**IAQF Student Problem**

**A PROJECT REPORT FOR**

**FRE 6073 – Introduction to Derivatives**

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**Abstract**

The objective of this study was to determine whether the given Democratic and Republican portfolios perform differently under the US presidential election in 2020. To analyze this problem through quantitative methods, we first compared these two portfolios in different perspectives and then used a multilinear regression model to determine what are the factors that are affecting the performance of these portfolios given the White House is occupied by a Republican or a Democrat. Finally, we constructed structured notes from the portfolios.

Key Words: US presidential election, Democratic portfolio, Republican portfolio, Multilinear regression

**Part A – Are there truly differences between these two portfolios?**

**Data and Methodology**

In this study, we used historical close prices of each stock in the Republican and the Democratic portfolios downloaded from Yahoo Finance. The sector performance data was taken from the SPDR sector ETFS website. We first compared two portfolios by breaking them into different sectors and it was clear that both portfolios have different concentrations. We then plotted the historical and annualized return to visualize their performance difference over the last 40 years. We also calculated and compared the Sharpe ratio and the Information ratio of both portfolios. For the Fama-French Three Factor model , we used data downloaded from the Kenneth French Data Library.

**Data Analysis and Discussion of Results**

1. Sectors

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| Figure A.1.1 Breakdown two portfolios by sectors |

To check if the Democratic and the Republican portfolios are different, we first compare them by sectors. There are 15 stocks with same weight in each portfolio. The Democratic Portfolio contains the following stocks: Exelon Corp., Ford Motor Co., Aptiv PLC, Constellation Brands Inc, Estee Lauder Cos., SunPower Corp., Coca-Cola Co., Walmart Inc., Home Depot Inc., NextEra Energy Inc., CSX Corp., McDonald’s Corp., Simon Property Group Inc., First Solar Inc. and Norfolk Southern Corp. The Republican Portfolio consists of the following stocks: Honeywell International Inc., Alphabet Inc., ConocoPhillips, Marathon Oil Corp., Citigroup Inc., Salesforce.com Inc., QUALCOMM Inc., Gilead Sciences Inc., Amazon.com Inc., Chevron Corp., Facebook Inc., Merck & Co., PayPal Holdings Inc., American Express Co. and Visa Inc. We divided the portfolios into different sectors based on SPDR sector ETFs. As shown in the diagram, we could see that the Democratic portfolio contains most companies within Consumer, utility and semi-conductor sectors, whereas the Republican portfolio has most companies within Technology, Energy, Financials and Healthcare sectors. To better compare the two portfolios, we looked up each sector’s past 5 years’ performance. As shown in the graph, the Technology sector has the best performance among others and the Energy sector has the worst performance in recent years.

The terrible performance of the Energy sector may account for the Republican’s withdrawal from the Paris Agreement in 2019 ([Pompeo](https://www.state.gov/biographies/michael-r-pompeo/),2020). The climate plan demonstrated by Joe Biden is about “put us on the right track”. Biden decided to join back the Paris Agreement and achieves a carbon-neutral economy before 2050. Moreover, he wanted to be the leader of all major countries to solve the environment problem. However, the Republican still insists that environmental problems are not manmade. Trump considered the Paris Agreement is one-side, harmful to the United States. These opinions may have great impact on the Republican portfolio.

Besides, the Republican also shows their impatience and dislike of the Technology sector. The Facebook Inc. and Twitter Inc. are both under subpoenas by Republican. Moreover, the Alphabet Inc. is also investigated by the government. Democratic shows support for those technology industries. These large technology companies may experience a boost from the supports and help from Democratic (Gabbatiss, 2020).

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| Figure A.1.2 Growth of stocks in sectors in past 5 years |

1. Headquarter locations

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| Figure A.2.1 The headquarters’ location of Democratic Portfolio and Republican Portfolio |

We initially look into the companies’ location distribution among sectors divided by parties. An overview of the distribution is in the following graph, which illustrates that most democratic portfolio stocks are condensed in states supporting republic and most republican portfolio stocks are condensed in states supporting democracy. For democratic portfolio stocks, they are distributed in both United States and Ireland. Ignoring the Aptiv PLC from Ireland, there are five stocks that came from democratic states: Exelon Corp. in Illinois, Constellation Brands Inc. and Estee Lauder Cos. In New York, and SunPower Corp. and McDonald’s Corp. in California. Other companies are from republican states and swing states. There are four companies from swing states: Michigan, Florida, and Virginia. According to United States presidential election from 1864 to present, there are 28 times that Michigan voted for Republican, 17 times that Florida voted for Republican, and 16 times that Virginia voted for Republican (Wikipedia, n.d.).

For republican portfolio stocks, they are distributed in six states with eight companies from California: Alphabet Inc., Salesforce.com Inc., QUALCOMM Inc., Gilead Sciences Inc., Chevron Corp., Facebook Inc., PayPal Holdings Inc., and Visa Inc. As summarized in official Federal Election Commission report (2008, 2012 & 2016), although California voted for Republican six times more than Democratic, it is inclined to Democratic since 1992. New York and New Jersey are deep blue states, while Texas is a deep red state. For the other two states, North Carolina and Washington are two swing states. According to the United States presidential selection history, there are 18 times that Washington voted Democratic, compared with 14 times for Republican. For North Carolina, it voted for Democratic 30 times, compared with 17 times for Republican (Wikipedia, n.d.).

From the statistics, we found that there are many intersections and overlaps between the two portfolios in terms of headquarters location. The location of headquarters may have impact on the stock performance of that company.

1. Return between the Democratic and the Republican portfolios

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| Figure A.3.1 Portfolio cumulative return from 1984-2020 |

We calculated the cumulative return of both the Democratic and the Republican portfolio and we found that the Democratic portfolio has higher cumulative return throughout 1984 to 2020. However, the pattern also shows that the difference between the two portfolios has shrank in recent years. We continued our analysis by calculating the annualized return of both portfolios.

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| Figure A.3.2 Portfolio annualized return from 1984-2020 |

Due to the fact that some companies in the Democratic portfolio were founded earlier than those in the Republican portfolio, we could see that the Democratic portfolio outperformed the Republican portfolio in earlier years. In more recent years starting from 2016, when Donald Trump was elected, the Republican portfolio outperformed the Democratic portfolio, however, the latest data showed that the Democratic portfolio has better performance. Therefore, we plotted the annual returns of both portfolios from 2016 to 2020.

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| Figure A.3.3 Portfolio’s annual return for past 4 years |

When we look at both portfolios in more recent years, we found that the Democratic portfolio generates higher return than the Republican portfolio, especially in year 2020. We compared each stock’s annual return in 2020 and found that this difference is mainly generated by the dramatic increase of SunPower Corporation in the Democratic portfolio and the drop in several traditional energy stocks within the Republican portfolio. This may be due to the fact that investors were bidding up renewable energy stocks given that the growing lead presidential candidate Joe Biden pledged to support renewable energy development and increase solar uptake.

1. Variance between the Democratic and the Republican portfolios

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| Figure A.4.1 Portfolio variance from 1984-2020 |

As for the variance of the two portfolios, despite periodic patterns as shown in the diagram, we found that the Republican portfolio has higher variance than that of the Democratic portfolio in earlier years. The dramatic rise of variance in 1980s corresponds to the Oil crisis and the peak in 2008 aligns with the financial crisis at that time. We used portfolio returns data from 2015, when both portfolios have full coverage, to calculate variances of returns and conducted an F-test to check if there is significant difference in variances between two portfolios.

The F-statistic of the null hypothesis with degree of freedom of (66,66) and 95% cumulative probability is 1.50 and therefore our calculation suggests that there is no significant difference between variances of the two portfolios in recent years.

1. The Sharpe ratio and the Information ratio

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| Figure A.5.1 Portfolio sharpe ratio from 1984-2020 |

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| Figure A.5.2 Portfolio information ratio from 1984-2020 |

We calculated the Sharpe ratio and the Information ratio to compare the risk-adjusted return of both portfolios relative to the risk-free rate and the market return taken from the Kenneth French Data Library.

According to the diagram, the Sharpe ratio and the Information ratio of both portfolios followed quite similar trends and the Democratic portfolio had higher Sharpe ratio and Information ratio in earlier years, indicating that the portfolio had higher risk adjusted returns both relative to the risk-free rate and the market return at that time, whereas the Republican portfolio tends to have higher Sharpe ratio and Information ratio in more recent years.

1. CAPM Fama-French three factor model

We continued our analysis of the two portfolios by comparing their performance with the market portfolio and applying the Capital Asset Pricing Model (CAPM) and Fama-French three-factor model to evaluate their differences. To do this, we used S&P 500 index as the market portfolio and conducted Ordinary least squares (OLS) regression on excess portfolio return of each portfolio and calculated their responding coefficients. For the Fama-French three factor model, it suggests that The results are shown below.

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| --- | --- | --- | --- | --- | --- |
| **Coefficients** | **MRP** | **SMB** | **HML** | **intercept** | **R-squared** |
| **Democratic** | 0.1155 | -0.0098 | 0.0414 | -0.1814 | 0.604 |
| **Republican** | 0.1257 | 0.0021 | 0.0210 | -0.1880 | 0.638 |
| Table A.6.1 CAPM data for two portfolios with S&P 500 | | | | | |

First of all, the R-squared results of both the Democratic and the Republican portfolio are above 0.6, indicating that the regression had explaining strength to some extent. Based on the Fama-French three-factor model, the highest coefficient among the three is the Market Risk Premium, this means that the market growth as a whole had greater influence on the excess return of both portfolios. One thing we found special was that the SMB (small minus big) coefficient of the Democratic portfolio was negative, this suggest that the Democratic portfolio could favor large-cap companies more than small companies. When we compare the image of the regression results of both the Democratic and the Republican portfolio, we could see that the excess return of the Republican portfolio is more sensitive to the market risk premium as the red points in the graph are more concentrated and suggested a linear pattern, this corresponds to the higher MRP coefficient of the Republican portfolio.

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| Figure A.6.1 CAPM for Democratic portfolio and Republican portfolio | |

We continued our analysis by conducting a significance test of difference between two portfolios, where we regressed the difference of the return of the Democratic and the Republican portfolio to the market excess return and the results are given below.

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| **Coefficients** | **Dem - Rep** | **Std.error** | **P-value** |
| **MRP** | -0.0102 | 0.005 | 0.770 |
| **SMB** | -0.0119 | 0.008 | 0.047 |
| **HML** | 0.0203 | 0.008 | 0.124 |
| **Intercept** | 0.0065 | 0.022 | 0.009 |
| Table A.6.2 CAPM for Democratic – Republican | | | |

The p-value of the coefficients suggest that there is no significant difference of MRP, SMB and HML coefficients between the Democratic and the Republican portfolio. However, the negative values of the MRP and the SMB coefficient suggest that the Republican portfolio is likely to be more sensitive to the market and the size factor than the Democratic portfolio. As shown in the regression diagram below, there is no significant difference in the Fama-French three-factor model analysis between the two portfolios as the blue points are quite sparse and does not follow the pattern of the market risk premium.

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| Figure A.6.2 CAPM for the difference between Democratic Portfolio and Republican Portfolio |

1. Correlation analysis

In order to better understand the Democratic and the Republican portfolio, we decided to have a look at the correlation between stocks of both portfolios and we used heat maps to visualize our results, which was given below. From these diagrams, we found that the correlation of the Republican portfolio is greater than that of the Democratic portfolio, this may be due to the fact that the stocks in the Republican portfolio are more concentrated in several sectors or industry, which could contribute to high correlations between stocks.

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| Figure A.7.1 Covariance matrix of two portfolios |

**Summary and Conclusion**

In conclusion, the CAPM model and the numerical result both demonstrates that the Democratic and Republican portfolios are not significantly different from each other but highly correlated. Moreover, the distribution of the headquarters even indicates that Democratic portfolio is more “Republican”, and vice versa. By calculating the difference between the return of two portfolios, we found the coefficients of three factors are all below 0.03 (Table A.6.2), which shows that there is no significant difference between the two portfolios under the CAPM model. All in all, these two portfolios are formed in an even way.

**Part B – Are the portfolios should be expected to perform differently depending on whether the White House is occupied by a Republican or a Democrat ?**

**Data and Methodology**

The 2020 US Presidential Election has been discussed and focused by the public internationally. This is because that this political event has global effect on different areas, such as politics, financial and economic markets. Not surprisingly, the result of the 2020 US Presidential election would impact the performance of the Democratic portfolio and the Republican portfolio directly and indirectly to some extent. How and how significantly the US Presidential election result would affect the performances the Democratic and Republican portfolios should be investigated in detail.

Chen (2020) states that “the stock market is affected by many interrelated factors, which include: 1) economic variables; 2) industry specific variables; 3) company specific variables; 4) psychological variables of investors; 5) political variables” (p.1). Also, Kenton (2020) describes that “Multiple linear regression (MLR), also known simply as multiple regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable”. Then the multiple regression can be considered as a physical methodology to estimate and predict the performance of stock portfolios.

Therefore, we would build multiple regression model by choosing reasonable factors to analyze how the performance of Democratic portfolio and the Republican portfolio would be affected by the US Presidential Election result and discuss whether these two portfolios would perform differently under the result of US Presidential Election.

**Analysis and Discussion of Results**

1. Choosing Factors in the Multiple Regression Model
   1. Single Independent Variable*s* 
      1. US Presidential Election Result

First of all, since the main problem is detecting the impact of the US Presidential election result on the return of the Democratic Portfolio and the Republican Portfolio, then the change of occupier of the White House does matter. So, we set four dummy explanatory variables which are corresponding to four different scenarios, they are the Democrat wins conditional on that Democrat won last time (DtD), Democrat wins conditional on that Republic won last time (DtR), Republic wins conditional on that Democrat won last time (RtD), and Republic wins conditional on that Republic won last time (RtR). Each dummy variable equals to one if the scenario happens and equals to zero otherwise.

* + 1. Sectors of Companies in These Portfolios

Moreover, by collecting and listing the company stocks and their sectors of two portfolios, the result shows that these stocks can be categorized into ten sectors, which are energy, technology, finance, consumer, industrials, communication, healthcare, real estate, utilities, and semiconductor. In details, the table B.2.1 and the table B.2.3 show that the approximately 53% of Democratic Portfolio are occupied by stocks in the consumer sector, and other companies are in the industrials, utilities, semiconductor, and real estate. For the Republican portfolio, the table B.2.2 and the table B.2.2 show that nearly 27% of companies are in the technology sector, other companies are in the energy, finance, consumer, industrials, healthcare, and communication sectors. Therefore, the distribution of sectors of these two portfolios are slightly different (as shown in figure B.2.1), and energy, technology, finance, consumer, industrials, communication, healthcare, real estate, utilities, semiconductor are set as ten dummy variables to indicate the sector of the stocks in each portfolio, where the independent variable equals to one if the stock belongs to the sector and equals to zero otherwise (as shown in the table B.2.4).

Hence, the different sector distributions of these two portfolios may be one of the important factors that influence the portfolios’ return and should be considered and analyzed in detail.

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| **Democratic** | **Ticker** | **HQ City** | **HQ State** | **Sector** |
| Exelon Corp. | EXC | Chicago | IL | utilities |
| Ford Motor | F | Detroit | MI | consumer |
| Aptiv PLC | APTV | Dublin | Ireland | consumer |
| Constellation Brands Inc. | STZ | Victor | NY | consumer |
| Estee Lauder Cos. | EL | New York | NY | consumer |
| SunPower Corp. | SPWR | San Jose | CA | semiconductor |
| Coca-Cola Co. | KO | Atlanta | GA | consumer |
| Walmart Inc. | WMT | Bentonville | AR | consumer |
| Home Depot Inc. | HD | Atlanta | GA | consumer |
| NextEra Energy Inc. | NEE | Juno Beach | FL | utilities |
| CSX Corp. | CSX | Jacksonville | FL | industrials |
| McDonald's Corp. | MCD | San Bernardino | CA | consumer |
| Simon Property Group Inc. | SPG | Indianapolis | IN | realestate |
| First Solar Inc. | FSLR | Tempe | AZ | semiconductor |
| Norfolk Southern Corp. | NSC | Norfolk | VA | industrials |
| Table B.2.1 Sector distribution of democratic portfolio | | | | |

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| **Republican** | **Ticker** | **HQ City** | **HQ State** | **Sector** |
| Honeywell International Inc. | HON | Charlotte | NC | industrials |
| Alphabet Inc. | GOOG | Mountain View | CA | communication |
| ConocoPhillips | COP | Houston | TX | energy |
| Marathon Oil Corp. | MRO | Houston | TX | energy |
| Citigroup Inc. | C | New York | NY | finance |
| Salesforce.com Inc. | CRM | San Francisco | CA | technology |
| QUALCOMM Inc. | QCOM | San Deigo | CA | technology |
| Gilead Sciences Inc. | GILD | Foster City | CA | healthcare |
| Amazon.com Inc. | AMZN | Seattle | WA | consumer |
| Chevron Corp. | CVX | San Ramon | CA | energy |
| Facebook Inc. | FB | Menlo Park | CA | communication |
| Merck & Co. | MRK | Kenilworth | NJ | healthcare |
| PayPal Holdings Inc. | PYPL | Palo Alto | CA | technology |
| American Express Co. | AXP | Buffalo | NY | finance |
| Visa Inc. | V | San Francisco | CA | technology |
| Table B.2.2 Sector distribution of republican portfolio | | | | |

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| |  |  | | --- | --- | | **Democratic Portfolio** | | | **Energy** | 0 | | **Technology** | 0 | | **Finance** | 0 | | **Consumer** | 8 | | **Industrials** | 2 | | **Communication** | 0 | | **Healthcare** | 0 | | **RealEstate** | 1 | | **Utilities** | 2 | | **Semiconductor** | 2 | | **Total** | 15 | | |  |  | | --- | --- | | **Republican Portfolio** | | | **Energy** | 3 | | **Technology** | 4 | | **Finance** | 2 | | **Consumer** | 1 | | **Industrials** | 1 | | **Communication** | 2 | | **Healthcare** | 2 | | **RealEstate** | 0 | | **Utilities** | 0 | | **Semiconductor** | 0 | | **Total** | 15 | |
| Table B.2.3 Sector distribution of two portfolios | |

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| Figure B.2.1 Sector distribution of companies in the portfolios |

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| 图形用户界面, 应用程序, 表格, Excel  描述已自动生成 |
| Table B.2.4 Sector dummy variables of two portfolios |

* + 1. Financial and Economic Factors
       1. GSPC

GSPC is the ticker symbol of the S&P 500 index, and it shows the movement and percentage change of stock prices in the S&P 500 index. Since S&P 500 “is a capitalization-weighted index of 500 stocks, it is a popular index and is used to measure the performance of the large cap U.S. stock market, and the 500 stocks of this index are selected to be a representative sample of leading companies” (Your dictionary, 2020). Then GSPC “represents the stock market's performance by reporting the risks and returns of the biggest companies. And investors use it as the benchmark of the overall market, to which all other investments are compared” (Amadeo, 2020). Therefore, GSPC not only is an important indicator of the whole US stock market, but also a powerful factor to analyze and predict the Democratic and Republican portfolios.

* + - 1. GDP

Gross domestic product (GDP) “is the monetary value of all the finished goods and services produced within a country's borders in a specific time period and includes anything produced within its borders by the country's citizens and foreigners. It is primarily used to assess the health of a country's economy” (Kramer, 2020). Investors usually focus on the percentage change of GDP because it “can have a significant impact on the stock market. In general, a bad economy usually means lower earnings for companies. And this can translate into lower stock prices” (Kramer, 2020). Hence, GDP should be a vital factor that is used to explain how the Democratic and Republican portfolios would perform in the stock market.

* + - 1. CPI

Consumer price index (CPI) “is defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households” (OECD, 2020). The formula of CPI is

× 100

Then CPI can measure the public’s purchasing power and the cost of living relative to the base year.

“Inflation occurs when the prices of goods and services rise, while deflation occurs when those prices decrease” (Segal, 2020). According to the definitions of inflation and deflation, during the period of inflation (deflation), the purchasing power of the public would decrease (increase), and the CPI indicator should decline (growth) correspondingly. Also, the inflation means that the economy was experiencing an expansion period, and the deflation means that the economy was in recession.

Thus, CPI is a useful tool to measure inflation or deflation and also an indicator of the overall economy and financial condition, then CPI can affect investor’s behaviors and strategies and the stock market to some extent.

* + - 1. Oil Price

Initially, by investigating companies that are included in the Democratic and Republican portfolios, some stocks are directly and indirectly related to the production and price of oil. For example, “Marathon Oil Corporation is an exploration and production (E&P) company”, and “the United States E&P segment explores for, produces and markets crude oil and condensate, natural gas liquids (NGLs) and natural gas in the United States” (Reuters, 2020). So, the Marathon Oil Corporation (MRO) in the Republican Portfolio is straightforwardly affected by the production and price of crude oil, and its stock return fluctuates with the oil market as well. Moreover, for companies in the utilities industry, such as Exelon Corp. (EXC) and NextEra Energy Inc. (NEE), these two companies provide different types of energy and relate to electricity. Also, oil is a major resource to generate power and electricity, “in 2019, about 4,127 billion kilowatt hours (kWh) (or about 4.13 trillion kWh) of electricity were generated at utility-scale electricity generation facilities in the United States.1 About 63% of this electricity generation was from fossil fuels—coal, natural gas, petroleum, and other gases” (U.S. Energy Information Administration, 2020). Hence, these two stock returns are indirectly relative with the U.S. oil price.

Furthermore, oil prices can impact the US stock market and affect investors behaviors as a whole. To illustrate, Kang, Ratti, and Vespignani (2016) searched and concluded that “shocks to U.S. oil production are positively associated with U.S. real stock returns and the link is statistically significant”. Also, conventionally study describes that the oil price and stock price “have an inverse correlation. In simplest terms, the relationship is as follows:

• As oil prices rise, equities valuations are driven down

• As oil prices fall, equities valuations are driven up” (FXCM, 2020).

To test this conventional wisdom,

in an observational study conducted by Forbes, possible correlations between the Dow Jones Industrial Average (DJIA) and crude oil pricing from 26 December 1990 to 25 January 2011 were looked at in depth. The following patterns in pricing behaviour were noticed:

• From 7/1/1997 to 16/2/1999 oil and stocks had a negative correlation of -0.84

• From 19/2/2009 to 27/4/2011 oil and stocks had a positive correlation of +0.94

• Several prolonged periods of no correlation between -0.30 and +0.30 were observed

• An aggregate positive correlation of +0.69 was present

The results of the investigation show a moderate correlation from 1991 to 2011, with periods of considerable positive and negative correlations. In effect, the exercise illustrated conventional wisdom holds true at least some of the time. (FXCM, 2020)

However, there are some different opinions state that “oil prices and stock prices actually show little correlation over time” (Ross, 2020) for some reasons. For instance, “other price factors in the economy—such as wages, interest rates, industrial metals, plastic, and computer technology—can offset changes in energy costs” (Ross, 2020); And there are “some economists suggest that general stock prices often rise on the expectation of an increase in the quantity of money, which occurs independently of oil prices” (Ross, 2020).

In conclusion, oil price could be a factor that have effect on the performances of the Democratic and the Republican portfolios, but there also exist some reasons that are conflict with this viewpoint. So, it is necessary to test whether the oil price is a significant explanatory variable in the multiple regression model to estimate how the Democratic and Republican portfolios perform.

* + - 1. Interest Rate

The changes of interest rate do affect stock market and portfolio performances. To explain, “the Federal Reserve makes adjustments to the federal funds rate in order to control inflation. By increasing the federal funds rate, the Federal Reserve is effectively attempting to shrink the supply of money available for making purchases” (Hall, 2020). This means that the fluctuation of interest rate is a signal of the overall economic condition.

Next, Equity markets are affected by interest rates whether they’re rising or falling. In a falling interest rate environment, newly issued debt will pay less than older debt. Since investors can no longer get the same yield on debt products after a rate cut, they often turn their attention to equities. When rates are lowered, it’s (usually) viewed as good news for the stock market. With cheaper money, investors are more willing to take on stock market risk since the bond market returns are hampered by low rates (Warrior Trading. 2020).

So, the stock market would be benefited if interest rate increases and be hurt if interest rate decreases.

In sum, the interest rate fluctuation not only be an indicator of the overall economic and financial status, but also impact the stock market and how portfolios would perform.

-- Interaction Terms

In addition to above individual independent variables to involved in the multiple regression model, their correlation and interaction should be considered as well. Then these factors should be combines and the interaction terms need to be included in the multiple regression model, which are DtD\*Energy, DtD\*Tech, DtD\*Finance, DtD\*Consumer, DtD\*Industrials, DtD\*Communication, DtD\*Healthcare, DtD\*RealEstate, DtD\*Utilities, DtD\*Semiconductor, DtR\*Energy, DtR\*Tech, DtR\*Finance, DtR\*Consumer, DtR\*Industrials, DtR\*Communication, DtR\*Healthcare, DtR\*RealEstate, DtR\*Utilities, DtR\*Semiconductor, RtD\*Energy, RtD\*Tech, RtD\*Finance, RtD\*Consumer, RtD\*Industrials, RtD\*Communication, RtD\*Healthcare, RtD\*RealEstate, RtD\*Utilities, RtD\*Semiconductor, RtR\*Energy, RtR\*Tech, RtR\*Finance, RtR\*Consumer, RtR\*Industrials, RtR\*Communication, RtR\*Healthcare, RtR\*RealEstate, RtR\*Utilities, RtR\*Semiconductor, Energy\*OilPrice, Consumer\*CPI, and Finance\*Interest. All of these interaction terms are dummy variables.

The general form of a multiple regression model is:

yi​ = β0 ​+ β1​xi1 ​+ β2​xi2​ + ... + βp​xip​ + ϵ

where, for I = n observations:

yi ​= dependent variable

xi ​= explanatory variables

β0 ​= y-intercept (constant term)

βp = slope coefficients for each explanatory variable

ϵ = the model’s error term (also known as the residuals)​

According to the previous analysis of explanatory variables, the model should look like:

Si = β0 ​+ βDtD​DtD ​+ βDtRDtR​ + βRtDRtD + βRtRRtR + βenergyEnergy + βtechTech +. βfinFinance + βconConsumer + βIndIndustrials + βcommCommunication + βhcHealthcare + βreRealEstate + βutilitiesUtilities + βscSemiconductor + βgspcGSPC + βgdpGDP + βcpiCPI + βwtiWTI + βintInterest + βDtD\*energy(DtD\*Energy) + βDtD\*tech(DtD\*Tech) + βDtD\*fin (DtD\*Finance)+ βDtD\*con(DtD\*Consumer) + βDtD\*Ind(DtD\*Industrials) + βDtD\*comm(DtD\*Communication) + βDtD\*hc(DtD\*Healthcare) + βDtD\*re(DtD\*RealEstate) + βDtD\*utilities(DtD\*Utilities) + βDtD\*sc (DtD\*Secconductor) + βDtR\*energy(DtR\*Energy) + βDtR\*tech (DtR\*Tech) + βDtR\*fin(DtR\*Energy) + βDtR\*con(DtR\*Consumer) + + βDtR\*Ind(DtR\*Industrials) + βDtR\*comm(DtR\*Communication) + βDtR\*hc(DtR\*Healthcare) + βDtR\*re(DtR\*RealEstate) + βDtR\*utilities(DtR\*Utilities) + βDtR\*sc (DtR\*Secconductor) + βRtD\*energy (RtD\*Energy) + βRtD\*tech(RtD\*Tech) + βRtD\*fin (RtD\*Finance)+ βRtD\*con(RtD\*Consumer) + βRtD\*Ind(RtD\*Industrials) + βRtD\*comm(RtD\*Communication) + βRtD\*hc(RtD\*Healthcare) + βRtD\*re(RtD\*RealEstate) + βRtD\*utilities(RtD\*Utilities) + βRtD\*sc (RtD\*Secconductor) + βRtR\*energy(RtR\*Energy) + βRtR\*tech (RtR\*Tech) + βRtR\*fin(RtR\*Energy) + βRtR\*con(RtR\*Consumer) + βRtR\*Ind(RtR\*Industrials) + βRtR\*comm(RtR\*Communication) + βRtR\*hc(RtR\*Healthcare) + βRtR\*re(RtR\*RealEstate) + βRtR\*utilities(RtR\*Utilities) + βRtR\*sc (RtR\*Secconductor) + βenergy\*wti (Energy\*WTI) + βcon\*cpi (Consumer\*CPI) + βfin\*int (Finance\*Interest) + ϵ

1. Test the Significance and Validation of the Multiple Regression Model

To test whether the above multiple regression model is valid and practical to determine the performances of the Democratic and Republican portfolios, and to estimate if these two portfolios perform differently on the US President Election results, it is necessary to compute the values of each parameter and test the significance of each explanatory variable. This work can be done by running and analyzing the Student’s t-test results by Python. The t-test results are shown in figure B.3.1.

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| Figure B.3.1 T-Test Results for All Coefficients |

* 1. Significance of Coefficients (Assuming 5% Significance Level)

By assuming 5% significance level, the p-value less than 5% means that the coefficient is significant and means a lot to the portfolio’s return. Therefore, it is necessary to find the value that is less than 0.05 in the column P > |t|.

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| Table B.3.1 Significant Coefficients |

As the table B.3.1 describes, technology, communication, semiconductor are significant sector variables, GSPC is the important economic variable, and DtD\*Communication, DtD\*Utilities, DtR\*Energy, DtR\*Semiconductor, DtR\*Industrials, and RtR\*Technology are meaningful interaction terms. This result can be explained and reasonable in the following in detail.

* + 1. Sector Factors

To demonstrate, technology and communication are important sector variables, and as analyzed previously (figure \*\*\*), there are no technology and communication companies in the Democratic portfolio, however, over a quarter of corporations are in the technology sector and about 13% of corporations are in the communication sector for the Republican portfolio. This may be because that technology and communicating do have crucial effect in the US stock market, and the Republican portfolio would be impacted more significantly since it consists of lots of technology and communication companies, but Democratic portfolio would not be affected too much by these factors.

Similar analysis can be applied to the semiconductor variable, semiconductor could be vital to the performance of the stock market, especially for the Democratic portfolio, but the Republican portfolio may not be affected by the semiconductor sector because it does not have semiconductor companies. Therefore, the Democratic and Republican portfolios perform differently since their performances are decided by various drivers.

* + 1. Interaction Terms

Furthermore, the powerful interaction term should be explained as well. To illustrate, DtD\*Communication and DtD\*Utilities are two significant interaction terms, also the communication corporations only exist in the Republican portfolio and the utilities companies only exist in the Democratic portfolio, which means that in the case of Democrat wins the US President Election, the Republican portfolio and Democratic portfolio would be affected significantly by the fluctuation in different sectors.

Similarly, DtR\*Energy, DtR\*Semiconductor are important factors as well, and two portfolios would be impacted by different drivers if Republic occupy the White House.

DtR\*Industrials is another vital interaction term, and both Democratic and Republican portfolios consist of industrial companies, then in the case of Republic wins and occupies the White House, both portfolios could be affected due to the industrials sector changes.

RtR\*Technology is an interaction term with significance, as explained previously, technology firms only exist in the Republican portfolio, and the factor is important with the RtR (the Republic wins the US President Election continuously) case, which is consistent with the early observation that the companies in the technology sector mainly affect the Republican portfolio.

* + 1. Financial and Economic Factors

GSPC is a financial factor in this multiple regression model with high level of significance, its t-test value is about 53.38, which means that GSPC and S&P 500 index impact the Democratic and Republican portfolios’ performances significantly and behave like a benchmark in the whole stock market. This result implies that it is important and necessary to include the GSPC factor in the model to predict the performances of the Democratic and Republican portfolios.

* 1. Values of Coefficients
     1. Single Independent Significant Factors

For Technology, Communication, Semiconductor, and GSPC, their coefficient values are all positive, which means that these factors are positively related to the portfolios’ performance and move with the portfolios’ returns in the same direction. Especially for the GSPC factor, its coefficient value is 1.0467, which indicates that the return of the portfolio would increase 1.0467 units when the GSPC grows by 1 unit. Again, this conclusion is highly consistent with previous analysis and findings that GSPC is an important symbol and indicator in the US stock market, it affects the whole stock market and the Democratic and Republican portfolios vitally.

* + 1. Significant Interaction Terms

For interaction terms, the coefficient value of DtD\*Communication is 0.0137, this positive value means that in the case of Democratic victory, the portfolios returns are positively related with the Communication sector, however Communication is the sector that only exist in the Republican portfolio. Similar situations occur in the DtD\*Utilities, DtR\*Semiconductor, and RtR\*Technology. These results could be the implication that the performances of Democratic and Republican portfolios are not affected by whether the White House is occupied by a Republican or a Democrat

* 1. Result Analysis

By using the multiple regression model, the returns of Democratic and Republican portfolios can be predicted. As the figure B.3.2 shows, the Democratic portfolio would perform better than the Republican portfolio in either cases of Republic victory and Democrat victory, and independent of the last US Presidential Election result.

Compared with the actual performances of Democratic and Republican portfolios in November 2020, the returns of portfolios in reality consist of forecast results by applying multiple regression model, that is the Democratic portfolio had higher returns than the Republican portfolio regardless of the US Presidential Election result.

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| 图表, 条形图  描述已自动生成 |
| Figure B.3.2 R Victory Case |

|  |
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| **图表, 条形图  描述已自动生成** |
| Figure B.3.2 D Victory Case |

**Summary and Conclusion**

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| Figure B.S OLS Regression results |

In conclusion, the multiple regression model and the actual result both indicate that the Democratic and Republican portfolios should not be expected to impact by whether the White House is occupied by a Republican or a Democrat, but since their stocks and companies are differently distributed on sectors they may perform differently. Although may variables that are included in the multiple regression model are not significant, the Adjusted R-Squared is only 0.224 (figure B.S) which also implies that this model may not be reasonable enough, the p-value of F-statistic is 0.00 (figure B.S) indicates that there does exist a linear statistical relationship between the dependent variable and at least one of the independent variables, and the prediction result of the model consist with the reality as well.

**Part C -** **Construct structured notes from the portfolios which have a differentiated payoff depending on the outcome of the election**

As the result in Part B predicts that the prices of the stock will rise however the election result would be, it is natural for us to seek for a bull spread solution to incorporate into our investment strategy, as it pre defines the range of potential payoffs, minimizing the risks with low cost and high flexibility. Based on the Bull and Bear Note construction, the design of the structured notes consists of two parts, a one-year zero-coupon bond and a bull spread. A common metric that investors seeking exposures to the stock market usually care about is the participation rate. The participation rate is the rate of return the investor gets in terms of the actual rate of the underlying stock or index. In other words, it is the proportion of the market risk reflected by the bull bread in one contract of the structured note. As the designer of the constructed note, we aim for a participation rate as high as possible. In order to raise the participation rate, the payoff that investors obtained at the maturity date of the notes should be as high as possible. In this section, we are going to present our building process of the notes, with a focus on the option constructing procedure.

1. Zero Coupon Bond

|  |  |
| --- | --- |
| Risk-free rate | 1.51% |
| Aa2 credit spread for JB | 0.78% |
| Discount rate | 2.29% |
| Value of ZCB | 977.6127 |
| Balance of fund | 22.3873 |
| Figure C.1.1 Parameter of zero-coupon bond | |
|  | |

Par for our constructed notes is designed to be 1,000 and Julius Baer Bank will receive 1,000 on the issuing date of the notes. The notes are completely principal-protected, which means for whatever outcome of the election, investors could leastwise get back the par value they paid for at the maturity date. Julius Baer Bank is the issuer and the JB credit spread is above the Treasury curve by approximately 0.78% per annum. Therefore, assuming a 1.51% risk-free rate per annum, the discount rate for the one-year JB zero-coupon bond is 2.29% per annum. After discounting, $997.6127 is the present value invested in zero-coupon bond and the remaining balance of the fund is utilized for investing in the bull option that we will discuss next for investors in the structured note.

1. Bull option

To make the product attractive for investors, the participation rate of the constructed notes should be highest attainable. The participation rate can be calculated by the ratio of the balance of the fund available to the option premium. Since the balance of the fund is restricted to an amount of $22.3873 in our case, we aimed at constructing a lower-cost product with options embedded in notes. Since we are designing structured notes linked to two portfolios of stocks, it is necessary for us to construct a way to measure the performance of each portfolio. Here, we introduce an average price index to each portfolio.

* 1. Index compilation

Considering that the stocks of the two portfolios are equal-weighted (here, by “equal-weighted, we define that there is exactly one share of each stock in a portfolio), we first performed the index compilation by the equation , where P denotes the price of a single stock, and the base month of the equation is defined to be the issuing date (2020/1/1) of the notes. To simply put, the base month, January 2020, has an index of 100, and the indices of the following months are based on the average portfolio price relative to that of the base month.

* 1. Option pricing

Combined with the fact that the cumulative distribution of historical portfolio index follows a lognormal distribution, the Black-Scholes model was applied to price the option premium with equations below,

where and .

We obtained the value of σ by looking at the historical stock prices during the past year (2019/1/1-2019/12/31), believing that the volatility of the year before would be a comparatively appropriate indicator for the market volatility. The calculation is done by taking the average stock price of the portfolio for each month and then calculating the overall standard deviation.

* 1. Option strategy

As mentioned previously, our objective in constructing the product is to raise the participation rate and lower the cost for purchasing options. Therefore, we embedded the bull option into the notes to achieve our goal for its flexibility and low cost. We recursively investigated different combinations of strike prices and determined the best strategies with the following considerations: costs of implementation, maximum payoff, minimum payoff, as well as the range of the possible payoffs.

* + 1. Democratic structured notes

For Democratic structured notes, we short one call option with strike price 110 and long one call option with strike price 90. Below are the two tables presenting the parameters for Democratic portfolio and our constructed options.

|  |  |
| --- | --- |
|  | 100 |
|  | 0.26 |
| Maturity | 1 year |
| Discount Factor | 1.51% |
| Table C.2.1 Parameters for Democratic portfolio | |

|  |  |
| --- | --- |
| Sell call option with strike price 110 | 7.03 |
| Buy call option with strike price 90 | 16.39 |
| Debt | -9.36 |
| Max payoff | 10.64 |
| Number of contracts | 2 |
| Max: 1000+22.3873+10.64\*2 = 1043.6697 | Min: 1000+22.3873-9.36\*2 = 1003.6697 |
| Table C.2.2 Options for Democratic portfolio | |

* + 1. Republican structured notes

For Republican structured notes, we short one call option with strike price 120 and long one call option with strike price 90. The spread is larger because the historical volatility of the Republican portfolio is higher than that of the Democratic portfolio. Below are the two tables presenting the parameters for Republican portfolio and our constructed options.

|  |  |
| --- | --- |
|  | 100 |
|  | 0.27 |
| Maturity | 1 year |
| Discount Factor | 1.51% |
| Table C.2.3 Parameters for Republican portfolio | |

|  |  |
| --- | --- |
| Sell call option with strike price 120 | 4.92 |
| Buy call option with strike price 90 | 16.923 |
| Debt | -12.01 |
| Max payoff | 17.99 |
| Number of contracts | 1 |
| Max: 1000+22.3873+17.99 = 1040.38 | Min: 1000+22.3873-12.01 = 1010.38 |
| Table C.2.4 Options for Republican portfolio | |

* + 1. Evaluation of payoff

To evaluate the constructed notes, we calculated the payoff of each note associated with different stock prices.

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| Table C.2.5 Payoff of Democratic structured notes |

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| Table C.2.5 Payoff of Republican structured notes |

In general, our design of structured notes successfully meets our initial target of high participation rates. In fact, not only does each portfolio have a full participation, the Democratic portfolio also achieved a participation rate of 200% as the fund is available for purchasing two bull spread strategies. Furthermore, our structured notes are even more attractive in a way that they will never have negative payoffs. In other words, since the minimum payoffs for both structured notes are above 1000, we have achieved a guaranteed positive return for the investors.

* + 1. Final term sheet

|  |  |
| --- | --- |
| Issuer | Julius Baer Bank |
| Principal | $1,000 |
| Underlying Index | Democratic index |
| Maturity | One year |
| Maturity Date | Jan 29 2021 |
| Coupon | zero |
| Issue Size | $40 million |
| Issue Price | $1,000 |
| Redemption | The amount of a cash payment at the end of maturity date with each principal amount of $1,000:  1. Principal:$1,000  2. Bull spread payoff:  -max( - 110, 0) + max( – 90, 0) |

*1-year democratic constructed notes term sheet*

|  |  |
| --- | --- |
| Issuer | Julius Baer Bank |
| Principal | $1,000 |
| Underlying Index | Republican index |
| Maturity | One year |
| Maturity Date | Jan 29 2021 |
| Coupon | zero |
| Issue Size | $40 million |
| Issue Price | $1,000 |
| Redemption | The amount of a cash payment at the end of maturity date with each principal amount of $1,000:  1. Principal:$1,000  2. Bull spread payoff:  -max( - 120, 0) + max( – 90, 0) |

*1-year republican constructed notes term sheet*

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