

U. PORTO

FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

CEO Compensation During Increased Market Volatility – 2008 Financial
Crisis

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Dissertation

Master's in Finance and Taxation

Supervised by

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2021

Biographical note

Arthur Ramos Arrais was born in São Paulo, Brazil on the 16th of December of 1996. He joined Engineering School (Universidade Presbiteriana Mackenzie) in 2014 and graduated in Industrial Engineering in 2019, with a final grade of 9 (out of 10). In the same year, he enrolled in the Master in Finance and Taxation at the University of Porto where he's currently, in 2021, a candidate to obtain the master's degree.

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Acknowledgments

Firstly, I would like to thank FEP's academic committee and staff for all the support throughout my master's period, especially this thesis' supervisor, Professor Samuel Ferreira, who has provided the upmost guidance during the elaboration of this dissertation.

I am equally grateful for the support that my family and friends have provided across my journey, greatly enhancing my experience and helping to build the person that I am today. In this regard, a special gratitude to my Portuguese grandmother that would be proud of this accomplishment and played a major role in my life as well as my mother for her unparalleled support during this period and my father for top-notch counselling.

Arthur Ramos Arrais

Abstract

This study intrinsically examines the financial crisis that took place in 2008 and subsequent years, and its respective impact on executive compensation through the analysis of previously used models as well as applying key changes to the old metrics representing, therefore, a modern approach with latest data regarding this topic.

Whenever economic impacts resonate, it is expected that top level management responses are to take actions to address investor's concerns which mainly result in restructuring or through implementing financial manoeuvres that could increase results. Nevertheless, when it regards managers' compensation, the impacts remain doubtful whether the decision makers will influence on their own pay slice. Hence, this study rises on the need to understand how the most recent and influential crisis has impacted executive compensation taking into consideration micro economical particularities, with data from public-listed US companies and 78 CEO annual compensation s from 2004 until 2013.

The results show that financial crisis indeed greatly impact executives' compensation and management power, proxied by duality, play a major role on diminishing the impacts on their compensation during a financial. Additionally, it has been noted that R&D, PPE and company size also influence on CEO's compensation and its fluctuation.

Keywords: Executive Compensation, Financial Crisis, Volatility, Earnings Management.

Resumo

Esse estudo examina, de maneira intrínseca, os impactos da crise financeira que ocorreu em 2008 e seu respetivo impacto na remuneração dos executivos através de modelos previamente utilizados com mudanças chave nas métricas representando, portanto, uma abordagem moderna com os dados mais recentes sobre este assunto.

Sempre que impactos económicos ressonam, espera-se que a alta administração tome medidas para abordar as preocupações dos investidores, principalmente em relação à reestruturação ou performam manobras financeiras que podem incorrer no aumento dos resultados contabilísticos. Contudo, quando se trata da remuneração dos executivos, os impactos permanecem duvidosos, pois os tomadores de decisão influenciarão, inevitavelmente, na sua remuneração. Logo, diante desta problemática, o presente estudo surge advindo da necessidade de entender como a crise mais recente e influente impactou a remuneração dos executivos levando em consideração particularidades microeconómicas, com dados de empresas americanas de capital aberto e 78 CEOs de 2004 a 2013.

Os resultados mostram que a crise financeira, de facto, tem um grande impacto na remuneração dos executivos e o poder dos gerentes, medido através da dualidade, desempenha um papel importante na diminuição dos impactos nos salários durante períodos de alta volatilidade. Adicionalmente, foi observado que R&D, PPE e o tamanho da empresa também influenciam no pacote de benefícios do CEO e sua respetiva flutuação.

Keywords: Remuneração, Crise Financeira, Volatilidade, Gerencimanto de Resultados.

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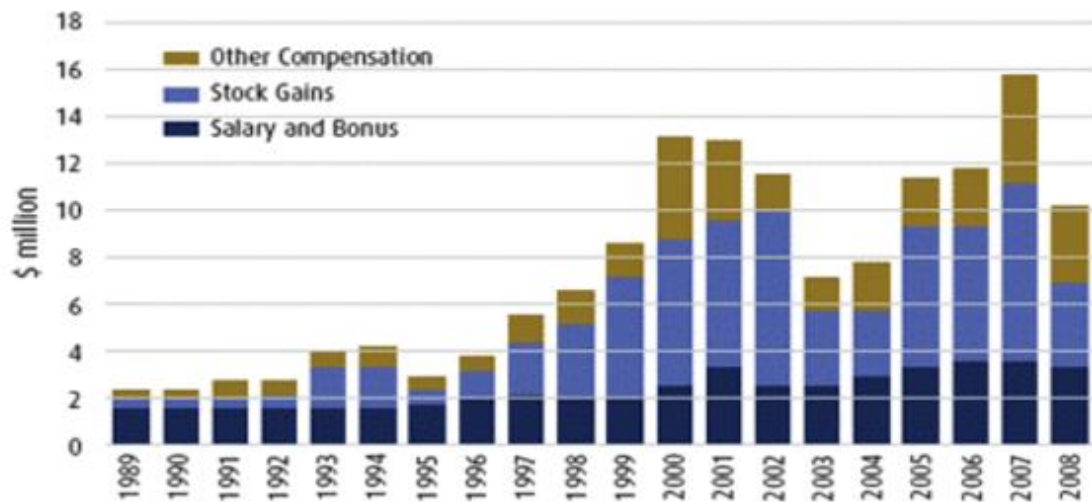
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1. Introduction

During the last decades, one of the most discussed topics was how executive compensation impacts the organization and its deliveries, moreover and arguably more important, CEO's total compensation during the same time frame has soared to reaching amounts never seen before as companies enhance in complexity and revenue management. Obviously, this matter, although it might have been exhaustively discussed, still has some caveats to be covered on many studies that are still being conducted or currently lack databases.

Figure 1 - Evolution of Compensation Packages: CEO Pay



Investing – Monetary base expansion (2012). Compensation Data Based on Forbes Magazine's Annual Survey (2007 Constant Dollars)

The graph above (Figure1) shows the evolution of CEO total compensation broken down by base salary, cash bonuses, stock gains and other compensation which can be attributed to welfare packages. As seen on the start of the series, in 1989, the average compensation, in constant dollars, is two million USD and eighteen years later it has multiplied eightfold, skyrocketing to reach sixteen million USD proving that the compensation for top executives has experienced a massive pickup. Further, if closely watched, this sharp increase comes almost entirely from the stock gains that begun to effectively kick in since 1998 and during the main year of the crisis it has shrunk from 16 million, the peak, to 10 million USD.

Hence, when comparing studies in this area, the number of variables compound to a considerable challenge and complexity, meaning that even with all the recent discoveries and analysis, there are some major improvements and considerations to be reviewed, especially

since it refers to human interaction and political influence on some degree, implying, consequently, on possible costs of agency and further implications to the business decisions to be done by its leaders.

The baseline for this study is Rajesh Aggarwal and Andrew Samwick (1999) that found the strict relationship between CEO compensation and pay-for-performance elements, significantly higher than estimated before by their predecessors that have used simpler models. Nevertheless, further, Cahill and George (2005) reviewed this analysis and concluded that there might have been a very critical bias on Aggarwal's sample selection as it was focused from 1993 to 1997, one of the biggest bull markets periods that the world has ever seen and, therefore, the results obtained by them will need to be tested on another period to understand if such findings holds during a bear market or period with higher market volatility.

Still, the latest analyses from 1999 to 2002 and, until this day, there has not been another study regarding this matter to verify if those results are somewhat different depending on the degree of market volatility. Hence, the purpose of this paper is to identify and retest, with more controls, if the results obtained earlier by both academic researches remain the same or if they have significant changes due to the modus operandi of benefit packs on corporations.

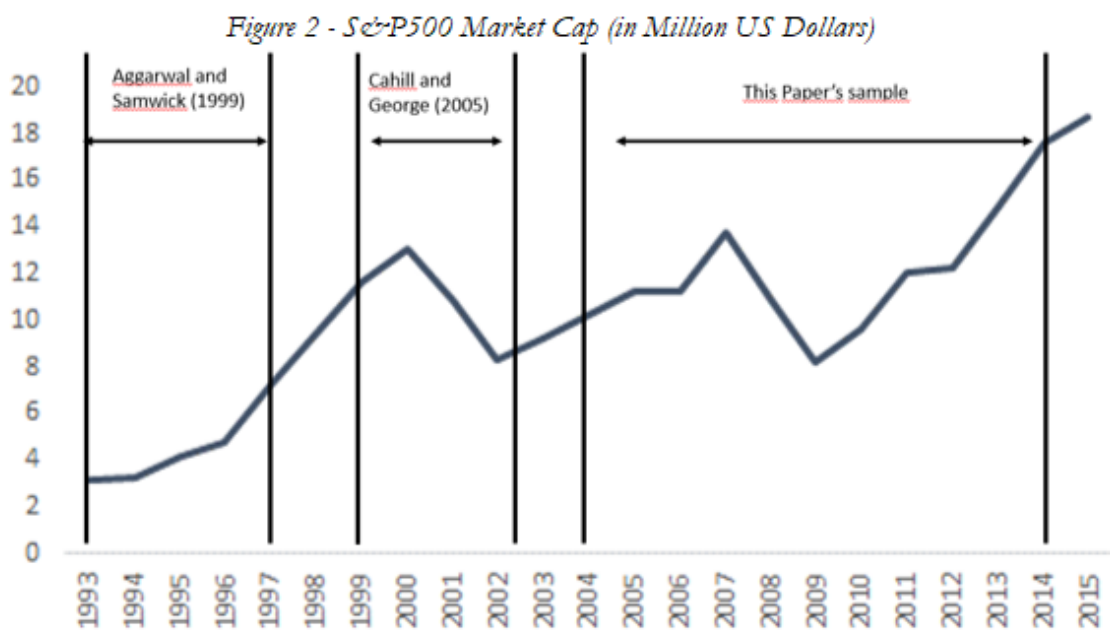


Figure 2 shows the main differences versus other studies that regards the matter, expliciting the time gap amongst them.

This study, it will be focused on the period from 2004 to 2013 to capture the entire subprime crisis that came to light more evidently in 2008. We expect amplified results as it was an unprecedented amount of volatility since it took place mainly due to financial instruments and the US government had multiple constraints to advocate during that period. By utilizing this sample, we address not only the bias but, moreover, test how robust Garen's analysis was on the study mentioned before. However, we advise, as well as our predecessors, that some relevant degree of caution needs to be taken to interpret these results as the time difference may implicate on incomparable results.

This study is organized as follows, section 2 will be dedicated to the literature review focusing on agency costs, executive compensation, and total compensation during crisis; Section 3 addresses the dataset that will be analyzed and its caveats; Section 4, the methodology of this research and further hypothesis for its development; Section 5, the results, and its discussion; finally, Section 6, the conclusion.

2. Literature Review

Since this problem, as referred before, is a construction of many variables and multiple theories that have surged during the years of academic research, this section will focus on clarifying some of the recent studies with major detail for the agency costs problem, principal agent theory, most caveats of executive compensation such as the constructs of its values and how the financial crisis that took place on 2008 impacted the compensation as seen through other studies.

2.1 Agency Costs

Ever since there are disconnected goals, there will be, unavoidably, a mismatch of interests contributing, therefore, for intrinsic costs that may impact the company's profitability. The actual misalignment between management decisions and shareholders is the cost of agency. The most common way of explaining this phenomenon is, if an individual is offered a fixed compensation if the outcome is positive, disregarding the price, this agent will, most likely, sell at the cheapest price to reap the best yield as number of units sold since the incentive is fixed. Nevertheless, if there is a variable compensation based upon price and results, this individual will manage the negotiation to obtain the best price and, hence, gain more.

However, in this example the problem is simplistic whereas in a company perspective, there are multiple key indicators that shall be aligned to make sure that top level management is committed to the same interest of most of the stakeholders, those of which shareholders influence the most by their participation in preferred and common shares. But, if these individuals do not monitor the same indicators, there can be misalignments amongst every participant, generating costs of agency.

The agency cost theory arose to address the studies of concerns that may arise from differences between the goals and interests from top level management and the leading agent, especially in the case of multiple roles being performed by the CEO without an independent board since each part will try to maximize their returns based on the outcomes that shall be evaluated by every market participant. Many authors have studied this regard, where Grabke – Rundell & Gomez-Mejia (2002), state that this separation can lead to empire-building like positions and entrenchment to enlarge payments to top level management and Marris (1963) describes that CEOs can, sometimes, depending on the metric of success, drive more growth of the company rather than profitability since this

metric is more likely related to the pay increase because greater firms are associated more with higher paying posts of work.

Additionally, another significant component that contributes to the presence of agency costs is the unilateral information gap where managers handle, almost as a monopoly, the access to insider information and can use this type of data to build best compensation plans based upon greater range of data and arguments, Murphy (1985). Moreover, there is a probability of misconduct by the manager in the case of hiding the information or manipulating it to some extent to grant the variable compensation of the contract.

Another theory that was vastly used to understand the concept of agency costs on firms is the principal-agent theory initially designed by Ross (1973), which is a derivative of the asymmetry regarding the firm's information where top-level management have the upper hand since they have unrestricted access and, as said, can lead to a serious level of entrenchment that could result in benefits from this misalignment of interests between parties such as shareholders and agents, i.e. CEOs in this scenario.

Hence, some owners and shareholders might want to monitor the principal-agent more thoroughly. However, as expected, this is costly and could cause great damage to the team's reputation and even the CEO's capacity to lead, implying in even more costly ventures and enlarging the agency costs. Therefore, this theory is used to diminish the impact of this asymmetry and it has been developed to understand and further enhance the alignment amongst the agents.

One way these goals can be met is by having larger contracts to ensure larger tenure, even, in some cases, offering a partnership model contract, and with a variable compensation more prominent linked directly to the key measures of the performance of the firm, since there are multiple possibilities to address this concern and metrics, namely the accounting-based method and stock monitoring for example, this topic will be subject to further analysis in the following section.

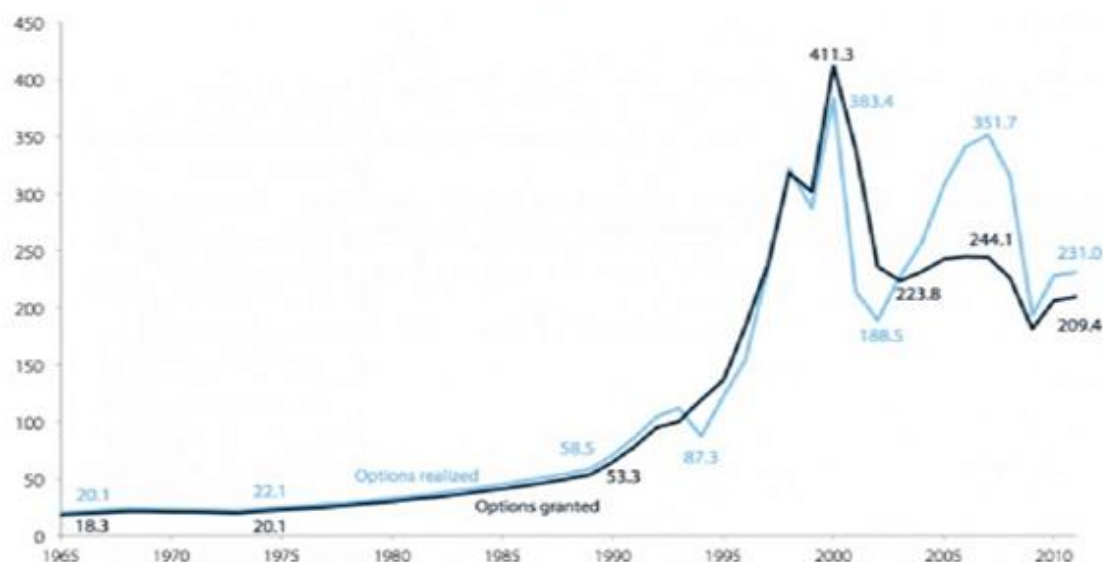
Bolton and Shapiro (2015), also comply with this theory by stating that sometimes it can be more efficient to pay workers more than the market average. However, when it comes to top level management, this cost is multiplied greatly and means a much larger impact for the organization if not measured correctly, therefore, Krulce and Darell (1992), state that often executives are paid too much but a highly paid executive can alternatively be extracting

rent if their participation contract is related, meaning that sometimes the high pay can be the solution to reach excelled performance and achieve better results to the firm.

2.2 Executive Compensation

During the last decades, one of the most addressed topics was how compensation impacts the organization and its deliveries, moreover and arguably more important, CEO's total compensation which plays a major role in the firm's prospect of future. The methodology of CEO compensation and all its caveats have evolved greatly during the last decade, as shown in the Introduction. Nevertheless, it also urged multiple discussions over the actual fairness of this super-high amounts and its relation to the average worker pay, therefore, some studies were conducted to assess the discrepancy as it can be found below.

Figure 3 - Evolution of CEO-Worker Pay Ratio



The Atlantic - What's Behind the Huge (and Growing) CEO-Worker Pay Gap? (2013).

The dark blue line is the value for CEO compensation as options granted and light blue line for options realized, when this ratio has started to be monitored, the average CEO would earn almost 20 times more than the common worker at the same company. However, this number is doubled by 1990 and from then onwards it soars to reach its peak during the early dotcom bubble close to 2000 when the ratio reached 411 meaning that the CEO would earn four hundred times more than the average worker. For our period of analysis, the value starts at 223 and is slightly maintained until 2010 at 209.

Due to the size of the figures, it is understandable that this matter has been in the focus point of many academic studies conducted in the field of economics and finance. This distortion has achieved unforeseen levels and can drastically impact the companies on their actions towards employees' motivation and not restricted to, how these abnormal values are indeed paid and subtracted from the companies' cash flow. This essentially rose the main question which is, is the high pay worth it? If so, how does it translate to performance to the firm and shareholders?

To help solve these questions, Core and Guay (2010), state that individuals are rational, risk averse and prominent to take actions that maximize personal benefits and minimize efforts and have assumed that CEOs like wealth meanwhile dislike risk. Additionally, they have shown that compensation can be addressed as the sum of four components: (I) ability, minimum amount necessary to attract the CEO to the job and persuade him to forgo his/hers next most attractive opportunity; (II) a payment that increases with the level of effort required of the CEO, (III) premium for risk stemming from performance based incentive risk; and (IV) excess pay, part that could not be explained by the other components.

The benefit packages found nowadays in multiples industries can be complex, but their baseline relies heavily on the following: (i) cash compensation, (ii) incentive plans, (iii) retirement plans, also known as deferred compensation, (iv) health insurance, (v) other allowances such as health clubs, travel, vacations and paid holidays, Sigler (2011). Companies, however, to address the agency theory have improved greatly in the manner that they incentivize and compensate managers specially in the second category, namely the incentive plans, since this compensation can be linked directly to goals and may be paid in multiples ways, such as: (a) cash deposit after reaching a milestone of key indicator that is crucial to the organization, generally focused on bottom line such as Earning per Share; (b) stock options that can be converted into stocks, this method incentivizes the managers to be less risk averse and actually take riskier measures to accomplish stakeholders goals; (c) restricted stocks is the way that companies retain the compensation through a vesting period that stocks cannot be sold to safeguard the company of a certain goal or any backfire that might occur if the CEO is determined to leave earlier than previously established.

It is important to mention that companies are more prominent to have longer periods to deliver compensation to have more motivated managers and have solutions that are focused

on the longer term that will, indeed, provide sustainable results to the company. At the same time, this *modus operandi* prevents these executives to search for other companies that will, most likely, not cover the restricted stock that would be lost if the manager leaves before the vesting period.

However, relying simply on stock-based compensation can be harmful for the executive's performance since less risk averse managers can be less motivated and even be considered inefficient due to the fluctuation nature of the stock price, reflecting, intrinsically, other factor such as monetary policy, laws and, especially in emerging markets, political events. These examples could greatly impact his/her compensation even without any possible control at his/her part. Hence, less risky managers can demand higher premiums to mitigate these high spikes and fluctuations that are not subject to their influence.

Nevertheless, it is important to note that accounting-based measures can be misleading since conventions and rules can be tweaked on the manager's behalf to trespass a better condition and grant the actual bonus and, therefore, could inflict into worse scenarios where managers manipulate, within the boundaries of the law, earnings to achieve the indicators that influence their bonus. But even though stock price performance is a better measure than accounting, Bushman et al (1996), state that the first methodology does not capture fully, or partially, the valuable management since investors do not have all the possible information and are not entirely aware of the efforts that are being directed to grow the firm and provide actual value in the long term.

While in this matter, there are two main designs of incentive schemes, namely: (a) Optimal Contracting Theory and (b) Managerial Power. The first relates to the compensation that is built by the board of directors. It addresses the proper incentives to generate significant value to shareholders and enterprise, which consequently, leads to a positive relationship between pay and performance. Further payments for the top executives are remedies to the agency problem Duffhues & Kabir (2008).

The second happens when managers have enough power that they can influence their own compensation package and use their influence to coerce the board to receive higher pay and, in this case, there is a negative relationship between pay and performance. Additionally, it is more prominent to occur when: the board is not independent, there is a duality of the CEO role or the corporate governance mechanisms are less effective Core et al (1999).

Some studies argue that CEOs are paid like bureaucrats meaning that their performance does not necessarily impact their pay, as said by Jensen and Murphy (1990), most publicly held companies, the compensation of top executives is virtually independent of performance and, on average, corporate America pays its most important leaders like bureaucrats. Additionally, this study finds that CEOs receive only 3,25 US dollars for every thousand dollars increase in shareholder wealth. Nevertheless, Brian Hall and Jeffrey Liebman (1998) disagree and found an intrinsic relationship between CEO performance and compensation even pointing out that since 1980 this relationship has risen drastically.

There are multiple authors that address the matter of executive compensation and its intrinsic relation to firm performance, as said by Rayton (2003), managers will maximize firm value if they receive net increases in utility from such behavior and the magnitude of the link between pay and performance is commonly interpreted as measure of these incentives, meaning, therefore, that the executive will comply with the shareholders' goals if the marginal increase also benefits himself making it easier to be more aligned in exchange of higher pay and, hence, less profitability but with lower agency costs that could easily surpass this trade off and, consequently, exhibit better performance.

Moreover, this relationship is complex since, as stated before, managers dislike risk but seek the optimum compensation, however stakeholders might seek a greater turn in business that requires high risk-taking behaviors which can lead to distinct impacts on the organization.

2.3 Crisis Impact on Compensation

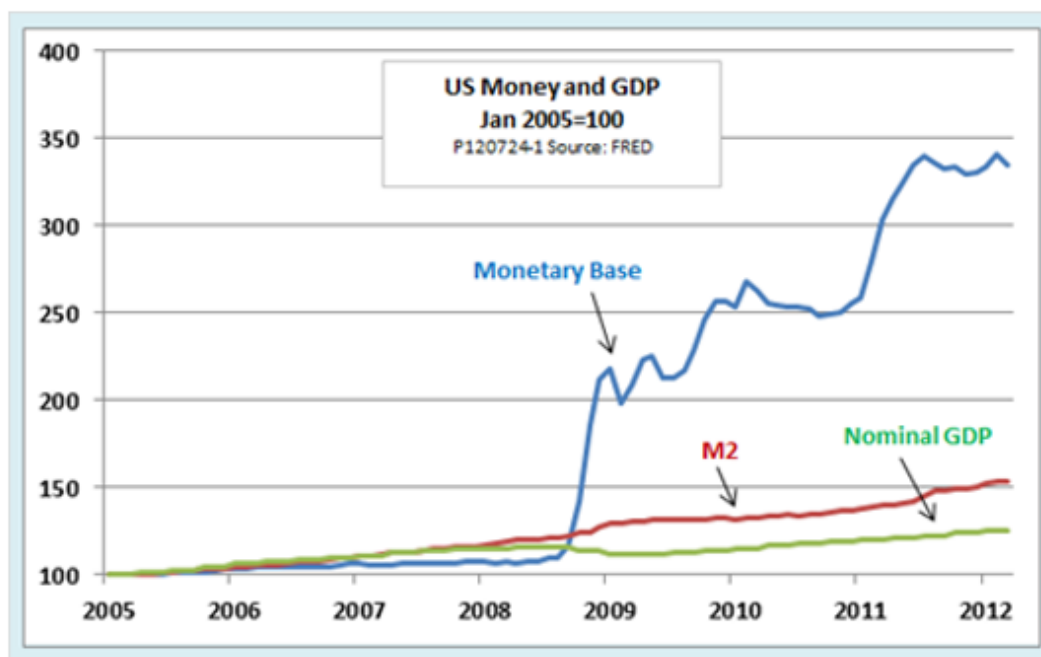
The subprime financial crisis that took place in 2008 was classified by multiple monitoring agents as the most severe crisis since the great depression in 1929 with multiple effects in the real economy that resonated for long and demanded a quick and heavy reaction from central banks across the globe.

As it can be seen on the graph below, the significant decrease in GDP experienced in 2009 was accompanied by what it has been called a newborn Marshall Plan that can be evidenced by the relevant spike of the FED's monetary base and its subsequent efforts to maintain the resonance of this crisis.

The fundamental reason of this crisis is attributed to some scenarios but most definitely the risk policy of banks at that time, specially to what refers to the mortgage policy and all its derivatives such as the mortgage-backed securities, collagenized debt obligation (CDO),

synthetic CDO, credit default swaps and others, was one, if not the most important, driver of the crisis. Therefore, by engaging into these dangerous products along with the ease for financing across the USA with almost no background check to the ability of the individuals to repay their debts, banks have surpassed all records of profits and became an industry known for its higher pay for performance in the market.

Figure 4 - Monetary Base, M2 and Nominal GDP Evolution



FTI Journal - Executive Compensation: A New Solution to an Old Problem (2010).

The renowned auditing and consulting firm KPMG said that the risks as well as the quality of the company's risk intelligence are two of the major oversight concerns for an audit committee member. But there is also concern about the culture, tone and incentives underlying the company's risk environment, with many saying that the board and/or audit committee needs to improve their effectiveness in addressing risks that may be driven by the company's incentive compensation structure.

Some authors such as Fahlenbranch and Stulz (2011) argue that the CEO incentives and its structure had no impact on performance of banks in which the variable incentives provided by the CEO were stronger, even reaching the conclusion that the banks that provided stronger incentives to CEO performed worse in the crisis. The logical explanation is that the executives thought it would be that those actions were in the best interest for all, including the shareholders, therefore would be welcomed but it turned out to be extremely

costly for the firms. Meanwhile, Díez-Esteban et al (2016) states that some existing agency problems and the increase of corporate risk levels might have caused the bankruptcies and severe long-term damages to companies' value and growth.

3 Research Methodology

3.1 Data

This study has as crucial data CEO compensation information which were extracted from ExecuComp database and provides detailed information over top executives' compensation extracted from the earnings report of United States' public traded firms. There is, however, some concerns over some methodologies of valuation of the stock options shown in this database and some authors have preferred to calculate its value by the Black and Scholes method as they believe that it reflects a better figure for this financial instrument. Nevertheless, Lambert (1993) has used as rational the value stock options at 25 percent of their exercise price. However, this study relies on the displayed value by the database which is already valorized by the actual value of the stock options by its fair value and how it has been presented in the earnings reports for the respective firms.

One of ExecuComp's drawback is that the value of existing options is only reported for options that are currently in the money and this results in the exclusion of options that may, even for small values, fall for out of the money due to the current exercise stock price date. Therefore, it poses somewhat a constraint in our analysis since it can overstate measures of sensitivity but, as Aggarwal and Samwick (1998) stated, this issue might not be severe on the results since the options are usually held for several years and were issued at in the money price.

The dollar increase is calculated each year by the difference of stock price like for like in each year considering a one hundred dollars baseline across the sample. This indicator will be key to reflect the behavior of pay and how it is related to the performance change in the company that will also be measured by other variables to avoid relying on a single metric and lead to inconclusive results. In this topic, the logarithm of total assets will be controlled to understand to which extent firm's size influence in the compensation for the executives with the expectation that larger firms pay greater salaries due to its capacity however, due to its nature, they might offer less variable compensation and a higher proportion of fixed cash compensation whereas smaller firms, due to the need to expand and grow at a fast pace, shall design this compensation package with larger stock and options based compensation.

To compare former studies and control if the results hold with the same metrics over time, CEO duality was included as a dummy variable that indicates if the executive is the executive

officer meanwhile being the president of the board. This variable is important because it represents the risk of the CEO and level of power for the executive which, as seen before, can greatly impact on the compensation package. Moreover, the R&D ratio to total assets is also used to understand if companies that invested heavily on research have lower payout due to the need to obtain innovative technologies to unlock value to shareholders. PPE was accounted as well to understand if companies with higher capital requirement can behave differently than their lighter counterparts when higher volatility surges due to the nature of the industry when it comes to CEO pay.

ROA is used as proxy of performance and its evolution overtime and intangible assets are used to capture if companies with larger metric can behave differently as well. Our data provider calculates this indicator differently accounting for industry specifics, so it differs amongst industrials, banks, insurance companies and other financial companies. It does it to prevent from benefiting some industries due to the nature of the business in detriment of others and, further, it uses a standard tax rate of 35% for periods after 1995 for US listed firms. The main concept is maintaining though, where the ROA is equals to the net income deducted by the bottom line and interest with its tax shelter already accounted for divided by the average of last year's and current year's total assets times 100.

As referred, risk can influence greatly on the performance and, hence, impact the CEO pay slice and to capture this effect we account for financial leverage and stock price's volatility as defined by Data Stream. This measure is important to account for company risk, however, there is, indeed, another component which is CEO risk which can be proxied by multiple indicators such as roles before reaching CEO, countries that the executive has worked, and number of companies participated.

It is important to mention that Datastream has two types of volatility in its database, namely the volatility rating and price volatility, the latter refers to a measure of a stock's average annual price movements to a high and low from a mean price for each year so, for example, an indication of 20% means that the stock's annual high and low price has shown a historical variation of +20% to -20% from its annual average price. Nevertheless the volatility rating, which is using in this study, measures the degree of fluctuation in the share price during the previous twelve months, based on the last 52 weekly values and it is calculated on a standard deviation of the price, and is a measure of its dispersion around the twelve month average, it is then divided by the mean price and the result is multiplied by forty to give a figure in

scale from 1 to 20, therefore, the scale is from 0 to fifty percent meaning that a rating of 10 indicates 25% of deviation and the higher the value the higher the volatility.

$$(1) 40 * \sqrt{\frac{\sum_{i=0}^n (x-\bar{x})^2}{n}} + 1$$

Where x stands for the previous price at weekly intervals, \bar{x} is the mean price and n equals to 52 to capture the previous year at weekly intervals. As said, the 40 comes to standardize and give provide the actual scale for the metric.

Finally, the time scope of this study differs from other studies, and it starts in 2004 to 2013 with the specific focus on the years of 2008 until 2010, hereby denominated as crisis years which has a dummy variable to have it reflected in the model. This period is chosen due to the financial crisis that took place in 2008 and is the main purpose of this analysis. The database counts with the information of 5555 top executives, however only US CEOs that had complete detail and those of which firm's details were also available were analyzed in this paper, ended up in 327 CEOs in our database for analysis.

3.2 Model

As said through this academic work, this paper is a construct of Aggarwal and Samwick (1999) in estimating the first approach done by Garen (1994) with the general properties of the estimation having as baseline another model built by Jensen and Murphy (1990a) which expresses the equation of:

$$(2) W = \alpha + \beta * \pi$$

Where W is the total executive compensation, α stands for the guaranteed or compensation that is not volatile and β is the sensitivity measure of compensation to performance having π as a proxy for performance measured by the change in shareholders wealth, which can be tracked, and will in this case, be indicated by the dollar increase on one hundred dollars baseline like for like year over year.

Nevertheless, Garen (1994) figured that the optimal value for β varies by firm and an aggregate estimation of β will result in biased results to the downside. Hence, some modifications were made and the inclusion of the absolute risk aversion, ρ , mean of the

random normally distributed proxy for performance and the variance of π would result in the best model for this extent.

$$(3) B = \frac{1}{(1+k*\rho*\sigma^2)}$$

This model was crucial to capture what the first approach lagged, namely its simplicity let forgo the inherent tradeoff between the insurance and incentive portions of a contract and, when having it accounted for, as done by Garen (1994) where element of risk is explicit and account for when estimation the pay-for-performance, the results hold with weak statistical significance, however.

Further, Aggarwal and Samwick (1999) were able to summarize through a linearization of both equations to the model that makes the estimation easier having the executive compensation regressed on firm performance and its variance, reaching the conclusion that the sensitivity is 14,52 USD for every thousand dollars of shareholder value, meaning that this new model, as well as dataset, provided much larger numbers than the first estimations. Of course, there is, unavoidably, an issue that the stock market during their study was steadily up and the difference amongst time series makes the difference in the analysis.

For this case study, Aggarwal and Samwick (1999) will be the benchmark, having the estimation done by using the least squares and with White's heteroskedasticity-robust standard errors, with the equation mentioned below:

$$(4) \text{Total_Comp} = \beta_0 + \beta_1 * \text{Crisis_Dummy} + \beta_2 * \text{R\&D} + \beta_3 * \text{PPE} + \beta_4 * \text{Size} + \beta_5 * \text{Intangible_Assets} + \beta_6 * \text{ROA} + \beta_7 * \text{Leverage} + \beta_8 * \text{Volatility} + \beta_9 * \text{Age} + \beta_{10} * \text{Duality} + \text{Error}$$

Where Total_Comp is the compensation, pi is the firm performance and sigma squared is the variance in firm performance. Nevertheless, we have included to this estimation some dummy variables, as stated above, to indicate: (i) years of crisis have impacted the CEOs' compensation, (ii) R&D's and PPE's effect on the CEO compensation during increased volatility and (iii) duality dummy to capture if CEOs that are also president of the board have greater impacts on their compensation.

Also, it was crucial eliminate the extreme deviation that occurs on CEO's total compensation packages since it depends heavily on multiple variables and can vary greatly,

hence a 2% winsorization was needed to get more linear and robust results. Additionally, since many variables can also have a great dispersion amongst companies, some were linearized by the application of natural logarithms that enables the researcher to address this issue and have a much clearer picture of the actual impact of each variable as well as an uniformed pattern to follow

3.3 Hypothesis development

In this work we expect to cover some concerns that were not covered by our predecessors and with a new dataset, we would like to be reassured that the results hold when compared to an even more severe crisis with no background of comparison due to its resonance into the economy for longer than others. With that said, this work will have three main hypothesis that shall be tested.

(1) Hypothesis 1: during the years of crisis, the CEO compensation will decrease drastically.

We estimate that this will occur since the CEO compensation is strictly related to the performance of the company and, if the firm performs badly, even if it is due exogenous problems such as a financial crisis meltdown, this should, in theory, greatly impact the CEO benefit package, especially for the ones that have higher variable pay slice. It is important to mention that some authors such as Hall and Liebman (1998) concluded that CEOs are paid like bureaucrats and therefore would not expect this sharp decrease on their compensation since it would be almost static overtime even when abrupt collapses happen.

(2) Hypothesis 2: R&D, PPE, leverage, intangible assets contribute to amplify the impacts on CEO's compensation

It is known that riskier firms would hire less risk averse managers to align their incentives and make sure that the shareholder's goals are meet without having the need for additional incentives to overcome the CEO's risk behavior. Nevertheless, riskier means that the premium shall be larger and, therefore, it implies that the variable component of their compensation is larger, hence, if the impact across the category is uniform, they will, following this line of thought, suffer an even greater impact.

Additionally, when accounting for R&D, firm's that have bold R&D to total assets ratios are expected to be much more innovation driven and can suffer greatly from the economic constraints that may arise during a period of financial crisis, leading to the lack of new

developments and frustration on its further impact on earnings translating into less shareholder's faith in the future cash flows of the company, decreasing, therefore, its value and consequently its CEO variable pay. For intangible assets, we estimate that the same might occur since this situation can imply that the acquisitions can no longer reap the best yield for the paid amount and frustrate the future earnings, decreasing companies' expectations.

Similarly, PPE is also accounted for to understand to which extent companies that are capital intensive suffer in their performance and how it impacts the CEO compensation. We estimate that since these companies tend to be much less agile in their comeback, especially during times of financial crisis and constraints, they can be largely impacted. Nonetheless, it is crucial to point out that during periods of crisis these sectors benefit from the general decrease in interest rates, and it could rebalance the overall damage on their capital structure.

(3) Hypothesis 3: CEOs with duality suffer less impact on their compensation

The expectation is that since these CEOs can greatly influence their compensation package due to their influence and, hence, could guarantee that the impact on their compensation is softened or even delayed into some type of deferred compensation. This comes from the theory that boards are a major blocker to top level management that, as theory states, always want to reap the best individual results and extract as much rent as they can, meaning that if the company lacks this type of vigilance and has a duality, this surveillance is compromised and can be more easily surpassed.

4 Results

The results hereby informed were achieved by applying the model explained in detail before on Eviews and had some caveats that had to be addressed to get to the end results that will be displayed. Note that the researchers that have developed this model, informed during the begging of this paper, have used similar strategies to analyze and define the variables.

Also, due to this management the number of samples was slightly reduced nevertheless, in contrast, the quality of the data was greatly enhanced, and the model has performed well according to the model defined earlier.

4.1 Descriptive Statistics

As it can be seen on Table 1, the sample was greatly diverse and had a wide range of participants as it counted with 687 observations across industries and ranges of CEO seniority as well as size of companies.

Table 1 - Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.
Total_Compensation	9,647,212	6,676,175	44,771,910	510,625	8,784,921
Options_ Exercised	5,498,072	2,814,615	34,696,550	3,749	6,567,910
Volatility	0,007	0,003	0,295	0,000	0,023
Roa	8,732	9,050	157,880	-63,990	12,003
R&D	4,212	4,176	8,950	0,391	1,520
PPE	5,390	5,503	9,762	-0,826	1,756
Intangible_Assets	5,395	5,996	10,163	0,000	2,457
Size	7,455	7,355	11,509	2,223	1,494
Leverage	45,571	29,990	381,400	0,000	56,807
Fixed_Compensation	769,302	706,000	1,852,319	236,602	305,207
Duality	0,553	1,000	1,000	0,000	0,498
Crisis_Dummy	0,176	0,000	1,000	0,000	0,381
Age	55,359	55,000	74,000	37,000	7,591

Table 1 presents summary descriptive statistics on the key variables for the sample.

Additionally, the mean value of the options exercised are vastly greater than its respective counterpart on fixed salary meaning that the theory that in recent years top level management has boosted its total compensation significantly and, hence, it represents, at first glance, that these values *per se* corroborate the hypothesis stated that, since they receive larger slice as variable, once the company performs poorly, it will automatically reflect on their compensation. Also, the range between the mean and median value of fixed compensation is not as wide as its counterpart on the options side, which indicates that, on average, CEO's receive alike salaries and it is the variable compensation that really makes the difference on the wage gap amongst senior management.

Interestingly, the duality mean indicates an above average number of samples for cases that the CEO is also head of the board and this can influence this paper's outcome as it can be slightly biased according to the dataset, however it does not indicate undoubtedly that the results are invalid and, as conclusion, the estimation, according to the rules explained, is robust. The executive's age, as it can play a major role since it can be used as proxy for experienced managers, indicates that longevous CEOs definitely on the sample even though it is displayed as a minority and maximum value, having 55 years as the mean, slightly higher than the median.

Finally, on the variables that are measured as percentage or as operational performance of the company, these values are within the expectations, but it is curious to see that these indicators have a significant range that can be found specially on Return on Assets and Leverage, since business can vary greatly on their *modus operandi* as well as capital structure decisions that influence these two variables directly. For the variables that have much larger figures we've applied the natural logarithm, as explained before, hence they are controlled in the way that their deviation is lower and having it this way is a method to avoid influencing the model with noisy residuals. Still, their range remains significant as in Size for example that, since the sample is large and industries are diverse, there could be even a startup that has few assets in place and, on the other hand, a massive capital intense player that lets to the distortion of the figure on the maximum end of the universe studied in this paper. Further, these initial conclusions on descriptive stats seem to be robust as it is highly relatable to the dataset found on Table 2, the correlation matrix.

Further, PPE is highly correlated to fixed compensation which could be inferred as safer industries that might attract more risk-averse CEOs and, hence, they ask for a higher participation on fixed compensation to compensate their risk-benefit assessment. This result holds when performing the same comparison on like for like basis but having intangible assets and size as baseline however these variables show less correlation than PPE. On the other hand, R&D seems to attract more risk-averse managers since their variable compensation is more correlated than the fixed amount, which goes along with the major theory in this field of research that has R&D as risky investment since it could lead nowhere and have a massive sunk cost Wu & Tu (2007). Also, R&D seems to be more strictly related to volatility than other variables, corroborating the theory described.

Table 2 - Correlation Matrix

	Total_ Compensation	Options_ Exercised	Volatility	Roa	R&D	PPE	Intangible_ Assets	Size	Leverage	Fixed_ Compensation	Duality	Crisis_ Dummy	Age
Total_Compe:	1,000												
Options_Execet	0,887	1,000											
Volatility	-0,018	-0,012	1,000										
Roa	-0,041	0,039	0,020	1,000									
R&D	0,398	0,293	0,161	-0,036	1,000								
PPE	0,381	0,258	0,107	-0,025	0,595	1,000							
Intangible_As	0,384	0,252	0,050	0,017	0,573	0,538	1,000						
Size	0,475	0,301	0,120	-0,026	0,733	0,884	0,698	1,000					
Leverage	0,111	0,042	-0,043	-0,067	-0,046	0,303	0,062	0,257	1,000				
Fixed_Compe	0,580	0,310	-0,032	-0,154	0,276	0,504	0,372	0,562	0,346	1,000			
Duality	0,247	0,167	0,024	0,140	-0,118	0,119	0,019	0,099	0,101	0,273	1,000		
Crisis_Dummur:	-0,059	-0,068	-0,044	-0,063	0,055	0,032	-0,011	0,028	-0,065	0,030	0,033	1,000	
Age	0,174	0,132	0,011	-0,046	-0,075	-0,030	-0,029	-0,001	0,003	0,204	0,265	0,001	1,000

For each component, the correspondent correlation coefficient is displayed when compared

Further, PPE is highly correlated to fixed compensation which could be inferred as safer industries that might attract more risk-averse CEOs and, hence, they ask for a higher participation on fixed compensation to compensate their risk-benefit assessment. This result holds when performing the same comparison on like for like basis but having intangible assets and size as baseline however these variables show less correlation than PPE. On the other hand, R&D seems to attract more risk-averse managers since their variable compensation is more correlated than the fixed amount, which goes along with the major theory in this field of research that has R&D as risky investment since it could lead nowhere and have a massive sunk cost Wu & Tu (2007). Also, R&D seems to be more strictly related to volatility than other variables, corroborating the theory described.

ROA is interestingly related to duality and could indicate that managers on the sample could be influencing somehow their results and, consecutively, this key performance indicator since they hold more power to decide capital allocations, as well as accounting standards that could be used to manage earnings. Additionally, it is correlated positively with variable compensation and negatively with fixed compensation that could be interpreted as the pay-for-performance scenario where higher ROA can lead to higher CEO compensation but not fixed compensation.

Finally, it is curious to analyze the crisis dummy correlation with other variables as it has immaterial figures and we would expect, by the model and hypothesis, that this variable had much larger numbers that could indicate its significance on CEO total pay and exercised options for instance. Nonetheless, it is important to notice that they are negatively correlated which means that although they are not bonded, it shows that it has some degree of confluence with our expectations.

4.2 Regression Results

After accessing the descriptive stats that were displayed on the last section, we proceed to the regression results to deepen the understanding of the variables on how they influence and to which extent they can distort the model as well as their ability to explain the results shown on this paper having the prob column a proxy to their p-values. For the first assessment, we've disregarded the variables that were intrinsically related to the compensation such as the fixed salary and options exercised to have this impact purged from the analysis and have a clear picture on how the other variables can explain the model

and variances. Still, it is important to reiterate that the OLS regression had into consideration White's heteroskedasticity-robust standard errors as it was done formerly by the researchers that have started this debate on CEO compensation and its relation to periods with increased market volatility.

Table 3 - Main Regression Results

Variable	Coefficient	Std. Error	T-Statistic	Prob.
Crisis_Dummy	-1.472,109	593,074	-2,482	0,013
R&D	540,337	264,994	2,039	0,042
PPE	-650,579	337,578	-1,927	0,054
Size	2.077,855	492,651	4,218	0,000
Intangible_Assets	383,737	147,438	2,603	0,009
Roa	-6,604	26,660	-0,248	0,804
Leverage	-0,310	0,223	-1,390	0,165
Volatility	-14.618,510	12.781,410	-1,144	0,253
Age	98,249	29,535	3,327	0,001
Duality	2.678,796	543,118	4,932	0,000
C	-15.598,980	2.318,137	-6,729	0,000
R-Squared	0,247	Mean Dependent Var		6.828,575
Adjusted R-Squared	0,237	S.D. Dependent Var		8.118,193
S.E. Of Regression	7.092,986	Akaike Info Criterion		20,586
Sum Squared Resid	3,800E+10	Schwarz Criterion		20,652
Log Likelihood	-7.883,669	Hannan-Quinn Criter.		20,611
F-Statistic	24,744	Durbin-Watson Stat		1,084
Prob(F-Statistic)	0,000	Wald F-Statistic		20,335
Prob(Wald F-Statistic)	0,000			0,000

For each variable, the respective values are represented in column (2) along with its p-value (column 4)

As expected on hypothesis 1, the dummy variable that indicated years where the financial crisis took place has large negative coefficient and it is significant at 2% meaning that it indeed has a meaningful impact on CEO compensation and its correlation accessed earlier is also in line with expectations since it has a negative composite when compared with the options exercised. Additionally, volatility has a relevant impact on the compensation, corroborating the hypothesis that higher volatility results on a massive impact, nonetheless although this variable has an impressive coefficient, it holds no statistical significance since its probability is higher than the threshold for p-value, namely the 5%.

Similar to the crisis variable and volatility but in opposite direction, duality has a large positive coefficient meaning that indeed more powerful CEOs can influence on their payment package as well as compensation that is defined along with the board and hence

manage to avoid massive impacts on their compensation during periods that the volatility is increased. Alike but less relevant, age plays a small but positive role on influencing on their compensation during these periods. Both are hold significance at 1%.

Also, as expected, the coefficient for PPE is negative and represents the fact that capital intense industries may suffer more on a volatile market since their assets need to have the optimum allocation and demand to reap the best yield on cost for these materials which is exactly the opposite that happens during periods of market distress, resulting on large idleness and financial impacts on results that are, unavoidably, to the investor's sentiment diminishing the market value of equity and consequently to CEO variable compensation. While this variable holds no statistical significance, the analysis should not be disregarded as it is in line with expectations and former studies. Different from this scenario, larger companies tend to have more stable cash flows and reserves as well as more margin of maneuver during periods of crisis and this could lead to the positive coefficient seen on the table.

Contrary to expectations, higher R&D or intangible assets, that could be used as proxy to riskier companies, have a positive and statistically significant relationship to total compensation on this dataset. It is important to note, however, that companies with these characteristics usually have a higher positive sentiment from the investor since it could be interpreted as higher premium if the company manages to go through the crisis period. Alternatively, companies that rely heavily on R&D and acquisitions/ intangible value creation are generally riskier and during higher volatility they should reflect a negative coefficient.

Finally, according to Cohen (1992), the adjusted R-squared value, namely the calculation that intents to act as a proxy to understand the explanation power of the model, can be segmented on three categories to access the model's capacity: (i) low, below 12%; (ii) medium, between 13% and 25%; and (iii) high, 26% or above. Hence, this model holds a medium explanatory power due to its adjusted r-squared of 23,7%.

4.3 Robustness Tests

To access the model's robustness, the variables intrinsically related to the compensation were added to the model to understand if the results of the other coefficients hold their statistical significance and, especially, if the signal remains the same meaning that the

respective variable is not subject to major changes when the dataset is modified. Also, it is important to note that adjusted R-squared obviously enhances greatly with the addition of these variables as they are extremely related to the dependent variable, namely CEO's total compensation. Hence, the first new estimation model is:

$$(5) \text{ Total_Comp} = \beta_0 + \beta_1 * \text{Fixed_Compensation} + \beta_2 * \text{Crisis_Dummy} + \beta_3 * \text{R\&D} + \beta_4 * \text{PPE} + \beta_5 * \text{Size} + \beta_6 * \text{Intangible_Assets} + \beta_7 * \text{ROA} + \beta_8 * \text{Leverage} + \beta_9 * \text{Volatility} + \beta_{10} * \text{Age} + \beta_{11} * \text{Duality} + \text{Error}$$

As shown on Table 4, despite ROA, the other variables remain with the same signal and have their p-value enhanced in almost all cases with age and total assets as outliers as they suffer an increase of prob meaning that these variables lose explanatory power on the model. In general, the variables experience a relevant decrease on their values as some of the impact is already absorbed by the fixed compensation variable. Nevertheless, crisis dummy, R&D and PPE coefficients are amplified and become statistic significant as fixed salary's impact is diluted amongst other variables. Therefore, even with the inclusion of Fixed Salary variable, the results hold, and it indicates that the model is indeed robust.

Table 4 - Robustness Tests with Salary Inclusion

Variable	Coefficient	Std. Error	T-Statistic	Prob.
Fixed_Compensation	12,835	1,701	7,544	0,000
Crisis_Dummy	-1.488,601	527,473	-2,822	0,005
R&D	1.107,982	243,434	4,551	0,000
PPE	-771,538	301,467	-2,559	0,011
Size	495,912	519,442	0,955	0,340
Intangible_Assets	244,758	109,545	2,234	0,026
Roa	20,334	13,521	1,504	0,133
Leverage	-0,369	0,143	-2,588	0,010
Volatility	-3.541,726	8.280,146	-0,428	0,669
Age	12,741	27,758	0,459	0,646
Duality	1.803,458	524,446	3,439	0,001
C	-9.457,530	2.469,463	-3,830	0,000
R-Squared	0,378	Mean Dependent Var		6.782,037
Adjusted R-Squared	0,369	S.D. Dependent Var		8.008,342
S.E. Of Regression	6.362,363	Akaike Info Criterion		20,370
Sum Squared Resid	2,960E+10	Schwarz Criterion		20,445
Log Likelihood	-7.556	Hannan-Quinn Criter.		20,399
F-Statistic	40,416	Durbin-Watson Stat		1,274
Prob(F-Statistic)	0,000	Wald F-Statistic		31,672
Prob(Wald F-Statistic)	0,000			0,000

For each variable, the respective values are represented in column (2) along with its p-value (column 4)

Even though after the first test the model seems to be robust, there was another variable that could somehow move the results towards the uncertainty or magnify the results already found, namely the *options_Exercised* that corresponds, as seen during this study, to the largest weight on CEO compensation. Hence, after this inclusion we expected that its effects would be like the ones reflected on *fixed_salary* inclusion meaning that the overall theoretical direction of the model would remain the same with some variables being magnified and other slightly diminished. Therefore, the final robustness test model is:

$$(6) \text{ Total_Comp} = \beta_0 + \beta_1 * \text{Options_Exercised} + \beta_2 * \text{Fixed_Compensation} + \beta_3 * \text{Crisis_Dummy} + \beta_4 * \text{R\&D} + \beta_5 * \text{PPE} + \beta_6 * \text{Size} + \beta_7 * \text{Intangible_Assets} + \beta_8 * \text{ROA} + \beta_9 * \text{Leverage} + \beta_{10} * \text{Volatility} + \beta_{11} * \text{Age} + \beta_{12} * \text{Duality} + \text{Error}$$

Nevertheless, as it can be seen on Table 5, most of the variables, despite duality, PPE and R&D, lose their statistical significance and, with it, their explanatory power in the model. That could be inferred by the inclusion of a variable that is closely related to the dependent variable as it can be seen by the massive enhancement on the adjusted R-squared that soars up to 90% whereas on the first assessment was 23% meaning that the model has now more explanatory power than before. However, it can be misleading since this inclusion is not exactly the intent of the model but rather a method of stressing it to make sure that the results hold even when variables surely related are added.

Also, a diminish on the coefficient figures can be seen if compared with the first results from the regressions however, when compared versus the first robustness test, there is a relevant increase that is closely tied to the loss in the explanatory power of the variables as their p-values rises as well. Once more, there a crucial piece of the model that remains with the same signal, the dummy variable for crisis periods and duality. Even though crisis loses its significance at 5%, it can be masked by the fact informed earlier and should be taken into consideration that its signal and, therefore, its meaning remains the same across models.

Table 5 - Robustness Tests with Salary and Options Inclusion

Variable	Coefficient	Std. Error	T-Statistic	Prob.
Options_ Exercised	1,007	0,029	35,121	0,000
Fixed_Compensation	8,605	1,125	7,649	0,000
Crisis_Dummy	-614,391	336,041	-1,828	0,068
R&D	432,582	158,803	2,724	0,007
PPE	-658,607	194,785	-3,381	0,001
Size	752,371	396,252	1,899	0,058
Intangible_Assets	84,643	85,964	0,985	0,325
Roa	-24,828	19,949	-1,245	0,214
Leverage	-3,940	2,301	-1,712	0,088
Volatility	-6.560,106	5.160,695	-1,271	0,205
Age	-1,549	17,247	-0,090	0,929
Duality	1.049,175	311,896	3,364	0,001
C	-6.789,654	1.809,063	-3,753	0,000
R-Squared	0,905	Mean Dependent Var		9.647,212
Adjusted R-Squared	0,902	S.D. Dependent Var		8.784,921
S.E. Of Regression	2.747,111	Akaike Info Criterion		18,708
Sum Squared Resid	2.820.000.000	Schwarz Criterion		18,840
Log Likelihood	-3.606,902	Hannan-Quinn Criter.		18,760
F-Statistic	297,783	Durbin-Watson Stat		0,653
Prob(F-Statistic)	0,000	Wald F-Statistic		277,687
Prob(Wald F-Statistic)	0,000			0,000

For each variable, the respective values are represented in column (2) along with its p-value (column 4)

Finally, after all the tests the results have held their meaning and, in most cases, their explanatory power proxied by their p-value. Additionally, these results are in line with the current theoretical framework and the former studies quoted on this academic paper for the variables that were addressed by their respective researchers. Therefore, we consider that the model holds the explanatory power necessary to be considered robust and, after analyzing its results, the conclusion is that CEO pay is massively impacted by the crisis and increased volatility meanwhile duality also plays an import role on decreasing the impact. Thus, the results indicate that all hypotheses are correct and in line with expectations.

5 Conclusion

This study has been developed majorly due to the need to update Aggrawals research that has been done in the late nineties and as mentioned in the introduction, the mechanics and compensation packages have changed massively from that moment onwards, having a much larger variable pay where stock-based compensation, generally by options, plays a major role on boosting the figures, as well as CEO compensation and average corporate workers' wage. Indeed, CEO compensation has risen to unimaginable heights since then, hence a much-needed update was performed by Garen that also proposed some changes to the model to include variables that could enhance the explanation power of the regressions and provide a clearer picture. However, it has been done relying on the data from the dotcom bubble in 2001 and, to some extent, it suffers, as referred by the author, from a bias since it reflects the data from the most bullish market that has risen right after the stock market crash.

Additionally, this study relies on key concepts that are the cobblestones for the understanding of the complex issue strictly linked to the CEO compensation, namely the multiple concepts and variables that can influence it directly. With this foundation, agency costs are a major topic when the underlying subject is compensation since it will unavoidably exist, and companies need strategies to have its impacts diminished somehow, especially when it regards top-level management. Also, it addresses the sharp increases and gaps on CEO compensations across the US market and lays the mindset of the financial crisis that will be studied which was, as explained, one of the most relevant crashes that had implications like never seen on the US stock market.

Further, to perform this analysis, the dataset was structured with information from 2004 to 2013 that regards CEO compensation and performance indicators from the respective companies to access their effect on the total CEO pay. The initial sample was massive, nevertheless, as expected, most of the information could not be used mainly due to three issues: (i) continuity issues, CEOs that did not hold their tenure during these years; (ii) companies that lacked information on the pay split on ExecuComp; and (iii) companies that had misaligned information available in ExecuComp and Datastream.

The model developed to tackle this assessment was designed having as baseline Garen's first approach since it was the most up to date study to the best of the researcher's knowledge that deployed an ordinary least squared regression with White's heteroskedasticity-robust

standard errors. However, some changes were needed to cover more company specific details such as the impact of performance, as well as micro indicators, to address more in-depth analysis regarding CEO pay. The variables that held most interest to this study is Crisis_Dummy and Volatility since they are strictly related with the problem of this study and CEO payment, as previously thought. In addition, it was intriguing to see the impacts of other variables and their respective correlation amongst themselves.

The hypotheses were built based on former studies as well as expectations developed from former financial analysis and estimations on how their fluctuation could impact CEO compensation. This paper relies mainly on three hypotheses: (a) CEO compensation suffer during periods of crisis, (b) R&D, PPE and Size play a relevant role on its fluctuation and (c) CEOs that are also directors of the board can diminish crisis' impacts on their compensation.

Finally, the results indicate that all hypotheses are correct and with coefficients that are statistically significant at 5% level although some interesting results do not hold this significance, they were aligned with our expectations as well. Also, to access the robustness of the model, both variables that directly impact the CEO pay are added to understand to which extent they influence the other coefficients and the respective interpretation. Since the underlying idea of the paper remains significant and constant even with the new variables' inclusion, we henceforth have considered the model to be robust and relevant to the academic spectrum.

Regarding limitations, it has been stated on the data section that the treatment of options value is not standardized across the scientific community and, therefore, ExecuComp's methodology was assumed as proper hence, it was deployed. Also, the sample size could be a limitation since it lacks a massive database that would've been more accurate on reflecting the model's capacity to operate when it is deployed to the complete universe of CEOs. Finally, the 2008 financial crisis was extremely impactful to markets and showed a new modus operandi regarding crisis management by the US government however the 2020 Covid-19 economic impact had never been seen before due to its rapidly reflection on market and when more information is available an update of this analysis should be performed to access if it remains relevant to the academic community.

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