

CSE 544 Project Milestone

Analyzing Executive Compensation, Financial Performance and Market Trends for S&P 500 Companies from 1992-2023

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1 Project Description

This project is to analyze financial performance of the top 500 publicly-traded in Northern America. It will compare the financial performance of companies across different industries using core financial metrics such as return on assets (ROA), return on equity (ROE), gross profit margin. It will also report the trends in revenue and net income throughout the years to see if there is any correlation between financial performance of firms and economic cycle such as during and after the Covid-19 pandemic or 2008 financial crisis. Additionally, this project is also aimed at exploring the relationship between stock price and the financial performance of firms. We are also interested in the relationship between executive compensation and firm's financial performance. To be more specific, this project can help us answer many questions including but not limited to:

- How has the revenue of companies in different industries changed over the past five years?
- What is the average ROE for companies in the technology sector compared to the healthcare sector?
- What is the correlation between the ROA and stock prices of companies in the dataset?
- How has the stock price volatility of technology companies changed over the last decade?
- Are there any patterns in the total returns of companies after significant events, such as mergers or acquisitions? Alternatively, one can ask: What impact did mergers have on the financial performance (e.g., ROE) of the involved companies?
- Compare the average ROA of companies within the same sector. Are there significant variations?
- How do macroeconomic factors, such as interest rates, impact the financial performance of different sectors?
- Identify outliers in sector performance and investigate the factors contributing to their performance.
- What is the relationship between CEO/CFO compensation and the company's stock volatility? This can help us explore questions that have been of interest to researchers such as whether bank's executive compensation is related to risk-taking behaviors of firms.[3]

2 Approach

This project makes use of data from the Wharton Research Data Services[4] including Compustat, Execucomp, CRSP (Center for Research in Security Prices) and possibly, FRED Economic Data by Federal Reserve Bank of St. Louis. We are thankful to the UW Library for granting us access to the WRDS. This project will make use Snowflake for importing the data, data analysis as well as Python and Tableau (sponsored through UW) for data visualization and additional financial or economic regression analysis.

Our approach is first, to create a schema for the three datasets 1 that allows us to access the data. The primary key is TICKER/tic for all datasets. Then, we will do some descriptive statistic analyses with each dataset before merging them and answering more in-depth questions. We want to focus on producing a business-like report that is interactive and comprehensive.

Table 1: Table Description

Table	Variable Description
Annual Financial Data	Includes important annual financial metrics of firms
Financial Ratios	Includes important financial ratios of firms
Executive Compensation	Includes components of firms’ executives’ compensation

Source: FIFA

3 Related Works

Chief executive officer (CEO) compensation packages are typically composed of salaries, performance-based bonuses, as well as stock and option awards. These packages have grown tremendously for executives at top firms in the United States, surpassing wage earners in the income distribution’s 0.1% and S&P stock market growth itself¹. Strikingly, the ratio of CEO to worker compensation was 399 to 1 when utilizing a realized measure for stock awards and options.

Increased regulation and declines in CEO compensation align with key financial events and subsequent policy responses. The most prominent shock, the 2008 financial crisis, brought about two consequential pieces of legislation that declined compensation growth. Specifically, the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 requires a triennial voting of shareholder opinions on executives’ compensation packages, though the vote itself is not legally binding[1]. Under the 2009 Troubled Asset Relief Program (TARP), the Special Master for TARP Executive Compensation, colloquially known as the “pay czar”, was tasked with evaluating the compensation structure of executives in firms who received TARP assistance². Both of these reforms restricted CEO’s compensation packages in an effort to mitigate excessive risk-taking. The relationship between executive compensation and risk-taking behaviors is premised on notions of risk-attitudes in the presence of incentives. Empirically, risk-taking incentives in compensation packages influence CEO risk-taking behavior: risk-taking is preferred as a means of maximizing shareholder value[2]. Nevertheless, the ramifications of excessive risk-taking prevail as observed in recent events in the banking sector, namely the collapse of Silicon Valley Bank, Signature Bank, and First Republic Bank. Hence, as a means of addressing concerns over financial stability, the primary research question, to what extent do CEO compensation packages induce risk-taking behavior, is observed under the dwindling of policy responses from the 2007 financial crisis.

The literature on top executive compensation and risk-taking in the banking industry is dense. A key inspiration for this research is by Guo et al. (2015) [3] in which they explore compensation structure itself as well as its effects on excessive risk-taking during the 2007-2008 financial crisis. Here, the authors introduce Altman’s Z-score and stock volatility as measures of risk-taking behavior and find a positive relationship between these risk proxies and incentive compensation.

For this project, given short time frame, we only explored different relationships amongst variables such as the relationship of executive compensation and firm’s risk-taking behaviors (measured by stock volatility) via data visualization which shows us visually whether executive total compensation or stock award packages move in line with firm’s stock price. The topic we chose has been extensively investigated in the scholarly community, mostly through econometric modelling. However, this project focuses on presenting an interactive model on the movements of interested variables, instead of looking into the econometric details of them.

¹Ibid

²Feinberg, “Office of the Special Master for TARP Executive Compensation.”

3.1

4 Recent Experiments

We have done some descriptive statistics analyses of each dataset.

4.1 Executive Compensation

Our analysis agrees with the literature that stock awards account for nearly half of executive compensation package, followed by base salary and non-equity incentives at approximately 16% and 15% each, as reported to the Security and Exchange Commission. For the analysis, we have adjusted all compensation data using CPI with 2023 as the base year.

```
01 | # Count number of CEOs and CFOs
02 | SELECT
03 |     COUNT(DISTINCT CASE WHEN CEOANN = 'CEO' THEN EXEC_FULLNAME END) AS CEO_Count,
04 |     COUNT(DISTINCT CASE WHEN CFOANN = 'CFO' THEN EXEC_FULLNAME END) AS CFO_Count
05 | FROM sp500execucompdpi;
06 |
07 | +-----+-----+
08 | | CEO_COUNT | CFO_COUNT |
09 | |-----+-----|
10 | |      1686 |      1519 |
11 | +-----+-----+
12 |
13 | # Count number of firms - missing values for 2 companies
14 | SELECT COUNT(DISTINCT TICKER) AS company_count
15 | FROM sp500execucompdpi;
16 | +-----+
17 | | COMPANY_COUNT |
18 | |-----+
19 | |           498 |
20 | +-----+
21 |
22 | # Report the CEO/CFO compensation package
23 | SELECT
24 |     SUM(aSALARY) AS total_salary,
25 |     SUM(aBONUS) AS total_bonus,
26 |     SUM(aSTOCK_AWARDS) AS total_stock_awards,
27 |     SUM(aOPTION_AWARDS) AS total_option_awards,
28 |     SUM(aNONEQ_INCENT) AS total_noneq_incent,
29 |     SUM(aPENSION_CHG) AS total_pension_chg,
30 |     SUM(aOTHCOMP) AS total_othcomp,
31 |     SUM(aTOTAL_SEC) AS total_total_sec,
32 |     SUM(aSALARY) / SUM(aTOTAL_SEC) * 100 AS salary_percentage,
33 |     SUM(aBONUS) / SUM(aTOTAL_SEC) * 100 AS bonus_percentage,
34 |     SUM(aSTOCK_AWARDS) / SUM(aTOTAL_SEC) * 100 AS stock_awards_percentage,
35 |     SUM(aOPTION_AWARDS) / SUM(aTOTAL_SEC) * 100 AS option_awards_percentage,
36 |     SUM(aNONEQ_INCENT) / SUM(aTOTAL_SEC) * 100 AS noneq_incent_percentage,
37 |     SUM(aPENSION_CHG) / SUM(aTOTAL_SEC) * 100 AS pension_chg_percentage,
38 |     SUM(aOTHCOMP) / SUM(aTOTAL_SEC) * 100 AS othcomp_percentage
39 | FROM
40 |     sp500execucompdpi;
41 |
42 | +---+
43 | | TOTAL_SALARY | TOTAL_BONUS | TOTAL_STOCK_AWARDS | TOTAL_OPTION_AWARDS |
44 | | TOTAL_NONEQ_INCENT | TOTAL_PENSION_CHG | TOTAL_OTHCOMP | TOTAL_TOTAL_SEC |
45 | | SALARY_PERCENTAGE | BONUS_PERCENTAGE | STOCK_AWARDS_PERCENTAGE |
46 | | OPTION_AWARDS_PERCENTAGE | NONEQ_INCENT_PERCENTAGE | PENSION_CHG_PERCENTAGE |
47 | | OTHCOMP_PERCENTAGE |
```

```

44 | | --
45 | | 62573825.9412638 | 42904158.1352653 | 163549044.382283 | 55940885.8051555 |
    | | 58070114.0679533 | 19070374.5183696 | 27225908.6952355 | 368608311.962687 |
    | | 16.975695857 | 11.639498281 | 44.369331639 | 15.17624101 |
    | | 15.753880795 | 5.173614891 | 7.386135313 |
46 | +--
47 |
48 | # Top 5 highest paid CEO/CFO
49 | SELECT
50 |     EXEC_FULLNAME,
51 |     CEOANN,
52 |     CFOANN,
53 |     aTOTAL_SEC
54 | FROM sp500execucompapi
55 | WHERE (CEOANN = 'CEO' OR CFOANN = 'CFO') AND aTOTAL_SEC IS NOT NULL
56 | ORDER BY aTOTAL_SEC DESC
57 | LIMIT 5;
58 |
59 | +-----+-----+-----+-----+
60 | | EXEC_FULLNAME | CEOANN | CFOANN | aTOTAL_SEC |
61 | |-----+-----+-----+-----|
62 | | Stephen Allen Schwarzman, B.A., M.B.A. | CEO | NULL | 11482348.270777 |
63 | | Elon R. Musk | CEO | NULL | 2771539.79874941 |
64 | | Sundar Pichai | CEO | NULL | 334455.728329379 |
65 | | Peter Maxwell Kern | CEO | NULL | 333126.477528132 |
66 | | Patrick W. Smith | CEO | NULL | 298537.398759971 |
67 | +-----+-----+-----+-----+
68 |
69 | # Gender Pay Gap - Male dominates!
70 | SELECT GENDER, AVG(aTOTAL_SEC) AS AVG_TOTAL_SEC
71 | FROM sp500execucompapi
72 | GROUP BY GENDER;
73 |
74 | +-----+-----+
75 | | GENDER | AVG_TOTAL_SEC |
76 | |-----+-----|
77 | | MALE | 8464.346451396 |
78 | | FEMALE | 6344.796941574 |
79 | +-----+-----+
80 |
81 | # Effect of Performance on Compensation
82 | SELECT TICKER, AVG(aTOTAL_SEC) AS AVG_TOTAL_SEC
83 | FROM sp500execucompapi
84 | WHERE aTOTAL_SEC IS NOT NULL
85 | GROUP BY TICKER
86 | ORDER BY AVG_TOTAL_SEC DESC LIMIT 10;
87 |
88 | +-----+-----+
89 | | TICKER | AVG_TOTAL_SEC |
90 | |-----+-----|
91 | | BX | 208366.286916298 |
92 | | META | 61291.497179888 |
93 | | TSLA | 47390.617014768 |
94 | | ORCL | 43466.584229347 |
95 | | AAPL | 34293.903126547 |
96 | | CMCSA | 29500.218467519 |
97 | | GOOGL | 27118.341923596 |
98 | | GS | 26984.560429475 |
99 | | JPM | 24088.985595424 |
100 | | FOXA | 24079.518063575 |
101 | +-----+-----+
102 |
103 | # Effect of Firm Size on Compensation
104 | SELECT TICKER, AVG(aTOTAL_SEC) AS AVG_TOTAL_SEC

```

```

105 | FROM sp500execucompapi
106 | WHERE aTOTAL_SEC IS NOT NULL
107 | GROUP BY TICKER
108 | ORDER BY AVG_TOTAL_SEC DESC LIMIT 10;
109 |
110 | +-----+-----+
111 | | TICKER |      AVG_TOTAL_SEC |
112 | |-----+-----|
113 | | BX      | 208366.286916298 |
114 | | META    | 61291.497179888 |
115 | | TSLA    | 47390.617014768 |
116 | | ORCL    | 43466.584229347 |
117 | | AAPL    | 34293.903126547 |
118 | | CMCSA   | 29500.218467519 |
119 | | GOOGL   | 27118.341923596 |
120 | | GS      | 26984.560429475 |
121 | | JPM     | 24088.985595424 |
122 | | FOXA    | 24079.518063575 |
123 | +-----+-----+
124 |
125 | # Effect of Tenure on Compensation
126 | WITH TenureCalculation AS (
127 |     SELECT EXEC_FULLNAME,
128 |           DATEDIFF(YEAR, JOINED_CO, CURRENT_DATE) AS TENURE,
129 |           MAX(aTOTAL_SEC) AS MAX_TOTAL_SEC
130 |     FROM sp500execucompapi
131 |     WHERE aTOTAL_SEC IS NOT NULL
132 |     GROUP BY EXEC_FULLNAME, TENURE
133 | )
134 | SELECT EXEC_FULLNAME,
135 |       TENURE,
136 |       MAX_TOTAL_SEC AS aTOTAL_SEC
137 | FROM TenureCalculation
138 | WHERE TENURE IS NOT NULL
139 | ORDER BY TENURE DESC
140 | LIMIT 10;
141 |
142 | +-----+-----+-----+
143 | | EXEC_FULLNAME | TENURE |      ATOTAL_SEC |
144 | |-----+-----+-----|
145 | | Earl E. Congdon |      75 | 8939.061916212 |
146 | | John R. Congdon, Sr. |      73 | 1348.789321671 |
147 | | David W. Grainger |      72 | 1344.958566158 |
148 | | Raymond B. Plank |      70 | 36655.9160498 |
149 | | Phupinder S. Gill |      69 | 10664.86834534 |
150 | | John Willard Marriott, Jr. |      68 | 19039.050551667 |
151 | | Richard A. Manoogian |      66 | 26137.106312946 |
152 | | Leland E. Tollett |      65 | 8290.891450526 |
153 | | Reuben Mark |      61 | 35160.66106994 |
154 | | Eugene R. McGrath |      61 | 19306.363077083 |
155 | +-----+-----+-----+
156 |
157 | # Effect of Company Headquarter on Compensation
158 | SELECT CITY, AVG(aTOTAL_SEC) AS AVG_TOTAL_COMPENSATION
159 | FROM sp500execucompapi
160 | WHERE aTOTAL_SEC IS NOT NULL
161 | GROUP BY CITY
162 | ORDER BY AVG_TOTAL_COMPENSATION DESC LIMIT 10;
163 |
164 | +-----+-----+
165 | | CITY |      AVG_TOTAL_COMPENSATION |
166 | |-----+-----|
167 | | Cupertino | 34293.903126547 |
168 | | Menlo Park | 29970.115165441 |
169 | | Austin | 23949.820900303 |
170 | | Bentonville | 20409.972554462 |
171 | | Mountain View | 19369.461387281 |
172 | | Tarrytown | 18421.226864601 |

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173 | | Burbank | 18063.803095246 |
174 | | New York | 17655.032480459 |
175 | | Philadelphia | 17267.460381994 |
176 | | Redmond | 16731.953767067 |
177 | +-----+

```

4.2 Annual Financial Performance

For the first task in the annual financial performance, we want to track down the top 15 companies with the most revenue growth over 10 years and their respective industries. By examining their financial records, we can identify the companies that have experienced significant increases in revenue over this period. This analysis will help us understand which companies have been successful in seizing opportunities and thriving in their respective industries.

```

01 | WITH PreviousRevenue AS (
02 |     SELECT
03 |         f1.TICKER,
04 |         f1.datadate AS Date,
05 |         MAX(f2.revt) AS PrevRevenue
06 |     FROM
07 |         sp500annualfinancial f1
08 |     JOIN
09 |         sp500annualfinancial f2 ON f1.TICKER = f2.TICKER
10 |                                AND f2.datadate < f1.datadate
11 |                                AND DATEDIFF(YEAR, f2.datadate, f1.datadate) <= 10
12 |     GROUP BY
13 |         f1.TICKER,
14 |         f1.datadate
15 | ),
16 | RevenueChanges AS (
17 |     SELECT
18 |         e.CONAME AS CompanyName,
19 |         f.TICKER AS Ticker,
20 |         f.datadate AS Date,
21 |         f.revt AS Revenue,
22 |         pr.PrevRevenue,
23 |         (f.revt - pr.PrevRevenue) AS RevenueChange,
24 |         e.INDDISC AS Industry,
25 |         RANK() OVER (ORDER BY ABS(f.revt - pr.PrevRevenue) DESC) AS Rank
26 |     FROM
27 |         sp500annualfinancial f
28 |     JOIN
29 |         sp500execucomp e ON f.TICKER = e.TICKER
30 |     JOIN
31 |         sp500stock s ON f.TICKER = s.TICKER
32 |     JOIN
33 |         PreviousRevenue pr ON f.TICKER = pr.TICKER AND f.datadate = pr.Date
34 | )
35 | SELECT
36 |     CompanyName,
37 |     Ticker,
38 |     Industry,
39 |     RevenueChange
40 | FROM
41 |     RevenueChanges
42 | WHERE
43 |     Rank <= 15
44 | ORDER BY
45 |     RevenueChange DESC;
46 |
47 | COMPANYNAME | TICKER | INDUSTRY | REVENUECHANGE |
48 | +-----+
49 | | AMAZON.COM INC | AMZN | Broadline Retail | 424995 |
50 | | EXXON MOBIL CORP | XOM | Integrated Oil & Gas | 220101 |
51 | | CVS HEALTH CORP | CVS | Health Care Services | 183100 |
52 | | BERKSHIRE HATHAWAY | BRK.B | Multi-Sector Holdings | 160958 |

```

53		CIGNA GROUP (THE)		CI		Health Care Services		145233	
54		CHEVRON CORP		CVX		Integrated Oil & Gas		141246	
55		MARATHON PETROLEUM CORP		MPC		Oil & Gas Refining & Marketing		121620	
56		COSTCO WHOLESALE CORP		COST		Consumer Staples Merchandise Retail		114314	
57		MICROSOFT CORP		MSFT		Systems Software		112950	
58		VALERO ENERGY CORP		VLO		Oil & Gas Refining & Marketing		111074	
59		PHILLIPS 66		PSX		Oil & Gas Refining & Marketing		105861	
60		WALMART INC		WMT		Consumer Staples Merchandise Retail		90000	
61		ELEVANCE HEALTH INC		ELV		Managed Health Care		82763.9	
62		TESLA INC		TSLA		Automobile Manufacturers		78263.644	
63		GENERAL ELECTRIC CO		GE		Industrial Conglomerates		71960	
64		+-----+-----+-----+-----+-----+							

For the second part, we will check the cash ratios of companies across different industries. Our goal is to find the top 15 industries with the highest cash ratios and rank them accordingly . This will help us understand how financially healthy and risky these industries are. By knowing this, investors can spot industries that are financially strong and may offer good investment opportunities.

```

01 | WITH IndustryMaxCashRatio AS (
02 |     SELECT
03 |         e.INDDDESC AS Industry,
04 |         MAX(fr.cash_ratio) AS CashRatio
05 |     FROM
06 |         sp500financialratios fr
07 |     JOIN
08 |         sp500execucomp e ON fr.TICKER = e.TICKER
09 |     WHERE
10 |         e.INDDDESC IS NOT NULL
11 |         AND fr.cash_ratio IS NOT NULL
12 |     GROUP BY
13 |         e.INDDDESC
14 | )
15 | SELECT
16 |     Industry,
17 |     CashRatio
18 | FROM
19 |     IndustryMaxCashRatio
20 | ORDER BY
21 |     CashRatio DESC
22 | LIMIT 15;
23 |
24 | +-----+-----+-----+-----+-----+
25 | | INDUSTRY                                     | CASHRATIO |
26 | |-----+-----+-----+-----+-----+
27 | | Life Sciences Tools & Services              | 42.309    |
28 | | Biotechnology                             | 36.884    |
29 | | Communications Equipment                  | 19.746    |
30 | | Health Care Equipment                     | 17.237    |
31 | | Broadline Retail                          | 8.981     |
32 | | Semiconductors                           | 8.93      |
33 | | Casinos & Gaming                          | 6.609     |
34 | | Soft Drinks & Non-alcoholic Beverages     | 5.69      |
35 | | Aerospace & Defense                       | 5.475     |
36 | | Automotive Retail                         | 5.2       |
37 | | Systems Software                         | 4.067     |
38 | | Semiconductor Materials & Equipment       | 3.913     |
39 | | Telecom Tower REITs                      | 3.527     |
40 | | Application Software                     | 3.166     |
41 | | Restaurants                              | 3         |
42 | +-----+-----+-----+-----+-----+

```

4.3 Financial Ratios

Understanding the sectors with the best returns and their risk levels is key for investors. By spotting the top and bottom 10 sectors by returns, investors get a sense of past performance. In this session, the "Average Return" shows how sectors have performed on average, while "Volatility" indicates how much their returns

have varied. This helps investors assess sector-specific risks and returns, guiding their investment choices based on their preferences and goals.

```

01 | WITH SectorPerformance AS (
02 |     SELECT
03 |         e.INDDDESC AS Sector,
04 |         AVG(s.RET) AS AverageReturn,
05 |         STDDEV(s.RET) AS Volatility
06 |     FROM
07 |         sp500stock s
08 |     JOIN
09 |         sp500execucomp e ON s.TICKER = e.TICKER
10 |     GROUP BY
11 |         e.INDDDESC
12 | )
13 | SELECT
14 |     Sector,
15 |     AverageReturn,
16 |     Volatility,
17 |     CASE
18 |         WHEN top_rank <= 10 THEN 'Top 10'
19 |         WHEN bottom_rank <= 10 THEN 'Last 10'
20 |     END AS RankCategory
21 | FROM
22 |     (
23 |         SELECT
24 |             Sector,
25 |             AverageReturn,
26 |             Volatility,
27 |             ROW_NUMBER() OVER (ORDER BY AverageReturn DESC) AS top_rank,
28 |             ROW_NUMBER() OVER (ORDER BY AverageReturn ASC) AS bottom_rank
29 |         FROM
30 |             SectorPerformance
31 |     )
32 | WHERE
33 |     top_rank <= 10 OR bottom_rank <= 10
34 | ORDER BY
35 |     top_rank, bottom_rank;

```

SECTOR	AVERAGERETURN	VOLATILITY	RANKCATEGORY
Broadline Retail	0.02860680706	0.1590272042	Top 10
Biotechnology	0.0261202536	0.2153082009	Top 10
Construction & Engineering	0.02437436418	0.1566835299	Top 10
Telecom Tower REITs	0.02350166289	0.1392367844	Top 10
Technology Distributors	0.02320285088	0.06861273802	Top 10
Semiconductor Materials & Equipment	0.02267948506	0.144592587	Top 10
Electronic Manufacturing Services	0.02099521933	0.1683639345	Top 10
Semiconductors	0.02099093244	0.1406800602	Top 10
Wireless Telecommunication Services	0.02084687069	0.07355947311	Top 10
Fertilizers & Agricultural Chemicals	0.02037557143	0.07383022981	Top 10
Household Products	0.008713526882	0.05434554965	Last 10
Cable & Satellite	0.008462287185	0.1204683746	Last 10
Electric Utilities	0.008038404181	0.08544437955	Last 10
Broadcasting	0.00727979646	0.0778783228	Last 10
Integrated Telecommunication Services	0.005116378433	0.0666943369	Last 10
Managed Health Care	0.00257203876	0.04743126895	Last 10
Multi-line Insurance	0.002003157895	0.09003855679	Last 10
Drug Retail	-0.0006872164948	0.07941953627	Last 10
Passenger Ground Transportation	-0.002410953488	0.1376272127	Last 10
Health Care REITs	-0.0220455	0.1804937964	Last 10

4.4 Stock Data

TBD.

5 What's next?

For the next steps, we will merge datasets together and explore more in-depth the relationship between different variables. We will connect Snowflake and Tableau to visualize data and present interactive report as final deliverables.

References

- [1] D. Baker, J. Bivens, and J. Schieder. Reining in ceo compensation and curbing the rise of inequality. 2019.
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- [4] W. R. D. Services. Wharton Research Data Services — wrds-www.wharton.upenn.edu. <https://wrds-www.wharton.upenn.edu/>. [Accessed 02-02-2024].