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Ownership and Control: Dissecting the Pyramid

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Abstract

Pyramids, cross-ownership, rings and other complex features are frequent in the European and Asiatic industrial world. The dissection of these structures requires a proper measurement of indirect shareholdings. First, the determination of integrated ownership among a set of firms is based on the matrix approach proposed by Huber and Ryll (1989). Then, integrated control coefficients are derived from the majority voting rule in General Meetings. Moving from integrated ownership towards integrated control (including chain effects), the paper defines a control ratio for any ultimate shareholder in any firm. The methodology is illustrated on the pyramidal structure of the largest Belgian holding company. By offering a way to evaluate control leverages, this paper provides a useful tool for empirical research in corporate governance.

Keywords: Integrated Ownership; Corporate Control; Corporate Governance.

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1. **Introduction**

Indirect cross-shareholdings carry the inconvenience to make the holdings structures of companies less transparent if not obscure. Therefore, they lead to fictive values in the firms’ balance sheets, on assets side for the participations held and on the liabilities side for the capital received.

This phenomenon is quite accurate in Japan, in the keiretsu structure. This is one of the reasons why authors specialised in the analysis of this country dedicated a special attention to the cross-holdings issue (Flath (1991, 1992); Hoshi and Ito (1991), Sheard (1994)).

But, if Japan is the most typical example of cross-holdings, this type of structure is common in continental Europe also (ECGN, 2001). Indeed, a few European papers proposed solutions to properly evaluate the firms included in a set of cross-holding companies (Huber and Ryll (1989), Ellerman (1991)). They have been followed by articles that focus on the measurement of market capitalisation and price-earnings ratios corrected for cross-ownership between listed companies (e.g., French and Poterba (1991), Bohren and Michalsen (1994)).

The aim of this paper is to improve the existing methodologies for determining the magnitude of separation between ownership and control among shareholders of a set of companies. Our approach follows three axes: voting shares, integrated ownership and majority-voting rules. Obviously, only voting shares are to be taken into account in control matters, putting forward the first difference between ownership and control. Then, the conservative majority assumption states that a shareholder having more than 50% of voting shares of a company holds a “total control”, i.e., 100% of control, in this company. Lastly, we assume that total control is transitive. Namely, a firm totally controlled by a totally controlled firm is itself totally controlled by the dominant shareholder of the intermediate firm. Working with these three basic principles, we compute control over ownership ratios that can be easily implemented for any group of firms.

Indirect control effects are crucial especially in complex structures like pyramids, cross-shareholdings, and rings. Indeed, integration heavily modifies the distribution of power and, maybe more importantly, might insulate firms from the external market of corporate control. Therefore, an indirect control indicator assesses the real influence of a shareholder in a company and exhibits the controlling investors. An apparently large shareholder might for instance act as leverage for its controlling parent company.

The literature on ownership and control is abundant starting with Berle and Means’ (1932) results on the separation of ownership and control in the US, and the paper by Leech (1987) on the UK firms in the seventies. More recent work links the ownership/control topic to various aspects of corporate governance. Novaes and Zingales (1995) study the impact of the separation between ownership and control on the financing structure of the firm. Denis *et al.* (1997) find that ownership structure influences internal monitoring efforts, partly due to external control threats. Denis and Sarin (1999) show on US firms that ownership and board changes are strongly related to top executive performance, prior stock price performance and corporate control threat. Thesmar (2001) argues that pyramids tend to amplify agency costs and provides empirical evidence on French firms.

La Porta *et al.* (1998, 1999) made wide empirical studies on the links between ownership and the legal environment of the firm in relation with investor protection. They find that
controlling shareholders typically use voting leverage, separating ownership from control through pyramids and further increase their control by participation in management.

In Japan and Continental Europe, control structures are far more complex than in the Anglo-Saxon world. Firstly, there are many more levels of ownership and secondly, ownership almost always implies voting stakes. As a consequence, it becomes more difficult to identify controlling investors, the perimeters of companies’ control, and the voting leverages in majority voting. A proper computation of control power is thus crucial for countries having corporate governance characteristics such as a high rate of voting shares, complex shareholdings structures and cross-ownership. In particular, cross-ownership structures play a role in intercorporate governance in Scandinavian countries (Bohren and Norli (1997), Eckbo (1997)). While indirect ownership has predominantly been studied by European and Japanese authors, recent papers also emphasize the importance of control issues for analysing the industrial structures of emerging economies, especially in Asia (Claessens et al. (2000), Wiwattanakantang (2001)).

The first papers which addressed this specific issue of ownership and control - not to be confused with the agency problem - have adopted an institutional approach. Namely, they compute ratios of control by dividing the size of voting blocks held by ultimate owners by the direct stakes held separately in each firm of the network. The data, mostly concerning European companies, come from ownership declarations of shareholders to the Market Authorities, in compliance with legal requirements.

For Italy, Barca (1996) analyses the various means used to separate ownership and control in Italy and exhibits pyramids, implied rules and shareholders coalitions. Bianchi and Casavola (1996) focus on pyramidal groups of control and on their impact on growth. Bianco et al. (1996), link separation between ownership and control to the firm efficiency. For Belgium, Chapelle (2000) and Renneboog (2000) give examples of pyramiding structures in Belgium and estimate the level of separation between ownership and control in the early nineties.

This institutional approach suffers from a systematic overestimation of the level of control, since blocks are commonly made of voting agreements between different shareholders but are considered in those papers as a single voting entity. Moreover, leading shareholders can be challenged for control once they do not have the absolute majority of the votes.

Other papers adopt a more microeconomic-oriented methodology on ownership computations. Data come from raw information on direct ownership links between the set of firms analysed. The computation starts from the direct link ownership matrix and recomposes integrated ownership through input-output matrix techniques (Huber and Ryll (1989), Ellerman (1991)). Hoshi and Ito (1991) and Flath (1992) propose a measure for indirect shareholdings and provide estimates for six major Japanese keiretsus. Baldone et al. (1997), improving on Brioschi et al. (1991), compute integrated shares, defined as the sum of the direct and indirect stakes, after the elimination of own shares effects.

This approach is adequate to evaluate integrated ownership but tends to underestimate the level of control exercised by ultimate shareholders, since it ignores voting coalitions and actual full control due to the majority-voting rule.

This paper starts from the input-output matrices approach but develops a method that explicitly incorporates the majority voting rules in the determination of control. As the institutional approach, it allows for computing control ratios; as the micro-oriented papers, it
uses only raw data. To that extent, it stands half-way between the two trends in the literature.

While the suggested technique is applicable to any corporate structure, it is mainly designed for dissecting interlocked complex features, such as pyramidal empires. This is the reason why it is illustrated by the most impressive Belgian pyramidal group held by Albert Frère.

The paper is organised as follows. Section 2 summarises the integrated ownership computation. Section 3 describes the methodology developed to quantify integrated control. Individual control ratios for the ultimate shareholders are presented in Section 4 while Section 5 defines synthetic control ratios. Section 6 applies the technique to real data. Section 7 concludes.

2. Integrated ownership

This section reviews the approaches proposed by the literature on the computation of integrated or consolidated ownership. Direct ownership refers to cash-flow rights. Integrated ownership refers to voting rights. Contrary to what appears in some papers, integrated ownership is meant here as different from the control power over a company. The difference lies in the fact that the control power takes into account the majority voting rule. This issue will be discussed in more details in Section 3.

Consider a set of n firms and let A = [a_{ij}] be the n x n matrix of direct cross ownership where a_{ij} is the percentage share that firm i holds in firm j. Thus a_{ij} is the percentage of the total cash-flow of firm i that will be allocated to firm j.

Without loss of generality, we will assume from now on that the firms do not have non-voting shares. Thus, matrix A represents indistinctively direct ownership and direct voting power.

Indirect ownership appears through the following feature: firm i has voting shares in firm j and firm j has voting shares in firm k. In this simple case, the indirect voting power (in percentage) of firm i in firm k is obtained by multiplying the voting power of firm i in firm j by the one of firm j in firm k. Integrated ownership is the sum of all direct and indirect participations. Its determination is useful for consolidation (accounting perspective) as well as for corporate governance concerns. However, the computation of integrated ownership is far from obvious because the simple summing of direct and indirect participations suffers from a double counting problem.

Note that indirect ownership does not give rise to additional cash-flow rights, but only to an increase of the voting power. For this reason, it is sometimes called control. However, control

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1 The n firms need not to constitute a closed set of firms. Therefore, some shareholders of these firms may well be out of the set and \( \sum_{j=1}^{n} a_{ij} \leq 1 \), for i = 1, ..., n. That is, ownership of the firms of the set may not be fully identified.

2 If there are non-voting shares, matrix A of direct ownership must be replaced by the matrix giving the direct voting powers.
considerations may go far beyond integrated ownership due to the impact of majority shareholders.

The traditional first step of the matrix approach to integrated ownership (Flath (1992)) involves the determination of matrix $Y$ obtained by multiplying all transitive voting powers:

$$Y = \sum_{\alpha=1}^{\infty} A^\alpha = A(I - A)^{-1}$$

(1)

The $\alpha$th term of the series, $A^\alpha$, stands for all possible voting chains of length $\alpha$.

Adding up all successive levels of ownership leads to double counting. Indeed, the sums of all shares held by direct and indirect shareholders of a company often exceed 100%, since the same shareholdings are included in the sum at each ownership level.

Starting from an accounting perspective, Huber and Ryll (1989) derive the real value of firms linked by complex cross-shareholdings that might lead to fictive amounts of assets and capital. They write the integrated ownership matrix $V = [v_{ij}]$ cleaned from double counting in the following way:

$$V = \left[Diag(I - \tilde{A})\right] Y = \left[Diag(I - \tilde{A})\right] (I - A)^{-1}A$$

(2)

where: $\tilde{A} = [a_{ij}]$ and $a_{ij} = \sum_i a_{ij}$.

Since $a_{ij}$ is the sum of all shares held in firm $j$ by the $n$ firm of the set, $Diag(I - \tilde{A})$ is the diagonal matrix giving the direct shares held outside the system. The column sums in $V$ never exceed 100%. Premultiplying matrix $Y$ by the diagonal matrix of shares lying outside the set of firms is equivalent to considering only the shares held at successive levels by the external shareholders, and to erase (i.e., multiply by zero) the shareholdings already taken into account at internal ownership levels.

This approach eliminates the double counting: the total holdings are the same for direct (matrix $A$) and integrated (matrix $V$) ownership. The difference between $A$ and $V$ lies in the structure, i.e., in the way the voting powers are allocated among firms.

The example involving 5 firms, in Graph 1, illustrates the transformation of matrix $A$ into matrix $V$ (Graph 2). As a matter of fact, the cash-flow right of firm 4 in firm 5 (50% in matrix $A$) leads to voting powers of firms 2 and 3 in firm 5 (respectively 30% and 20% in matrix $V$) as shown in Graph 2. The method suggested by Huber and Ryll (1989) is thus intended to determine the voting power of the ultimate shareholders. The shares of the intermediate corporations, like firm 4 in the example, are reallocated to their shareholders.

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3 Note that the authors consider these indirect voting shares as control shares, since they do not include a majority voting rule.
3. Majority control

Control is defined through the majority rule. Usually, 50% of the votes at the General Meeting enable to control the important decisions. Therefore, we assimilate 50% of the votes to absolute control over the firm. This hypothesis, however, can be restrictive in some ways. On the one hand, the simple majority of the votes is not always sufficient to take decisions at the General Assembly. Supermajorities of 66% or 75% could be required for important decisions and for deeper changes like mergers. On the other hand, in case of dispersed ownership, a large minority (20% or 30% for instance) of the votes might be enough to benefit from full control. Supermajorities and large minorities are not considered in this paper. Nevertheless, the 50% threshold can easily be modified in the algorithm.

According to our hypothesis, a voting share larger than 50% is turning into absolute control. This transformation has to be applied at each step of the shareholding chain in order to properly take into account the sequence of holdings. To that extent, we diverge from the approach of Ellerman (1991) who, after using a methodology similar to the one suggested by Huber and Ryll (1989), applies the majority rule to the integrated ownership coefficients, i.e., to the elements of matrix $V$.

This majoritization applied at the final step may induce misleading conclusions. Consider, for instance, the structure displayed in Graph 3. According to Ellerman’s approach (1991), one would conclude that firm A controls firms D since the indirect share of 40% X 51% = 20.4% is added to its direct share of 40% making its integrated ownership of 60.4% larger than the threshold of 50%. However, firm B is the actual controlling shareholder of firm D because D controls the intermediate firm C (more than 50%) which in turn controls D (more than 50%). As will be shown, this inconsistency disappears when the majority rule is applied to direct ownership (matrix $A$).

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$^4$ La Porta et al. (1999) estimate that 20% is sufficient to get control over a company, arguing that, in their sample, this threshold selects a single dominant shareholder per company in 70% of the cases. Claessens et al. (2000) use the same argument to justify thresholds of 20% and 10% but recognise that they should be fixed according to the legal context.
Since 50% of the votes provide the absolute control over the firm, as far as control issues are concerned, we may replace all the percentages above 50% by 100% in the original matrix $A$. But obviously, the sum of all control shares held over one company cannot exceed 100%. Therefore, when the control stake is put equal to 100% in, say, firm $j$, the minority shareholders of firm $j$ have no control left. Therefore, we annihilate their control power. This transformation does formalize the expropriation from control faced by the minority shareholders often documented in the literature (e.g., Shleifer and Vishny (1997), Zingales (1994, 1995), La Porta et al. (1998)).

According to this principle, the square matrix $AC = [ac_{ij}]$ of direct control is obtained from the following transformation of matrix $A$ of direct ownership:

$$ac_{ij} = \begin{cases} 
100 & \text{if } a_{ij} > 50 \\
0 & \text{if } \exists k \neq i : a_{ij} > 50 \\
a_{ij} & \text{otherwise}
\end{cases}$$

(3)

Next, the transition from direct control to integrated control is similar to the transition from direct ownership to integrated ownership. Denoting by $IC = [ic_{ij}]$ the matrix of integrated control, we have:

$$IC = [Diag(I - AC)](I - AC)^{-1}AC$$

(4)

where: $\overline{AC} = [\overline{ac}_{ij}]$ and $\overline{ac}_{ij} = \sum_i ac_{ij}$.

Following the example provided by Graph 1 and Graph 2, Graph 4 exhibits AC. Due to the majority rule, firm 1 and firm 3 are expropriated from their shares of control over firm 5 and 4, respectively. Graph 5 shows IC. It appears that firm 2 controls firm 5 through firm 4. The elimination of the arrow from firm 4 to firm 5 is a consequence of the no double counting principle, attributing to the ultimate shareholder, here firm 2, the whole control exerted by its branches.
4. Control Ratios and ultimate shareholders

The determination of the matrices V of integrated ownership and IC of integrated control makes it possible to compute control ratios. The control ratio of firm i in firm j is defined by:

$$cr_{ij} = \frac{v_{ij}}{ic_{ij}}.$$  

Note that a control ratio is obtained by dividing the integrated control by the integrated ownership, not by direct ownership. This measure looks more consistent than the one sometimes found in the literature, where separation between ownership and control is understood as the difference between integrated ownership and direct ownership.

Technically, the matrices of interest are V (integrated ownership) and IC (integrated control). Any control ratio measure is meant to reflect the extent of discrepancies between the entries of these two matrices. However, control ratios are meaningful only for the ultimate shareholders, i.e., the firms of the system having no known shareholders in the system (Becht and Chapelle, 1997). Such ultimate firms are characterized by empty columns in A:

$$\sum_i a_{ij} = 0.$$  

Typically, there are two types of ultimate shareholders. The first type includes the firms whose shareholders are too small to be identifiable. Such ultimate shareholders have a 100% float. Alternatively, ultimate shareholders can be families, individual investors, or even foundations. Pyramids led by individuals are common in countries like Italy (Bianchi and Casavola, 1996) and in Belgium (Becht, Chapelle and Renneboog, 1999). Foundations are frequent in the Netherlands (Kabir, Catrijns et Jeuninck, 1997).

In that perspective, the analysis of the ultimate shareholders’ portfolios is fundamental for apprehending the corporate governance structure and the control power distribution of an economy. Indeed, ultimate shareholders are the ones who really control the corporate
decisions, whereas the firms sitting at the lower levels down the ownership pyramid act just as their agents.

However, this radical definition of ultimate shareholders excluding identifiable owners, has some drawbacks when applied to real cases. For instance, long pyramids led by large corporations can be linked to one another by participations of a few percents, making them unidentifiable as separate ultimate shareholders. Even more confusing is the case of a subsidiary, four or five levels down the pyramid, holding a small voting share in its top parent company. Such cross-ownership links prevent the identification of the head of the pyramid as the ultimate shareholder.

To exert an effective control over a chain, an ultimate shareholder needs to hold a significant part of the voting shares at each level of the chain. So, the previous definition of ultimate shareholder can be softened and generalised:

$$\sum_{i} a_{ij} \leq T,$$  (7)

where the threshold $T$ can range from 0 to 50% according to the wished strength. According to this definition, ultimate shareholders may be not only individuals and firms with 100% float, but also “non-dominated” firms, that is, firms that will never be totally controlled by others.

The nature of this $T$ threshold is very different from the one of the majoritization rule, but at least as important. Indeed, the threshold level largely influences the main characteristics of the industrial groups under consideration, in particular, their size and the number and identity of the ultimate shareholders. A group appearing as a single pyramid for $T=0$ will often by split into smaller groups for larger values of $T$. Unfortunately, researchers are sometimes missing the point because their data set is subject to more or less artificial restrictions like geographical delimitations or incomplete ownership declarations.

Control ratios quantify the leverage of voting power exercised by an ultimate shareholder on the various levels of the pyramid. All other things being equal, the longer the pyramid, the higher the control ratio, giving potential rise to expropriation of minority shareholders. This is consistent with Wolfenzon's (1999) model which predicts that the level of expropriation should be high in firms that belong to pyramidal structures.

The selection of ultimate shareholders (set US) is performed on matrix $A$ of direct ownership. The corresponding rows of $V$ and $IC$, denoted respectively by $UV$ and $UIC$, display the integrated ownership and control portfolios of the ultimate shareholders. Observe that $UV$ and $UIC$ are no longer square matrices.

In our example (see Graphs 6 and 7 drawn for $T=0$), firms 1, 2 and 3 are the ultimate shareholders: $US = \{1, 2, 3\}$. So, only the first three rows of matrix $V$ are kept to obtain integrated ultimate ownership. The same rows in $IC$ provide the corresponding integrated control matrix.
Control ratios are computed by dividing the non-zero entries in matrix UV by their corresponding entries in matrix UIC.

Assuming for simplicity that the ultimate shareholders are the p first firms of the set, we have:

$$uv_{ij} = v_{ij}, \quad if \quad i = 1, \ldots, p, \quad j = 1, \ldots, n. \quad (8)$$

Subsequently, UIC is the submatrix of IC such that:

$$uic_{ij} = ic_{ij}, \quad if \quad i = 1, \ldots, p, \quad j = 1, \ldots, n. \quad (9)$$

The matrix of “ultimate ratios of control”, denoted by $UR = (ur_{ij})$, is defined by:

$$ur_{ij} = \begin{cases} 
uic_{ij} / \nuv_{ij} & if \nuv_{ij} \neq 0 \\ 0 & otherwise \end{cases} \quad (10)$$

The computation of control ratios only applies to the $(i,j)$’s for which $uv_{ij} \neq 0$, $i \in US$, $j \notin US$, i.e., to the cases where there is an ownership link, either direct or indirect, between an ultimate shareholder and a company of the set. In our example, $UR$ is given by:

$$UR = \begin{pmatrix} 0 & / & / & / & 0 \\ / & / & / & 1.67 & 3.33 \\ / & / & 0 & 0 & 0 \end{pmatrix}$$

The existing entries of $UR$ correspond to the non-zero entries of $UV$. The control ratio is equal to zero when the ultimate owner $i$ has no control on the company $j$ while having some integrated ownership in it. Ratios of $1.67=100/60$ and $3.33=100/30$ give the integrated control leverage of owner 2 in, respectively, firm 4 and in firm 5.

To sum up, we suggest the following algorithm to compute the ultimate control ratios:

1. Build V (integrated ownership) by equation (2) applied to A.
2. Set 50.01% of the votes = 100% of control. Minority owners get 0% of control when there is a 100% controller in the firm: A becomes AC (direct control).
3. Build IC (integrated control) by equation (4) applied to AC.
4. Restriction to the ultimate shareholders: V becomes UV, IC becomes UIC.
5. Compute UR following equation (9): division of each entry of UIC by its corresponding entry in UV.

5. Synthetic Control Ratios

Each individual ratio is an entry of UR. Synthetic control ratios can be computed in various ways, according to the wished economic interpretation:

- Control ratios per firm are column averages of UR. They express the average separation between ownership and control exercised by the owners of a given firm. A high average ratio will typically arise for a firm sitting at the end of the ownership chain, or far from its ultimate controllers in the organisation chart;
- Control ratios per shareholder are row averages of UR. They quantify the voting leverage of shareholders in their whole portfolio;
- Average control ratios can be weighted by the market capitalisation of the firms (Biebuyck, 2002). Control ratios per owner then express the power of the shareholder relatively to his investments. Unweighted ratios give a picture of the ownership and control links between firms.

Tables 1, 2 and 3 display different synthetic ratios for the example.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Average Control Ratios per Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm 4</td>
<td>0.83</td>
</tr>
<tr>
<td>Firm 5</td>
<td>1.11</td>
</tr>
<tr>
<td>Gross Average</td>
<td>0.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Average Control Ratio per Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shareholder 1</td>
<td>0</td>
</tr>
<tr>
<td>Shareholder 2</td>
<td>2.5</td>
</tr>
<tr>
<td>Shareholder 3</td>
<td>0</td>
</tr>
<tr>
<td>Gross Average</td>
<td>0.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Average Weighted Control Ratio per Owner (Hyp.: Market capitalisation of firm 4 : 100, Market capitalisation of firm 5 : 500)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shareholder 1</td>
<td>0</td>
</tr>
<tr>
<td>Shareholder 2</td>
<td>3.05</td>
</tr>
<tr>
<td>Shareholder 3</td>
<td>0</td>
</tr>
<tr>
<td>Gross Average</td>
<td>1.02</td>
</tr>
</tbody>
</table>

Table 1 shows that the ultimate shareholders of firm 4 control on average 17% stakes less than they actually own, whereas the ultimate shareholders of firm 5 control on average 11% more than what they own. From Table 2 it appears that shareholder 2 is the only one who controls the firms he owns with a leverage of 2.5.
Table 3 displays the weighted control ratios per owner, assuming a market capitalisation of 100 for firm 4 and 500 for firm 5. The control ratio of owner 2 rises then from 2.5 to 3.05, since this investor has a higher control ratio in the largest firm. Finally, a global index averaging all control ratios in the system provides a synthetic view on the leverages at work in the economy.

According to the intended analysis, one can choose between various kinds of indices. In Section 4, we provide a dynamic extension by comparing control ratios of a given system at two distinct points in time.

6. Application to Albert Frère’s pyramid

This real world example of a large industrial empire offers a typical case the matrix approach is designed for. The organisation charts displayed in Appendix 1 come from the same industrial group in 31 December 1995 and 31 December 1998.

The group is dominated by the commercial company Frère-Bourgeois, a non-listed company that is controlled at 100% by Albert Frère, one of the most important businessmen in Europe today. In December 1998, Frère-Bourgeois is at the head of a cascade of 25 shareholdings counting 9 ownership levels. The listed Belgian company CNP (Compagnie Nationale à Portefeuille) constitutes its masterpiece. CNP is the first holding company having several subsidiaries in Belgium and in the Netherlands: financial companies, industrial companies in the energy sector and telecommunications. At the end of the ownership chain, Suez is held at 10.7%, making the Frère group the largest shareholder in this big French holding, which in turn owns 100% of the Générale de Belgique, which was at that time the largest holding company in Belgium. As a consequence, the Frère condominium looks like a pyramid mostly dominated by a single owner. Table 4 details the portfolio of Frère-Bourgeois in December 1998.

In December 1998, the maximum control ratio is about 6 and concerns the firm CLT-UFA where Frère-Bourgeois has a large blocking minority stake in terms of control, whereas he only owns 4% of the firm directly and indirectly. The minimum control ratio is above one: in all cases, integrated control dominates integrated ownership. This is due to majority voting coupled with pyramiding. An additional point is worth mentioning. Besides the control measured by the computed ratios, Frère has a partnership with the Canadian businessman Paul Desmarais. They jointly control most companies in portfolio and they take every important decision together. However, according to our majority rule, Frère’s control share in these companies remains 50%.

Note that, by construction, the group under consideration has a single ultimate shareholder, namely Albert Frère, appearing in the pyramid through the firm Frère-Bourgeois. Nevertheless, the group delimitation problem mentioned in Section 4 may affect the analysis. Indeed, it is technically impossible to take into account firstly the shareholders of all firms of the system, then their own shareholders, etc. For instance, Frère might be a minority shareholder of some corporations dominated by a controller lying outside the system. Globally, this tends to overvaluate average control ratios. Note however, that the individual control ratios in firms dominated by Frère cannot be affected.

The average control ratio of Frère-Bourgeois in 1998 amounts to 2.76 in the group. This company controls more than two times the shares it possesses in the pyramid.
Table 4: Frère-Bourgeois Portfolio - Dec. 1998

<table>
<thead>
<tr>
<th>Firms</th>
<th>Integrated Ownership</th>
<th>Integrated Control</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACP</td>
<td>9.88</td>
<td>15.45</td>
<td>1.56</td>
</tr>
<tr>
<td>Ageoa</td>
<td>68.1</td>
<td>100</td>
<td>1.47</td>
</tr>
<tr>
<td>Audiofina</td>
<td>4.08</td>
<td>24.4</td>
<td>5.98</td>
</tr>
<tr>
<td>CLT - UFA</td>
<td>2.04</td>
<td>12.2</td>
<td>5.98</td>
</tr>
<tr>
<td>CNP</td>
<td>34.9</td>
<td>100</td>
<td>2.87</td>
</tr>
<tr>
<td>Distripar</td>
<td>26.52</td>
<td>100</td>
<td>3.77</td>
</tr>
<tr>
<td>Dupuis</td>
<td>34.9</td>
<td>100</td>
<td>2.87</td>
</tr>
<tr>
<td>Electrafina</td>
<td>7.9</td>
<td>24.4</td>
<td>3.09</td>
</tr>
<tr>
<td>Elf Aquitaine</td>
<td>0.14</td>
<td>0.22</td>
<td>1.57</td>
</tr>
<tr>
<td>Erbe</td>
<td>54.5</td>
<td>100</td>
<td>1.83</td>
</tr>
<tr>
<td>GBL</td>
<td>10.29</td>
<td>24.4</td>
<td>2.37</td>
</tr>
<tr>
<td>Hélio</td>
<td>17.45</td>
<td>27.3</td>
<td>1.56</td>
</tr>
<tr>
<td>Iméral</td>
<td>8.21</td>
<td>19.47</td>
<td>2.37</td>
</tr>
<tr>
<td>Orior</td>
<td>17.81</td>
<td>50</td>
<td>2.81</td>
</tr>
<tr>
<td>Pargesa</td>
<td>21.08</td>
<td>50</td>
<td>2.37</td>
</tr>
<tr>
<td>Partjoinco</td>
<td>34.05</td>
<td>50</td>
<td>1.47</td>
</tr>
<tr>
<td>Petrofina</td>
<td>4.02</td>
<td>9.01</td>
<td>2.24</td>
</tr>
<tr>
<td>Suez-Lyonnaise</td>
<td>0.85</td>
<td>2.61</td>
<td>3.07</td>
</tr>
<tr>
<td>Suzy</td>
<td>34.9</td>
<td>100</td>
<td>2.87</td>
</tr>
<tr>
<td>Transcor</td>
<td>33.22</td>
<td>100</td>
<td>3.01</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>21.24</strong></td>
<td><strong>50.47</strong></td>
<td><strong>2.76</strong></td>
</tr>
<tr>
<td><strong>Min</strong></td>
<td>0.14</td>
<td>0.22</td>
<td>1.47</td>
</tr>
<tr>
<td><strong>Max</strong></td>
<td>68.1</td>
<td>100</td>
<td>5.98</td>
</tr>
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</table>


Over the last years, the trend of mergers and acquisitions in the European financial sector has brought several Belgian holding companies (Générale de Banque via Suez, GBL, CNP) to refocus their activities towards their core industrial business. In the industrial group under study, GBL ceased most of its financial shareholdings (BBL sold to ING, a Dutch group, Royale Belge to Axa, a French Insurance company). Royal Vendôme has disappeared. The structure between the holding companies Fibelpar, Parfinance, and among communication companies has been simplified. Appendix 1 displays both organisation charts, respectively in December 1995 and 1998.

The changes in the group structure lead directly to a reduction of control indicators. Globally, the average control ratio of Frère-Bourgeois on the group dropped from 3.3 in 1995 to 2.9 in 1998. Table 5 compares the control ratios for the firms appearing in both charts. Apart from three cases (Audiofina, Electrafina, CLT) the control ratio has decreased from 1995 to 1998. Note that these numbers are to be taken with caution since the ratios are not weighted by the market capitalisation.
### Table 6: Portfolio - Frère - Bourgeois Common Firms

<table>
<thead>
<tr>
<th>Firms</th>
<th>Ratio Dec. 95</th>
<th>Ratio Dec. 98</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erbe</td>
<td>1.83</td>
<td>1.83</td>
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<tr>
<td>CNP</td>
<td>3.39</td>
<td>2.87</td>
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<tr>
<td>Agesca</td>
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<tr>
<td>Partjoinco</td>
<td>1.73</td>
<td>1.47</td>
</tr>
<tr>
<td>Pargesa</td>
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<td>2.37</td>
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<tr>
<td>GBL</td>
<td>2.78</td>
<td>2.37</td>
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<tr>
<td>Audiofina</td>
<td>5.40</td>
<td>5.98</td>
</tr>
<tr>
<td>Electrafina</td>
<td>3.00</td>
<td>3.09</td>
</tr>
<tr>
<td>CLT - UFA</td>
<td>5.58</td>
<td>5.98</td>
</tr>
<tr>
<td>Petrofina</td>
<td>2.97</td>
<td>2.24</td>
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<tr>
<td>Imétal</td>
<td>5.27</td>
<td>2.37</td>
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<tr>
<td>Orior</td>
<td>4.02</td>
<td>2.81</td>
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<tr>
<td>Suzy</td>
<td>2.77</td>
<td>2.87</td>
</tr>
<tr>
<td>Dupuis</td>
<td>3.15</td>
<td>2.87</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3.31</strong></td>
<td><strong>2.90</strong></td>
</tr>
<tr>
<td><strong>Min</strong></td>
<td><strong>1.73</strong></td>
<td><strong>1.47</strong></td>
</tr>
<tr>
<td><strong>Max</strong></td>
<td><strong>5.58</strong></td>
<td><strong>5.98</strong></td>
</tr>
</tbody>
</table>

### 7. Conclusion

This paper puts forward and illustrates a method for measuring the magnitude of separation between integrated ownership and integrated control among ultimate shareholders of a set of companies. Control ratios have been defined per stake, per firm and per shareholder.

Furthermore, by revealing the actual control pattern, the current paper helps to identify controlling minorities. While the issue of controlling coalitions remains beyond our scope, this issue might be seen as a privileged domain for further applications.

Section 6 has presented a real world application including a dynamic analysis. Between 1995 and 1998, Albert Frère’s empire went towards a reduction of the control ratios via the simplification of the levels of the pyramid and the selling of several shareholdings at the end of the chain.

Other applications of our results include industrial groups showing various patterns. The methodology identifies actual controlling investors and the leverage they use to get control. More generally, it indicates the real power acting in capitalistic systems, and is especially designed for the complex structures observed in Continental Europe and Asia. Furthermore, large-scale comparisons between control structures in the US, the UK, Continental Europe, Japan and developing countries could provide new insights on the benefits and the shortcomings of each system.

By offering a way for quantifying the control leverage of ultimate shareholders in any ownership structure, this paper provides a useful tool for research on corporate governance. Indeed, the methods proposed for analysing the perimeters of control of large investors may be used to study the links within and between industrial groups, but also the situation of
minority shareholders, whether they are dominated or not by a majority owner. Precise information on control should help regulators and minority shareholders’ advocates arguing their case. In this field, market implications of ownership and control designs will be easier to evaluate thanks to control ratios per firm. The question of how these ratios should be weighted remains open.

The debate on the adequate threshold for control opposes the conservative view that 50% of the votes are the only way to provide full control over a company to the assessment that lower values (for instance, 20% or 30%) are often sufficient to drive the firm policy. While this paper has stick to the 50% threshold, our method is theoretically applicable to any other value.

Another threshold problem concerns the definition of ultimate shareholders. According to the strictest definition, the ultimate shareholders are the ones for which there is no identified owner in the system. However, the determination of ultimate shareholders is less obvious to address in practice. Indeed, due to restrictions inherent to the data collection, it may be impossible to fully take into account all links among firms as well as all ultimate shareholders indirectly involved in the group of interest. Furthermore, the most restrictive threshold unreasonably extends the perimeter of industrial groups because of very small participations. Therefore, a more realistic inferior bound may be useful for analysing those situations where insignificant participations appear in the group. Further research would be needed to investigate the robustness of the ratios according the variations of both the control threshold and the ultimate shareholder threshold.

Finally, in contrast to the institutional approach of pyramidal groups, this paper is clearly microeconomically-oriented. However, by incorporating the majority-based control, it reduces the underestimation of control typically present in the matrix approach. Another promising way to deal directly with this issue could be based on graph theory.

6. Bibliography

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