How to measure corporate control? Evidence from panel threshold effects of the degree of control on CEO pay monitoring.

Lionel ALMEIDA*

This version:
30 November 2016

Abstract

Based on CEO pay monitoring in French listed companies, this study searches for the relevant metrics to measure the effects of control by large shareholders. It first discriminates among equity and voting shares, direct and ultimate ownership, having or not seats on the board, the existence of more than one large shareholder and of shareholder agreements. The relevant metric is then included in a panel threshold model. The model provides an empirical foundation to the definition of a threshold of 10% as separating out *diffusely-held* and *controlled* firms. Controlling shareholders above this threshold are not homogeneous or do not have a linear impact as usually found in the literature. Instead, the model shows the existence of three regimes in the degree of control that are termed as *influential*, *dominant*, and *exclusive* controls. The first and last one efficiently monitor CEO pay but the intermediate one shows some evidence of entrenchment.

JEL classification: *G32, G34, L22*
Keywords: *Monitoring, corporate control, CEO compensation, panel thresholds*

*: Lirsa, Cnam (Conservatoire national des Arts et Métiers), 40 rue des Jeûneurs, 75002 Paris, France.
E-mail : lionel.almeida@lecnam.net

1. Introduction

Large shareholders may have the voting power to influence the governance of a firm and the monetary incentive to engage in management monitoring activities (Shleifer & Vishny, 1986). Hence they may influence major corporate decisions and significantly impact the firm's strategy, performance, and value. Nevertheless, very little is known about the necessary conditions for considering a firm as controlled and the management monitored by its large shareholders. As pointed out by Bhagat et al. (2004) and Holderness (2003; 2009), there is no guidance in the literature as to the portion of shares or votes required to exert a significant influence on a firm's governance. There is also no consensus as to the relevant metric for identifying the controlling shareholders among the major shareholders in a given firm.

Concentrated ownership and large shareholdings are essentially the rule around the world (La Porta, et al., 1999; Faccio & Lang, 2002). But the tremendous development of financial markets in many countries in recent decades may bring about major, rapid changes in ownership structures. For instance, a larger number of firms may become diffusely-held or controlling shareholders may lose their majority control in favor of intermediary positions in equity. Yet the literature provides no insight about the potential impacts of such changes.

Most studies about ownership are interested in the shares held by insiders – i.e. shares individually owned by top executives and/or directors (Holderness, 2003) – or by institutional investors. An underlying assumption of these studies is that firms are mostly diffusely-held so that large shareholdings may play a secondary role[1]. When studies are interested in the role of large shareholders, they usually use coarse metrics: a dummy variable for the existence of large

[1] Large shareholdings are either no taken into account or merely included as a control variable. If large shareholdings were considered as a major player in corporate governance, the impacts of minority shareholders would be studied conditionally to the existence of such a large shareholder. To the best of my knowledge, only one study does so by distinguishing the impacts of institutional minority shareholders conditional to the existence of a specific type of large shareholders, namely family vs. non-family firms (Croci, et al., 2012).

shareholders above a given threshold (designated as *blockholders*) or the percentage of shares or voting rights held above this threshold.

These metrics raise two main issues. First, the value of the threshold mostly relies on the share that triggers mandatory disclosure of equity positions, but there is no empirical evidence that these legal thresholds are economically meaningful. Specifically, there is no evidence that these legal thresholds also trigger the ability to exert effective monitoring and that they are associated with corporate control. Most empirical studies still use this threshold because, as stressed out by Holderness, "given how little we actually know about large shareholders, the prudent course of action is to use the full array of publicly available data" (Holderness, 2009).

Second, the metrics based on a unique minimum threshold to define large shareholdings implicitly make an assumption of homogeneity, considering that all large shareholders above this threshold behave similarly. The measurement of their impact with a dummy variable assumes they have a flat impact on the firm, whether they own a minority or a majority share of equity. Similarly, the measurement with the percentage of shares assumes a simple continuous linear relationship. Such an assumption has low intuitive foundation as it is difficult to understand why an increase of some percentage points at around, say, 25% or 75% of shares, should change the way shareholders monitor; on the other hand, a change in ownership that makes the shareholder move from a minority and contestable position to a majority and exclusive control might create a jump in the influence it can exert on a firm's governance. The relationship between a shareholder's position and the effects of its monitoring activities is then more likely to be non-continuous and with breakpoints.

Until the early 2000s, most empirical studies about ownership were conducted in the U.S., where public firms are mostly considered as diffusely-held (Holderness, 2009). This may explain why the metrics defined in the early literature are so coarse about large shareholdings. But the availability of the data in many other countries since then, and the diversity of configurations that may be found in the degree of control by large shareholders call for more precise knowledge

about how to account for corporate control. This paper intends to address this need. It specifically provides an empirical methodology that allows for the identification of the relevant number of regimes in the degree of control, and of the associated threshold values in large shareholdings.

Aside from looking for relevant thresholds in corporate control, another objective of this study is to define who are the controlling shareholders and monitors of a firm. The literature on ownership uses a large array of metrics to account for the control exerted by large shareholders. As already mentioned, this includes indicator variables that account for the existence of at least one blockholder (Beatty & Zajac, 1994; Hambrick & Finkelstein, 1995), or the percentage of equity shares or voting rights held by large shareholders. In the latter case, large shareholders may alternatively concern all blockholders (Mehran, 1995; Holderness, 2009; Konijn, et al., 2011), the largest shareholder (Cyert, et al., 2002), or the largest ultimate one (La Porta, et al., 1999; Faccio & Lang, 2002; Ben-Nasr, et al., 2015). Despite these various metrics found in the literature about large shareholdings, none of these studies attempt to disentangle the respective impacts of each metric and to determine which one is the most appropriate for measuring effective corporate control. The present paper also intends to isolate the relevant metric that accounts for corporate control and monitoring activities, before using it to look for relevant thresholds and regimes in the degree of control.

The empirical study is based on a panel of French listed companies. French companies are interesting in the context of ownership thresholds because they offer a variety of controlling shareholding patterns and some continuity from diffusely-held to majority-controlled firms. This panel thus allows to test for a broad range of alternate metrics of effective corporate control. Also, a large part of the panel data is hand-collected; this allows to have some precise information about the characteristics of large shareholders and their role in governance. For instance, large

shareholders that are indirectly represented on the board are consistently associated to *insider* shareholders, which is generally not the case when the data rely on ownership databases[2].

The aim of the paper is to identify characteristics of larges shareholdings associated with effective corporate control and management monitoring. A large array of literature shows that the existence of monitoring activities by large shareholders have a direct impact on the design of CEO pay schemes. In theory, both the managerial power and agency relationship views predict that the absence of a monitor among large shareholders is associated to higher levels of pay. Based on the managerial power approach, the absence of a large shareholder on the board of directors allows CEOs to exert a higher influence on the appointment of directors and to collude with them, so that they have the power to determine their own pay (Bebchuk, et al., 2002). Based on the agency view, in the absence of a large shareholder in a position to monitor, *outsiders* (i.e., external minority shareholders) have to rely on alternative monitoring tools, these tools include contingent-based pay aimed at providing *insiders* (i.e., top management) with incentives to maximize shareholder value. In the end, when no large shareholder takes over the monitoring activities, CEO pay levels are expected to be higher either because of powerful and entrenched managers, or because of higher performance-sensitive components of pay.

Conversely, empirical studies tend to show that the presence of large shareholders, measured with ownership concentration (Dyl, 1988) or the existence of blockholders (Beatty & Zajac, 1994; Mehran, 1995; David, et al., 1998; Core, et al., 1999; Cyert, et al., 2002; Chhaochharia & Grinstein, 2009), is associated with management monitoring, as evidenced by lower levels of pay and less need for incentive-based components. Nevertheless, agency theorists still have a suspicion that in the presence of large shareholdings, the conflict between outsiders and

[2] This is especially a matter when large shareholders are companies or institutions. Most often, "insider shareholdings" collected from databases correspond to equity shares held by individuals who sit on the board. Hence, blocks of shares held by companies or institutions that are indirectly represented on the board by one of their employees are incorrectly associated to *external* or *outsider* blockholders, and only the shares individually held by the employee are associated to *insider* shareholdings. See Holderness (2003, p. 54) for a discussion about this inaccuracy in ownership databases.

entrenched top managers may translate into a conflict between outsiders and entrenched large shareholders (Shleifer & Vishny, 1997). In this entrenchment perspective, controlling shareholders are expected to extract private benefits at the expense of outside shareholders, notably through higher levels of pay for the CEO – as a form of direct private benefit if the CEO is a member of the controlling family, or as a mean to buy the loyalty and induce the CEO to act in the sole interest of the monitor (Gomez-Mejia, et al., 2003).

Relying on earlier findings about the relation between effective management monitoring and CEO pay schemes, the present paper first searches for the relevant metric of controlling shares. It is found that the metrics correlated with effective monitoring are the percentage of equity held by the largest shareholder, directly or indirectly represented on the board, plus the percentage held by shareholders acting in concert with it. Other blockholders, whether or not they are on the board, or have higher voting rights do not enhance monitoring on the panel of French listed firms. Also, distinguishing largest shareholders that are themselves ultimately controlled or diffusely-held do not make a significant difference in their monitoring activities.

Then, based on this definition of controlling shares, a panel threshold regression (PTR) model is applied and looks for threshold effects and the existence of various regimes in the degree of control. The model identifies three thresholds and four associated regimes. It is found that large shareholders start exerting an effective influence on governance and CEO pay design when they cross a 10% threshold in equity shares. Below this point, the level and structure of pay reveal higher CEO power and agency issues, and firms are deemed to be *non-controlled*.

Above this point, the results show controlling shareholders are not homogeneous. More precisely, three types of controlling shareholders are identified. From 10% to an upper threshold of about one third of equity, shareholders are in a contestable position. They may face other large shareholders that could take over control so that they have incentives to exert an efficient management monitoring. They are associated with significantly lower levels of pay, and they are designated in this study as having an *influential control*. Conversely, the results show that above

slightly less than one half of equity shares (45%), controlling shareholders get an *exclusive control* over the firm and they exert the most effective management monitoring. Controlling shareholders lying between the thresholds of one third and 45% of equity shares present a specific pattern. They exert an effective but less efficient control than both influential and exclusive controls. Indeed, these shareholders are no longer in a contestable position and are quite protected from hostile takeovers, but they do not yet have an exclusive control nor a majority cash flow return on their monitoring activities. The results show some evidence of entrenchment in this intermediate category of control with higher levels of pay than in other controlled firms, possibly to buy the loyalty of the CEO and extract private benefits. But they still counterbalance the managerial power as the levels of pay are lower than in non-controlled firms. These controlling shareholders are designated in this study as having a *dominant control*.

The paper lastly discusses the methodological choice of a panel threshold model. This approach assumes that controlling shareholders have a flat or homogeneous impact from one threshold up to the next one, and that the threshold is a breakpoint. This non-linear and non-continuous specification is compared with non-linear continuous specifications found in the literature about insider ownership (i.e. shares of equity held by top executives and directors). Precisely, this literature uses piecewise (Morck, et al., 1988; Cho, 1998) or polynomial specifications (McConnell & Servaes, 1990; Short & Keasey, 1999; Davies, et al., 2005) that allow for a positive or negative linear impact between turning points. These specifications have some drawbacks compared to a PTR model as they require to arbitrarily choose the number and value of turning points in the piecewise linear form, or the number of degrees for the polynomial function[3]. Nonetheless, the paper compares the results of both types of models and it shows that the PTR model is more efficient. In addition, the comparison shows that non-linear continuous specifications bring misleading interpretations. The value of turning points are inaccurately

[3] Hamadi and Heinen (2015) suggest a semiparametric panel model that allows not to impose any *a priori* functional form to the non-linear continuous impact of large shareholdings.

identified, and the interpretation about linear impacts between these points lead to incorrectly attribute alignment or entrenchment effects to some shareholding brackets.

One contribution of this paper is to provide guidelines to identify controlling shareholders among large shareholders, and to measure their impact with a panel threshold approach using one indicator variable for each regime. The PTR methodology can also easily be applied to other contexts than French listed companies. This approach is also an improvement compared to the variables usually used in the literature about large shareholdings, i.e. a unique indicator variable for all blockholders, or a simple linear relationship with their percentage of shares. Beyond the technical aspect, it also allows to account for varying effects among controlling shareholders and to better qualify the results regarding the debate between alignment or entrenchment effects of large shareholders. The results thus show that only intermediate levels of control seem to provide incentives to entrench and extract private benefits, but that the other regimes of control are associated with efficient management monitoring.

Another contribution is showing that non-linear continuous approaches used in earlier studies may have brought misleading interpretations, and that threshold effects better account for ownership impacts. Specifically, continuous specifications may have led to spurious conclusive comments about the share of equity top executives and directors should hold to enhance firm value. This paper applies the panel threshold approach in an ownership study for the first time, to the best of my knowledge, and it could be used in the future to review earlier results about the relation between ownership and firm performance.

The remainder of this paper is organized as follows: Section 2 provides a review of the literature, and Section 3 presents the methodology for measuring controlling shareholdings and identifying the degree of control thresholds. Section 4 describes the sample data and Section 5 presents empirical results. Sections 6 discusses the relevance of a discontinuous specification against a continuous one, and the last section includes concluding remarks.

2. Review of the literature

2.1. Who are large shareholders?

The literature on large shareholdings provides few evidence of the relevant metrics to assess corporate control and gauge the effectiveness of management monitoring. **Table 1** supports this statement with a survey of the metrics found in some seminal and reference studies[7] dealing with the effects of large shareholdings (*Survey A*) or of managerial ownership (*Survey B*).

At first glance, there is a broad and heterogeneous range of alternative metrics intended to capture the effects of large shareholdings (*Survey A*). The first major alternative is to either focus on ownership concentration and the existence of blockholders[8] (*Survey A1*), or on the controlling interest held by the largest or ultimate largest shareholder (*Surveys A2 and A3*). However, none of these studies attempt to define the most relevant metrics for determining control. Some of the reported studies use several of these metrics either for the purpose of robustness checks (Dyl, 1988) or as control variables (Cyert, et al., 2002). But none of these studies attempt to separate out their relative influence and define a straightforward identification criteria for effective monitoring. A preliminary contribution of the present empirical study is to define such criteria and isolate the metric associated to effective management monitoring.

2.2. The degree of control

A second alternative when accounting for the effects of large shareholdings lies in the metrics used to account for the degree of control (see second column of the table). Except for

[7] **Table 1** only reports the studies that suggested new or adjusted metrics for ownership. Other subsequent studies using similar methodologies were also reviewed but not reported, for Survey A1 (Mikkelson & Ruback, 1985; Core, et al., 1999; Chhaochharia & Grinstein, 2009), Survey A2 (Gomez-Mejia, et al., 1987; Kraft & Niederprüm, 1999; Cyert, et al., 2002), Survey A3 (Faccio & Lang, 2002; Laeven & Levine, 2008; Amoako-Adu, et al., 2011; Croci, et al., 2012; Lins, et al., 2013; Ben-Nasr, et al., 2015) and Survey B (Hermalin & Weisbach, 1991; Lambert, et al., 1993; Mehran, 1995; Faccio & Lasfer, 1999; Himmelberg, et al., 1999; Demsetz & Villalonga, 2001; Baran & Forst, 2015).

[8] Blockholders are shareholders that individually own more than 5% of equity.

two early studies relying on the weight of the top five shareholders (Demsetz & Lehn, 1985; Dyl, 1988), most authors first identify firms with at least one large shareholder, i.e. shareholders above a given threshold (see third column), then they either choose a discontinuous metric (an indicator variable or a dichotomous approach based on the existence of large shareholders) or a linear continuous one (the portion of equity shares held by large shareholders).

[Insert Table 1 about here]

A first issue related to the degree of control concerns the choice between continuous or discontinuous specifications and thus the existence of a threshold effect. Among the studies listed in *Survey A*, only Dyl (1988) and Hambrick and Finkelstein (1995) discuss this issue. Dyl contends that a continuous metric is more appropriate in an "agency" context but does not provide a rationale or empirical test for the validity of this assertion. Conversely, Hambrick and Finkelstein empirically show that a discontinuous metric is more appropriate to assess CEO pay monitoring and they conclude that a threshold effect in shareholdings is more relevant than a linear continuous relation. They argue that as soon as major shareholders hold a significant position, an increase by a few percentage points in equity shares should not substantially increase their vigilance.

A second issue about the degree of control relates to the threshold value the authors choose. Large shareholdings are taken into account as soon as they cross the minimum threshold reported in the third column of the table. Large shareholders are thus in most cases defined as blockholders (i.e., shareholders owning at least 5% of the common stock) or as shareholders crossing a threshold of 10% or 20% ownership. However, these thresholds have no theoretical or empirical rationale. They mostly rely on the regulatory thresholds that trigger the mandatory public reporting of ownership positions, which is 5% under the U.S. SEC and is 5% or 10% under other stock exchange authorities around the world. Some studies use a threshold of 20% or 25% but these values have no empirical, or even regulatory, foundations. Holderness and

Sheehan (1988) only hint that shareholders would not have enough voting power to affect firm policies below a 20% threshold. La Porta et al. also make a similar unfounded assumption that "this is usually enough to have an effective control of a firm" (La Porta, et al., 1999, p. 477). To the best of my knowledge, there is no study that intends to define the proper level of ownership required to have effective control over a firm.

The empirical study presented in the following sections deals with these issues. First, it provides a methodology to identify the relevant threshold values and also the relevant number of thresholds. Second, it tests for the validity of threshold effects compared to continuous ones.

2.3. Managerial ownership and non-linear continuous specifications

The present study deals with large shareholders and their monitoring behavior. Managerial ownership is a different subject that mostly focuses on agency conflicts between insider managers and outsider minority shareholders, and their impacts on firm performance (Berle & Means, 1932; Jensen & Meckling, 1976). This literature is yet presented here because it provides alternative methodologies to assess ownership impacts. Specifically, a major issue in this literature is about the amount of common stock a manager should hold to have a positive impact on firm value. In this context, empirical studies investigate the impacts of different levels of shareholdings more insightfully than the literature on large shareholdings.

Survey B in **Table 1** lists studies that suggested new or improved methodologies to study the impacts of insider ownership. Overall, these studies contrast with those listed in Survey A because they use non-linear continuous specifications instead of linear continuous ones or dichotomous variables. In the first instance, Morck et al. (1988) specify a piecewise (or spline) regression to test for a non-monotonic relation between insider ownership and firm value. This methodology is limited because it requires to exogenously set the number and value of breakpoints. Their specification with two breakpoints at 5% and 25% indeed finds their limits as some subsequent studies cannot replicate their results (Hermalin & Weisbach, 1991;

McConnell & Servaes, 1990). Other studies try to improve the piecewise specification. Cho (1998) introduces a grid search technique that allows to endogenously find breakpoint values, though in a model that still exogenously set the number of breakpoints. He finds a first point ranging between 7% and 10%, and a second between 34% and 38%.

Other studies use polynomial specifications for identifying the values of change points. First, McConnel and Servaes (1990) specify a quadratic function allowing for one turning point (the extreme value of the function) and two regimes. The authors find an inverted U-shaped relation between managerial ownership and firm value, with a maximum value at around 40% to 50%. Second, Short and Keasey (1999) refer to the spline regression of Morck et al. with three "pieces" to specify a cubic function allowing for two turning points and three regimes. Finally, Davies et al. (2005) think that a cubic specification is too restrictive to account for the evolution of managerial behavior. They then specify a quintic equation with four turning points and five regimes. One benefit of these polynomial specifications is that they allow to define endogenously the values of turning points. However, they are still limited because the number of regimes is exogenously predetermined by the number of degrees in the polynomial function.

Furthermore, these investigations do not discuss the possibility of threshold effects in managerial shareholdings instead of a continuous relation with change points. Specifically, piecewise and polynomial specifications assume that each percentage point in ownership has an incremental impact on firm value and that this impact is either positive or negative between two turning points. This surely brings very different results from a threshold specification with flat impacts of ownership between two breakpoints. Although there is no theoretical or empirical rationale for such a non-linear continuous impact, this choice is never discussed in these studies. Yet, the already-mentioned study by Hambrick and Finkelstein (1995) show that discontinuous threshold effects are more relevant when talking about shareholding impacts.

Overall, the literature on large shareholdings is limited because it assumes the value of a minimum threshold and then it includes a rough indicator variable or a linear continuous impact

above this threshold. The literature on managerial ownership is also limited because the non-linear specifications impose to arbitrarily choose the number of regimes or "pieces", and then assumes an unsupported linear continuous relation within each regime. By comparison, the PTR model that is used in the present study assumes there are threshold effects with a flat impact of ownership in each regime. It also allows to endogenously define both the value and the relevant number of breakpoints.

3. Methodology

3.1. The controlling shareholder

The present study intends to assess the impacts of large shareholders in terms of corporate control and, in the first instance, to identify which of the large shareholders can be identified as the controlling shareholders. For this purpose, I use the well-established relation between the existence of good governance, or efficient monitoring, and CEO pay design. In other terms, I assess the CEO pay monitoring activity of large shareholders.

In the absence of management monitoring, top managers may have enough influence over the board of directors to determine their own pay (Gomez-Mejia, et al., 1987; Hambrick & Finkelstein, 1995; Bebchuk, et al., 2002). Inversely, as the degree of control by large shareholders and/or the board increases, the level of cash compensation (Core, et al., 1999; Chhaochharia & Grinstein, 2009) and equity-based compensation (Cyert, et al., 2002) are found to decrease significantly. This inverse relation between the control of a firm and the level of management compensation is consistently supported in the literature.

However, the methods used to measure control are inconsistent from one study to another (e.g., in the identification of the monitor, the minimum level of equity shares or voting rights used to define large shareholdings) and none attempt to separate out their respective effects or identify the most relevant way to measure controlling shareholdings. The metrics are also

imprecise to some extent, specifically regarding the links between so-called "external" blockholders and directors[9].

A preliminary step in this study relates to the appropriate identification of controlling shareholders. For this purpose, different metrics for controlling shareholdings are tested for. First, the broadest measure of controlling shareholdings is the percentage of equity held by all blockholders. A distinction can then be made between blockholders that are directly or indirectly represented on the board of directors and those that are not. Second, the largest shareholder may have a specific influence, either among other shareholders represented on the board of directors, or as an external largest shareholder if no greater shareholder is represented on the board. Third, the largest shareholder can enhance control with devices such as shareholder agreements and deviations from "one share-one vote" principle. Fourth, the largest shareholder may be a company or any type of organization that may itself ultimately be controlled or diffusely-held with possibly different effects on its monitoring role. Most of these alternative metrics can be found in some articles listed in **Table 1**. Nevertheless, the literature provides no supporting references to differentiate between these many alternatives and draw up a hypothesis on the most relevant measure of controlling shareholdings. Also, I adopt an empirical approach using a set of measures aimed at identifying and isolating the large shareholding patterns that are associated with control. This is based on the following specification:

$$Comp_{j,i,t} = \alpha_j + \sum_{k=1}^{8} \vartheta_{k,j} Holdings_{k,i,t} + \sum_{k=1}^{9} \beta_{k,j} Firm \text{ \& CEO } characteristics_{k,i,t} + \sum_{k=1}^{10} \rho_{k,j} Industry_{k,i} + \sum_{k=1}^{2} \mu_{k,j} Type\ of\ control_{k,i,t} + \varepsilon_{j,i,t} \quad (1)$$

where the subscript j is equal to $\{1, 2\}$ and stands for, alternatively, cash compensation or total compensation, as defined in **Table 2**. The subscripts i and t respectively stand for firms ($i =$

[9] As noted by Holderness (2003), ownership databases basically define "insider ownership" as the individual holdings of officers and directors. Hence a blockholder in the form of a company, bank, or holding company, represented indirectly on the board through one of its employees, would be treated as an "outsider" blockholder. Indirect representation is not usually correctly taken into account as it requires manually-collected information about the links between directors and "outsider" blockholders.

$\{1, \dots, 123\}$) and year ($t = \{1, \dots, 10\}$). The $Holdings$ variable is subdivided into eight categories as presented in **Table 2**. These variables are aimed at identifying the large shareholders that effectively play a management monitoring role and providing a relevant definition of controlling shareholdings.

Eq. (1) is specified for pooled panel data, with robust errors clustered at the firm level to account for correlations within the firms. Panel data with fixed individual effects would not be a relevant alternative in the present study, notably because CEO compensation and ownership patterns mostly vary from one firm to another rather than within each firm. The above-specified equation aims to estimate the impacts of differentiated ownership patterns on CEO compensation from one firm-year to another, and not the impacts of ownership variations within each firm over the sample period, as a fixed effect model would do.

[Insert Table 2 about here]

Firm and CEO characteristics are control variables listed and described in **Table 2**. One of the most influential determinants of CEO pay according to the literature is $firm\ size$ (Gabaix & Landier, 2008; Cyert, et al., 2002). As firm size grows, the complexity of the organization and the number of hierarchical levels increase and push the top compensation upwards. Similarly, the $age\ of\ the\ company$ denotes the complexity and maturity of a firm's organization. $Capital\ intensity$ is a proxy for measuring the asymmetry of information between the CEO and the shareholders regarding growth opportunities: a high proportion of tangible assets would reduce such asymmetries (Margaritis & Psillaki, 2010) and thus have a negative impact on CEO pay. $Average\ ROA$ stands for profitability of the firm and is expected to have an inverse relation with CEO pay: low profitability is associated with higher risk for the firm, which in turn increases the contingent portion of pay and the level of total compensation for risk-averse CEOs (Beatty & Zajac, 1994). Lastly, indicator variables are included to account for industry-specific fixed-effects (Gomez-Mejia, et al., 2003; Cyert, et al., 2002).

It can be noted that $firm\ size$ has two metrics: sales and the market value of equity. Unreported tests show that the accounting measure, i.e. sales, better explains the level of salary, and the market-based one better accounts for variable components of pay (bonus and equity-based pay). Both variables are then included to accurately account for the size effect on cash and total pay.

Other firm characteristics were also tested in this study but are not included in the regressions. It includes the firm's risk as measured with the standard deviation of ROA (Core, et al., 1999; Cyert, et al., 2002). It is strongly negatively correlated to the earlier-mentioned $average\ ROA$ variable so that its inclusion would be redundant. Growth opportunities, as measured with a market-to-book ratio, and firm's leverage (Conyon, et al., 2011) were also tested. The former has an explanatory power but is redundant with the simultaneous use of an accounting and market-based metric for firm size (i.e., sales and market value), and the latter is found to be non-significant on the panel. They are not included in the tables for the sake of simplicity.

CEO characteristics are taken into account with the following variables. $CEO\ tenure$[10] is expected to have a nonlinear impact on compensation: tenure may have a positive impact on pay raises in the first years because of experience and increased CEO bargaining power, but in subsequent years long-tenured CEOs develop firm-specific human capital and lose attractiveness in the managerial labor market, this in turn reduces their bargaining power in the pay-setting process (Hambrick & Finkelstein, 1995; Cyert, et al., 2002). In addition, CEOs may accumulate stock ownership over the years that reduces the need for additional equity-based pay for long-tenured CEOs (Chourou, et al., 2008). This nonlinear impact is taken into account by adding the square value of $CEO\ tenure$ in **Eq. (1)**. Next, Hambrick and Finkelstein (1995) show that newly-nominated CEOs are paid less than their predecessors if they are promoted internally

[10] $CEO\ age$ is also usually included as a determinant for CEO pay. It is not included here because it results in information positively correlated to $CEO\ tenure$ and it is redundant (Croci, et al., 2012).

($new\ insider\ CEO$), conversely $new\ outsider\ CEOs$ are paid a premium so as to attract them and are expected to have at least the same level of compensation as their predecessors. The last two control variables are indicator variables that control for the positive impact expected from CEOs who also chair the board (Core, et al., 1999; Cyert, et al., 2002), and for the premium provided to CEOs who are firm founders but do not hold a large share of equity. The age of CEOs is also usually included as a determinant for CEO pay. It is not included here because it results in information strongly positively correlated to $CEO\ tenure$ and it would be redundant (Croci, et al., 2012).

Beyond the degree of control, the type of control as defined by the identity of the largest shareholder can also influence CEO compensation schemes. Two specific types of control, characterized by their diversified or passive involvement in firms (namely, $investment\ companies$ and $passive\ families$), were found to be significantly associated with higher levels of compensation in an earlier study (Almeida, 2014). The effects of these two categories are then controlled for with an indicator variable to avoid biased analyses of the degree of control.

3.2. Degree of control and the PTR model

To define the different degrees of control, I use the panel threshold regression (PTR) model developed by Hansen (1999). It derives from the literature on time series structural changes with unknown change points, and provides an extension to panel data with threshold effects. The procedure described by Hansen provides testing techniques to measure the relevant number m of thresholds that allows for $m + 1$ regimes to be significantly differentiated, and to determine a confidence region or interval around each threshold value (for γ_1 to γ_m).

In this empirical study, the threshold variable is the percentage of the equity held by the controlling shareholder. The control variables that were included in **Eq. (1)** – namely, firm and CEO characteristics, industry-specific effects, and the type of control – are unchanged and are

denoted as X in the following equations. But the $Holdings$ variable that represented a percentage of shares in (1) is replaced by a set of $M+1$ indicator variables that represents the distinct regimes in the degree of control. The equation takes the following form:

$$Comp_{j,i,t} = \alpha_j + \sum_{m=1}^{M+1} \theta_{j,\mathrm{m}-1}\, \mathrm{I}\{\gamma_{\mathrm{m}-1} \leq CS_{i,t} < \gamma_{\mathrm{m}}\} + \sum_{k=1} \beta_{j,k} X_{k,i,t} + \varepsilon_{j,i,t} \qquad (2)$$

where CS denotes the percentage of controlling shares, and $\mathrm{I}\{.\}$ is an indicator function that takes value one for $\gamma_{\mathrm{m}-1} \leq CS_{i,t} < \gamma_{\mathrm{m}}$, and zero otherwise. M is the number of thresholds. The smallest and highest thresholds are set to zero and one ($\gamma_0 = 0, \gamma_{M+1} = 1$). This discontinuous measure assumes that the degree of control has a homogeneous effect in each regime. In other words, as soon as the controlling shareholder crosses a given threshold, the control regime has a fixed effect up to the next threshold. The effect thus does not depend on the relative percentage of holdings in each regime and thresholds are defined as breakpoints with no transition.

The first regime, denoted $\mathrm{I}\{\gamma_0 \leq CS_{i,t} < \gamma_1\}$, includes firms with no large shareholder (i.e., $CS_{i,t} = 0\%$), plus firms with large shareholders below the first threshold value (i.e., $1\% \leq CS_{i,t} < \gamma_1$)[11]. Below this γ_1 threshold, large shareholders design compensation schemes similar to the ones offered by firms with no large shareholders. Hence, firms falling in this first regime can be considered as non-controlled, or to be diffusely-held. The PTR specification notably aims to identify this first threshold above which large shareholders are deemed to effectively monitor the management. This regime of non-controlled firms also serves as a benchmark for the specific effects of the other control regimes. For this reason, it will be omitted in the estimations, which is equivalent to imposing a constraint making $\theta_{j,0}$ be equal to zero.

[11] Large shareholders are defined as shareholders with a minimum of 1% ownership, so CS has no values between 0% and 1%.

The procedure for estimating the threshold values starts with a single-threshold model ($M = 1$) and first consists of one iteration aimed at determining the value of γ_1 that minimizes the sum of squared errors of the following equation:

$$Comp_{j,i,t} = \alpha_j + \theta_{j,1} \{\gamma_1 \leq CS_{i,t} < \gamma_2\} + \beta_{j,k} X_{k,i,t} + \varepsilon_{j,i,t} \quad (2')$$

where $\gamma_2 = 1$. The sum of squared errors is denoted S_1 and the least-square estimator of γ_1 is as follows:

$$\widehat{\gamma_1} = \underset{\gamma}{argmin}\, S_1(\gamma)$$

As recommended by Hansen (1999), γ should take such values that a sufficient number of observations lie in each regime to avoid defining regimes by picking out outliers; the iteration will thus be applied with values of γ starting with the lowest decile of controlling shareholdings in the whole sample and incremented by 1% up to the top decile.

The second step consists of testing the significance of the single-threshold model with $\widehat{\gamma_1}$ as compared to a zero-threshold model. It thus consists of testing the alternative hypothesis of the existence of a threshold effect in controlling shareholdings, as opposed to the null hypothesis of no threshold effect on the CEO pay setting process whatever the level of controlling shareholdings, all other things equal. The null hypothesis is then represented by the following constraint:

$$H_0: \theta_{j,1} = \theta_{j,0}$$

where, as stated above, $\theta_{j,0}$ is set to zero. The sum of squared errors under the null hypothesis is denoted S_0 and the test statistic takes the following form:

$$F_1 = \frac{S_0 - S_1(\widehat{\gamma_1})}{\widehat{\sigma^2}}$$

where $\widehat{\sigma^2}$ is the residual variance under the alternative hypothesis. The null hypothesis of a zero-threshold model is rejected for large values of F_1[12], with critical values obtained from a simulated *bootstrap* distribution.

If the single-threshold model is validated, the second stage consists of testing for a double-threshold model. Taking the threshold value $\widehat{\gamma_1}$ found in the first stage as given, an iterative grid search looks for a second threshold value γ_2 that minimizes the sum of squared errors of **Eq. (2)**. The value of $\widehat{\gamma_1}$ found in the first stage is then confirmed with a *refined* estimation: the iterative procedure is repeated taking the value of $\widehat{\gamma_2}$ as given this time.

The following step is to test the null of a single-threshold against the alternative of a double-threshold model with the F-statistic. If the null is rejected, the next stage consists of looking for a third threshold point γ_3. These stages are repeated as long as the null hypothesis of $M-1$ against the alternative of M threshold points is rejected. At the end, the procedure defines the relevant number of thresholds and regimes for the sample, and the refined estimated values of the thresholds.

The appendix of this paper provides further details about the motivation and procedure for the *bootstrap* distribution of the F-statistic and for the *refined* estimates of threshold values. The appendix also explains the last stage of the procedure, i.e. the construction of confidence intervals (more precisely, *no-rejection regions*) around the estimated threshold values.

4. The data

4.1. Sample data

The sample firms are selected from 180 French firms listed on Euronext Paris and members of the SBF120 Index for at least one year between 2003 and 2012. The sample is restricted to public

[12] A large value of F_1 means that the sum of squared errors for the zero-threshold model (S_0) is much higher than the sum of squared errors for the single-threshold model ($S_1(\widehat{\gamma_1})$): the higher the value of the test statistic, the better the latter model is estimated compared to the former.

limited companies headquartered in France[13] and to firms that have fully available data for at least four years. This leaves a sample of 1,119 firm-year observations for 123 firms from 2003 to 2012. CEO characteristics and compensation data are manually collected from annual reports, and firm characteristics are extracted from *Datastream*. *Thomson One Banker – Ownership* database provides the annual percentages of equity held by shareholders. Blockholders (i.e. shareholders holding more than a five-percent share) are isolated, cross-checked with ownership data provided in annual reports, and corrected when necessary[14]. Based on the identities of directors and the lists of their mandates disclosed in annual reports, I discriminate between blockholders that are directly or indirectly represented on the boards of directors, and those who are not. If no blockholder is represented on the board, I identify the largest shareholder represented on the board, provided there is at least one large shareholder (i.e., shareholders with at least one percent of ownership) represented on the board[15]. Shareholders that are part of a shareholder agreement with the largest shareholder are also identified. Lastly, the voting rights of the largest shareholder, and of shareholders that are part of a shareholder agreement with him/her/it, are hand-collected when company bylaws provide for double voting rights for certain shareholders[16].

[13] This omits foreign companies in order to avoid country-specific effects, and companies that are not public limited ("société anonyme"), namely limited partnerships with shares ("société en commandite par actions") in which CEOs have a specific status and, most often, specific pay packages.

[14] A number of errors need some attention in the ownership database and were checked by comparing with the mandatory information about blockholders disclosed in companies' annual reports. For instance, in the absence of updates from investors, shareholdings are maintained unaltered for two fiscal years in the database; this may result in significant inaccuracies when some large blockholders withdraw, or in the event of capital transactions (splitting or combining of shares, capital increases…) in the meantime. The database also includes some duplicates because of multiple sources of data.

[15] Largest shareholders below 1% ownership are not taken into account because annual reports and the Thomson database do not provide exhaustive data for such shareholders, even though they are represented on the board.

[16] In France, the deviation from "one share-one vote" principle takes the form of shares with double voting rights allocated to shareholders that have been registered for more than, typically, two or four years.

4.2. Descriptive statistics

Table 3 displays some descriptive statistics for the data. The average size of sample firms is €11,764 million in terms of sales and €9,477 million in terms of market capitalization, in constant 2007 euros. The average firm has a capital intensity of 23.39% and a five-year average ROA of 3.01%, was first established 87 years ago, and went public 23 years ago. The average CEO has served as CEO for 10 years. He/she is a new CEO for 21% of the firm-year observations, including 12% as an insider and 9% as an outsider. He/she is also the board chairperson, and is the founder of the company but not a blockholder, respectively for 54% and 4% of the firm-year observations. His/her mean cash and total compensation are respectively €1.27 million and €2.16 million. Following previous studies (Finkelstein & Boyd, 1998; Gomez-Mejia, et al., 2003), the value of stock-options is estimated as the number of options multiplied by 25 percent of the exercise price[17]. Other stock-based pay is estimated based on the value of the stock on the day it is granted.

[Insert Table 3 about here]

Companies do not provide their CEOs with equity-based compensation on any standard timetable. Some grant it on an annual basis, others from one year to another, or triggered by a specific event (newly nominated CEO, IPO, an exceptional operating or financial success…), and some firms do not provide any stock-based pay. This accounts for a large dispersion of the total compensation and high relative values in the last decile. Hence, the regressions of the following sections will be based on two-year averaged equity-based compensation in order to mitigate the irregular practices in these grants (the averaged equity-based pay included in the total compensation for 2003, i.e. for the first year in the sample period, is thus the average of the

[17] Since 2007, listed companies on the panel have to disclose the fair value of the equity-based compensation according to IFRS2 (most of them use the binomial or Black and Scholes methods). Using this data instead of the above-mentioned estimates does not change the quality or significance of the subsequent results.

options granted in 2002 and 2003). Still, this does not attenuate the very high relative values for a number of these grants. Equity-based compensation is then *winsorized* in the following way: the ratio of equity-based to total compensation has a top decile of 56% (not reported), the value of equity-based pay is then trimmed so as to represent a maximum of 56% of total compensation.

In the average sample firm, about 2.1 blockholders hold 43.09% of the common stock, and 32.41% is held by the largest shareholder. Out of these 2.1 blockholders, 1.3 are *insiders* (i.e., they are directly or indirectly represented on the board of directors). Panel B in **Table 3** is made up of the 929 firm-year observations in which at least one blockholder is represented on the board. In these firms, an average of 2.3 blockholders hold about half of the company's equity, including 43.58% held by an average of 1.6 insider blockholders. The largest shareholder holds on average 37.42% of the equity share compared to 37.24% for the largest insider shareholder[18]. Other shareholders that concluded an agreement with the latter add an average control of 3.32%, reaching a combined interest of 40.55%[19]. Another device for increasing control consists of conferring double voting rights on certain categories of shares. This gives nearly 6% of additional interest to the average largest insider shareholder, alone or in concert, who thus reaches a voting control of 46.16%[20].

Panel C in **Table 3** presents descriptive data for the 190 firm-years in which no blockholder is represented, directly or indirectly, on the board. For the average firm in this sub-sample, about 1.6 outsider blockholders still hold 12.26% of the shares, but 42 of these firm-years (not

[18] The slight difference between these shareholdings is explained by the 55 firm-years (not reported) in which the largest shareholder is an *outsider* (i.e., not represented on the board).

[19] More specifically, the largest shareholder acts in concert with other shareholders in 184 firm-years. In this sub-sample (not reported in **Table 3**), the largest shareholder owns an average 28.13% of equity shares, and the shareholders acting in concert with it add 16.74%, together totaling an average of 44.87% of equity control.

[20] On Panel B, a sub-sample of 556 firm-years provides double voting rights to shares that have been registered under the same shareholder's name for more than two or four years. In this sub-sample (not reported), the average largest shareholder holds, by itself or in concert, 38.79% of the common stock and 48.14% of the voting rights.

reported) have no blockholders at all. Most of the largest shareholders in this sub-sample (180 out of 190, not reported) are outsider shareholders holding a larger share of equity than the largest shareholder represented on the board. Consequently, the average share of the former is 7.90% compared to 1.24% for the latter. In addition, in more than half of this sub-sample (119 firm-years, not reported), there are no large shareholders (with more than 1% of equity shares) represented on the board.

To sum up, some firms have no large shareholder represented on the board but have outsider blockholders; among firms that have a large insider shareholder, some also have other insider and/or outsider blockholders, and some outsider blockholders may hold higher positions than the largest one represented on the board. In addition, some of the largest insider shareholders act in coalition with other insider shareholders and some have additional control with double voting rights. These various patterns leave a variety of alternatives for measuring and identifying which shareholders exert effective control on the firm. The following section aims to separate the respective influences of each of these various categories of shareholders by estimating their impacts on CEO compensation monitoring.

5. Empirical results

5.1. Metrics of corporate control

A number of studies provide evidence of a negative relation between the level of CEO compensation and the existence of monitoring by large shareholders. I also find this relation to be significant for the French sample, either with the synthetic measurement of control (i.e. the shares held by the top five shareholders such as in Dyl (1988)), or with an indicator for the presence of a blockholder, such as in Tosi and Gomez-Mejia (1989) or in Hambrick and Finkelstein (1995). These results with the synthetic measurements are not reported here as they provide no insight into who precisely exerts control. Instead, I split the synthetic measures into

variables measuring the holdings of the large shareholders according to the criteria presented in **Table 2**. **Eq. (1)** is then run and the results are reported in **Table 4**.

Regarding the effect on cash compensation (**Table 4**, column 1), only the holdings of the largest shareholder represented on the board of directors, plus the holdings of the shareholders that have concluded an agreement with him/her/it, present a significant negative relation with the salary and bonus levels granted to the CEO. The holdings of the other blockholders, either represented on the board or not, have no impact. A largest shareholder that is not represented on the board has also no impact on the cash compensation scheme.

The effect of the holdings of shareholders acting in concert is retained, and the largest shareholders are subdivided between those that are ultimately controlled (including, by definition families and the State, and companies or institutions that are themselves controlled) and those that are not (column 2). The results show that both have a significant negative impact on cash compensation, although the former's is more significant than the latter's. The striking result is that both exert an effective control over cash compensation. This justifies keeping shareholders that are ultimately diffusely-held companies or institutions as a measure of effective control, together with ultimately controlled shareholders.

[Insert Table 4 about here]

The regression in column 2 also includes the percentage of voting rights in addition to cash flow rights for the largest shareholder on the board plus the shareholders acting in concert. Two opposite results may be expected for this variable. Double voting rights may increase the degree of control and have an additional negative impact on compensation. Conversely, in an "entrenchment" situation, the effect of this variable may be positive because shareholders are expected to use their additional influence to extract private benefits (Claessens, et al., 2002; Gompers, et al., 2010; Belkhir, et al., 2014) – they would pay higher salaries to their CEOs either as a form of private benefit if the CEO is a major shareholder (Core, 1997) or as a means to buy

his/her loyalty (Croci, et al., 2012). The results show no significant impact of double voting rights, and neither alternative expected effect is confirmed.

Column 3 presents the regression with the relevant measure of the degree of control, i.e. the portion of equity held by the largest shareholder represented on the board of directors and by the shareholders acting in concert with him/her/it. Columns 4 to 6 present the same regressions with total compensation as the dependent variable. The relevant measure of controlling shareholdings is similar to that of cash compensation, i.e. the shares held by the largest shareholder represented on the board, either ultimately controlled or not, alone or in concert. The impact of these shareholders on total compensation is presented in column 6. The holdings of these shareholders are hereafter referred to as "controlling shareholdings", and will serve as the measure of the degree of control in the following section.

The results show that only the large shareholders represented on boards of directors carry out management monitoring activities in France. This tempers the results found in prior studies regarding the effects of "outsider" shareholders. Core et al. (1999) and Cyert et al. (2002) find that the existence of large outsider shareholders and the holdings of the largest external shareholder, respectively, have a negative impact on the level of CEO compensation for U.S. firms. As previously stated, these studies are based on databases that do not take into account the indirect representation of large shareholders on the board. Such shareholders are then bound to be categorized as outsider or external shareholders while they might be indirectly represented on the board (Holderness, 2003). Although the sample data are based on different countries, this imprecision in ownership database might account for differing results between earlier studies and the tests reported above and based on manually-collected information. The results then suggest that among the various categories of shareholders, only those that can have

their interests voiced on the board of directors may exert effective monitoring, and the effects of other large shareholders are not significant[21].

As for firm characteristics, the size effect is positive and significant both as measured by sales and market capitalization[22]. The age of the firm, in relation to the size and the maturity of the firm's business, is positively and significantly associated with the levels of CEO pay. Capital intensity has a significant negative coefficient, consistent with the prediction that in firms with a high ratio of tangible assets, the top manager has less discretion and needs less monitoring through contingent pay. Average ROA is also negatively and significantly related to CEO compensation: low performance is associated with higher firm's risk[23] and CEOs in these firms may receive a higher level of compensation to compensate for uncertain contingent pay (Cyert, et al., 2002).

Regarding CEO characteristics, the square of CEO tenure has a negative impact on the levels of pay, which is consistent with the nonlinear relation found by Hambrick and Finkelstein (1995). During their first two years of tenure, CEOs coming from outside the firm (*New outsider CEO*) are paid the same as their predecessors in terms of cash compensation, but they receive higher equity-based compensation resulting in higher total compensation; CEOs recruited from inside the firm (*New insider CEO*) are paid less both in terms of cash and total compensation. This is also consistent with the predictions of Hambrick and Finkelstein (1995). CEOs who also chair the boards of directors receive higher cash compensation but do not receive higher long-

[21] This result may be different if other large shareholders were categorized by type of control, notably to account for the influence of outside activism from certain types of shareholders (see for instance Croci et al. (2012) for the effects of minority institutional investors in family firms). This is however beyond the scope of this study.

[22] Both measures are correlated, but each contributes independently to explain the levels of CEO compensation: unreported regressions show that sales better explain the base salary component and market capitalization better explains the contingent components of pay, hence both measures are kept in the base specification.

[23] This is verified by the highly negative correlation between average ROA and the standard deviation of ROA (not reported).

term incentives. CEOs who are also firm founders but do not hold large blocks of shares are paid significantly more.

Lastly, the type of control in the form of investment companies and passive families has a significant positive impact on CEO pay, as expected for diversified or passive largest shareholders. Industry fixed effects are also accounted for: consistent with the analysis of Demsetz and Lehn (1985), the media pay among the highest cash and total compensation while regulated industries (utilities, banks and insurance companies) pay among the lowest cash and total compensation (not reported).

5.2. Estimation of thresholds in the degree of control

This section follows the methodology presented earlier to identify one or more thresholds in the controlling shareholdings (denoted CS). Following the results of the previous section, controlling shareholdings are defined as the equity shares held by the largest shareholder, alone or in concert, represented on the board of directors. In the first stage, I look for the value of γ that best discriminates between a first class of non-controlled firms (including firms with no large shareholders on the board) and a second class of controlled firms, based on the differing effects of the two regimes of controlling shareholdings on CEO pay monitoring. γ can take all integer values from the lowest to the highest deciles of the controlling shareholding distribution, i.e. from 1% (actually above the first decile, as 119 out of 1,119 firm-years have no large shareholders on the board) to 68%. If the threshold effect is significant, the next step consists of looking for the second, third, etc. threshold, while taking the previously found thresholds as given and as long as the m^{th} threshold is significant.

Table 5 displays the results of this sequential iterative procedure. The first threshold found for cash and total compensation has an F-statistic that is much higher than the bootstrap 1% critical value (84.71 vs. 11.40 for cash compensation, and 141.32 vs. 12.10 for total compensation); the same applies for the second threshold found. Thus, the zero- and the single-threshold models

are successively rejected. The existence of a third threshold point is also validated for cash and total compensation at the 1% and 5% levels of confidence, respectively (bootstrap p-values are 0.8% and 4%, respectively). Finally, the tests for a quadruple-threshold model against a triple-threshold model are rejected for both dependent variables, with bootstrap confidence levels of 97% and 13%, respectively.

In the single- and double-threshold models, the estimate values are respectively 46% and 11% both for cash and total compensation. These two values are used in the triple-threshold model to find the third threshold, which is 34% for both dependent variables. The two first values were estimated while ignoring the existence of a second or third threshold point. The refined estimation consists of first taking the 34% and 46% thresholds as given and looking again for the first threshold, and then taking 34% and 11% as given and looking again for the second threshold. The refined estimates confirm the 11% and 46% threshold points found in the single and double threshold models, and are displayed in **Table 6**[24].

[Insert Table 5 and Table 6 about here]

Table 6 also displays the confidence interval for the three refined threshold estimates, based on the LR-test described in the appendix. The confidence intervals for the 11% and 46% threshold values are quite tight and provide good confidence in the value of the breakpoints separating one regime of the degree of control from another. The confidence interval for the 34% threshold value is wider: [31%, 42%] at the 5% level of significance. The specific pattern of this regime that presents a CEO pay design similar to the omitted regime (further described below) may account for such a relaxed confidence interval.

[24] As a robustness test, I also run a simultaneous search for γ values in the triple threshold model, i.e. looking for the three threshold values that simultaneously minimize the sum of squared errors in **Eq. (2)**. The simultaneous procedure provides the same three estimate points as in the sequential one.

5.3. Thresholds for the degree of control

The dummy variables for the degree of control regimes are integrated into the base regression specified in **Eq. (2)** and displayed in columns 1 and 2 of **Table 7**. As the dependent variable is log-transformed, the coefficients of the dummy variables can be interpreted as approximated deviations in percentage from the omitted regime of non-controlled firms. Firms falling into the second monitoring regime with controlling shareholdings ranging from 11% to 34% pay about 17% less cash compensation to their CEOs. After adding the long-term incentives, the discrepancy between the first and second regimes increases with an approximately 31% lower level of total compensation in the latter. Controlling shareholders holding 46% or more of the common stock exert significantly stronger CEO pay monitoring: the cash and total compensation are about 32% and 54% lower compared to the first regime, respectively[25].

[Insert Table 7 about here]

These coefficients for the control regimes are also significant in terms of their economic impact on CEO compensation. The average CEO in the first class of non-controlled firms receives a cash compensation of €1.4 million and a total compensation of €2.5 million. If he/she served as a CEO in the second class of firms, he/she would receive €222,000 and €692,000 less, respectively and all other things equal. It would be a lower cash and total pay of €357,000 and €1.10 million, respectively, in the fourth class of firms.

The third regime present a specific pattern as CEOs receive cash compensation at similar levels as in the first regime of non-controlled firms (column 1 in **Table 7**). They receive a slightly lower total compensation of about 16%, at the 10% significance threshold, which represents a difference of about €344,000 for the average CEO. Unreported tests of difference show that the levels of pay in this regime are higher than in the two other regimes of controlled firms, which

[25] The specific effects of the second and fourth control regimes are also significantly different from each other: Wald tests for the equality of the coefficients are rejected with a level of confidence of 98% and 99.7% for cash and total compensation, respectively.

is quite surprising as the degree of control in this third regime is stronger compared to the second one.

Higher levels of pay in the third regime lead to a different interpretation compared to higher levels found in the first one. In the latter class of non-controlled firms, higher CEO compensation can be interpreted as higher influence of the CEO over the board of directors in the absence of a controlling shareholder. In the third class of firms, similarly higher CEO compensation may instead be interpreted as entrenched behavior of the controlling shareholder. Paying a higher compensation can be a means to make the CEO manage the firm in the interest of the monitor, potentially at the expense of minority shareholders.

Entrenchment at this intermediate level of control can be explained in two ways, first by comparison with the controlling position of the second regime, second by comparison with the fourth one. First, controlling shareholders in the second regime are in a contestable position. Largest shareholders with a minority position may face other large shareholders with a slightly lower position that could easily take over the controlling position. Also, in the absence of such other large shareholders, the largest shareholder has an incentive to provide an efficient monitoring so as not to send a negative signal to the markets and increase the risk of a hostile takeover. Conversely, shareholders in the third regime may be protected from the external threat of hostile takeovers. Some authors refer to anecdotal evidence suggesting that hostile takeover attempts cannot succeed when an existing shareholder owns more than 25% or 30% of equity shares (Weston, 1979; Holderness, 2003)[26]. Such protection can provide incentives to entrenched behavior.

Second, shareholders in the fourth regime also hold a position that protects them from hostile takeovers, though the results show they do not adopt entrenched behaviors. Shareholders

[26] Also, the French regulation provides that holding one-third of the voting rights gives a blocking minority in extraordinary general meetings, and gives control over every decision related to capital transactions or mergers and acquisitions. This is an additional anecdotal evidence in the French context that such positions protect from hostile takeovers.

in the third and fourth regime are actually in a distinct controlling position. Both bear the full costs of monitoring activities – minority shareholders are presumably free-riding (Shleifer & Vishny, 1997) – but monitors in the third regime only get a minority cash flow return, while those in the fourth regime own majority rights on the benefits. Thus, controlling shareholders in this intermediate position may be willing to capture private benefits and increase the cash flow return on their monitoring activities, at the expense of free-riding outsider shareholders.

The structure of pay in this regime can provide a robustness check for this interpretation. High levels of equity-based compensation would contradict the entrenchment view, as entrenched controlling shareholders should not be willing to provide market-based incentives that might align the interests of the CEO with those of outside shareholders. The coefficients found in this third regime in **Table 7** show that CEOs receive significantly lower total pay but a similar cash pay compared to non-controlled firms. This translates into lower equity-based compensation compared to non-controlled firms[27]. Consequently, the higher level of total compensation in the third regime compared to the second and fourth ones is mainly comprised of higher cash compensation, which is consistent with the entrenchment interpretation.

6. Continuous vs. discontinuous measures

The estimations presented above assume a threshold effect at certain points of the controlling holdings and homogeneity of the degree of control within a given regime. This assumption shaped the base specification (**Eq. (2)**) where the metrics of the degree of control are indicator variables. A number of studies concerning ownership concentration and large shareholders (see **Table 1**, survey A) use instead a continuous ownership measure taking the percentages of equity held rather than indicator variables. Other studies related to managerial ownership (**Table 1**,

[27] This was also checked with a specific regression for equity-based compensation (not reported). It consistently shows that, *ceteris paribus,* firms in the third regime grant significantly lower equity-based pay than in the regime of non-controlled firms.

survey B) rely on specific continuous measures, namely spline and polynomial functions, to estimate the impacts of executives' shareholdings on firm value.

The present section compares the results found with these methods with those found with the PTR model. The comparison can serve as robustness tests for earlier results[28]. More fundamentally, it is also used to discuss the relevance of such continuous measures used in the literature and to highlight their consequences in terms of interpretations compared to discontinuous specifications with threshold effects.

6.1. Continuous and piecewise linear forms

First, I re-estimate **Eq. (2)** using the percentages of controlling shareholdings in each regime instead of indicator variables. If a continuous measure is better to capture the degree of control, indicator variables would be too restrictive because they do not account for varying degrees of control within one regime. A specification that includes the percentage of controlling shares for each regime should then raise the quality of the estimate. These results are displayed in columns 1 and 2 of **Table 8**.

[Insert Table 8 about here]

Second, I re-estimate **Eq. (2)** using a spline function in the form of a piecewise linear regression, as found in Morck et al. (1988) and Cho (1998). This specification requires to create the following variables:

[28] In addition, I also run a panel smooth transition regression (PSTR) model (Gonzáles, et al., 2005) as a robustness check for the relevance of a PTR model. This model is similar to the PTR one except that the transition between two regimes is not a breakpoint but a continuous smooth transition defined by a logistic function. The results show that the potential transition has a range of less than 1 percent point, so that the PTR specification, with sharp transitions from one percent threshold point to another, is more relevant.

$$
\begin{aligned}
1st\ regime &\quad \begin{cases} = CS\ \%, & if\ CS\ \% < 11\% \\ = 11\% & if\ CS\ \% \geq 11\% \end{cases} \\
2nd\ regime &\quad \begin{cases} = 0, & if\ CS\ \% < 11\% \\ = CS\ \% - 11\%, & if\ 11\% \leq CS\ \% < 34\% \\ = 34\% - 11\%, & if\ CS\ \% \geq 34\% \end{cases} \\
3rd\ regime &\quad \begin{cases} = 0, & if\ CS\ \% < 34\% \\ = CS\ \% - 34\%, & if\ 34\% \leq CS\ \% < 46\% \\ = 46\% - 34\%, & if\ CS\ \% \geq 46\% \end{cases} \\
4th\ regime &\quad \begin{cases} = 0, & if\ CS\ \% < 46\% \\ = CS\ \% - 46\%, & if\ CS\ \% \geq 46\% \end{cases}
\end{aligned}
\tag{4}
$$

where $CS\ \%$ stands for the percentage held by the controlling shareholders. A drawback of this specification is that it does not provide a methodology to define the value of breakpoints. They have to be defined exogenously and I thus use the threshold values earlier found with the PTR model. The results are displayed in columns 3 and 4 of **Table 8**.

The first regime is omitted for both specifications, consistent with the base specification for the PTR model. In the first specification (columns 1 and 2), the coefficients for each regime have the same level of significance as in the PTR model. In the second specification (columns 3 and 4), the coefficients for the second and fourth regimes are not significant (19% and 12% p-values, respectively) for cash compensation[29] but are significant for total compensation. The coefficients for the third regime are not statistically different from zero as in the discontinuous specification. These results are not very different from the discontinuous specification, and it provides some robustness for the estimated impacts of the degree of control found in **Table 7**.

Nonetheless, the adjusted R^2 are slightly lower in the four columns of **Table 8** compared to the PTR model in **Table 7**. Thus, the percentage held by the controlling shareholder in each regime does not improve the measurement of the degree of control, in spite of a finer measure of its continuing changes in the degree of control. At this stage, these results tend to support the

[29] The coefficients in column 3 should be interpreted as follows: a controlling shareholder holding for instance 50% of the common stock first has a negative impact of 0.49 for each percentage point between 11% and 34%, a negative impact of 0.32 for each percentage point between 34% and 46%, and a negative impact of 0.54 for each additional percentage point above 46%.

existence of threshold effects when measuring the impacts of ownership, and qualify the relevance of using continuous metrics.

6.2. Non-linear continuous function

Referring to studies of managerial ownership by McConnel and Servaes (1990), Short and Keasey (1999) and Davies et al. (2005), I also use a polynomial equation to estimate the continuous impact of the degree of control on CEO compensation.

Contrary to the piecewise linear form, the polynomial function does not require to set exogenously the value of change points, but it still requires to arbitrarily set the number of degrees of the function and hence the number of regimes. The aforementioned studies chose respectively quadratic, cubic or quintic functions. In the present study, for the purpose of comparison, I rely on the number of regimes that were found with the PTR model (i.e., four regimes), which requires a six-degree function. As in the piecewise linear form and contrary to, The polynomial specification does not assume a flat impact between change points as the threshold model does, but, as in the piecewise linear form, it expects successively negative and positive slopes within each regime[30].

In order to make the comparison between the PTR model and the polynomial specification more straightforward, with also a view of presenting it graphically below, I run both specifications with excess pay as a dependent variable. Excess pay is the difference between observed pay and its estimated value based on usual control variables (firm and CEO characteristics). It is defined as the residuals of the base specification (**Eq. (2)**) with no *controlling shareholdings* variable, and it can be interpreted as deviations of CEO pay from its expected value according to its economic determinants.

[30] The difference between the piecewise and the polynomial forms is that the former specifies linear forms and the latter non-linear forms between change points.

It is then denoted as $Excess\ comp$ and it is regressed on the six-degree polynomial function[31], as follows:

$$Excess\ comp_j = \alpha_{j0} + \alpha_{j1}\, CS + \alpha_{j2}\, CS^2 + \alpha_{j3}\, CS^3 + \alpha_{j4}\, CS^4 + \alpha_{j5}\, CS^5 + \alpha_{j6}\, CS^6 + \varepsilon_j \quad (5)$$

where $j = 1$ denotes cash compensation, $j = 2$ denotes total compensation; CS stands for the percentage of controlling shareholdings with a minimum value of 1%. The intercept α_{j0} can be interpreted as an approximation for the average excess compensation in firms with no large shareholders on the board of directors (i.e., when $CS = 0\%$).

The estimated coefficients α_{j0} to α_{j6} that define the polynomial function are displayed in columns 1 and 2 of **Table 9**. The first degree of the function was not different from zero and was therefore dropped. The other coefficients are significant and are, consistently, alternatively positive and negative. This nonlinear continuous measure of the degree of control accounts for about 7% of the deviations between cash compensation and its estimated values, and about 12% of the deviations for total compensation.

[Insert Table 9 about here]

The issue is whether this smooth and continuous measurement of the change from one regime to another is better than a sudden breakpoint between regimes as in the PTR model. The regressions in columns 3 and 4 of **Table 9** are run using the same dependent variables as in the polynomial function (i.e., excess cash and total compensation) but on the four rough indicator variables as defined by the PTR model. It appears that the latter discontinuous threshold specification slightly enhances the quality of the estimates for both dependent variables compared to the continuous polynomial function (adjusted R^2 of 0.083 vs. 0.072, and 0.135 vs. 0.123, respectively). Defining sharp transitions at each threshold point, with flat impacts

[31] This two-stage procedure is used because it will allow for a direct reading of the positive or negative impacts of controlling interests on the ordinate axis in **Fig. 1**. The polynomial function can also be directly integrated into the base specification, as has been done in previous studies, and it yields similar coefficients with the same statistical significance.

between them, thus provides better estimates than the polynomial specification with smooth change points and continuous impacts between them.

6.3. Consequences of choosing a continuous function instead of threshold effects

Fig. 1 presents simultaneously the polynomial and the threshold models for respectively excess cash compensation (Panel A) and excess total compensation (Panel B). The graph illustrates some previous findings. The discontinuous functions show that non-controlled firms (first regime) and firms with "entrenched" monitors (third regime) provide higher pay to their CEOs (positive residuals or "excess pay"), while the second and fourth classes of firms provide lower pay packages to their CEOs, with the latter having a much stronger effect.

[Insert Fig. 1 about here]

One interesting exercise is to compare the threshold point estimates from the PTR model with the shape of the polynomial function. In the literature on managerial ownership, the authors interpret the curve maxima and minima as change points in the behavior of owner-executives, and the slope between extrema is used to define a positive or negative impact of an incremental 1% holdings between change points[32]. Here, the change points would thus be the extremums of the functions (i.e., 20%, 36%, and 65% for cash compensation, and 23%, 37%, and 66% for total compensation[33]) and the impact of a 1% increase in ownership between each change point would be interpreted as negative if the slope is negative, and positive otherwise. This interpretation of the coefficients in the piecewise specification is very misleading because

[32] The comments about polynomial functions also apply to piecewise linear forms as the latter is equivalent to firstly assuming or iteratively searching for the extremum values and then estimating the slopes between these change points.

[33] The abscissa axis is limited to 68% (the top decile of controlling shareholdings on the sample panel), as in the PTR model, to avoid defining non-representative upper regimes. The polynomial function has actually a positive slope up to 81% of controlling holdings (both for cash and total compensation, and excess pay reaches -0.04 and -0.13, respectively), and a negative slope beyond. Consequently, the effect above 68% is still negative with the polynomial function (curves remain below the abscissa axis) and it does not question the higher degree of control above the 46% threshold compared to other regimes.

the negative slope between 0% and 20% ownership would be interpreted as a negative impact of shareholdings on CEO pay and as effective monitoring in this whole range (each 1% increase in holdings would be associated with a reduction in excess CEO pay), which is not representative of what actually happens: the excess compensation is still positive in this range (as can be seen in the ordinate axis), and, in the perspective of a threshold effect, there is indeed a flat positive impact up to the 11% threshold.

Using a polynomial function to study the impacts of ownership instead of a threshold model may then lead to some spurious interpretations. Based on the interpretations found in the literature relying on polynomial or spline functions, the results found in **Table 9** and in **Fig. 1** would be interpreted as the following. Shareholders have an increasing monitoring role, and as such a negative impact on CEO cash (total) compensation, from 0% to 20% (23%), and from 36% (37%) to 65% (66%), and they become entrenched and have a positive effect on pay from 20% (23%) to 36% (37%), and beyond 65% (66%). Instead, the PTR model shows that shareholders have no effective monitoring role up to 11% of holdings (the first threshold), and that there is no entrenchment effect between 20% (23%) and 34%, but that there is actually one up to 46%. It also shows that the entrenchment interpretation of the positive slope above 65% (66%) would be inconsistent with the observation that shareholders above this point are actually still associated with excess pays largely below those observed under the first three regimes (i.e. below 46% ownership).

The PTR model also allows to identify the relevant number of thresholds, while the polynomial function requires to assume *a priori* a number of regimes so as to determine the number of degrees in the function. The values of change points are then substantially conditional on this preliminary choice. Still, if using a polynomial function instead of a threshold model, the comparison between the polynomial and threshold models in **Fig. 1** also brings the following remark. The maxima and minima of the polynomial function are usually used in the literature as revealing changes in ownership patterns, but they actually appear as approximate

"midpoints" for each regime. Instead, the change points between regimes appear to be approximated by the inflexion points of the polynomial function, i.e. the points at which the concavity of the curve changes (calculated as the roots of the second derivative). The inflexion points of the polynomial function are 7%, 28%, and 52% for cash compensation, and 8%, 30%, and 53% for total compensation[34]. These points are rather more consistent with the threshold estimates found in the panel threshold analysis than the extremums.

It may still be questioned rather these inflexion points are a better estimate of changes in the behavior of the controlling shareholders than those found in the PTR model. As a robustness check, I re-run the regressions presented in columns 3 and 4 of **Table 9** but with the inflexion points found above instead of the panel threshold points. This yields an R^2 of 0.045 and 0.096, respectively (not reported). They are of markedly lower quality, which does not support the better relevance of a polynomial function to determine change points in controlling shares.

In the end, if one uses a polynomial specification to measure the nonlinear effects of ownership, the most appropriate estimate of the change points are inflexion points. Such nonlinear continuous measurement may approximate the changes in monitoring behavior but with less precision and quality than a discontinuous panel threshold analysis. Conversely, using the signs of the slopes between the extremums of a polynomial function, or similarly between change points in a piecewise linear specification, undoubtedly brings misleading interpretations about monitoring behaviors.

7. Conclusive comments

Large shareholdings and ownership concentration are usually measured using rough variables such as the interest held by all blockholders or the weight of the top five shareholders. Some

[34] The fourth inflexion point for both polynomial functions is 75%, it is dropped because it is above the already mentioned top decile of 68%, and has not enough firm-year observations to be representative.

studies also distinguish between outsider blockholders and insider shareholders, but use databases that do not account for blockholders indirectly represented on the board of directors (i.e. companies or other organizations sitting on the board via an individual representative). Based on a panel of French listed companies, this study uses hand-collected data regarding largest shareholders (starting at 1% ownership and above) represented directly or indirectly on the board, information on whether or not they act in combination with other shareholders, and whether they benefit from double voting rights. The data also include information regarding the direct or indirect representation of all identified blockholders (over 5% ownership) on the board. These various ways of holding a significant ownership interest in a firm are tested for based on their respective influence on the design of CEO pay. The results show that the only metric associated with effective pay monitoring is the percentage of ownership of the largest shareholder represented on the board of directors, plus the percentage held by the shareholders acting in concert with him/her/it. These *controlling shareholdings* are then used in the framework of a panel threshold model so as to identify the point at which the shareholder has enough influence to effectively monitor, and other points at which the degree of control may vary.

Three threshold points in the *degree of control* are found. The largest shareholder on the board, alone or in concert, exerts effective management monitoring from about 11% ownership. Below this threshold, firms can be considered as "non-controlled". The degree of control reaches its highest level above about 46% ownership, with a significant negative impact on CEO pay in the form of cash and total compensation. An intermediate level of control is identified between about 34% and 46% of ownership. In this regime, equity-based compensation is still lower than for non-controlled firms but CEOs receive higher cash compensation. This may be interpreted as a means to induce CEOs to act in the interest of an "entrenched" shareholder.

These three estimated thresholds can be approximated as thresholds of 10%, one-third and 45% of the common stock and the three regimes of controlled firms are here termed as

"influential", "dominant", and "exclusive" control. Firstly, "influential" shareholders hold between 10% and one-third of the equity which is enough to voice their interests and apply for representation on the board. Yet they are in a vulnerable position in a takeover market, and other large shareholders may already hold positions close to theirs. Secondly, large shareholders holding more than one-third but less than about 45% of the equity are in a "dominant" position. Under French law, they benefit from a "minority blocking" interest that enables them to veto any decision in extraordinary general meetings, hence they do not fear takeover threats. Also, in this position, they may incur all of the monitoring costs of the firm (other minority shareholders are presumably free-riding) while receiving less than half of the cash flow returns. These "dominant" shareholders may then be tempted to provide their CEO with higher pay so as to secure his/her loyalty and so that he/she acts first in their interest and not in that of other minority shareholders. Thirdly, "exclusive" shareholders are defined as shareholders holding more than about 45% of the equity. They are not vulnerable to hostile takeovers and they have enough bargaining power to effectively monitor the management. They also benefit from a major share of cash flow rights, which may compensate for the costs incurred from monitoring activities and is expected to limit "entrenched" behaviors.

Threshold effects in large shareholdings means that the monitoring behavior changes radically at certain points and not continuously. This is consistent with some regulations cited in Section 5.3 that justifies such ruptures in the influence of the largest shareholder. Conversely, assuming a non-linear continuous relation with change points lead to spurious interpretations as it was shown that the positive and negative slopes do not correspond to the effective impact of the corresponding level of ownership.

The thresholds and regimes found in this study specifically apply in the context of French listed companies; the PTR model may also be relevant in the future for international comparison of corporate control thresholds. The criteria and methodology used to define controlling shareholdings and the forms of control suggest that future research on corporate governance

could benefit from including such characteristics of corporate control that contrast with the dichotomous or broadest measures usually found in this literature. Beyond the impacts on CEO compensation, these criteria might also provide insights into the effects of corporate control on such issues as firm performance, characteristics of the board of directors, financial policies, R&D expenses, or takeover activity, among various other corporate decisions controlling shareholders may influence.

Appendix – Further explanations about the PTR estimation

As already described in section 3.2, the first stage of the procedure described by Hansen (1999) consists of looking for the threshold value γ_1 that minimizes the sum of squared errors of the single-threshold model specified in **Eq. (2')**. Then, an F-statistic is calculated in order to test for the null hypothesis (H_0) of a zero-threshold model against the alternative (H_1) of a single-threshold model. The F-statistic is calculated as the following:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma}_1)}{\widehat{\sigma^2}}$$

where S_0 denotes the sum of squared errors under the null hypothesis, $S_1(\hat{\gamma}_1)$ is the sum of squared errors under the alternative hypothesis of a single-threshold model with an estimated threshold value of $\hat{\gamma}_1$, and $\widehat{\sigma^2}$ is the residual variance under the alternative hypothesis[35].

The present appendix provides further details about this test-statistic and about the following stages of the PTR model procedure.

If the null hypothesis is to be rejected, it can be noted that the sum of squared errors under the null hypothesis, S_0, would have ignored the presence of the threshold point γ. Hansen (1996) shows that this creates a nuisance in the F-statistic; as a consequence, the asymptotic distribution of the test-statistic is non-standard and does not follow a chi-squared distribution.

[35] Calculated as: $\widehat{\sigma^2} = \frac{S_1(\hat{\gamma})}{n(T-1)}$, where n denotes the number of firms and T the number of periods on the panel.

Hansen (1999) shows that a bootstrap procedure can approximate its asymptotic distribution and its associated p-values in the context of panel data.

The bootstrap procedure is based on a number of random draws (set to 400 in the present study) that are used to randomly resample the residuals returned under the H_0 specification. For each draw, the resampled residuals are used as the dependent variable in H_1 specification and a simulated F_1 is calculated. The estimated p-value of F_1 is the percentage of draws for which the simulated statistic is higher than the actual above-defined F_1 statistic. The null hypothesis of a zero-threshold model is thus rejected for p-values under the chosen α% significance level.

If the single-threshold model is validated, the second stage consists of testing for a double-threshold model. Taking the threshold value $\widehat{\gamma_1}$ found in the first stage as given, an iterative grid search looks for a second threshold value γ_2 that minimizes the sum of squared errors of **Eq. (2)**. If this threshold value proves to be significant, $\widehat{\gamma_1}$ would be asymptotically inefficient because the presence of this second threshold point was ignored when it was estimated. Following Bai (1997), the first threshold is estimated again at this stage ("refinement estimation", denoted $\widehat{\gamma_1}^r$) by repeating the latter procedure taking $\widehat{\gamma_2}$ as given this time and looking again for the value of γ_1[36]. At the end of this process, both threshold estimates $\widehat{\gamma_1}^r$ and $\widehat{\gamma_2}^r$ are asymptotically efficient. The validity of a double-threshold model against a single-threshold model is then tested based on the following statistic:

$$F_2 = \frac{S_1(\widehat{\gamma_1}) - S_2(\hat{\gamma}_1{}^r, \hat{\gamma}_2{}^r)}{\widehat{\sigma^2}}$$

The null hypothesis of a single-threshold model is rejected if this statistic is above the critical value obtained from the simulated bootstrap distribution of F_2.

[36] The iterative procedure could also be specified to search *simultaneously,* instead of *sequentially* with refined estimates, for the two threshold points γ_1 and γ_2. Nevertheless, Bai (1997) demonstrated for multiple change point models that a sequential search is consistent and Hansen (1999) extended this argument to multiple-threshold models. This sequential procedure will prove necessary to estimate the confidence intervals in the last stage.

If the alternative hypothesis of a double-threshold model is not rejected, the next stage consists of looking for a third threshold point γ_3, following the same steps as for the previous stages: a grid search iteration taking $\widehat{\gamma_1}$ and $\widehat{\gamma_2}$ as given looks for the estimated value of $\widehat{\gamma_3}$, followed by a refinement estimation of these first two thresholds and by a test for a triple- against a double-threshold model with bootstrap estimated p-values. These stages are repeated as long as the alternative hypothesis of M against the null of $M-1$ threshold points is not rejected. At the end, the procedure defines the relevant number of thresholds and regimes for the sample, and the estimated values of the thresholds.

In the final stage, confidence intervals are constructed around the true values of the refined estimated points. For clarity, the number of significant thresholds M found in the previous stages is set to three and this paragraph describes the confidence interval construction for a triple-threshold model. The construction of the confidence interval for $\widehat{\gamma_1}^r$ is based on the determination of a "no-rejection region" around this estimated point. Taking the values of $\widehat{\gamma_2}^r$ and $\widehat{\gamma_3}^r$ as given, the triple-threshold regression is re-estimated for all possible values of γ instead of $\widehat{\gamma_1}^r$. The sum of squared errors for each re-estimate is kept in $S_3(\gamma)$ and the test statistic takes the form of the following likelihood ratio test:

$$LR_1 = \frac{S_3(\gamma) - S_3(\widehat{\gamma_1}^r)}{\widehat{\sigma^2}}$$

By construction, the LR-statistic takes value zero when γ is equal to $\widehat{\gamma_1}^r$. The confidence interval is defined by the set of LR_1 values that are around its null point and below the critical value. This statistic is free of nuisance parameters (both sums of squared errors are obtained from specifications with the same number of threshold points) and does not require a bootstrap-estimated critical value. However, Hansen (1999) shows it has a non-standard asymptotic distribution and he provides a distribution function that returns the following fixed critical values[37]: 6.53, 7.35 and 10.59 for, respectively, the 10%, 5% and 1% confidence levels. Thus, at

[37] The critical value at the $1-\alpha$ confidence level is given by: $c(\alpha) = -2\log(1-\sqrt{1-\alpha})$.

the 5% level of confidence, LR values below 7.35 define the "no-rejection region" (or confidence interval) for the true value of γ_1. The same procedure is then run for $\widehat{\gamma_2}^r$ taking $\widehat{\gamma_1}^r$ and $\widehat{\gamma_3}^r$ as given, and eventually for $\widehat{\gamma_3}^r$taking $\widehat{\gamma_1}^r$ and $\widehat{\gamma_2}^r$ as given, which constructs the confidence intervals for the true values of γ_2 and γ_3, respectively.

Tables and Figures

Table 1 Survey of ownership metrics

References	Measure of the degree of control	Thresholds	Subject of study
Survey A: Large shareholders			
Survey A1: Ownership concentration / Blockholders			
Demsetz and Lehn, 1985	Concentration measures: Log(Top5 equity shares / (100 - Top5 eq.sh.)); Herfindahl index (HHI)	0%	Determinants of ownership
Dyl, 1988	Concentration measure: Log(Top5 equity shares)	0%	CEO pay
Beatty and Zajac, 1994	Indicator for the presence of an outside blockholder	5%	CEO pay
Mehran, 1995	Equity shares of outside blockholders	5%	CEO pay and perf.
Holderness, 2009	Equity shares of blockholders (voting rights≥5%); Indicator for the presence of a blockholder	5%	Ownership patterns
Konijn et al., 2011	Equity shares of blockholders; Dispersion measure: HHI (scaled) for 5 largest blockholders	5%	Firm value (Q)
Tosi and Gomez-Mejia, 1989	Dichotomous (indicator): ▫ Owner-controlled ▫ Management-controlled	 ▫ ≥5% ▫ <5%	CEO pay
Hambrick and Finkelstein, 1995	Dichotomous (indicator vs. equity shares): ▫ Owner-controlled ▫ Management-controlled	 ▫ ≥5% ▫ <5%	CEO pay
Shleifer and Vishny (1997)	Definition of: ▫ Large minority shareholders ▫ Large shareholders	▫ 10%/20%-50% ▫ ≥51%	Survey of corporate governance
Survey A2: Largest shareholder			
Shleifer and Vishny 1986	Equity shares of one non-manager large shareholder (+ a fringe of risk-neutral atomistic shareholders)	5%	Firm value (theoretical model)
Cyert et al., 2002	Equity shares of largest sh., non-CEO/CEO; Indicator for internal/external blockholder	5%	CEO pay and market for corp. control
Holderness and Sheehan, 1988	Dichotomous (paired categories): ▫ Diffusely held equity ▫ Majority shareholders	 ▫ <20% ▫ ≥ 50%	Inv. policy, Corp. control, Firm perf., CEO pay
Survey A3: Largest ultimate shareholder			
La Porta et al., 1999	Sub-samples by category: ▫ Widely held ▫ Voting shares by type of ultimate control	 ▫ <10%/20% ▫ ≥10%/20%	Corporate ownership (intern. comparison)
Claessens et al., 2002	Equity shares of ultimate owner; Voting minus equity shares; Indicator for "Control exceeds ownership"	10%	Firm value (Q)
Survey B: Insider or managerial ownership			
Morck et al., 1988	Equity shares, piecewise linear regression	5% and 25% (3 regimes)	Firm value (Q)
Cho, 1998	Equity shares, piecewise linear regression	7%/10% and 34%/38% (3 regimes)	Firm value (Q) and Investestment (CapEx; R&D)
McConnel and Servaes, 1990	Equity shares, quadratic/curvilinear relationship (+ control for equity shares held by blockholders and largest shareholder)	5% and 40%/50% (2 regimes)	Firm value (Q)
Short and Keasey, 1999	Equity shares, cubic relation	13% and 42% (3 regimes)	Firm performance (RSE and VAL)
Davies et al., 2005	Equity shares, quintic relation	7%, 26%, 51% and 76% (5 regimes)	Firm value (Q)

Table 2

Description of variables

Note: Large (Largest) shareholders are shareholders owning at least 1% of the common stock. Blockholders are shareholders owning at least 5% of the common stock.

Variable	Description
CEO compensation:	
Cash compensation	Salary + Bonus
Total compensation	Cash compensation + Long-term incentives (stock-options, restricted stocks, and deferred compensation)
Large shareholdings:	
Holdings:	Equity shares held by:
1. Largest sh. on BoD	- the largest shareholder (≥1%) represented on the board of directors (BoD)
2. Concert with largest sh.	- shareholders that have concluded an agreement with the "largest sh. on BoD"
3. Other block. on BoD	- all other blockholders represented on the board who are neither a "largest sh. on BoD", nor in "concert with largest sh."
4. Largest sh. not on BoD	- the largest shareholder, if he/she/it owns more shares than "largest shareholder on BoD"
5. Other block. not on BoD	- all blockholders not represented on the board, who are not a "largest sh. not on BoD"
6. Largest sh. on BoD is ultimately controlled	- the largest shareholder represented on the board who is not a diffusely-held company or organization
7. Largest sh. on BoD is ultimately diffusely-held	- the largest shareholder represented on the board who is a diffusely-held company or organization
8. Excess voting rights	Share of voting rights in excess of equity share.
Control variables:	
Firm characteristics:	
Size	Sales; and Market value of equity.
Age of company	Years since foundation of the firm x Years since firm is listed
Capital intensity	Tangible assets (gross property, plant and equipment) / Total assets
Average ROA	Return on Assets (EBIT/Total assets) averaged over the past five years.
Industries	Ten industries from the ICB classification (dummy variables).
CEO characteristics:	
Tenure	Number of years the CEO has served as a CEO.
New insider CEO	Takes value 1 if the CEO was appointed less than two years ago and had been in the firm for more than 2 years before his/her appointment.
New outsider CEO	Takes value 1 if the CEO was appointed less than two years ago and had been in the firm for less than 2 years before his/her appointment.
CEO is chairman	Takes value 1 if the CEO is also the chairman of the board.
CEO is founder	Takes value 1 if the CEO is the founder of the company and is not the main shareholder.
Type of control:	
Investment company	Takes value 1 if the largest shareholder is an investment company.
Passive families	Takes value 1 if the largest shareholder is a passive family (family conglomerate, or family with no incumbent or past executive member).

Table 3

Descriptive statistics

Panel A presents summary statistics for firm and CEO characteristics, CEO compensation, and shareholdings (largest shareholder and blockholders) for the full sample of 1,119 firm-years, from the panel of 123 French listed companies between 2003 and 2012. Panel B presents summary statistics for alternative measures of controlling shares on the subsample of 929 firm-years with at least one blockholder represented on the Board of directors (BoD). Panel C presents summary statistics of relevant metrics of controlling shareholdings for a subsample of 190 firm-years with no blockholder represented on the BoD. Amounts in Euros are expressed in constant 2007 Euros. *Tenure* is expressed in years and other CEO characteristics are indicator variables.

Variable	Mean	Median	Min	1st decile	9th decile	Max
PanelA: All firms						
Firm characteristics:						
Sales (€000)	11,764,045	2,621,648	2,133	458,232	35,900,500	167,610,992
Market capitalization (€ 000)	9,477,162	2,894,800	6,904	396,368	26,301,308	148,470,400
Capital intensity	23.39%	16.58%	0.03%	2.30%	53.90%	98.32%
Average ROA (over five years)	3.01%	3.29%	-229.39%	-1.12%	9.11%	28.99%
Years since foundation	87.3	78.0	3.00	23.0	161.0	348.00
Years since listed	22.7	19.0	1.00	6.0	38.0	128.00
CEO characteristics:						
Tenure	9.8	6.0	1.0	1.0	24.0	47.0
New insider CEO	0.12	0.00	0.00	0.00	1.00	1.00
New outsider CEO	0.09	0.00	0.00	0.00	0.00	1.00
CEO is chairman	0.54	1.00	0.00	0.00	1.00	1.00
CEO is founder	0.04	0.00	0.00	0.00	0.00	1.00
CEO compensation:						
Cash compensation (€ 000)	1,274	1,136	29	362	2,431	7,478
Total compensation (€ 000)	2,164	1,556	29	394	4,372	22,976
Blockholders:						
% All blockholders	43.09%	46.72%	0.00%	8.24%	72.64%	94.22%
% Largest shareholder	32.41%	29.17%	1.10%	6.75%	66.25%	89.22%
Num. blockholders	2.1	2.0	0.0	1.0	4.0	7.00
Num. blockholders on BoD	1.3	1.0	0.0	0.0	2.0	7.00
N. = 1119 firm-year obs.						
Panel B: Firms with at least one blockholder on BoD						
% All blockholders	49.40%	51.01%	5.00%	22.28%	75.10%	94.22%
% Blockholders on BoD	43.58%	45.51%	5.00%	14.35%	71.98%	89.22%
% Largest shareholder	37.42%	35.70%	5.00%	10.17%	68.38%	89.22%
% Largest shareholder on BoD	37.24%	35.70%	5.00%	9.99%	68.38%	89.22%
% Largest sh. on BoD + Concert	40.56%	41.81%	5.00%	10.72%	70.86%	93.40%
% (voting rights) Largest sh. on BoD + Concert	46.16%	46.36%	5.00%	14.25%	75.10%	93.40%
Num. blockholders	2.3	2.0	1.0	1.0	4.00	7.00
Num. blockholders on BoD	1.6	1.0	1.0	1.0	3.00	7.00
N. = 929 firm-year obs.						
Panel C: Firms with no blockholder on BoD						
% All blockholders	12.26%	8.39%	0.00%	0.00%	32.09%	63.90%
% Largest shareholder	7.90%	7.34%	1.10%	3.95%	11.62%	33.30%
% Largest shareholder on BoD	1.24%	0.00%	0.00%	0.00%	4.11%	4.96%
Num. blockholders	1.6	1.0	0.0	0.0	4.0	6.00
N. = 190 firm-year obs.						

Table 4

Regression results for CEO compensation on alternative measures of controlling shareholdings

Pooled panel regressions with standard errors clustered at the firm level, as specified in **Eq. (1)**. The dependent variables are cash and total compensation (expressed in thousands of constant euros and log-transformed) in models 1 to 3 and in models 4 to 6, respectively. Alternative measures of controlling shares are expressed as a percentage of equity shares, except if *voting rights* is mentioned. *BoD* stands for Board of directors. Control variables include firm and CEO characteristics, the type of control, and industry specific effects. All variables are as defined in **Table 2**. *I(.)* denotes the indicator function. The adjusted R^2 is expressed in percentages.

	Ln(Cash compensation)			Ln(Total compensation)		
	(1)	(2)	(3)	(4)	(5)	(6)
	coef p-value	*coef p-value*	*coef p-value*	*coef p-value*	*coef p-value*	*coef p-value*
Alternative measures of contr. sh.:						
% Largest sh. not on BoD	-0.33 (0.44)			-0.03 (0.95)		
% Other block. not on BoD	0.20 (0.51)			0.12 (0.78)		
% Largest sh. on BoD	-0.44 (0.00)			-0.80 (0.00)		
% Concert with largest sh.	-0.59 (0.08)	-0.59 (0.08)		-0.93 (0.03)	-0.95 (0.03)	
% Other block. on BoD	-0.02 (0.95)			-0.09 (0.80)		
% Largest sh. on BoD:						
* Ultimately controlled		-0.41 (0.00)			-0.82 (0.00)	
* Ultimately diffusely-held		-0.42 (0.09)			-0.75 (0.04)	
% Excess in voting rights		-0.13 (0.75)			0.20 (0.68)	
% Largest sh. on B. + Concert			-0.44 (0.00)			-0.82 (0.00)
Firm characteristics:						
Ln(Sales)	1.37 (0.00)	1.36 (0.00)	1.35 (0.00)	1.41 (0.00)	1.41 (0.00)	1.40 (0.00)
Ln(Sales)^2	-0.04 (0.00)	-0.04 (0.00)	-0.04 (0.00)	-0.04 (0.00)	-0.04 (0.00)	-0.04 (0.00)
Ln(Market capitalization)	0.16 (0.00)	0.16 (0.00)	0.16 (0.00)	0.26 (0.00)	0.25 (0.00)	0.25 (0.00)
Age of company	0.07 (0.00)	0.07 (0.00)	0.08 (0.00)	0.08 (0.00)	0.08 (0.01)	0.08 (0.01)
Capital intensity	-0.36 (0.01)	-0.36 (0.01)	-0.35 (0.01)	-0.35 (0.02)	-0.35 (0.02)	-0.35 (0.02)
Av. ROA	-1.45 (0.00)	-1.45 (0.00)	-1.41 (0.00)	-1.42 (0.00)	-1.42 (0.00)	-1.40 (0.00)
CEO characteristics:						
Tenure^2	-0.0004 (0.00)	-0.0004 (0.00)	-0.0004 (0.00)	-0.001 (0.00)	-0.001 (0.00)	-0.001 (0.00)
New insider CEO	-0.09 (0.03)	-0.0873 (0.03)	-0.09 (0.03)	-0.11 (0.03)	-0.11 (0.03)	-0.11 (0.03)
New outsider CEO	0.07 (0.22)	0.0618 (0.25)	0.06 (0.24)	0.15 (0.02)	0.15 (0.02)	0.15 (0.03)
I(CEO is Chairman)	0.12 (0.01)	0.12 (0.01)	0.12 (0.01)	0.09 (0.11)	0.09 (0.11)	0.09 (0.10)
I(CEO is founder)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.91 (0.00)	0.91 (0.00)	0.91 (0.00)
Type of control:						
I(Investment companies)	0.22 (0.00)	0.22 (0.00)	0.22 (0.00)	0.32 (0.00)	0.32 (0.00)	0.31 (0.00)
I(Passive families)	0.51 (0.00)	0.51 (0.00)	0.52 (0.00)	0.70 (0.00)	0.71 (0.00)	0.70 (0.00)
Intercept	-7.30 (0.00)	-7.23 (0.00)	-7.17 (0.00)	-8.32 (0.00)	-8.34 (0.00)	-8.25 (0.00)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm-year obs.	1119	1119	1119	1119	1119	1119
Adj. R^2 (%)	77.72	77.67	77.70	77.32	77.35	77.38

Table 5

Tests for an m[th] threshold given m-1 threshold(s)

Looking for the relevant number of thresholds in controlling shareholdings, based on a panel threshold regression (PTR) model as developed by Hansen (1999), and based on its impacts on CEO cash and total compensation. A first threshold estimate $\hat{\gamma}$ is determined by minimizing the sum of squared errors in a single-threshold model (see **Eq. (2')**), testing all possible integer values of γ between 1% and 68% (the top decile of controlling shares on the panel). The first column tests for the null hypothesis (H_0) of a zero-threshold model against the alternative (H_1) of a single-threshold model with $\hat{\gamma}$. It is based on the $F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$ statistic, where S_0 and S_1 are the sum of squared errors under H_0 and H_1, respectively, and σ^2 is the residual variance under H_1. As demonstrated by Hansen (1999), the asymptotical distribution of the F-stat requires a bootstrap procedure; it is run with 400 iterations and leads to p-values and critical values presented in the table. The null of zero threshold is rejected for cash and total compensation with F-stats largely higher than the 1% critical value. The single-threshold model is then similarly rejected against a double-threshold model (second column), which is itself rejected against a triple-threshold model (third column), both for cash and total compensation. The existence of a fourth threshold is not accepted with p-values of 0.97 and 0.13 for cash and total compensation, respectively.

	First	Second	Third	Fourth
Cash compensation				
Threshold estimate ($\widehat{\gamma_m}$)	46%	11%	34%	8%
F-stat. for *m* vs. *m-1* thresholds	84.71	46.15	12.87	2.30
p-value (bootstrap)	0.00	0.00	0.008	0.97
(10%, 5%, 1% critical values)	(7.13, 9.03, 11.40)	(8.08, 9.29, 11.34)	(8.40, 9.63, 12.75)	(9.48, 10.71, 12.80)
Total compensation				
Threshold estimate ($\widehat{\gamma_m}$)	46%	11%	34%	5%
F-stat. for *m* vs. *m-1* thresholds	141.32	53.55	11.37	8.54
p-value (bootstrap)	0.00	0.00	0.04	0.13
(10%, 5%, 1% critical values)	(6.92, 9.33, 12.10)	(7.99, 8.98, 11.96)	(8.63, 10.95, 15.38)	(9.00, 10.16, 13.19)

Table 6

Threshold estimates in a triple threshold model

Threshold values found in **Table 5** are re-estimated (*refined* estimates) in the framework of a triple-threshold model: $\widehat{\gamma_1}^r$ is estimated taking $\widehat{\gamma_2}$ and $\widehat{\gamma_3}$ as given, and so on. Refined estimates $\hat{\gamma}^r$ are found to be the same as the initial estimates $\hat{\gamma}$. Following Hansen (1999), the confidence interval of $\widehat{\gamma_1}^r$ is determined as follows: $LR_1 = \frac{S_3(\gamma) - S_3(\widehat{\gamma_1}^r)}{\hat{\sigma}^2}$ is calculated for each possible integer value of γ (i.e. [1%; 68%]), where S_3 is the sum of squared errors of the triple threshold model (with $\widehat{\gamma_2}^r$ and $\widehat{\gamma_3}^r$ taken as given); by construction $LR_1 = 0$ when $\gamma = \widehat{\gamma_1}^r$. Then, the confidence interval is found around the null point of LR_1 and defined by all γ values for which LR_1 is below the critical values defined by Hansen (i.e. 7.35 and 10.59 for the 5% and 1% critical values, respectively). The same procedure is applied to $\widehat{\gamma_2}^r$ and $\widehat{\gamma_3}^r$.

	$\widehat{\gamma_1}^r$	$\widehat{\gamma_2}^r$	$\widehat{\gamma_3}^r$
Cash compensation			
Refined threshold estimates	11%	34%	46%
95% confidence interval	[10%, 16%]	[31%, 42%]	[45%, 46%]
99% confidence interval	[9%, 17%]	[27%, 42%]	[45%, 48%]
Total compensation			
Refined threshold estimates	11%	34%	46%
95% confidence interval	[10%, 14%]	[31%, 42%]	[46%, 48%]
99% confidence interval	[9%, 15%]	[28%, 45%]	[45%, 48%]

Table 7

Regression of CEO compensation on control regimes

Pooled panel regressions as specified in **Eq. (2)**, with standard errors clustered at the firm level. The dependent variables are either cash (column 1) or total (column 2) compensation, expressed in thousands of constant euros and log-transformed. The regime of non-controlled firms (degree of control below 11% of shareholdings) is omitted and serves as a benchmark for the other regimes. Columns 1 and 2 include indicator variables (denoted *I(.)*) for the three regimes of controlled firms. Control variables (firm and CEO characteristics, type of control, industry specific effects) are the same as in **Table 4**. The adjusted R^2 is expressed in percentages.

	Ln(Cash comp.) (1)		Ln(Total comp.) (2)	
	coef	*t-stat.*	*coef*	*t-stat.*
Degree of control:				
1st regime: *I* (0% to 11%) - omitted				
2nd regime: *I* (11% to 34%)	-0.17	-2.91***	-0.32	-4.39***
3rd regime: *I* (34% to 46%)	-0.03	-0.47	-0.16	-1.85*
4th regime: *I* (≥ 46%)	-0.31	-5.05***	-0.54	-7.91***
Intercept	-7.16	-7.11***	-8.15	-5.79***
Other control variables	Yes		Yes	
Firm-year obs.	1119		1119	
Adj. R^2 (%)	78.40		78.14	

Table 8

Continuous measures with percentage of holdings per regime and piecewise linear form

Pooled panel regressions with standard errors clustered at the firm level. Dependent variables are cash and total compensation (log-transformed). *CS* stands for controlling shareholdings and refer to equity shares held by the largest shareholder (alone or in concert) represented on the board. The regressions in columns 1 and 2 are specified based on **Eq. (2)**, but with percentages of *CS* instead of the indicator function, for each regime. The regressions in columns 3 and 4 are also based on **Eq. (2)**, but the regimes take the piecewise linear form defined in **Eq. (4)** instead of the indicator function. The control variables are the same as those displayed in **Table 4**.

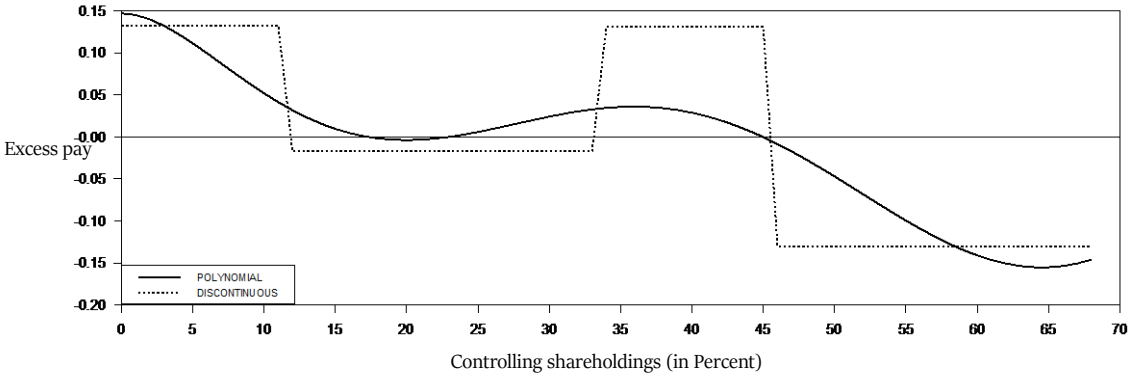
	Continuous (% CS per regime)				Piecewise linear form			
	Ln(Cash comp.) (1)		Ln(Total comp.) (2)		Ln(Cash comp.) (3)		Ln(Total comp.) (4)	
	coef	*p-value*	*coef*	*p-value*	*coef*	*p-value*	*coef*	*p-value*
1st regime (0% to 11%) - omitted								
2nd regime (11% to 34%)	-0.61	(0.00)	-1.24	(0.00)	-0.49	(0.19)	-1.30	(0.01)
3rd regime (34% to 46%)	-0.02	(0.88)	-0.34	(0.11)	-0.32	(0.66)	0.01	(0.99)
4th regime (≥ 46%)	-0.46	(0.00)	-0.83	(0.00)	-0.54	(0.12)	-0.95	(0.02)
Intercept	-7.23	(0.00)	-8.21	(0.00)	-7.37	(0.00)	-8.35	(0.00)
Control variables	Yes		Yes		Yes		Yes	
Firm-year obs.	1119		1119		1119		1119	
Adj. R^2 (%)	78.30		78.11		77.57		77.16	

Table 9

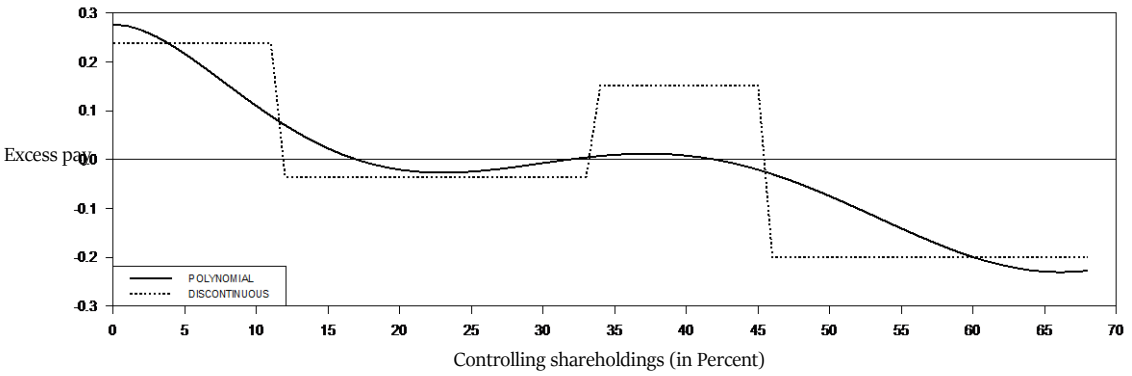
Regression of excess pay on polynomial vs. threshold specifications

Pooled panel regressions with standard errors clustered at the firm level. The dependent variables are $Excess\ cash\ compensation$ and $Excess\ total\ compensation$, they are defined as the residuals of **Eq. (2)** run without the CS variable. CS stands for "Controlling shareholdings", i.e. shareholdings of the largest shareholder represented on the board, alone or in concert. In columns 1 and 2, excess compensation is regressed on a six-degree polynomial function (**Eq. (5)**). The first degree of the polynomial function is dropped because it is non-significant (not reported). In columns 3 and 4, excess compensation is regressed on the indicator variables for the three regimes of controlled firms (the first regime of non-controlled firms is omitted and serves as a benchmark). In columns 1 and 2, the intercept can be interpreted as excess pay when CS is equal to zero (i.e. when there is no large shareholder with at least 1% of equity shares represented on the board), and in columns 3 and 4, as excess pay in the first regime of control (i.e. CS ranging from 0% to 11%). The R^2 is expressed in percentages.

	Polynomial function				Discontinuous (indicator per regime)			
	Excess cash comp. (1)		Excess total comp. (2)		Excess cash comp. (3)		Excess total comp. (4)	
	coef	*p-value*	*coef*	*p-value*	*coef*	*p-value*	*coef*	*p-value*
CS^2	-20.59	(0.03)	-33.77	(0.00)				
CS^3	145.15	(0.03)	220.30	(0.00)				
CS^4	-386.43	(0.02)	-555.59	(0.00)				
CS^5	442.24	(0.02)	612.05	(0.00)				
CS^6	-182.94	(0.02)	-246.34	(0.00)				
1st regime: I(0% to 11%) - omitted								
2nd regime: I(11% to 34%)					-0.15	(0.01)	-0.27	(0.00)
3rd regime: I(34% to 46%)					0.00	(0.98)	-0.09	(0.29)
4th regime: $I(\geq 46\%)$					-0.26	(0.00)	-0.44	(0.00)
Intercept	0.15	(0.00)	0.28	(0.00)	0.13	(0.00)	0.24	(0.00)
Firm-year obs.	1119		1119		1119		1119	
Adj. R^2 (%)	7.16		12.45		8.35		13.45	



Panel A: Excess cash compensation



Panel B: Excess total compensation

Fig. 1 Discontinuous vs. polynomial continuous relation between excess CEO pay and degree of control

The threshold model and the polynomial function are both displayed on Panel A and Panel B for *excess cash compensation* and *excess total compensation*, respectively. *Controlling shareholdings* refer to the equity shares held by the largest shareholder represented on the Board, alone or in concert. The polynomial function is drawn based on the coefficients found in columns 1 and 2 of **Table 9**. The discontinuous relation is based on the results found in columns 3 and 4 of **Table 9**: the coefficient for the first regime is the intercept, and the coefficients for the other regimes are the addition of the intercept and of the regime-specific effect.

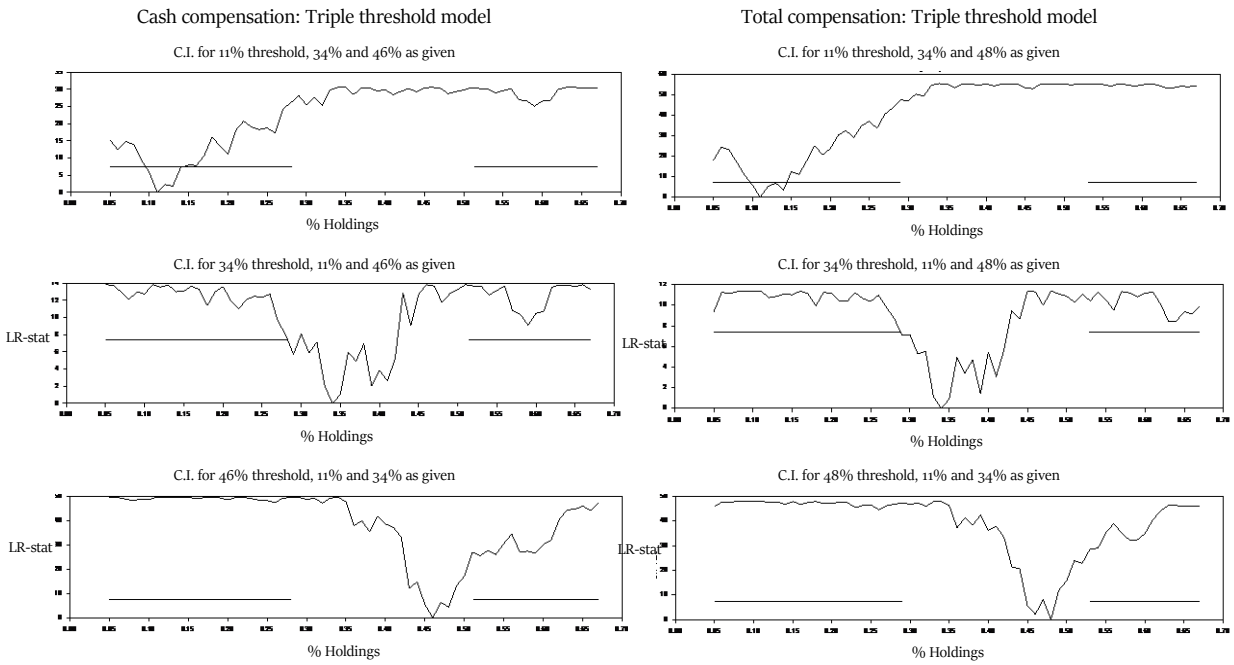


Fig. A-1 Confidence interval construction in a triple threshold model

Note: LR-stat values below the dotted line (5% critical value, equal to 7.35) define the "no-rejection region" or confidence interval.

References

Allen, M. P., 1981. Power and privilege in the large corporation: Corporate control and managerial compensation. *American Journal of Sociology,* 86(5), pp. 1112-1123.

Almeida, L., 2014. The level and structure of CEO compensation: Does ownership matter?. *Revue d'Economie Politique,* 124(4), pp. 653-666.

Amoako-Adu, B., Baulkaran, V. & Smith, B. F., 2011. Executive compensation in firms with concentrated control: The impact of dual class structure and family management. *Journal of Corporate Finance,* 17(5), pp. 1580-1594.

Bai, J., 1997. Estimating multiple breaks one at a time. *Econometric Theory,* 13(3), pp. 315-352.

Baran, L. & Forst, A., 2015. Disproportionate insider control and board of director characteristics. *Journal of Corporate Finance,* Volume 35, pp. 62-80.

Beatty, R. P. & Zajac, E. J., 1994. Managerial incentives, monitoring, and risk bearing: A study of executive compensation, ownership, and board structure in initial public offerings. *Administrative Science Quarterly,* 39(2), pp. 313-335.

Bebchuk, L. A., Fried, J. M. & Walker, D. I., 2002. Managerial power and rent extraction in the design of executive compensation. *The University of Chicago Law Review,* 69(3), pp. 751-846.

Belkhir, M., Boubaker, S. & Derouiche, I., 2014. Control–ownership wedge, board of directors, and the value of excess cash. *Economic Modelling,* Volume 39, pp. 110-122.

Ben-Nasr, H., Boubaker, S. & Rouatbi, W., 2015. Ownership structure, control contestability, and corporate debt maturity. *Journal of Corporate Finance,* Volume 35, pp. 265-285.

Berle, A. A. J. & Means, G. C., 1932. *The Modern Corporation and Private Property.* New York: MacMillan.

Bhagat, S., Black, B. & Blair, M., 2004. Relational investing and firm performance. *The Journal of Financial Research,* 27(1), pp. 1-30.

Chhaochharia, V. & Grinstein, Y., 2009. CEO compensation and board structure. *The Journal of Finance,* 64(1), pp. 231-261.

Cho, M.-H., 1998. Ownership structure, investment, and the corporate value: An empirical analysis. *Journal of Financial Economics,* 47(1), pp. 103-121.

Chourou, L., Abaoub, E. & Saadi, S., 2008. The economic determinants of CEO stock option compensation. *Journal of Multinational Financial Management,* 18(1), pp. 61-77.

Claessens, S., Djankov, S., Fan, J. P. H. & Lang, L. H. P., 2002. Disentangling the incentive and entrenchment effects of large shareholdings. *The Journal of Finance,* 57(6), pp. 2741-2771.

Conyon, M. J., Core, J. E. & Guay, W. R., 2011. Are U.S. CEOs paid more than U.K. CEOs? Inferences from risk-adjusted pay. *The Review of Financial Studies,* 24(2), pp. 402-438.

Core, J. E., 1997. On the corporate demand for directors' and officers' insurance. *The Journal of Risk and Insurance,* 64(1), pp. 63-87.

Core, J. E., Holthausen, R. W. & Larcker, D. F., 1999. Corporate governance, chief executive officer compensation, and firm performance. *Journal of Financial Economics,* 51(3), pp. 371-406.

Croci, E., Gonenc, H. & Ozkan, N., 2012. CEO compensation, family control, and institutional investors in Continental Europe. *Journal of Banking & Finance,* 36(12), pp. 3318-3335.

Cyert, R. M., Kang, S.-H. & Kumar, P., 2002. Corporate governance, takeovers, and top-management compensation: Theory and evidence. *Management Science,* 48(4), pp. 453-469.

David, P., Kochhar, R. & Levitas, E., 1998. The effect of institutional investors on the level and mix of CEO compensation. *Academy of Management Journal,* 41(2), pp. 200-208.

Davies, J., Hillier, D. & McColgan, P., 2005. Ownership structure, managerial behavior and corporate value. *Journal of Corporate Finance,* 11(4), pp. 645-660.

Demsetz, H., 1983. The structure of ownership and the theory of the firm. *Journal of Law and Economics,* Volume 26, pp. 375-393.

Demsetz, H. & Lehn, K., 1985. The structure of corporate ownership: Causes and consequences. *Journal of Political Economy,* 93(6), pp. 1155-77.

Demsetz, H. & Villalonga, B., 2001. Ownership structure and corporate performance. *Journal of Corporate Finance,* 7(3), pp. 209-233.

Dyl, E. A., 1988. Corporate control and management compensation: Evidence on the agency problem. *Managerial and Decision Economics,* Volume 9, pp. 21-25.

Faccio, M. & Lang, L. H., 2002. The ultimate ownership of Western European corporations. *Journal of Financial Economics*, 65(3), pp. 365-395.

Faccio, M. & Lasfer, M. A., 1999. Managerial ownership, board structure and firm value: The UK evidence. *Cass Business School Research Paper*.

Finkelstein, S. & Boyd, B. K., 1998. How much does the CEO matter? The role of managerial discretion in the setting of CEO compensation. *Academy of Management Journal,* 41(2), pp. 179-199.

Gabaix, X. & Landier, A., 2008. Why has CEO pay increased so much?. *The Quarterly Journal of Economics,* 123(1), pp. 49-100.

Gomez-Mejia, L. R., Larraza-Kintana, M. & Makri, M., 2003. The determinants of executive compensation in family-controlled public corporations. *Academy of Management Journal,* 46(2), pp. 226-237.

Gomez-Mejia, L. R., Tosi, H. & Hinkin, T., 1987. Managerial control, performance, and executive compensation. *Academy of Management Journal,* 30(1), pp. 51-70.

Gompers, P. A., Ishii, J. & Metrick, A., 2010. Extreme governance: An analysis of dual-class firms in the United States. *The Review of Financial Studies,* 23(3), pp. 1051-1088.

Hamadi, M. & Heinen, A., 2015. Firm performance when ownership is very concentrated: Evidence from a semiparametric panel. *Journal of Empirical Finance,* Volume 34, pp. 172-194.

Hambrick, D. C. & Finkelstein, S., 1995. The effects of ownership structure on conditions at the top: The case of CEO pay raises. *Strategic Management Journal,* 16(3), pp. 175-193.

Hansen, B. E., 1996. Inference when a nuisance parameter is not identified under the null hypothesis. *Econometrica,* 64(2), pp. 413-430.

Hansen, B. E., 1999. Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics,* Volume 93, pp. 334-368.

Hermalin, B. E. & Weisbach, M. S., 1991. The effects of board composition and direct incentives on firm performance. *Financial Management,* 20(4), pp. 101-112.

Himmelberg, C. P., Hubbard, R. G. & Palia, D., 1999. Understanding the determinants of managerial ownership and the link between ownership and performance. *Journal of Financial Economics,* 53(3), pp. 353-384.

Holderness, C. G., 2003. A Survey of Blockholders and Corporate Control. *FRBNY Economic Policy Review,* April.pp. 51-64.

Holderness, C. G., 2009. The Myth of Diffuse Ownership in the United States. *The Review of Financial Studies,* 22(4), pp. 1377-1408.

Holderness, C. G. & Sheehan, D. P., 1988. The Role of Majority Shareholders in Publicly Held Corporations. *Journal of Financial Economics,* Volume 20, pp. 317-46.

Jensen, M. C. & Meckling, W. H., 1976. Theory of the firm: Managerial behaviour, agency costs and ownership structure. *Journal of Financial Economics,* 3(4), pp. 305-360.

Konijn, S. J., Kräussl, R. & Lucas, A., 2011. Blockholder dispersion and firm value. *Journal of Corporate Finance,* 17(5), pp. 1330-1339.

Kraft, K. & Niederprüm, A., 1999. Determinants of management compensation with risk-averse agents and dispersed ownership of the firm. *Journal of Economic Behavior & Organization,* Volume 40, pp. 17-27.

La Porta, R., Lopez-De-Silanes, F. & Shleifer, A., 1999. Corporate ownership around the world. *Journal of Finance,* 54(2), p. 471–517.

Laeven, L. & Levine, R., 2008. Complex ownership structures and corporate valuations. *The Review of Financial Studies,* 21(2), pp. 579-604.

Lambert, R. A., Larcker, D. F. & Weigelt, K., 1993. The structure of organizational incentives. *Administrative Science Quarterly,* 38(3), pp. 438-461.

Lins, K. V., Volpin, P. & Wagner, H. F., 2013. Does family control matter? International evidence from the 2008–2009 financial crisis. *The Review of Financial Studies,* 26(10), pp. 2583-2619.

Margaritis, D. & Psillaki, M., 2010. Capital structure, equity ownership and firm performance. *Journal of Banking & Finance,* 34(3), p. 621–632.

McConnell, J. J. & Servaes, H., 1990. Additional evidence on equity ownership and corporate value. *Journal of Financial Economics,* 27(2), pp. 595-612.

Mehran, H., 1995. Executive Compensation Structure, Ownership, and Firm Performance. *Journal of Financial Economics,* 38(2), pp. 163-84.

Mikkelson, W. & Ruback, R. S., 1985. An empirical analysis of the interfirm equity investment process. *Journal of Financial Economics,* 14(4), pp. 523-53.

Morck, R., Shleifer, A. & Vishny, R., 1988. Management ownership and market valuation: An empirical analysis. *Journal of Financial Economics,* Volume 20, pp. 293-316.

Shleifer, A. & Vishny, R. W., 1986. Large shareholders and corporate control. *Journal of Political Economy,* 94(3), pp. 461-88.

Shleifer, A. & Vishny, R. W., 1997. A survey of corporate governance. *The Journal of Finance,* 52(2), pp. 737-783.

Short, H. & Keasey, K., 1999. Managerial ownership and the performance of firms: Evidence from the UK. *Journal of Corporate Finance,* 5(1), pp. 79-101.

Tosi, H. L. J. & Gomez-Mejia, L. R., 1989. The decoupling of CEO pay and performance: An agency theory perspective. *Administrative Science Quarterly,* 34(2), pp. 169-189.

Villalonga, B. & Amit, R., 2006. How do family ownership, control and management affect firm value?. *Journal of Financial Economics,* 80(2), pp. 385-417.

Weston, J. F., 1979. The tender takeover. *Mergers and Acquisitions,* Volume 14, pp. 74-82.