The Effect of Government Policy on the Stock Market

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Abstract:

This study examines the impact of government policies on S&P 500, Dow Jones, and NASDAQ using six economic indicators. We hypothesize that government policies will have a significant impact on stock market prices, and our findings support this hypothesis. Our study aims to understand the relationship between government policies and stock market prices and the mechanisms by which they impact economic growth and stability. The findings demonstrate the significant impact of government policies on the stock market indices, highlighting their relevance for policymaking and investment decisions.

Introduction:

The relationship between government policies and the economy has been the subject of much debate and analysis. In particular, the role of government policies in shaping the stock market has been of interest to economists, policymakers, and investors alike. Understanding the factors that drive stock market movements is essential for making informed investment decisions, evaluating economic policies, and predicting future economic trends. By exploring the relationship between government policies and the stock market, we can gain insights into the broader economic landscape and the mechanisms by which government policies can impact economic growth and stability. This paper will aim towards analyzing the impact of government policies in the United States on the prices of the S&P 500, Dow Jones, and NASDAQ stock market indices. Specifically, we examine the impact of six economic indicators directly or indirectly influenced by government policies on stock market prices. These indicators include the 10-year constant maturity rate, Federal Funds Rate, Consumer Price Index, Unemployment Rate, Producer Price Index, and Real Gross Domestic Product.

The COVID-19 pandemic caused a severe economic downturn worldwide and had a significant impact on the stock market in the United States. The pandemic led to increased volatility and uncertainty in the markets, with stock prices fluctuating dramatically in response to news and government actions. However, the government also implemented a wide range of policies to help mitigate the economic impact of the pandemic, many of which had a positive impact on stock prices. Given the significant role that government policies played in responding to the pandemic, we were interested in understanding how government policies more broadly impact stock market prices. We believe that this research is particularly relevant and timely given the ongoing impact of the pandemic on the global economy and the continued importance of government policies in responding to economic challenges. We hope that this research will contribute to a better understanding of the relationship between government policies and stock market prices, and provide insights that can inform policymaking and investment decisions.

The paper will begin with a literature review of previous research on the relationship between government policies and stock market prices, followed by a section describing the data collection process, data cleaning, and statistical methods used in the analysis. We will then present our results and discuss their implications, providing descriptive statistics on the economic indicators and stock market prices, as well as correlation and regression analyses to assess the relationship between these variables. To conclude, we will discuss the limitations of our analysis and the potential for future research and summarize our findings on the relationship between government policies and the stock market.

Literature Review:

With our literature review we wanted to emphasize the importance of not just looking at qualitative papers examining the effects of different policy on variables but we also wanted to analyze models that may already be built to try and infer and gather suggestions on what our model could focus on to be the most effective. This is why we started of the project looking at Nikhil Kohli's model on "Stock Prediction using linear regression". His dataset was larger than we wanted for our model with 60 different features encompassing other index prices, technical indicators and more complicated statistical tools experiential moving averages and stochastic %k oscillator (Kohli). What was also different about this study compared to the one we wanted to conduct was that his also only looked at one stock, trying to predict the value over time; this was Apple Stock. The test R squared for this model ending up being 0.96 (Kohli), meaning that 96% of the variation can be explained by the model. We used this as a kind of case study or proof of concept; we wanted to make sure that our ideas on how the model could work did not have any significant faults and this case study and good results showed that this was indeed possible. While we wanted to change the model discussed significantly, through the use of less variables and stock price indexes instead of specific stocks, this regression analysis showed us that we were on the right track and that our project was indeed viable. (Kohli)

While the previous regression analysis was more similar to the type of project we were doing we also wanted to explore how the AI revolution could potentially affect prediction algorithms and how stocks are traded. While our paper is on the effect of government policy it is important to realize the fact that stock markets do have a long memory and all types of stimulus or contractions have mostly been done before. Hence, the use of machine learning algorithms could be successful just as it seems to be in Emioma and Edeki's paper. The model described in

their paper is relatively simple with a least square regression estimate combining a dependant variable of closing price of a stock with the independent variable of the day the stock price was recorded (Emioma and Edeki (Emioma and Edeki 1). The paper posits that while the stock market may seem completely unpredictable and random, after careful inspection a pattern can emerge (Emioma and Edeki 3). While this model does explicitly include any factors that we included like the FED funds rate or the 10 year treasury having the time of the data included gives out a specific market sentiment which can be used a kind of predictive model. While we may not have the skills to implement a machine learning model just yet what this research does show us is that the least squares regression estimates can be highly accurate in predicting stock market data specifically. After looking through the results and their accuracy our belief in the kind of model we were building was affirmed as we saw that it can lead to highly accurate results. What we did want to emphasize in our model was the variables we picked out specifically and the effect they can have on our stock market variables. While the previous research was more quantitative we also wanted to look through some more qualitative research as the effect of different government policies would be integral to our model and understanding.

Singer and Layna's research dictated exactly this and ,hence, helped us gain an understanding of what variables we might like to include in our model; they " hypothesize a positive association between stock-market valuations and levels of democracy, shareholder rights, legal traditions, and capital-account liberalization, a negative association with real interest rates, and no association with fiscal deficits or surpluses (Mosley and Singer 405)." What they suggest is that the stock market does have some links to the reactions of bond markets and FDI to different governmental policies ,however, the true effect can only really be identified once the different asset classes are disaggregated (Mosley and Singer 405).

These quantitative and qualitative papers both were able to help us as a group gain an understanding of the types of models already developed and how we can use them to develop our own specifically. These papers also reaffirmed our view that using a least square regression estimate can lead to relatively accurate estimates on stock prices and also gave us an indication on what variables could be included in our model to give us an accurate estimate of the price of the stock price indexes.

Emperical Review

The theoretical source of the hypothesis to be tested is the idea that government policies have a significant impact on the stock market. This hypothesis is based on the theory that government policies, such as monetary and fiscal policies, can affect economic indicators, which in turn can impact the stock market. For example, monetary policies such as changing interest rates can affect the cost of borrowing, which in turn can impact corporate profits and stock prices. Similarly, fiscal policies such as tax cuts or increased government spending can stimulate economic growth and lead to higher stock prices.

Empirical research on the relationship between government policies and stock market prices has produced mixed results. Some studies have found a strong positive relationship between government policies and stock market prices, while others have found little or no relationship. One meta-analysis of over 100 studies on the topic found that the relationship between government policies and the stock market is complex and multifaceted, with many different factors influencing the relationship. Despite the mixed results, there is a growing consensus that government policies can play an important role in shaping stock market prices, particularly in the short term. Recent research has focused on understanding the mechanisms by

which government policies impact the stock market, such as the transmission channels of monetary policy and the effect of fiscal policies on investor sentiment.

Overall, the theoretical and empirical literature suggests that government policies can have a significant impact on the stock market and that understanding the relationship between the two is essential for policymakers, investors, and economists when making decisions. Through this study, we aim to provide empirical evidence on the relationship between government policies and the stock market and contribute to a better understanding of the mechanisms by which government policies impact economic growth and stability.

Data:

In the original model we built, we used 6 different independent variables to predict 3 different dependent variables. The independent variables we used were all retrieved from the Federal Reserve of St. Louis website. The independent variables are the following:

1. The 10 year constant maturity rate (weekly)
2. The Federal Funds Rate (weekly)
3. Consumer Price Index (monthly)
4. Unemployment Rate (monthly)
5. Producer Price Index (monthly)
6. Real Gross Domestic Product (quarterly)

The dependent variables were retrieved from Investopedia and are the following:

1. Price of S&P 500
2. Price of Dow Jones
3. Price of NASDAQ

In terms of the independent variables, weekly data was gathered and cleaned between January 7th 1990 and December of 2022. However, given the fact that some variables are not reported weekly, in the cleaning process the empty reportings were filled with the previous reporting until the next reporting was available. For example, if CPI was reported as 130 for January 1st, that value was used for multiple weeks in January until the February 1st reporting. We felt as though gaining a higher number of observations would lead to a more accurate model than simply using monthly or even quarterly reports. This led to having 1722 total observations for the model. The point of the models was to see how government policies (which directly and indirectly affect our independent variables) affects the prices of the 3 most popular indices in the United States Stock Market.

OLS Regression Results:

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Dep. Variable: S&P500
R-squared: 0.864
Adj. R-squared: 0.863
F-statistic: 1810.
Prob (F-statistic): 0.00
No. Observations: 1722

	Coefficient Value	Standard Error	t-value	p-value
Constant	-4672.1703	210.92	-22.151	0
10YR	133.0712	16.199	8.215	0
FedFunds	52.9288	9.078	5.831	0
CPI	38.5238	1.35	28.546	0
UERate	-63.1167	7.433	-8.492	0
PPI	-11.8111	1.064	-11.103	0
RGDP	13.5815	1.952	6.957	0

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Dep. Variable: Dow
R-squared: 0.908
Adj. R-squared: 0.908
F-statistic: 2819.
Prob (F-statistic): 0.00
No. Observations:1722

	Coefficient Value	Standard Error	t-value	p-value
Constant	-3.78E+04	1440.035	-26.26	0
10YR	1016.8599	110.598	9.194	0
FedFunds	356.6959	61.977	5.755	0
CPI	326.4367	9.214	35.429	0
UERate	-485.4803	50.746	-9.567	0
PPI	-106.6197	7.263	-14.681	0
RGDP	93.659	13.328	7.027	0

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Dep. Variable: NASDAQ
R-squared: 0.759
Adj. R-squared: 0.758
F-statistic: 900.9
Prob (F-statistic): 0.00
No. Observations: 1722

	Coefficient Value	Standard Error	t-value	p-value
Constant	-2.08E+04	950.741	-21.826	0
10YR	668.7706	73.019	9.159	0
FedFunds	202.5005	40.918	4.949	0

CPI	143.4664	6.083	23.584	0
UERate	-41.6193	33.503	-1.242	0.214
PPI	-47.7622	4.795	-9.961	0
RGDP	67.1695	8.8	7.633	0

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Interpretation:

From the model summaries above, we see high R^2 values along with high F-statistics for all of the models. The "Prob (F-statistic)" value being 0, conveys that in all three models the null hypothesis is rejected, and our model is significant. In the model for the S&P 500, as well as the model for the Dow Jones, every single independent variable has a high t-value and a p-value of 0. This means that every single independent variable we used in these models was significant, and thus we decided not to attempt to remove any of the variables used for these models. For the Nasdaq model, however, while 5 of the independent variables also had a p-value of 0 and are thus significant, the Unemployment Rate variable had a high p-value of 0.214. This means that at an alpha value less than 0.214, our null hypothesis that the coefficient of the Unemployment Rate variable is equal to zero would not be rejected. More on this in the section below titled "Restricted Nasdaq Model". Overall, both the S&P 500 model and the Dow Jones model conveyed the same story about the respective variables. The coefficient for the 10 year constant maturity rate variable is positive, indicating a positive correlation with the price of both the S&P 500 and the Dow Jones. Similarly, so were the coefficients of Federal Funds rate, CPI, and Real GDP. On the contrary, the variables of Unemployment Rate and PPI had negative coefficients which suggests a negative correlation with the prices of both the S&P 500 and the Dow Jones.

With respective R^2 values of .864 and .908, our model represents 86.4% of variation in the S&P 500 prices and 90.8% of variation in Dow Jones prices.

Restricted Nasdaq Model:

As explained above in the interpretation of the models, the Nasdaq model exhibited 5 significant independent variables and 1 that seemed insignificant: the Unemployment Rate. Thus, we built another model to predict the Nasdaq prices, this time without the Unemployment Rate as an independent variable. The plan was to build a restricted model, and use the following formula to test if the Unemployment Rate variable is significant or not to the Nasdaq model:

$$\frac{(R^2_{UR} - R^2_R)/q}{(1 - R^2_{UR})/n-k-1}$$

Dep. Variable:NASDAQ
R-squared: 0.759
Adj. R-squared: 0.758
F-statistic: 1080.
Prob (F-statistic): 0.00
No. Observations: 1722

	Coefficient Value	Standard Error	t-value	p-value
Constant	-2.15E+04	759.201	-28.27	0
10YR	679.9592	72.473	9.382	0
FedFunds	228.1375	35.338	6.456	0
CPI	146.988	5.383	27.306	0
PPI	-49.9674	4.455	-11.216	0
RGDP	69.4951	8.6	8.081	0

Above are results for this restricted model without the Unemployment Rate included.

The results above clearly show that the Unemployment Rate is not significant for the Nasdaq model. When running the F-test using the formula shown above, we see that the F-value is 0 because there is no change in the R^2 between the unrestricted and restricted models. This means that the null hypothesis that the Unemployment Rate is insignificant is not rejected. Thus, we decided to keep the restricted model for the Nasdaq dependent variable. With a lower R^2 value than the S&P 500 and Dow Jones models (0.759), this model is slightly less successful in predicting variation in prices. However, similar to the other 2 models, we still see the same correlation between independent and dependent variables: 10 Year Constant Maturity Rate, Federal Funds Rate, CPI, and Real GDP have positive coefficients while PPI has a negative coefficient (with Unemployment Rate not included).

Multicollinearity

Macroeconomic variables such as the ones we used as the ones we chose for this model often have significant correlations that are highly studied by people trying to understand the movements of the stock market. Therefore, when creating our model, it was important to assume and test for multicollinearity within our independent variables. Multicollinearity occurs when two or more variables have a strong linear relationship, and it can lead to uncertainty in regression coefficients and individual contribution of variables within the model as a whole. The correlation matrix is often used to determine multicollinearity, which should be assumed to be present when the correlation between two or more independent variables is high, typically greater than 0.8 or even 0.9. However, it is important to note that high correlation does not always indicate multicollinearity, as sometimes two variables can be highly correlated without affecting the regression results.

Therefore, a more reliable way to detect multicollinearity is to compute the variance inflation factor (VIF) for each independent variable in the regression model. VIF is a measure of how much the variance of the estimated regression coefficient for a variable is increased due to multicollinearity with other variables in the model. A VIF greater than 5 or 10 is often considered to be an indication of multicollinearity.

Before discussing multicollinearity found in our model, it is worth noting the common market assumptions that predict where multicollinearity may be found in our model. These are correlations that most financial professionals accept to be widely true within the US financial markets. First is the relationship between PPI and CPI; these are the two most widely used measures of US inflation, and it follows that during times of economic stability these two have a strong correlation because the changes in producer prices are typically passed onto the consumers. However this relationship can deteriorate due to factors such as economic instability, disparity of pricing power, and supply chain issues—the latter of which has been a lingering issue since the beginning of the covid pandemic in 2020. Another correlation that should be expected in the market occurs between the Fed Funds rate and the 10yr treasury yield. This widely accepted direct relationship, as during periods of higher short term interest rates, investors will demand more yield to compensate for their higher expected cost of borrowing. The correlation between bond yields and the fed funds rate becomes accurate the shorter the bond maturity—for example the 2yr follows the fed funds rate much closer than the 10yr.

After calculating the VIF for each of our independent variables, CPI and PPI both had extremely high VIF's of 42 and 21 respectively; and the Fed Funds and 10yr had 5 and 13. As a VIF over 5 is considered to be a heavy indication of multicollinearity, it is clear that our assumptions were proven right.

In an attempt to fix this multicollinearity in CPI and PPU, we created the restricted model, which removed CPI as a variable entirely. This significantly reduced multicollinearity—bringing PPI down to a VIF of 3—however it significantly reduced our R-squared and therefore was a significantly less comprehensive model. Therefore we instead tried to linearly combine the two variables into one variable called “PI”; this also significantly reduced multicollinearity and only resulted in a somewhat lower R-squared than the original. These three VIF tables can be found below in respective order.

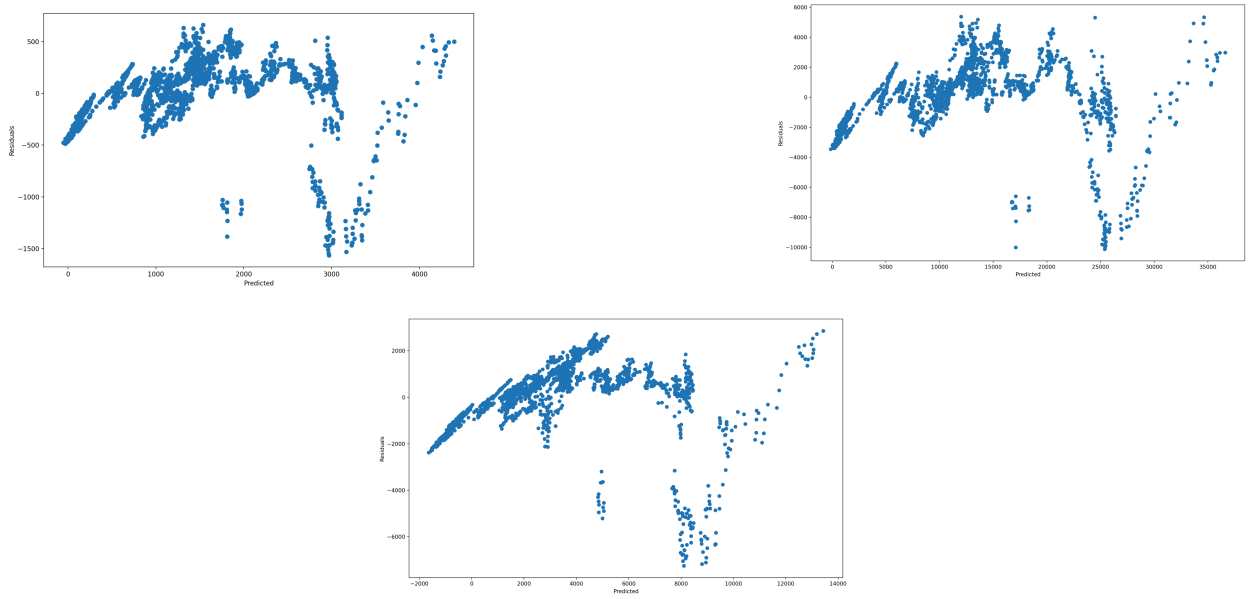
	variable	VIF
0	const	560.539141
1	10YR	13.511957
2	FedFunds	5.813330
3	CPI	42.563126
4	UERate	2.086116
5	PPI	21.411786
6	RGDP	1.055542

	variable	VIF
0	const	160.483435
1	10YR	7.204472
2	FedFunds	5.810140
3	UERate	1.633042
4	PPI	3.409957
5	RGDP	1.050725

	variable	VIF
0	const	252.337244
1	10YR	8.667253
2	FedFunds	5.808676
3	UERate	1.695450
4	RGDP	1.052789
5	PI	4.870114

Heteroscedasticity

Another concern in regression accuracy in the presence of Heteroscedasticity. This refers to the presence of non-constant variance in the error terms of a regression model. It violates one of the assumptions of ordinary least squares (OLS) regression, which assumes homoscedasticity (constant variance of errors). We tested this by creating a residuals plot, which tests for heteroscedasticity by examining the scatter plot of the residuals (the differences between the observed and predicted values) against the predicted values. If the spread of the residuals widens or narrows as the predicted values change, it suggests the presence of heteroscedasticity.



Above are the residual plots for the S&P, Dow, and Nasdaq; and the spread of the residuals do not indicate that there is noticeable heteroscedasticity in the model. Heteroscedasticity can be identified by widening spreads that make a cone or funnel shape of the residuals moving further away from each other, however through most of our data the distribution stays tight. There are definitely exceptions where the spread seems much more random and chaotic, which can be understood by extreme disruptions in the market: covid being the most recent and illustrative example. This was an example of when the model assumptions break down because covid lockdowns and spending essentially made macro data meaningless, and stock prices became driven heavily by speculation. Nonetheless, during normal market conditions our model seems to hold up the assumption of homoscedasticity quite well.

Conclusion

Throughout the process of undergoing research for the model and then developing the model itself we have realized the true practical applications of many base level econometrics that we can use to develop further models. By using three different stock indexes and 6 different

variables we were able to create three different models describing the effect that many different governmental policies could have on the stock prices. We were impressed by the R^2 values as many of them were quite high, showing that our models were relatively accurate which was quite a surprise considering the model only has 6 different variables. The fact that the majority of variables were significant throughout all three models did also show us that our choice of variables was quite accurate and it seems like most effects of governmental policy can be shown by the 6 variables chosen in our model. By choosing more reactionary variables we were sble to gauge a more general understanding of how different government policy can affect the stock market; for example the use of unemployment rate could dictate how stock market prices relate to fiscal stimulus, like the stimulus checks given out during a covid period. Further investigation could go even more specifically using dummy variables to map out if a specific type of stimulus was being given out in a period. Additionally, going further with this project it would be interesting to test more variables and their significance as well as looking at more indexes and other markets as well such as bond markets, to gauage a kind of comparison between what variables might be more accurate in predicting one type of index or market compared to another.

Practical based applications like algorithm based trading and financial planning simulations are definitely important to consider in a project like this. As mentioned in the literature review applications of these base and simple models can defintely be combined with the larger emphasis on things like machine learning and AI to create a more accurate stock market predictor that may not only help larger companies make profits but also help individual people get interested and start investing. How the market will react to such tools will be interesting seeing as these tools and predictions are likely to become better and better.

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