Investigating Stock Market Trading Strategies

Emma Burke, Elaine Jin, Andy Miller and Ben Sarr
Under the Guidance of Dr. Douglas Eckley and Kibre Bekele

Mason Experimental Geometry Lab

GEORGE MASON UNIVERSITY

5/2/2025 Exploratory 3301

Background

One useful description of the stock market is that it is a casino with a long-term uptrend. That is, a casino where the player has the edge.
Philosophically, we have two camps:

- The stock market is a Markov chain: history does not affect the probabilities of what might happen next
- Past price trends can be analyzed and used to more accurately assess future price movements

If the latter is correct, then our investigations should not suggest that any particular strategy is more successful than any other.

Data

We gathered a large amount of historical data on stock market prices, then used the data to test a variety of trading strategies. The following data were gathered:

- Dow Jones Industrial Average ("DJIA") closing prices, for every trading day between December 31, 1912 and December 31, 2024.
- Consumer Price Index (CPI) measures, monthly, for the same time period
- Dividend yield rates for the 500 top US companies, S&P 500 companies, quarterly, for the same time period

Historical Rates of Return (ROR)

Our variable of study was the DJIA adjusted for

- long-term uptrend removed
- inflation removed
- dividend yields included

We facilitated the calculation of daily rates of return by fitting cubic splines to monthly data for the CPI and quarterly data for dividend payout rates. This gave us very nearly 30,000 daily rates of return. The Excel program was used to find the Dow/CPI, Log(Dow/CPI), Diff(Log), Yield per Day, Log(1+Yield), and the Daily ROR. This inflation adjusted internal rate of return (IRR) was the metric used to measure if the investment strategy was profitable.

Strategies

- Randomly choosing entry points over the time period
- DCA: Invest fixed amount of money at regular intervals, regardless of market conditions
  - Investment Frequencies: Daily, Monthly, Weekly, Yearly
  - Generational (assume person invests from ages 18-65)
- Calendar-based strategies
  - Every month, day of week, day of the month
- Economic environment-related strategies
  - Democrat vs. Republican President in office
  - War vs peacetime
  - Labor wages

Cubic Spline

Significance and Methodology

- The financial metrics that we used were all discrete with varying time frames. For example, the Consumer Price Index is updated each month, while average dividend yields are measured each year. To avoid large, quick changes in these measures, our team decided to interpolate these periodic values daily during trading days of the stock market.
- The difficulty of finding the splines was more of a problem of data manipulation than of mathematics. We have enough constraints from the zeroth, first and second derivative conditions at branch boundaries that our system is fully determined. However, we need to coerce our input data, given as a vector of dates at specific time intervals, into a vector of numeric inputs and outputs. Afterwards, we need to evaluate the spline at each date. In practice this was all done using a simple Python program.

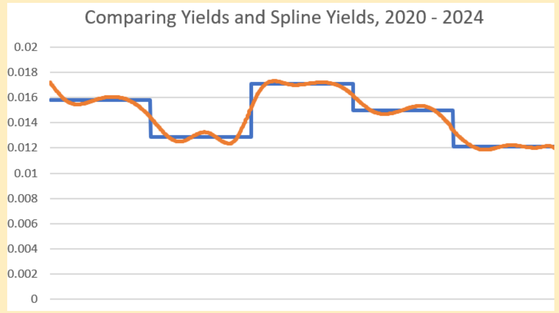

Figure: Comparing Yields and Spline Yields, 2020 - 2024

Findings

Random Strategies

- 1 USD was invested on n, between 100 to 1000, randomly selected days
- 1000 random strategies were tested and the histogram to the right shows the IRRs from all the strategies
- 6.74% was the average of all these IRRs and was used as the baseline value to determine if the other strategies were successful in "beating the market"

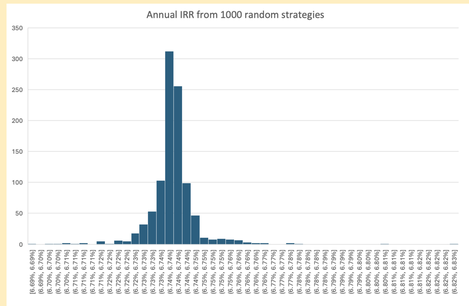

Figure: IRR from 1,000 Random Strategies

Value of 1 USD Overtime Since December 1912

- The graph to the right represents how much 1 USD invested in December of 1912 has grown across the years
- Major events that affected the value of 1 USD include WWI, great depression, WWII, cold war, lost decade of the 1970s, internet boom, and housing crisis.

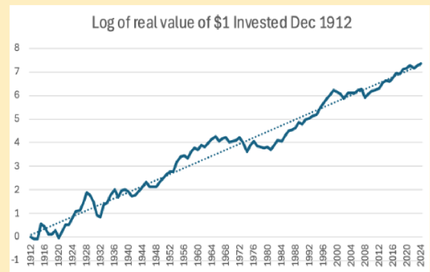

Figure: Growth of 1 USD from 1912-2024

Calendar-based Strategy

- This strategy investigates how certain events and the combination of events can influence the stock market

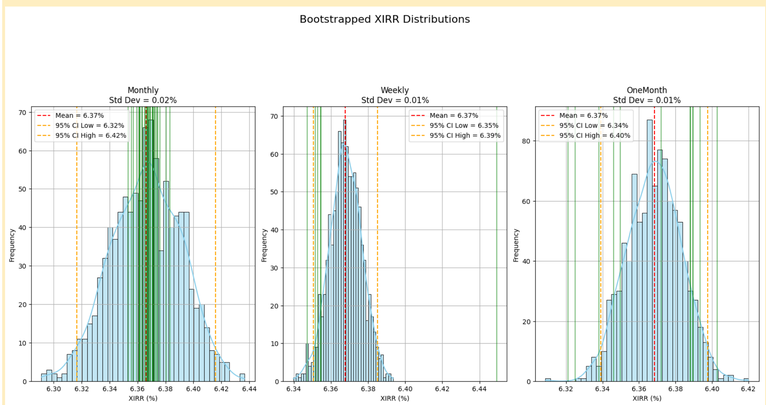

Figure: XIRR Distributions for Calendar-Based Investing

Events Based Strategy

- When explaining a series of numbers, such as the stock market, there is more than meets the eye. Using the current events of the time including presidential status, war status, minimum labor wages, and combinations of the sort, I can help determine whether the events of the present have any impact on peoples choice to invest.
- Findings: When evaluating the current events, there are not many cases where you can consider "wins". However, there are a few cases that you can consider losses, such as when there is a republican in office, and war is occurring, as shown by the internal rates of return.

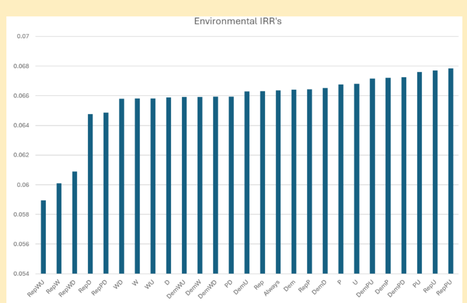

Figure: Event Based IRR

Dollar Cost Averaging (DCA) Strategy

- Applying DCA on DJIA data from 1915-2024 showed that, regardless of investment amount or frequency, the IRRs stayed in a narrow range of 6.63% - 6.64%. In conclusion, the DCA strategy did not outperform the stock market when compared to the random strategies.
- When applying DCA across generational periods (to mimic 401K-style investing), the silent generation performed the worst no matter how often 1 USD was invested, with an average IRR of 6.02%. Millennials achieved the greatest average IRR of 7.89% despite investing 29 years less than the silent generation. Potential explanations: the silent generation was negatively impacted by the downfall of the "lost decade of the 1970s" while the baby boomers gained from the post-1970s recovery and the millennials are benefiting from the post-2008 housing crisis rebound, which can also be seen in Figure: Growth of 1 USD from 1912-2024.

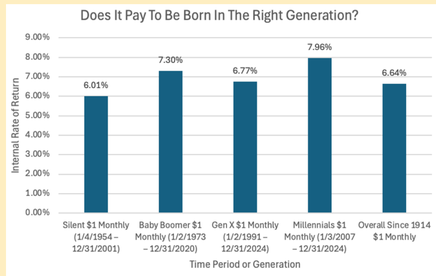

Figure: Does It Pay To Be Born In The Right Generation?

Conclusions

We identified some strategies that "beat the market", though not by much when compared to the performance of the random strategies. Across the 122 strategies investigated, only a handful were outside of a very narrow range, as measured by the IRR.

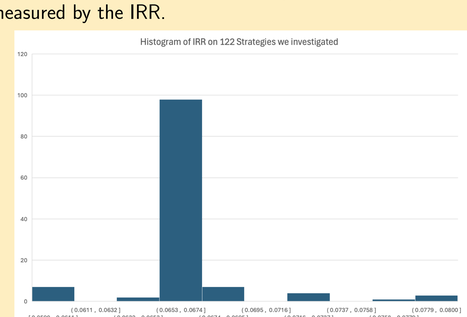

Figure: Histogram of IRR on 122 Strategies Investigated

- DCA does NOT beat the market
- Investing on certain days of the month and days of the week do not produce significantly better investing results
- War is NOT a good time for the stock market