Analyzing the Impact of and Factors Influencing Harvard's Endowment and Investment Portfolio

Harvard controls the largest university endowment in the world, and much of that is reliant on its successful investment portfolio. In the face of protests against Harvard's investment choices and international financial struggles, how well has Harvard bolstered its endowment and maintained its financial strength? In this analysis, I use data from Harvard's annual financial reports dating back to 2004 to conduct a brief analysis of Harvard's endowment, investment performance, and key factors in the university's financial success. In particular, I investigate which components of the investment portfolio are most influential to its success, how the endowment is associated with student and staff benefits, and how we can predict the Harvard endowment's performance in the future.

In short, I conclude that although the lack of historical data regarding Harvard's finances make it difficult to predict future performance of the endowment, we can see close associations between the endowment and student/staff benefits, as well as indications that real assets, absolute returns, and hybrid bonds have been most associated with Harvard's investment portfolio performance over time.

Exploratory Analysis:

We can begin by calculating some standard metrics of Harvard's investment portfolio. I first determine the risk associated with the Harvard investment portfolio by calculating the standard deviation of the investment portfolio over the last 16 years; this risk is roughly 9450000000, or 15 percent of the investment portfolio's current value. The risk of the portfolio is thus relatively low, which can be interpreted as being due to its low makeup of equities and high proportion of bonds and cash. The portfolio's beta, using the S&P 500 baseline, is roughly 6940000, indicating much more volatility in the portfolio than in the overall market. Lastly, using interest rate data in the U.S. since 2003, the delta of Harvard's investment portfolio with respect to interest rates is -0.505 (p-value 0.0325), indicating an overall decrease in the portfolio's value as interest rates increase. This is to be expected, considering the high proportion of bonds within the portfolio over time.

We can also infer information on the impact of Harvard's investment portfolio and endowment from the correlations between Harvard's endowment and other related values. As expected, the endowment is highly correlated with the investment portfolio's performance; the correlation between the two values is 0.830 (p-value $2.07 * 10^{-5}$). Additionally, the correlation between the endowment and

Harvard Endowment and Investment Portfolio Over Time
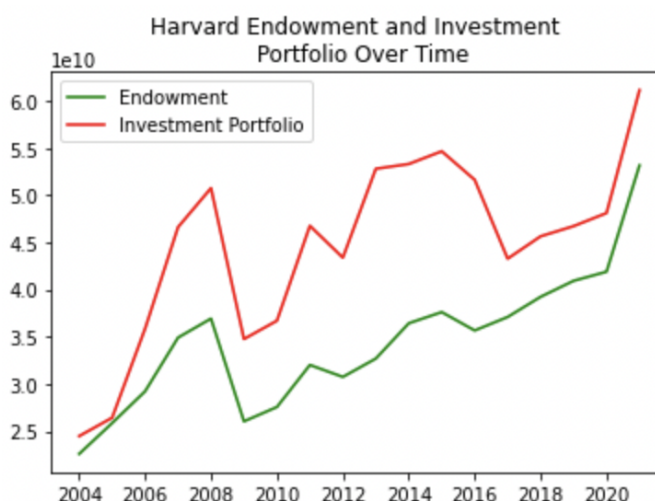
Harvard employee salaries and wages is 0.824 (p-value $2.62 * 10^{-5}$), showing that there is a high association between Harvard's overall financial performance and employee wages/benefits. Similarly, the correlation between the endowment and Harvard scholarships and student awards is relatively high at 0.797 (p-value $7.50 * 10^{-5}$), showing that when Harvard's endowment is successful, we may expect to see the associated increase in staff and student monetary benefits.
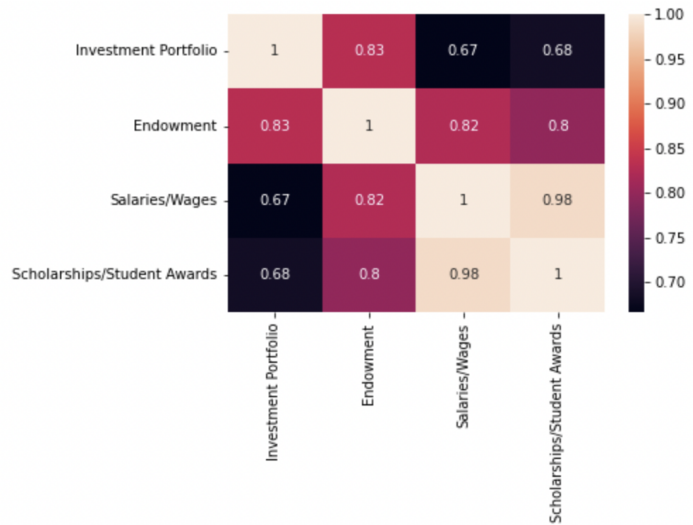

What affects the endowment and how can we predict its performance?

We can next try to understand which factors of the investment portfolio most impact its and the endowment's performance by taking into account the time lag between our data. Unfortunately, the lack of frequency and overall availability of data regarding the value of the investment portfolio and endowment made it unlikely that a time series analysis would provide much insight into predicting both's performances.

Looking first to the correlations between Harvard's investment portfolio returns and contributing factors to it, there were high correlations between the investment portfolio and real assets including natural resources and real estate (0.512, p-value 0.030) and absolute returns (0.520, p-value 0.027). Additionally, a strong association could be observed between the investment portfolio and hybrid bonds (correlation -0.668, p-value 0.002). Meanwhile, lower correlations could be observed between the investment portfolio and domestic/foreign bonds, albeit with higher p-values. These findings indicate that the performance of the investment portfolio was strongly associated with factors such as real assets, absolute returns, and hybrid bonds over time, which can be somewhat explained as the high volatility contained within most real assets would likely make them more influential towards a portfolio they are contained within than bonds. It is important to note that the data used in this research is directly from Harvard's annual financial reports, which have changed their definitions of specific asset and bond groupings over time. Nevertheless, the general trends observed by looking at these correlations should hold true overall.
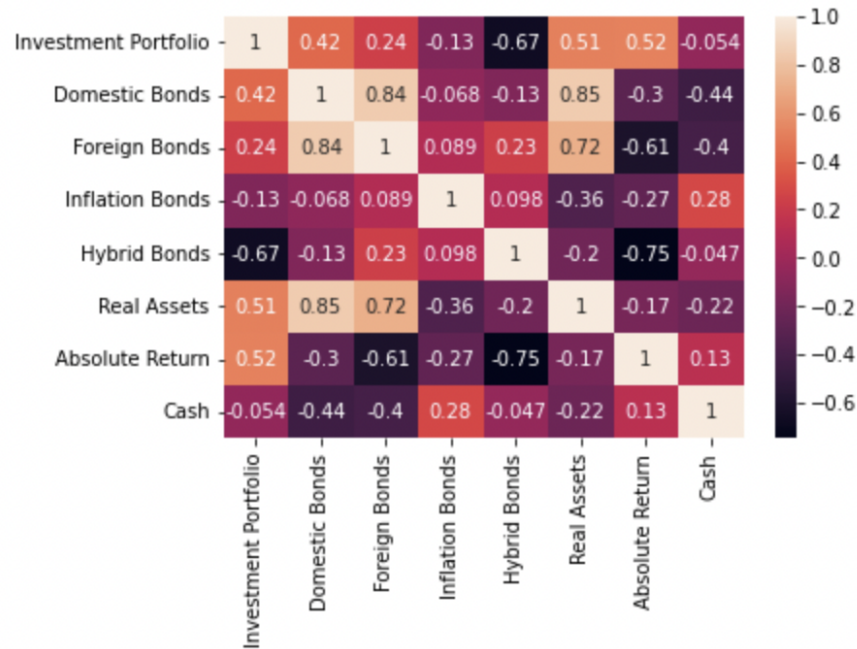
Next, we can conduct a Dickey-Fuller test and generate autocorrelation plots to check for stationarity and seasonality. Based on the Dickey-Fuller p-value (0.349), we cannot reject the null hypothesis that there is no stationarity present in the data. Additionally, the autocorrelation plots show that there is no seasonality as there is no detectable pattern over periods of time in the data (although there is not enough data to truly determine seasonality). There is also no stationarity present in the autocorrelation plots, as the autocorrelation in the data continues to decrease over time.
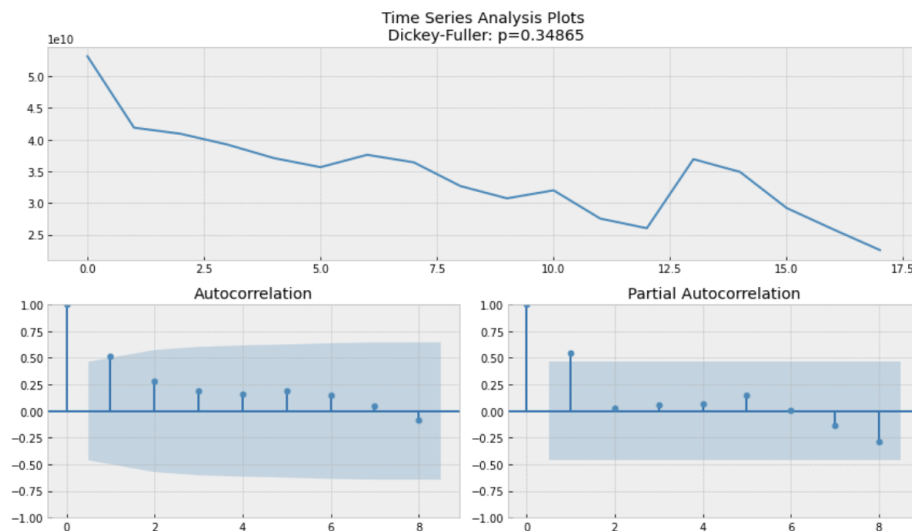
We can also create some simple time lag models using the endowment data over time. Starting with a moving average model, using a model with a large window created a smoother line, but as the existing data was already very small in size and thus smooth, a very small

window size of 2 was used. Due to the lack of data, it was unclear whether there are seasonal trends to be observed in the endowment data due to the lack of historical data and the downward trend in Harvard's finances throughout two national recessions. Using models with exponential smoothing applied with two different smoothing factors proved the same results, as an overall downward trend without any periodic patterns could be observed in the endowment data. Although additional machine learning models could be used to make somewhat reliable predictions of the endowment's performance using the available data as a training set, they most likely would not have provided further insights into the contributing factors of the endowment.
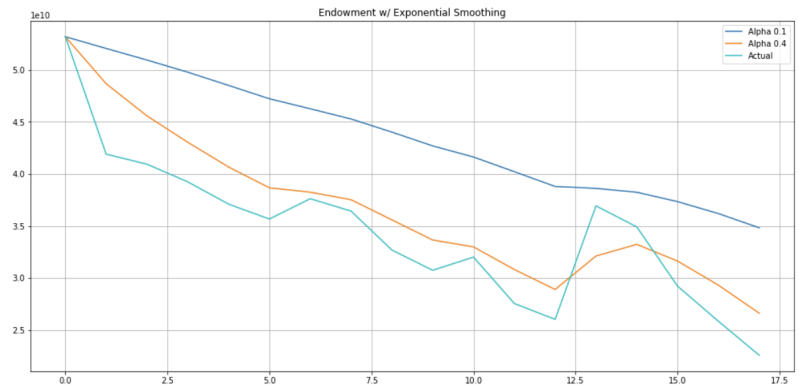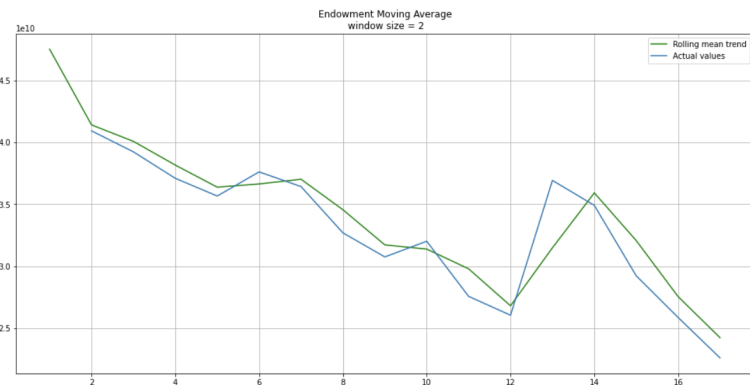
Conclusion:

Clearly, with more in-depth data on Harvard's finances spread out even over months instead of years, it would be possible to make a stronger attempt at forecasting Harvard's future financial performance. Nevertheless, this analysis provides some insights into the significance of various components of Harvard's investment portfolio, as well as the impact that the university's endowment has on student and staff life. All code used for this project is here.