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The Governance of Subsidiaries : How Pyramidal Ownership Magnifies the Separation of Ownership and Control*

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Abstract: This paper shows that pyramidal ownership - a prevalent organizational structure among French corporations - has sizeable agency costs. These agency costs arise because ownership pyramids tend to magnify the degree of separation between ownership and control: a group leader may have effective control over a subsidiary, while holding a small fraction of its cash flow rights. This hypothesis is tested on a panel of 2,121 subsidiaries between 1989 and 1997. Using robust econometric techniques and an economically founded reduced form, I find strong relation between corporate performance and the share of cash flow rights, while the share of primary owner in total equity - a more traditionnal measure of ownership concentration - is found to have no impact. A simple interpretation is that, in ownership pyramids, control is located at the top, and very little delegated. From the quantitative viewpoint, costs related to the increased separation of ownership and control within such groups amount to 1% TFP in our sample, and to 3% TFP for a quarter of the subsidiaries surveyed. I then turn to the causes of these costs. I find that minority shareholder expropriation, and not information asymmetries between the top and its subsidiary, is likely to be the main driving force.

Résumé: Ce papier évalue empiriquement l'importance des coûts d'agence au sein des groupes d'entreprises - une structure organizationelle très fréquente en France. Ces coûts d'agences proviennent du fait que la structure de groupe (en pyramide) tend à amplifier de degré de séparation entre droits de propriété et droits de contrôle: en effet, la tête de groupe peut contrôler sa filiale, tout en ne recevant qu'une faible part de ses profits. Cette hypothèse est testée sur un panel de 2,121 filiales françaises entre 1989 et 1997. En utilisant des techniques économétriques robustes et une forme réduite fondée par un modèle structurel, je trouve une très forte corrélation entre productivité de la filiale et la part des profits que peut réclamer sa tête de groupe. La part du principal actionnaire de l'entreprise - une mesure plus traditionnelle de la concentration de l'actionnariat - n'a aucun effet sur la performance de la filiale. Une interprétation simple est que le pouvoir est concentré à la tête du groupe, et n'est pas délégué. Du point de vue quantitatif, ces coûts d'agences spécifiques à la structure de groupe sont évalués à 1% de la productivité globale des facteurs dans l'échantillon considéré. Pour un quart des filiales, ils s'élèvent à 3% de le PGF. Deux causes potentielles de ces coûts sont explorées: (1) l'asymétrie d'information entre l'équipe dirigeante de la filiale et la tête de groupe et (2) expropriation par la tête de groupe des actionnaires minoritaires de la filiale. Les tests donnent plus de poids au second mécanisme.

Keywords: Separation of ownership and control, Pyramidal ownership, Information asymmetry, Minority shareholder expropriation

Motsclés: Séparation des droits de contrôle et de propriété, Groupe d'entreprises, Asymétries d'information, Expropriation des actionnaires minoritaires

JEL Classification: D23, L20, G32.

1 Introduction

The Berle and Means view of a public, widely held, manager controlled corporation is now known to be a singularity of English Speaking countries (LaPorta et al. [1999]). Even there, its relevance is restricted to large corporations.[1] Around the world, most firms are in general privately held and owner controlled. Very often, though, this owner happens to be another corporation. The firm is then the subsidiary of a group: this organizational form caracterizes companies that are controlled by a mother firm through a stock pyramid.[2]

However, although group leaders tend to keep their subsidiaries under control, groups are potentially subject to large agency costs. Stock pyramids allow the group leader to hold far more control than cash flow rights over its subsidiaries (Bebchuk et al. [1999]). To see why, think of a simple stock pyramid. A firm A holds 51% of another corporation B's equity, which in turn has 51% of a third firm C. In this example, A has effective control of C, but can claim only 25% of its cash flow rights. Such a disconnection between ownership and effective control rights will result in lower subsidiary performance. For two possible reasons. The first one is information asymmetry between the subsidiary's management team and the top of the stock pyramid. Overcoming this information asymmetry is costly, and the group leader's incentive to do so depends on its share of the cash flow rights. Secondly, the group leader has both incentive and power to expropriate the subsidiary's minority shareholders. For example, expropriation could take the form of asset transfer or purchase of the subsidiary's output at price lower than prevailing on the market. Whatever the mechanism involved however, stock pyramids amplify the problem of separation of ownership and control.

This paper is a first empirical attempt at evaluating the separation of ownership and control in subsidiaries. I first empirically establish that, in a stock pyramid, subsidiary control is not effectively exerted by its direct owner (B in the above example), but by the top of the group (A). Hence, as far as subsidiaries are concerned, ownership concentration has to be measured through effective cash flow rights (25%), and not through the dominant owner share of equity (51%). This distinction has important consequences in terms of agency costs measurement, since corporate performance is highly related to cash flow rights[3]. I find that, for 25% of

[1] For a US study of the separation of ownership and control in small firms, see Ang et al. [2000]

[2] Alternative structures, such as cross ownership or dual equity class, have been emphasized and theoretically assessed by Bebchuk et al. [1999]. These are however less prevalent, and will be ignored in this paper.

[3] Moreover, these two measures tell very different stories in the sample: for a

the firms in the sample, costs of separation of ownership and control *due* to the group structure amount to 3% of total factor productivity. I then build an empirical methodology in order to discriminate among the two potential mechanisms that relate cash flow rights and corporate performance: information asymmetries vs minority shareholder expropriation. I find strong evidence in favor of the second one.

Heavily influenced by Veblen's [1904] and Galbraith's [1967] view of shareholding as absentee ownership, the literature has given birth to many empirical studies on the separation of ownership and control of public, widely held corporations (see Short [1994], Shleifer and Vishny [1997] for surveys). The issue of the governance of subsidiaries, by far more common than publicly listed corporations, has been surprisingly ignored so far. This paper makes use of a unique French dataset of firm-to-firm ownership relations in order to focus on the separation of ownership and control within groups, i.e. stock pyramids. This allows to highlight the relevance of an alternative measure of ownership concentration: the group leader cash flow rights. Moreover, we are in position to discriminate among two mechanisms, information asymmetry or minority shareholder expropriation.

In addition to its novel concern about subsidiary, this paper introduces some methodological innovation in the study of the costs of separation of ownership and control. First, I build an economic model whose reduced form is simple to estimate, and which provides structural (economic) content to parameters involved in the correlation of firm performance and ownership concentration. Hence, while interpretations are made conditionnal on that model being true, it allows to provide economic foundation to our empirical strategy. Second, this model allows to account for various econometric limitations usually faced by empirical studies of separation of ownership and control, like unobserved heterogeneity, measurement error and simultaneity biases. We use fixed effects and IV techniques to account for these biases. There are economic reasons to believe that these biases may be sizeable[4], and indeed they are,

sizeable share of all observations (25%), primary owner's stake depicts highly concentrated ownership (the average dominant owner has 94% of equity), while group leader cash flow rights are much more moderate (average CFR of the group leader is 63%)

[4]Unobserved heterogeneity may bias our estimates upward, since product market competition and ownership concentration tend to be substitute to impose managerial discipline for example. Hence, firms that operate on oligopolistic markets will tend to have more concentrated ownership *and* a better performance.

Similarly, upward simultaneity bias may arise if the group leader decides to provide its subsidiary with new technology - through cheap financing for example. In this case, it is optimal to increase its stake in the firm's cash flows.

as discussed in the main text.

Section 2 briefly describes data construction and makes, through descriptive statistics, a strong case in favor of cash flow rights as opposed to dominant owner share as a measure of ownership concentration. Section 3 introduces the economic model, derives the reduced form. Estimates are then presented and discussed. Section 4 concludes and gives leads for further research.

2 Data and Preliminary Statistics

Our basic dataset is a panel of French corporations over the 1989-1997 period. It provides information about their performance and about their ownership structure. Both pieces of information are drawn from two separate surveys conducted each year by the French statistical office (*liaisons financières* and *bénéfices industriels et commerciaux*, INSEE). We will describe these datasets very briefly in the first subsection. We then construct our main dataset, and provide descriptive statics in order to motivate the use of an alternative measure of ownership concentration for subsidiaries.

2.1 Basic Datasets

The goal of our main survey (*financial relations*) is to provide detailed information about ownership relations between French corporations. It has been conducted each year between 1989 and 1997. It consists of an expanding sample of some 50,000 firm/corporate owner relations in the first year to some 110,000 such relations in 1997. Its field is unrestricted, and covers all industries from manufacturing to services. For each firm present in the sample, it records the share of equity held by a given owner, and both firm and owner's 9 digit idenfiying number (SIREN). Some firms have more than one large owner, and are therefore represented by more than one observation. The sampling method goes as follows: each year, the survey is conducted among all firms employing more than 500 people, with total sales above 200 millions francs (some 30 millions dollars) or corporations whose total equity holding exceeds 8 millions francs (some 1.3 million dollars). In addition, the survey method adds to this core sample all companies whose equity were partially held by corporations that were present in the sample the year before. It also adds all companies who had significant stake in the firms already present in the previous year. Hence, each year, new firms are added that had ownership links with firms already present in the sample, or new firms that have no such ties with sampled companies, but who entered the

In the opposite, measurement error tends to cause a downward bias.

basic "large corporation" core sample.

Performance measures are provided by the *Bénéfices industriels et commerciaux* survey. It is drawn from an administrative database designed to help the collection of taxes on corporate profits and value added. This survey therefore has an extensive coverage and records detailed and relatively accurate information on firms' accounts and employment. From the various variables available in this dataset, we keep the firm identifying number (SIREN, for matching purposes), value added, capital (as measured by fixed assets), employment (in terms of workers), labor costs (average labor cost per worker), capital costs (average debt cost per franc borrowed) and the sector of activity.

In a first step, our basic dataset is obtained through matching both samples by SIREN and year. 677,319 observations are present in both surveys, corresponding to 50,255 firms - owner relations in 1989 and 95,147 in 1997. For the average firm - owner relation, the equity stake is large: 53%. Looking at the average corporation, the major corporate owner holds some 62% of equity. 65% of the firms in our sample have a primary owner holding more than 50% of the shares, and are therefore subsidiaries. Hence, ownership concentration is high, and at least 2/3 of the corporations are subsidiaries of others.

2.2 Data Construction

As far as our sample can be considered as representative, it is therefore very common for French firms to be controlled by another corporation. As we define it, control can take the form of direct share ownership - a firm A is said to directly control B when it holds more than 50 percent of B's equity. But control can also be indirect: firm A controls several firms, whose total stake in B's equity exceeds 50 percent. We then also say that A controls B, but that the control is indirect. Firms that have the same ultimate owner are said to belong to the same *group*. By definition, the ultimate owner is not controlled by any firm, and is called *group leaders*. The group leader may be widely held, but may also be controled by the state or a family.

We then construct an algorythm in order to determine each firm's group leader assuming it is in our sample. This algorythm looks for pyramidal ownership and goes in two steps. First, we take all firms that are directly controlled by another corporation. These corporations are potentially group leaders. We then take the sample of these potential group leaders, and look for the one that are directly controlled by another corporation. We iterate, and go up the stock pyramid as far as our sample permits. We end up with chains of direct control between subsidiaries and their group leader; the number of steps is called the rank

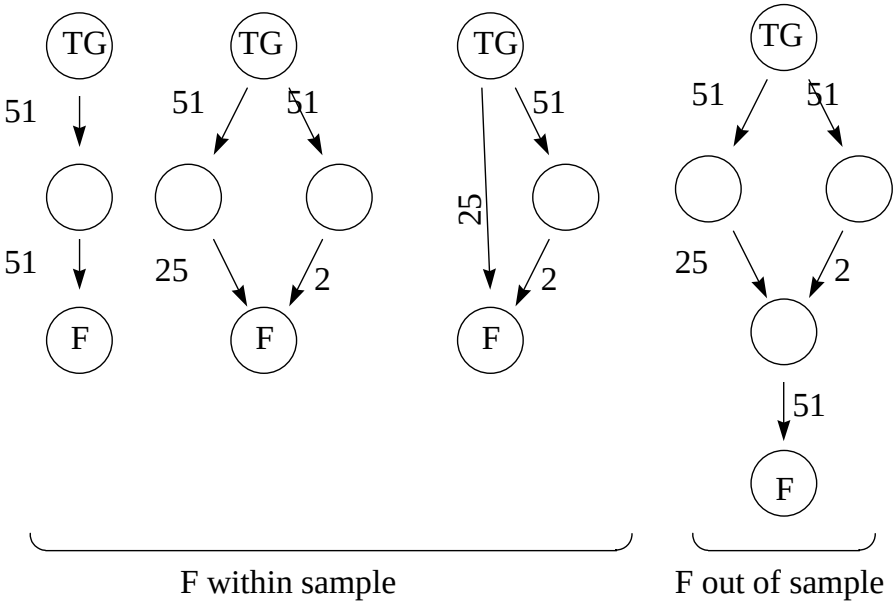

Figure 1: Group reconstruction from the sample

of control. The second step of the algorythm aims at including some of the indirectly controlled firms. We look for all corporations whose more than half of the equity is held by two or more firms controlled by a single group leader, and stop there. Hence, some of the complex relations between a subsidiary and its group leader are not captured by our algorythm. An exemple is given in figure 1. However, since the second step of our algorythm adds less than 1% to the total of our observations, we think that such cases are rare in the data.

We end up with an unbalanced panel of subsidiaries - 152,780 observations. Due to the expanding nature of the initial sample, we have 9,966 firms in 1989 and 24,661 in 1997. For each of them, we know the identity - in terms of identifying number SIREN - of the major shareholder, and that of the group leader. We also know the rank of control of each of these subsidiaries. In 44% of the cases, the major shareholder is not controlled, i.e. the rank of control is equal to one. For almost 25% of our observations however, there are at least 3 layers between the group leader and its subsidiary.

As forcefully argued by Bebchuk et al. [1999], the presence of several layers can increase the problem of separation of ownership and control. Think of the example given in figure 3: TG holds 51% of B, which holds 51% of C, which in turn holds 51% of D. D is fully controlled by TG through this pyramidal arrangement. TG however only holds

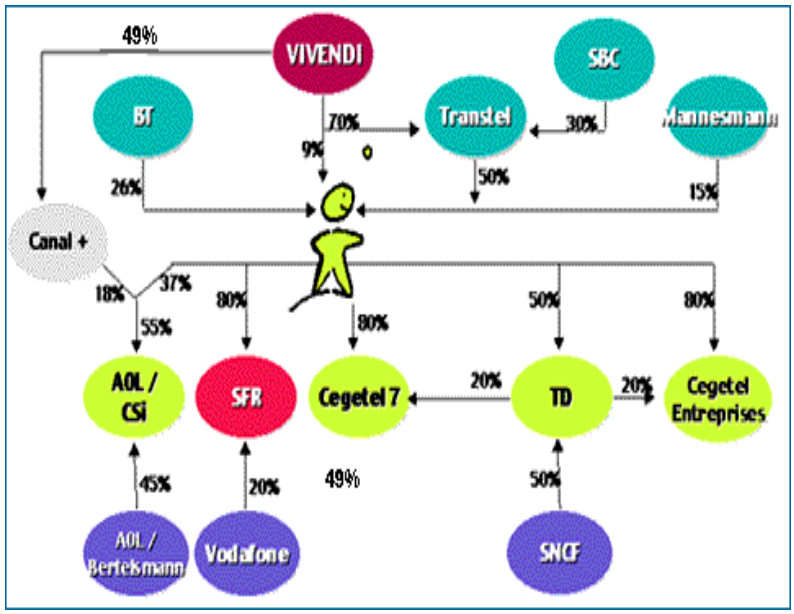

Figure 2: An Example of Pyramidal Ownership: VIVENDI's Telecom Activity

$51\% \times 51\% \times 51\% = 12.5\%$ of the cash flow rights. Hence, pyramidal ownership structures tend to give to the group leader control in excess to its cash flow rights, and - provided there is more than one layer - amplify the problem of separation of ownership and control.[5]

We therefore used our algorythm to compute, for all the subsidiaries of our sample, the cash flow rights of the group leader. For ownership relations obtained in step 1 of our algorythm, we compute the cash flow rights as the product of equity shares at each layer, as in the above example. When the *rank of control* is 1, the cash flow rights then equals the share of equity held by the group leader, which is just above the subsidiary in this case. For those subsidiaries that were obtained in step 2 of our algorythm, the CFR are defined as the sum of equity share held by corporations controlled by the same group leader, weighted by the shares of CFR of each of these firms.

For regression purpose, we will focus on the 2,121 subsidiaries that are present throughout the 1989-1997 period. Our results may thus

[5] VIVENDI - a French telecom/environment/media group - provides an interesting real life example of dilution of ownership through pyramidal stock ownership. Its pyramidal Structure is detailed in figure 2. For example, the group leader - VIVENDI holding - controls SFR - the second largest mobile operator in France, while having only 35% of its cash flow rights. It also controls AOL/CSI - a French internet service provider, with only 25% of the cash flow rights.

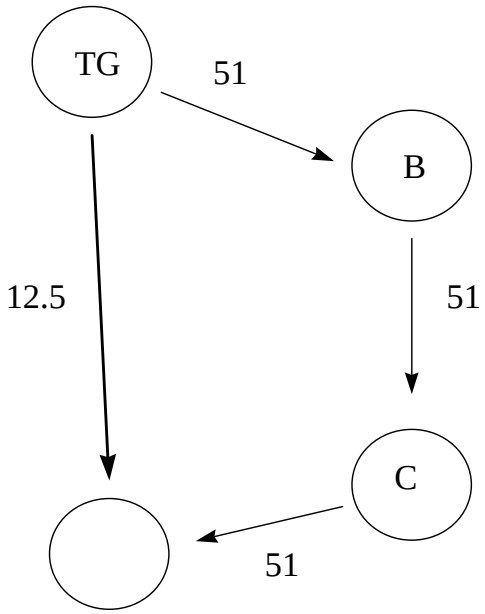

Figure 3: How Pyramidal Structure Amplifies the Separation of Ownership and Control

be affected by an important selection bias. In particular, if we believe that firms outside groups have a larger probability of decline or death (through bankruptcy or acquisition). Such an effect will however bias *downward* our estimates of the relation between ownership concentration and firm performance.

2.3 Cash Flow Rights and the Separation of Ownership and Control within Groups

We thus have constructed a panel of subsidiaries with two measures of ownership concentration within groups (the share of the dominant shareholder, and the CFR held by the group leader). We have seen that they may differ substantially, provided the corporation belongs to a stock pyramid that has more than 1 layer. This section documents and describes the differences between the two measures.

Table 1 provides descriptive statistics for two datasets both in 1989 and in 1997. The first one is the balanced panel of 2,121 subsidiaries built above (panel A). The second one is an unbalanced panel of "large" corporations directly taken from the financial relation survey, for which it is representative (we thus focused on firms that are above the thresholds given in the beginning of section 2.1). For those firms that are controlled, we performed the same algorythm as the one described above.

Table 1: Group Structure Change: 1989 - 1997

	Panel A		Panel B	
	1989	1997	1989	1997
Cash flow rights	80.4	80.7	70.5	73.5
	(0.5)	(0.5)	(0.7)	(0.6)
Rank of Control	1.82	2.11	1.34	1.55
	(0.02)	(0.02)	(0.02)	(0.02)
Primary Owner Share	91.1	93.7	77.4	81.6
	(0.3)	(0.3)	(0.7)	(0.5)
Share of Subsidiaries	100.0	100.0	80.3	85.3
	-	-	(0.9)	(0.6)
Observations	19089	19089	19998	19998

Note: Mean value for each year. Panel A is a balanced panel of 2121 subsidiaries continuously present in the data over the 1989 - 1997 period. Panel B is an unbalanced panel of firms whose total sales exceed 400 million francs or whose total employment is above 500 workers.

Hence, this second dataset is a representative unbalanced panel of large firms, where we have computed the group leader cash flow rights when they are subsidiaries (panel B). Since our goal in this paper is to study subsidiaries, we just present panel B to assess representativeness of panel A, and table 1 is the only one where it appears.

Let us start with the representative (of large firms) dataset. In 1997, more than 85% of them are subsidiaries to a group. This share has increased since 1989, but was already very large (80%). As far as medium/large firms are concerned, French corporations belong mostly to a group. This result is not new since it was indeed the motivation for starting the financial relation survey in the 1980s ! On a broader, more representative of small firms, sample, Kremp and Sevestre [2000] indeed find that 80% of the French firms are subsidiaries in 1994[6]. All in all, this suggest that any proper assessement of the relation between ownership and control of these unlisted corporation requires that we account for this group structure. The fact that an increasing proportion of firms became subsidiaries explains the rise in average primary owner stake (from 77 to 82%) over the period. However, the number of layers of the average pyramid has significantly increased, such that, in the

[6] On a sample identical to my panel B, but restricted to manufacturing industries, Moussalam [2000] has 85% of subsidiaries.

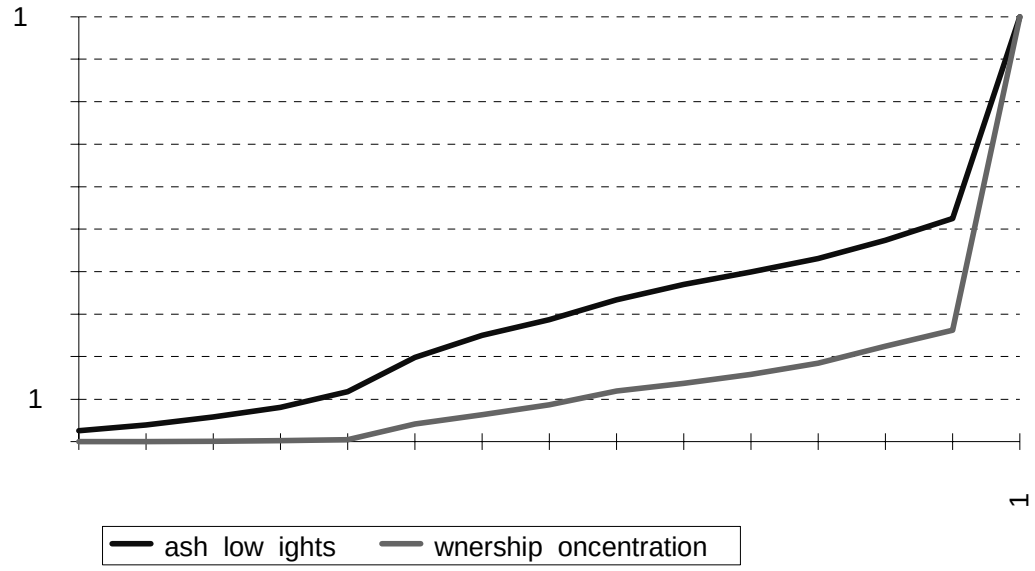

Figure 4: Cumulative Distribution of Primary Owner Stake and Cash Flow Rights

end, the average cash flow right of the group leader has increased by a lesser amount (3 instead of 5 points). These features also emerge in our subsidiary sample (panel A). Average dominant owner equity has risen by 2.6 points over the period, while the average cash flow rights has remained stable. Once again, the reason is increasing distance between group leaders and their subsidiaries.

Hence, the number of pyramidal layers magnifies the separation between cash flow and control rights. To see this more neatly, I have drawn in figure 4 the empirical cumulative distribution functions of both variables from panel A (I will stop mentionning it from now on, since I will never use panel B again). They differ sensibly. Only 25% of the subsidiaries have primary owner stake under 95%, while more than 50% have a group leader CFR under that limit. While we have less than 5% corporations with dominant owner share in equity with less than 60%, this figure goes above 25% for the other ownership concentration measure. Put differently, 25 % of our subsidiaries have the two measure differing by more than 25 points.

Thus cash flow rights and major equity owner stake differ sensibly for a sizeable fraction of the firms in our sample. The reason is that almost 60% of them have at least one intermediate subsidiary between themselves and their group leader (see figure 5). More than 25% are more

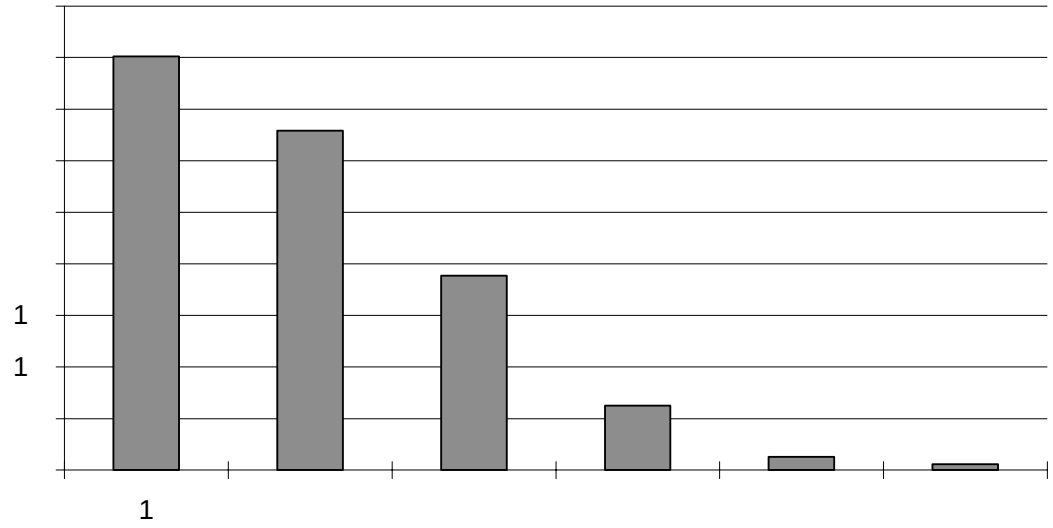

Figure 5: Number of Layers Between Subsidiaries and their Group Leader.

than 2 layers away from their controlling group leader. For the former corporations, the average cash flow rights are 73% (20 points below what a standard measure of ownership concentration would suggest). For the latter, the average CFR goes down to 63% (while in both cases the average equity of the major shareholder is above 94%).

2.4 Ownership Concentration and Subsidiary Performance

From the theoretical viewpoint, ownership concentration has a positive impact on corporate performance. The basic argument is that large shareholders have enough control in the firm to have their interest respected. Large owners thus allow to overcome the *coordination problem* raised by dispersed voting power. As all firms are controlled in our sample, this effect will not play any role here. A second line of argument related to the effect of large shareholders is that disciplining the manager entails a private cost to the monitoring party, while all owners benefit from it. Because he gets a large share of the gains from increased discipline, a large investor is able to partly overcome the *free rider problem* on monitoring (Jensen and Meckling [1976], Shleifer and Vishny [1986]). This "control" externality remains however, as long as the primary owner's stake does not reach 100%. Another mechanism,

more specific to stock pyramids may be at work in our sample of subsidiaries (Bebchuk et al. [1999]): minority shareholder expropriation may be worthwhile if the group leader holds control, but a small share of the firm's cash flow rights. Expropriation thus relates ownership concentration and corporate performance.

There is now a pretty large empirical literature on the relation between ownership structure and performance (surveyed by Short [1994], see Nickel et al. [1997] for a recent contribution). Most certainly intellectually influenced by Galbraith [1967]'s view of shareholding as absentee ownership and by Berle and Means [1933]'s book, this literature has restricted its attention to large, public, diffusely held corporations. [7] However, as we have seen above, and as forcefully shown by LaPorta et al. [1998], the Veblenian corporation is largely a myth outside the US, the UK and Japan. Even there, it mostly applies to very large firms (for an american example of the study of ownership structure of small firms, see Ang et al. [2000]).

In order to quantify the impact of separation of ownership and control among subsidiaries, the share of equity held by the primary owner may however not be the relevant measure of ownership structure. As Bebchuk et al. [1999] argue, multiple layers in stock pyramids tend to disconnect ownership from control, making the firm in control a very small claimant over the subsidiary's cash flows (remember figure 3). Hence, from the theoretical viewpoint at least, evaluating the relation between ownership structure and corporate performance requires to use the share of cash flow rights held by the group leader.

Simple correlation between corporate performance and these two measures of ownership concentration confirm this view. I have regressed an estimate of subsidiary log TFP (assuming the labor share equal to 0.66, and the capital share equal to 0.33) on both measure of ownership concentration. I added sectoral and year dummies. Results are provided in table 2 and use five models. Model 1 includes primary owner stake only, while model 2 include CFR claimed by the group leader. Model 3 adds both variables. Model 4 uses CFR only, but restricts the sample

[7] As Thorstein Veblen puts it in 1904, in his *Theory of the Business Enterprise*:

> This method of capitalization, therefore, effects a somewhat thoroughgoing separation between the management and the ownership of the industrial equipment. Roughly speaking, under corporate organization the owners of the industrial material have no voice in its management, and where preferred stock is a large constituent of the capital this alienation of control on the parts of the owners may be, by so much, irrevocable.

Table 2: Performance of Subsidiaries and Cash Flow Rights

	Model 1	Model 2	Model 3	Model 4	Model 5
Cash flow rights	-	0.05	0.04	0.04	0.04
		(2.0)	(1.7)	(1.4)	(1.2)
Primary Owner Share	0.05	-	0.02	-	-
	(1.2)		(0.4)		
Sector dummies	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes
Own. Conc. above	50%	50%	50%	95%	99%
Observations	19085	19085	19085	14169	12459

Note: Balanced Panel of subsidiaries: 1989-1997. Top and Bottom 1% values of TFP have been removed from the sample. The sample includes all sectors except farm and non traded services. Student statitics are between parentheses. Estimates correct for a broad form of heteroskedasticity in the fashion of White [1982], where observations are allowed to be correlated between observations of a given firm. Model 4 and model 5 are estimated on the restricted sample where OC stands above 0.95 and 0.99.

to corporations whose primary owner holds more than 95% of equity. Model 5 uses a higher cutoff value: 99%.

Results in table 2 are strongly in favor of the CFR view. First, group leader cash flow rights are well and significantly correlated with productivity. The estimated elasticity is not massive, but is fairly consistent across models: 0.04-0.05. Even for subsamples where the primary owner stake does not vary (models 4 and 5), cash flow rights affect productivity. In the opposite, the correlation between performance and primary owner stake is very weakly singificant, and vanishes to zero once we introduce CFR in the regression.

3 Opening the Black Box of The Separation of Ownership and Control in Stock Pyramids

Our analysis has so far highlighted the importance of group leader cash flow rights as the relevant measure of ownership concentration in our sample of subsidiaries. It is however subject to two main caveats: (1) the reduced forms used in the regression analysis (table 2.4) have not been given structural content. Hence, it is difficult, from an economic viewpoint, to provide interpretation of the results obtained so far. (2) Estimations presented in table 2 are subject to severe econometric problems. First, there may be unobserved determinants of productivity, that are correlated with ownership concentration and cash flow rights. Second, there may be other endogeneity biases, which induce potential correlation between our measures of ownership concentration and the error term.

This section attempts to fill these gaps. We first propose a microeconomic foundation for the relation between productivity and ownership concentration: this helps us (1) getting the right reduced form to estimate (2) pinning down the exact economic meaning of the estimated parameters and (3) evaluating the identifying power of our explicit restrictions and data. Second, we use fixed effects and instrumental variable techniques to provide estimates that are robust to unobserved heteorgeneity, simultaneity and measurement error biases.

3.1 The Model

Let us consider the typical relation between a subsidiary and its group leader as in figure 6. A firm C is directly controled by another corporation B, which owns $\beta\%$ of its equity. As it is the case in more than 2/3 of the cases in our data, B may however not be the group leader. A group leader A holds $\alpha\%$ of B's cash flows. We assume that C's production

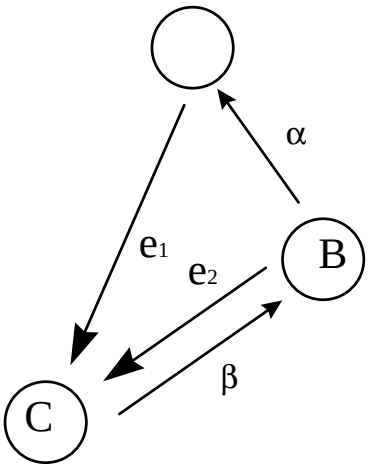

Figure 6: A Typical Relation Between a Subsidiary and its Group Leader

function is given by:

$$Y = MF(a_i(e_{Ai}, e_{Bi})x_i)$$

where x_i represents the quantity of input i (labor, capital) used for production Y. M is a productivity parameter. Production is subject to X-inefficiencies: C's manager may make a productivity enhancing effort, which is costly to her. We therefore denote $e_j = (e_{ji})_i$ a vector of managerial effort as imposed by firm j (A or B), which is assumed to be possibly directed toward a given input i. Let p be the vector of input prices, P the price - taken as given - of output. Hence, C makes profit:

$$\pi(e_A, e_B) = \max_{(x_i)_i} \{PMF(a_i(e_{Ai}, e_{Bi}).x_i) - p'x\}$$

A and B may however solve C's X inefficiency problem through imposing a certain level of effort to its manager. At a cost that is privately borne by the monitoring corporation. Such monitoring by A (resp. by B) costs $C_A(e_A)$ (resp. $C_B(e_B)$) to the group leader (resp. to B). A therefore maximizes the following objective function:

$$\underbrace{\max_{e_A} \left\{ \alpha \underbrace{\left[\max_{e_B} \beta\pi(e_A, e_B) - C_B(e_B) \right]}_{\text{Objective of } B} - C_A(e_A) \right\}}_{\text{Objective of } A}$$

Hence, we do not attempt to model the way shareholders impose managerial discipline to managers. First, existing theory about those

mechanisms tends to be very diverse and stylized, and is thus unlikely to produce relations that are robust enough to pass the data test. Second, our dataset does not provide any information about the workings of managerial discipline in firms: a model of owner - manager contracting would thus not be identified by the data. Therefore, we focus on the link between corporate shareholder monitoring and performance, and use a reduced form for what we call "agency costs".

Our model highlights the issue of management monitoring by the dominant owner of the firm. In the ownership concentration and performance literature, this mecanism is seen as one of the most powerful at realigning owners' and managers' interests (Shleifer and Vishny [1986,1997]). Our fairly reduced form could however be interpreted in terms of minority shareholder expropriation. The dominant owner - who has control in our sample - may divert some of the firm's assets for its own purpose (like buying real estate property from its subsidiary at a low price). It could also buy its subsidiary's output at a lower-than-market-price. In this case, C_j is negative, and a_i is decreasing in e. e has then to be interpreted as controlling owner's effort at expropriating the subsidiary's inputs or output: it decreases productivity (a_i) and induces a private benefit $-C_j$.

Hence, we view the relation between ownership and concentration among subsidiaries as driven by two forces: (1) insufficient information asymmetry reduction by both direct owner and group leader and (2) input and output expropriation by both firms in control. The first mechanism is not specific to pyramidal ownership structure, while the second one has been highlighted and illustrated by Bebchuk et al. [1999].

To simplify exposition, we furthermore assume that C_j and a_i take - at least locally - the following forms:

$$C_j(e_j) = z_j^{\mu_j} \left(\sum_i \Gamma_{ij}.x_i.e_{ij}^{\eta_{ij}} \right)$$

$$a_i(e_A, e_B) = a_i.e_{iA}^{\varepsilon_{iA}}.e_{iB}^{\varepsilon_{iB}}$$

Hence, productivity depends only on management effort as imposed by both group leader A and intermediary subsidiary B, while monitoring costs also depend on the quantity of input used x_i and other parameters (like the degree of information asymmetry) z_j. Note that in case of minority shareholder expropriation, both ε_{ij} and Γ_{ij} have to be negative, while positive in case of information asymmetry.

We show in appendix that the following relation can be derived under

fairly general conditions:

$$\frac{\Delta Y - p'\Delta x}{Y} = \sum_i \frac{\varepsilon_{iA}}{\eta_{iA}}.s_i.\frac{\Delta\alpha\beta}{\alpha\beta} + \sum_i \frac{\varepsilon_{iB}}{\eta_{iB}}.s_i.\frac{\Delta\beta}{\beta}$$

$$+\sum_i \left(\frac{\mu_A.\varepsilon_{iA}}{\eta_{iA}} + \frac{\mu_B.\varepsilon_{iB}}{\eta_{iB}}\right).\pi_i.\frac{\Delta z}{z} + \frac{\Delta M}{M} + \frac{\Delta P}{P} \quad (1)$$

where $s_i = p_i x_i / Y$ are the input shares and Δ a difference operator. Note that $(\Delta Y - p'\Delta x)/Y$ is not very different from the standard measure of TFP growth.

In the absence of asymmetries ($\varepsilon_{ij} = \varepsilon_j$, $\eta_{ij} = \eta_j$), and positing F homogenous of degree λ, we get:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\frac{\varepsilon_A}{\eta_A}.\frac{\Delta\alpha\beta}{\alpha\beta} + \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + \lambda\left(\frac{\mu_A.\varepsilon_A}{\eta_A} + \frac{\mu_B.\varepsilon_B}{\eta_B}\right)\frac{\Delta z}{z} + u$$

where u is a random noise including (1) temporary technology shocks and (2) output price changes. These evolution may have a persistent component (fixed effect for example). This equation is valid if and only if there are two different firms A and B, which is the case of more than 60% of our subsidiaries. If A does not exist, we get:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + u$$

Hence, a general equation, valid for all subsidiaries in our sample is:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\left(\frac{\mu_A.\varepsilon_A}{\eta_A} + \frac{\mu_B.\varepsilon_B}{\eta_B}\right).\frac{\Delta z}{z}.I_{\{rank\geqslant 2\}}$$

$$+\lambda\frac{\varepsilon_A}{\eta_A}.\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}} + \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + u \quad (2)$$

Thus, for firms that have both a direct owner and a group leader (for whom $rank \geqslant 2$), omitting the cash flow rights leads to overstating the elasticity ε_B/η_B, since β and $\alpha\beta$ are positively correlated. Productivity gain asymetries in capital and labor can be measured through the following equation:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\varepsilon_{AK}}{\eta_{AK}}.s_K\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}} + \frac{\varepsilon_{AL}}{\eta_{AL}}.s_L\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}}$$

$$+\frac{\varepsilon_{BK}}{\eta_{BK}}.s_K\frac{\Delta\beta}{\beta} + \frac{\varepsilon_{BL}}{\eta_{BL}}.s_L\frac{\Delta\beta}{\beta} + u \quad (3)$$

In terms of empirical strategy, this relation has three main advantages. First, it holds as long as F is homogenous of degree λ, and does not rely on any other assumption on production technology. Second, (1) is a difference equation, and therefore accounts for unobserved firm level heterogeneity in the levels of the price P and productivity M. To see this, let k index the firm. As long as it is possible to decompose the productivity and price terms as $A_{kt} = A_k.A_t$ and $P_{kt} = P_k.P_t$, (1) remains valid. Moreover, assume agency costs vary for unobservable reasons across firms: Γ_{ij} depends on k. (1) is also unchanged. Hence, our equation is robust to productivity, price and monitoring costs level heterogeneity. Last, estimation is easy to implement. Coefficients of those explanatory variables are easily estimated (through any method of moments for example) and can receive simple structural interpretation. Coefficients on the concentration weighted increases of those costs shares $\beta_{ji}/\varepsilon_{ji}$ can be interpreted as the productivity elasticities to agency costs.

In addition to its advantages in terms of empirical strategy, equation (1) provides several insights on which parameters of the economic model we can recover from the data. Indeed, elasticities of productivity with respect to managerial effort β_i are not identified separately from ε_i. The main reason for this is that we do not observe agency costs in our data. [8] Second, the equation shows that by regressing something close to TFP on both primary owner stake and cash flow rights of the group leader, we can evaluate the relative agency costs (or private benefits in case of expropriation) of the two firms. Third, equation (1) allows to evaluate easily the impact of some measures of information asymmetry and/or expropriation opportunity on monitoring costs / private benefits. If these determinants affect the Γ parameters, they need to be added in the regression (like the z's). If they affect the elasticity of monitoring costs/private benefits, they need to be interacted with our explanatory variables.

Finally, the above derivation highlights several econometric problems linked with the estimation of the relation between ownership concentration and corporate performance, that have been surprisingly overlooked in the literature so far. First, plain OLS regression on the level of TFP on ownership concentration are potentially subject to severe biases since ownership concentration may be related to some firm's unobserved characteristic that goes in the error term. Product market competition, for

[8] On the basis of Jensen and Meckling [1976]'s conjecture, Ang et al. [2000] reconstruct agency costs from comparing the difference in profitability between 100% manager owned firms and more diffusely held ones. They then evaluate the relationship between agency costs and ownership structure. In that sense, they estimate our ε.

example, increases performance, and can act as a substitute for ownership concentration (Schmidt [1997]). Hence, plain OLS will overestimate the impact of ownership concentration, as estimates will capture some of this negative correlation. As we noticed above, our equation being a difference equation, it it robust to the existence of fixed factors affecting monitoring costs or productivity M. Secondly, equation (1) shows that the residual includes price and productivity parameters. Once again, ownership concentration is a decision that may be correlated with these determinants: for example the group leader may choose to promote a given subsdiary by giving it access to better technologies, or cheap financing. It is then optimal to increase its share of cash flow rights. This may create a simultaneity - upward - bias on the coefficient. Besides, if we look at the version of (1) given in equation (3), independant variables include the share of labor and capital, which are set by profit maximization, and therefore depend on M and P. Finally, ownership concentration variables are certainly subject to sizeable measurement error, because of firm misreports, because the primary owner's stake may not be the relevant measure of ownership concentration, and also because of the way we constructed cash flow rights - our dataset is by no means exhaustive, and we may overlook some firms - owner relations.

To eliminate these endogeneity biases, we need to instrument our independent variables. Such instruments are difficult to find: in the absence of a natural experiment - a change in corporate law for example, we will take the lags of the explanatory variables. Such instruments are useful at removing transitory measurement error and simultaneity biases, which in our example are likely to be negative. If however there is something in the firm's growth prospects that also influences ownership concentration, our instrumental variables will be missing it. The best we can do in this case is to differentiate once again equation (1).

3.2 Locating Power within Groups

Let us start with estimating the relative importance of monitoring by the group leader and monitoring by the direct owner. In other words, we are going to ask the following question: where is power located within stock pyramids ? Does the group leader delegate authority to the subsidiary's direct owner, or does it affect firm performance directly ? We start running the following regression:

$$\frac{\Delta Y - p'\Delta x}{Y} = a + b.\frac{\Delta CFR}{CFR}.I_{\{rank \geqslant 2\}} + c.\frac{\Delta OC}{OC} + u \qquad (4)$$

where CFR stands for cash flow rights - when the direct owner and the group leader differ, and OC for the direct owner's stake in the subsidiary's equity. Results are presented in table 3. Equation (4) - which is

a difference equation - is estimated both through OLS and IV technique. It is also differentiated, in order to account for potential unobserved heterogeneity in firm TFP growth. As it turns out, instrumentation increases the estimate coefficient: this suggest that measurement errors are likely to be large, in particular as far as the CFR is concerned - which is not very surprising, given the approximate way we constructed it. Double difference estimates are weaker than our IV estimate, but remain significant, suggesting that our findings are robust to unobserved heterogeneity in TFP growth. We will restrict our comments on the level IV estimates (column 2).

Table 3: Performance of Subsidiaries and Cash Flow Rights: IV/difference estimates

	Differences		Double Diff.	
	OLS	IV	OLS	IV
Cash flow rights	0.02	0.09	0.02	0.03
$\times(Rank >= 2)$	(2.6)	(2.8)	(2.3)	(2.6)
Primary Owner Share	-0.02	-0.01	-0.03	-0.03
	(1.1)	(0.2)	(1.3)	(1.1)
Sector dummies	yes	yes	no	no
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	-	0.60	-	0.28

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of log ownership concentration and cash flow rights.

First, our estimates confirm that the important relation in stock pyramids is the one between the ultimate owner and its subsidiary. The share of equity held by the dominant direct owner does not come out significant, either in the OLS, nor in the IV estimations. These results therefore confirm our preliminary statistical analysis: the relevant concept for ownership concentration for subsidiaries is the share of cash flow rights held by the group leader. In terms of our model (equation (1)), it can receive two alternative interpretations: (1) expropriation benefits - ε/η - are potentially larger for the group leader than they are for the intermediate subsidiary B, or (2), monitoring costs are lower, or managerial

discipline by the group leader is more effective.

Notice that our difference OLS estimations lead to estimates of b (0.02) that are lower than those previously obtained in the decriptive analysis (0.05). This suggests the important of significant upward biases in the estimation of this relation when fixed effects in productivity are not accounted for. On the opposite, IV estimates of ε_A/η_A (0.09) are four times as large as the difference OLS estimates. As we said measurement errors of the cash flow rights are potentially important, since their accurate computation is limited by the availability of firm - owner relations in the data. This problem is likely to affect the CFR coefficient more than the OC one, for which the difference between OLS and IV is small. In the above discussion we highlighted two potential upward biases arising from plain OLS estimation: (1) substitutability between product market competition and ownership concentration (2) simultaneity between the decision of promoting subsidiary performance and increasing the group's share in its cash flows. Our IV estimates suggest that these biases are beaten by the measurement error problem.

The IV estimate suggests a sizeable effect of CFR on productivity. At the level of the sample, the cost of stock pyramid is small: considering the average corporation in our sample, there is a 10 point difference between the primary owner's stake (some 92%) and the group leader cash flow rights (some 80%). Hence, pyramidal ownership costs some $0.09 \times 12\% \sim 1\%$ in term of total factor productivity. As expected, if we restrict attention to those subsidiaries that are more than one layer away from their group leader, the impact of separation of ownership and control is much stronger. Recall that almost 2/3 of the subsidiaries in our sample are in this case. The difference between their average primary owner stake (94%) and the leader's share of cash flow rights (73%) is now 20 points, which yields an estimated cost of pyramidal stock ownership of 2% of TFP. For corporations whose rank of control exceeds 2 (27% of our observations), the cost is estimated to 3%.

3.3 Testing two alternative Mecanisms

Stock pyramids thus lead to significant productivity losses due to amplified separation of ownership and control. Above, we have highlighted two separate forces that could be responsible for this phenomenon. The first one is an inefficient degree of management monitoring by the leader: this effect is not specific to groups, and is rooted in information asymmetry between the subsidiary's management team and the leader. The second one is related to the possiblity and incentive for the controlling corporation to expropriate minority shareholders of the subsidiary (Bebchuk et al. [1999], LaPorta et al. [1998] It can either divest some of the

firm's assets - capital goods, real estate property - for its own use, or in favor of another subsidiary that is more closely held (in which it has more cash flow rights). It could also compell its subsidiary to undertake a project that yields private benefits to the controlling corporation, but that deteriorates its performance. It can finally buy (sell) output from (to) its subsidiary at a price lower (higher) than the market price.

Table 4: Cash Flow Rights and the productivities of Labor and Capital

	Differences	Double Diff.	Differences	Double Diff.
Cash flow rights × capital	-	-	1.60	0.51
$\times(rank \geqslant 2)$			(1.5)	(1.2)
Cash flow rights × labor	-	-	-0.01	0.02
$\times(rank \geqslant 2)$			(0.3)	(1.2)
Primary Owner Share	-1.34	-0.56	-	-
× capital	(0.6)	(0.7)		
Primary Owner Share	0.01	-0.01	-	-
× labor	(0.1)	(0.4)		
Sector dummies	yes	no	yes	no
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.17	0.37	0.43	0.40

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of log ownership concentration and cash flow rights.

In this section, we aim at evaluating the relative strength of both mechanisms in shaping stock pyramids costs. Assume first that information asymetries bear equally of labor and capital productivities. Then, as far as expropriation is concerned, it is reasonnable to assume that, capital is easier to divest than labor. If minority shareholder expropriation is a relevant force, cash flow rights concentration should therefore impact capital productivity by more than labor productivity. To see this, we estimate equation (3) using IV techniques on both difference and double difference equations, and using both measures of ownership concentration. Table 4 presents the results. The primary owner's stake has no impact on either capital, nor labor productivity, which confirms the results obtained in table 3. Estimates suggest however a much stronger

impact of group leader interests on capital than labor productivity. Double difference estimates confirm this conclusion, though significance is weakened. Hence, our equation presents evidence in favor of minority shareholder expropriation through capital divestiture.

There are however reasons to think that information asymmetries between a corporate management team and its owners may be more detrimental to capital than labor productivity[9]. Results from table 4 could be seen as confirming this view. To go a step further, we thus need to confront both forces in the same model. If information asymmetries matter, they will affect monitoring costs, and therefore impact ε_A/η_A negatively, or raise costs parameters Γ_{ij}. If expropriation is the driving force, private benefits will be positively impacted by such opportunities. In this case, $-\Gamma_{ij}$ and $-\varepsilon_A/\eta_A$ will increase with expropriation opportunities.

Acknowledging this suggests two empirical strategies for confronting the two forces. First, we may estimate equation (2) adding two more explanatory variables $\Delta z/z$ measuring the evolution of information asymmetry and the evolution of minority shareholder expropriation. This may account for the impacts of both forces on costs parameters Γ_{ij}. We would be then estimating the following equation, directly derived from (2):

$$\frac{\Delta Y - p'\Delta x}{Y} = a.\frac{\Delta EXPROP}{EXPROP} + b.\frac{\Delta ASYM}{ASYM} + c.\frac{\Delta CFR}{CFR} + u \qquad (5)$$

The variability of the first two explanatory variables may however be small, since the degree of expropriation or of information asymmetry may be fairly constant over time. Hence, a second empirical strategy seeks to directly explain elaticity ε_A/η_A by the (1) degree of information asymmetry between the subsidiary managers and the group leader and (2) expropriation opportunities. Doing this boils down to add in equation (1) interaction terms between this factors and the CFR:

$$\frac{\Delta Y - p'\Delta x}{Y} = a.\frac{\Delta CFR}{CFR} + b.ASYM.\frac{\Delta CFR}{CFR} + c.EXPROP.\frac{\Delta CFR}{CFR} + u \qquad (6)$$

We take two different measures of asymmetry (ASYM). The first one is at the firm level: the number of layers that separate the subsidiary and its group leader (rank of control). Its validity relies on the assumption

[9] In particular, Jensen [1986] provides examples in which agency costs of free cash flows translate into overaccumulation of capital (excess oil prospection in the US energy sector). Baghat et al. [1989] show how the wave of hostile takeovers in the US by the end of the 1980's has been triggered by previously excessive corporate diversification.

that each management team reports to its direct owner, and not directly to the top. In this case, imperfect information transmission and strategic lies amplify information asymmetry. The second measure ASYM is at the group level: the ratio of the number of subsidiaries belonging to different sectors of activity divided through the number of subsidiaries. This quantity measures the degree of diversification; its meaning relies on the fact that it is more costly to a diversified group to discipline its managers since it will have less opportunity to use relative performance evaluation (Holmstrom [1982]).[10]

We measure expropriation opportunities at the group level: we take a dummy that equals one if the firm's CFR are less than the average CFR the group leader has in all its subsidiaries. In this case indeed, and in the absence of transfer costs, it is optimal for the controlling leader to transfer all of its subsidiary's assets to other firms of the group. Expropriation is then limited by the fact that some assets are too specific or costly to transfer.

Tables 5 and 6 present the results of both estimation strategies. Results in double differences have been omitted for exposition clarity; we focus on difference IV estimates.[11] Only CFR is instrumented, while our measures of IA and expropriation as assumed exogenous. There is ample convergence between the two methodologies: minority shareholder expropriation seems to be the dominant force in shaping the cost of pyramidal ownership, while our measures of information asymmetry fail to influence monitoring costs parameters.

4 Conclusions

This paper has shown that pyramidal ownership - a prevalent organizational structure among French corporations - has sizeable agency costs. These agency costs arise because pyramidal ownership further disconnects control rights from ownership: a group leader may have effective control over a subsidiary, while holding a small fraction of its cash flow rights. Using robust econometric techniques and an economically founded reduced form, I find strong relation between corporate performance and the share of cash flow rights, while the share of primary owner in total equity - a more traditional measure of ownership concentration -

[10] Other measures of IA based on the total number of subsidiaries, or on the total number of sectors within the group have been tried. They could be justified by diseconomies of scale in monitoring. The use of these measures instead of the ones shown in the paper did not change the results, but are availalble from the author upon request.

[11] Double difference present qualitiatively similar results, but their significance is weaker.

Table 5: Minority Shareholder Expropriation vs Information Asymmetry: Test I

	Model 1	Model 2	Model 3	Model 1+2
Cash flow rights	0.22	0.10	0.05	0.22
	(2.2)	(2.6)	(1.4)	(2.0)
Expropriation Opportunities	-0.20	-	-	-0.18
× CFR	(1.8)			(1.8)
Information Asymmetry 1	-	0.05	-	0.02
× CFR		(1.8)		(1.1)
Information Asymmetry 2	-	-	0.09	-
× CFR			(0.4)	
Sector dummies	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.37	0.58	0.79	0.38

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statistics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of cash flow rights. Information asymmetry 1 is based on the number of layers separating the subsidiary from its group leader. Information asymetry 2 is based on the degree of diversification at the group level. Expropriation opportunities is a dummy equal to 1 if the firm level CFR is less than the average group CFR. These explanatory variables are assumed exogenous and are not instrumented.

Table 6: Minority Shareholder Expropriation vs Information Asymmetry: Test II

	Model 1	Model 2	Model 3	Model 1+3
Cash flow rights	0.22	0.10	0.08	0.22
	(2.0)	(2.6)	(2.9)	(2.0)
Expropriation opportunity	-0.19	-	-	-0.19
	(1.8)			(1.8)
Information Asymmetry 1	-	0.05	-	-
		(1.8)		
Information Asymmetry 2	-	-	-0.01	-0.01
			(0.5)	(0.7)
Sector dummies	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.61	0.72	0.72	0.65

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Information asymmetry 1 is based on the number of layers separating the subsidiary from its group leader. Information asymetry 2 is based on the degree of diversification at the group level. Expropriation opportunities is the average group CFR. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of cash flow rights.

is found to have no impact. Our interpretation is that, in stock pyramid, control is located at the top, and very little delegated. From the quantitative viewpoint, these agency costs amount to 1% TFP in our sample, and to 3% TFP for a quarter of the subsidiaries surveyed. I then turn to the causes of these costs. I find that minority shareholder expropriation, and not information asymmetries between the top and its subsidiary, is likely to be the driving force.

I believe these results are relevant from the economic policy viewpoint. They suggest that significant efficiency losses from separation of ownership and control do not only arise from the Veblenian, widely held, public corporation, but also from a much more prevalent ownership structure: the subsidiary. Moreover, the results in the end of this paper suggest that the state could prevent these efficiency losses by further guaranteeing the rights of minority shareholders.

This paper has left many questions unanswered, that could provide fruitful leads for further research. In particular, why would other shareholders be willing to buy equity of a subsidiary that they do not control and which they know will be inefficiently managed ? This question points towards the potential benefits of stock pyramids, which could match the costs we have highlighted. I also think that the issue of group diversification deserves a more thorough treatment than the one I gave in the last section. Finally, these group data may allow to compute consolidated accounts, which could be related to ownership structure of the group leader.

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5 Appendix: Derivation of Equation (1)

From the first order conditions, e_A and e_B must solve:

$$\beta \frac{\partial \pi}{\partial e_{Bi}}(e_A, e_B) = \frac{\partial C_B}{\partial e_{Bi}}(e_B), \text{ for all } i$$

$$\alpha\beta \frac{\partial \pi}{\partial e_{Ai}}(e_A, e_B) = \frac{\partial C_A}{\partial e_{Ai}}(e_A), \text{ for all } i$$

By the envelope theorem applied to profits, these two equations rewrite:

$$\frac{\partial C_B}{\partial e_{Bi}}(e_B) = \beta \frac{\partial F}{\partial x_i}.x_i.\frac{\partial a_i}{\partial e_{Bi}}$$

$$\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta \frac{\partial F}{\partial x_i}.x_i.\frac{\partial a_i}{\partial e_{Ai}}$$

From the first order conditions of profit maximization:

$$\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta \frac{p_i x_i}{a_i}.\frac{\partial a_i}{\partial e_{Ai}}$$

Hence, noting ε_{iA} and ε_{iB} the elasticities of a_i with respect to e_{Ai} and e_{Bi}, we obtain:

$$e_{Ai}.\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta\varepsilon_{iA}.p_i x_i$$

Posit now that:

$$C_A(e_A) = \sum_i \left(c_{Ai}.x_i^{\gamma_A}.z^{\mu_A}\right).e_{Ai}^{\eta_{iA}} \tag{7}$$

where z is a factor that influences monitoring costs (like the effective number of subsidiaries between A and C for example). η_{iA} and η_{iB} are the respective elasticities of C_A and C_B with respect to e_{Ai} and e_{Bi}. We get, by differentiation of (7):

$$\frac{\Delta e_{Ai}}{e_{Ai}} = \frac{A}{\eta_{iA}}\left((A-\gamma_A).\frac{\Delta p_i x_i}{p_i x_i} + \frac{\Delta\beta}{\beta} + \mu_A\frac{\Delta z}{z} + \gamma_A.\frac{\Delta p_i}{p_i}\right)$$

Besides, output variation is given by:

$$\begin{aligned}\frac{dY}{Y} &= \frac{\Delta A}{A} + \frac{\Delta P}{P} + \frac{A}{Y}.\sum_i \frac{\partial F}{\partial x_i}.\left(x_i\Delta a_i + a_i\Delta x_i\right)\\ &= \frac{\Delta A}{A} + \frac{\Delta P}{P} + \frac{A}{Y}.\sum_i p_i x_i\frac{\Delta a_i}{a_i} + p_i\Delta x_i\end{aligned}$$

which yields the following relationship:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\Delta A}{A} + \frac{\Delta P}{P} + \sum_i s_i\frac{\Delta a_i}{a_i}$$

where $s_i = p_i x_i/Y$ is the share of output buying input i. Productivity rate of increase:

$$\frac{\Delta a_i}{a_i} = \varepsilon_{iA}\frac{\Delta e_{iA}}{e_{iA}} + \varepsilon_{iB}\frac{\Delta e_{iB}}{e_{iB}} + \zeta_i$$

where we assume that productivity may increase at rate ζ_i for other reasons that are not modeled (technical change, organizational choices etc.). We get the fairly general equation:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\Delta A}{A} + \frac{\Delta P}{P} + \sum_i\left(\frac{(A-\gamma_A).\varepsilon_{iA}}{\eta_{iA}} + \frac{(A-\gamma_B).\varepsilon_{iB}}{\eta_{iB}}\right).\frac{\Delta p_i x_i}{Y}$$

$$+\sum_i \left(\frac{\mu_A.\varepsilon_{iA}}{\eta_{iA}} + \frac{\mu_B.\varepsilon_{iB}}{\eta_{iB}} \right) .s_i.\frac{\Delta z}{z} + \sum_i \frac{\varepsilon_{iA}}{\eta_{iA}}.s_i.\frac{\Delta \alpha\beta}{\alpha\beta}$$

$$+\sum_i \frac{\varepsilon_{iB}}{\eta_{iB}}.s_i.\frac{\Delta \beta}{\beta} + \sum_i \zeta_i s_i + \sum_i \left(\frac{(A-\gamma_A).\varepsilon_{iA}}{\eta_{iA}} + \frac{(A-\gamma_B).\varepsilon_{iB}}{\eta_{iB}} \right) .s_i.\frac{\Delta p_i}{p_i}$$

Positing $\gamma_j = A$ and $\zeta_i = 0$ as in the main text yields equation (1).

1 Introduction

The Berle and Means view of a public, widely held, manager controlled corporation is now known to be a singularity of English Speaking countries (LaPorta et al. [1999]). Even there, its relevance is restricted to large corporations.[1] Around the world, most firms are in general privately held and owner controlled. Very often, though, this owner happens to be another corporation. The firm is then the subsidiary of a group: this organizational form caracterizes companies that are controlled by a mother firm through a stock pyramid.[2]

However, although group leaders tend to keep their subsidiaries under control, groups are potentially subject to large agency costs. Stock pyramids allow the group leader to hold far more control than cash flow rights over its subsidiaries (Bebchuk et al. [1999]). To see why, think of a simple stock pyramid. A firm A holds 51% of another corporation B's equity, which in turn has 51% of a third firm C. In this example, A has effective control of C, but can claim only 25% of its cash flow rights. Such a disconnection between ownership and effective control rights will result in lower subsidiary performance. For two possible reasons. The first one is information asymmetry between the subsidiary's management team and the top of the stock pyramid. Overcoming this information asymmetry is costly, and the group leader's incentive to do so depends on its share of the cash flow rights. Secondly, the group leader has both incentive and power to expropriate the subsidiary's minority shareholders. For example, expropriation could take the form of asset transfer or purchase of the subsidiary's output at price lower than prevailing on the market. Whatever the mechanism involved however, stock pyramids amplify the problem of separation of ownership and control.

This paper is a first empirical attempt at evaluating the separation of ownership and control in subsidiaries. I first empirically establish that, in a stock pyramid, subsidiary control is not effectively exerted by its direct owner (B in the above example), but by the top of the group (A). Hence, as far as subsidiaries are concerned, ownership concentration has to be measured through effective cash flow rights (25%), and not through the dominant owner share of equity (51%). This distinction has important consequences in terms of agency costs measurement, since corporate performance is highly related to cash flow rights[3]. I find that, for 25% of

[1] For a US study of the separation of ownership and control in small firms, see Ang et al. [2000]

[2] Alternative structures, such as cross ownership or dual equity class, have been emphasized and theoretically assessed by Bebchuk et al. [1999]. These are however less prevalent, and will be ignored in this paper.

[3] Moreover, these two measures tell very different stories in the sample: for a

the firms in the sample, costs of separation of ownership and control *due* to the group structure amount to 3% of total factor productivity. I then build an empirical methodology in order to discriminate among the two potential mechanisms that relate cash flow rights and corporate performance: information asymmetries vs minority shareholder expropriation. I find strong evidence in favor of the second one.

Heavily influenced by Veblen's [1904] and Galbraith's [1967] view of shareholding as absentee ownership, the literature has given birth to many empirical studies on the separation of ownership and control of public, widely held corporations (see Short [1994], Shleifer and Vishny [1997] for surveys). The issue of the governance of subsidiaries, by far more common than publicly listed corporations, has been surprisingly ignored so far. This paper makes use of a unique French dataset of firm-to-firm ownership relations in order to focus on the separation of ownership and control within groups, i.e. stock pyramids. This allows to highlight the relevance of an alternative measure of ownership concentration: the group leader cash flow rights. Moreover, we are in position to discriminate among two mechanisms, information asymmetry or minority shareholder expropriation.

In addition to its novel concern about subsidiary, this paper introduces some methodological innovation in the study of the costs of separation of ownership and control. First, I build an economic model whose reduced form is simple to estimate, and which provides structural (economic) content to parameters involved in the correlation of firm performance and ownership concentration. Hence, while interpretations are made conditionnal on that model being true, it allows to provide economic foundation to our empirical strategy. Second, this model allows to account for various econometric limitations usually faced by empirical studies of separation of ownership and control, like unobserved heterogeneity, measurement error and simultaneity biases. We use fixed effects and IV techniques to account for these biases. There are economic reasons to believe that these biases may be sizeable[4], and indeed they are,

sizeable share of all observations (25%), primary owner's stake depicts highly concentrated ownership (the average dominant owner has 94% of equity), while group leader cash flow rights are much more moderate (average CFR of the group leader is 63%)

[4]Unobserved heterogeneity may bias our estimates upward, since product market competition and ownership concentration tend to be substitute to impose managerial discipline for example. Hence, firms that operate on oligopolistic markets will tend to have more concentrated ownership *and* a better performance.

Similarly, upward simultaneity bias may arise if the group leader decides to provide its subsidiary with new technology - through cheap financing for example. In this case, it is optimal to increase its stake in the firm's cash flows.

as discussed in the main text.

Section 2 briefly describes data construction and makes, through descriptive statistics, a strong case in favor of cash flow rights as opposed to dominant owner share as a measure of ownership concentration. Section 3 introduces the economic model, derives the reduced form. Estimates are then presented and discussed. Section 4 concludes and gives leads for further research.

2 Data and Preliminary Statistics

Our basic dataset is a panel of French corporations over the 1989-1997 period. It provides information about their performance and about their ownership structure. Both pieces of information are drawn from two separate surveys conducted each year by the French statistical office (*liaisons financières* and *bénéfices industriels et commerciaux*, INSEE). We will describe these datasets very briefly in the first subsection. We then construct our main dataset, and provide descriptive statics in order to motivate the use of an alternative measure of ownership concentration for subsidiaries.

2.1 Basic Datasets

The goal of our main survey (*financial relations*) is to provide detailed information about ownership relations between French corporations. It has been conducted each year between 1989 and 1997. It consists of an expanding sample of some 50,000 firm/corporate owner relations in the first year to some 110,000 such relations in 1997. Its field is unrestricted, and covers all industries from manufacturing to services. For each firm present in the sample, it records the share of equity held by a given owner, and both firm and owner's 9 digit idenfiying number (SIREN). Some firms have more than one large owner, and are therefore represented by more than one observation. The sampling method goes as follows: each year, the survey is conducted among all firms employing more than 500 people, with total sales above 200 millions francs (some 30 millions dollars) or corporations whose total equity holding exceeds 8 millions francs (some 1.3 million dollars). In addition, the survey method adds to this core sample all companies whose equity were partially held by corporations that were present in the sample the year before. It also adds all companies who had significant stake in the firms already present in the previous year. Hence, each year, new firms are added that had ownership links with firms already present in the sample, or new firms that have no such ties with sampled companies, but who entered the

In the opposite, measurement error tends to cause a downward bias.

basic "large corporation" core sample.

Performance measures are provided by the *Bénéfices industriels et commerciaux* survey. It is drawn from an administrative database designed to help the collection of taxes on corporate profits and value added. This survey therefore has an extensive coverage and records detailed and relatively accurate information on firms' accounts and employment. From the various variables available in this dataset, we keep the firm identifying number (SIREN, for matching purposes), value added, capital (as measured by fixed assets), employment (in terms of workers), labor costs (average labor cost per worker), capital costs (average debt cost per franc borrowed) and the sector of activity.

In a first step, our basic dataset is obtained through matching both samples by SIREN and year. 677,319 observations are present in both surveys, corresponding to 50,255 firms - owner relations in 1989 and 95,147 in 1997. For the average firm - owner relation, the equity stake is large: 53%. Looking at the average corporation, the major corporate owner holds some 62% of equity. 65% of the firms in our sample have a primary owner holding more than 50% of the shares, and are therefore subsidiaries. Hence, ownership concentration is high, and at least 2/3 of the corporations are subsidiaries of others.

2.2 Data Construction

As far as our sample can be considered as representative, it is therefore very common for French firms to be controlled by another corporation. As we define it, control can take the form of direct share ownership - a firm A is said to directly control B when it holds more than 50 percent of B's equity. But control can also be indirect: firm A controls several firms, whose total stake in B's equity exceeds 50 percent. We then also say that A controls B, but that the control is indirect. Firms that have the same ultimate owner are said to belong to the same *group*. By definition, the ultimate owner is not controlled by any firm, and is called *group leaders*. The group leader may be widely held, but may also be controled by the state or a family.

We then construct an algorythm in order to determine each firm's group leader assuming it is in our sample. This algorythm looks for pyramidal ownership and goes in two steps. First, we take all firms that are directly controlled by another corporation. These corporations are potentially group leaders. We then take the sample of these potential group leaders, and look for the one that are directly controlled by another corporation. We iterate, and go up the stock pyramid as far as our sample permits. We end up with chains of direct control between subsidiaries and their group leader; the number of steps is called the rank

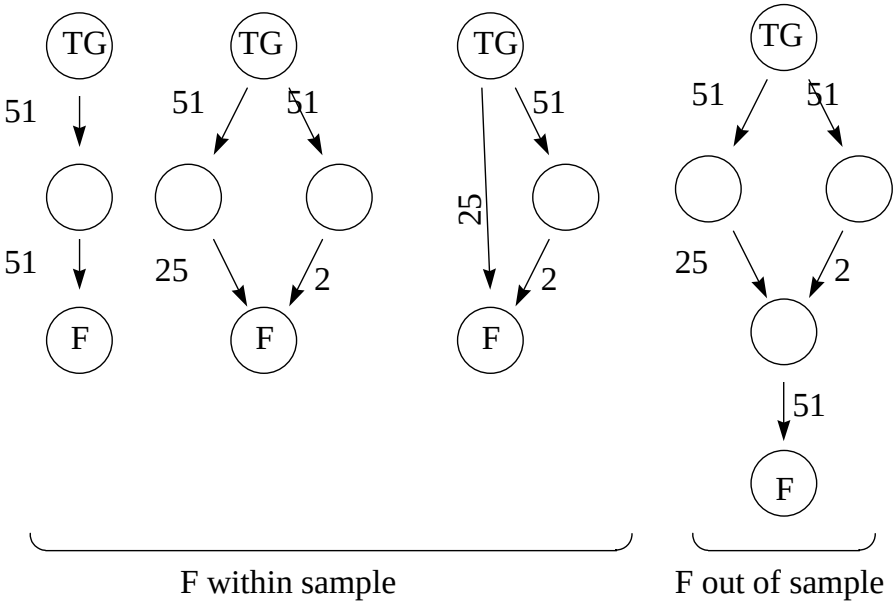

Figure 1: Group reconstruction from the sample

of control. The second step of the algorythm aims at including some of the indirectly controlled firms. We look for all corporations whose more than half of the equity is held by two or more firms controlled by a single group leader, and stop there. Hence, some of the complex relations between a subsidiary and its group leader are not captured by our algorythm. An exemple is given in figure 1. However, since the second step of our algorythm adds less than 1% to the total of our observations, we think that such cases are rare in the data.

We end up with an unbalanced panel of subsidiaries - 152,780 observations. Due to the expanding nature of the initial sample, we have 9,966 firms in 1989 and 24,661 in 1997. For each of them, we know the identity - in terms of identifying number SIREN - of the major shareholder, and that of the group leader. We also know the rank of control of each of these subsidiaries. In 44% of the cases, the major shareholder is not controlled, i.e. the rank of control is equal to one. For almost 25% of our observations however, there are at least 3 layers between the group leader and its subsidiary.

As forcefully argued by Bebchuk et al. [1999], the presence of several layers can increase the problem of separation of ownership and control. Think of the example given in figure 3: TG holds 51% of B, which holds 51% of C, which in turn holds 51% of D. D is fully controlled by TG through this pyramidal arrangement. TG however only holds

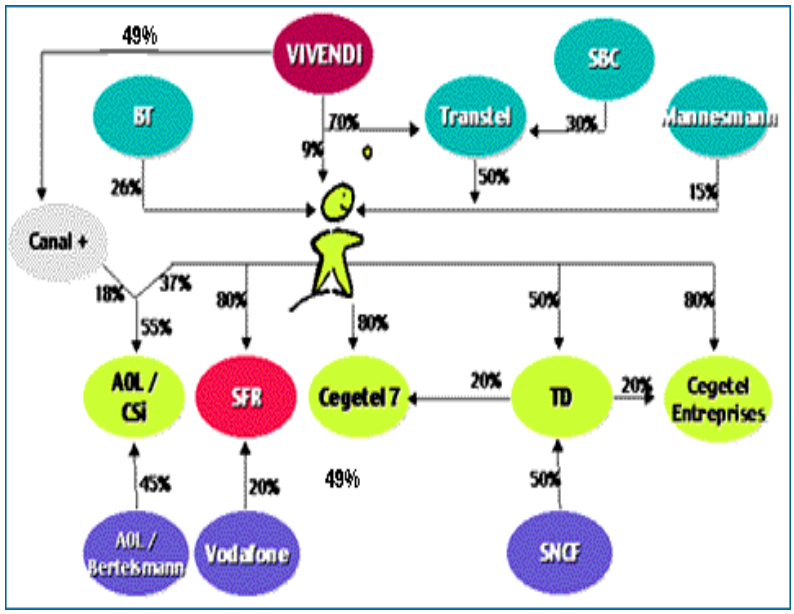

Figure 2: An Example of Pyramidal Ownership: VIVENDI's Telecom Activity

$51\% \times 51\% \times 51\% = 12.5\%$ of the cash flow rights. Hence, pyramidal ownership structures tend to give to the group leader control in excess to its cash flow rights, and - provided there is more than one layer - amplify the problem of separation of ownership and control.[5]

We therefore used our algorythm to compute, for all the subsidiaries of our sample, the cash flow rights of the group leader. For ownership relations obtained in step 1 of our algorythm, we compute the cash flow rights as the product of equity shares at each layer, as in the above example. When the *rank of control* is 1, the cash flow rights then equals the share of equity held by the group leader, which is just above the subsidiary in this case. For those subsidiaries that were obtained in step 2 of our algorythm, the CFR are defined as the sum of equity share held by corporations controlled by the same group leader, weighted by the shares of CFR of each of these firms.

For regression purpose, we will focus on the 2,121 subsidiaries that are present throughout the 1989-1997 period. Our results may thus

[5] VIVENDI - a French telecom/environment/media group - provides an interesting real life example of dilution of ownership through pyramidal stock ownership. Its pyramidal Structure is detailed in figure 2. For example, the group leader - VIVENDI holding - controls SFR - the second largest mobile operator in France, while having only 35% of its cash flow rights. It also controls AOL/CSI - a French internet service provider, with only 25% of the cash flow rights.

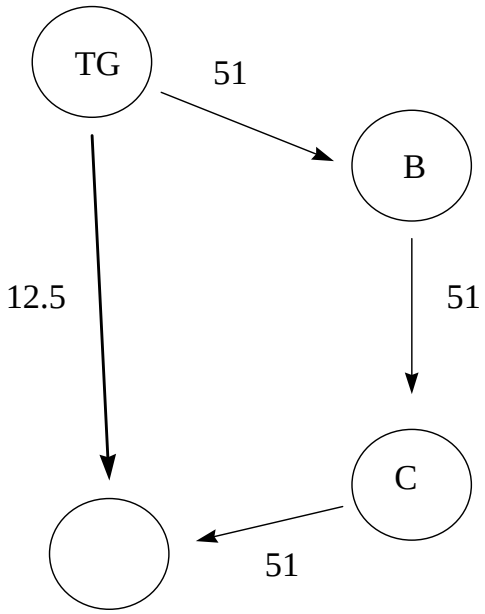

Figure 3: How Pyramidal Structure Amplifies the Separation of Ownership and Control

be affected by an important selection bias. In particular, if we believe that firms outside groups have a larger probability of decline or death (through bankruptcy or acquisition). Such an effect will however bias *downward* our estimates of the relation between ownership concentration and firm performance.

2.3 Cash Flow Rights and the Separation of Ownership and Control within Groups

We thus have constructed a panel of subsidiaries with two measures of ownership concentration within groups (the share of the dominant shareholder, and the CFR held by the group leader). We have seen that they may differ substantially, provided the corporation belongs to a stock pyramid that has more than 1 layer. This section documents and describes the differences between the two measures.

Table 1 provides descriptive statistics for two datasets both in 1989 and in 1997. The first one is the balanced panel of 2,121 subsidiaries built above (panel A). The second one is an unbalanced panel of "large" corporations directly taken from the financial relation survey, for which it is representative (we thus focused on firms that are above the thresholds given in the beginning of section 2.1). For those firms that are controlled, we performed the same algorythm as the one described above.

Table 1: Group Structure Change: 1989 - 1997

	Panel A		Panel B	
	1989	1997	1989	1997
Cash flow rights	80.4	80.7	70.5	73.5
	(0.5)	(0.5)	(0.7)	(0.6)
Rank of Control	1.82	2.11	1.34	1.55
	(0.02)	(0.02)	(0.02)	(0.02)
Primary Owner Share	91.1	93.7	77.4	81.6
	(0.3)	(0.3)	(0.7)	(0.5)
Share of Subsidiaries	100.0	100.0	80.3	85.3
	-	-	(0.9)	(0.6)
Observations	19089	19089	19998	19998

Note: Mean value for each year. Panel A is a balanced panel of 2121 subsidiaries continuously present in the data over the 1989 - 1997 period. Panel B is an unbalanced panel of firms whose total sales exceed 400 million francs or whose total employment is above 500 workers.

Hence, this second dataset is a representative unbalanced panel of large firms, where we have computed the group leader cash flow rights when they are subsidiaries (panel B). Since our goal in this paper is to study subsidiaries, we just present panel B to assess representativeness of panel A, and table 1 is the only one where it appears.

Let us start with the representative (of large firms) dataset. In 1997, more than 85% of them are subsidiaries to a group. This share has increased since 1989, but was already very large (80%). As far as medium/large firms are concerned, French corporations belong mostly to a group. This result is not new since it was indeed the motivation for starting the financial relation survey in the 1980s ! On a broader, more representative of small firms, sample, Kremp and Sevestre [2000] indeed find that 80% of the French firms are subsidiaries in 1994[6]. All in all, this suggest that any proper assessement of the relation between ownership and control of these unlisted corporation requires that we account for this group structure. The fact that an increasing proportion of firms became subsidiaries explains the rise in average primary owner stake (from 77 to 82%) over the period. However, the number of layers of the average pyramid has significantly increased, such that, in the

[6] On a sample identical to my panel B, but restricted to manufacturing industries, Moussalam [2000] has 85% of subsidiaries.

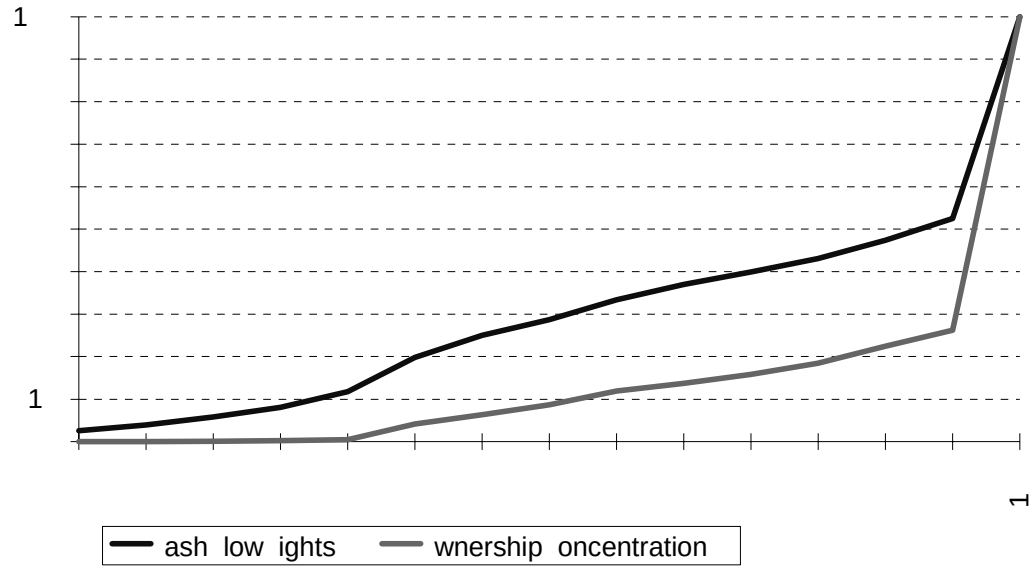

Figure 4: Cumulative Distribution of Primary Owner Stake and Cash Flow Rights

end, the average cash flow right of the group leader has increased by a lesser amount (3 instead of 5 points). These features also emerge in our subsidiary sample (panel A). Average dominant owner equity has risen by 2.6 points over the period, while the average cash flow rights has remained stable. Once again, the reason is increasing distance between group leaders and their subsidiaries.

Hence, the number of pyramidal layers magnifies the separation between cash flow and control rights. To see this more neatly, I have drawn in figure 4 the empirical cumulative distribution functions of both variables from panel A (I will stop mentionning it from now on, since I will never use panel B again). They differ sensibly. Only 25% of the subsidiaries have primary owner stake under 95%, while more than 50% have a group leader CFR under that limit. While we have less than 5% corporations with dominant owner share in equity with less than 60%, this figure goes above 25% for the other ownership concentration measure. Put differently, 25 % of our subsidiaries have the two measure differing by more than 25 points.

Thus cash flow rights and major equity owner stake differ sensibly for a sizeable fraction of the firms in our sample. The reason is that almost 60% of them have at least one intermediate subsidiary between themselves and their group leader (see figure 5). More than 25% are more

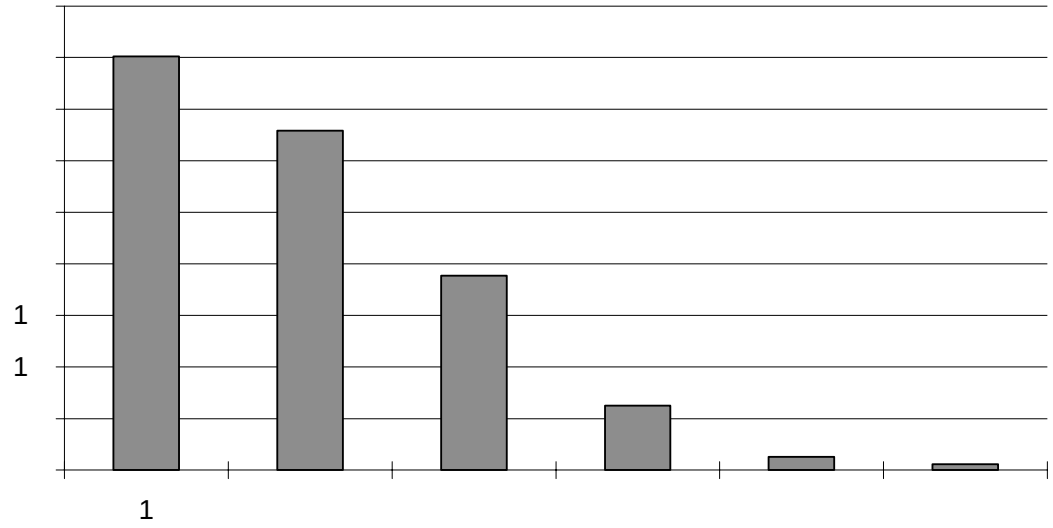

Figure 5: Number of Layers Between Subsidiaries and their Group Leader.

than 2 layers away from their controlling group leader. For the former corporations, the average cash flow rights are 73% (20 points below what a standard measure of ownership concentration would suggest). For the latter, the average CFR goes down to 63% (while in both cases the average equity of the major shareholder is above 94%).

2.4 Ownership Concentration and Subsidiary Performance

From the theoretical viewpoint, ownership concentration has a positive impact on corporate performance. The basic argument is that large shareholders have enough control in the firm to have their interest respected. Large owners thus allow to overcome the *coordination problem* raised by dispersed voting power. As all firms are controlled in our sample, this effect will not play any role here. A second line of argument related to the effect of large shareholders is that disciplining the manager entails a private cost to the monitoring party, while all owners benefit from it. Because he gets a large share of the gains from increased discipline, a large investor is able to partly overcome the *free rider problem* on monitoring (Jensen and Meckling [1976], Shleifer and Vishny [1986]). This "control" externality remains however, as long as the primary owner's stake does not reach 100%. Another mechanism,

more specific to stock pyramids may be at work in our sample of subsidiaries (Bebchuk et al. [1999]): minority shareholder expropriation may be worthwhile if the group leader holds control, but a small share of the firm's cash flow rights. Expropriation thus relates ownership concentration and corporate performance.

There is now a pretty large empirical literature on the relation between ownership structure and performance (surveyed by Short [1994], see Nickel et al. [1997] for a recent contribution). Most certainly intellectually influenced by Galbraith [1967]'s view of shareholding as absentee ownership and by Berle and Means [1933]'s book, this literature has restricted its attention to large, public, diffusely held corporations. [7] However, as we have seen above, and as forcefully shown by LaPorta et al. [1998], the Veblenian corporation is largely a myth outside the US, the UK and Japan. Even there, it mostly applies to very large firms (for an american example of the study of ownership structure of small firms, see Ang et al. [2000]).

In order to quantify the impact of separation of ownership and control among subsidiaries, the share of equity held by the primary owner may however not be the relevant measure of ownership structure. As Bebchuk et al. [1999] argue, multiple layers in stock pyramids tend to disconnect ownership from control, making the firm in control a very small claimant over the subsidiary's cash flows (remember figure 3). Hence, from the theoretical viewpoint at least, evaluating the relation between ownership structure and corporate performance requires to use the share of cash flow rights held by the group leader.

Simple correlation between corporate performance and these two measures of ownership concentration confirm this view. I have regressed an estimate of subsidiary log TFP (assuming the labor share equal to 0.66, and the capital share equal to 0.33) on both measure of ownership concentration. I added sectoral and year dummies. Results are provided in table 2 and use five models. Model 1 includes primary owner stake only, while model 2 include CFR claimed by the group leader. Model 3 adds both variables. Model 4 uses CFR only, but restricts the sample

[7] As Thorstein Veblen puts it in 1904, in his *Theory of the Business Enterprise*:

> This method of capitalization, therefore, effects a somewhat thoroughgoing separation between the management and the ownership of the industrial equipment. Roughly speaking, under corporate organization the owners of the industrial material have no voice in its management, and where preferred stock is a large constituent of the capital this alienation of control on the parts of the owners may be, by so much, irrevocable.

Table 2: Performance of Subsidiaries and Cash Flow Rights

	Model 1	Model 2	Model 3	Model 4	Model 5
Cash flow rights	-	0.05	0.04	0.04	0.04
		(2.0)	(1.7)	(1.4)	(1.2)
Primary Owner Share	0.05	-	0.02	-	-
	(1.2)		(0.4)		
Sector dummies	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes
Own. Conc. above	50%	50%	50%	95%	99%
Observations	19085	19085	19085	14169	12459

Note: Balanced Panel of subsidiaries: 1989-1997. Top and Bottom 1% values of TFP have been removed from the sample. The sample includes all sectors except farm and non traded services. Student statitics are between parentheses. Estimates correct for a broad form of heteroskedasticity in the fashion of White [1982], where observations are allowed to be correlated between observations of a given firm. Model 4 and model 5 are estimated on the restricted sample where OC stands above 0.95 and 0.99.

to corporations whose primary owner holds more than 95% of equity. Model 5 uses a higher cutoff value: 99%.

Results in table 2 are strongly in favor of the CFR view. First, group leader cash flow rights are well and significantly correlated with productivity. The estimated elasticity is not massive, but is fairly consistent across models: 0.04-0.05. Even for subsamples where the primary owner stake does not vary (models 4 and 5), cash flow rights affect productivity. In the opposite, the correlation between performance and primary owner stake is very weakly singificant, and vanishes to zero once we introduce CFR in the regression.

3 Opening the Black Box of The Separation of Ownership and Control in Stock Pyramids

Our analysis has so far highlighted the importance of group leader cash flow rights as the relevant measure of ownership concentration in our sample of subsidiaries. It is however subject to two main caveats: (1) the reduced forms used in the regression analysis (table 2.4) have not been given structural content. Hence, it is difficult, from an economic viewpoint, to provide interpretation of the results obtained so far. (2) Estimations presented in table 2 are subject to severe econometric problems. First, there may be unobserved determinants of productivity, that are correlated with ownership concentration and cash flow rights. Second, there may be other endogeneity biases, which induce potential correlation between our measures of ownership concentration and the error term.

This section attempts to fill these gaps. We first propose a microeconomic foundation for the relation between productivity and ownership concentration: this helps us (1) getting the right reduced form to estimate (2) pinning down the exact economic meaning of the estimated parameters and (3) evaluating the identifying power of our explicit restrictions and data. Second, we use fixed effects and instrumental variable techniques to provide estimates that are robust to unobserved heteorgeneity, simultaneity and measurement error biases.

3.1 The Model

Let us consider the typical relation between a subsidiary and its group leader as in figure 6. A firm C is directly controled by another corporation B, which owns $\beta\%$ of its equity. As it is the case in more than 2/3 of the cases in our data, B may however not be the group leader. A group leader A holds $\alpha\%$ of B's cash flows. We assume that C's production

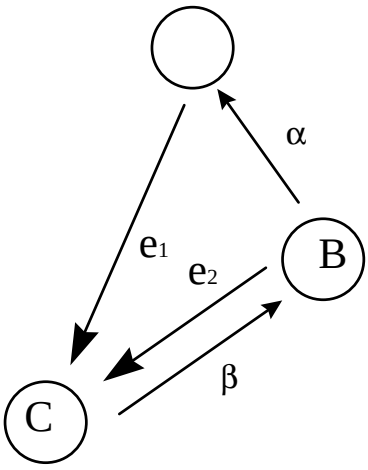

Figure 6: A Typical Relation Between a Subsidiary and its Group Leader

function is given by:

$$Y = MF(a_i(e_{Ai}, e_{Bi})x_i)$$

where x_i represents the quantity of input i (labor, capital) used for production Y. M is a productivity parameter. Production is subject to X-inefficiencies: C's manager may make a productivity enhancing effort, which is costly to her. We therefore denote $e_j = (e_{ji})_i$ a vector of managerial effort as imposed by firm j (A or B), which is assumed to be possibly directed toward a given input i. Let p be the vector of input prices, P the price - taken as given - of output. Hence, C makes profit:

$$\pi(e_A, e_B) = \max_{(x_i)_i} \{PMF(a_i(e_{Ai}, e_{Bi}).x_i) - p'x\}$$

A and B may however solve C's X inefficiency problem through imposing a certain level of effort to its manager. At a cost that is privately borne by the monitoring corporation. Such monitoring by A (resp. by B) costs $C_A(e_A)$ (resp. $C_B(e_B)$) to the group leader (resp. to B). A therefore maximizes the following objective function:

$$\underbrace{\max_{e_A} \left\{ \alpha \underbrace{\left[\max_{e_B} \beta\pi(e_A, e_B) - C_B(e_B) \right]}_{\text{Objective of } B} - C_A(e_A) \right\}}_{\text{Objective of } A}$$

Hence, we do not attempt to model the way shareholders impose managerial discipline to managers. First, existing theory about those

mechanisms tends to be very diverse and stylized, and is thus unlikely to produce relations that are robust enough to pass the data test. Second, our dataset does not provide any information about the workings of managerial discipline in firms: a model of owner - manager contracting would thus not be identified by the data. Therefore, we focus on the link between corporate shareholder monitoring and performance, and use a reduced form for what we call "agency costs".

Our model highlights the issue of management monitoring by the dominant owner of the firm. In the ownership concentration and performance literature, this mecanism is seen as one of the most powerful at realigning owners' and managers' interests (Shleifer and Vishny [1986,1997]). Our fairly reduced form could however be interpreted in terms of minority shareholder expropriation. The dominant owner - who has control in our sample - may divert some of the firm's assets for its own purpose (like buying real estate property from its subsidiary at a low price). It could also buy its subsidiary's output at a lower-than-market-price. In this case, C_j is negative, and a_i is decreasing in e. e has then to be interpreted as controlling owner's effort at expropriating the subsidiary's inputs or output: it decreases productivity (a_i) and induces a private benefit $-C_j$.

Hence, we view the relation between ownership and concentration among subsidiaries as driven by two forces: (1) insufficient information asymmetry reduction by both direct owner and group leader and (2) input and output expropriation by both firms in control. The first mechanism is not specific to pyramidal ownership structure, while the second one has been highlighted and illustrated by Bebchuk et al. [1999].

To simplify exposition, we furthermore assume that C_j and a_i take - at least locally - the following forms:

$$C_j(e_j) = z_j^{\mu_j} \left(\sum_i \Gamma_{ij}.x_i.e_{ij}^{\eta_{ij}} \right)$$

$$a_i(e_A, e_B) = a_i.e_{iA}^{\varepsilon_{iA}}.e_{iB}^{\varepsilon_{iB}}$$

Hence, productivity depends only on management effort as imposed by both group leader A and intermediary subsidiary B, while monitoring costs also depend on the quantity of input used x_i and other parameters (like the degree of information asymmetry) z_j. Note that in case of minority shareholder expropriation, both ε_{ij} and Γ_{ij} have to be negative, while positive in case of information asymmetry.

We show in appendix that the following relation can be derived under

fairly general conditions:

$$\frac{\Delta Y - p'\Delta x}{Y} = \sum_i \frac{\varepsilon_{iA}}{\eta_{iA}}.s_i.\frac{\Delta\alpha\beta}{\alpha\beta} + \sum_i \frac{\varepsilon_{iB}}{\eta_{iB}}.s_i.\frac{\Delta\beta}{\beta}$$

$$+\sum_i \left(\frac{\mu_A.\varepsilon_{iA}}{\eta_{iA}} + \frac{\mu_B.\varepsilon_{iB}}{\eta_{iB}}\right).\pi_i.\frac{\Delta z}{z} + \frac{\Delta M}{M} + \frac{\Delta P}{P} \quad (1)$$

where $s_i = p_i x_i / Y$ are the input shares and Δ a difference operator. Note that $(\Delta Y - p'\Delta x)/Y$ is not very different from the standard measure of TFP growth.

In the absence of asymmetries ($\varepsilon_{ij} = \varepsilon_j$, $\eta_{ij} = \eta_j$), and positing F homogenous of degree λ, we get:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\frac{\varepsilon_A}{\eta_A}.\frac{\Delta\alpha\beta}{\alpha\beta} + \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + \lambda\left(\frac{\mu_A.\varepsilon_A}{\eta_A} + \frac{\mu_B.\varepsilon_B}{\eta_B}\right)\frac{\Delta z}{z} + u$$

where u is a random noise including (1) temporary technology shocks and (2) output price changes. These evolution may have a persistent component (fixed effect for example). This equation is valid if and only if there are two different firms A and B, which is the case of more than 60% of our subsidiaries. If A does not exist, we get:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + u$$

Hence, a general equation, valid for all subsidiaries in our sample is:

$$\frac{\Delta Y - p'\Delta x}{Y} = \lambda\left(\frac{\mu_A.\varepsilon_A}{\eta_A} + \frac{\mu_B.\varepsilon_B}{\eta_B}\right).\frac{\Delta z}{z}.I_{\{rank\geqslant 2\}}$$

$$+\lambda\frac{\varepsilon_A}{\eta_A}.\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}} + \lambda\frac{\varepsilon_B}{\eta_B}.\frac{\Delta\beta}{\beta} + u \quad (2)$$

Thus, for firms that have both a direct owner and a group leader (for whom $rank \geqslant 2$), omitting the cash flow rights leads to overstating the elasticity ε_B/η_B, since β and $\alpha\beta$ are positively correlated. Productivity gain asymetries in capital and labor can be measured through the following equation:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\varepsilon_{AK}}{\eta_{AK}}.s_K\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}} + \frac{\varepsilon_{AL}}{\eta_{AL}}.s_L\frac{\Delta\alpha\beta}{\alpha\beta}.I_{\{rank\geqslant 2\}}$$

$$+\frac{\varepsilon_{BK}}{\eta_{BK}}.s_K\frac{\Delta\beta}{\beta} + \frac{\varepsilon_{BL}}{\eta_{BL}}.s_L\frac{\Delta\beta}{\beta} + u \quad (3)$$

In terms of empirical strategy, this relation has three main advantages. First, it holds as long as F is homogenous of degree λ, and does not rely on any other assumption on production technology. Second, (1) is a difference equation, and therefore accounts for unobserved firm level heterogeneity in the levels of the price P and productivity M. To see this, let k index the firm. As long as it is possible to decompose the productivity and price terms as $A_{kt} = A_k.A_t$ and $P_{kt} = P_k.P_t$, (1) remains valid. Moreover, assume agency costs vary for unobservable reasons across firms: Γ_{ij} depends on k. (1) is also unchanged. Hence, our equation is robust to productivity, price and monitoring costs level heterogeneity. Last, estimation is easy to implement. Coefficients of those explanatory variables are easily estimated (through any method of moments for example) and can receive simple structural interpretation. Coefficients on the concentration weighted increases of those costs shares $\beta_{ji}/\varepsilon_{ji}$ can be interpreted as the productivity elasticities to agency costs.

In addition to its advantages in terms of empirical strategy, equation (1) provides several insights on which parameters of the economic model we can recover from the data. Indeed, elasticities of productivity with respect to managerial effort β_i are not identified separately from ε_i. The main reason for this is that we do not observe agency costs in our data. [8] Second, the equation shows that by regressing something close to TFP on both primary owner stake and cash flow rights of the group leader, we can evaluate the relative agency costs (or private benefits in case of expropriation) of the two firms. Third, equation (1) allows to evaluate easily the impact of some measures of information asymmetry and/or expropriation opportunity on monitoring costs / private benefits. If these determinants affect the Γ parameters, they need to be added in the regression (like the z's). If they affect the elasticity of monitoring costs/private benefits, they need to be interacted with our explanatory variables.

Finally, the above derivation highlights several econometric problems linked with the estimation of the relation between ownership concentration and corporate performance, that have been surprisingly overlooked in the literature so far. First, plain OLS regression on the level of TFP on ownership concentration are potentially subject to severe biases since ownership concentration may be related to some firm's unobserved characteristic that goes in the error term. Product market competition, for

[8] On the basis of Jensen and Meckling [1976]'s conjecture, Ang et al. [2000] reconstruct agency costs from comparing the difference in profitability between 100% manager owned firms and more diffusely held ones. They then evaluate the relationship between agency costs and ownership structure. In that sense, they estimate our ε.

example, increases performance, and can act as a substitute for ownership concentration (Schmidt [1997]). Hence, plain OLS will overestimate the impact of ownership concentration, as estimates will capture some of this negative correlation. As we noticed above, our equation being a difference equation, it it robust to the existence of fixed factors affecting monitoring costs or productivity M. Secondly, equation (1) shows that the residual includes price and productivity parameters. Once again, ownership concentration is a decision that may be correlated with these determinants: for example the group leader may choose to promote a given subsdiary by giving it access to better technologies, or cheap financing. It is then optimal to increase its share of cash flow rights. This may create a simultaneity - upward - bias on the coefficient. Besides, if we look at the version of (1) given in equation (3), independant variables include the share of labor and capital, which are set by profit maximization, and therefore depend on M and P. Finally, ownership concentration variables are certainly subject to sizeable measurement error, because of firm misreports, because the primary owner's stake may not be the relevant measure of ownership concentration, and also because of the way we constructed cash flow rights - our dataset is by no means exhaustive, and we may overlook some firms - owner relations.

To eliminate these endogeneity biases, we need to instrument our independent variables. Such instruments are difficult to find: in the absence of a natural experiment - a change in corporate law for example, we will take the lags of the explanatory variables. Such instruments are useful at removing transitory measurement error and simultaneity biases, which in our example are likely to be negative. If however there is something in the firm's growth prospects that also influences ownership concentration, our instrumental variables will be missing it. The best we can do in this case is to differentiate once again equation (1).

3.2 Locating Power within Groups

Let us start with estimating the relative importance of monitoring by the group leader and monitoring by the direct owner. In other words, we are going to ask the following question: where is power located within stock pyramids ? Does the group leader delegate authority to the subsidiary's direct owner, or does it affect firm performance directly ? We start running the following regression:

$$\frac{\Delta Y - p'\Delta x}{Y} = a + b.\frac{\Delta CFR}{CFR}.I_{\{rank \geqslant 2\}} + c.\frac{\Delta OC}{OC} + u \qquad (4)$$

where CFR stands for cash flow rights - when the direct owner and the group leader differ, and OC for the direct owner's stake in the subsidiary's equity. Results are presented in table 3. Equation (4) - which is

a difference equation - is estimated both through OLS and IV technique. It is also differentiated, in order to account for potential unobserved heterogeneity in firm TFP growth. As it turns out, instrumentation increases the estimate coefficient: this suggest that measurement errors are likely to be large, in particular as far as the CFR is concerned - which is not very surprising, given the approximate way we constructed it. Double difference estimates are weaker than our IV estimate, but remain significant, suggesting that our findings are robust to unobserved heterogeneity in TFP growth. We will restrict our comments on the level IV estimates (column 2).

Table 3: Performance of Subsidiaries and Cash Flow Rights: IV/difference estimates

	Differences		Double Diff.	
	OLS	IV	OLS	IV
Cash flow rights	0.02	0.09	0.02	0.03
$\times(Rank >= 2)$	(2.6)	(2.8)	(2.3)	(2.6)
Primary Owner Share	-0.02	-0.01	-0.03	-0.03
	(1.1)	(0.2)	(1.3)	(1.1)
Sector dummies	yes	yes	no	no
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	-	0.60	-	0.28

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of log ownership concentration and cash flow rights.

First, our estimates confirm that the important relation in stock pyramids is the one between the ultimate owner and its subsidiary. The share of equity held by the dominant direct owner does not come out significant, either in the OLS, nor in the IV estimations. These results therefore confirm our preliminary statistical analysis: the relevant concept for ownership concentration for subsidiaries is the share of cash flow rights held by the group leader. In terms of our model (equation (1)), it can receive two alternative interpretations: (1) expropriation benefits - ε/η - are potentially larger for the group leader than they are for the intermediate subsidiary B, or (2), monitoring costs are lower, or managerial

discipline by the group leader is more effective.

Notice that our difference OLS estimations lead to estimates of b (0.02) that are lower than those previously obtained in the decriptive analysis (0.05). This suggests the important of significant upward biases in the estimation of this relation when fixed effects in productivity are not accounted for. On the opposite, IV estimates of ε_A/η_A (0.09) are four times as large as the difference OLS estimates. As we said measurement errors of the cash flow rights are potentially important, since their accurate computation is limited by the availability of firm - owner relations in the data. This problem is likely to affect the CFR coefficient more than the OC one, for which the difference between OLS and IV is small. In the above discussion we highlighted two potential upward biases arising from plain OLS estimation: (1) substitutability between product market competition and ownership concentration (2) simultaneity between the decision of promoting subsidiary performance and increasing the group's share in its cash flows. Our IV estimates suggest that these biases are beaten by the measurement error problem.

The IV estimate suggests a sizeable effect of CFR on productivity. At the level of the sample, the cost of stock pyramid is small: considering the average corporation in our sample, there is a 10 point difference between the primary owner's stake (some 92%) and the group leader cash flow rights (some 80%). Hence, pyramidal ownership costs some $0.09 \times 12\% \sim 1\%$ in term of total factor productivity. As expected, if we restrict attention to those subsidiaries that are more than one layer away from their group leader, the impact of separation of ownership and control is much stronger. Recall that almost 2/3 of the subsidiaries in our sample are in this case. The difference between their average primary owner stake (94%) and the leader's share of cash flow rights (73%) is now 20 points, which yields an estimated cost of pyramidal stock ownership of 2% of TFP. For corporations whose rank of control exceeds 2 (27% of our observations), the cost is estimated to 3%.

3.3 Testing two alternative Mecanisms

Stock pyramids thus lead to significant productivity losses due to amplified separation of ownership and control. Above, we have highlighted two separate forces that could be responsible for this phenomenon. The first one is an inefficient degree of management monitoring by the leader: this effect is not specific to groups, and is rooted in information asymmetry between the subsidiary's management team and the leader. The second one is related to the possiblity and incentive for the controlling corporation to expropriate minority shareholders of the subsidiary (Bebchuk et al. [1999], LaPorta et al. [1998] It can either divest some of the

firm's assets - capital goods, real estate property - for its own use, or in favor of another subsidiary that is more closely held (in which it has more cash flow rights). It could also compell its subsidiary to undertake a project that yields private benefits to the controlling corporation, but that deteriorates its performance. It can finally buy (sell) output from (to) its subsidiary at a price lower (higher) than the market price.

Table 4: Cash Flow Rights and the productivities of Labor and Capital

	Differences	Double Diff.	Differences	Double Diff.
Cash flow rights × capital	-	-	1.60	0.51
$\times(rank \geqslant 2)$			(1.5)	(1.2)
Cash flow rights × labor	-	-	-0.01	0.02
$\times(rank \geqslant 2)$			(0.3)	(1.2)
Primary Owner Share	-1.34	-0.56	-	-
× capital	(0.6)	(0.7)		
Primary Owner Share	0.01	-0.01	-	-
× labor	(0.1)	(0.4)		
Sector dummies	yes	no	yes	no
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.17	0.37	0.43	0.40

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of log ownership concentration and cash flow rights.

In this section, we aim at evaluating the relative strength of both mechanisms in shaping stock pyramids costs. Assume first that information asymetries bear equally of labor and capital productivities. Then, as far as expropriation is concerned, it is reasonnable to assume that, capital is easier to divest than labor. If minority shareholder expropriation is a relevant force, cash flow rights concentration should therefore impact capital productivity by more than labor productivity. To see this, we estimate equation (3) using IV techniques on both difference and double difference equations, and using both measures of ownership concentration. Table 4 presents the results. The primary owner's stake has no impact on either capital, nor labor productivity, which confirms the results obtained in table 3. Estimates suggest however a much stronger

impact of group leader interests on capital than labor productivity. Double difference estimates confirm this conclusion, though significance is weakened. Hence, our equation presents evidence in favor of minority shareholder expropriation through capital divestiture.

There are however reasons to think that information asymmetries between a corporate management team and its owners may be more detrimental to capital than labor productivity[9]. Results from table 4 could be seen as confirming this view. To go a step further, we thus need to confront both forces in the same model. If information asymmetries matter, they will affect monitoring costs, and therefore impact ε_A/η_A negatively, or raise costs parameters Γ_{ij}. If expropriation is the driving force, private benefits will be positively impacted by such opportunities. In this case, $-\Gamma_{ij}$ and $-\varepsilon_A/\eta_A$ will increase with expropriation opportunities.

Acknowledging this suggests two empirical strategies for confronting the two forces. First, we may estimate equation (2) adding two more explanatory variables $\Delta z/z$ measuring the evolution of information asymmetry and the evolution of minority shareholder expropriation. This may account for the impacts of both forces on costs parameters Γ_{ij}. We would be then estimating the following equation, directly derived from (2):

$$\frac{\Delta Y - p'\Delta x}{Y} = a.\frac{\Delta EXPROP}{EXPROP} + b.\frac{\Delta ASYM}{ASYM} + c.\frac{\Delta CFR}{CFR} + u \qquad (5)$$

The variability of the first two explanatory variables may however be small, since the degree of expropriation or of information asymmetry may be fairly constant over time. Hence, a second empirical strategy seeks to directly explain elaticity ε_A/η_A by the (1) degree of information asymmetry between the subsidiary managers and the group leader and (2) expropriation opportunities. Doing this boils down to add in equation (1) interaction terms between this factors and the CFR:

$$\frac{\Delta Y - p'\Delta x}{Y} = a.\frac{\Delta CFR}{CFR} + b.ASYM.\frac{\Delta CFR}{CFR} + c.EXPROP.\frac{\Delta CFR}{CFR} + u \qquad (6)$$

We take two different measures of asymmetry (ASYM). The first one is at the firm level: the number of layers that separate the subsidiary and its group leader (rank of control). Its validity relies on the assumption

[9] In particular, Jensen [1986] provides examples in which agency costs of free cash flows translate into overaccumulation of capital (excess oil prospection in the US energy sector). Baghat et al. [1989] show how the wave of hostile takeovers in the US by the end of the 1980's has been triggered by previously excessive corporate diversification.

that each management team reports to its direct owner, and not directly to the top. In this case, imperfect information transmission and strategic lies amplify information asymmetry. The second measure ASYM is at the group level: the ratio of the number of subsidiaries belonging to different sectors of activity divided through the number of subsidiaries. This quantity measures the degree of diversification; its meaning relies on the fact that it is more costly to a diversified group to discipline its managers since it will have less opportunity to use relative performance evaluation (Holmstrom [1982]).[10]

We measure expropriation opportunities at the group level: we take a dummy that equals one if the firm's CFR are less than the average CFR the group leader has in all its subsidiaries. In this case indeed, and in the absence of transfer costs, it is optimal for the controlling leader to transfer all of its subsidiary's assets to other firms of the group. Expropriation is then limited by the fact that some assets are too specific or costly to transfer.

Tables 5 and 6 present the results of both estimation strategies. Results in double differences have been omitted for exposition clarity; we focus on difference IV estimates.[11] Only CFR is instrumented, while our measures of IA and expropriation as assumed exogenous. There is ample convergence between the two methodologies: minority shareholder expropriation seems to be the dominant force in shaping the cost of pyramidal ownership, while our measures of information asymmetry fail to influence monitoring costs parameters.

4 Conclusions

This paper has shown that pyramidal ownership - a prevalent organizational structure among French corporations - has sizeable agency costs. These agency costs arise because pyramidal ownership further disconnects control rights from ownership: a group leader may have effective control over a subsidiary, while holding a small fraction of its cash flow rights. Using robust econometric techniques and an economically founded reduced form, I find strong relation between corporate performance and the share of cash flow rights, while the share of primary owner in total equity - a more traditional measure of ownership concentration -

[10] Other measures of IA based on the total number of subsidiaries, or on the total number of sectors within the group have been tried. They could be justified by diseconomies of scale in monitoring. The use of these measures instead of the ones shown in the paper did not change the results, but are availalble from the author upon request.

[11] Double difference present qualitiatively similar results, but their significance is weaker.

Table 5: Minority Shareholder Expropriation vs Information Asymmetry: Test I

	Model 1	Model 2	Model 3	Model 1+2
Cash flow rights	0.22	0.10	0.05	0.22
	(2.2)	(2.6)	(1.4)	(2.0)
Expropriation Opportunities	-0.20	-	-	-0.18
× CFR	(1.8)			(1.8)
Information Asymmetry 1	-	0.05	-	0.02
× CFR		(1.8)		(1.1)
Information Asymmetry 2	-	-	0.09	-
× CFR			(0.4)	
Sector dummies	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.37	0.58	0.79	0.38

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Student statistics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of cash flow rights. Information asymmetry 1 is based on the number of layers separating the subsidiary from its group leader. Information asymetry 2 is based on the degree of diversification at the group level. Expropriation opportunities is a dummy equal to 1 if the firm level CFR is less than the average group CFR. These explanatory variables are assumed exogenous and are not instrumented.

Table 6: Minority Shareholder Expropriation vs Information Asymmetry: Test II

	Model 1	Model 2	Model 3	Model 1+3
Cash flow rights	0.22	0.10	0.08	0.22
	(2.0)	(2.6)	(2.9)	(2.0)
Expropriation opportunity	-0.19	-	-	-0.19
	(1.8)			(1.8)
Information Asymmetry 1	-	0.05	-	-
		(1.8)		
Information Asymmetry 2	-	-	-0.01	-0.01
			(0.5)	(0.7)
Sector dummies	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Observations	8276	8276	8276	8276
Chi square (t -prob)	0.61	0.72	0.72	0.65

Note: Balanced Panel of subsidiaries: 1994-1997. All sectors except farm and non traded services. Information asymmetry 1 is based on the number of layers separating the subsidiary from its group leader. Information asymetry 2 is based on the degree of diversification at the group level. Expropriation opportunities is the average group CFR. Student statitics between parenthesis. Heteroskedastic robust estimates. Instruments are the 1,2,3,4 period lagged variations of cash flow rights.

is found to have no impact. Our interpretation is that, in stock pyramid, control is located at the top, and very little delegated. From the quantitative viewpoint, these agency costs amount to 1% TFP in our sample, and to 3% TFP for a quarter of the subsidiaries surveyed. I then turn to the causes of these costs. I find that minority shareholder expropriation, and not information asymmetries between the top and its subsidiary, is likely to be the driving force.

I believe these results are relevant from the economic policy viewpoint. They suggest that significant efficiency losses from separation of ownership and control do not only arise from the Veblenian, widely held, public corporation, but also from a much more prevalent ownership structure: the subsidiary. Moreover, the results in the end of this paper suggest that the state could prevent these efficiency losses by further guaranteeing the rights of minority shareholders.

This paper has left many questions unanswered, that could provide fruitful leads for further research. In particular, why would other shareholders be willing to buy equity of a subsidiary that they do not control and which they know will be inefficiently managed ? This question points towards the potential benefits of stock pyramids, which could match the costs we have highlighted. I also think that the issue of group diversification deserves a more thorough treatment than the one I gave in the last section. Finally, these group data may allow to compute consolidated accounts, which could be related to ownership structure of the group leader.

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5 Appendix: Derivation of Equation (1)

From the first order conditions, e_A and e_B must solve:

$$\beta \frac{\partial \pi}{\partial e_{Bi}}(e_A, e_B) = \frac{\partial C_B}{\partial e_{Bi}}(e_B), \text{ for all } i$$

$$\alpha\beta \frac{\partial \pi}{\partial e_{Ai}}(e_A, e_B) = \frac{\partial C_A}{\partial e_{Ai}}(e_A), \text{ for all } i$$

By the envelope theorem applied to profits, these two equations rewrite:

$$\frac{\partial C_B}{\partial e_{Bi}}(e_B) = \beta \frac{\partial F}{\partial x_i}.x_i.\frac{\partial a_i}{\partial e_{Bi}}$$

$$\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta \frac{\partial F}{\partial x_i}.x_i.\frac{\partial a_i}{\partial e_{Ai}}$$

From the first order conditions of profit maximization:

$$\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta \frac{p_i x_i}{a_i}.\frac{\partial a_i}{\partial e_{Ai}}$$

Hence, noting ε_{iA} and ε_{iB} the elasticities of a_i with respect to e_{Ai} and e_{Bi}, we obtain:

$$e_{Ai}.\frac{\partial C_A}{\partial e_{Ai}}(e_A) = \alpha\beta\varepsilon_{iA}.p_i x_i$$

Posit now that:

$$C_A(e_A) = \sum_i \left(c_{Ai}.x_i^{\gamma_A}.z^{\mu_A}\right).e_{Ai}^{\eta_{iA}} \tag{7}$$

where z is a factor that influences monitoring costs (like the effective number of subsidiaries between A and C for example). η_{iA} and η_{iB} are the respective elasticities of C_A and C_B with respect to e_{Ai} and e_{Bi}. We get, by differentiation of (7):

$$\frac{\Delta e_{Ai}}{e_{Ai}} = \frac{A}{\eta_{iA}}\left((A-\gamma_A).\frac{\Delta p_i x_i}{p_i x_i} + \frac{\Delta\beta}{\beta} + \mu_A\frac{\Delta z}{z} + \gamma_A.\frac{\Delta p_i}{p_i}\right)$$

Besides, output variation is given by:

$$\begin{aligned}\frac{dY}{Y} &= \frac{\Delta A}{A} + \frac{\Delta P}{P} + \frac{A}{Y}.\sum_i \frac{\partial F}{\partial x_i}.\left(x_i\Delta a_i + a_i\Delta x_i\right)\\ &= \frac{\Delta A}{A} + \frac{\Delta P}{P} + \frac{A}{Y}.\sum_i p_i x_i\frac{\Delta a_i}{a_i} + p_i\Delta x_i\end{aligned}$$

which yields the following relationship:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\Delta A}{A} + \frac{\Delta P}{P} + \sum_i s_i\frac{\Delta a_i}{a_i}$$

where $s_i = p_i x_i/Y$ is the share of output buying input i. Productivity rate of increase:

$$\frac{\Delta a_i}{a_i} = \varepsilon_{iA}\frac{\Delta e_{iA}}{e_{iA}} + \varepsilon_{iB}\frac{\Delta e_{iB}}{e_{iB}} + \zeta_i$$

where we assume that productivity may increase at rate ζ_i for other reasons that are not modeled (technical change, organizational choices etc.). We get the fairly general equation:

$$\frac{\Delta Y - p'\Delta x}{Y} = \frac{\Delta A}{A} + \frac{\Delta P}{P} + \sum_i\left(\frac{(A-\gamma_A).\varepsilon_{iA}}{\eta_{iA}} + \frac{(A-\gamma_B).\varepsilon_{iB}}{\eta_{iB}}\right).\frac{\Delta p_i x_i}{Y}$$

$$+\sum_i \left(\frac{\mu_A.\varepsilon_{iA}}{\eta_{iA}} + \frac{\mu_B.\varepsilon_{iB}}{\eta_{iB}} \right) .s_i.\frac{\Delta z}{z} + \sum_i \frac{\varepsilon_{iA}}{\eta_{iA}}.s_i.\frac{\Delta \alpha\beta}{\alpha\beta}$$

$$+\sum_i \frac{\varepsilon_{iB}}{\eta_{iB}}.s_i.\frac{\Delta \beta}{\beta} + \sum_i \zeta_i s_i + \sum_i \left(\frac{(A-\gamma_A).\varepsilon_{iA}}{\eta_{iA}} + \frac{(A-\gamma_B).\varepsilon_{iB}}{\eta_{iB}} \right) .s_i.\frac{\Delta p_i}{p_i}$$

Positing $\gamma_j = A$ and $\zeta_i = 0$ as in the main text yields equation (1).