

How does US economy affect college donor growth?

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4/14/2022

Research Question/ Goal:

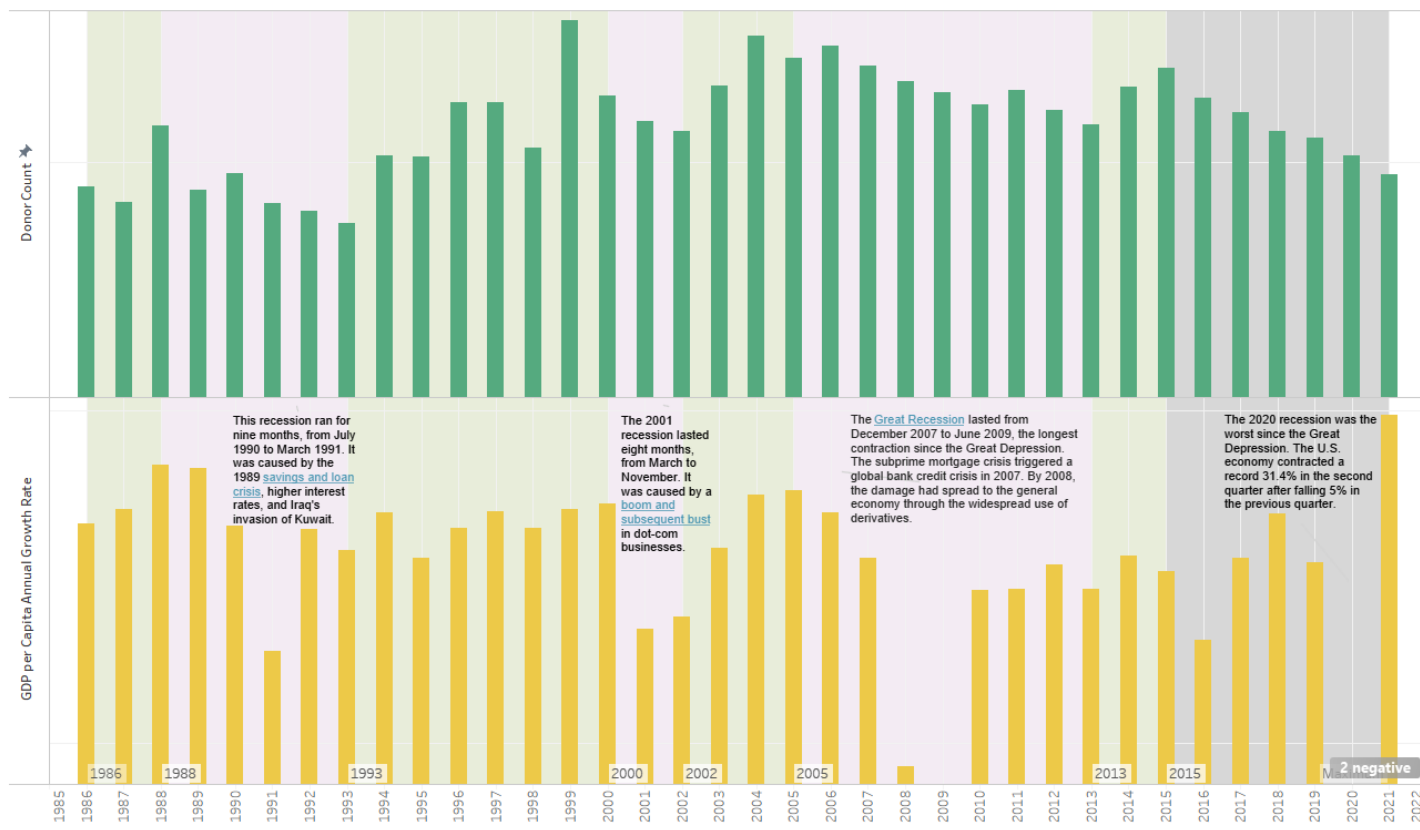
For any U.S. higher education, a large portion of a school's operating budget comes from endowment funds. Donating to your university also helps give back to the next generation of students. The money you donate to the school is often used for new scholarships and to help fund new programs for the next class of students who will be attending your college. Additionally, most rankings in national magazines rank colleges based on the percentage of alumni who give back to the school. More donors will lead to higher rankings. Previous economic studies have shown that economic factors have large impacts in annual charitable giving. So, how does the current economy affect the behavior of our school donors? What does this mean for us during economic shocks such as the COVID 19 economic crisis? In this project, we will try to uncover these questions by looking at our past donor data.

Analysis Plan:

Correlation Analysis and Regression Analysis: find the correlation between the school yearly donor numbers and US economic outcomes (US GDP per Capita), Giving per school Donors and NASDAQ performance. By doing this, we can roughly estimate or forecast the total amount we can expect and set goals for the present. Also, I want to find out what would happen to our donor growth if an economy shock happens; and what happens to US economy would negatively or positively impact the growth of school donors.

I got the yearly donor data which contains Year, Donor Count and Total Donation Amount from the school development side. I also got the US economic yearly data from macro trends.net which contains Year, US GDP per Capita and Annual_Growth_rate (GDP per Capita growth rate); as well as the NASDAQ historical annual data from macro trends.net which contains Year and Average Closing Price. Then I combined them into one table by Year, and included every data records from 1986 to now (because our giving data was not very accurate before 1986).

USF Donor Counts V.S. US GDP per Capita Growth Rate



From the graph above, we can see that the trend in number of school donors follows the US GDP per Capita Growth rate trend quite a bit. During some recessions, both have some ups and downs. So this raises the question, how exactly does GDP per capita in the US affect the number of school donors? And how much of an impact would a positive or negative economic shock have on the number of school donors?

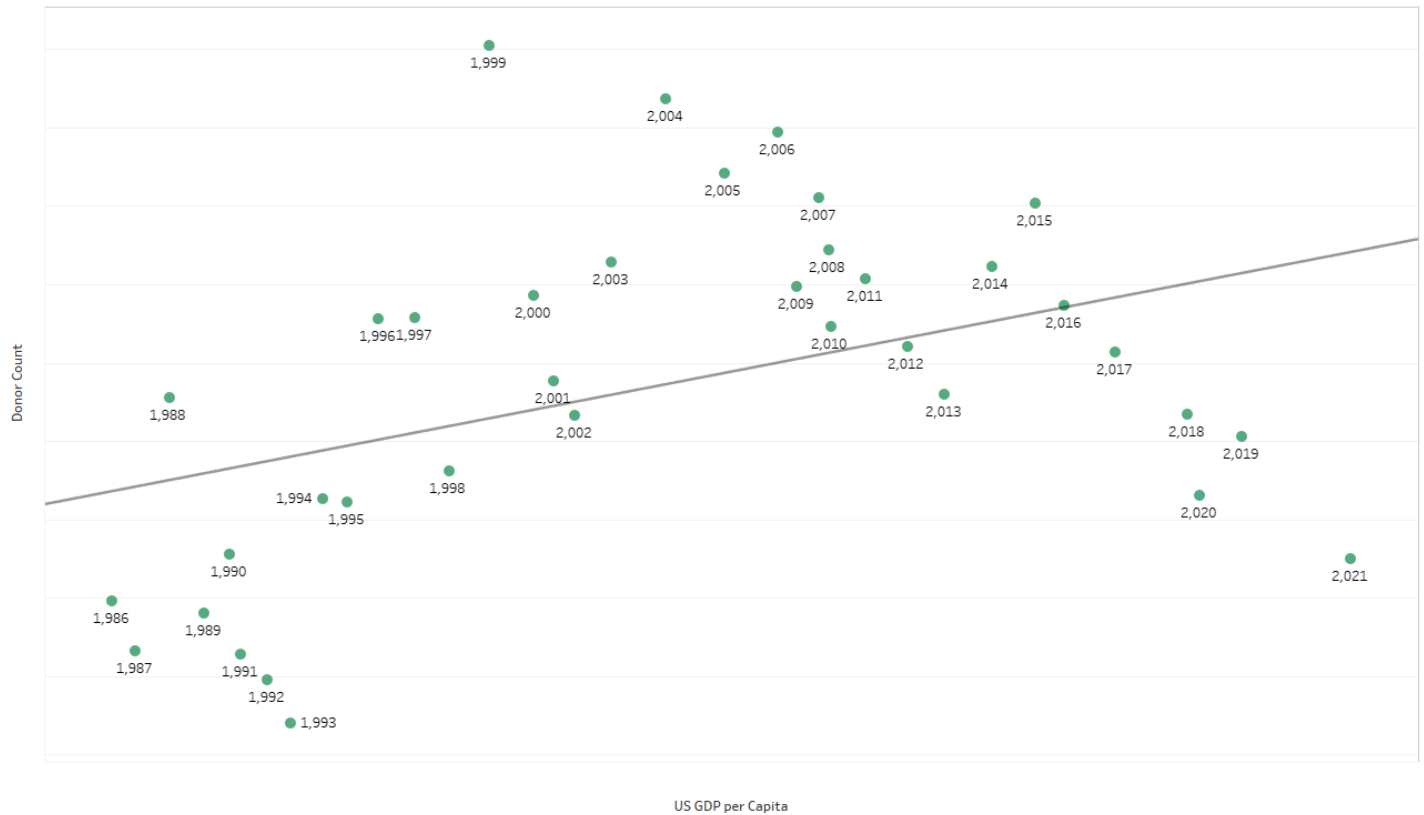
```
ECON_DATA_R <- read.csv("ECON_DATA_R.csv", head=TRUE, sep=",")
ECON_DATA_R2 <- ECON_DATA_R[ECON_DATA_R$CY >= 1986, ]
cor.test(ECON_DATA_R2$DONOR_COUNT, ECON_DATA_R2$US_GDP_per_Capita)
```

```
##
## Pearson's product-moment correlation
##
## data: ECON_DATA_R2$DONOR_COUNT and ECON_DATA_R2$US_GDP_per_Capita
## t = 2.5629, df = 34, p-value = 0.01498
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.08509786 0.64557608
## sample estimates:
## cor
## 0.4023839
```

```
logit_model <- lm(DONOR_COUNT ~ US_GDP_per_Capita, data = ECON_DATA_R2)
summary(logit_model)
```

```
##
## Call:
## lm(formula = DONOR_COUNT ~ US_GDP_per_Capita, data = ECON_DATA_R2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3908.0 -1460.1  -40.7   1408.0  4750.0
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    9.212e+03  1.029e+03   8.949 1.85e-10 ***
## US_GDP_per_Capita 6.022e-02  2.349e-02   2.563  0.015 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2026 on 34 degrees of freedom
## Multiple R-squared:  0.1619, Adjusted R-squared:  0.1373
## F-statistic: 6.569 on 1 and 34 DF, p-value: 0.01498
```

USF Donor Count V.S. US GDP per Capita

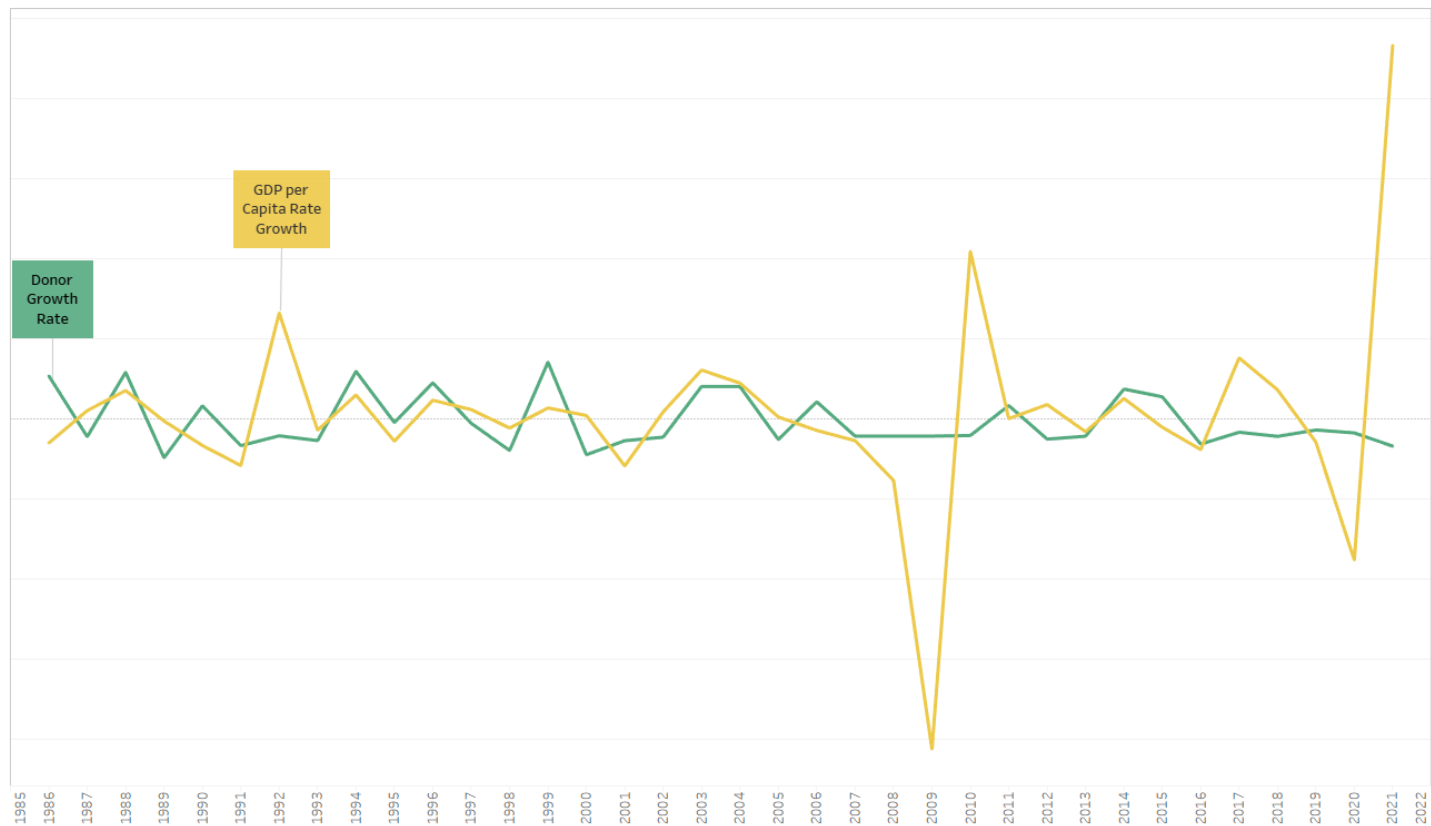


As we can see from the model above, There is some kind of correlation between school donor numbers and US GDP per capita (with a p-value of 0.015); however, we also got a very low R-squared; which means US GDP per capita may not be the only factor to impact school donor number. What are the other potential factors? Let's discuss more here.

Progress & Visualization:

First, let's see how much of an impact would a positive or negative economic shock have on the number of school donors? I graphed the square root of school donor count growth rate by using this formula, $((D_i - D_{i-1})/D_{i-1})^{1/2}$, where D_i is the total school donor count in year i , and D_{i-1} is the school donor count in the prior year, as well as the US GDP per Capita growth rate acceleration by using this formula, $(R_i - R_{i-1})/R_{i-1}$, where R_i is the US GDP per Capita growth rate in year i . The US GDP per Capita growth rate acceleration can represent US economic shocks (positive or negative) when we see spikes on the line.

Donor Count Growth V.S. GDP per Capita Rate Growth

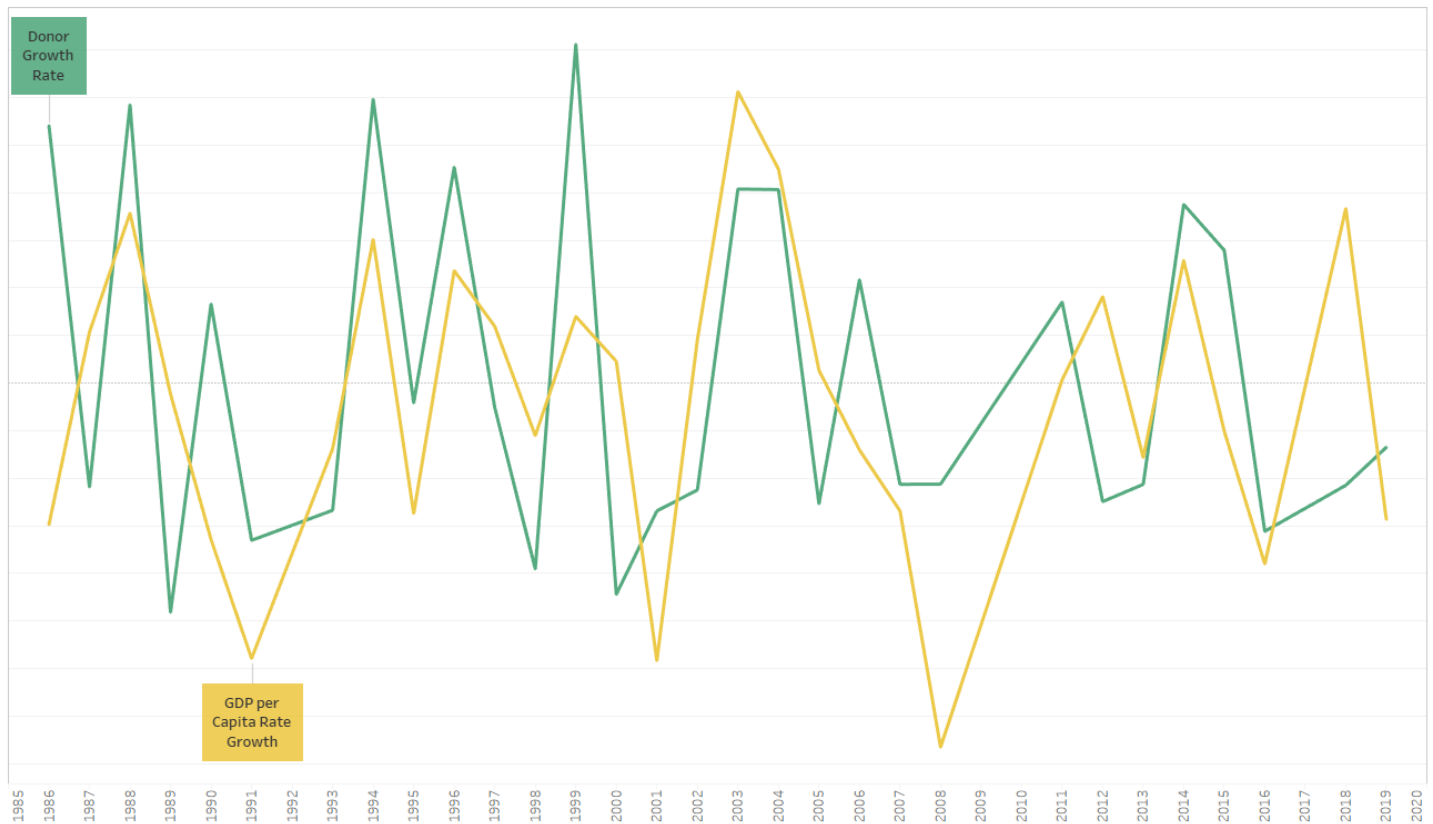


```
cor.test(ECON_DATA_R2$sq_donor_growth_rate, ECON_DATA_R2$GDP_per_Capita_Growth_Acc)
```

```
##
## Pearson's product-moment correlation
##
## data: ECON_DATA_R2$sq_donor_growth_rate and ECON_DATA_R2$GDP_per_Capita_Growth_Acc
## t = 0.13486, df = 34, p-value = 0.8935
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## -0.3077515 0.3490066
## sample estimates:
## cor
## 0.02312208
```

From this correlation test, we can barely see a correlation between the school donor growth rate and the pace of US GDP per Capita growth rate. However, from the graph above, we also can see these 2 lines lined up except at some points during the US economic shocks.

Donor Count Growth V.S. GDP per Capita Rate Growth (without economy shocks)



```
ECON_DATA_R3 <- ECON_DATA_R[ECON_DATA_R$CY >= 1986 & ECON_DATA_R$CY != 1992 & ECON_DATA_R$CY != 2009 & ECON_DATA_R$CY != 2010 & ECON_DATA_R$CY != 2017 & ECON_DATA_R$CY != 2020 & ECON_DATA_R$CY != 2021, ]
cor.test(ECON_DATA_R3$sq_donor_growth_rate, ECON_DATA_R3$GDP_per_Capita_Growth_Acc)
```

```
##
## Pearson's product-moment correlation
##
## data: ECON_DATA_R3$sq_donor_growth_rate and ECON_DATA_R3$GDP_per_Capita_Growth_Acc
## t = 2.7114, df = 28, p-value = 0.01132
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## 0.1145820 0.7011088
## sample estimates:
## cor
## 0.4560263
```

When we take out those points during the US economic shocks, the new correlation test improves the result to have a correlation score of 0.456 with a 0.01 p-value.

From the analysis above, we also can see that, shocks of the US economy actually won't help to increase our donor growth (as fast as in the years that US economy had a constant growth); This may be due to people who were not recovered by the downfall of the economy in the previous year, and they were still in a panic mode.

So we can see that the economic shock in the US won't affect the number of school donors to a large extent, but what will? According to this article "Larger Donations, Fewer Donors" (<https://www.insidehighered.com/news/2019/06/20/donations-colleges-are-number-donors-down>), the passage of the 2017 Tax Cuts and Jobs Act, which eliminated the need for many middle-class people to itemize their deductions would largely impact the number of donors. Many have worried that, absent those itemized deductions, donations would drop. the organization's philanthropic is disproportionately reliant on small donations from middle-income donors, who will be more affected by the tax code changes, as this is indeed the group that will move from itemized lists to non-projects, and will no longer be able to deduct charitable gifts.

```
ECON_DATA_R2$is_shock <- ifelse(ECON_DATA_R2$CY == 1992 | ECON_DATA_R2$CY == 2009 | ECON_DATA_R2$CY == 2010 |
ECON_DATA_R2$CY == 2017 | ECON_DATA_R2$CY == 2020 | ECON_DATA_R2$CY == 2021, 1, 0)
ECON_DATA_R2$after_tax_cuts <- ifelse(ECON_DATA_R2$CY >= 2017, 1, 0)
logit_model2 <- lm(DONOR_COUNT ~ US_GDP_per_Capita + is_shock + after_tax_cuts, data = ECON_DATA_R2)
summary(logit_model2)
```

```
##
## Call:
## lm(formula = DONOR_COUNT ~ US_GDP_per_Capita + is_shock + after_tax_cuts,
##     data = ECON_DATA_R2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3060.2 -1016.4  -379.3  1098.2  4516.8
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    7.051e+03  9.871e+02   7.144 4.15e-08 ***
## US_GDP_per_Capita  1.296e-01  2.503e-02   5.177 1.19e-05 ***
## is_shock        -9.884e+02  8.374e+02  -1.180  0.24657
## after_tax_cuts   -3.925e+03  1.105e+03  -3.551  0.00121 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1652 on 32 degrees of freedom
## Multiple R-squared:  0.4755, Adjusted R-squared:  0.4263
## F-statistic: 9.669 on 3 and 32 DF,  p-value: 0.0001078
```

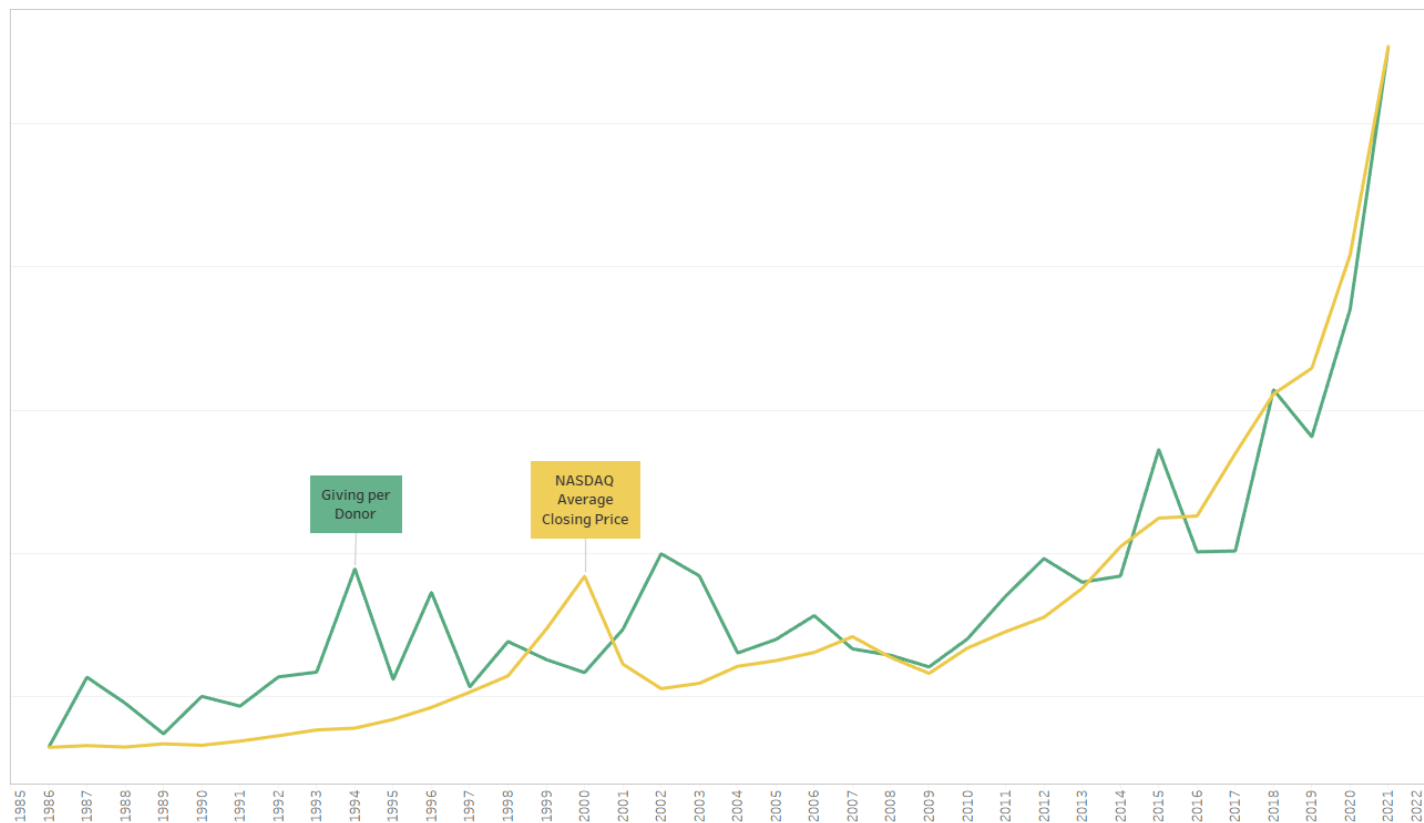
So, if we put those valuables into the model, the R-squared is improved to 0.4755 from 0.16.

We could argue that there is some correlation between the US economy and the growth in the number of school donors over time. The drafted model shows that the ideal situation for school donor count growth is for US GDP per Capita growth rate to have a steady rate of growth. When people feel their economic is growing steadily in the current year, and they are optimistic about their future economic growth, they are more willing to give to school. However, any Tax act that would affect charitable gift deductions would mess up the trend and largely impact the school donor growth.

Giving per USF Donors and NASDAQ performance

Per Give Global Blog (<https://charity.org/give-global-blog/developing-your-fundraising-strategy-under-triple-threat-economic> (<https://charity.org/give-global-blog/developing-your-fundraising-strategy-under-triple-threat-economic>)): there's a strong relationship between how much money Americans give to charity and the stock market's performance. That means people give more when they feel that they have money to spare. I also did a correlation analysis between Giving per school Donors and NASDAQ performance to see if this statement is also true for our school.

USF Amount per Donor V.S. NASDAQ Performance



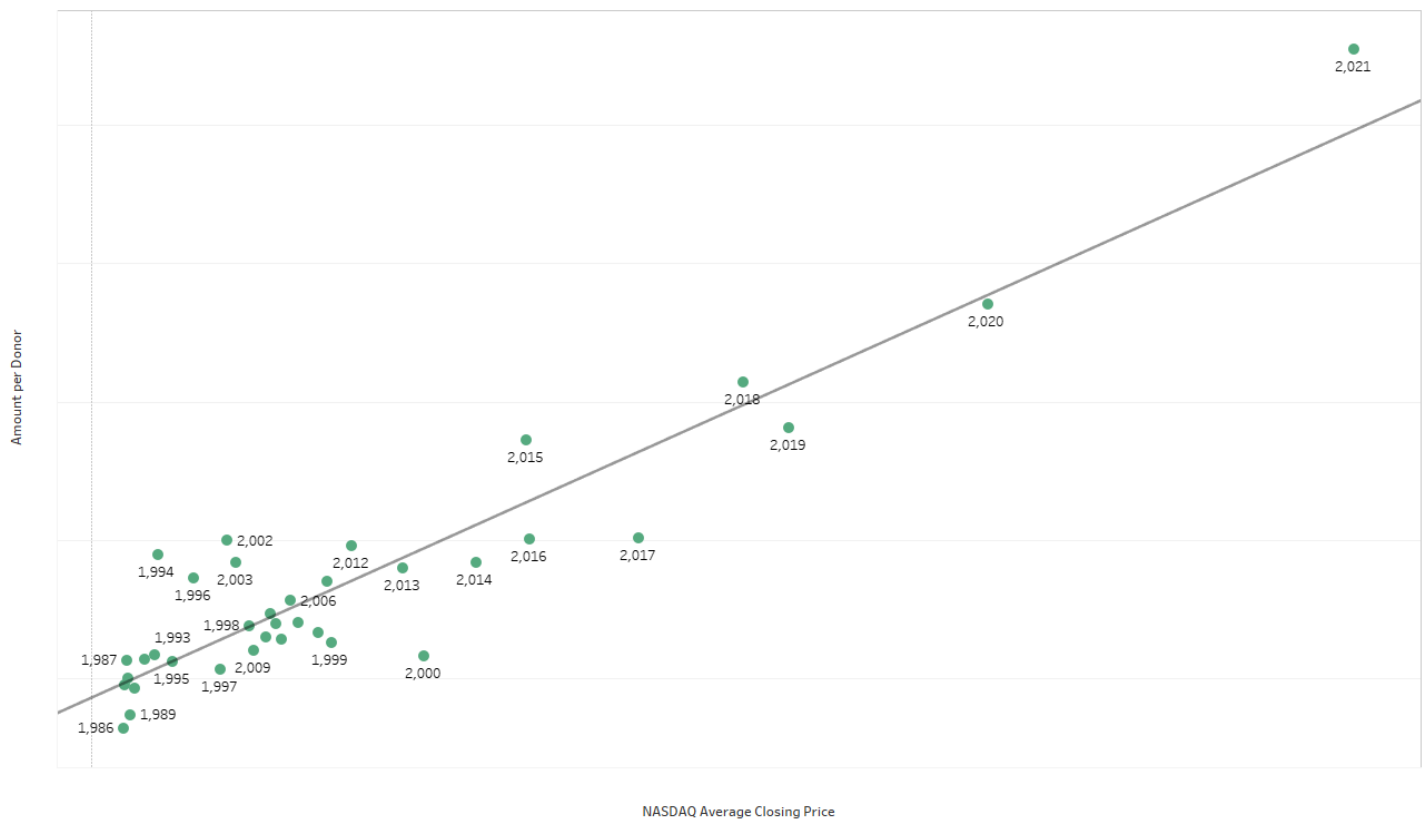
```
ECON_DATA_R2$AMT_per_Donor <- ECON_DATA_R2$TOTAL_AMOUNT/ECON_DATA_R2$DONOR_COUNT
cor.test(ECON_DATA_R2$AMT_per_Donor, ECON_DATA_R2$Average_Closing_Price)
```

```
##
## Pearson's product-moment correlation
##
## data: ECON_DATA_R2$AMT_per_Donor and ECON_DATA_R2$Average_Closing_Price
## t = 14.647, df = 34, p-value = 2.999e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.8643873 0.9635164
## sample estimates:
##          cor
## 0.9290807
```

```
logit_model2 <- lm(AMT_per_Donor ~ Average_Closing_Price, data = ECON_DATA_R2)
summary(logit_model2)
```

```
##
## Call:
## lm(formula = AMT_per_Donor ~ Average_Closing_Price, data = ECON_DATA_R2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -773.05 -221.86  -38.28  118.19  815.95
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    860.85841    82.02310    10.49 3.33e-12 ***
## Average_Closing_Price  0.28506     0.01946    14.65 3.00e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 350.2 on 34 degrees of freedom
## Multiple R-squared:  0.8632, Adjusted R-squared:  0.8592
## F-statistic: 214.5 on 1 and 34 DF, p-value: 2.999e-16
```

USF Amount per Donor V.S. NASDAQ Performance



As we can see, the USF Giving per school Donor definitely follows a linear trend with NASDAQ performance! We can argue that when NASDAQ performance is strong, the Giving per school Donor will be higher. However, in this research, we could not find the real causality between the NASDAQ performance and the Giving amountnt per school Donor; more future studies need to be conducted to determine school donor behavior as we see strong stock market performance. Maybe every donor will be more generous when stocks are doing well; or maybe only those own high-performing stocks will give more to school. For this, we definitely need different strategies.