrix *T* with the table of the absolute global influences, the latter were very close resembled direct influences. As we explained earlier (p. 22), autarkies were non-existent.

Result 2:

The European electricity market can be segmented into four regional markets.

A simple glance at the exchange structure of the electricity industry reveals a regional concentration of European exchanges. This is a direct consequence of the fact that we are studying a network industry. Logically, exchanges are easier between two countries that share a border than between two countries located at a remote distance from one another. Initially we intuitively divided the European electricity market into four regional markets; now we will use the theorem on the division to show that this segmentation was effective and acceptable.

The theorem on the division was used to obtain a more accurate evaluation of the degree of interdependency between these regions: "[…] the Leontief matrix is divided into square submatrices, *the determinant of the Leontief matrix is smaller than the product of the determinants of the submatrices.* The difference is a measure of the interdependence between the submatrices (due to the linkage terms between them)." [1] The level of interconnection (or interdependency) among the four regions that we have defined can then be measured by the difference between the determinant of the matrix [I-T] and the product of the determinants of the square submatrices representing each region. So we have 0.9919 - 0.9912 = 0.0007. This difference is actually very small compared to $\Pi b_{ii} - | I\text{-}T | = 1 - 0.9912 = 0.0088$ (where there are no regional, but only national markets). The best division is the one that results in the smallest difference. Ideally, this difference among the determinants should be 0 or close to 0, indicating that there are no exchanges or at least very few ones between the different regions. We can establish that the intuited division was very close to the best possible one. Hence, we can conclude that it was the most appropriate one.

The European electricity industry, described by many authors as a "juxtaposition of national market," also has a small regional structure. As we will see in our empirical study, the majority of M&As are national;

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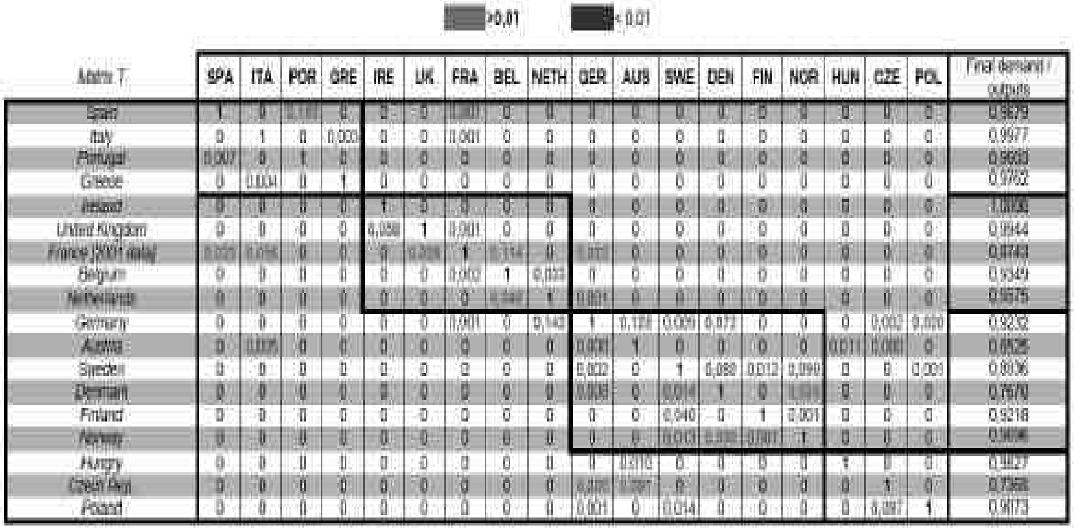
[1] Lantner R. and F. Carluer (2004)

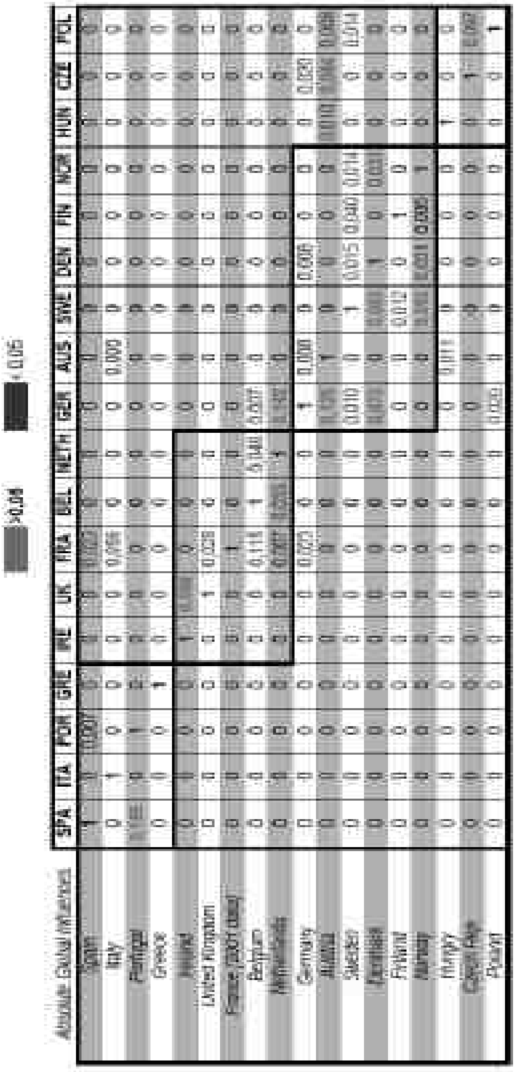
however, the liberalization process has tended to reinforce the integration of the European regional markets (See result 3).

Table 6: matrix T for exchange structure of the European electricity industry



Matrix T	SPA	ITA	POR	GRE	IRE	UK	FRA	BEL	NETH	GER	AUS	SWE	DEN	FIN	NOR	HUN	CZE	POL	Final demand / outputs
Spain	1	0	[illegible]	0	0	0	0,001	0	0	0	0	0	0	0	0	0	0	0	0,9879
Italy	0	1	0	0,003	0	0	0,001	0	0	0	0	0	0	0	0	0	0	0	0,9977
Portugal	0,007	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,9803
Greece	0	0,004	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,9752
Ireland	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1,0000
United Kingdom	0	0	0	0	0,058	1	0,001	0	0	0	0	0	0	0	0	0	0	0	0,9944
France (2001 data)	0,020	0,016	0	0	0	0,208	1	0,114	0	0,077	0	0	0	0	0	0	0	0	0,8743
Belgium	0	0	0	0	0	0	0,012	1	0,033	0	0	0	0	0	0	0	0	0	0,9349
Netherlands	0	0	0	0	0	0	0	0,040	1	0,001	0	0	0	0	0	0	0	0	0,9575
Germany	0	0	0	0	0	0	0,001	0	0,142	1	0,128	0,009	0,073	0	0	0	0,002	0,020	0,9232
Austria	0	0,005	0	0	0	0	0	0	0	0,001	1	0	0	0	0	0,011	0,001	0	0,8525
Sweden	0	0	0	0	0	0	0	0	0	0,022	0	1	0,088	0,012	0,090	0	0	0,001	0,8036
Denmark	0	0	0	0	0	0	0	0	0	0,008	0	0,014	1	0	[illegible]	0	0	0	0,7670
Finland	0	0	0	0	0	0	0	0	0	0	0	0,040	0	1	0,001	0	0	0	0,9218
Norway	0	0	0	0	0	0	0	0	0	0	0	0,001	0,002	0,001	1	0	0	0	0,9696
Hungary	0	0	0	0	0	0	0	0	0	0	0,310	0	0	0	0	1	0	0	0,9127
Czech Rep	0	0	0	0	0	0	0	0	0	0,001	0,007	0	0	0	0	0	1	0,07	0,7368
Poland	0	0	0	0	0	0	0	0	0	0,001	0	0,014	0	0	0	0	0,097	1	0,9073

Table 7: The absolute global influences (sensitivities)



▨ >0,05 ■ < 0,05

Absolute Global Influences	SPA	ITA	POR	GRE	IRE	UK	FRA	BEL	NETH	GER	AUS	SWE	DEN	FIN	NOR	HUN	CZE	POL
Spain	1	0	0,007	0	0	0	0,023	0	0	0	0	0	0	0	0	0	0	0
Italy	0	1	0	0	0	0	0,056	0	0	0	0,000	0	0	0	0	0	0	0
Portugal	0,159	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	1	[illegible]	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	0	0	0	0	0	1	0,028	0	0	0	0	0	0	0	0	0	0	0
France (2001 data)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0,118	1	0,040	0,017	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0,087	[illegible]	1	[illegible]	0	0	0	0	0	0	0	0
Germany	0	0	0	0	0	0	0,023	0	0	1	0,000	0	0,006	0	0	0	0,020	0
Austria	0	0	0	0	0	0	0	0	0	[illegible]	1	0	0	0	0	0,010	[illegible]	0,069
Sweden	0	0	0	0	0	0	0	0	0	0,010	0	1	0,015	0,040	0,014	0	0	0,014
Denmark	0	0	0	0	0	0	0	0	0	[illegible]	0	[illegible]	1	0	0,031	0	0	0
Finland	0	0	0	0	0	0	0	0	0	0	0	0,012	0	1	0	0	0	0
Norway	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0,031	0,095	1	0	0	0
Hungary	0	0	0	0	0	0	0	0	0	0	0,011	0	0	0	0	1	0	0
Czech Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0,092
Poland	0	0	0	0	0	0	0	0	0	0,026	0	0	0	0	0	0	0	1

The global influences in table 7 should be read as follows: when Portugal's final demand increases by 1GWh, the country has to increase its imports from Spain by 0.159 GWh. Or in other words: Portugal's imports from Spain represent 15.9% of its final demand. For the sake of relevance, the table only includes figures higher than 0.005. When comparing the matrix in table 6 with its translation into the matrix of table 7, there is a small difference between the direct and the global influences. The indirect effects are very small because, as stated in result 1, the relationships between the nodes are based on dependency.

Some national markets have a greater influence on the exchange system than others. These markets have a high multiplier m_i (which adds up all the influences of a country). The countries we studied are Germany, France, and Sweden. We will later determine that firms operating on national markets with a high m_i are more active in the area of M&A (See result 5).

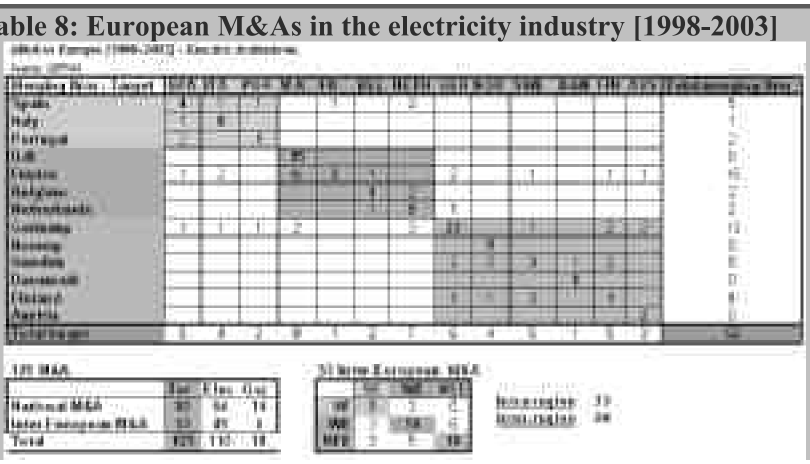
The liberalization of the European electricity industry was meant to allow companies to challenge the triangular structure by creating new circuits. M&A is one of the privileged ways in which firms can gain a foothold in a new market. Although contributing to the reinforcement of the interdependency phenomenon and the integration of the European market, European M&As always first have to be approved by the European Commission. However, in order to promote the interests of their national firms, the national authorities have a tendency to oppose some of the European M&As. In the electricity industry, the European energy security issue is mostly a matter of industrial organization. The main problem of this industry is the lack of investments in and the rationalization of offers at the European level, while the growth of the demand is major and more volatile, and the supply conditions in the primary energies are more uncertain (gas takes up 20% of the European electricity production). The rationalization of the offer at the European level should contribute to the energy security by allowing a better allocation of the investments. One of the fundamental aspects of this rationalization is the reinforcement of the interconnection capacities of the national networks. Encouraging the internationalization of national firms, notably through M&A, is an incentive for firms to invest in these interconnections. Electricity firms could indeed invest in them in order to enhance or reinforce their hierarchical position within the exchange system and to increase their influence on the other companies. M&As, at least some of them, could contribute to making the European market more competitive by increasing the interdependence between firms. The progressive implementation of a unique, homogeneous, and competitive market, along with the implementation of a strong European energy policy, should facilitate a better management of energy security issues.

3.2 An empirical study on M&As in the electricity industry in Europe

We based our empirical analysis on a report entitled "Mergers and Acquisitions in the European Electricity Sector – Cases and Patterns" produced by the CERNA[2]. This report gives an overview of M&As that took place in the European Union from January 1998 until August 2003.

We can now start with our study on the M&A phenomenon during the first step of the European deregulation: a period of five years from the 1998 European directives on the deregulation of the gas and electricity industries until the 2003 new European directives that accelerated this deregulation process. The CERNA report lists 135 M&As in the European sector of electricity. Of the 172 firms mentioned in this study, 89 belong exclusively to the electricity industry, 18 mainly to the gas industry, while 65 are active in both industries. The data presented in table 8 below were extracted from this report:

Table 8: European M&As in the electricity industry [1998-2003]



Data from "*Mergers and Acquisitions in the European Electricity Sector – Cases and Patterns*", CERNA, 2003.

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[2] The CERNA is the center of industrial economics at the Ecole des Mines de Paris.

In this paragraph, we intend to empirically validate the approach we developed on M&A. We will confront the results that we obtained from the application of the model of economic dominance with the data that were collected by the CERNA on the M&As that took place in the European electricity industry between 1998 and 2003. The model of economic dominance was meant to be focused on exchanges between firms, but as it was impossible for us to obtain such data, we decided to study the exchanges between countries instead. This did not affect the relevance of our study, since firms are generally strongly represented within their national market.

- *82 national M&As:*
    - Germany (23), Austria (2), Norway (9), Sweden (3), Denmark (1), Finland (1),
    - United Kingdom (15), Netherlands (9), Belgium (4), France (2),
    - Italy (8), Spain (4), Portugal (1).

In our study, the phenomenon of the concentration of electricity and gas industries is more important at the national level than at the international level, since 60% of the M&As listed in the CERNA study involved companies of the same nationality. Given that most of the electricity exchanges take place within the national markets, this is not a surprising result. According to our theory, electricity firms should either try to acquire a sufficient size or a sufficient economic dominance to reduce the risks of being taken over by a foreign company (defensive strategy), or implement a strategy aimed at conquering the European market (offensive strategy). The concentration of national industries will continue with their endorsement by the national states. These national states want to avoid losing control over their own energy industry at the benefit of other European states. They would even encourage the entrance of a European leader within the national industry.

- *53 international M&As:*

One of the fundamental hypotheses of our approach to M&A is that firms are focused on either reinforcing their economic influence on both their partners in the upstream market and those dispersed more globally within the whole exchange system, or strengthening their energy security in the downstream market. We tested this hypothesis by confronting the data collected by the CERNA with the results on the data we obtained by applying the economic dominance model to investigate the inter-European electricity exchanges. We found 37 M&A cases (70% of the international M&As — as highlighted in grey in table 8) which showed dependency or interdependency relationships between the countries that the firms belonged to.

Result 3:

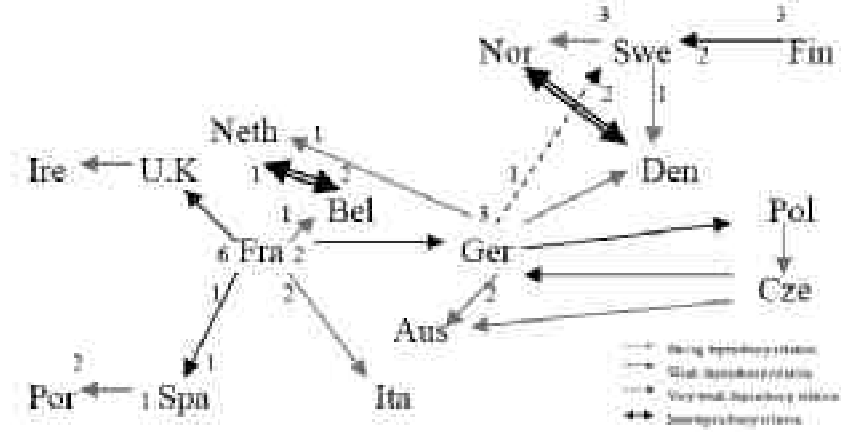
The merger strategies of the European electricity firms tend to create regional concentrations of businesses in the European market.

Among the 53 international M&As, 33 (62%) formed part of the three regional groups that we described in the beginning of paragraph 2.1 according to the theorem on the regional division. We can therefore establish that merger strategies create regional concentration, which supports the validation of the hypothesis that M&As pursue a pattern of economic dominance. We have divided the M&As into two tables. The first lists the 33 regional M&As and the second classifies the remaining 20 into two categories: cross-border mergers (10) and non cross-border mergers (10).

Result 4:

The M&A strategies of the electricity firms are aimed at strengthening the economic dominance of these businesses in the upstream market or to preserve their energy security in the downstream market.

Graph 1: The electricity firms' M&As and the relationships of dependency and interdependency between the European electricity industries.



To provide a better overview of the dependency relationships between the European electricity industries, we have drawn graph 5 by using the data in table 7. We found that 37 M&As concerned countries linked by a relation of dependency. Only 16 M&As appeared not to be focused on a strategy of economic dominance as defined in our model (these M&As are listed in the blanc rows of table 8). They are essentially non-cross-border M&As.

In tables 9 and 10 below, the first firm is the acquiring firm and the second the target firm. The global influences are represented in brackets. Offensive strategies (marked by one star) are used when the acquiring firms belong to a country which exerts economic influence on the target's country. Offensive strategies are aimed at strengthening the economic dominance over industries in the upstream market. They represent 24 of the 37 M&A cases which we introduced. Defensive strategies (marked by two stars) are used when the target's country has more economic influence than the acquiring firm's country. These strategies are aimed at preserving the energy security of the industries in the downstream market. They represent 10 of the 37 M&A cases. The three remaining M&As involve countries that are interdependent (Germany and the Netherlands). These figures indicate that between 1998 and 2003 the M&As in the electricity industry were principally motivated by the objective of reinforcing the commercial influence of the acquiring firms.

Table 9: 20 M&As that do not fit into our regional clustering.

10 cross-borders mergers

- Germany / the Netherlands : [0,142 – 0]*
  - Veba / EZH (2000)
  - *WFG-RWE / Nutsbedrijf Haarlemmermeer (1999-2000)*
  - *RWE / Obragas (2002)*
- the Netherlands / Germany : [0 – 0 ,142]**
  - Essent / Stadtwerke Bremen (2000-2002)
- France / Germany : [0,023 – 0]*
  - EDF / EnBW (2000-2001)
- France / Spain : [0,023 – 0]*
  - Electrabel (Suez) / Gamesa CT (2002)
- Spain / France : [0 – 0,023]**
  - Endesa / SNET (2000)
- France / Italy : [0,056 – 0]*
  - Electrabel (Suez) / ACEA (2002-2003)
  - Electrabel (Suez) / Interpower (2002)
- Germany & France / Germany : [0,023 – 0]*
  - *Bewag & GDF / Gasag (2000)*

10 non cross-borders mergers

- Germany / UK :
  - E.ON / Powergen (2001-2002)
  - RWE / Innogy (2002)
- Germany / Portugal :
  - RWE / Tapada Power Plant (2000)
- Germany / Spain :
  - RWE / Agrupacio Energias Renovables (2002)
- Germany / Italy :
  - RWE / Elettra (2002)
- France / Sweden :
  - EDF / Graninge (1998)
- France / Finland :
  - Graninge (EDF) / Kainuun Säkhö Oy (2002)
- France / Austria :
  - EDF / ESTAG (1998)
- Spain / the Netherlands :
  - Endesa / NRE-GRE (2000-2002)
  - Endesa / REMU (2000-2002)

The firms in italics primarily belong to the gas industry

Table 10: 33 regional M&As

NEE : Germany, Sweden, Finland, Austria (18)	***WE : United Kingdom, France, Benelux (10)***	***SE : Portugal, Spain, Italy (5)***
Germany / Sweden : [0,01 - 0]* - E.ON / Skykraft (2001) (Ger)Sweden /Norway: [0,092 – 0,014]* - E.ON-Skykraft / H&F Energi (2001-2002) Germany / Austria : [0,125 – 0,008]* - E.ON / Verbund/Energie Allianz (2002-2003) - RWE / Kelag (2001) Sweden / Danmark : [0,083 – 0,015]* - Vattenfall / Ström as (1999) Sweden / Finland : [0,012 – 0,04]** - Vattenfall / Revon Sakho & Heinola Energia (1999-2000) - Vattenfall / Keski-Suomen Valo Oy & Hameenlinnan Energia (2000) Sweden / Norway: [0,014 – 0,092]** - Vattenfall / Oslo Energi (1999-2000) - Vattenfall / Hafslund (2001)	France / UK : [0,028 – 0]* - EDF / London Electricity (1998) - EDF / Sweb supply business (1999) - EDF-London Electricity / Sutton Bridge Power (2000) - EDF-London Electricity / Cottam Power Station (2000) - EDF-London Electricity / West Burton Power Station (2001) - EDF-London Electricity / Seeboard (2002) France / Belgium : [0,115 – 0]* - Suez / Tratebel-Electrabel (1999-2002) (Fr)Belgium /the Netherlands : [0,033 – 0,046] - Electrabel (Suez) / EPON (1999) - Electrabel (Suez) / Spark Energy	Portugal & France-Germany / Spain: [0,007 – 0,159]** - EdP-Cajastur & EnBW / Hidrocantabrico (2001-2002) Portugal/ Spain: [0,007 – 0,159]** - Hidrocantabrico / *Gas Figueras SA (2002)* Spain / Portugal: [0,159 – 0,007]* - Endesa / Spinveste (2001-2002)

Sweden / Germany: [0 – 0,01]** - Vattenfall / HEW (1999-2002) - Vattenfall Europe / Bewag / HEW / Laubag /Veag (2002) Finland / Sweden: [0,04 – 0,012]* - Gullspang Kraft / Stockholm Energi (1998) - Fortum / Stora Enso Power Assets (2000) - Fortum / Birka Energi (2001)	(2001) the Netherlands / Belgium: [0,046 – 0,033] - Essent / Wattplus (2002)	
Gemany / Finland : - E.ON / Fortum Energi (2002) - E.ON / Espoon Sakho (2002) Finland / Germany: - Fortum / Elektrizitatswerk Wersertal (1999-2000) Finland / Norway: - Fortum / Ostfold (2003)		Spain / Italy : - Endesa / Elletrogen (2001) Italy / Spain: - Enel / Viesgo (2001)

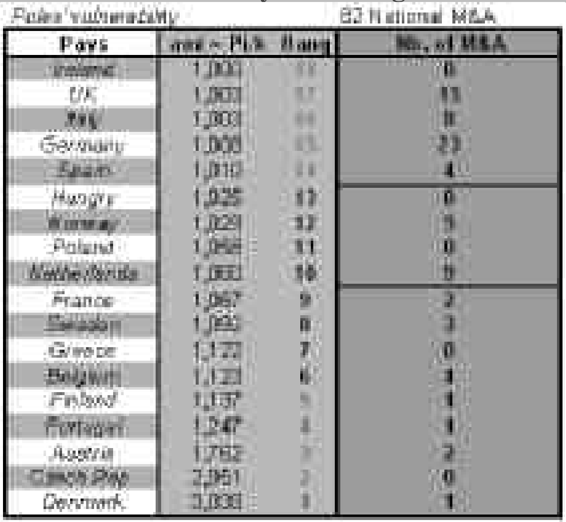
Based on these figures, our model represents 70% of the cases in our empirical study. This tells us that, at least in the electricity industry, the M&A strategies generally follow an upstream pattern with respect to economic dominance (offensive strategy, with a *) and a downstream pattern with respect to energy security (defensive strategy, with a µ). According to the balance of dominance that exists between the firms' countries, the acquiring firms use either one of these strategies. For example, the balance of dominance between Sweden and Finland is [0.012

– 0.04]. An increase in the production of Sweden implies an increase in its imports from Finland. Thus, when Vattenfall (Sweden) acquires a Finnish firm, one would expect that it will seek to enhance its import conditions in the downstream market, which could be regarded as a strategy of energy security. On the other hand, when Fortum (Finland) acquires a Swedish firm, it could be assumed it will implement a strategy of economic dominance in the upstream market with the intentions to capture more value creation resulting from part of their exports to Sweden and to gain more influence. This is a commercial strategy of market conquest. The firms of the exporting countries seek to deliver their goods directly to the end client of the importing countries. At the European level, the energy security is considerably better organized because the investments of the electricity firms are by definition directed at countries that need to increase their production capacities.

Result 5:

> *The electricity firms that initiate the most M&As at an international level belong to the most dominant national industries.*

Table 11: the nodes' hierarchy according to their dominance.



Poles' vulnerability | 83 National M&A

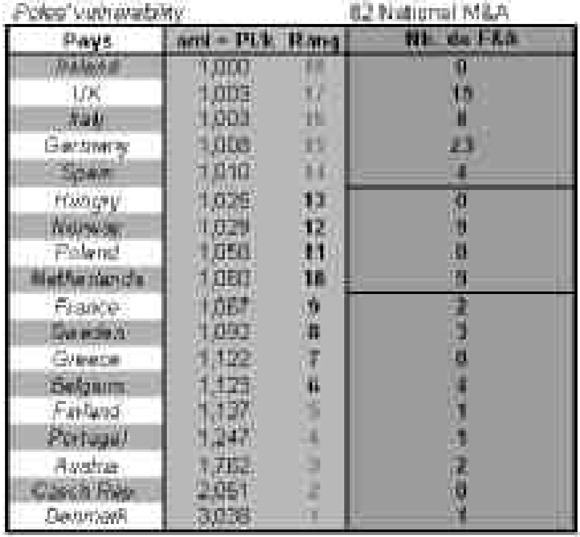
Pays	[illegible] ~ Pi/λ	Rang	Nb. of M&A
Ireland	1,000	[illegible]	0
UK	1,000	[illegible]	13
Italy	1,000	[illegible]	8
Germany	1,000	[illegible]	23
Spain	1,010	[illegible]	4
Hungary	1,025	13	0
Norway	1,029	12	5
Poland	1,048	11	0
Netherlands	1,053	10	5
France	1,067	9	2
Sweden	1,093	8	3
Greece	1,122	7	0
Belgium	1,123	6	1
Finland	1,137	5	1
Portugal	1,247	4	1
Austria	1,762	3	2
Czech Rep	2,351	2	0
Denmark	3,000	1	1

Using the nodes' multipliers, table 11 presents a hierarchy of the various national electricity industries according to their total economic dominance. We found that 41 of the 53 international M&As were initiated by the four most dominant industries. This result is a corollary of result 4, showing that the European electricity firms' merger strategies follow a pattern of economic dominance.

Result 6:

> *The electricity firms that initiate the most M&As at a national level belong to the less vulnerable national industries.*

Table 12: the nodes' hierarchy according to their vulnerability.



Poles' vulnerability — 82 National M&A

Pays	anti - PLK	Rang	Nb. de F&A
Ireland	1,000	18	0
UK	1,003	17	15
Italy	1,003	16	8
Germany	1,008	15	23
Spain	1,010	14	4
Hungary	1,026	13	0
Norway	1,029	12	9
Poland	1,050	11	0
Netherlands	1,060	10	9
France	1,067	9	2
Sweden	1,090	8	3
Greece	1,122	7	0
Belgium	1,125	6	4
Finland	1,127	5	1
Portugal	1,247	4	1
Austria	1,702	3	2
Czech Rep	2,051	2	0
Denmark	3,038	1	1

The nodes' anti-multipliers listed in table 11 allowed us to make a hierarchy from the less vulnerable European electric industries to the more vulnerable. We found that 68 of the 82 national M&As were initiated by firms belonging to the nine less vulnerable national industries. This result can be explained by the fact that the less vulnerable countries were also the ones that were less reluctant to liberalize.

In theory, the exchange structure model can explain long-distance mergers because the economic influence of a node can be transmitted to remote nodes via intermediary nodes. The economic influence of a node A on a node B can be direct or indirect, that is, moving via other nodes. According to the type of structure, the “diffusion” of the nodes’ economic influence may be either easy or difficult. However, in the case of the electricity industry, the structure is highly triangular (strong relationships of dependency and weak relationships of interdependency between the nodes), while the indirect effects are very small. Consequently, the model does not explain the long distance mergers (what we call “non-cross-borders mergers”) in the European electricity industry. In our empirical study, they represent 16 of the 53 international M&As.

In addition, the model is limited to the commercial type of dominance based on exchange flows between European countries. Therefore, the factors determining the dominance of countries in the energy sector are the level of their energy production, their imports, and their exports. Further, since electricity is traded, transported, and distributed through rigid networks of transportation lines, transport constraints (for instance in terms of interconnections with other countries) can also form an important factor that determines the dominance of countries in the energy sector.

Yet another important example of dominance that can motivate European energy firms to enter the domain of M&A is technological dominance. In the next decades, the fossil energy productions will decline. Consequently, European energy firms need to develop and acquire technologies that will give them the best competitive advantage in the future. As a result, many M&As are focused on collaborations with firms specialized in renewable energies, such as wind or solar energies: RWE / Agrupacio Energias Renovables (2002), RWE / Innogy (2002), and Electrabel (Suez) / Gamesa CT (2002). The strategy of EDF in the UK, aimed at targeting the nuclear industry, is also motivated by the acquisition of a “technological dominance.” In addition, another approach which could give the European energy firms a significant competitive advantage is energy diversification. This is why many firms in the electricity industry have an interest in targeting companies in the gas industry, for example, Electrabel (Suez) / Spark Energy (2001), Hidrocantabrico / *Gas Figueras SA (2002)*, EDF / ESTAG (1998), and Endesa / NRE-GRE (2000-2002).

In brief, our definition of economic dominance has not covered all aspects on which the initiation of M&As can be based. However, we may conclude that the aspect as defined in our study is the most important one in the European electric industry.

4 - Conclusion

Our adaptation of the economic dominance theory to explain the process of M&A is validated by our empirical analysis of the European electricity industries. We have shown that in the majority of M&A cases studied, the firms involved belong to countries that are linked by a relation of dependency or independency. Most of these M&As involve offensive strategies with the objective of acquiring more economic dominance within the markets. We have also shown how these merger strategies result in the emergence of regional markets, which may eventually be dominated by a small number of energy leaders competing within an oligopoly market. However, our theory of economic dominance has not been sufficient in fully explaining the phenomenon of regional integration. In the process of the regional integration of national industries also institutional and cultural aspects play an important role, as well as the way in which the process of liberalization is being led within these countries. Further research could improve this model by taking into account these aspects and/or possible other constraints, such as congestions in the transport networks or the limited interconnections between national networks. Game theory could provide promising perspectives for the further development of this model. Finally, the use of this model could be extended to other network industries, such as the telecommunications and transport sectors, as well as the oil and gas industries.

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