**Introduction:**

**Context and Background**

CEO pay has been a major topic in business for many years. People often ask, “How does CEO pay affect company performance?” The idea is that if companies pay CEOs well, they will work harder and help the business grow. But not everyone agrees. Some believe high pay can lead to risky choices or a focus on short-term results instead of long-term goals (Jensen and Murphy, 1990; Edmans, Gabaix and Jenter, 2017).

In the past twenty years, rules around CEO pay have changed. Laws like the Dodd-Frank Act in the United States and the UK Corporate Governance Code now require companies to clearly explain how they pay their executives. They also allow shareholders to vote on pay decisions (Gregg, Jewell and Tonks, 2005). Still, the link between CEO pays and company performance is not clear. Some studies say higher pay leads to better results (Mehran, 1995; Manders, 2012), while others find little or no connection (Jensen and Murphy, 1990; Cai, Huang and Ye, 2020). It often depends on the company, industry or how long the wait to measure the effect.

With access to big datasets like Kaggle’s “Financial Data of 4400 Public Companies” (Kaggle, 2023), it is now easier to explore this topic in more detail. This project will study how CEO pay helps companies perform better in the long run and what factors influence that.

**Problem Statement:**

Even though many researchers have looked at CEO pay and performance, the connection is still not clear. Some think that performance-based pay encourages CEOs to work harder (Jensen and Meckling, 1976). Others believe CEOs may have too much control and can influence their own pay, even if the company does not do well (Bebchuk and Fried, 2004).

Recent studies also show the results of CEO pay may take time to appear. For example, long-term stock options may lead to results years later (Edmans, Gabaix and Jenter, 2017). But short-term bonuses may lead to quick decisions that hurt the company in the future (Cai, Huang and Ye, 2020). Many past studies also used small samples or short timeframes, which limits their usefulness. This research will look at a large dataset over many years, while considering firm size, industry, and finances. Many older studies on the link between executive pay and company performance used small or outdated data, which makes their findings less reliable. For example, famous studies from the 1990s and early 2000s (like Jensen and Murphy, 1990; Gregg, Jewell and Tonks, 2005) were useful but they only looked at certain regions or short time periods.

The problem is that executive pay has changed a lot over time because of:

* **New rules and reforms**: After the 2008 financial crisis, many new laws were introduced, like the Dodd-Frank Act in the US and changes to the UK Corporate Governance Code (Ferri and Maber, 2013). Old data does not show these changes.
* **Market changes**: Technology companies, shareholder activism, and new performance measures linked to sustainability have also changed how executive pay works (Conyon, Judge and Useem, 2011).
* **Bigger and wider data today**: Earlier research only had data from hundreds of firms for a few years. Now, large datasets cover thousands of companies worldwide over many decades (Kaggle, 2023). This makes results more reliable and allows deeper analysis.

So, if only use old or small data, miss how new rules, market shifts and industry changes affect pay and performance. Using a large, long-term dataset gives a better picture of how CEO pay impacts company performance over time.

**Project Objectives**

This project aims to study how different types of executives pay like salary, bonuses and equity. Those are linked to performance measures such as stock price, revenue growth, return on assets (ROA) and total shareholder return.

It will also explore whether the effects of pay appear later, using longitudinal methods and Generalized Method of Moments (GMM). The study will check if results change depending on firm size, industry or market maturity and will look for non-linear and interaction effects.

Finally, the project will offer clear advice to policymakers, boards and investors on how to design better executive pay systems that support long-term success.

**Scope and Limitations:**

This study mainly looks at publicly listed companies. The dataset includes information from 4,400 companies across several years. The project focuses on certain areas. It studies executive compensation as the independent variable. This includes base salary, bonus and stock options. The dependent variables are important company performance indicators, such as revenue growth, market capitalisation, return on assets (ROA) and return on equity (ROE). It also includes control variables like the industry sector, firm size, debt ratio and asset structure, which help make the results more accurate.

Even though the data is large and detailed, there are still some limitations. First, not all financial data is complete. Some values might be missing and will either need to be estimated or left out. Second, it is hard to prove exact causality even when using methods like Generalized Method of Moments (GMM). Because this is not an experiment, it is based on real-world data. Third, the study mostly looks at financial numbers and might miss non-financial factors like leadership style or company culture, which can also affect performance. Lastly, the data includes pay information for several top executives, not just CEOs, so the results might not show CEO-specific effects clearly.

Even with these challenges, the large dataset, careful design and strong analysis methods give this study a good base for finding useful insights.

**Value Proposition:**

This study brings value in **three main ways:**

First, for academic research which combines different theories into one full framework. These include agency theory, value theory, symbolic theory and managerial power theory. Many past studies looked at these theories one by one (Otten, 2007; N’Guessan, 2022) but this study connects them all to better understand both the money side and the social side of executive pay.

Second, for real-world business use which gives useful ideas for company boards and remuneration committees. The findings can help them design better pay systems that reward both short-term results and long-term success. This helps companies grow in a smart and balanced way.

Third, for policy and governance, the results could help shape better rules and policies. For example, it may help with improving disclosure rules or setting limits on short-term incentives. This can reduce big risks in the system and support sustainable corporate behaviour (ScienceDirect, 2024).

**Project Structure Overview:**

This report has several main sections. The Literature Review looks at past research on executive pay and company performance and points out gaps and new ideas. The Theoretical Framework explains four key theories and shows how they connect pay to company outcomes. The Methodology describes how the research was done, what data was used and which tools were applied, including panel data methods, regression and Generalized Method of Moments (GMM). The Data Analysis and Results section shows the findings using statistics and models. The Discussion explains what the results mean, compares them with past studies and gives useful insights. Lastly, the Conclusions and Recommendations sum up the findings, suggest policy ideas and offer directions for future research.

**Literature Review and Industry Analysis:**

**Critical review of relevant academic literature:**

**What theory predicts about pay and performance?**Agency theory says that when managers and owners are separate, pay contracts should be designed to make managers act in the best interest of shareholders (Jensen & Meckling, 1976). A fixed salary gives security but no motivation, while variable pay especially equity links CEO rewards to company results (Murphy, 1999; Core, Guay & Larcker, 2003). In theory, performance-based pay should lead to better outcomes by reducing laziness, stopping wasteful expansion and encouraging smart risk-taking. But theory also shows problems. If rewards are tied to noisy or incomplete measures, CEOs may focus on short-term gains and harm long-term value (myopia). Equity pay can also push them to take too much risk if their losses are limited (convexity). In addition, boards often fail to remove the effect of luck like industry-wide or market shocks, when judging CEO performance (Jensen & Murphy, 1990; Bertrand & Mullainathan, 2001).

The key point is that it is not about simply “paying more,” but about **how pay is structured**, “cash vs equity”, whether it adjusts for luck, vesting periods and which performance metrics are used. These details decide whether pay truly motivates the right behaviour.

**What the empirical evidence says:**

**Pay–performance sensitivity and “pay for luck”**  
Early studies found that CEO wealth changed only a little for every $1,000 change in firm value (Jensen & Murphy, 1990). Later research showed that equity grants and stock options make this link stronger (Core et al., 2003). But CEOs often gain from “pay for luck,” where their pay rises because of market or industry shocks like “oil price booms” that are outside their control (Bertrand & Mullainathan, 2001). Boards only partly adjust for this, showing weak relative performance evaluation (RPE).

Research also shows that RPE failures have consequences. For example, CEOs are more likely to be fired after negative industry shocks, even if they were not at fault. This means boards punish and reward CEOs for luck, which weakens incentives (Jenter & Kanaan, 2015).

**Incentives, horizons, and short-term behaviour**  
When CEOs have stock options about to vest, they often cut long-term investment and R&D to boost short-term results, showing short-termism (Gao & Li, 2015). Option heavy pay also pushes firms to take more risk and debt, which can be harmful if the firm already has high leverage (Coles, Daniel & Naveen, 2006).

**Does high pay mean better performance?**  
Not always. One large study found that firms paying very high incentive-based pay later underperformed on stock returns, suggesting overpayment or CEO power (Cooper, Gulen & Rau, 2016). This does not mean all high pay is bad but it shows that pay levels alone do not guarantee value creation.

**What surveys conclude**  
Reviews of the literature find mixed results. Well-designed equity pay can improve performance but it is hard to prove causality because good firms may simply afford higher pay or other factors like talent are not measured (Edmans, Gabaix & Jenter, 2017). Strong evidence comes when pay design changes due to regulation or natural experiments.

**Bottom line:** CEO pay affects performance more through **how** it is designed than **how** much is paid. Poorly designed contracts encourage short-termism and pay-for-luck, while indexed, deferred and well-targeted equity pay creates stronger alignment with shareholders.

**Industry and regulatory best practice: how design is evolving:**

**United States**  
In 2022, the SEC introduced a rule that forces companies to show how CEO pay is linked to shareholder return (TSR), peer performance and key financial measures (SEC, 2022). This aims to stop cases where pay rises without results. In 2023, new clawback rules were also added, meaning companies must take back bonuses if financial reports are corrected, reducing incentives to misreport (SEC, 2023).

**United Kingdom**  
The UK Corporate Governance Code focuses on pay tied to long-term, sustainable results. It supports clawbacks, equity holding periods and clear performance measures. The Investment Association (IA) Principles (2024/25) demand stricter explanations for high pay, longer vesting and careful use of non-financial targets like ESG, only when they are clear and measurable. Still, FTSE 100 CEO pay is very high about £4.2m in 2023 and pay gaps remain wide, keeping pressure on boards (High Pay Centre, 2024).

**What boards actually do:**  
Today, many boards use: (i) more equity-based pay, (ii) relative performance evaluation (RPE) to remove luck, (iii) longer deferrals, (iv) clawbacks to stop misreporting and (v) balanced performance metrics such as ROIC, EBITDA, TSR and in some cases ESG. These practices are growing as investors push back against “pay for luck” and short-termism.

**Technical framework for credible inference**:

The big challenge in asking **“How does CEO pay affect company performance?”** is endogeneity. This means the relationship can be confused by other factors. One issue is **reverse causality**: strong firms can both pay more and attract better CEOs.

Another is **omitted variables**: hidden factors such as CEO talent, board quality, or strategy may influence both pay and performance. A further challenge is **dynamic persistence**, since company performance often carries over from year to year while CEO contracts change only slowly.

To handle this, researchers use careful methods:

* **Dynamic panel models (System GMM)**: These link performance to past performance, CEO pay (cash, equity, vesting), firm traits and governance. They use past data as instruments to solve simultaneity problems and check validity with statistical tests, while keeping instruments limited to avoid bias (Roodman, 2008).
* **Quasi-experiments**: Natural policy shocks, like the UK “say on pay” (2002) or SEC disclosure/clawback rules, provide before-and-after comparisons to isolate effects (Ferri & Maber, 2013; SEC, 2022/2023).
* **Contract-level measures**: Instead of total pay, researchers study detailed incentives: delta (pay sensitivity to firm value), Vega (sensitivity to risk), vesting schedules and RPE indicators (Core et al., 2003; Gao & Li, 2015). These directly reflect theory.
* **Outcome measures**: Both market outcomes (returns, value, cost of capital) and operating outcomes (ROIC, margins, efficiency, innovation) are used, so results are not distorted by “gaming” one metric (Edmans, Gabaix & Jenter, 2017).

Credible studies need strong methods, good instruments, clear contract measures and broad performance outcomes to truly capture how CEO pay impacts firm performance.

**Market and sector dynamics**:  
CEO pay is still very high in both the US and UK, and it is now mostly equity based. Reports from 2024–2025 show pay at the top rising even faster. This makes the design of pay packages very important. In retail and consumer services, pay gaps are especially large because many workers are low paid. In tech, CEOs often receive stock awards with long vesting periods which create stronger pay–performance links. Recent reports confirm that median CEO pay keeps rising and public attention remains high, stressing the need for tools like RPE, clawbacks and longer vesting horizons to tie pay more closely to performance (Financial Times, 2025; High Pay Centre, 2024).

**Where the gaps and opportunities remain:**

* **From pay levels to design**: Many studies still use total pay as a proxy for incentives. The opportunity is to study design features such as indexation (removing luck), vesting schedules and post-vesting holding and link them to long-term value creation like R&D and investment productivity.
* **Filtering luck better**: Boards still struggle with RPE. Wider use of indexed equity and RPE-based scorecards can reduce pay-for-luck, as supported by research (Bertrand & Mullainathan, 2001; Jenter & Kanaan, 2015).
* **Non-financial metrics**: ESG targets can matter if they are material and measurable. The challenge is to identify which ESG metrics truly improve long-term performance and how to use them without allowing gaming.
* **Better identification**: Careful use of System GMM (with proper tests and instrument control) and natural experiments, like SEC disclosure rules or the UK say-on-pay, can give stronger causal evidence.

Overall, the evidence shows CEO pay can improve performance but only if contracts are well designed. Features like RPE, indexation, long horizons and clawbacks help align incentives. Poorly designed contracts that reward luck, pay out too quickly or encourage risk without accountability tend to destroy value.

**Methodology and Data:**

**Methodological Justification**

The research question, *“How does CEO pay affect company performance?”*, requires a method that can capture cause-and-effect while considering differences between firms and changes over time. A single cross-sectional study is not enough, as it cannot handle hidden factors or the dynamic nature of performance (Wooldridge, 2010). To address this, **panel data** is used, which covers many firms across several years and controls for firm-specific characteristics that remain constant over time.

The choice of method is also linked to theories of executive pay. **Agency theory** explains that CEO pay is designed to align managers’ interests with those of shareholders (Jensen and Meckling, 1976). In contrast, **managerial power theory** argues that CEOs may use their influence to obtain higher pay not related to performance (Bebchuk and Fried, 2004). Both perspectives highlight variation across firms and time, making panel regression suitable for analysing pay–performance sensitivity.

A key issue in this type of research is **endogeneity**, which arises from three main sources:

* **Reverse causality**: better-performing firms may simply afford higher CEO pay, making performance both a cause and an effect.
* **Omitted variables**: unobserved factors such as CEO talent or board strength may influence both pay and performance.
* **Dynamic persistence**: company performance often depends on past outcomes, while executive pay contracts change gradually.

Conventional models such as OLS, Fixed Effects (FE), and Random Effects (RE) can address some heterogeneity but fail to fully correct for simultaneity and reverse causality (Wooldridge, 2010). To overcome these challenges, the **System Generalized Method of Moments (System GMM)**, introduced by Arellano and Bond (1991) and extended by Blundell and Bond (1998), is applied. System GMM uses lagged variables as instruments, making it effective for dynamic panels and endogenous regressors. It is widely recognised as a robust method in studies of corporate governance and executive pay (Roodman, 2008; Edmans, Gabaix and Jenter, 2017).

The basic regression model looks like this:

Where:

* Per means how the company is doing (ROA, ROE, Tobin’s Q, TSR) or firm *i* at time *t*
* means CEO salary, bonus or equity pay
* are other factors like company size, debt and industry
* is used to capture how results carry over from year to year
* is the error term  
    
  System GMM uses lagged instruments to handle reverse causality and simultaneity. Unlike OLS, Fixed Effects, or Random Effects models, it is better at solving these issues. FE and RE control for some hidden factors but still cannot deal with reverse causality fully. That is why **System GMM is the best choice** for this study (Blundell and Bond, 1998).

**Data Collection and Sources:**

The dataset for this study comes from Kaggle’s *“Financial Data of 4,400 Public Companies”* (Kaggle, 2023). It contains financial and governance information for listed companies from different industries and countries. The time period covered is from July 2012 to May 2020, based on the variable endDate.

The dataset includes:

* Independent variables: executive pay measures (such as salary, bonus, equity).
* Dependent variables: company performance indicators (such as ROA, ROE, Tobin’s Q, and TSR).
* Control variables: firm size, leverage, and industry dummies.

The file has 29 columns and 17,511 rows, with a panel-style structure that links firms to time through the endDate variable.

**Variables and Definitions:**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Definition | Formula / Construction | Role in Analysis |
| CEO Pay (lnPay) | Total CEO compensation (log-transformed) | *ln(totalCompensation)* | Independent variable |
| Return on Assets (ROA) | Profitability measure | *ROA* = | Dependent variable |
| Tobin’s Q | Market-based performance | *Q =* | Dependent variable |
| Debt-to-Assets | Leverage indicator | *DA =* | Control variable |
| Firm Size | Natural log of total assets | *ln(totalAssets)* | Control variable |
| Revenue Growth | Growth potential |  | Control variable |

This structure makes it possible to study the relationship in more than one way. It shows not only how CEO pay affects company performance but also how factors like industry, firm size and financial leverage influence that link.

**Data Preprocessing and Cleaning**

The raw dataset had some problems that needed cleaning before analysis. The following steps were taken:

* Missing values: If less than 5% of data was missing, the mean value was used to fill the gap. If more than 20% was missing for a firm in a given year, that record was removed.
* Outliers: CEO pay data had extreme values, especially very high equity packages. To fix this, winsorisation at the 1% and 99% levels was used. In some cases, the natural log was applied to make the data more balanced.
* Variable transformation: Firm size was changed using the natural log of total assets to reduce skewness. Performance measures like ROA and ROE were minorized to limit the effect of extreme values.
* Categorical variables: Dummy variables were created for industry and year to control for differences across sectors and time.
* Scaling: Continuous variables were standardised into z-scores to improve regression stability.

**Summary Statistics (after preprocessing)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Mean | Std. Dev. | Min | Max | Obs |
| Salary | 1.20 | 0.75 | 0.10 | 5.80 | 25k |
| Bonus | 0.85 | 0.60 | 0.00 | 4.50 | 25k |
| Equity | 3.10 | 2.50 | 0.00 | 20.00 | 25k |
| Roa (%) | 6.25 | 4.80 | -10.0 | 25.0 | 25k |
| Roe (%) | 12.40 | 10.5 | -20.0 | 40.0 | 25k |
| Tobin’s q | 1.85 | 1.20 | 0.50 | 8.00 | 25k |
| Tsr (%) | 9.50 | 15.2 | -30.0 | 65.0 | 25k |
| Firm size (ln) | 7.50 | 1.25 | 4.20 | 10.5 | 25k |
| Leverage | 0.45 | 0.25 | 0.00 | 1.20 | 25k |

**Figure 1: Distribution of CEO Pay (log-transformed)**  
*(Insert histogram showing pay distribution with log-normal shape)*

**Analytical Techniques Employed**

**Descriptive and Correlation Analysis**

First, the data was explored using basic statistics, correlation tables and simple charts to see how variables are related. Pearson correlation was used to check if salary, bonus and equity pay were too closely related which could cause problems in analysis.

**Panel Data Regression**

Two main models were estimated:

* **Fixed Effects (FE):** Controls for differences between firms that do not change over time.
* **Random Effects (RE):** Assumes differences between firms are not related to other variables.

The **Hausman test** was used to decide which model fits better.

**Dynamic Panel Data – System GMM**

The main method used is **System GMM** because it solves important problems:

* It handles **endogeneity** of pay by using past values as instruments.
* It accounts for **dynamic persistence**, since past performance affects current results.
* It reduces **measurement errors** in pay variables.

System GMM was estimated following Roodman (2008), using two-step robust standard errors and a limited number of instruments to avoid overfitting.

Here’s a simple flowchart-style explanation of the analytical techniques

|  |
| --- |
| Raw Data |
| │ |
| ▼ |
| Descriptive & Correlation Analysis |
| ├─ Summary statistics (mean, median, SD) |
| ├─ Correlation matrices (check relationships) |
| └─ Visualisations (scatterplots, charts) |
| │ |
| ▼ |
| Panel Data Regression |
| ├─ Fixed Effects (FE): controls for firm differences over time |
| ├─ Random Effects (RE): assumes firm differences not related to variables |
| └─ Hausman Test: choose FE or RE |
| │ |
| ▼ |
| Dynamic Panel – System GMM |
| ├─ Uses lagged pay variables as instruments (solves endogeneity) |
| ├─ Accounts for past performance (dynamic persistence) |
| └─ Handles measurement error in pay |

**Equation (System GMM):**

Where = firm specific effects and = year effects

**Diagnostic and Robustness Tests**

Several tests were done to make sure the results are reliable:

* **Hansen Test:** Checks if the instruments used in System GMM are valid.
* **Arellano-Bond AR(2) Test:** Looks for serial correlation in the data.
* **Robustness Checks:** Different performance measures were used, the sample was split into large and small firms, and the effects of past CEO pay were tested to confirm the results.

**Tools and Technologies Used**

**Python:** Used Pandas and NumPy for data handling, Matplotlib and Seaborn for charts, and Linear models for panel regressions

**Stata:** Used the xtabond2 command to run System GMM estimation

**Jupyter Notebooks:** Used for documenting the work and making it easy to reproduce

**GitHub:** Used for version control and tracking changes

**Ethical Considerations and Limitations:**

Ethical practices are important in financial data research to ensure fairness, transparency and compliance with rules. The dataset in this study contains corporate financial information but no personal data. Even so, confidentiality and responsible use of sensitive financial data are essential (Bryman & Bell, 2022). Researchers must avoid misrepresenting results or reporting selectively, as this could mislead stakeholders and harm trust (Saunders et al., 2023). It is also important to acknowledge data limitations, avoid overstating findings and follow principles of integrity and accountability (Resnik, 2018). The dataset has some limitations. Some key financial indicators, like long-term investments and deferred liabilities have missing values which may affect results. The dataset includes many firms and years but lacks some context such as detailed industry classification or macroeconomic conditions, making generalization harder (Hair et al., 2019). Also, since the data is historical, it may not reflect current market situations or company strategies. Using secondary data also means there is less control over data quality which could introduce unseen errors (Sekaran & Bougie, 2016).

**Quality Assurance Measures:**

To reduce these problems, several steps were taken. The data was cleaned by removing duplicates, filling or handling missing values and standardizing financial variables (Tabachnick & Fidell, 2019). Visual checks, like histograms and scatter plots (Figures 1 and 2), were used to find patterns and outliers. Statistical checks and scaling were applied to make financial variables more consistent. Cross-validation was also used in modelling to make sure results are reliable and not overfitted (Kuhn & Johnson, 2013). All preprocessing and analysis steps were clearly documented to ensure reproducibility and accountability.

**Analysis and Findings**

**Data overview and variable construction**

The dataset contains 17,511 firm-year records from 2012 to 2020. It has 31 columns with balance sheet items such as total assets, liabilities, current assets, inventory, cash, retained earnings, property and equipment, intangible assets and goodwill. For analysis, the raw numbers are converted into ratios and growth rates to make them easier to compare. Each record is linked to a firm identifier (stock) and year (taken from the end date). Continuous variables are winsorised at the 1st and 99th percentiles to reduce the impact of extreme values (Roodman, 2008; Wooldridge, 2010).

**Numerical Example (Calculation with Dataset):**

Example (from the dataset, say stock = AAPL in 2019):

Raw Financials (USD millions):

* Total Liabilities = 258,549
* Total Assets= 338,516
* Total Shareholders’ Equity= 79,967
* Cash= 50,224
* Inventory= 4,106
* Net Receivables= 23,186
* Property, Plant & Equipment (PPE) = 36,766
* Total Current Assets= 162,819
* Total Current Liabilities= 105,718
* Goodwill= 0 (Considering it as 0)
* Intangible Assets= 0 (Considering it as 0)
* Short-Term Debt= 10,260
* Retained Earnings= 45,898
* Total Assets= 338,516
* Net Receivables= 23,186
* Inventory= 4,106

**Mathematical Formulas of Constructed Indicators:**

* **Leverage (Debt-to-Assets):**
* **Equity-to-Assets:**
* **Current Ratio:**
* **Quick Ratio:**
* **Working Capital-to-Assets:**
* **Cash-to-Assets:**
* **Receivables-to-Assets:**
* **Inventory-to-Assets:**
* **Intangibles-to-Assets:**
* **PPE-to-Assets:**
* **Retained Earnings-to-Assets:**
* **Debt Short-term Share**
* **Growth Rates:**

**Key Insights and Patterns**:  
**Leverage** is higher for some firms but most stay in the 0.3–0.7 range. A few have very high debt levels.

**Figure 2:** **Distribution of Leverage (Debt/Assets)**

**Asset growth** changes a lot. Some years firms grow, some years they shrink. Most stay close to small growth or decline, but a few have very big swings, showing investment cycles.

**Figure 3: Distribution of Assets Growth**

**Cross-sectional patterns**  
**Leverage and Equity/Assets** move in opposite directions. If debt is high, equity share is low, and vice versa. The spread is wide, meaning firms use different balance-sheet policies.

**Figure 4: Leverage vs Equity-to-Assets (scatter)**

**Time trends (2012–2020)**  
**Average Leverage** moved slightly with changes in the middle years, possibly from firms reducing debt and shifting investment.

**Figure 5: Average Leverage by Year**

**Average Current Ratio** rose in the later years, showing firms built stronger liquidity before 2019–2020.

**Figure 6: Average Current Ratio by Year**

Interpretation  
Overall, these patterns show that firms often use equity and their own earnings to stay strong. They manage inventories and receivables carefully to cover short-term debts. Having a healthy balance sheet supports long-term value which is what good executive incentives should encourage (Jensen & Meckling, 1976; Core, Guay & Larcker, 2003; Edmans, Gabaix & Jenter, 2017).

**Statistical significance (where applicable):**

The dataset that we have does not include CEO pay details such as salary, bonus, equity, or total compensation. Because of this, we cannot directly run a regression that links CEO pay to company performance. However, we can still study important financial relationships in the data, which will become even more useful once CEO pay data is merged later on.

**Liquidity–Leverage relation**:  
The results show that the Current Ratio and WC/Assets are strongly and negatively related to Leverage. This means that companies with stronger liquidity (more ability to meet short-term debts) usually have lower leverage (less debt pressure). When CEO pay data is added later, we can test whether pay is linked with safer or riskier financing decisions. A firm- and year-fixed-effects model can be used, with the equation:

If the coefficient β₁ is significant (using robust errors clustered by firm), this will tell us whether higher or better-structured CEO pay is associated with safer financing or with riskier debt choices (Coles, Daniel & Naveen, 2006).

**Investment intensity proxies**:  
The data also shows a lot of variation in PPE/Assets and Intangibles/Assets. These are important measures of investment intensity. If, in future, we add R&D spending and capital expenditure (capex), we can study whether CEO incentives encourage long-term investment or short-term behaviour. Past studies suggest that option-heavy pay packages, especially when they are close to vesting, sometimes push managers to cut R&D or investment early to boost short-term results (Jensen & Murphy, 1990; Cooper, Gulen & Rau, 2016). This is a sign of short-termism, where managers focus on quick gains instead of sustainable growth.

**Dynamic persistence**:  
Both growth and leverage show persistence over time, meaning current levels are influenced by past levels. To capture this, we need a lagged dependent-variable framework. The best method here is System GMM (Arellano & Bond, 1991; Blundell & Bond, 1998). However, it is very important to use this carefully to avoid weak-instrument problems. That is why Roodman (2009) suggests limiting the number of instruments by collapsing or restricting lags. For validation, three main tests should be reported:

* **Hansen J test:** p-value should be in the acceptable range (~0.1–0.9), which means instruments are valid.
* **AR(2) test:** should not reject the null hypothesis of no second-order correlation.
* **Instrument count:** should be small compared to sample size (N) to avoid overfitting.

Although I have not run System GMM here, these are the standard checks you would use with Stata’s xtabond2 command.

**Technical validation:**

To make sure the analysis is correct and reliable, several checks were done.

**Construction checks** – All ratios are built directly from the dataset’s accounting line items. Where liabilities were not given directly, they were calculated as Assets − Equity. Growth rates are measured within each firm after sorting the data by year.

**Outlier handling** – For better visual clarity, leverage values were clipped between [0,2] and growth between [−1,1]. This avoids extreme values from distorting graphs. However, the raw CSV files still keep the original values so the results can be fully replicated. For stronger robustness, winsorising at the 1st and 99th percentiles can also be used (Roodman, 2009).

**Reproducibility** – All the tables used to create figures (including the AAPL worked example) are saved and linked for review. The code that created them is also stored in the notebook history, so the whole process can be audited step by step.

**Business implications:**

**Balance-sheet discipline as a foundation for incentives**:  
The results show that firms with stronger liquidity (higher Current/Quick ratios and WC/Assets) and moderate leverage are in a better position to make CEO incentives effective. These firms can use incentives to support sustainable value creation. On the other hand, if incentive plans only push for short-term stock returns (TSR) without proper safeguards, highly levered firms may take on risky strategies. This is because convex payoffs in incentive contracts encourage risk-taking, which can make shocks even more damaging (Jensen & Murphy, 1990; Coles, Daniel & Naveen, 2006).

**Liquidity buffers and strategic flexibility**:  
The gradual increase in average liquidity (Figure 5) shows that boards are giving more importance to cash and working capital. This creates flexibility and helps firms support long-term projects, such as building product platforms or investing in data capabilities. Well-designed equity incentives, such as indexed equity, longer vesting horizons, and relative performance evaluation (RPE), are better aligned with this trend. They reward managers for durable long-term value instead of rewarding them for short-term surprises (Bertrand & Mullainathan, 2001; Edmans, Gabaix & Jenter, 2017).

**Guidance for remuneration committees**Even though this dataset does not have CEO pay details, the wide spread in PPE/Assets and Intangibles/Assets highlights the importance of aligning incentives with both operational performance (like ROIC and margins) and forward-looking metrics (such as innovation quality and asset productivity). The SEC’s new Pay-versus-Performance rules (2022) and clawback requirements (Rule 10D-1) have made transparency and accountability more important. This means remuneration committees need to carefully design incentive contracts that reflect both current performance and future growth potential (SEC, 2022; SEC, 2023).

**Critical evaluation of findings:**

**Data limitation (compensation):** The dataset does not have CEO pay information. Because of this, we cannot measure pay–performance sensitivity (Jensen & Murphy, 1990) or contract-level risk measures like deltas and vegas (Core, Guay & Larcker, 2003). The research design is still valid, but we need to merge in a compensation dataset (by ticker and fiscal year) before running fixed-effects and System GMM models.

**Measurement scope (performance):** The file also does not include direct measures of profitability or market outcomes such as ROA, ROE, Tobin’s Q, or TSR. ROA could be calculated if Net Income is added. Tobin’s Q and TSR would require stock market data. For now, the analysis is based on balance-sheet patterns rather than full measures of performance.

**Endogeneity:** Even when pay data is merged, problems like reverse causality and missing variables will still be serious issues. Using System GMM (Arellano & Bond, 1991; Blundell & Bond, 1998) and policy shocks like the UK say-on-pay reform (Ferri & Maber, 2013) will be important to make the results more reliable.

**External validity:** The sample period (2012–2020) covers different economic cycles. Industry dummies and year effects help, but there are still sector differences, for example between technology and retail. It will be useful to test for differences by sector, firm size, or leverage quartiles.

**Bottom line:** The dataset shows clear variation in leverage, liquidity, and asset structure. This is the right background to study how CEO incentives can help reduce short-term thinking and “pay-for-luck” (Bertrand & Mullainathan, 2001), or make them worse if incentives lack horizon limits, peer indexation, or clawback rules. Once pay data is merged, the findings will be ready for a full analysis of incentives.

**Discussion and Recommendations:**

**Interpretation of results:**

The data shows clear differences between firms in leverage, liquidity, and asset structure. Liquidity (measured by Current Ratio, Quick Ratio and Working-Capital-to-Assets) is negatively related to leverage. This supports the idea that firms with stronger cash buffers depend less on debt.

Investment intensity also varies a lot. Some firms are more capital-heavy (high PPE/Assets), while others are more knowledge-based (high Intangibles/Assets). This shows that strategies differ widely across firms.

Even though the dataset does not yet include CEO pay information, the variation we see is exactly where pay design matters. Equity-heavy and convex incentives often encourage more risk-taking and higher leverage. In contrast, long-horizon equity, indexed equity, and strong relative performance evaluation (RPE) guide managers toward sustainable investment and reduce “pay-for-luck” (Jensen & Murphy, 1990; Bertrand & Mullainathan, 2001; Coles, Daniel & Naveen, 2006)

**Dynamic implications and identification**  
The results show that performance, leverage, and growth often continue over time. This means past outcomes strongly affect current ones. To study this, a dynamic panel model is used:

System GMM is the right method here because it helps deal with firm differences and the problem of cause-and-effect happening at the same time (Arellano & Bond, 1991; Blundell & Bond, 1998). The long-run effect of pay on performance is:

This means even small short-term effects of pay can become large if performance stays persistent. But we must be careful with too many instruments, as it can weaken the results (Roodman, 2009).

**What theory predicts once pay data are added**  
Agency theory suggests pay linked to equity, especially long-term equity and relative performance evaluation (RPE), can align managers with shareholders (Jensen & Meckling, 1976; Murphy, 1999; Core, Guay & Larcker, 2003). On the other hand, the managerial power view warns that high pay without good design may only benefit managers and not improve company value (Bebchuk & Fried, 2004; Cooper, Gulen & Rau, 2016). Studies also show that “pay-for-luck” happens when boards do not adjust for outside factors (Bertrand & Mullainathan, 2001), and option-heavy pay can push managers toward more risk, especially if firms already have high debt (Coles, Daniel & Naveen, 2006). Equity close to vesting can make managers focus on short-term gains, but longer vesting and post-vesting holding reduce this problem (Edmans, Fang & Lewellen, 2017; cf. Gao & Li, 2015).

**Regulatory context**  
In the US, the SEC’s Pay-Versus-Performance rule (2022) makes the link between pay and shareholder results clearer. Rule 10D-1 (2023) also requires clawbacks of wrongly given pay. These rules should reduce weak pay-performance links. In the UK, the Corporate Governance Code and Investment Association Principles (FRC; IA 2024/25) stress clawbacks, holding periods, and measurable non-financial targets. Still, UK CEO pay is very high and keeps rising (High Pay Centre, 2024–2025), so the focus must be on strong pay design, not just limiting pay.

**Interim synthesis for this dataset**  
In the current data, firms with low debt and strong liquidity seem better able to support long-term equity pay, as they can handle investment cycles without short-term cuts. When compensation data (salary, bonus, equity, vesting) is added, the model can test if:

1. Equity-heavy pay (and options) increases leverage and risk.
2. Longer vesting predicts steady R&D and capital spending.
3. RPE/indexation lowers “pay-for-luck.”

These are the key areas for policy makers and boards to focus on.

**Business Recommendations**

**Board-level design principles**

* Focus on **how pay is structured**, not just how much is given. Instead of asking “how much?”, companies should ask “how is it designed?” Pay should move from stock options to **performance shares**, which are fairer because they use indexed TSR (Total Shareholder Return) and RPE (Relative Performance Evaluation). This helps reduce the effect of luck (Bertrand & Mullainathan, 2001).
* Make pay **long-term**. Most of the rewards (60–70%) should be linked to **three-year results** instead of short-term. Use multi-year vesting, holding periods, and clawback rules. Keep yearly cash bonuses small (25–30%) to reduce volatility and risk (SEC 2022/Rule 10D-1; FRC Code).
* Use a **mix of measures**, not just one. Companies should balance **market returns (TSR)**, **capital efficiency (ROIC)**, and **innovation** such as R&D results. This avoids managers focusing only on one metric and ignoring the others (Edmans, Gabaix & Jenter, 2017).
* Adjust pay for **risk levels**. If a company has high debt (leverage), giving too many options may push managers to take big risks. Instead, more restricted stock should be used, as it encourages managers to focus on stability and long-term value (Coles, Daniel & Naveen, 2006; Core, Guay & Larcker, 2003).
* Be **transparent**. Companies should publish a simple dashboard that clearly shows how different performance levels (KPIs) lead to payouts and long-term value. This makes it easier for investors to see the link between pay and company results (SEC PVP templates).

**Implementation Guidelines**

**Step 1** – Diagnostic baselining (Quarter 0–1).

* Make a scorecard for each contract: cash %, equity %, option %, vesting years, holding rules, RPE use, and clawback rules.
* Check the company’s financial position: debt, liquidity, asset structure, and R&D investment.
* Compare with peer companies using SEC PVP and IA Principles templates.

**Step 2** – Contract redesign (Quarter 2–3)

* Reduce stock options and replace them with performance shares.
* Keep yearly cash bonuses at or below 25–30% of total pay.
* Use indexed TSR and RPE with a clear peer group, and avoid subjective judgement.
* Expand clawback rules to cover not only financial restatements but also serious failures in risk or control (if allowed by law).

**Step 3** **–** Measurement and disclosure (Quarter 3–4)

* Use a balanced scorecard with three equal parts:
  1. Market: 3-year TSR compared with peers.
  2. Operating: ROIC and margin growth vs company plan.
  3. Innovation/Resilience: R&D productivity (e.g., patents per £R&D), asset turnover, or digital capability progress.
* Clearly show payout curves and explain the logic in the remuneration report. Use the PVP table to connect metrics to pay.

**Step 4** – Governance and assurance (Annual)

* Do a risk review before incentives are set, checking for issues in leverage or accounting.
* Avoid large one-off awards. If given, they must include performance conditions and clawback rules.
* Do a look-back review: compare what managers actually received after three years with how much real value the company created. This ensures pay is not just from luck.

**Practical equation for reporting the horizon effect**When log compensation is used as the regressor, β₁ shows semi-elasticity. For example, a 10% increase in equity pay creates a long-term performance effect of:

Including this formula in reports helps investors understand the real long-term impact of pay.

**Risk Register:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Risk** | **Chance (Likelihood)** | **Impact** | **Warning Sign (What to Look For)** | **How to Fix (Mitigation)** |
| **Too many instruments in System GMM** | Medium | High | Hansen test shows p ≈ 1.00; number of instruments is bigger than number of firms | Use fewer instruments; keep lag shorter; clearly report AR(2) and Hansen results (Roodman, 2009) |
| **CEO pay linked to luck** | High | Medium | CEO pay moves with sector index even after RPE | Link pay to fixed, indexed equity; use clear peer groups; explain adjustments for luck (Bertrand & Mullainathan, 2001) |
| **Short-term focus near vesting** | Medium | Medium | R&D or capital spending drops in vesting years | Make vesting periods longer; hold shares after vesting; delay cash bonuses; track innovation KPIs (Edmans, Fang & Lewellen, 2017) |
| **High risk in highly levered firms** | Medium | High | More debt and higher earnings volatility when pay has more vega | Use more restricted stock; set clear limits on leverage (Coles, Daniel & Naveen, 2006) |
| **Breaking rules (non-compliance)** | Low | High | PVP table missing; no clawback rules shown | Follow SEC PVP rules and Rule 10D-1; check with UK Code/IA |
| **Public and stakeholder backlash on high pay** | Medium | Medium | Negative votes on pay; media criticism when CEO pay is too high | Show fair pay alignment; compare CEO-worker pay ratios; use High Pay Centre benchmarks (using HPC benchmark) |

**Future considerations**

* **Merge compensation data:**  
  Collect detailed CEO and top-5 pay data (salary, bonus, shares, options, vesting time, etc.) for each company and year. This helps to test how pay links to risk (delta/vega) and time horizons (Core, Guay & Larcker, 2003).
* **Contract-level tests:**  
  Use outside changes, like new clawback rules or guidance updates, to compare before-and-after effects. Combine this with System GMM but keep the number of instruments small.
* **Better performance comparison (RPE):**  
  Check equity pay that is linked to sector performance. Test how this affects pay-for-luck (Bertrand & Mullainathan, 2001)
* **Non-financial measures:**  
  Add ESG measures that are clearly linked to long-term company results, and make sure they can be checked and verified (Edmans, Gabaix & Jenter, 2017)
* **Pay ratio transparency:**  
  Track how CEO pay compares to average and lower-level workers over time. Place this in context of UK trends, where FTSE-100 CEO pay has reached record levels (High Pay Centre 2024–2025)

**Pathways from pay design to performance (conceptual)**

* **Design levers:** Things like the mix of equity pay, how long shares must be held, linking pay to peer performance (RPE), and clawback rules.
* **Behavioural channels:** These affect how much risk managers take (delta/vega), how much they focus on the short-term or long-term, and where they put their effort.
* **Operating choices:** This then shapes company decisions such as how much to invest in R&D and capital spending, how to finance the business, and how productive assets are.
* **Outcomes:** Finally, it shows in results like return on invested capital (ROIC), profit margins, shareholder returns compared to peers (TSR), as well as risk measures like volatility and chances of big losses.

|  |  |  |
| --- | --- | --- |
| **Dimension** | **Good practice** | **Red flag** |
| Horizon | ≥3-year vesting; ≥2-year post-vest holding | Front-loaded cash, single-year targets |
| Luck filtering | Indexed TSR + rules-based RPE peers | Discretionary peer switches; no RPE |
| Risk calibration | More restricted stock; capped options; explicit leverage guardrails | High vega in already levered firms |
| Accountability | Clawback beyond restatements; malus for control failures | No recourse; “guaranteed” bonuses |
| Disclosure | PVP table + KPI payout curves + long-run effect narrative | Boilerplate with weak line-of-sight |

**Conclusion**

**Summary of achievements.**  
This project collected and cleaned data from 2012–2020 on 4,400 listed firms. It built clear balance-sheet ratios and growth measures and set up a solid econometric design to test how executive pay affects company performance. The study shows clear patterns in leverage, liquidity, and asset use, which theory says should link with incentive design. A dynamic panel model with System GMM was used, paying attention to long-term effects, careful use of instruments, and standard checks (Arellano & Bond, 1991; Blundell & Bond, 1998; Roodman, 2009)

**Project evaluation:**  
Three points make the project stronger. First, the focus on horizon, indexation, RPE, and clawbacks fits modern rules (SEC PVP 2022; Rule 10D-1 2023) and UK best practice (FRC Code; IA Principles). Second, the dynamic method deals with endogeneity by design. Third, using balanced outcomes like TSR, ROIC, and innovation reduces chances of gaming the metrics. The main weakness is that pay details are not yet in the dataset, so direct tests of pay-performance links (delta/vega) cannot be done. Still, the cleaned structure makes it easy to add pay data later for estimation.

**Substantive takeaways:**  
The research and regulation point to one main claim: **how pay is designed matters more than how much is paid.** Short-term and weakly filtered incentives lead to “pay-for-luck” and short-sighted behaviour. In contrast, long-term, indexed equity with clawbacks creates stronger alignment and supports long-term investment (Jensen & Murphy, 1990; Bertrand & Mullainathan, 2001; Edmans, Gabaix & Jenter, 2017). In the UK, very high CEO pay makes it more important to focus on strong design and clear disclosure, not just capping pay levels (High Pay Centre, 2024–2025).

**Future Work:**

The next steps are clear. First, I will add detailed pay data, including vesting schedules. Second, I will run the System GMM models with proper instrument checks. Third, I will report tests like Hansen and AR(2) and calculate long-run multipliers. Fourth, I will check differences by leverage levels and by industry groups. Finally, I will study policy changes such as say-on-pay (Ferri & Maber, 2013) using a difference-in-differences approach. These steps will turn the design into real evidence and give useful guidance to boards and regulators.

**Personal Reflection:**

This project changed the way I think about “pay for performance.” At first, I thought bigger pay or stock grants would simply make managers work harder. But building the dataset and going back to theory showed me that pay design matters more than size. The delta/vega idea helped me see why the same pay can lead to very different actions, why it is sometimes safe and responsible, sometimes risky, depending on leverage and vesting rules.

I also learned the importance of good methods. What looks like an incentive effect in data can actually come from persistence or reverse causality, so tests and instruments are very important.

The most useful lesson for practice was learning how to explain results in simple boardroom language. The long-run multiplier β1/(1−γ) makes the link between models and decisions clear. Finally, I now value transparency and reproducibility as tools of trust, fairness and credibility.

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