DTE 633

Exploring Executive Bargaining Dynamics

AN EMPIRICAL INVESTIGATION

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Abstract

This article empirically identifies changes in CEOs' bargaining power using data from ExecuComp and Annual Snapshot databases. It employs a Pareto Weights representation of the agency model to bridge managerial power theory and standard agency theory, proposing an empirical equation to track changes in bargaining power over time. Findings reveal the pivotal role of salary and stock grants in CEO compensation, aligning with both managerial power and agency theories. Analysis also uncovers a significant relationship between CEO age and bargaining power stability. Differences in bargaining power estimates across sectors indicate a multifaceted nature of CEO compensation, influenced by organizational factors and company size. Specifically, in large-cap companies, future compensation instances, like option grants, significantly influence changes in bargaining power, while in mid-cap companies, both present and future compensation factors contribute. Small-cap companies, however, show changes in bargaining power primarily linked to salary, bonus, and stock grants.

Keywords: Dynamic Analysis, Contract Theory, Executive Compensation.
JEL Codes: C61, D86, J33

Resumen

Este artículo identifica empíricamente los cambios en el poder de negociación de los gerentes principales, CEOs por sus siglas en inglés, utilizando datos de las bases de datos ExecuComp y Annual Snapshot. Se utiliza una representación del modelo de agencia con ponderadores de Pareto para conectar la teoría del poder gerencial y la teoría estándar de agencia, proponiendo una ecuación empírica para medir los cambios en el poder de negociación a lo largo del tiempo. Los resultados revelan el papel crucial del salario y las concesiones de acciones en la compensación de los CEOs, alineándose con ambas teorías, la del poder gerencial y la de agencia. El análisis también pone en evidencia una relación significativa entre la edad del CEO y la estabilidad del poder de negociación. Las diferencias en las estimaciones del poder de negociación entre sectores indican una naturaleza multifacética de la compensación de los CEOs, que

viene determinada por factores organizacionales y el tamaño de la empresa. Específicamente, en las empresas de gran capitalización, las instancias de compensación futura, como las concesiones de opciones, influyen significativamente en los cambios en el poder de negociación, mientras que, en las empresas de mediana capitalización, tanto los factores de compensación presentes como futuros contribuyen. Sin embargo, las empresas de pequeña capitalización muestran cambios en el poder de negociación principalmente vinculados al salario, los bonos y las concesiones de acciones.

Palabras clave: análisis dinámico, teoría de contratos, compensación gerencial.
Códigos JEL C61, D86, J33

Exploring Executive Bargaining Dynamics: An Empirical Investigation

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Abstract

This article empirically identifies changes in CEOs' bargaining power using data from ExecuComp and Annual Snapshot databases. It employs a Pareto Weights representation of the agency model to bridge managerial power theory and standard agency theory, proposing an empirical equation to track changes in bargaining power over time. Findings reveal the pivotal role of salary and stock grants in CEO compensation, aligning with both managerial power and agency theories. Analysis also uncovers a significant relationship between CEO age and bargaining power stability. Differences in bargaining power estimates across sectors indicate a multifaceted nature of CEO compensation, influenced by organizational factors and company size. Specifically, in large-cap companies, future compensation instances, like option grants, significantly influence changes in bargaining power, while in mid-cap companies, both present and future compensation factors contribute. Small-cap companies, however, show changes in bargaining power primarily linked to salary, bonus, and stock grants.

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1 Introduction

Reconciling the theoretical predictions of agency models with what is observed in real-life executive compensation packages has proven to be a complex endeavor because those contracts have experienced remarkable variations both in their level and composition over time. Moreover, ascertaining causal relations between compensation packages' characteristics and measures of firms' performance has yet to be successful not only because of the observed heterogeneity in compensation packages but also because of the vast array of factors influencing the behavior of industries, firms and individual CEOs. By using US data on CEO compensation, Edmans and Gabaix (2016) are able to document several empirical regularities such as the significant increase in the level of CEO compensation since the decade of the 1990s, a phenomenon that is not restricted to companies with high capitalization levels (S&P 500), and the evolution of the structure of those packages with evidence of changes in their main components starting with salary and bonus in the period 1930-1955, stock options between 1980-2006, and performance-based stock grants since 2006. One explanation put forward to explain the increasing trend in the level of CEO pay is their increasing power to determine their own compensation packages. Although some theoretical and empirical analyses about this explanation have already been performed (Bebchuk and Fried (2003); Choe et al. (2014); Edmans and Gabaix (2016)), there is still room to contribute to the issue of measuring the changes in the bargaining power of CEOs when negotiating their pay.

The main objective of this article is to empirically identify a measure of changes in CEOs' bargaining power using data from a sample of CEOs and their companies obtained from the ExecuComp and Annual Snapshot databases from Compustat covering the period 1999-2022. The theoretical framework behind this empirical exercise is the Pareto Weights representation of the agency model proposed in Di Giannatale et al. (2023) , which has been proven to be equivalent to the dynamic agency model of Spear and Srivastava (1987) in terms of efficiency, while simultaneously embedding a dynamics of the bargaining power of the agent. Furthermore, from the analytical predictions of this model combined with results of its numerical simulations, a proposal for an empirical equation to identify how the agent's bargaining power changes from one period to the next behaves. This model can be envisioned as a middle ground between two competing theoretical models that have been used to explain the behavior of real-life CEO compensation packages. One approach is the managerial power theory, which is built upon the hypothesis that CEOs have a strong influence in the process of determining the level and composition of their own compensation packages while pursuing the objective of extracting rents from the shareholders (Bebchuk and Fried (2003); Choe et al. (2014); Edmans and Gabaix (2016)). The other competing approach is the standard agency theory, whose fundamental assumption is that the choice of CEOs compensation packages is driven by the maximization of shareholders' value (Hölmstrom (1979); Spear and Srivastava (1987); Edmans and Gabaix (2016)). These seemingly opposite strategies for modeling the contractual relationship between shareholders and their CEOs result in different predictions regarding the structure of

the optimal incentive schemes and their efficiency, while the aforementioned Pareto Weights approach encompasses predictions from both modelling strategies.

According to the managerial power theory, the primary component of CEO pay through which CEOs are able to extract rent is salary because it is not based on performance. Hence, CEOs' power in setting their own compensation should manifest through their ability of obtaining higher salary levels (Choe et al. (2014)). Even though the average weight of this component of CEO pay has been decreasing through time, it remains a significant component of CEO pay. In S&P 500 companies, for example, salary was 42% of their total compensation in 1990, steadily declining to 13% in 2014 (Edmans and Gabaix (2016)). Furthermore, this average in 2014 varies when classifying firms according to their level of capitalization: 29% for small-cap companies, 19% for mid-cap companies, and 13% for S&P 500 (large-cap) companies. Therefore, it is reasonable to assume that this pay structure is partly due to the possibility that CEOs' decisions can have a greater impact in the performance of smaller companies (Edmans et al. (2023)). These differences are also observed in the weights of other components of CEO pay (bonus, present value of future compensation, options and stocks) across firms of different capitalization levels. By exploiting the observed heterogeneity in CEO pay components among companies of three different capitalization levels, we aim to capture differences in the empirical measure of changes in CEO bargaining power through our econometric exercise.

The principal prediction of standard agency models is that CEOs should be paid based on their companies' performance. An issue that has captured the attention of the CEO pay literature is whether real-life compensation packages are actually consistent with what those models predict. In their seminal article, Jensen and Murphy (1990) found that the sensitivity of changes of CEO's wealth relative to changes in shareholders' wealth is very low, a result that was interpreted as a negative indication of the consistency of standard agency theory with real-life CEO pay packages. While some studies, such as Garen (1994), Haubrich (1994), and Wang (1997), have found positive evidence between the predictions of standard agency models and real-life CEO pay practices, the reality is that CEO compensation packages have dramatically evolved from the types of contracts that Jensen and Murphy originally analyzed using data that spanned from 1974 to 1986. Nowadays, those compensation packages tend to weigh more heavily towards performance-based elements of compensation, such as stock grants, and furthermore, evidence shows that theoretical advances in agency models make them better at capturing some of the real-life features of pay practices (Edmans et al. (2012)). In addition to the composition of those packages, there is an understanding that other factors related to CEOs' individual characteristics (age and tenure) and competitive forces from the input (managerial talent) and output (industry-side characteristics) markets impact the levels and structure of such compensation schemes (Edmans and Gabaix (2016)).

As mentioned earlier, the underlying framework for our empirical analysis is based on the model analyzed by Di Giannatale et al. (2023). This models a dynamic principal-agent model where the CEO's initial bargaining power replaces the agent's usual reservation utility as the key state variable. A law of motion governing the evolution of the agent's bargaining power based on output realizations, incorporating a small positive parameter ε to measure the change from one period to the next of such bargaining power. Among the findings of this article, we can cite a positive link between CEO salary level/variability and initial bargaining power, while the variability of salary decreases with the parameter ε. Additionally, an empirical equation to identify CEOs' changes in their bargaining power is proposed, and a preliminary econometric exercise is performed using model-generated data. This exercise allows the conclusion that the suggested dynamics are better suited for identifying such changes for low initial bargaining power values. The present article represents an attempt to provide empirical validity to the proposed empirical equation with an approach that is different from related research, such as Pander and Currie (2013) which looks into the competition for resources within the firm between executives and stakeholders other than shareholders, while Bova and Yang (2017) explores the connection between non-executives' equity-based compensation and decisions in the product market.

The findings emphasize the importance of salary and stock grants in CEO compensation, especially for performance incentives, with stock grants displaying higher variability. These results are consistent with managerial power and agency theories. Additionally, CEO age correlates significantly with bargaining power stability. Across sectors, there are variations in CEO bargaining power changes compared to a reference sector, indicating diverse compensation dynamics. This highlights the complexity of CEO compensation, impacted by sector and company size. Analysis by company size (capitalization levels) reveals differences: in large-cap companies, changes in bargaining power are linked to future compensation (e.g., option grants), while in mid-cap companies, present and future compensation (salary, bonus, stock grants) are significant. In small-cap companies, changes in bargaining power primarily relate to salary, bonus, and stock grants.

The rest of the present article is organized as follows: in the next section, we analyze some descriptive statistics of the dataset examined in this study. A succinct presentation of the theoretical framework underlying the empirical strategy carried out in this article is offered in Section 3. In Section 4, we present and interpret the econometric results we obtain through the empirical strategy implemented in this paper. In Section 5, we perform an additional empirical exercise to attempt to predict actual managerial compensation components from our empirical equation. Finally, we conclude.

2 Descriptive Analysis

In this section, we analyze various empirical aspects related to CEO compensation. We utilize data from a subset of CEOs and their corresponding companies, sourced from the ExecuComp and Annual Snapshot datasets within Compustat, spanning the period from 1999 to 2022. CEO compensation packages typically comprise salary, annual bonus, Long Term Incentive Plans (LTIP) payouts, option grants, and restricted stock grants (Edmans et al. (2017)). In Table 1, we summarize the variables used in our empirical analysis, which include variables that characterize the firms (output and size), various components of CEO compensation, and a personal characteristic of CEOs (age). The table provides information about each variable's name, description, and unit of measurement.

Table 1: Variable Definitions

Name	Description	Units
year	fiscal year of observation	-
mkval	market value (fiscal-year end)	millions of dollars
small_cap	indicates that a company has a market value between 250 million and 2 billion	binary
medium_cap	indicates that a company has a market value between 2 billion and 10 billion	binary
large_cap	indicates that a company has a market value between 10 billion and 200 billion	binary
naics	North America industry classification System Code	-
execid	executive ID number. The ExecID is a unique identifier for each person on the ExecuComp database	-
tdc1	total compensation (salary + bonus + other annual + restricted stock grants + LTIP payouts + all other + value of option grants)	millions of dollars
tdc2	total compensation (salary + bonus + other annual + restricted stock grants + LTIP payouts + all other + value of option exercised)	millions of dollars
total current	compensation (salary + bonus)	millions of dollars
salary	annual salary	millions of dollars
age	executive's age	years

In Table 2, we present descriptive statistics of the key variables used in the regression analysis, including firm output (mkval), CEO salary (salary), CEO total current

compensation (total current), and CEO present compensation elements, which comprise LTIP payouts and the value of either option grants (tdc1) or stock exercised (tdc2). Additionally, in Table 3, we provide the same information as in the previous table but classified according to the companies' level of capitalization (small-cap, medium-cap, and large-cap). As expected, we observe that for each variable included in this table, the higher the capitalization level, the higher the mean values of the variables. Also, the sample size decreases as the capitalization level increases. On the other hand, while the standard deviations of salary and total current compensation show only slight differences across the three capitalization levels, the standard deviations of instances that include future compensation (tdc1 and tdc2) exhibit greater differences across capitalization levels. Therefore, heterogeneity in CEO pay packages seems to be mainly driven by elements of future compensation. It is plausible to hypothesize that one manifestation of CEOs' power resides in keeping salaries growing and with little dispersion.

Table 2: Descriptive Statistics of the sample.

variable	mkval	salary	total current	tdc1	tdc2
mean	2026.020	0.310	0.375	1.405	1.586
std. dev.	3034.917	0.144	0.190	1.807	2.792
min	0.619	0.000*	0.000*	0.000*	0.000*
q0.25	548.211	0.213	0.241	0.537	0.491
q.50	1165.459	0.279	0.327	0.926	0.882
q0.75	2466.451	0.376	0.471	1.623	1.688
max	129605.300	1.033	1.039	134.296	134.296

Notes: All variables are measured in millions. Statistics based on 112603 observations.
*Indicates <US$100,000

Table 3: Descriptive Statistics by Level of Capitalization.

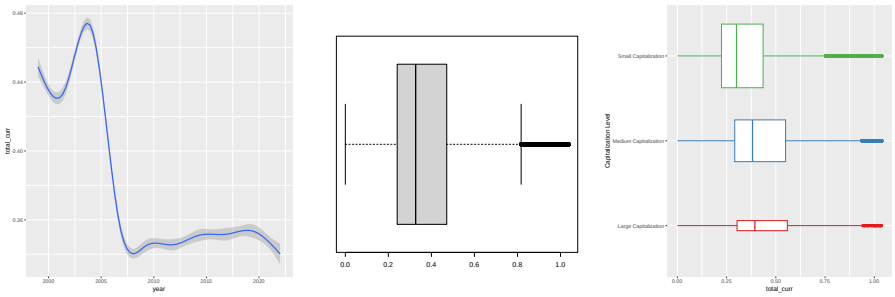
cap level	mkval	salary	total current	tdc1	tdc2	obs
small_cap	**838.782**	**0.287**	**0.349**	**1.081**	**1.138**	77353
	(515.344)	(0.135)	(0.182)	(1.288)	(1.668)	
medium_cap	**3918.734**	**0.360**	**0.430**	**2.019**	**2.410**	33302
	(1789.052)	(0.151)	(0.194)	(2.115)	(3.621)	
large_cap	**16813.134**	**0.374**	**0.439**	**3.755**	**5.302**	1948
	(11460.771)	(0.149)	(0.197)	(5.500)	(9.095)	

Notes: All variables are measured in millions. Sample means are reported in bold. Standard deviations are reported in parenthesis.

To gain insight into the behavior of the variables included in Tables 2 and 3, we now present a series of figures detailing those variables. In Figure 1, we depict the evolution over time, a box plot, and a classification by capitalization level of CEO total current compensation, which includes salary and annual bonus. As we can observe,

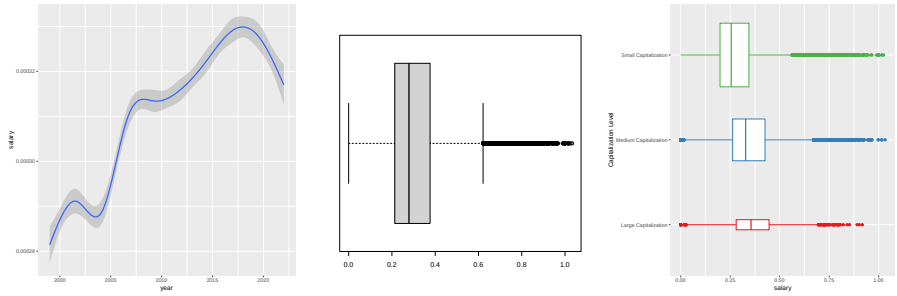
CEO total current compensation exhibits various patterns over time. Prior to 2005, there is an increasing trend, followed by a stark decrease between 2005 and 2010, and a slight recovery from 2010 to 2018, after which a decreasing pattern resumes. The box plot indicates that the distribution leans towards values lower than the mean but with significant dispersion for high total current compensation values. Observing the classification by capitalization levels, we notice that the mean total current compensation is non-decreasing with the company's capitalization level, with lower dispersion for low-cap companies (see Table 3). Figures 1 and 2 follow the same structure, but the former includes CEO salary and bonus while the latter includes only salary. Interestingly, the dramatic decrease observed in Figure 1 is not due to a corresponding decrease in salary but rather in bonuses. The temporal behavior of CEO salary is observed in the first panel of Figure 2. The corresponding box plot shows that the distribution of CEO salary also leans towards values lower than the mean but less pronounced than total current compensation. The third panel of Figure 2 allows us to draw almost the same conclusion as the corresponding panel in Figure 1.

Figure 1: Total current compensation (salary + bonus)



(a) Evolution over time (b) Box plot (c) By capitalization level

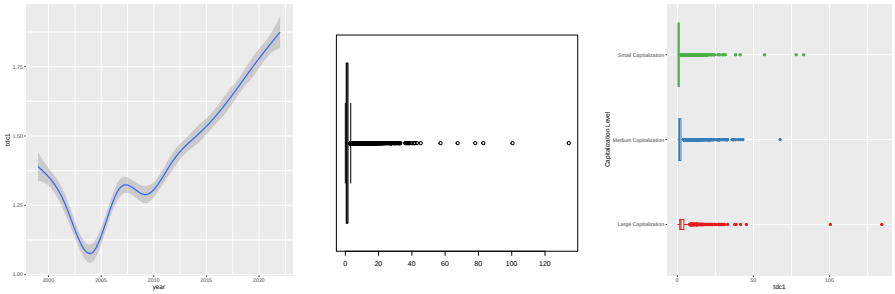
Figure 2: Salary



(a) Evolution over time (b) Box plot (c) By capitalization level

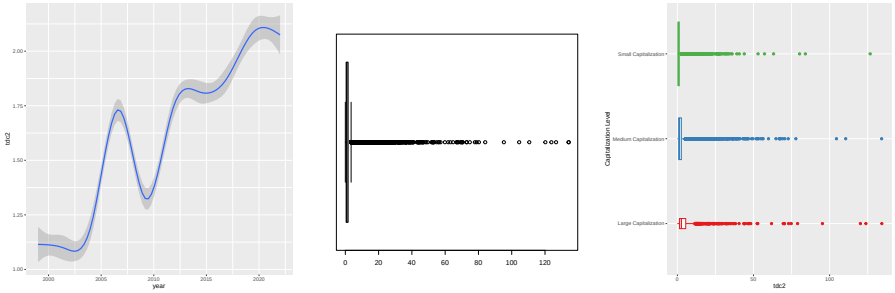
Figures 3 and 4 depict information about instances of CEO compensation that include future compensation (tdc1 and tdc2). Both elements of CEO pay show an increasing temporal path with significant fluctuations. The second and third panels of these figures indicate that these variables have considerable levels of dispersion, which is also observed when classifying them by capitalization levels of companies. Similarly, the mean values and standard deviations of these variables increase with capitalization levels, as shown in Table 3. Hence, we see elements of predictions from both managerial power and agency theories: salaries keep increasing over time with fluctuations but not dramatic ones, and high-power incentives are provided through instances of future compensation, which also show an increasing pattern but with distributions that are more dispersed compared to those of present compensation elements, particularly salary.

Figure 3: tdc1



(a) Evolution over time (b) Box plot (c) By capitalization level

Figure 4: tdc2

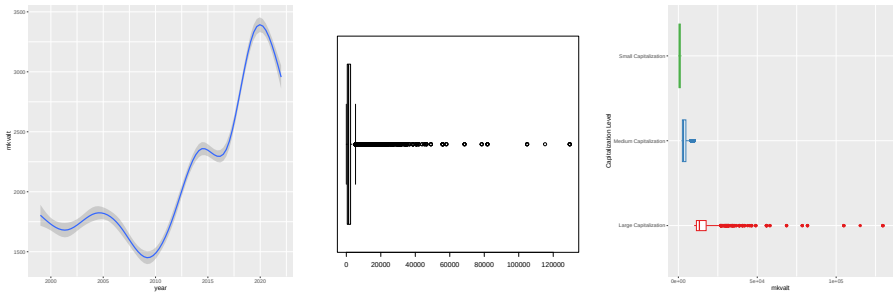


(a) Evolution over time (b) Box plot (c) By capitalization level

The measure of companies' output we consider in this article is their market value, which was selected because it also allows for classification by capitalization levels. Figure 5 shows that this variable experienced significant variations during the period

under study, particularly with low levels during the Great Recession years, but its overall temporal trend is increasing. The last two panels of this figure show that the market value of companies included in the sample is highly dispersed. The mean market value increases with capitalization levels, as does the standard deviation (see Table 3). Through the analysis of these observable variables, our aim is to empirically identify an unobservable variable: how the bargaining power of CEOs over their own compensation packages changes over time. This constitutes the objective of the forthcoming econometric exercise to be presented in this article.

Figure 5: Market value



(a) Evolution over time (b) Box plot (c) By capitalization level

3 Theoretical Framework

In this section, we summarize the theoretical framework proposed in Di Giannatale et al. (2023) to analyze the relation between the shareholders (principal) and the CEO (agent) of a company. The paper proposed a dynamic agency model in which the state variable is the agent's bargaining power, denoted by δ. At each period of time, the agent's compensation, denoted by w, depends on the company's output, $y \in \{y_L, y_H\}$, and his bargaining power, i.e. $w = w(\delta, y)$. Furthermore, we model the evolution of bargaining power using a Markovian law of motion, the next period agent's bargaining power depends on his current bargaining power and the output, $\delta' = z(\delta, y)$.

The paper provides proof that the model is equivalent to the standard dynamic contracting problem where the state variable is the agent's reservation utility, as in Spear and Srivastava (1987). Moreover, the dynamic problem is transformed into a static variational one and the contraction mapping theorem is employed to find a unique series of Pareto optimal contracts. This representation is solved numerically for a rich set of parameters. [2]

[2]Further information is available here: https://github.com/genarobasulto/Project-Dynamics-of-Bargaining-Power

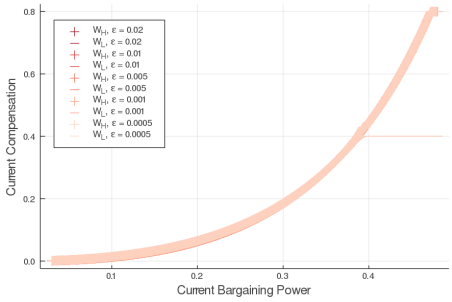
In particular, we give a simple yet meaningful representation their proposed law of motion for the agent´s bargaining power's evolution as follows:

$$\delta' = z(\delta, y) = \begin{cases} \min\{1, \delta + \varepsilon \cdot \frac{y}{y_H}\} & if \quad y = y_H, \\ \max\{0, \delta - \varepsilon \cdot \frac{y}{y_H}\} & if \quad y = y_L. \end{cases} \tag{1}$$

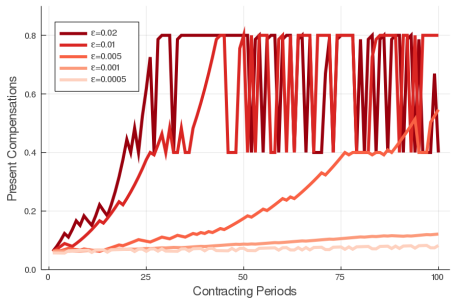
where ε is an arbitrarily small and positive number. This law of motion contemplates incentive provision in the form of a greater next-period bargaining power if high output y_H is observed, and a punishment in the opposite direction if output y_L occurs in the current period. We interpret the parameter ε as a measure of how closely future values of the CEO's bargaining power represent rewards or punishments for good versus bad performance of the firm.

The optimal contracts offered to the CEO lead to a Markov series of compensation and bargaining power pairs, as shown in Figure 6. From panel (a) of Figure 6, the optimal contracts imply that, fixing the parameter ε, we have a one-to-one relation between current bargaining power, which is unobserved, and current CEO compensation, which is observed. Furthermore, as shown in panel (b) of Figure 6, the change in compensation from one period to the next is informative of the change in bargaining power of the CEOs ε. These results suggest a positive correlation between CEO salary level/variability and initial bargaining power. Additionally, the variability of salary decreases with the parameter ε.

Figure 6: Current Compensation.



(a) Different Values for ε



(b) Simulation. 100 periods starting with $\delta_0 = 0.20$

We exploit this fact and propose the following methodology to measure empirically the change in CEOs bargaining power over the years. Informed by panel (a) of Figure 6 (and subsequent robustness results in the original article), we assume that both the agent compensation and his bargaining power are stochastic at any period of time, and

that this relationship takes the following form:

$$\delta_t = \frac{1}{f(y_H)} f(w_t) + e_t \tag{2}$$

where $f(w_t)$ is a real, continuous and concave function of w_t, and e_t are independent and normally distributed errors with mean 0 and variance σ^2 for all t.

Now, we note that the law of motion of bargaining power in (1) is equivalent to

$$\delta_{t+1} - \delta_t = \varepsilon \left((-1)^{I_t^-} \frac{y_t}{y_H} \right).$$

Replacing δ_{t+1} and δ_t in the last expression, the following result is obtained:

$$\underbrace{\frac{1}{f(y_H)} f(w_{t+1}) + e_{t+1}}_{\delta_{t+1}} - \underbrace{\frac{1}{f(y_H)} f(w_t) - e_t}_{\delta_t} = \varepsilon \left((-1)^{I_t^-} \frac{y_t}{y_H} \right),$$

$$f(w_{t+1}) - f(w_t) = \varepsilon \left((-1)^{I_t^-} \frac{y_t}{y_H} \right) f(y_H) + [e_t - e_{t+1}] f(y_H),$$

$$f(w_{t+1}) = f(w_t) + \varepsilon \left((-1)^{I_t^-} \frac{y_t}{y_H} \right) f(y_H) + u_t, \tag{3}$$

with $u_t = (e_t - e_{t+1}) f(y_H)$.

By fixing a concave transformation f, the parameter ϵ can be identified from Equation (3) in a linear regression of transformed wages and company outputs. An f functional that seems to work well in the estimation is $\delta_t = f(w_t) = w_t^{\beta}$ with $\beta \in (0, 1)$. Results from an econometric exercise performed by Di Giannatale et al. (2023) using model-generated data, as part of robustness checks that were performed for the proposed empirical equation, suggest that working with values of β around 0.5 are consistent with numerical results. The next section will be devoted to an empirical exercise to test this framework, where we estimate such parameter ϵ using the dataset described in Section 2.

4 Econometric Results

In the present section, we empirically implement Expression (3) with the goal of estimating the parameter ε using the dataset described in Section 2. Two main regression models were used: *i.e.*, **OLS** as a first approximation to our econometric analysis, with the caveat that it doesn't take into account the dynamic structure of the dataset; and **Linear Panel**, whose structure seems more appropriate to exploit the information from such a dataset. Furthermore, for each of the two methods, regressions **without** and

with controls were run to properly study the effects of characteristics identified by related literature as impacting CEO pay features, such as CEOs' age, company size, and industry characteristics, among others. Additionally, we performed a comparative analysis of these estimates by the capitalization levels of companies.

4.1 OLS

In this subsection, we present the econometric results obtained using the OLS method. Table 4 displays the results from the OLS regression without controls. We observe that for all instances of CEO compensation considered in this analysis, the ε estimates are statistically significant at the 99% confidence level. The numerical values of these estimates fall within the interval $[0, 1]$, as expected. Furthermore, all estimates exhibit a non-decreasing trend as the values of the exponent decrease, indicating a concave relationship between the agent's bargaining power and their compensation. In other words, as the relationship between compensation and bargaining power becomes more concave, the change in bargaining power tends to be higher. This leads to the conclusion, supported by both theoretical and numerical results, that all instances of present compensation tend to show lower variability.

It's worth noting that empirically distinguishing salary changes resulting from changes in ε versus changes in the CEOs' risk aversion parameter solely based on observed salaries would be challenging. In other words, we cannot attribute the lower variability in instances of CEO pay given higher values of ε solely to an effect driven by the risk aversion parameter. We anticipate that some of the effects from different values of the risk aversion parameter will be controlled for in the linear panel regression to be presented later in this section. The rationale is that the panel with controls will allow us to isolate the change in salary due to changes in ε only, as we control for CEO and firm characteristics.

Furthermore, when comparing the ε estimates between the two instances of present (future) compensation, total current compensation, and salary (tdc1 and tdc2), it's worth noting that salary exhibits greater variability compared to total current compensation (tdc2 shows greater variability than tdc1). Therefore, it appears that salary and stock grants are the primary elements of CEO pay employed for incentive provision, with stock grants generating higher variability in CEO pay. Consequently, our results identify elements of both managerial power and agency theories at play in determining CEO pay and changes in CEOs' bargaining power. Additionally, the estimates in the last two lines of this table appear to contradict some of the monotonic results mentioned earlier, raising concerns about the suitability of the last two exponent values in the present empirical exercise.

Regarding the results of the OLS regression with controls, the results shown in Table 5 display a general increase in the numerical values of the ε estimates, but the

Table 4: OLS Estimates - Without Controls

	tdc1	tdc2	total current compensation	salary
	without controls			
$f = x^{0.5}$	0.0003^{***}	0.00003^{***}	0.0001^{***}	0.00004^{***}
	(0.00003)	(0.00000)	(0.00001)	(0.00001)
$f = x^{0.4}$	0.001^{***}	0.0001^{***}	0.0002^{***}	0.0001^{***}
	(0.00005)	(0.00000)	(0.00002)	(0.00001)
$f = x^{0.3}$	0.001^{***}	0.0004^{***}	0.0004^{***}	0.0002^{***}
	(0.0001)	(0.00001)	(0.00003)	(0.00003)
$f = x^{0.2}$	0.002^{***}	0.001^{***}	0.001^{***}	0.0003^{***}
	(0.0001)	(0.00004)	(0.0001)	(0.00005)
$f = x^{0.1}$	0.002^{***}	0.002^{***}	0.001^{***}	0.0004^{***}
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
$f = x^{0.05}$	0.001^{***}	0.002^{***}	0.001^{***}	0.0003^{***}
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Note:				*p<0.1; **p<0.05; ***p<0.01

same conclusions discussed above apply. Furthermore, we observe a loss of statistical significance in the ε estimates in the last two lines of this table. Specifically, exponents ranging in the interval $[0.4, 0.5]$ appear to have better statistical significance. On the other hand, Table 6 allows the visualization of the particular effects of the controls introduced in this regression, namely the fiscal year, the CEO's age, and the industrial sectors where the firm operates (with accommodation and food services as the industrial sector of reference). The sign of the relationship between the CEO's age and the respective ε estimates is negative for all compensation instances (significant at the 99% level); that is, the older the CEO, the lower the change in their bargaining power. Moreover, all sectors have similar levels of the ε estimates to that of the reference sector (accommodation and food services) except for mining, where the estimates tend to be higher than those of the reference sector for most compensation instances.

4.2 Linear Panel

We consider that this regression method does a better job of taking into account the dynamic structure of the dataset. In Table 7, we show the results of the linear panel regression without controls, and our conclusions are similar to those from the OLS regression without controls. The results of the linear panel regression with controls are depicted in Table 8, and those results are closer in numerical magnitude to the linear panel regression without controls when compared with the results of the OLS regres-

Table 5: OLS Estimates - With Controls

	tdc1	tdc2	total current compensation	salary
	with controls			
$f = x^{0.5}$	0.021^{***}	0.004^{***}	0.021^{***}	0.004^{*}
	(0.011)	(0.0005)	(0.003)	(0.002)
$f = x^{0.4}$	0.030^{**}	0.012^{***}	0.047^{***}	0.009^{**}
	(0.018)	(0.002)	(0.006)	(0.005)
$f = x^{0.3}$	0.039	0.037^{***}	0.095^{***}	0.021^{**}
	(0.030)	(0.005)	(0.012)	(0.010)
$f = x^{0.2}$	0.046	0.097^{***}	0.169^{***}	0.042^{**}
	(0.043)	(0.014)	(0.022)	(0.019)
$f = x^{0.1}$	0.050	0.190^{***}	0.223^{***}	0.063^{*}
	(0.048)	(0.030)	(0.035)	(0.033)
$f = x^{0.05}$	0.053	0.180^{***}	0.187^{***}	0.058
	(0.042)	(0.035)	(0.044)	(0.042)
Note:				*p<0.1; **p<0.05; ***p<0.01

sion without and with controls. That is, the linear panel method generates more stable values of the ε estimates. On the other hand, Table 9 allows the visualization of the particular effects of the controls we introduce in this regression, namely the CEO's age and the industrial sectors where the firm operates (with accommodation and food services as the industrial sector of reference). The sign of the relationship between the CEO's age and the respective ε estimates is negative for all compensation instances (significant at the 99% level); that is, the older the CEO, the lower the change in their bargaining power. Unlike the results in Table 6, we observe more heterogeneity in the levels of the ε estimates when compared to those of the reference sector (accommodation and food services). For instance, the sectors of arts, entertainment, and recreation (information) show levels of the ε estimates that are lower (higher) for total current compensation and salary, which means that in these sectors, these compensation instances show greater (lesser) variability when compared with the reference sector.

4.3 Capitalization Levels

This subsection is devoted to the analysis of how the ε estimates vary with the level of capitalization of companies. Table 10 shows the results of OLS regressions without and with controls. These results indicate that in the case of the regression without controls, almost all the ε estimates are statistically significant at the 99% level, and these estimates tend to be lower in medium-cap companies compared with large and small-cap companies, indicating higher variability in CEO compensation in medium-cap com-

Table 6: OLS With Controls - $f = x^{0.5}$,

	tdc1	tdc2	total current compensation	salary
year	0.001^{***}	-0.00003^{***}	0.00004	-0.001^{***}
	(0.0002)	(0.00001)	(0.0001)	(0.00004)
age	-0.002^{***}	-0.0001^{***}	-0.001^{***}	-0.001^{***}
	(0.0001)	(0.00001)	(0.00004)	(0.00003)
Sector Admin. and Support and Waste Svcs.	0.001	-0.001	-0.002	-0.002
	(0.010)	(0.0004)	(0.003)	(0.002)
Sector Ag., Forestry, Fishing and Hunting	-0.002	-0.001	0.005	-0.003
	(0.025)	(0.001)	(0.006)	(0.005)
Sector Arts, Entmt., and Rec.	0.010	-0.001	-0.004	-0.0003
	(0.018)	(0.001)	(0.005)	(0.004)
Sector Construction	0.012	-0.0003	-0.0004	0.002
	(0.011)	(0.001)	(0.003)	(0.002)
Sector Educational Svcs	-0.008	-0.0004	0.002	0.001
	(0.013)	(0.001)	(0.003)	(0.003)
Sector Finance and Insurance	0.003	-0.001	0.002	0.003^{*}
	(0.008)	(0.0003)	(0.002)	(0.001)
Sector Health Care and Social Asst.	0.012	0.0003	0.005^{*}	0.002
	(0.010)	(0.0005)	(0.003)	(0.002)
Sector Information	0.002	0.0003	0.0001	-0.0003
	(0.008)	(0.0004)	(0.002)	(0.002)
Sector Manufacturing	0.007	-0.0002	0.001	0.001
	(0.007)	(0.0003)	(0.002)	(0.001)
Sector Mining	0.041^{***}	0.001	0.007^{***}	0.004^{**}
	(0.009)	(0.0004)	(0.002)	(0.002)
Sector Other Svcs. (except Public Adm.)	-0.006	-0.0004	0.006	0.001
	(0.017)	(0.001)	(0.004)	(0.003)
Sector Pro., Sci., and Technical Svcs	0.002	-0.0001	-0.001	0.001
	(0.009)	(0.0004)	(0.002)	(0.002)
Sector Real Estate Rental and Leasing	0.006	-0.0003	-0.0003	-0.0005
	(0.010)	(0.0005)	(0.003)	(0.002)
Sector Retail Trade	-0.004	-0.0003	-0.001	-0.0003
	(0.008)	(0.0004)	(0.002)	(0.002)
Sector Transp. and Warehousing	0.008	-0.001	-0.001	-0.001
	(0.010)	(0.0004)	(0.002)	(0.002)
Sector Utilities	0.014	-0.001	0.004	0.002
	(0.009)	(0.0004)	(0.002)	(0.002)
Sector Wholesale Trade	0.0002	-0.001	-0.001	-0.001
	(0.009)	(0.0004)	(0.002)	(0.002)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 7: Linear Panel - Without Controls

	tdc1	tdc2	total current compensation	salary
	without controls			
$f = x^{0.5}$	0.001^{***}	0.00005^{***}	0.0002^{***}	0.0001^{***}
	(0.00004)	(0.00000)	(0.00001)	(0.00001)
$f = x^{0.4}$	0.001^{***}	0.0002^{***}	0.0004^{***}	0.0002^{***}
	(0.0001)	(0.00001)	(0.00002)	(0.00002)
$f = x^{0.3}$	0.002^{***}	0.001^{***}	0.001^{***}	0.0004^{***}
	(0.0001)	(0.00002)	(0.00004)	(0.00003)
$f = x^{0.2}$	0.003^{***}	0.002^{***}	0.001^{***}	0.001^{***}
	(0.0001)	(0.00005)	(0.0001)	(0.0001)
$f = x^{0.1}$	0.003^{***}	0.003^{***}	0.002^{***}	0.001^{***}
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
$f = x^{0.05}$	0.002^{***}	0.004^{***}	0.001^{***}	0.001^{***}
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 8: Linear Panel - With Controls

	tdc1	tdc2	total current compensation	salary
	with controls			
$f = x^{0.5}$	0.001^{***}	0.0001^{***}	0.0004^{***}	0.0003^{***}
	(0.0004)	(0.00002)	(0.0001)	(0.0001)
$f = x^{0.4}$	0.002^{**}	0.0003^{***}	0.001^{***}	0.001^{***}
	(0.001)	(0.0001)	(0.0002)	(0.0002)
$f = x^{0.3}$	0.002^{**}	0.001^{***}	0.002^{***}	0.001^{***}
	(0.001)	(0.0002)	(0.0004)	(0.0003)
$f = x^{0.2}$	0.003^{**}	0.003^{***}	0.003^{***}	0.002^{***}
	(0.001)	(0.0005)	(0.001)	(0.001)
$f = x^{0.1}$	0.003^{*}	0.006^{***}	0.004^{***}	0.003^{***}
	(0.002)	(0.001)	(0.001)	(0.001)
$f = x^{0.05}$	0.002	0.006^{***}	0.003^{**}	0.003^{*}
	(0.001)	(0.001)	(0.001)	(0.001)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 9: Linear Panel - $f = x^{0.5}$

	tdc1	tdc2	total current compensation	salary
age	-0.004^{***}	-0.0001^{***}	-0.003^{***}	-0.004^{***}
	(0.0004)	(0.00002)	(0.0001)	(0.0001)
Sector Admin. and Support and Waste Svcs.	-0.094	-0.005	0.020	0.013
	(0.063)	(0.003)	(0.016)	(0.012)
Sector Ag., Forestry, Fishing and Hunting	-0.113	-0.006	0.052	0.023
	(0.169)	(0.008)	(0.043)	(0.032)
Sector Arts, Entmt., and Rec.	-0.091	-0.008	-0.089^{**}	-0.089^{***}
	(0.139)	(0.006)	(0.035)	(0.026)
Sector Construction	-0.193^{**}	-0.007^{*}	-0.010	-0.002
	(0.083)	(0.004)	(0.021)	(0.016)
Sector Educational Svcs	0.043	-0.0002	0.050^{*}	0.069^{***}
	(0.115)	(0.005)	(0.029)	(0.022)
Sector Finance and Insurance	-0.031	-0.006^{*}	-0.007	0.0002
	(0.074)	(0.003)	(0.019)	(0.014)
Sector Health Care and Social Asst.	0.332^{***}	0.001	0.016	-0.013
	(0.083)	(0.004)	(0.020)	(0.016)
Sector Information	-0.043	-0.003	0.049^{***}	0.033^{***}
	(0.057)	(0.003)	(0.014)	(0.011)
Sector Manufacturing	0.011	-0.001	0.032^{**}	0.015
	(0.050)	(0.002)	(0.013)	(0.009)
Sector Mining	0.005	-0.003	0.012	0.014
	(0.072)	(0.003)	(0.018)	(0.014)
Sector Other Svcs. (except Public Adm.)	-0.416^{***}	-0.007	0.063^{**}	0.052^{**}
	(0.123)	(0.006)	(0.031)	(0.023)
Sector Pro., Sci., and Technical Svcs	-0.007	-0.002	0.010	0.015
	(0.060)	(0.003)	(0.015)	(0.011)
Sector Real Estate Rental and Leasing	-0.068	-0.004	0.013	0.004
	(0.058)	(0.003)	(0.015)	(0.011)
Sector Retail Trade	0.008	-0.002	0.031^{**}	0.028^{***}
	(0.054)	(0.003)	(0.014)	(0.010)
Sector Transp. and Warehousing	0.014	-0.002	0.024	0.022^{*}
	(0.068)	(0.003)	(0.017)	(0.013)
Sector Utilities	-0.061	-0.003	0.062^{***}	0.019
	(0.084)	(0.004)	(0.021)	(0.016)
Sector Wholesale Trade	-0.003	-0.004	0.045^{***}	0.031^{***}
	(0.060)	(0.003)	(0.015)	(0.011)

Note: *p<0.1; **p<0.05; ***p<0.01

panies. On the other hand, in the regression with controls, almost all the ε estimates are not statistically significant, casting doubt on the suitability of the OLS method for estimating ε.

Furthermore, the results from the regression using the linear panel method without and with controls are presented in Table 11. Almost all the ε estimates obtained from the linear panel regression without controls are statistically significant at the 99% level, and we observe that the estimates tend to be lower in medium-cap companies compared with large and small-cap companies, a result similar to that reported for the OLS regression without controls. When using the linear panel method with controls, we find heterogeneity in the instances of compensation for which their respective ε estimates are statistically significant. For instance, in large-cap companies, the ε estimate that is statistically significant at the 99% level is that of tdc1, the future compensation instance that includes option grants. In mid-cap companies, the ε estimates that are statistically significant at the 90% and 95% levels, respectively, are tdc2 (the future compensation instance that includes stock grants) and salary. In small-cap companies, the ε estimates that are statistically significant at the 95%, 99%, and 95% levels, respectively, are tdc2 (the future compensation instance that includes stock grants), total current compensation, and salary.

Table 10: OLS by Capitalization Level - $f = x^{0.5}$

	tdc1	tdc2	total current compensation	salary
	without controls			
large capitalization	0.0003^{***}	0.00003^{***}	0.00000	0.00001
	(0.0001)	(0.00000)	(0.00001)	(0.00001)
medium capitalization	0.0003^{***}	0.00002^{***}	0.00003^{***}	0.00001
	(0.00004)	(0.00000)	(0.00001)	(0.00001)
small capitalization	0.0005^{***}	0.00003^{***}	0.0002^{***}	0.0001^{***}
	(0.00001)	(0.00000)	(0.00001)	(0.00001)
	with controls			
large capitalization	0.001	-0.00002	-0.004	-0.001
	(0.043)	(0.002)	(0.004)	(0.004)
medium capitalization	0.004	0.001^{*}	0.008^{**}	0.002
	(0.017)	(0.001)	(0.003)	(0.003)
small capitalization	0.0004	0.004^{***}	0.050^{***}	0.010^{***}
	(0.020)	(0.001)	(0.005)	(0.004)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 11: Linear Panel by Capitalization Levels, $f = x^{0.5}$

	tdc1	tdc2	total current compensation	salary
	without controls			
large capitalization	0.0005^{***} (0.0001)	0.00005^{***} (0.00001)	0.00001 (0.00002)	0.00002 (0.00002)
medium capitalization	0.0005^{***} (0.00001)	0.00003^{***} (0.00000)	0.0001^{***} (0.00001)	0.00004^{***} (0.00001)
small capitalization	0.001^{***} (0.0001)	0.0001^{***} (0.00000)	0.0003^{***} (0.00002)	0.0001^{***} (0.00001)
	with controls			
large capitalization	0.007^{***} (0.002)	0.0001 (0.0001)	0.0001 (0.0002)	0.0002 (0.0002)
medium capitalization	-0.0001 (0.001)	0.0001^{*} (0.00003)	0.0001 (0.0001)	0.0002^{**} (0.0001)
small capitalization	0.0004 (0.001)	0.00005^{**} (0.000)	0.001^{***} (0.0002)	0.0002^{**} (0.0001)
Note:				*p<0.1; **p<0.05; ***p<0.01

5 Compensation Predictions

In this section, we embark on an exploration to evaluate the predictive capacity of the empirical equation utilized in our analysis. Our initial step involves simulating the compensation paths of median CEOs within our dataset, offering a rigorous assessment of our model's predictive accuracy against observed salary data. To ensure reliability and account for the intricate variations in CEO remuneration across industries and firms, we adopt the econometric model recognized for its stability in yielding consistent ε estimates: the linear panel with controls and $f(w) = w^{0.5}$. Leveraging the ε estimators derived from the primary row of Table 8, we proceed to identify CEOs with median compensations in salary, total current compensation, tdc1, and tdc2. Employing their initial salary figures as reference points, we utilize equation (3) to project their future salary trajectories. This methodological approach facilitates a thorough assessment of our model's efficacy in predicting the dynamics of CEO compensation, this is

$$\hat{w}_{t+1} = f^{-1}\left(f(\hat{w}_t) + \hat{\varepsilon}\left((-1)^{I_t^-}\frac{y_t}{y_H}\right)f(y_H)\right) \tag{4}$$

In Figure 7, we present the results of a standard simulation conducted using our model. Our analysis indicates that while the simulations effectively capture the overall trajectory of CEO salaries over time, they struggle to account for sudden spikes

in compensation. This limitation stems from the gradual nature of salary adjustments within our model, primarily driven by shifts in bargaining power (denoted as ε) and company performance. Consequently, our framework is unable to accurately reflect abrupt fluctuations caused by external factors, such as widespread economic crises like the 2008 financial downturn. Recognizing the inherent predictive constraints of the empirical equation utilized in this study, our focus will shift towards exploring additional avenues. This includes conducting a more thorough analysis of the structural influences of error terms on various CEO compensation components to ensure that we obtain unbiased and efficient ε estimates. Additionally, we aim to delve deeper into examining the impact of market power on CEO remuneration, thereby enhancing the breadth and depth of our investigation.

Figure 7: Compensation Simulations.

(a) Median salary.

(b) Median total current compensation.

(c) Median tdc1.

(d) Median tdc2.

6 Conclusions

The aim of this article is to empirically identify changes in CEOs' bargaining power using data from ExecuComp and Annual Snapshot databases. It utilizes a Pareto Weights representation of the agency model, bridging the gap between managerial power the-

ory and standard agency theory. The model proposes an empirical equation to track changes in bargaining power over time. Managerial power theory suggests CEOs influence their compensation to extract rents from shareholders, while standard agency theory posits compensation decisions are driven by shareholder value maximization. The Pareto Weights approach used in this article integrates predictions from both theories, offering insights into optimal incentive schemes and their efficiency.

Our findings underscore the pivotal role of salary and stock grants as principal components of CEO compensation packages, particularly in incentivizing performance, with stock grants exhibiting a greater degree of variability. This observation aligns with the tenets of both managerial power and agency theories, elucidating their influence on CEO pay structures. Moreover, our analysis reveals a significant relationship between CEO age and bargaining power, indicating that older CEOs experience less fluctuation in their bargaining power. Interestingly, across various sectors, the estimates of changes in CEOs' bargaining power show some differences from those of the reference sector for most compensation instances, indicating a distinct pattern of compensation dynamics. This observed heterogeneity underscores the multifaceted nature of CEO compensation, with differing impacts across sectors and company sizes, thereby highlighting the nuanced interplay between organizational factors and executive remuneration practices. Regarding the measure we considered for company size, capitalization levels, we find that in large-cap companies, the estimate of CEOs' bargaining power change is significantly associated with future compensation instances, such as option grants. Conversely, in mid-cap companies, both measures of present compensation (salary and bonus) and future compensation (stock grants) exhibit statistical significance in explaining those changes. In the case of small-cap companies, changes in their CEOs' bargaining power seem to be mostly explained by salary, bonus, and stock grants.

Our assessment of the predictive capability of the empirical equation employed in this article reveals a notable disparity: while the simulations effectively outline the overall trajectory of CEO salaries over time, they falter in capturing sudden spikes in compensation. This limitation arises from the gradual nature of salary adjustments in our model, predominantly driven by shifts in bargaining power (denoted as ε) and company performance. Consequently, our framework lacks the capacity to accommodate abrupt fluctuations triggered by external factors, such as major economic crises like the 2008 financial downturn. Acknowledging the predictive constraints inherent in the empirical equation utilized in this study, our focus will shift towards exploring additional avenues. This includes conducting a more thorough analysis of the structural impacts of error terms on various CEO compensation components. Furthermore, we aim to delve deeper into investigating the influence of market power on CEO remuneration, thereby enriching the scope and depth of our research. These objectives will steer both the current and future projects.

References

L. Bebchuk and J. Fried. Executive Compensation as an Agency Problem. *Journal of Economic Perspectives*, 17(3):71–92, 2003.

F. Bova and L. Yang. Employee bargaining power, inter-firm competition, and equity-based compensation. *Journal of Financial Economics*, 126:342–363, 2017.

Ch. Choe, G. Tian, and X. Yin. CEO power and the structure of CEO pay. *International Review of Financial Analysis*, 35:237–248, 2014.

S. Di Giannatale, I. T. Q. Curiel-Cabral, and G. Basulto. The dynamics of bargaining power in a principal-agent model. Working Paper 630, CIDE, 2023.

A. Edmans and X. Gabaix. Executive compensation: A modern primer. *Journal of Economic Literature*, 54(4):1232–87, December 2016.

A. Edmans, X. Gabaix, T. Sadzik, and Y. Sannikov. Dynamic ceo compensation. *Jounal of Finance*, LXVII(5):1603–1647, 2012.

A. Edmans, X. Gabaix, and D. Jenter. Executive Compensation: A Survey of Theory and Evidence. In Benjamin E. Hermalin and Michael S. Weisbach, editors, *The Handbook of the Economics of Corporate Governance*, volume 1 of *The Handbook of the Economics of Corporate Governance*, pages 383–539. North-Holland, January 2017. 10.1016/bs.hecg.2017.11.010.

A. Edmans, T. Gosling, and D. Jenter. Ceo compensation: Evidence from the field. *Journal of Financial Economics*, 150(3):103718, 2023.

J. Garen. Executive compensation and principal-agent theory. *Journal of Political Economy*, 102:1175–1199, 1994.

J. Haubrich. Risk aversion, performance pay, and the principal-agent model. *Journal of Political Economy*, 102:258–276, 1994.

B. Hölmstrom. Moral hazard and observability. *The Bell Journal of Economics*, pages 74–91, 1979.

Michael C. Jensen and Kevin J. Murphy. Performance Pay and Top-Management Incentives. *Journal of Political Economy*, 98(2):225–264, 1990.

G. Pander and R. Currie. Ceo compensation: A resource advantage and stakeholder-bargaining perspective. *Strategic Management Journal*, 34:22–41, 2013.

S. Spear and S. Srivastava. On repeated moral hazard with discounting. *The Review of Economic Studies*, 54(4):599–617, 1987.

Ch. Wang. Incentives, ceo compensation, and shareholder wealth in a dynamic agency model. *Journal of Economic Theory*, 76(1):72–105, 1997.