Assignment – 7

Step – 3: why I picked Cyber-Security Proportion?

I picked the cybersecurity proportion method because it provides a more balanced and accurate measure of a firm's cybersecurity risk exposure. Instead of just counting the number of cybersecurity-related sentences, which could be biased by the overall length of the filing, this method accounts for the total number of sentences in the Item 1A section. By using the proportion, I can better compare the emphasis different firms place on cybersecurity, regardless of the total length of their risk disclosures. This approach allows for more meaningful comparisons and reflects the relative importance of cybersecurity within each firm's risk profile.

Step – 4:

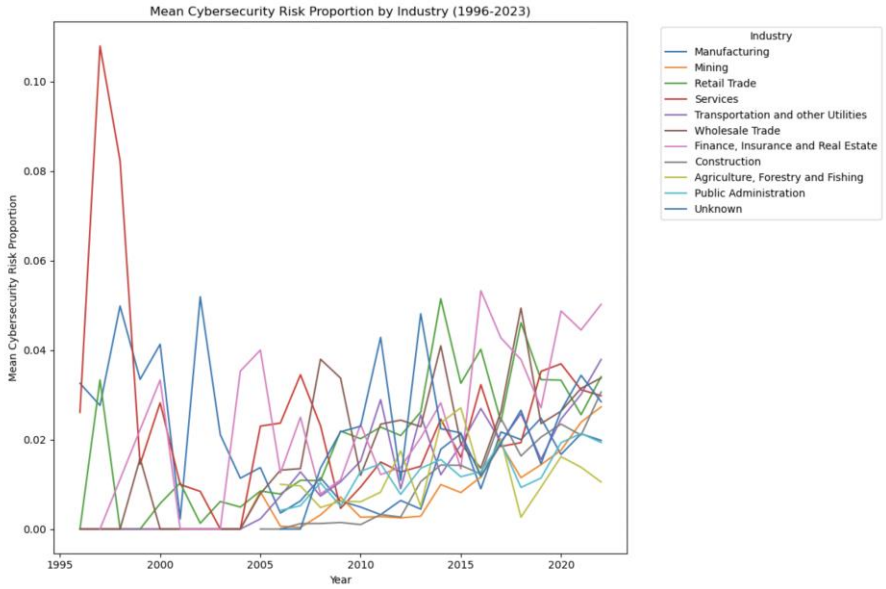
industry	N	Mean	Std	Skewness	Kurtosis	Min	Max	1%	5%	25%	50%	75%	95%	99%
Agriculture, Forestry and Fishing	170.0	0.011910	0.015326	1.658191	2.707177	0.0	0.066667	0.0	0.0	0.0	0.006154	0.018434	0.048294	0.062500
Construction	180.0	0.011056	0.014413	1.657375	2.810581	0.0	0.072289	0.0	0.0	0.0	0.007519	0.015255	0.042568	0.061224
Finance, Insurance and Real Estate	240.0	0.024202	0.039003	4.775312	37.016019	0.0	0.400000	0.0	0.0	0.0	0.012410	0.032000	0.083333	0.176471
Manufacturing	270.0	0.018674	0.039419	4.178881	21.219464	0.0	0.285714	0.0	0.0	0.0	0.003031	0.019902	0.087500	0.250000
Mining	270.0	0.006441	0.012126	3.201862	14.371198	0.0	0.095238	0.0	0.0	0.0	0.000000	0.008541	0.030000	0.054500
Public Administration	170.0	0.012581	0.014993	2.039482	5.549077	0.0	0.089744	0.0	0.0	0.0	0.007648	0.018123	0.039285	0.067538
Retail Trade	270.0	0.019719	0.025611	1.723294	3.249790	0.0	0.136364	0.0	0.0	0.0	0.011634	0.028571	0.070976	0.111111
Services	270.0	0.025236	0.036880	2.444977	6.701504	0.0	0.200000	0.0	0.0	0.0	0.013637	0.033333	0.110330	0.168154
Transportation and other Utilities	260.0	0.012707	0.019987	2.329078	6.966774	0.0	0.131579	0.0	0.0	0.0	0.000000	0.018182	0.050473	0.085865
Unknown	151.0	0.022936	0.024848	1.091533	0.372215	0.0	0.097222	0.0	0.0	0.0	0.018182	0.035971	0.074074	0.084507
Wholesale Trade	260.0	0.018043	0.027265	1.784197	2.821591	0.0	0.136364	0.0	0.0	0.0	0.000000	0.026316	0.076923	0.108049

In analyzing the descriptive statistics for the cybersecurity risk measure across industries, I observed several important trends. For instance, industries like "Finance, Insurance and Real Estate" and "Services" exhibit higher mean cybersecurity risk proportions, with means of 0.0242 and 0.0252, respectively. These industries, being more exposed to data breaches and attacks on digital infrastructure, naturally reflect greater cybersecurity concerns in their filings.

On the other hand, industries such as "Mining" and "Construction" have much lower means (0.0064 and 0.0111), which is consistent with their lower dependence on digital infrastructure compared to industries like finance. However, these industries still display a non-zero level of risk, which could be related to emerging threats as their operations become more digitized.

Additionally, skewness values highlight interesting patterns. "Finance, Insurance and Real Estate" has a high skewness of 4.775, indicating that while most firms in this industry report low cybersecurity risk, a few have extremely high proportions. This could reflect concentrated risk among larger institutions or those with more detailed disclosures on cyber risk. Similarly, industries like "Manufacturing" and "Mining" also show high skewness values, reflecting the occasional but significant cybersecurity concerns in what are typically lower-risk sectors.

The high kurtosis in industries like "Finance" and "Manufacturing" suggests the presence of extreme values or outliers in the data, with some firms showing disproportionately high levels of cybersecurity risk disclosure. Overall, these patterns suggest that industries with more digitization and customer data, like finance and services, exhibit more variability and higher reported cybersecurity risk compared to traditional sectors.



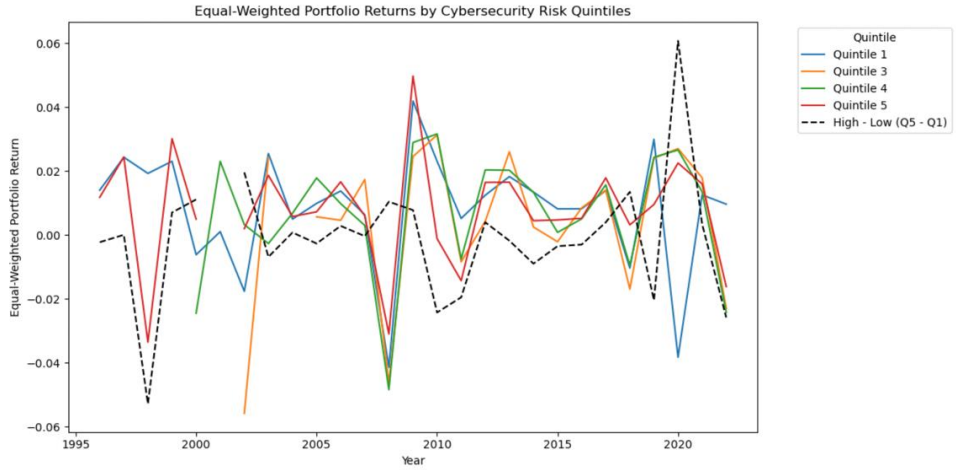
Looking at the plot of mean cybersecurity risk proportion by industry from 1996 to 2023, I observe some interesting trends. First, industries like "Services" and "Finance, Insurance and Real Estate" tend to show higher and more volatile proportions of cybersecurity risk over time. This makes sense, given the increasing reliance on digital systems and the rising awareness of cyber threats in these sectors. The spike in "Services" around the early 2000s may be due to heightened concern after major cybersecurity incidents or regulatory changes that emphasized disclosure.

Most industries experience relatively low cybersecurity risk proportions before the mid-2000s, which aligns with the fact that cybersecurity concerns became more prominent with advancements in technology. Post-2010, there is a noticeable rise across all industries, likely driven by an increasing focus on data protection, privacy regulations, and high-profile breaches.

Interestingly, industries like "Mining" and "Agriculture" show minimal or sporadic increases in cybersecurity risk, reflecting their lower exposure to digital threats compared to sectors like finance. However, the upward trend across almost all industries after 2015 suggests a growing recognition of cybersecurity risks even in traditionally low-tech sectors.

This overall upward trajectory highlights how cybersecurity has become a universal concern, not just for tech-heavy industries but across the entire market landscape.

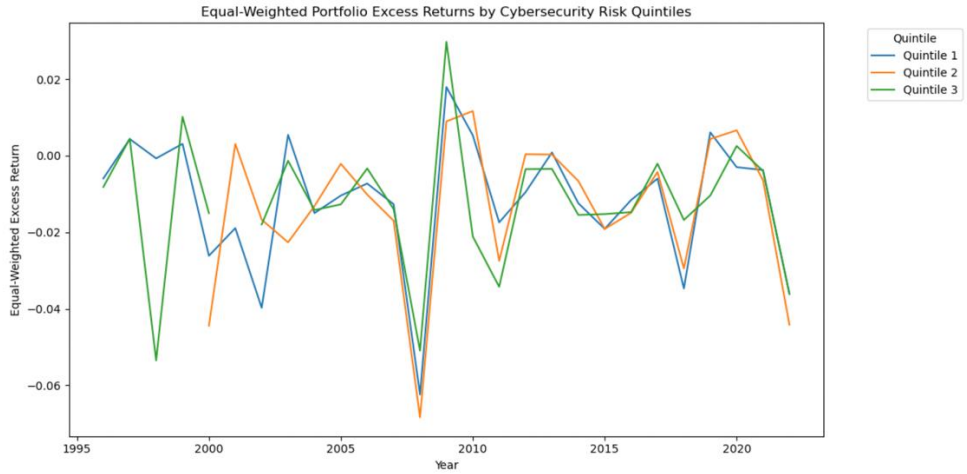
Step - 5:



Equal-Weighted Portfolio Returns by Cybersecurity Risk Quintiles

This graph shows yearly portfolio returns for five cybersecurity risk quintiles. Across the years, returns fluctuate significantly, showing no consistent advantage or disadvantage for higher or lower risk portfolios. Particularly, during economic crises like the dot-com bubble (2000-2002) and the financial crisis (2008-2009), all quintiles experienced sharp drops, suggesting that broader market conditions overshadowed cybersecurity risk factors during these periods.

The black dashed line (spread between Q5 and Q1) shows variable differences, with spikes in certain years (e.g., 2010, 2020), indicating that during these times, higher cybersecurity risk either added or detracted value, possibly due to industry-specific events like regulatory changes or cyber incidents.



Equal-Weighted Portfolio Excess Returns by Cybersecurity Risk Quintiles

In this plot, only three quintiles (1, 2, and 3) are shown, with Q4 and Q5 missing. This absence could indicate several potential factors:

- Data Limitations: Companies in extreme risk quintiles may have been delisted or bankrupt, limiting their contribution.
- Economic Shifts: Market crises might have clustered company performance, reducing the distinctiveness of the upper and lower cybersecurity risk quintiles.
- Market Behavior: High-risk firms (Q4 and Q5) may have underperformed significantly, while safer firms provided minimal excess returns, reflecting market punishment for extreme risks.

Insights on Companies and Cybersecurity Risk

The absence of higher quintiles in excess returns suggests that during some periods, companies with extreme cybersecurity risks faced heavy market penalties, underperforming relative to moderate-risk firms. Conversely, low-risk companies may have had reduced growth potential, explaining their limited presence in excess returns.

In summary, while cybersecurity risk impacts returns, this relationship is inconsistent and highly context-dependent. The gaps in quintile representation point to structural changes in the market, economic crises, or company-specific outcomes that affect how cybersecurity risk plays into returns.