Incentivizing the Owner: Why Family Firms offer Pay-for-performance Contracts to their CEOs *

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Abstract

We study the managers' compensation schemes adopted by publicly listed family firms by means of a theoretical model and an empirical analysis. Existing empirical literature finds puzzling evidence about the structure of family CEOs' pay, which apparently contradicts the fundamental tenets of principal-agent theory under moral hazard. In particular, family CEOs typically exhibit lower expected pay but higher pay-for-performance sensitivity than external managers, despite their large inside ownership. In a theoretical model, we show that the outcome-related compensation structure of family CEOs reduces the CEO's incentive to divert value from minority shareholders. We test the main hypotheses on a panel of Italian listed family firms (2000-2017), for which we have collected data on CEOs' parental ties, cash and equity-based components of CEOs' pay and internal corporate governance mechanisms. The evidence confirms our theoretical predictions.

Keywords: CEO pay, diversion, family firms, shareholder protection.

JEL codes: J33, G34, M52, D22, L20

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1 Introduction

Managerial compensations are a deeply studied topic, much less so within family firms, and when the manager is a member of the controlling family. The purpose of this paper is to start filling this gap. We provide a theory to the provision of incentive pay to family CEOs, using the lens of the shareholder value view (Edmans and Gabaix, 2016).

One of the fundamental tenets of principal-agent theory is that managers need to be provided with incentives to exert effort, owing to the shareholders' imperfect monitoring on CEOs' behavior. Naturally, family CEOs should be immune to these problems thanks to their large ownership stake, which aligns their incentives as managers and owners. In fact, when firms are owned and managed by their founders or by their heirs, the agency problem is mitigated and a milder use of incentive pay in executive compensations is to be expected. Or maybe not. Recent evidence on CEOs' compensations in family firms suggests that also family CEOs receive incentive contracts (Chahine and Goergen, 2014; Mazur and Wu, 2016; Graziano and Rondi, 2018).

This evidence raises some important questions. The first one is why family firms adopt a pay-for-performance compensation scheme for their inside managers, given that they obviously should not suffer from the problem of managerial slack. A second question concerns the design of these contracts. What are the features of the incentive contracts paid to family CEOs? Do they differ from incentive contracts implemented to prevent managerial slack by external managers? From a theoretical point of view, managerial compensations in family businesses are still an open issue, despite their practical relevance. In the US, almost 40% of the 2000 largest industrial firms are family-controlled (Anderson and Reeb, 2003). On Hong Kong Stock Exchange, family owners control more than 64% of the public companies (Claessens et al., 2000). In Continental Europe, family firms are the most prevalent ownership structure (Croci et al. 2012). Finally, in Italy, according to the Italian Stock Exchange Authority, the main shareholder owns more than half of the ordinary shares in 52% of listed firms (CONSOB, 2018).

A clue towards the answers is provided by the literature on concentrated ownership (see, for example, Huddart, 1993; Pagano and Röell, 1998; Durnev and Kim, 2005 and an early

discussion in Jensen and Meckling, 1976), which highlights that insider dominated firms – such as family firms– are susceptible to a specific kind of agency problem, often referred to as "diversion" (see also Shleifer and Vishny, 1997; Burkart et al., 2003 and Morck et al., 2005). The diversion problem originates from the conflict of interest between insiders and minority shareholders, and it occurs when large shareholders foster their personal profit or utility by means, for example, of expensive perks, unprofitable pet projects, nepotistic appointments, or other tunneling activities, ultimately expropriating minority shareholders (Johnson et al., 2000).

In this paper we study the role of managerial compensations in the diversion problem in family businesses by means of a theoretical model that we test on a panel of Italian listed family firms over the period 2000-2017. The model describes how firms can design the compensation of a family CEO with a controlling share (e.g., a family shareholder) so as to prevent him from expropriating minority shareholders.

The idea that managerial compensation is an endogenous response to the contracting environment faced by the firm has been posited both in the theoretical and empirical literature (Holmstrom, 1979; Grossman and Hart, 1983; Holmstrom and Milgrom, 1991; Murphy, 1985; Jensen and Murphy, 1990; Palia, 2001). However, these models typically hinge on the conflict between a manager and shareholders about the exertion of an effort, not considering the conflict amongst shareholders. On the contrary, the literature on diversion (Huddart, 1993; Durnev and Kim, 2005; Pagano and Röell, 1998) studies the conflict between majority and minority shareholders, focusing on the role of ownership structure, but it commonly factors out executive compensations. This gap has relevant implications in practice, as the founder -or the heir- of a family firm is a natural candidate for the position of CEO.[1] Hence, the compensation that the family CEO receives, as a manager, could serve to mitigate the conflict that he has, as shareholder, with minority shareholders. The agency problem between shareholders could be resolved via the channel of the CEO's compensation scheme.

In our model, a new investment opportunity arises, which requires managerial effort and external capital. The firm can be managed by an external CEO or by a family CEO.

[1]Indeed, among S&P 500 family firms, 45 percent of the CEOs are family members (Anderson and Reeb, 2003), while in Europe, the CEO is a family member in 39.5% of family firms (Croci et al., 2012).

The external CEO has an incentive to shirk effort, but he cannot divert resources from shareholders, as he is subject to the tight monitoring of the large shareholder (indeed, the diversion problem typically arises between shareholders). The family CEO can divert value from minority shareholders, as in Pagano and Röell (1998), but he doesn't shirk. In fact, managers who own a part of the firm have incentives to work hard (e.g., Jensen and Meckling, 1976), but not necessarily to share the result of their effort with the other shareholders.

We determine the CEO's type and the compensation scheme that maximizes the value of the venture, subject to the different information problems posed by each type of CEO. We thus bridge the gap between two strands of literature: the one studying how pay-for-performance compensations can align the conflicting interests between owners and managers (e.g., Shleifer and Vishny, 1986; Huddart, 1993), and the one on managerial discretion studying the conflicting interests between owners (Pagano and Röell, 1998; Durnev and Kim, 2005; Shleifer and Vishny, 1997; Burkart et al., 1998). As we discuss more in detail in Section 2, this second strand of literature focuses on the role ownership structure -and specifically on the presence of blockholders large enough to limit the main shareholder's discretionality- as a solution to the diversion problem. We contribute to this literature by bringing out the role of the CEO's compensation as an instrument that could help solve the diversion problem in alternative to the ownership structure, thus taking the ownership structure as given.

We obtain three main results. The first one is about the structure of family CEOs' compensations. The model predicts that the pay-for-performance sensitivity (PPS) of the family CEO is higher in sectors where it is easier to divert funds. Intuitively, the family CEO has an incentive to understate the firm's actual profits to minority shareholders, so as to steal the difference between actual and reported profits. By a pay-for-performance contract, the family CEO is rewarded in function of the profit that he communicates to shareholders, hence his incentive to understate the actual profit decreases.

This first result offers very interesting insights into the drivers of the family CEO's compensation. In fact, we find that the pay-for-performance contracts designed to prevent diversion present starkly different features from the pay-for-performance contracts designed to prevent the outside CEO's shirking of effort. In the case of diversion, the incentive rent is larger, the larger the profits (as the prize of diversion is greater). As a consequence,

the family CEOs' pay increases linearly with industry profits: the PPS of family CEOs is constant regardless of the size of the industry profits. Conversely, external CEOs receive an informational rent that does not depend on profits, but just on the cost of their effort and the probabilities of its outcomes. Hence, the PPS of external CEOs is lower in industries where profits are higher: in fact, when profits are high, a lower share of them is sufficient to incentivize effort of external CEOs.

Our second and third results are related to the equilibrium choice between family CEOs and external CEOs. This choice reflects a trade-off. On the one hand, with a family CEO, minority shareholders need to be secured against the risk of expropriation; on the other hand, an external CEO requires costly incentives to be induced to exert effort. When we account for the equilibrium choice of the type of CEO, we find our second result: in the presence of diversion problems, family CEOs' contracts display a higher PPS than external CEOs' contracts. In fact, industries with higher profits have a more severe diversion problem and thus an external CEO represents the least costly solution. When industry profits are high, the PPS of external CEOs is low. Family CEOs emerge in equilibrium only when profits are low, hence family CEOs have a higher PPS than external ones.

This result is directly connected to the third one: in the presence of diversion problems, family-CEOs must receive a lower expected pay than external ones. In fact, in equilibrium family CEOs emerge only if profits (and thus compensations) are sufficiently low.

In the empirical analysis, we define "family" firms as those where the largest individual shareholder and his relatives own more than 50% of the equity. Data about the CEO's identity, parental ties with the controlling shareholder and pay (both cash and equity-based) were hand-collected from the companies' annual reports. To proxy for diversion, we use the industry-specific intensity of sunk intangible investment (R&D and advertising expenditures are difficult to monitor and evaluate, see Aboody and Lev, 2000, and Klapper and Love, 2002) Our theoretical predictions match the evidence emerging from the dataset. First, industries characterized by large advertising and R&D expenditures, where diversion is easier, have family CEOs with a pay-for-performance compensation scheme. In contrast, in industries with low R&D and advertising intensity, where diversion is more difficult, family CEOs have a fixed compensation scheme. Second, in high-diversion industries, the compensation of

family CEOs has a lower expected value, but higher pay-for-performance sensitivity than the compensation of non-family CEOs. Our results hold when we account for endogeneity issues related to the choice of the CEO, when we use an alternative definition of diversion (i.e. external finance dependence), alternative definitions of firm performance and when total pay includes equity-based components (stock options, etc.)

Our contribution to the literature is threefold. First, we provide a theory that explains the observed provision of incentives to family CEOs in publicly-traded family companies. Second, we provide empirical support to the argument that asset intangibility increases the potential of diversion, hence of minority shareholders' expropriation. Third, we propose pay-for-performance contracts as an incentive device complementary to ownership structure when the formation and the activism of blockholders are unlikely or ineffective.

The rest of the paper is organized as follows. Section 2 investigates the connections between our approach and the pertinent literature. Section 3 describes the theoretical model and the testable hypotheses, Section 4 presents the data and the empirical analysis. Section 5 concludes. All proofs and technical details, as well as a battery of robustness checks are contained into an Appendix.

2 Related Literature

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Concentrated –family– ownership is the most prevalent type of ownership structure in Continental Europe (La Porta et al., 1999; Faccio and Lang, 2002; Barca and Becht, 2002; Franks et al., 2008). When a member of the family is also CEO, agency problems might arise both in relation to the conflict between shareholders, and to the conflict between shareholders and manager. As a consequence, this paper lies at the intersection between two main strands of theoretical literature. The first one studies the conflict of interest between a manager and shareholders and focuses on the role of large shareholders, who can more effectively monitor the actions of the manager (e.g., Shleifer and Vishny, 1986; Huddart, 1993). This literature maintains that shareholders with a large stake can better internalize the benefits of their monitoring effort, thus alleviating the problem of rent extraction resulting from the

separation between ownership and control (Shleifer and Vishny, 1986; Grossman and Hart, 1983).

The second strand of literature focuses on the conflict of interest between majority and minority shareholders (Pagano and Röell, 1998; Durnev and Kim, 2005; Burkart et al., 1998). Minority shareholders with a bloking stake can reduce profit diversion by monitoring the controlling shareholder, as in Pagano and Röell (1998). Hence, this literature argues that the presence of blockholders has been optimized as a response to the contracting environment. As concentrated ownership is a structural characteristic of family firms, decisions in family firms can be made in the interests of the controlling family, which may diverge from those of minority shareholders (Morck and Yeung, 2003; Bertrand and Schoar, 2006).

Despite the evident overlapping between the roles of owner and that of manager in family firms, these two strands of research apparently developed along parallel courses. We bridge the gap between the two and, to this aim, we borrow from two main contributions.

The first one is Huddart (1993), who develops a model of a concentrated firm whose performance depends on a manager's imperfectly observable effort. The major shareholder designs the manager's compensation contract so as to trade off informative rents with costly monitoring activities. He shows that the welfare maximizing ownership structure has to balance two opposite forces. On the one hand, more concentrated ownership induces better monitoring, thus increasing firm value. On the other hand, concentrated ownership forces the major shareholder to undertake more risk, thus causing inefficiency due to his risk aversion. Huddart's (1993) model is close to ours, in that it analyzes the optimal compensation scheme paid to an external manager in a moral hazard setup, assuming that the firm ownership is asymmetrically distributed between one major shareholder and a large number of small shareholders. However, there are important differences as well. First, in Huddart's (1993) paper, the conflict between shareholders pertains exclusively to the public-good nature of the monitoring activity, so that small shareholders tend to free ride on the large one. No diversion takes place, and the informational problem pertains only to the exertion of the effort. Second, the manager and shareholders are distinct individuals, which implies that the manager's compensation has no direct effect on the alignment of objectives between shareholders.

The second contribution to which we are closely related is that of Pagano and Röell (1998), who develop a model in which an entrepreneur can divert value from minority shareholders. The firms' ownership structure emerges endogenously, as a result of the major's shareholder's attempt to limit the minority shareholders' monitoring on his diversion activities. Blockholders with a smaller stake have a lower incentive to play an active role in corporate decisions, but the entrepreneur eventually pays via the IPO price for the private benefits he will extract later and for any monitoring expenses incurred by shareholders. Hence, the ownership structure works as a pre-commitment device to mitigate agency costs. Similarly to Pagano and Röell (1998), we also analyze the conflict of interest between shareholders. However, we focus on the role of the manager's compensation scheme as an instrument to solve it, whereas their focus is on the ownership structure. Indeed, the literature on diversion (Durnev and Kim, 2005; Johnson et al., 2000; Lombardo and Pagano, 2002; Shleifer and Wolfenzon, 2002; Pagano and Röell, 1998; Shleifer and Vishny, 1997; Burkart et al., 1998) typically study the role of the ownership structure on the size of the diversion problem. We complement this strand of literature by investigating the role of the managers' compensation schemes on mitigating diversion problems.

3 A simple model

In this Section we present a simple model of an all-equity firm in which the controlling shareholder can be appointed as the manager of the firm. This is a frequent situation in family firms, where the CEO often belongs to the family. The controlling shareholder can divert corporate resources for private gains by means of some value-decreasing managerial practices. These are broadly defined and range from managerial perks, excessive shirking, unprofitable "pet" projects, nepotistic appointments, to outright stealing of corporate resources (Jensen and Meckling, 1976; Pagano and Röell, 1998). In order to obtain equity capital, the main shareholder needs to restrain his own future tendency to stray from value maximization. To this aim, he could use the compensation structure he receives as a manager of the family firm as a signaling device to limit agency costs between shareholders. Our model captures this intuition.

Since our objective is to analyze the role of managers' compensation schemes on their incentives for diversion, in our theoretical analysis we assume that the family owner wants to keep the controlling stake in the firm, therefore the ownership structure is given. It might be worthwhile to note that this assumption is also consistent with the empirical evidence on the dynamics of the controlling stake in family firms, which suggests that the latter is relatively stable over time.[2]

In order to provide testable predictions, we maximize tractability by building a deliberately parsimonious model where the family CEO is risk-neutral and the effort decision is binary, as in Edmans et al. (2008). Appendix C demonstrates that the analysis is unchanged under risk aversion.

3.1 Setup and timing

An entrepreneur owns a large stake $\alpha \in [0, 1]$ of an all-equity business (a family firm), in which he has invested all his wealth. The remaining share $1-\alpha$ of the stock is divided equally among a large number of small shareholders. A new investment opportunity arises, which requires two complementary inputs: managerial effort e and capital k. The investment is risky, and the managerial effort affects the probability that the investment succeeds, while the amount of capital affects the profit in case it succeeds.

A board of directors appoints the manager, and decides his compensation. There are two types of manager m: a family CEO ($m = F$) or a professional CEO from outside ($m = O$). The family CEO is the entrepreneur himself, while the outside CEO is hired externally. In order to put the two types of CEOs on the same level, we assume that they are identical in terms of capability. The shareholders (i.e. the entrepreneur and the minority shareholders) split the profit, net of the manager's compensation, in proportion to their ownership.

We now lay out the main features of the model.

Effort. The effort e defines a standard moral hazard problem, similar to that described by Huddart (1993). In particular, the effort can take two values: $e = \{e_0, e_1\}$, and it is

[2]According to the 2018 report of the Italian Stock Exchange Authority, for example, the average largest shareholder in Italian listed companies holds a stake that fluctuates between 46.0 and 47.7 over the period 2010-2017. Figure A.1 in Appendix A shows that the variability of the average controlling share in family firms in Italy is even lower.

provided by the CEO of the firm at personal cost $\psi(e)$, with the normalizations $\psi(e_0) = 0$ and $\psi(e_1) = c$. The effort exerted is private information of the CEO. If the effort is exerted, the investment succeeds with probability p, and fails with probability $1 - p$. Conversely, in the case of no effort, the investment always fails.

Capital. As the entrepreneur is wealth constrained, the capital k is entirely provided by minority shareholders and it takes the form of straight equity (as in Pagano and Röell, 1998). When the investment succeeds, the profit is $\pi = a\sqrt{k}$, with $a > 0$, i.e. the capital k has decreasing marginal returns. If the investment fails, $\pi = 0$.

Diversion. When profits π are achieved, the manager can divert them for private gains. Minority shareholders cannot observe actual profit π, but only the after-diversion profit $\hat{\pi} = [0, \pi]$. Diversion is costly to the manager. As Durnev and Kim (2005, p.1463) put it, "The most obvious costs are fines, jail terms, and loss of reputation associated with illegal diversion. Another cost is bribery of employees, regulators, and politicians to facilitate and hide diversion. A third cost is the difference between the controlling shareholder's private value of corporate perks or of diverted resources and their fair replacement value.". Then, the diverted amount $\pi - \hat{\pi}$ yields to the manager a private benefit equal to $b(\pi - \hat{\pi})$, where $b \leq 1$ is the constant rate of diversion (Pagano and Röell, 1998). The constant b can be interpreted as the value that the entrepreneur places on each dollar diverted from the company. Then, the share $1 - b$ is the inefficiency of diversion, i.e. the loss that the firm incurs for each unit diverted (Durnev and Kim, 2005; Johnson et al., 2000; Lombardo and Pagano, 2002; Shleifer and Wolfenzon, 2002; Pagano and Röell, 1998; Jensen and Meckling, 1976).

The manager's compensation. The CEO's compensation contract comprises cash and shares (Edmans et al., 2008). In particular, the CEO's wage $w_m(\hat{\pi}) = T_m + t_m\hat{\pi}$ is composed of a fixed cash salary $T_m \geq 0$, plus a share $t_m \in [0, 1]$ of the profits $\hat{\pi}$ observed by minority shareholders. The share t_m represents the pay-for-performance (PPS) coefficient of the CEO's wage.

Timing. The timing of the problem is as follows:

- Stage 0: The board chooses a type of manager $m = \{F, O\}$ (i.e., the family CEO or an external CEO), and his compensation contract (T_m, t_m);

- Stage 1: Minority shareholders choose the level of their investment k, such that $k \geq 0$;

- Stage 2: The manager exerts the effort and the outcome π is realized;

- Stage 3: The manager carries out eventual diversion activities; the after-diversion profit $\tilde{\pi}$ is observed by minority shareholders; finally, payoffs are received.

Monitoring diversion. Diversion can be prevented by monitoring activities carried out by shareholders. The effectiveness of such a monitoring depends positively on the ownership stake (see, e.g., Pagano and Röell, 1998; Burkart et al., 1998; Shleifer and Vishny, 1986; Maug, 1998). In order to streamline the analysis, we assume that the major shareholder's monitoring is perfect, by virtue of his large ownership stake. Hence, eventual diversion activities carried out by the external manager can be perfectly observed, and prevented by the large shareholder. As a consequence, with an external CEO, $\hat{\pi} = \pi$.

Conversely, the minor shareholders' monitoring is imperfect. Hence, in the case of a family CEO, where the major shareholder is also the manager, the free-rider problem prevents small shareholders from monitoring the family CEO. The latter can carry out diversion, and minority shareholders are unable to detect it.

Utility functions. The external CEO exhibits constant absolute risk aversion, with preferences represented by a Von Neumann utility function $r(w_O, \psi)$, which is concave with respect to the wage w_O and linear with respect to the cost of effort ψ: $r(w_O, \psi) = 1 - e^{-w_O} - \psi$. We normalize the expected utility of his outside option to zero.

Shareholders (both the entrepreneur and minority shareholders) are risk neutral (Pagano and Röell, 1998; Burkart et al., 1998, 2003). Risk-neutrality and perfect congruence of interests in every way, other than the private benefits extraction, allow us to ignore potential efficiency costs due to the entrepreneur being under-diversified, and just focus on the inefficiency of his exercising control at the expense of minority shareholders.[3]

The utility s_m of minority shareholders is given by the firm observed value, in proportion to their ownership, net of the capital k invested:

$$s_m(\hat{\pi}, k) = (1 - \alpha)(\hat{\pi} - w_m(\hat{\pi})) - k, \text{ for } m = \{F, O\}. \quad (1)$$

[3]The assumption of risk neutral entrepreneur allows to significantly streamline the analysis. However, given that the entrepreneur might exhibit risk aversion due to his under-diversified wealth, Appendix C fully develops the model under the alternative hypothesis of risk averse entrepreneur, and shows that our main results hold.

Minority shareholders choose their investment k in such a way to maximize the value $s_m(\hat{\pi}, k)$ of their portfolio (Durnev and Kim, 2005). The value of their outside option is normalized to zero.

The utility u_m of the entrepreneur depends on whether he is also CEO or not. In the case of an external CEO, the entrepreneur's utility u_O is equal to his share α of the value of the venture (recall that with an external CEO, $\hat{\pi} = \pi$ because of the perfect monitoring of diversion by the entrepreneur):

$$u_O(\pi) = \alpha\left(\pi - w_O(\pi)\right).$$

Conversely, in the case of a family CEO, the entrepreneur-manager's utility u_F is given by his share of (after-diversion) firm value, plus the income as CEO, net of the effort cost, plus any rents he derives from eventual diversion activities:

$$u_F(\hat{\pi}, \pi) = \alpha\left(\hat{\pi} - w_F(\hat{\pi})\right) + w_F(\hat{\pi}) - \psi + b(\pi - \hat{\pi}). \tag{2}$$

The family CEO is subject to limited liability ($E[w_F] - \psi \geq 0$) and has a reservation utility of zero.

Finally, the board maximizes the shareholder value $v_m(\hat{\pi}) = \hat{\pi} - w_m(\hat{\pi})$, defined as the after-diversion profit, net of the manager's compensation. [4] This assumption is grounded on the practice of establishing compensation committees within board of directors in order to monitor decisions on executive compensation packages and protect the interests of minority shareholders (John and Senbet, 1998; Monks and Minow, 2008)[5].

[4]The large stake of the family CEO could enable him to influence the decisions of the board on the matter of the CEO's identity and wage. This is the rent-extraction perspective (Bebchuk and Fried, 2004), according to which compensations are not chosen by boards to maximize shareholder value, but instead by the executives themselves to maximize their own rents. Recently, this view has been challenged both on theoretical and empirical grounds, and originated the "shareholder value" view (see Edmans and Gabaix (2016) for a review of this debate). In line with the "shareholder value" approach, in our model the board maximizes the shareholder value, and not the entrepreneur's rent, because the entrepreneur has to tap the public equity market for funds. Hence, the entrepreneur cannot extract openly the profit via the channel of the wage, and a diversion problem arises.

[5]At large public companies, boards of directors are usually in charge of how and what to pay their CEOs. When venture capital is raised, "almost invariably, the investor will insist on the right to appoint a nonexecutive director," especially if the investment is large or particularly risky (Sharp, 1991, p. 160).

In our setup, two information problems arise. The first one is a moral hazard problem, originated from the fact that exerting effort has a private cost for the CEO, but a public benefit as it raises the probability of obtaining a positive profit. The second information problem is the possibility of the family CEO to divert profits. As we already pointed out, this problem is especially severe with family CEOs, because external CEOs in family firms are subject to a tighter monitoring owing to the concentrated ownership. As well known in the literature (Pagano and Röell, 1998), the incentive to divert depends on the relationship between the ownership share α and the efficiency of diversion b. In fact, from (2), the family CEO's utility can also be expressed as:

$$u_F(\hat{\pi}, \pi) = (1 - \alpha)w_F(\hat{\pi}) + b\pi + (\alpha - b)\hat{\pi} - \psi. \tag{3}$$

Expression (3) highlights that the utility of the family CEO is increasing in $\hat{\pi}$ when $b \leq \alpha$. Then, if $b \leq \alpha$, the family CEO has a strict incentive to refrain from diversion ($\hat{\pi} = \pi$), regardless of the compensation contract (T_F, t_F). Conversely, when $b > \alpha$, the diversion problem might emerge for some values of t_F. Hence, when $b > \alpha$, the value of t_F must be appropriately chosen so as to eliminate the CEO's incentive to rent expropriation.

Note also that, due to the linearity of the diversion technology, the family CEO's strategy is simple: either he extracts as many private benefits as he can ($\hat{\pi} = 0$), or he extracts none ($\hat{\pi} = \pi$)[6].

In the next Section, we examine as a benchmark the equilibrium in the case the diversion problem cannot arise, i.e. $b \leq \alpha$. In Section 3.3, we will instead analyze the equilibrium when $b > \alpha$.

3.2 The benchmark: no diversion

Let us consider, as a benchmark, the case of no diversion, i.e. $b \leq \alpha$ and $\hat{\pi} = \pi$.

If effort is not exerted (regardless of whether the manager is a family CEO or an external CEO), the value of the venture is always $\pi = 0$ and the manager's compensation is zero as well.

[6]This is the same approach adopted by Pagano and Röell (1998).

Conversely, if effort is exerted, shareholders invest the capital k^* that maximizes $E[s_m(\hat{\pi}, k)]$. In equilibrium, by imposing truthful revelation $\hat{\pi} = \pi$, the optimal investment is

$$k^* = \arg\max_k (1-\alpha)E[\pi - w_m(\pi)] - k.$$

First order conditions allow to obtain

$$k^*(t_m) = \left(\frac{(1-\alpha)(1-t_m)pa}{2}\right)^2. \tag{4}$$

Note that the investment $k^*(t_m)$ is decreasing in $t_m \in [0,1]$, as a pay-for-performance contract reduces the marginal return of the investment.

Let us now determine the value-maximizing contract (T_m, t_m) in the two different scenarios (family and external CEO).

3.2.1 The external CEO 's compensation

The external CEO is not intrinsically motivated to exert effort, and a fixed contract does not provide the incentives for it.[7] As a consequence, the following incentive compatibility constraint must be imposed in the case of an external CEO:

$$E[1 - e^{-T_O - t_O \pi} - c] \geq 1 - e^{-T_O}, \tag{5}$$

where $\pi = \{0, a\sqrt{k^*}\}$ and $k^* = k^*(t_O)$ from (4).

Note that in this setup an increase in t_O has a non-monotonic effect on the l.h.s. of (5), because of the decrease of $k^*(t_O)$. This implies that under certain conditions (i.e., a sufficiently low relative to c), the IC constraint cannot be satisfied and the only possible equilibrium is that entailing no effort, where the value of the venture is zero. This is the well known trade-off between incentives for effort and efficient allocation of risk, which is the object of a large amount of literature on moral hazard and is not the aim of the present study. Indeed, our focus is rather on the choice between external and family CEO and the latter's

[7] In fact, the external CEO's utility with a fixed contract in the case effort is exerted, $1 - e^{-T_O} - c$, is always lower than his utility in case of no effort, $1 - e^{-T_O}$.

compensation schemes. Therefore, in order to make our point in the most straightforward way, we will restrict our attention to equilibria entailing the exertion of effort by the external CEO. Hence, we assume that inducing effort by the external manager is always preferred over the option of no effort.

To this aim, we make the following assumption:[8]

Assumption 1 *Condition (5) can be satisfied for some* $t_O \in [0,1]$.

It is convenient to identify the conditions under which Assumption 1 holds. Since the l.h.s. of (5) is maximized when $t_O = 1/2$, and it is equal to $\frac{(1-\alpha)pa^2}{8} + \ln\left(1-\frac{c}{p}\right)$ for $T_O = 0$, a necessary condition for Assumption 1 to hold is $\frac{(1-\alpha)pa^2}{8} + \ln\left(1-\frac{c}{p}\right) > 0$, i.e. the return a of the investment is sufficiently high, relative to the effort cost c.

The optimal compensation contract maximizes the venture's value subject to the minority shareholders' participation constraint and the manager's incentive compatibility constraints[9]:

$$\begin{aligned}(\tilde{t}_O, \tilde{T}_O) = \arg\max_{t_O, T_O} \quad & E[\pi - T_O - t_O\pi] \\ s.t. \quad & (1-\alpha)E[\pi - T_O - t_O\pi] - k^* \geq 0 \\ & E[1 - e^{-T_O - t_O\pi} - c] \geq 1 - e^{-T_O}.\end{aligned} \tag{6}$$

We thus obtain the following result:

Lemma 1 *The solution of Problem (6) is* $\tilde{t}_O = \frac{1-\sqrt{1+\frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right)}}{2}$, $\tilde{T}_O = 0$.

Proof. See Appendix D. ■

As is typical of principal-agent problems with moral hazard, the external CEO must receive a pay-for-performance contract, in order to have sufficient incentives to exert effort. However, and more interestingly, Lemma 1 allows to identify an additional feature of the contract paid to the external manager. In fact, from the expression of $\tilde{t}_O$ in Lemma 1, the

[8]This assumption allows our framework to converge to a standard principal-agent model with moral hazard, where the agent's utility is strictly increasing in the pay-for-performance sensitivity.

[9]The manager's participation constraint, $E[1 - e^{-T_O - t_O\pi} - c)] \geq 0$, is not binding given the IC constraint (5) and can therefore be omitted here.

optimal PPS of the external CEO's compensation is negatively correlated with the profitability a of the investment. Intuitively, an external CEO's wage does not depend on profits, but only on the marginal cost and benefit of effort (c and p, respectively). In fact, the CEO's expected wage is constant and equal to

$$p\tilde{t}^{O}a\sqrt{k^{*}(\tilde{t}_{O})} = -p\ln\left(1-\frac{c}{p}\right), \tag{7}$$

Then, an increase in industry profitability (by means of an increase of the parameter a) must be compensated by a decrease in his PPS.

The expected value of the venture with an external CEO is

$$E[\tilde{v}_{O}] = p(1-\tilde{t}_{O})a\sqrt{k^{*}(\tilde{t}_{O})} = pa\sqrt{k^{*}(\tilde{t}_{O})} + p\ln\left(1-\frac{c}{p}\right), \tag{8}$$

which is strictly positive from (7). Hence, the board always prefers that the external CEO exerts effort, rather than no effort.

Note that this specific pay-for-performance contract is costly and it decreases the value of the venture for two reasons. First, it reduces the minority shareholders' investment. Second, it implies an inefficient allocation of risk, as it forces a risk averse agent to undertake some risk, hence the manager must be compensated with an expected wage ($-p\ln(1-c/p)$) that is higher than his effort cost (c).

3.2.2 The family CEO 's compensation

Let us now consider the case of a family CEO in the benchmark situation of no diversion (i.e., $b \leq \alpha$).

Given the investment expressed by (4), the optimal contract (t_F^*, T_F^*) in the absence of information asymmetries in terms of diversion can be obtained by maximizing the venture's value subject to the manager's participation constraint (i.e., the expected wage must at the

least compensate him for his effort):

$$(t_F^*, T_F^*) = \arg\max_{t_F, T_F} \quad E[\pi - T_F - t_F\pi] \qquad (9)$$
$$s.t. \quad E[T_F + t_F\pi - c] \geq 0,$$

whose solution is straightforward and it is expressed by the following Lemma:

Lemma 2 *The solution of Problem (9) is* $t_F^* = 0$, $T_F^* = c$.

Proof. See Appendix D. ■

In the benchmark case of no diversion, a family CEO is optimally paid with a fixed compensation scheme. In fact, a pay-for-performance compensation would reduce the marginal return of the investment for minority shareholders, thus discouraging their investment.

From (4), we also obtain $k^*(t_F^*) = \left(\frac{(1-\alpha)pa}{2}\right)^2$. Then, the family CEO's expected utility is:

$$E[u_F^*] = \alpha\left(\frac{(1-\alpha)p^2a^2}{2} - c\right). \qquad (10)$$

From Assumption 1, it is easy to show that $E[u_F^*] > 0$[10], implying that exerting effort is worthwhile for the family CEO and that he does not require further incentives for it.

The value of the venture in the family CEO case is:

$$E[v_F^*] = pa\sqrt{k^*(t_F^*)} - c = \frac{(1-\alpha)p^2a^2}{2} - c. \qquad (11)$$

By comparing the venture's value in the case of external CEO in (8), and in the case of family CEO in (11), we note that $\sqrt{k^*(t_F^*)} > \sqrt{k^*(\tilde{t}_O)}$ and $c < -p\ln(1-c/p)$: a family CEO allows a higher return from the investment and requires a lower wage. Then, we easily obtain $E[v_F^*] > E[\tilde{v}_O]$: in our simplified setup, and in the absence of diversion problems, the value is higher when the CEO is the entrepreneur himself rather than an external CEO. In fact, the family CEO is intrinsically motivated to exert effort, and he does not need a costly

[10]Indeed, given that $-\frac{c}{p} \geq \ln\left(1-\frac{c}{p}\right)$, then: $1 + \frac{8}{p(1-\alpha)a^2}\frac{-c}{p} \geq 1 + \frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right) > 0$. In turn, $1 + \frac{8}{p(1-\alpha)a^2}\frac{-c}{p} > 0$ can be rewritten as $\frac{(1-\alpha)p^2a^2}{8} - c > 0$. Then, $\frac{(1-\alpha)p^2a^2}{2} - c > 0$.

pay-for-performance contract. By accepting a fixed wage, that just covers his effort cost, he induces the optimal investment by investors. On the contrary, an external CEO must be provided with the incentive to exert effort by a pay-for-performance contract. Such a contract reduces the investment by minority stockholders. As a consequence, in the absence of diversion problems, the family CEO emerges as the dominant solution[11].

3.3 Diversion

We now study the implications of the diversion problem on the equilibrium compensation contract and on the choice of CEO. Accordingly, in this Section we assume that $b > \alpha$. Given that the compensation of the external CEO is not affected by the diversion problem, in what follows we focus on the family CEO's contract.

3.3.1 The family CEO's compensation

As a first step, we show that the first best fixed contract (t_F^*, T_F^*) induces diversion, and it cannot be an equilibrium. In the previous section we showed that, given the first best contract and absent diversion, the expected utility for the family CEO is Eu_F^*, as expressed by (10). Conversely, if the family CEO diverts value, he obtains $Eu_F^{div} = E[\alpha\,(-T_F^*) + T_F^* + b\pi - c]$. Given that $T_F^* = c$, the expected utility for the family CEO when he exercises diversion is

$$Eu_F^{div} = bpa\sqrt{k^*(t_F^*)} - \alpha c > Eu_F^*. \tag{12}$$

Hence, when $b > \alpha$, a fixed contract provides him with a strict incentive to steal in stage 3, and this stops minority shareholders from investing in stage 1. Naturally, in the absence of investment, the value of the firm is zero. Therefore, the family CEO must be provided with the incentives not to expropriate minority shareholders after their investment. This is

[11]Naturally, in reality other dimensions may affect this result. For example, family CEOs and external CEOs can differ in their ability, or being the CEO of the family firm can give an additional utility to the entrepreneur. A full-fledged analysis is however beyond the scope of the present work, and we focus here on the trade-offs originated exclusively from the diversion problem.

ensured by the following IC constraint:

$$E[\alpha(\pi - T_F - t_F\pi) + T_F + t_F\pi - \psi] \geq E[\alpha(-T_F) + T_F + b\pi - \psi],$$

i.e.

$$t_F \geq \frac{b-\alpha}{1-\alpha}. \tag{13}$$

It might be worthwhile to point out that condition (13) allows understanding how diversion impacts on the PPS, net of any other factor that also impacts on PPS, such as the managerial talent. It is at times argued that family CEOs exhibit a lower ability than professional ones. However, it is important to point out that a lower family CEO's ability would operate in the opposite direction on the PPS, relative to the diversion effect, moving towards contracts with a stronger fixed component. This observation is important for the empirical testing of our propositions, as it reinforces our results. We will come back on this point in the empirical analysis.

We can now state our first result, which summarizes the findings about the optimal contract paid to family CEOs for all levels of b[12].

Proposition 1 *When the efficiency of diversion is low ($b \leq \alpha$), the PPS of the family-CEO's compensation is $t_F^* = 0$. When the efficiency of diversion is high ($b > \alpha$), the PPS of the family-CEO's compensation is $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$.*

Proof. See Appendix D. ■

Although Proposition 1 does not make an equilibrium argument, as it considers only the case in which the manager is the family CEO, still it allows to highlight that a pay-for-performance contract can be employed to ensure that the family CEO will not expropriate minority shareholders. Thus, the compensation structure acts as a device to limit agency costs. The intuition is very simple. The family CEO has an incentive to understate the firm's actual profits to minority shareholders, so as to steal the difference between actual

[12]In the Appendix we fully develop the model under the assumption of risk averse entrepreneur, and we show that the assumption of risk neutrality is made with no loss of generality.

and reported profits. By rewarding the family CEO in function of the profit that he communicates to shareholders, his incentive to understate the actual profit decreases. This result complements the findings obtained by Pagano and Röell (1998), who study the incentives against diversion by focusing instead on the ownership structure.

From Proposition 1, $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$ when $b > \alpha$. Then, the shareholders' investment is $k^*(\tilde{t}_F) = \left(\frac{(1-b)pa}{2}\right)^2$. Moreover, when $b > \alpha$, the family CEO's wage is such that $\tilde{T}_F + \tilde{t}_F pa\sqrt{k^*(\tilde{t}_F)} \geq c$, i.e.

$$\tilde{T}_F + \frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} \geq c \tag{14}$$

If $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} \leq c$, the variable part of the contract is not sufficient to compensate the CEO for the effort. Then, it is necessary to integrate it with the fixed part $\tilde{T}_F$, such that the total expected wage is $\tilde{T}_F + \tilde{t}_F pa\sqrt{k^*(\tilde{t}_F)} = c$.

If instead $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} > c$, then $\tilde{T}_F = 0$. In this case, the total expected wage is $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2}$.

We can thus express the value of the venture when $b > \alpha$:

$$E[\tilde{v}_F] = \begin{cases} E[\tilde{v}'_F] = pa\sqrt{k^*(\tilde{t}_F)} - c \text{ if } \frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} \leq c \\ E[\tilde{v}''_F] = (1-\tilde{t}_F)pa\sqrt{k^*(\tilde{t}_F)} \text{ if } \frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} > c, \end{cases} \tag{15}$$

with $E\tilde{v}'_F \geq E\tilde{v}''_F$.

3.3.2 The choice of the CEO

In this section we study the value-maximizing type of CEO. In the initial stage of the game, the board chooses they type of manager $\tilde{m}$ such that $\tilde{m} = \arg\max E[\tilde{v}_m]$. In particular, an external CEO is preferred iff $E[\tilde{v}_O] > E[\tilde{v}_F]$. To this aim, recall that $E[\tilde{v}'_F] \geq E[\tilde{v}''_F]$. Then, a necessary (but not sufficient) condition for external CEOs to emerge in equilibrium is $E[\tilde{v}_O] > E[\tilde{v}''_F]$, i.e.:

$$(1-\tilde{t}_O)E[\pi\left(k^*(\tilde{t}_O)\right)] > (1-\tilde{t}_F)E[\pi\left(k^*(\tilde{t}_F)\right)], \tag{16}$$

which implies $\tilde{t}_O < \tilde{t}_F$. We can thus establish our second result.

Proposition 2 *In sectors where the efficiency of diversion is high ($b > \alpha$), the PPS of the family-CEO's compensation (i.e., $\tilde{t}_F$) in equilibrium is higher than the PPS of external CEOs (i.e., $\tilde{t}_O$).*

Proof. See Appendix D. ■

When $b > \alpha$, the family and external CEO's compensations must both be pay-for-performance. However, they are deeply different under other respects. The PPS of the family-CEO , $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$, only depends on b and α, but it is constant with respect to the profits. Conversely, the PPS of external CEOs, $\tilde{t}^O = \frac{1}{\pi} \ln\left(\frac{p}{p-c}\right)$, is negatively correlated to the profits in case of success. Given that offering pay-for-performance contracts is costly, external CEOs become optimal when profits are sufficiently high, i.e. their PPS becomes low. Then, given that they are hired only when profits are sufficiently high, their PPS in equilibrium is lower than the PPS of family CEOs.

The fact that the PPS of family CEOs is constant, whereas the PPS of external CEOs is negatively correlated to profits, has important implications also on the level of the expected wage. The expected wage of a family CEO is equal to $E[\tilde{T}_F + \tilde{t}_F \pi\left(k^*(\tilde{t}_F)\right)]$; as $\tilde{t}_F$ is constant, then the expected wage of a family CEO increases linearly with the profit level $\pi\left(k^*(\tilde{t}_F)\right)$. On the contrary, the expected wage of an external CEO is constant and equal to $p \ln \frac{p}{p-c}$. Its being constant depends on the fact that an increase in profit is compensated by a decrease of the PPS of the external CEO's contract. As the expected wage of the external CEO is constant, it provides a sort of ceiling to the cost of the venture. A family CEO emerges only when his wage is lower than this "ceiling", $p \ln \frac{p}{p-c}$. We can thus establish our third result.

Proposition 3 *In sectors where the efficiency of diversion is high ($b > \alpha$), the expected compensation of the family-CEO in equilibrium is lower than that of external CEOs.*

Proof. See Appendix D. ■

In family firms with a family CEO, the problem of diversion is more severe, the higher the profits. As a consequence, industries with higher profits are more likely to hire external CEOs. Therefore, family CEOs emerge only if profits (and thus compensations) are sufficiently low.

4 Empirical Design, Data, and Results

To test the theoretical propositions, we use an unbalanced panel of 102 Italian publicly listed family firms (2000-2017). There are several reasons why we employ firms from within a single country instead of conducting a cross-country analysis. First, by focusing on the ownership and control structures that firms actually have adopted within a given legal regime (i.e. a French Civil law system), we do not have to control for the potential that country-specific laws, financial institutions and cultures allow to owners for expropriation of non-controlling shareholders. Country specific factors indeed influence at a great extent both the choice of the family to retain the controlling stake, and the decision to appoint a family CEO as well as the compensation policy (La Porta et al., 1999). All firms in our sample face exactly the same investor protection laws and the same institutional and cultural environment, but have nonetheless very different compensation structures. Second, Italy is an excellent research case because family firms with controlling shareholders are very common, long-lasting, even among publicly listed firms, and are often run by the founder or by a descendant (Morck et al., 2005). Ownership structure is very stable in Italy and highly concentrated, among quoted firms. As reported by CONSOB (2018), the share of the largest shareholder was 49% in 1998 and is still 47.7% in 2017. Conversely, the aggregate share of the other "relevant" shareholders (i.e. those with an interest of at least 2% in the company, including institutional investors) is about 12%. Such ownership structures do not favor the formation of blockholders large enough to threaten the controlling shareholder or to play a relevant monitoring role. The stability of the largest shareholder's share (α) is a useful feature in our empirical test in that it allows us to focus exclusively on the efficiency of diversion, b, to estimate empirically the PPS parameter.

In the theoretical analysis, the compensation policy (e.g. the provision of managerial incentives) ultimately depends on the efficiency of diversion and on the ownership share of the controlling shareholder. Empirically, a measure of diversion or stealing is not easy to find. However, as suggested by (Klapper and Love, 2002; Himmelberg et al., 1999; Aboody and Lev, 2000), the scope and potential of diversion increases when the firm's activity requires large and sunk investment in intangible assets, human capital, technology and marketing,

which are difficult to observe, evaluate and monitor. We thus rely on R&D and advertising investments, at the industry level, as the main sources of information asymmetry and evaluation uncertainty that potentially allow insiders the room to carry out diversion activities (see for example, Aboody and Lev, 2000, who study the link between R&D expenses and insider trading by corporate insiders). In addition, as a robustness check, we use an alternative measure of diversion, based on the concept of external finance dependence as developed by Rajan and Zingales (1998).

4.1 The Data

We construct our dataset starting from the population of non-financial firms quoted in the "Industrial Companies" segment of Italian stock exchange (Borsa Italiana) and we track company data back to 2000[13]. We exclude firms with less than three continuous years of CEO compensation data and we remain with an unbalanced panel of 150 non-financial firms, publicly listed firms in the period 2000-2017.[14] To identify "family" ownership we used information by CONSOB on the identity of the CEO, the board of directors, the largest individual shareholder (direct "ultimate owner" of the ownership stake, as per CONSOB's definition) and of investors with more than 2% of the voting shares ("relevant" investors, according to CONSOB). Then we collected information about the relevant investors' parental ties with the largest shareholder as obtained from the press or the news on the web/internet. A "family firm" is one where either the largest individual shareholder or a group of individual shareholders related by blood or marriage have more than 50% of the equity shares. We used 50% as the cut-off value to define a "family" owned firm because ownership is highly concentrated and stable in Italy (see Figure A.1 in Appendix A). We end up with 102 "family firms". To identify the *Family CEO*, we started from the CEO identity, we tracked whether

[13]The starting date is 2000 because information on CEO compensations only became publicly available since that year, as a result of CONSOB's Regulation n. 11971 (May 14, 1999).

[14]Accounting and financial data are collected from three annual directories, *Le Principali Società, Indici e Dati* and *Il Calepino dell'Azionista* published by Mediobanca, a large Italian investment bank (www.mbres.it). Information about firms' ultimate ownership, corporate governance, family ties of the CEO group affiliation, location, age, business activity and primary industry at 3-digit NACE classification was collected merging different sources: annual reports, DUN's and Bradstreet, company websites, CONSOB and Borsa Italiana's websites, other directories.

the CEO is also the largest shareholder or a member of the controlling family group, based on the CEO's surname and his/her direct or indirect parental ties.

We then collected data to control for the quality of the corporate governance of each firm. *Institutional Investor* denotes the presence of mutual, pension or investment funds with more than 2% of the shares, which are expected to play a disciplining role on compensation policy (Croci et al., 2012; Fernando et al., 2014). *Dual* returns if the firm has a dual-class security structure to make turnover of control more difficult (Grossman and Hart, 1988). *STAR* denotes whether the firm is listed in the special Stock Exchange segment with more stringent requirements on corporate governance, transparency and information disclosure. *Shareholder Agreements* indicates the presence of a "voting pact" or a "coalition", i.e. an agreement among few minority shareholders to stabilize, secure and enhance the exercise of control in the firm (Bianchi and Bianco, 2006). *Independence of Remuneration Committee*, the fraction of independent directors in the remuneration committee (Conyon and Peck, 1998), is included to account for possible collusion over diversion activities between an external CEO and the large shareholder. Finally, *CEO-Chair duality* indicates when the CEO is also Chair of the Directors' Board, a situation that entrust an unusual concentration of powers to the CEO, such as that of manipulating his/her compensation scheme (Adams et al., 2010).

Data about CEO pay were collected from company annual reports. We use *Total Compensation* because, in the earlier years, several companies only report the *total* (cash) pay and many others do not report the individual items consistently over time. Being aware that a comprehensive measure of CEO pay should also cover the values of the CEO's stock and option holdings, in the robustness analysis we use a measure of total pay that includes the year to year change of the Fair value of equity compensation, sourced from the annual report of the Remuneration Committee. Unfortunately, equity-based data are only available from 2012, when CONSOB mandated their disclosure for listed companies. However, many companies do not actually use such equity-related forms of compensation (see Conyon et al. 2013, for a comparative analysis of the use of stock options in Continental Europe and Anglo-Saxon countries). We then include other CEO characteristics. *CEO Tenure*, the number of years the CEO has been in charge, controls for CEO experience, but also for potential managerial entrenchment, also on the part of external CEOs, since a longer tenure

may ensure internal power over the Board's decisions(Bebchuk and Fried, 2004). *CEO Age* indicates when the CEO is more than 62 years old (the 75th percentile in our dataset), and proxies the CEO's experience and expertise. *CEO Turnover* is a binary variable returning when there is a change in the CEO, an event that generates a discontinuity in the time-series of the pay variable.

To measure firm performance (*Performance*) we use the *EBITDA* (Earnings Before Interests, Taxes, Depreciation and Amortization) and, in the robustness analysis, the Return on Assets, (*ROA*), the ratio between EBITDA and total assets, and the Tobin's q, i.e. the market-to-book ratio, calculated as (total asset -equity + market capitalization)/total assets. While the value of EBITDA allows us to control for incremental profits, in line with the theoretical model, ROA is an accounting profitability rate which measures how efficiently the CEO uses the assets, regardless of the capital structure, and *Tobin's q* allows for a market-based valuation of firm performance and prospects. As firm-specific control variables we include the log of real total sales to measure *Firm Size*, since past research has found that CEO pay is positively related with firm size (Murphy, 1985) and *Financial Leverage*, the ratio of total financial debt to total asset, since high levels of debt may lead to reduce the CEO pay. We then include *Industry ROA* to provide a benchmark to the firm-level profitability to which the CEO pay should be referred. Finally, we add *Firm Age* because older family firms may be more inclined to revert to an external CEO, if none of the founder's descendants is available to run the business.

To implement a measure of diversion that accounts for the intensity of intangible assets, we use an industry typology originally constructed by Davies and Lyons (1996, see Table A2.1, pp. 258-260) following Sutton (1991). The typology classifies 3-digit NACE industries based on UK industry data on R&D and advertising to sales ratios. *High diversion* industries are characterized by high R&D and/or advertising expenditures, i.e. the sunk intangible investments that firms often use to differentiate their product while *Low diversion* industries report no or low R&D and Advertising intensity. We opt for a typology based on UK data because reliable and consistent industry-level measures of R&D and advertising intensity are not available in Italy. Moreover, using pre-sample, out-of-sample industry data should reduce endogeneity concerns that typically arise when firm-level data are employed to classify the

firms themselves.[15] The sample firms are assigned to Low/High diversion groups based on their primary industry at the beginning of the period, which is assumed not to change over the sample period. Finally, for the alternative definition of diversion, based on the industry-specific dependence on external finance, we draw the data directly from Rajan and Zingales (1998, Table 1, p. 566-567), who report the median level of external finance dependence for ISIC industries, calculated as the fraction of capital expenditures not financed with cash flow from operations. We use the ratios calculated for mature companies, i.e. public for at least ten years, as most of the firms in our data are quite old.

Table 1 reports the summary statistics for the full sample of family firms while Appendix Table A1 describes all the variables.

Table 1: Summary Statistics – Family firms, full sample

	Mean	**Std. Dev.**	**Min**	**Max**	**N Obs.**
CEO pay (cash)	828.196	1008.876	61.39	17191.66	1170
CEO pay (cash + equity)	958.438	1065.115	-745.79	8328.67	272
ROA	0.094	0.068	-0.14	0.38	1135
Tobin's q	1.413	0.883	0.37	9.06	1148
EBITDA	116587.500	238125.701	-221097.95	2120963.75	1135
Family CEO	0.569	0.495	0.00	1.00	1170
Firm size (sales)	878958.780	1538122.010	16307.56	11764183.00	1151
Financial leverage	0.275	0.147	0.00	0.83	1150
CEO-Chair Duality	0.330	0.470	0.00	1.00	1168
CEO age > 62	0.285	0.452	0.00	1.00	1170
CEO tenure	8.885	7.598	1.00	40.00	1170
CEO turnover	0.096	0.294	0.00	1.00	1170
Dual-class shares	0.332	0.471	0.00	1.00	1167
Shareholders' agreement	0.238	0.426	0.00	1.00	1148
Institutional investors	0.486	0.500	0.00	1.00	1162
Indep. of Remun. Comm.	0.598	0.372	0.00	1.00	1170
STAR Segment	0.439	0.497	0.00	1.00	1170
Firm Age	57.732	38.967	0.00	271.00	1170
ROA Industry	0.070	0.032	-0.01	0.18	1153
High Diversion	0.644	0.479	0.00	1.00	1170
External Financial Dependence	0.082	0.201	-1.33	0.39	1170

Note: CEO pay and Firm sales are in Thousands of 2000 constant Euros.

In Table 2, tests of mean differences between family and non-family CEOs' pay in High

[15]However, using Italian data might also raise reverse causality concerns because the R&D or advertising expenditures of the large companies in our dataset determine to a large extent the industry-level data in the domestic market. Fortunately, cross-industry differences are typically correlated in industrialized countries, (see for example, Rajan and Zingales, 1988).

and Low diversion industries explore the initial conditions of the variable at the core of the theory. We find that, on average, family CEOs have significantly lower compensations than non-family CEOs and that the difference is driven by the pay levels in high diversion industries, in line with Proposition 3. Moreover, compensations are higher in High diversion industries, particularly those of outside CEOs, but the difference is not statistically significant.

Table 2: Mean differences of CEO pay by CEO and Industry types

	Family CEOs	**External CEOs**	**Difference (p-value)**
CEO Pay	719	971	252***
	(801)	(1216)	(0.000)
CEO Pay in High diversion industries	690	1023	332***
	(609)	(954)	(0.000)
CEO Pay in Low diversion industries	776	886	109
	(1081)	(1552)	(0.39)
Difference	-86.4	136.7	
(p-value)	(0.187)	(0.221)	

Note: Standard deviations and p-values in parentheses. CEO pay is in Thousands of 2000 constant Euro. ***, **, * denote significance of the mean differences at 1%, 5% and 10%.

4.2 Regression results

In order to test model's Proposition 1 model, we estimate the sensitivity of CEO pay to firm performance (Jensen and Murphy, 1990) using the following fixed-effects specification on the subsample of family CEOs:

$$LogCEOpay_{it} = \alpha_0 + \alpha_1 PERF_{it} + \alpha_2 PERF * LowDiv_{it} + X'_{it}\gamma + \mu_i + \lambda_t + \varepsilon_{it},$$

where the coefficient α_1 estimates the sensitivity of CEO pay to firm performance, while the coefficient α_2 on the interaction $PERF * LowDiv$ allows us to test whether the PPS of the family CEOs is significantly lower in low diversion industries. To test Propositions 2 and 3, we then estimate the following model on the full sample of family firms:

$$LogCEOpay_{it} = \beta_0 + \beta_1 PERF_{it} + \beta_2 FamCEO_{it} + \beta_3 PERF \cdot FamCEO_{it} + X'_{it}\delta + \mu_i + \lambda_t + \varepsilon_{it},$$

Where β_2 indicates if family and outside CEO's pay statistically differ, while β_3 on the interaction $PERF \cdot FamCEO$ tests the difference in pay sensitivity to performance between family- and non-family CEOs.

In both models, X'_{it} is the vector of control variables described in Section 4.1, μ_i are the firm fixed effects that control for time invariant firm and sectoral unobservable characteristics, and λ_t are year fixed effects, which account for time-specific common factors, like the business cycle and changes in corporate governance laws, best-practices and CONSOB's requirements about CEO compensations. Finally, ε_{it} is the error term. Standard errors are robust to heteroscedasticity and clustered at the firm level. The time period is 2000-2017.

The PPS equations use the logarithm of total cash pay as dependent variable, EBITDA as a measure of performance (both in thousands of 2000 constant Euros), and a binary variable to denote high R&D and Advertising intensity as a proxy for the scope for diversion. In Appendix B we report the results of a a battery of robustness tests using alternative measures of performance (ROA and Tobin's Q), a measure of CEO pay that includes stock options and equity-based components, and an alternative definition of diversion, based on external finance dependence (Rajan and Zingales, 1995)).

Table 3 presents the regression results to test Proposition 1, which focuses on Family CEOs and predicts that the sensitivity to performance of their pay is higher in industries where the potential for diversion is higher.

Table 3: Proposition 1: Family CEO's pay – Fixed effects estimates

Dep. Var.: Log(Pay)	Full (1)	Low Div (2)	High Div (3)	Full (4)
Performance (t_F)	0.0006**	0.00040	0.00484***	0.0051***
	(0.000)	(0.00024)	(0.00146)	(0.001)
Performance (t_F*Low Diversion)				-0.0047***
				(0.001)
Control variables: CEO tenure, CEO turnover, CEO age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors Dummy, Dual-class shares, Voting pact, Independence of Rem. Comm., Industry ROA Firm and Year FE				
H0: $t_F + t_F * LowDiversion = 0$				3.52*
F-test (p-value)				0.07
Observations	630	206	424	630
Number of firms	66	23	43	66
R2	0.3372	0.2839	0.4655	

Notes. Fixed effects estimates. Performance is EBITDA in 2000 constant Euros. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Results show that the PPS of family CEOs' pay is significant when the efficiency of diversion is high (Column (3)), but insignificant in the subsample of low diversion industries (Column (2)). Finally, Column (4) shows the results when we allow the PPS parameter to vary across high and low diversion industries, using all firm-year observations with family CEOs. The negative and significant interaction term indicates that family CEOs' PPS in low diversion industries is significantly lower than in high diversion industries, consistently with Proposition 1. At the bottom of the table, test of the sum in low diversion industries $t_F + t_F * LowDiv$ show that the PPS parameter is not null, but very small.

We now turn to Propositions 2 and 3 about the differences in pay levels and PPS between family and outside CEOs when efficiency of diversion is high. We also estimate the results for low diversion industries, as a benchmark to the test.[16] The binary variable FamCEO tests whether the level of the pay of family and non-family CEOs is significantly different (w_F–w_O). The coefficient on the interaction between FamCEO and Performance allows us

[16]Because the typology to distinguish low and high R&D and Advertising intensity industries is a dichotomous, time invariant variable, we estimate our models on separate subsamples. To ensure that we can separate the sub-samples without loss of information, we report, at the bottom of Columns (1) and (2), F-tests of the joint significance of cross-samples differences of all coefficients. In the robustness analysis, however, we use an alternative measure of diversion which is a continuous variable, thus allowing us to estimate the PPS differences on the full sample.

to test the difference between the PPS of family and external CEOs. Columns (1) and (2) of Table 4 focus on high diversion industries. The fixed effects estimates show that the pay of family CEOs is significantly lower and significantly more related to firm performance than the pay of outside CEOs. This evidence is consistent with Propositions 2 and 3. Conversely, looking at low diversion industries in Columns (3) and (4), we note that neither the level nor the performance sensitivity of Family CEOs' pay differ from those of outside CEOs.

Turning to the control variables, we find that, in high diversion industries, CEO pay increases with firm size and with CEO tenure, and tends to be higher the younger the CEO. Contrary to our expectations, we find no evidence CEO-Chair duality affects the level and the structure of CEO pay. More generally, many control variables, including the characteristics of the firm's corporate governance, are statistically insignificant, suggesting that the fixed firm specific factors ultimately absorb most of the effect. Results for firms in low diversion industries show that the coefficients of most control variables, albeit insignificant, bear the opposite sign as compared to high diversion industries, confirming the differences between the two sub-samples verified by the F-tests at the bottom of he table.

Table 4: Propositions 2 and 3 –Fixed effects estimates

	High diversion		Low diversion	
Dep.Var.: Log(Pay)	(1)	(2)	(3)	(4)
Performance (t_O)	0.0010***	0.0008**	0.0010**	0.0020**
	(0.0004)	(0.0003)	(0.0004)	(0.0010)
Famceo ($w_F - w_O$)	-0.3783***	-0.5783***	0.0098	0.1453
	(0.122)	(0.129)	(0.378)	(0.358)
Performance*Famceo ($t_F - t_O$)		0.0031***		-0.0015
		(0.0006)		(0.0010)
Control variables				
CEO-Chair Duality	-0.0440	0.0650	0.1449	0.0714
	(0.102)	(0.123)	(0.195)	(0.193)
CEO-Chair Duality*Performance		-0.0008		0.0006
		(0.002)		(0.000)
Firm size	0.1934*	0.1702*	0.1981	0.1611
	(0.106)	(0.090)	(0.184)	(0.177)
Firm leverage	-0.2874	-0.2410	0.0033	-0.0600
	(0.267)	(0.255)	(0.524)	(0.515)
CEO Age> 62	-0.1895**	-0.1811**	0.1423	0.0864
	(0.087)	(0.088)	(0.092)	(0.077)
CEO tenure	0.0309***	0.0261**	-0.0045	-0.0013
	(0.012)	(0.011)	(0.019)	(0.018)
CEO turnover	-0.1013*	-0.1072*	-0.1180	-0.0518
	(0.056)	(0.055)	(0.111)	(0.106)
Dual-class shares	0.0584	0.0762	-0.1032	-0.1735
	(0.096)	(0.095)	(0.140)	(0.131)
Voting Pact	-0.0561	-0.0377	0.0131	-0.0009
	(0.100)	(0.096)	(0.170)	(0.176)
% Indep. Directors in Rem. Com.	-0.0125	-0.0095	0.2744	0.2210
	(0.126)	(0.125)	(0.269)	(0.238)
Institutional Investors	0.0396	0.0367	0.0110	-0.0199
	(0.067)	(0.065)	(0.086)	(0.084)
Industry ROA	1.2055	1.0828	-4.6806	-4.4007
	(2.006)	(1.776)	(4.146)	(4.190)
Firm and Year FE	Yes	Yes	Yes	Yes
H_0: High-Low sub-samples differences =0	2.14	3.18		
F-test (p-value)	(0.002)	(0.000)		
Observations [Number of firms]	712 [63]	712 [63]	377 [37]	377 [37]
R2	0.2922	0.3242	0.1843	0.2122

Notes. Fixed effects estimates. Performance is EBITDA in 2000 constant Euros. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

4.3 Endogeneizing the choice of the CEO

We now consider two selection-based endogeneity issues that could bias the fixed-effects results (Heckman, 1976, 1979; Lee, 1982) due to an omitted variable problem. [17] A sample-selection issue arises because the choice to appoint a family CEO (vis-à-vis an outside manager) may depend on the different degree of diversion efficiency in the industry. This problem may affect our test of Proposition 1, in which we focus on the sub-sample of family CEOs to estimate the difference in PPS between Low and High diversion industries, censoring de-facto the firm-year observations for non-family CEOs.

The second endogeneity issue is due to the self-selection of the family CEO in high or low diversion industries, potentially affecting our test of the Propositions 2 and 3 on pay differences between family and outside CEOs within high diversion industries. . . The self-selection problem arises due to the non-random assignment of the family CEO (i.e. the "treatment"), as the same factors that influence the choice of the CEO, such as CEO characteristics, corporate governance arrangements and expected profitability, may also affect the choice of the compensation policy.

We deal with the sample-selection problem using the Heckman's model for maximum likelihood estimates (Heckman, 1976), where the variables specified in the selection equation are assumed to determine whether a family or an outside CEO is likely to be observed (chosen). We then estimate whether the PPS of the family CEOs differ in High and Low diversion industries. In the selection equation, the set of variables includes the High Diversion industry dummy, industry profitability (ROA), to control for the general attractiveness of the firm's primary activity and a binary variable indicating the firm operates in a manufacturing sector (instead of service). We then include firm's age (as the probability of hiring an external CEO may increase the older the firm is), the CEO age (continuous variable), a dummy denoting the presence of dual-class shares (control-enhancing mechanism), and the total stake held by institutional investors, to control for the potential disciplining role of block-holders. Finally, as a proxy of the extent of corporate governance compliance, we include

[17] See Clougherty et al. (2016) for a comprehensive review and an empirical survey of the methodological problems that derive from sample- and self-selection endogeneity. Maddala (1983) has derived the maximum likelihood estimators of the model. See also Wooldridge (2010).

the dummy STAR, denoting if the firm's shares trade in the exchange segment with the tightest transparency and disclosure standards. Results are reported in the Appendix Table B.2. Comfortingly, the maximum likelihood estimates are very similar to the fixed effects results in Table 3. They show that the PPS of family CEOs in low diversion industries is significantly lower than the PPS in high diversion industries, in line with Proposition 1.

To deal with the self-selection bias, or endogenous treatment, we employ a latent variable approach similar to Heckman's procedure for the sample selection problem. In this case, we first consider the potentially endogenous "treatment", i.e. the decision to hire a family or an external CEO, in the selection equation and then we model the "outcome" equation for *CEO pay* in the full sample of firms, after controlling for the CEO choice.

We thus estimate the following linear regression with endogenous treatment, where the variables $\boldsymbol{X}$ are used to model the outcome - the pay equation - and the covariates $\boldsymbol{W}$ are used to model the treatment assignment -the CEO choice -, respectively.

$$CEOpay_{ijt} = \boldsymbol{X}_{ijt}\delta + \delta FamCEO_{ijt}\varepsilon_{ijt}$$

$$FamCEO_{ijt} = \begin{cases} 1, \text{ if } \boldsymbol{W}_{ijt}\gamma + u_{ijt} > 0 \\ 0, \text{ otherwise} \end{cases}$$

The set of variables for the purpose of identification in the selection equation is very similar to the one used in the sample-selection model.

Notably, however, the above model allows us to test the difference between the level of the pay of family and outside CEOs, i.e. an intercept effect on the outcome variable. To test the difference in the PPS, however, the treatment must also be allowed a slope effect on CEO pay, which allows the relationship between CEO pay and performance to vary "by treatment level", i.e. by CEO type. To this end, we estimate an endogenous-switching model that allows the interaction between the treatment and the firm's performance, i.e. the outcome variable of interest.

Table 5: Propositions 2 and 3 - Endogenous treatment regression model

Outcome Equation: Dep. Var. is Log(Pay)				
	High diversion		Low diversion	
Dep.Var.: Log(Pay)	(1)	(2)	(3)	(4)
Performance (t_O)	0.0010***	0.0008**	0.0010**	0.0020**
	(0.0003)	(0.0003)	(0.0004)	(0.001)
Famceo ($w_F - w_O$)	-0.4187**	-0.6337***	-0.0234	0.0397
	(0.175)	(0.163)	(0.482)	(0.439)
Performance*Famceo ($t_F - t_O$)		0.0031***		-0.0015
		(0.001)		(0.001)
Control variables: CEO tenure, CEO turnover, CEO age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors Dummy, Dual-class shares, Voting pact, Independence of Rem. Comm., Industry ROA Firm and Year FE				
Treatment (selection) equation: Dep. Var. is Family CEO				
Firm size	-0.4335***	-0.4337***	-0.0105	-0.0138
	(0.151)	(0.151)	(0.131)	(0.128)
Dual-class shares	0.7281**	0.7285**	0.1742	0.1745
	(0.342)	(0.343)	(0.358)	(0.357)
CEO age	0.0180	0.0180	0.0229	0.0231
	(0.014)	(0.014)	(0.015)	(0.015)
Firm age	0.0110**	0.0110**	0.0053*	0.0052*
	(0.005)	(0.005)	(0.003)	(0.003)
STAR segment	0.2012	0.2009	-1.3352***	-1.3494***
	(0.302)	(0.301)	(0.396)	(0.392)
Institutional investor share (%)	-0.0238	-0.0238	-0.0387	-0.0373
	(0.031)	(0.031)	(0.035)	(0.035)
Industry ROA	5.8305	5.8486	-2.9115	-2.9936
	(4.550)	(4.558)	(5.045)	(4.978)
Wald Test (all var.=0): p-value	0.000	0.000	0.000	0.000
Wald test of indep. eqns.($\rho = 0$): χ^2	0.15	0.34	0.03	0.34
(p-value)	(0.700)	(0.556)	(0.861)	(0.560)
Observations [Firms]	712 [63]	712 [63]	377 [37]	377 [37]

Notes. Endogenous treatment model. Maximum likelihood estimates. Performance is EBITDA in 2000 constant Euros. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 5 reports the results for both the linear outcome regression and the selection equation for both high and low diversion industries. At the bottom of the tables, we report the Wald tests of the null hypothesis of no correlation between the treatment assignment (FamCEO) errors and the outcome (CEO Pay) errors.

The selection equation shows that family CEOs in high diversion industries are more

likely to run smaller and older companies, firms with dual-class shares, lower participation by institutional investors, in more profitable industries. In the outcome equation, the estimates confirm that the pay-performance sensitivity of family CEOs is statistically higher than the PPS of outside CEOs, while the level of family CEOs' pay is statistically lower than the level of outside CEOs' pay. The evidence is consistent with Propositions 2 and 3. Conversely, in low diversion industries, the pay levels and sensitivities of family and outside CEOs do not statistically differ.

4.4 Robustness analysis

In this Section, we test whether our results hold when we use an alternative definition of diversion, alternative measures of firm performance and when CEO pay include equity-based components. Results are reported in the Appendix.

Alternative measure of diversion

For an alternative definition of the potential of diversion, we draw on the concept of "free cash flow" developed by Jensen (1986). Free cash flow, i.e. firm's liquidity in excess of its investment opportunity, provides insiders with larger room to extract private benefits of control. To find a reliable proxy for free cash flow, we turn to the "external finance dependence" variable, constructed by Rajan and Zingales (1998) for ISIC industries, i.e. the fraction of capital expenditures not financed with cash flow from operations. An out-of-sample measure at the industry level is required to circumvent endogeneity concerns. In our setting, the lower is the firm's dependence from external financing of investment, the higher the potential for profit diversion. Models are estimated using three alternative measures of performance: EBITDA, ROA and Tobin's Q. We present the results both for separate subsamples of low/high diversion industries (based on the median of the values reported by Rajan and Zingales, 1998, in Table 1) and for the entire dataset, using the continuous "external finance dependence" variable. Appendix Table B.2 reports the results on the difference of family CEOs' PPS (Proposition 1). Low (High) external financial dependence stands for high (low) efficiency of diversion. In Panel A, where financial dependence is a binary variable, we find that family CEOs' PPS is positive and significant in industries where external

financial dependence is low, i.e. the scope for diversion is high (Columns (1), (3), (5)). In contrast, in low diversion industries, ROA and Tobin's Q are statistically insignificant, while the EBITDA coefficient is three times smaller. In Panel B, we use the continuous financial dependence variable. We find that the multiplicative term Performance*External Finance Dependence is negatively signed and significant in Column (2), with ROA, and very close to significance with EBITDA and Tobin's q (p-values are 0.122 and 0.136, respectively). This evidence suggests, in line with Proposition 1, that family CEOs' compensations become more incentivizing as the industry specific dependence on external finance diminishes, i.e. when diversion becomes an easier and more alluring option for insiders

Appendix Table B.2 reports the results Propositions 2 and 3. In Panel A, we find that, in industries with low external finance dependence (high diversion) the pay family CEO pay is significantly lower and more sensitive to firm performance than the pay of outside CEOs, regardless of the measure of performance. In contrast, family and non-family CEOs' pay does not differ in low diversion industries (Columns (2), (4) and (6)). This evidence is consistent with the theory. In Panel B, where we use the continuous variable for financial dependence on the full sample, the specification allows for the differences between the pay level and sensitivity for family and outside CEOs at various degrees of diversion. We find that the level of family CEOs' pay increases with financial dependence, while its PPS, i.e. the coefficient of Ext. Fin. Dep*Performance*Famceo, decreases, suggesting that when large free cash flows increase the scope for diversion activities, family CEOs' compensations become more incentivizing.

Alternative measures of firm performance when the choice of the CEO is endogenized

As shown in Appendix Tables B.3 and B.4, our findings hold when we use ROA and Tobin's Q as alternative measures of firm performance, both when we account for the selection problems and when we use fixed effects estimation (results available on request). Though the coefficients of the regressions with the market-to-book ratio are less precisely estimated, the empirical evidence is qualitatively and quantitatively consistent with the theory predictions.

Total pay includes the fair value of equity-based compensation

Finally, in Appendix Tables B.5 and B.6, we report the results considering the total pay

inclusive of the equity-based component as the dependent variable. The data to derive a measure of pay comprehensive of the equity-based component became publicly available only in 2012, when the CONSOB first required listed firms to do so. This is revealing of the fact that in Italy, as in other Continental Europe countries, the practice of assigning stocks and equity related forms of compensation is not very common, and the fraction of equity-based compensation is usually low (Conyon et al., 2013). Therefore, the sample period is shorter (2012-2017) and the number of firm-year observations is limited, especially for low diversion industries. Comfortingly, however, the empirical findings are in line with previous evidence and consistent with the theoretical predictions.

In the Appendix Table B.5, we find that the PPS of family CEOs in low diversion industries is significantly lower than in high diversion industries when firm performance is EBITDA and ROA, or insignificant, with Tobin's Q. Appendix Table B.6 shows that, within high diversion industries, family CEOs' pay is significantly more related to firm performance (measured by EBITDA and ROA) than outside CEOs'. Results are less informative in low diversion industries, where the number of firm-year observations is small and the coefficient on family CEO dummy cannot be estimated due to collinearity problems. For the subsample of firms operating in high diversion industries, we were also able to estimate the endogenous treatment models, finding further support to the evidence of family CEOs' lower pay and higher PPS. Results are available on request.

5 Conclusions

In this paper, we use a theoretical model and an empirical analysis to study CEOs' compensation contracts in family firms. Family firms may suffer from a form of agency problem, consisting in the misalignment of objectives between the controlling shareholder -typically belonging to the family- and minority shareholders. Agency problems intensify when the CEO is a member of the controlling family and the stake of the family is so high that the presence of a blockholder large enough to exert effective monitoring is unlikely. We show that the structure of the family CEO's compensation contract may realign the divergent objectives between shareholders. In particular, through a theoretical model, we show that the

outcome-related compensation structure of family CEOs may emerge in industries where it is easier to divert value from minority shareholders. In these industries, incentive contracts act as a pre-commitment, disciplining device to ensure to minority shareholders that the family CEO will not divert value from the firm. We are motivated by findings in the recent empirical literature whereby, in contrast with the fundamental tenets of principal-agent theory under moral hazard, family CEO, despite their inside ownership, reveal pay-for-performance sensitivity higher than or similar to external managers.

We test our model against a dataset of publicly listed family firms in Italy from 2000 to 2017. We define "family" firms as those where the largest individual shareholder and his relatives have more than 50% of the equity and we use high (low) R&D and advertising intensity in the industry or, alternatively, low (high) external finance dependence to proxy for high (low) potential of diversion.

The evidence we find from fixed effect results and from models that deal with selection-based endogeneity matches our theoretical predictions about the effect of diversion on family CEO pay. First, we find that the sensitivity to performance of family CEO pay is higher in high-diversion industries and lower or null in low-diversion industries. Second, in industries where diversion is easier, the pay-performance sensitivity of family CEOs is significantly higher than the PPS of external CEOs. In contrast, we find no difference in the PPS of family and outside CEOs in industries where diversion is less likely. Third, in high-diversion industries family CEOs receive significantly lower compensations than outside CEOs. The evidence holds when we account for endogeneity issues related to the choice of the CEO, when we use the alternative definition of diversion, alternative definitions of firm performance and when total pay includes equity-based components.

Our paper makes three contributions to the literature. First, we provide an explanation to the provision of incentives to family CEOs in public family companies. Second, we contribute theoretical and empirical support to the argument that asset intangibility increases the efficiency and the potential of diversion, hence of minority shareholders' expropriation. Third, we propose incentive contracts as a precommittment device alternative to ownership structure when the formation and the activism of blockholders are unlikely to be effective.

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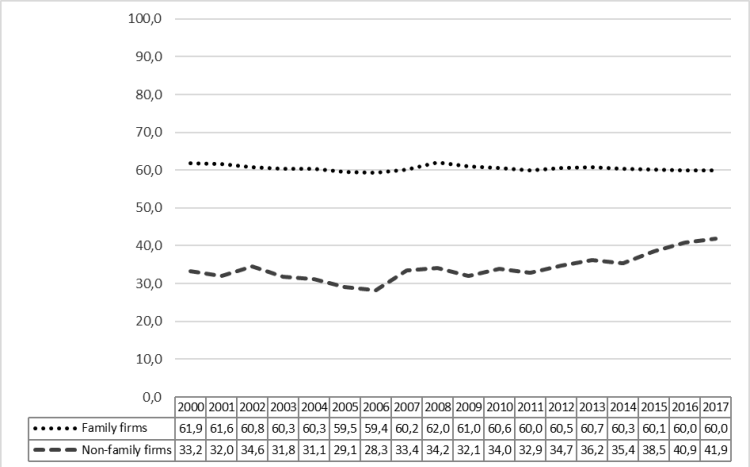
Appendices

Appendix A Variables



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Family firms	61,9	61,6	60,8	60,3	60,3	59,5	59,4	60,2	62,0	61,0	60,6	60,0	60,5	60,7	60,3	60,1	60,0	60,0
Non-family firms	33,2	32,0	34,6	31,8	31,1	29,1	28,3	33,4	34,2	32,1	34,0	32,9	34,7	36,2	35,4	38,5	40,9	41,9

Figure A.1: Average controlling share of family and non-family firms (private firms)

Table A.1: Variable descriptions

Variable	**Description**
Family	Dummy = 1 if the firm is majority (50%) controlled by individuals related by blood or marriage
Famceo	Dummy = 1 if CEO is a member of the controlling family by blood or marriage ties
CEO Chair	Dummy = 1 if the CEO is also Chair of the Directors' Board (managerial power)
Firm size	Log of real sales (firm size) in '000 of 2000 constant Euros
Financial leverage	Ratio of financial LT and ST debt to total assets
ROA	Ratio of Ebitda to total assets (firm's accounting profitability)
Tobin's q	Ratio of value firm value (total asset – book value of common equity + market value of common equity) to total asset (financial performance)
Firm age	Firm age from foundation (N. of years)
Institutional investor dummy and share	Total equity share held by institutional investors with an equity share >= 2%(Consob)
Dual-class shares	Dummy = 1 if the firm issues dual-class shares (azioni privilegiate) (O-C separation)
STAR segment	Dummy = 1 if the firm lists in the STAR segment of the stock exchange (high transparency and corporate governance requirements)
Shareholders' agreement	Dummy = 1 if a few minority shareholders have signed a voting pact/coalition (full disclosure)
Indep. Rem. Committee	Fraction of independent directors in the Remuneration Committee
CEO pay (cash)	CEO's total pay (cash) in '000 of 2000 constant Euros
CEO pay (cash and equity)	CEO's total pay (cash+fair value of equity-based compensation) in '000 of 2000 constant Euros
CEO tenure	The number of years the CEO has been in charge
CEO age	The CEO age in years
CEO turnover	Dummy = 1 if a new CEO is appointed
ROA-Industry	Industry-level ratio of Ebitda to total assets (benchmark for profitability) (Mediobanca)
High-diversion dummy	Dummy = 1 if the firm's primary activity is in a 3-digit industry with high R&D to sales ratio
External Financial Dependence	Ratio of investment divided by the sum of cash flow and investment. US data sourced from Rajan and Zingales (1988, Table 1, pp. 566-67)

Appendix B Robustness checks

Appendix B.1 Alternative definitions of diversion and performance

In this section we use "external financial dependence" as an alternative definition of diversion (Rajan and Zingales, 1998). Low financial dependence corresponds to high efficiency of diversion. ROA and Tobin's q are the alternative measures of performance.

Table B.1: Alternative definitions of diversion and firm performance: Test of Proposition 1 for the subsample of firms with family CEO

Panel A: Financial dependence is a binary variable

	EBITDA		ROA		Tobin's q	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
Performance (t_F)	0.0012*	0.0004**	2.9622**	0.4002	0.2626***	0.0730
	(0.001)	(0.000)	(1.257)	(1.045)	(0.052)	(0.103)
Control variables: CEO tenure, CEO turnover, CEO age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors Dummy, Dual-class shares, Voting pact, Independence of Rem. Comm., Industry ROA Firm and Year FE						
Observations	295	333	295	333	294	338
Number of nfirm	30	35	30	35	30	35
R2	0.4627	0.4834	0.4753	0.4665	0.4924	0.4781

Panel B: Financial dependence is a continuous variable

	EBITDA (1)	ROA (2)	Tobin's q (3)
Performance(t_F)	0.0009*	2.0161***	0.1795***
	(0.000)	(0.719)	(0.059)
Performance(t_F)* Ext. Finance Dependence	-0.0036[a]	-3.7454**	-0.3188[b]
	(0.003)	(1.684)	(0.211)
Control variables: CEO tenure, CEO turnover, CEO-Age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors, Dual-class shares, Voting pact, Indep. Rem. Comm., Industry ROA (and their interactions with Financial dependence) Firm and Year FE			
H0: $t_F + t_F * Ext.Fin.Dep. = 0$	1.20	0.95	0.46
p-value	0.28	0.33	0.50
F-test on control variables' interactions (p-value)	0.000	0.000	0.000
Observations	628	628	632
Number of nfirm	65	65	65
R2	0.4612	0.4535	0.4708

[a] p-value = 0.122
[b] p-value = 0.136
Notes. Fixed effects estimates. Sample: firm-year observations with Family CEO. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Table B.2: Alternative definitions of diversion and firm performance: Test of Propositions 2 and 3 for the subsample of firms with family CEO

Panel A: Financial dependence is a binary variable

	EBITDA		ROA		Tobin's q	
	Low (1)	High (2)	Low (3)	High (4)	Low (5)	High (6)
Performance (t_O)	0.0010	0.0003	0.0008	0.6708	-0.0096	0.1479
	(0.001)	(0.000)	(1.588)	(1.265)	(0.059)	(0.204)
Famceo ($w_F - w_O$)	-0.8232***	-0.0679	-1.0612***	-0.1065	-1.1719***	0.0332
	(0.267)	(0.198)	(0.315)	(0.248)	(0.387)	(0.356)
Performance*Famceo ($t_F - t_O$)	0.0006	0.0003	3.3945**	0.2310	0.1990**	-0.0901
	(0.001)	(0.001)	(1.685)	(1.628)	(0.094)	(0.252)
Control variables: CEO tenure, CEO turnover, CEO age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors Dummy, Dual-class shares, Voting pact, Independence of Rem. Comm., Industry ROA, Firm and Year FE						
Observations	547	545	547	545	546	559
Number of firms	55	47	55	47	55	47
R-squared	0.2909	0.2713	0.2940	0.2547	0.2808	0.2637

Panel B: Financial dependence is a continuous variable

	EBITDA (1)	ROA (2)	Tobin's q (3)
Performance	0.0006	1.4739*	0.0830**
	(0.001)	(0.834)	(0.040)
Famceo	-0.6755**	-0.7356**	-0.7205*
	(0.311)	(0.331)	(0.386)
Performance*Famceo	0.0009	1.2671	0.0496
	(0.001)	(1.097)	(0.078)
Ext. Fin. Dep * Famceo	2.7774*	2.9358*	2.8903*
	(1.481)	(1.577)	(1.691)
Ext. Fin. Dep *Performance	0.0023	6.7506***	0.3809***
	(0.003)	(1.803)	(0.092)
Ext. Fin. Dep *Performance* Famceo	-0.0080[a]	-8.1907***	-0.4408**
	(0.0051)	(2.457)	(0.207)
Control variables: CEO tenure, CEO turnover, CEO age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors Dummy, Dual-class shares, Voting pact, Independence of Rem. Comm., Industry ROA, Firm and Year FE			
Observations	1,092	1,092	1,105
Number of firms	102	102	102
R2	0.2278	0.2301	0.2144

[a] p-value = 0.119

Fixed effects estimates. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Appendix B.2 Non-random choice of the family CEO

Table B.3: Sample-selection and alternative measures of Performance: test of Proposition 1

Heckman 2nd stage			
Estimation sample: Family CEOs. Dependent variable is Log(CEO Pay)			
Performance is:	EBITDA	ROA	Tobin's q
Dep.Var.: Log(Pay)	(1)	(2)	(3)
Performance (t_F)	0.0051***	3.3449***	0.1547***
	(0.001)	(0.983)	(0.058)
Performance (t_F)*Low Diversion	-0.0046***	-2.6698**	-0.1150
	(0.001)	(1.184)	(0.155)
Wald test H0: $t_F + t_F * LowDiv$ =0	3.72*	1.03	0.07
(p-value)	0.054	0.309	0.784
Log Pseudo Likelihood	-736.03	-742.17	-749.13
Control variables: CEO tenure, CEO turnover, CEO Age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors, Dual-class shares, Voting pact, Independence of Remuneration Comm., Industry ROA, Firm and Year FE			
Heckman 1st stage			
Estimation sample: Family and non-family CEOs. Dependent variable is Family CEO			
Dual class shares	0.4967*	0.4974*	0.5071*
	(0.265)	(0.265)	(0.267)
Firm age	0.0060*	0.0060*	0.0061*
	(0.003)	(0.003)	(0.003)
Industry ROA	4.0876	4.0923	4.2491
	(3.618)	(3.614)	(3.654)
Manufacturing	0.8003*	0.7988*	0.8171*
	(0.469)	(0.470)	(0.475)
CEO age	0.0307***	0.0309***	0.0309***
	(0.011)	(0.011)	(0.011)
High Diversion dummy	0.0340	0.0345	0.0297
	(0.271)	(0.272)	(0.273)
STAR	-0.1651	-0.1652	-0.1537
	(0.237)	(0.237)	(0.238)
Institutional Investor share	-0.0290	-0.0286	-0.0282
	(0.022)	(0.022)	(0.022)
Likelihood ratio χ^2 (8) for 1st stage	190.55	190.55	192.73
Wald test of indep. eqns. ($\rho = 0$): χ^2	0.68	0.60	0.44
(p-value)	(0.410)	(0.439)	(0.510)
Observations with Outside CEO (censored)	488	488	488
Observations with Family CEO	630	630	627
Number of firms	100	100	100

Notes. Heckman selection model. Maximum likelihood estimates. Estimation sample in the second stage: firm-year observations with family CEO. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table B.4: Self-selection and alternative measures of Performance: test of Propositions 2 and 3. Endogenous treatment regression model: second stage + first stage

2nd stage: Outcome Equation. Dep. Var. is Log(Pay)				
	High diversion		Low diversion	
Dep.Var.: Log(Pay)	ROA (1)	Tobin's q (2)	ROA (3)	Tobin's (4)
Performance (t_O)	0.086	-0.025	2.678	0.072**
	(1.098)	(0.069)	(2.091)	(0.032)
Famceo ($w_F - w_O$)	-0.685***	0.042	-0.075	-0.066
	(0.221)	(0.200)	(0.456)	(0.586)
Perf*Famceo ($t_F - t_O$)	3.220***	0.164*	-1.261	-0.065
	(1.136)	(0.093)	(1.776)	(0.181)
Control variables: CEO tenure, CEO turnover, CEO Age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors, Dual-class shares, Voting pact, Indep. Rem. Comm., Industry ROA, Firm and Year FE				
1st stage: Treatment (selection) equation: Dep. Var. is Family CEO				
Firm size	-0.415***	-0.419***	0.012	-0.014
	(0.150)	(0.130)	(0.125)	(0.130)
Dual-class shares	0.732**	0.682**	0.222	0.290
	(0.340)	(0.300)	(0.352)	(0.365)
CEO age	0.018	0.014	0.020	0.021
	(0.014)	(0.012)	(0.015)	(0.014)
STAR segment	0.170	0.155	-1.271***	-1.163***
	(0.298)	(0.254)	(0.380)	(0.394)
Institutional investor share	-0.021	-0.027	-0.037	-0.038
	(0.031)	(0.021)	(0.035)	(0.034)
Firm age	0.011**	0.011**	0.004	0.005
	(0.005)	(0.004)	(0.003)	(0.004)
Industry ROA	5.480	6.537	-2.125	-2.747
	(4.532)	(3.976)	(4.853)	(4.869)
Wald Test (all var.= 0): p-value	0.000	0.000	0.000	0.000
Correlation between outcome and treatment errors: ρ	0.0374	-1.231	0.144	0.076
Wald test ($\rho = 0$): p-value	0.8877	0.0004	0.632	0.794
Observations [Firms]	717 [63]	721 [63]	381 [39]	384 [39]

Notes. Endogenous treatment model. Maximum likelihood estimates. Estimation sample is the full sample. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Appendix B.3 Results with Total pay including equity-based components

Table B.5: Total Pay includes equity-based compensation (2012-2017): Test of Proposition 1.

	EBITDA				ROA	Tobin's q
Log(Cash+Equity Pay)	Full (1)	Low Div (2)	High Div (3)	Full (4)	Full (5)	Full (6)
Performance (t_F)	0.0004	0.0005	0.0103**	0.0055*	6.5265***	0.1462
	(0.000)	(0.001)	(0.004)	(0.003)	(2.396)	(0.207)
Performance (t_F)*Low Div				-0.0052*	-5.5522**	0.0714
				(0.003)	(2.383)	(0.229)
Control variables: CEO tenure, CEO turnover, CEO Age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors, Dual-class shares, Voting pact, Independence of Remuneration Comm., Industry ROA, Firm and Year FE						
H0: $t_F + t_F * LowDiv = 0$				0.97	1.85	1.52
F-test (p-value)				0.33	0.18	0.22
Observations	144	44	100	144	144	144
Number of firms	38	12	26	38	38	38
R2	0.248	0.553	0.404	0.269	0.311	0.244

Notes. Fixed effects estimates. Estimation sample is the subsample of firm-years observations with family CEO. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Table B.6: Total Pay includes equity-based compensation (2012-2017): Test of Propositions 2 and 3

	High diversion			Low diversion		
Log(Cash+Equity Pay)	EBITDA (1)	ROA (2)	Tobins' q (3)	EBITDA (4)	ROA (5)	Tobin's q (6)
Performance (t_O)	0.0033	-0.325	0.012	-0.0032**	-4.612	1.331*
	(0.0033)	(0.910)	(0.094)	(0.0012)	(8.787)	(0.659)
famceo ($w_F - w_O$)	0.0123	-0.129	-0.081	-	-	-
	(0.200)	(0.293)	(0.253)	-	-	-
Performance*famceo ($t_F - t_O$)	0.0099*	4.659*	0.214	0.0039***	6.249	-1.745**
	(0.0054)	(2.618)	(0.187)	(0.0013)	(8.828)	(0.725)
Control variables: CEO tenure, CEO turnover, CEO Age, CEO-Chair Duality, Firm size, Financial leverage, Institutional investors, Dual-class shares, Voting pact, Independence of Remuneration Comm., Industry ROA, Firm and Year FE						
Observations	176	165	163	78	78	78
Number of firms	46	43	43	24	24	24
R2	0.125	0.135	0.133	0.332	0.308	0.330

Notes. Fixed effects estimates. Estimation sample is the full sample of firms. Definitions of variables are in Section 4.1 and in Appendix Table A1. Robust standard errors in parentheses are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Appendix C Risk aversion

This Appendix extends the model by assuming a risk averse entrepreneur, as in Huddart (1993). The entrepreneur exhibits constant absolute risk aversion, represented by the utility function $u_F(y) = 1 - e^{-y}$. In the case of family CEO, the entrepreneur has preferences represented by the Von Neumann-Morgenstern utility function $u_F(\pi) = 1 - e^{-\pi}$. His expected utility is concave with respect to the wealth and linear with respect to the effort cost:

$$E[u_F(w_F)] = E[1 - e^{-[\alpha(\pi - w_F) + w_F]} - c]. \tag{C.1}$$

Let us assume for simplicity that $a = 1$. Given the investment expressed by (4), the optimal contract (t_F^*, T_F^*) in the absence of information asymmetries in terms of diversion can be obtained by maximizing the venture's value subject to the manager's participation constraint (i.e., the manager's expected utility (C.1) must be positive):

$$\begin{aligned} (t_F^*, T_F^*) = \arg\max_{t_F, T_F} \quad & p\sqrt{k^*(t_F)} - T_F - t_F p\sqrt{k^*(t_F)} \\ s.t. \quad & p\left(1 - e^{-T_F - t_F\sqrt{k^*(t_F)}}\right) + (1-p)\left(1 - e^{-T_F}\right) - c \geq 0. \end{aligned} \tag{C.2}$$

The solution of problem (C.2) is $t_F^* = 0$ and $T_F^* = -\ln(1-c)$, which is our benchmark. Then, $k^* = \left(\frac{(1-\alpha)p}{2}\right)^2$ and the expected value of the venture is

$$E[v_F^*] = p\sqrt{k^*(t_F^*)} + \ln(1-c). \tag{C.3}$$

We now compare $E[v_F^*]$ in (C.3) with $E[\tilde{v}_O] = p\sqrt{k^*(\tilde{t}_O)} + p\ln\left(1 - \frac{c}{p}\right)$ in (8). To this aim, note that $\ln(1-c) > \ln\left(1 - \frac{c}{p}\right)$. Then, $\ln(1-c) > p\ln\left(1 - \frac{c}{p}\right)$. Moreover, $p\sqrt{k^*(t_F^*)} > p\sqrt{k^*(\tilde{t}_O)}$. Then, $v_F^* > \tilde{v}_O$: in the absence of diversion problems, the value is higher when the CEO is the entrepreneur himself rather than an external CEO manager. In fact, an external CEO must bear some risk, otherwise he would shirk effort, but his risk aversion makes a pay-for-performance contract costly. Conversely, a family CEO can be compensated with a fixed wage, thus inducing an efficient allocation of risk.

We now study the case in which diversion is possible. The family CEO's IC constraint is $E[1-e^{-[\alpha(\pi-w_F)+w_F]}-c] \geq E[1-e^{-[(1-\alpha)T_F+b\pi]}-c]$, where the term on the l.h.s. is

$$E[1-e^{-[\alpha(\pi-w_F)+w_F]}-c] = p\left(1-e^{-\alpha\sqrt{k^*(t_F)}-(1-\alpha)\left(T_F+t_F\sqrt{k^*(t_F)}\right)}\right)+(1-p)\left(1-e^{-(1-\alpha)T_F}\right)-c,$$

and the term on the r.h.s. is

$$E[1-e^{-[(1-\alpha)T_F+b\pi]}-c] = p\left(1-e^{-(1-\alpha)T_F+b\sqrt{k^*(t_F)}}\right)+(1-p)\left(1-e^{-(1-\alpha)T_F}\right)-c.$$

Straightforward computations allow to obtain

$$t_F \geq \frac{b-\alpha}{1-\alpha}. \tag{C.4}$$

Condition (C.4) expresses the PPS of a risk averse family CEO, and it matches exactly the PPS of a risk neutral family CEO in (13). Risk aversion does not affect the level of PPS that is consistent with incentive compatibility in the case of a family CEO when diversion is possible. Then, if $b > \alpha$, $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$ and $k^*(\tilde{t}_F) = \left(\frac{(1-b)p}{2}\right)^2$, extending the validity of Proposition 1 to the case of risk averse entrepreneur.

Moreover, when $b > \alpha$, the family CEO's wage is such that $p\sqrt{\tilde{T}_F+\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}+(1-p)\sqrt{\tilde{T}_F} \geq c$, i.e.

$$p\left(1-e^{-\tilde{T}_F-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right)+(1-p)\left(1-e^{-\tilde{T}_F}\right) \geq c \tag{C.5}$$

If $p\left(1-e^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) \leq c$, the variable part of the contract is not sufficient to compensate the CEO for the effort. Then, it is necessary to integrate it with the fixed part, so that (C.5) holds with the equality sign.

If instead $p\left(1-e^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) > c$, then $\tilde{T}_F = 0$. In this case, the total expected wage is $p\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}$.

We can thus express the value of the venture when $b > \alpha$:

$$E[\tilde{v}_F] = \begin{cases} E[\tilde{v}'_F] = (1-\tilde{t}_F)p\sqrt{k^*(\tilde{t}_F)} + \ln \frac{1-c}{1-p+pe^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}} \text{ if } p\left(1-e^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) \leq c \\ E[\tilde{v}''_F] = (1-\tilde{t}_F)p\sqrt{k^*(\tilde{t}_F)} \text{ if } p\left(1-e^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) > c, \end{cases} \tag{C.6}$$

with $E[\tilde{v}'_F] \geq E[\tilde{v}''_F]$.

We can thus study the type of CEO chosen in the first stage. An external CEO is preferred iff $E[\tilde{v}_O] > E[\tilde{v}_F]$. A necessary (but not sufficient) condition for external CEOs to emerge in equilibrium is $E[\tilde{v}_O] > E[\tilde{v}''_F]$, i.e.:

$$(1-\tilde{t}_O)E[\pi\left(k^*(\tilde{t}_O)\right)] > (1-\tilde{t}_F)E[\pi\left(k^*(\tilde{t}_F)\right)].$$

The previous condition can be rewritten by expressing explicitly the profit term:

$$(1-\tilde{t}_O)\frac{(1-\alpha)(1-\tilde{t}_O)p}{2} > (1-\tilde{t}_F)\frac{(1-\alpha)(1-\tilde{t}_F)p}{2},$$

After straightforward simplifications, it can be rewritten as $(1-\tilde{t}_O)^2 > (1-\tilde{t}_F)^2$, which implies $\tilde{t}_O < \tilde{t}_F$, thus confirming the validity of Proposition 2.

The expected wage of a family CEO is equal to $E[\tilde{T}_F + \tilde{t}_F\pi\left(k^*(\tilde{t}_F)\right)]$; as $\tilde{t}_F$ is constant with respect to profits, then the expected wage of a family CEO increases linearly with the profit level $\pi\left(k^*(\tilde{t}_F)\right)$. On the contrary, the expected wage of an external CEO is constant and equal to $p\ln\frac{p}{p-c}$. A family CEO emerges only when his expected wage is lower than $p\ln\frac{p}{p-c}$. We thus confirm the result of Proposition 3. More formally, let us distinguish between two cases depending on the value of $E[\tilde{v}_F]$.

i)$E[\tilde{v}_F] = E[\tilde{v}'_F]$ (i.e., $p\left(1-e^{-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) \leq c$).

The expected wage of the family CEO satisfies

$$p\left(1-e^{-\tilde{T}_F-\tilde{t}_F\sqrt{k^*(\tilde{t}_F)}}\right) + (1-p)\left(1-e^{-\tilde{T}_F}\right) = c, \tag{C.7}$$

while the expected wage of the external CEO satisfies

$$p\left(1-e^{-\tilde{T}_O-\tilde{t}_O\sqrt{k^*(\tilde{t}_O)}}\right)+(1-p)\left(1-e^{-\tilde{T}_O}\right)=c. \tag{C.8}$$

Then, the certainty equivalent in both the family CEO and the external CEO case is $CE = -\ln(1-c)$. The risk premium is equal to $\sigma^2_{w_m}/2$, where $\sigma^2_{w_m} = p(1-p)\tilde{t}^2_m k^*(\tilde{t}_m)$ is the variance of the compensation for the manager m. As $\tilde{T}_F > \tilde{T}_O = 0$, then $\tilde{T}_F + \tilde{t}_F\sqrt{k^*(\tilde{t}_F)} < \tilde{T}_O + \tilde{t}_O\sqrt{k^*(\tilde{t}_O)}$. Then, $\sigma^2_{w_F} < \sigma^2_{w_O}$.

The expected value of the CEO's compensation is given by the sum of the certainty equivalent and the risk premium: $E[w_m] = -\ln(1-c) + \sigma^2_{w_m}/2$, for $m = \{F, O\}$. Given that $\sigma^2_{w_F} < \sigma^2_{w_O}$, then $E[w_F] < E[w_O]$.

ii)$E[\tilde{v}_F] = E[\tilde{v}''_F]$ (i.e., $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2}{2} > c$). In this case, choosing a family CEO over an external CEO maximizes the firm's value only if $E[\tilde{v}''_F] > E[\tilde{v}_O]$:

$$(1-\tilde{t}_F)p\sqrt{k^*(\tilde{t}_F)} > (1-\tilde{t}_O)p\sqrt{k^*(\tilde{t}_O)},$$

i.e.

$$\tilde{t}_O p\sqrt{k^*(\tilde{t}_O)} - \tilde{t}_F p\sqrt{k^*(\tilde{t}_F)} > \frac{(1-\alpha)p^2}{2}\left(\tilde{t}_F - \tilde{t}_O\right) \tag{C.9}$$

Given that, from Proposition 2, in equilibrium $\tilde{t}_F > \tilde{t}_O$, then the r.h.s of (C.9) is positive. Hence, condition (C.9) implies $\tilde{t}_O p\sqrt{k^*(\tilde{t}_O)} - \tilde{t}_F p\sqrt{k^*(\tilde{t}_F)} > 0$: the expected wage of external CEOs in equilibrium is higher than that of family CEOs.

Appendix D Proofs

Proof of Lemma 1. The IC constraint of Problem (6) can be rewritten as

$$t_O a\sqrt{k^*(t_O)} \geq -\ln\left(1-\frac{c}{p}e^{T_O}\right). \tag{D.10}$$

We can thus express Problem (6) in explicit terms:

$$\begin{aligned}(\tilde{t}_O,\tilde{T}_O) = \arg\max_{t_O,T_O} \quad & pa\sqrt{k^*(t_O)} - T_O - t_O pa\sqrt{k^*(t_O)} \\ s.t. \quad & (1-\alpha)\left(pa\sqrt{k^*(t_O)} - T_O - t_O pa\sqrt{k^*(t_O)}\right) - k^*(t_O) \geq 0 \\ & t_O a\sqrt{k^*(t_O)} \geq -\ln\left(1-\frac{c}{p}e^{T_O}\right). \\ & T_O \geq 0, 0 \leq t_O \leq 1.\end{aligned} \tag{D.11}$$

Suppose that the minority shareholders' participation constraint and the constraint $0 \leq t_O \leq 1$ are not binding (we will check their validity afterwards). Then, the Lagrangean function of the above problem is:

$$\mathcal{L} = pa\sqrt{k^*(t_O)} - T_O - t_O pa\sqrt{k^*(t_O)} + \lambda_1\left(t_O a\sqrt{k^*(t_O)} + \ln\left(1-\frac{c}{p}e^{T_O}\right)\right) + \lambda_2 T_O. \tag{D.12}$$

The Kuhn-Tucker conditions are:

$$\frac{\partial\mathcal{L}}{\partial T_O} = -1 + \lambda_1\frac{-\frac{c}{p}e^{T_O}}{1-\frac{c}{p}e^{T_O}} + \lambda_2 = 0 \tag{D.13}$$

$$\frac{\partial\mathcal{L}}{\partial t_O} = -\frac{(1-\alpha)p^2a^2}{2}2(1-t_O) + \lambda_1\frac{(1-\alpha)pa^2}{2}(1-2t_O) = 0 \tag{D.14}$$

$$\lambda_1\left(t_O a\sqrt{k^*(t_O)} + \ln\left(1-\frac{c}{p}e^{T_O}\right)\right) = 0 \tag{D.15}$$

$$\lambda_2 T_O = 0 \tag{D.16}$$

$$\lambda_1, \lambda_2 \geq 0, t_O a\sqrt{k^*(t_O)} + \ln\left(1-\frac{c}{p}e^{T_O}\right) \geq 0, T_O \geq 0.$$

We now prove that $\lambda_2 > 0$. Suppose, by contradiction, that $\lambda_2 = 0$. Then, from (D.13), $\lambda_1 = \frac{1-\frac{c}{p}e^{T_O}}{-\frac{c}{p}e^{T_O}}$, which is positive only if $1-\frac{c}{p}e^{T_O} < 0$. However, this is impossible as it is the

argument of the logarithm. Hence, $\lambda_2 > 0$. From (D.16), this implies that $\tilde{T}_O = 0$.

Using $\tilde{T}_O = 0$, we can rewrite the IC constraint (D.10) as

$$t_O a\sqrt{k^*(t_O)} \geq -\ln\left(1-\frac{c}{p}\right) \tag{D.17}$$

We now prove that $\lambda_1 > 0$. Suppose, by contradiction, that $\lambda_1 = 0$. Then, condition (D.14) allows to obtain $t_O = 1$. From (4), $k^*(1) = 0$. However, this implies that the IC constraint (D.17) cannot be satisfied. Hence, $\lambda_1 > 0$.

Given $\lambda_1 > 0$, condition (D.15) requires that $t_O a\sqrt{k^*(t_O)} + \ln\left(1-\frac{c}{p}\right) = 0$. Using (4), the latter gives

$$t_O a\frac{(1-\alpha)(1-t_O)pa}{2} + \ln\left(1-\frac{c}{p}\right) = 0.$$

This is a second degree equation with two solutions: $t_O = \frac{1\pm\sqrt{1+\frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right)}}{2}$. We now prove that only the solution with the minus sign solves problem (6). To see this, consider condition (D.14). It can be simplified into $-2p(1-t_O)+\lambda_1(1-2t_O)=0$, which allows to obtain $\lambda_1 = 2p\frac{1-t_O}{1-2t_O}$. As $\lambda_1 \geq 0$, then $2p\frac{1-t_O}{1-2t_O} \geq 0$, i.e. $t_O \leq 1/2$. We can thus exclude the solution $t_O = \frac{1+\sqrt{1+\frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right)}}{2}$. Then, $\tilde{t}_O = \frac{1-\sqrt{1+\frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right)}}{2}$. Note that it holds $0 < \tilde{t}_O < 1$.

Finally, we verify that the minority shareholders' participation constraint is satisfied for $\tilde{T}_O = 0$ and $\tilde{t}_O = \frac{1-\sqrt{1+\frac{8}{p(1-\alpha)a^2}\ln\left(1-\frac{c}{p}\right)}}{2}$, i.e.

$$(1-\alpha)\left(pa\sqrt{k^*(\tilde{t}_O)} - \tilde{T}_O - \tilde{t}_O pa\sqrt{k^*(\tilde{t}_O)}\right) - k^*(\tilde{t}_O) \geq 0.$$

By substituting expression (4) and $\tilde{T}_O = 0$, the previous condition becomes

$$(1-\alpha)(1-\tilde{t}_O)pa\frac{(1-\alpha)(1-\tilde{t}_O)pa}{2} - \frac{(1-\alpha)^2(1-\tilde{t}_O)^2p^2a^2}{4} \geq 0,$$

which is always verified. ■

Proof of Lemma 2. Let us write in explicit terms the constrained optimization problem:

$$\begin{aligned} \max_{t_F, T_F} \quad & pa\sqrt{k^*(t_F)} - T_F - t_F pa\sqrt{k^*(t_F)} \\ s.t. \quad & (1-\alpha)\left(pa\sqrt{k^*(t_F)} - T_F - t_F pa\sqrt{k^*(t_F)}\right) - k^*(t_F) \geq 0 \\ & T_F + t_F pa\sqrt{k^*(t_F)} - c \geq 0, \\ & T_F \geq 0, 0 \leq t_F \leq 1, \end{aligned} \tag{D.18}$$

Suppose that the minority shareholders' participation constraint and the constraint $t_F \leq 1$ are not binding (we will check their validity afterwards). Then, the Lagrangean function of the above problem is:

$$\mathcal{L} = pa\sqrt{k^*(t_F)} - T_F - t_F pa\sqrt{k^*(t_F)} + \lambda_1\left(T_F + pt_F a\sqrt{k^*(t_F)} - c\right) + \lambda_2 T_F + \lambda_3 t_F. \tag{D.19}$$

The Kuhn-Tucker conditions are:

$$\frac{\partial \mathcal{L}}{\partial T_F} = -1 + \lambda_1 + \lambda_2 = 0 \tag{D.20}$$

$$\frac{\partial \mathcal{L}}{\partial t_F} = -\frac{(1-\alpha)p^2a^2}{2}2(1-t_F) + \lambda_1\frac{(1-\alpha)p^2a^2}{2}(1-2t_F) + \lambda_3 = 0 \tag{D.21}$$

$$\lambda_1\left(T_F + pt_F a\sqrt{k^*(t_F)} - c\right) = 0 \tag{D.22}$$

$$\lambda_2 T_F = 0 \tag{D.23}$$

$$\lambda_3 t_F = 0 \tag{D.24}$$

$$\lambda_1, \lambda_2, \lambda_3 \geq 0, T_F + pt_F a\sqrt{k^*(t_F)} - c \geq 0, T_F, t_F \geq 0.$$

Let us suppose that $\lambda_3 = 0$. Then, from (D.21), $\lambda_1 = 2\frac{1-t_F}{1-2t_F}$, which satisfies $\lambda_1 \geq 0$ only if $t_F < \frac{1}{2}$. However, from (D.20), $\lambda_2 = 1 - \lambda_1$. By substituting $\lambda_1 = 2\frac{1-t_F}{1-2t_F}$, we obtain $\lambda_2 = \frac{-1}{1-2t_F}$, which satisfies $\lambda_2 \geq 0$ only if $t_F > \frac{1}{2}$. We can thus conclude that $\lambda_3 > 0$. Hence, from (D.24), $t_F^* = 0$.

Let us now suppose that $\lambda_1 = 0$. From (D.21), and using $t_F^* = 0$, we obtain $\lambda_3 = (1-\alpha)p^2a^2$. Moreover, from (D.20), $\lambda_2 = 1$, which implies $T_F = 0$. However, when $t_F = T_F = 0$,

condition $T_F+pt_Fa\sqrt{k^*(t_F)}-c\geq 0$ cannot be satisfied. We thus conclude that in equilibrium $\lambda_1>0$. Hence, from (D.22), $T_F+pt_Fa\sqrt{k^*(t_F)}-c=0$. Using $t_F^*=0$, we obtain $T_F^*=c$.

It is immediate to verify that $t_F^*<1$. We just need to check that the minority shareholders' participation constraint is satisfied as well, that is

$$(1-\alpha)\left(pa\sqrt{k^*(t_F^*)}-T_F^*-t_Fpa\sqrt{k^*(t_F^*)}\right)-k^*(t_F^*)\geq 0.$$

By using $t_F^*=0$ and $T_F^*=c$, the above condition can be rewritten as

$$(1-\alpha)\left(\frac{(1-\alpha)p^2a^2}{2}-c\right)-\left(\frac{(1-\alpha)pa}{2}\right)^2\geq 0,$$

i.e.

$$\frac{(1-\alpha)p^2a^2}{4}-c\geq 0. \tag{D.25}$$

From Assumption 1, we know that $\frac{(1-\alpha)p^2a^2}{8}+p\ln\left(1-\frac{c}{p}\right)>0$. Then, $\frac{(1-\alpha)p^2a^2}{4}+p\ln\left(1-\frac{c}{p}\right)>0$. Given that $\ln\left(1-\frac{c}{p}\right)<-\frac{c}{p}$, condition (D.25) is satisfied.

■

Proof of Proposition 1. The first part of the Proposition ("When the efficiency of diversion is low ($b\leq\alpha$), the PPS of the family-CEO's compensation is $t_F^*=0$") is proven by Lemma 2. We now prove the second part.

The optimal contract in the case of diversion with a family CEO solves the following Problem:

$$\begin{aligned}(\tilde{t}_F,\tilde{T}_F)=\arg\max_{t_F,T_F}\quad & pa\sqrt{k^*(t_F)}-T_F-t_Fpa\sqrt{k^*(t_F)} \\ s.t.\quad & (1-\alpha)\left(pa\sqrt{k^*(t_F)}-T_F-pt_Fa\sqrt{k^*(t_F)}\right)-k^*(t_F)\geq 0 \\ & t_F\geq\frac{b-\alpha}{1-\alpha}. \\ & T_F+t_Fpa\sqrt{k^*(t_F)}-c\geq 0 \\ & T_F\geq 0.\end{aligned} \tag{D.26}$$

Suppose that the minority shareholders' participation constrain is not binding (we will check it afterwards). Then, the Lagrangean function of the above problem is:

$$\mathcal{L} = \frac{(1-\alpha)p^2a^2}{2}(1-t_F)^2 - T_F + \lambda_1\left(t_F - \frac{b-\alpha}{1-\alpha}\right) + \lambda_2\left(T_F + pat_F\frac{(1-\alpha)(1-t_F)pa}{2} - c\right) + \lambda_3 T_F,$$

whose Kuhn-Tucker conditions are:

$$\frac{\partial \mathcal{L}}{\partial T_F} = -1 + \lambda_2 + \lambda_3 = 0 \tag{D.27}$$

$$\frac{\partial \mathcal{L}}{\partial t_F} = -\frac{(1-\alpha)p^2a^2}{2}2(1-t_F) + \lambda_1 + \lambda_2\frac{(1-\alpha)p^2a^2}{2}(1-2t_F) = 0 \tag{D.28}$$

$$\lambda_1\left(\frac{b-\alpha}{1-\alpha} - t_F\right) = 0 \tag{D.29}$$

$$\lambda_2\left(T_F + pat_F\frac{(1-\alpha)(1-t_F)pa}{2} - c\right) = 0$$

$$\lambda_3 T_F = 0 \tag{D.30}$$

$$\lambda_1, \lambda_2, \lambda_3 \geq 0, t_F \geq \frac{b-\alpha}{1-\alpha}, T_F + pt_F a\sqrt{k^*(t_F)} - c \geq 0, T_F \geq 0.$$

We now prove that $\lambda_1 > 0$. Suppose by contradiction that $\lambda_1 = 0$. Then, from (D.28), $\lambda_2 = \frac{2-2t_F}{1-2t_F}$, i.e. $\lambda_2 > 1$. Given that (D.27) is $\lambda_2 + \lambda_3 = 1$, then $\lambda_3 < 0$, but this contradicts the condition $\lambda_3 \geq 0$. This proves that $\lambda_1 > 0$, which implies, from (D.29), that $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$.

As a last step, let us check that the minority shareholders' participation constraint is not binding when $\tilde{t}_F = \frac{b-\alpha}{1-\alpha}$.

First note that the minority shareholders' utility decreases when the expected wage $\tilde{T}_F + p\tilde{t}_F a\sqrt{k^*(\tilde{t}_F)}$ increases. Hence, we can focus on the case in which $\tilde{T}_F + p\tilde{t}_F a\sqrt{k^*(\tilde{t}_F)} > c$, i.e. $\lambda_2 = 0$: in fact, if the minority shareholders' utility

$$E[s_F] = (1-\alpha)\left(p\sqrt{k^*(\tilde{t}_F)} - \tilde{T}_F - p\tilde{t}_F\sqrt{k^*(t_F)}\right) - k^*(\tilde{t}_F)$$

is strictly positive when $\tilde{T}_F + pa\tilde{t}_F\sqrt{k^*(\tilde{t}_F)} > c$, then it is also strictly positive when $\tilde{T}_F + pa\tilde{t}_F\sqrt{k^*(\tilde{t}_F)} = c$.

If $\lambda_2 = 0$, then from (D.27) $\lambda_3 = 1$. This implies, from (D.30), that $\tilde{T}_F = 0$. By

substituting $\tilde{T}_F = 0$ in the minority shareholders' utility, it becomes:

$$E[s_F] = (1-\alpha)\left(1-\tilde{t}_F\right) pa\sqrt{k^*(\tilde{t}_F)} - k^*(\tilde{t}_F).$$

Using (4), the previous function can be rewritten as

$$E[s_F] = \frac{(1-\alpha)^2(1-\tilde{t}_F)^2 p^2 a^2}{2} - \left(\frac{(1-\alpha)(1-\tilde{t}_F)pa}{2}\right)^2,$$

which is clearly strictly positive for any $\tilde{t}_F < 1$. ■

Proof of Proposition 2. In the case of external CEO, the value of the venture is $E[\tilde{v}_O] = pa\sqrt{k^*(\tilde{t}_O)} - p\ln\frac{p}{p-c}$. In the case of family CEO, the value of the venture is given by (15). We thus distinguish between two cases, corresponding to the value of $E\tilde{v}_F$.

i)$E[\tilde{v}_F] = E[\tilde{v}'_F]$ (i.e., $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} \leq c$). In this case, choosing an external CEOs over a family CEO maximizes the firm's value only if $E[\tilde{v}_O] > E[\tilde{v}'_F]$:

$$pa\sqrt{k^*(\tilde{t}_O)} + p\ln\left(1-\frac{c}{p}\right) > pa\sqrt{k^*(\tilde{t}_F)} - c,$$

i.e.

$$pa\sqrt{k^*(\tilde{t}_O)} - pa\sqrt{k^*(\tilde{t}_F)} > -p\ln\left(1-\frac{c}{p}\right) - c.$$

Given that $\ln\left(1-\frac{c}{p}\right) < -\frac{c}{p}$, then $-p\ln\left(1-\frac{c}{p}\right) - c > 0$. This implies that $pa\sqrt{k^*(\tilde{t}_O)} - pa\sqrt{k^*(\tilde{t}_F)} > 0$, i.e. $k^*(\tilde{t}_O) > k^*(\tilde{t}_F)$. Therefore, $\tilde{t}_O < \tilde{t}_F$.

ii)$E[\tilde{v}_F] = E[\tilde{v}''_F]$ (i.e., $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} > c$). In this case, the choice of an external CEOs maximizes the firm's value only if $E[\tilde{v}_O] > E[\tilde{v}''_F]$:

$$(1-\tilde{t}_O)pa\sqrt{k^*(\tilde{t}_O)} > (1-\tilde{t}_F)pa\sqrt{k^*(\tilde{t}_F)},$$

i.e.

$$(1-\tilde{t}_O)\frac{(1-\alpha)(1-\tilde{t}_O)pa}{2} > (1-\tilde{t}_F)\frac{(1-\alpha)(1-\tilde{t}_F)pa}{2}.$$

After straightforward simplifications, it can be rewritten as $(1-\tilde{t}_O)^2 > (1-\tilde{t}_F)^2$, i.e $\tilde{t}_O < \tilde{t}_F$. ■

Proof of Proposition 3. We distinguish between two cases depending on the value of $E[\tilde{v}_F]$.

i)$E[\tilde{v}_F] = E[\tilde{v}'_F]$ (i.e., $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} \leq c$). The expected wage of the family CEO is equal to c. The expected wage of the external CEO is equal to $\tilde{t}_O pa\sqrt{k^*(\tilde{t}_O)} = -p\ln\left(1-\frac{c}{p}\right)$. Given that $\ln\left(1-\frac{c}{p}\right) < -\frac{c}{p}$, then $-p\ln\left(1-\frac{c}{p}\right) > c$.

ii)$E[\tilde{v}_F] = E[\tilde{v}''_F]$ (i.e., $\frac{b-\alpha}{1-\alpha}\frac{(1-b)p^2a^2}{2} > c$). In this case, choosing a family CEO over an external CEO maximizes the firm's value only if $E[\tilde{v}''_F] > E[\tilde{v}_O]$:

$$(1-\tilde{t}_F)pa\sqrt{k^*(\tilde{t}_F)} > (1-\tilde{t}_O)pa\sqrt{k^*(\tilde{t}_O)},$$

i.e.

$$\tilde{t}_O pa\sqrt{k^*(\tilde{t}_O)} - \tilde{t}_F pa\sqrt{k^*(\tilde{t}_F)} > \frac{(1-\alpha)p^2a^2}{2}\left(\tilde{t}_F - \tilde{t}_O\right) \tag{D.31}$$

Given that, from Proposition 2, in equilibrium $\tilde{t}_F > \tilde{t}_O$, then the r.h.s of (D.31) is positive. Hence, condition (D.31) implies $\tilde{t}_O pa\sqrt{k^*(\tilde{t}_O)} - \tilde{t}_F pa\sqrt{k^*(\tilde{t}_F)} > 0$: the expected wage of external CEOs in equilibrium is higher than that of family CEOs. ■