Cybersecurity Ratings and Stock Performance

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Contents

Abstract

A cyberattack is likely to cause a public company's share price to drop, at least temporarily. Now, with SecurityScorecard, it is possible to determine the quality of a company's cyber defenses based on a variety of parameters. We sought to determine if there is a connection between the security ratings of public companies, as determined by SecurityScorecard, and their stock performance over time. This paper explores whether there is such a connection, analyzing the relationship between stock prices and security ratings for the companies constituting the S&P 500 index.

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Introduction

Is there a connection between a public company's cybersecurity posture and its stock performance? Industry research shows a fairly clear relationship between a public company suffering a data breach and a decline in its share price, at least temporarily. Would that also mean that a company with a robust cybersecurity posture enjoys strong stock performance? That's the question this paper seeks to answer.

Until recently, this would have been a challenging hypothetical exercise. Today, with security ratings such as SecurityScorecard, however, it is possible to determine the quality of cybersecurity practices for thousands of companies on a nearly instantaneous basis. Their technology scans a range of public information, including dark-web data, relating to a given company. From this, they are able to build a cyber risk profile that rates the security of the company's networks, DNS, endpoint security, malware infections, patching, and so forth.

This paper compares security ratings from SecurityScorecard with 52-week returns on shares for companies in the S&P 500 index, which comprises the shares of 500 large U.S. companies. The findings are surprising. Strong cybersecurity posture does not always translate into better stock price performance, with some exceptions. However, it should be noted that the data represents a snapshot of a time period when unprecedented events occurred. On a global scale, companies and markets were forced to adapt to a global pandemic while at the same time deploying remote workforces and business continuity technologies, which may have affected scores both positively and negatively.

The Impact of Cyberattacks on Stock Prices

Extensive research exists regarding the impact of cyberattacks and data breaches on the share prices of public companies. For example, a report featured in CFO found that some data breaches have erased as much as 15% off companies' stock market valuations. According to the research, a severe data breach can cause an average decline of 1.8% in share price on a permanent basis.

Another analysis looked at the closing prices of 28 New York Stock Exchange-listed companies, starting the day before they disclosed a data breach. In these cases, the breached companies' share prices hit a low point approximately 14 market days following the attack. Share prices fell an average of 7.27% and underperformed the NASDAQ by -4.18%. However, six months after a breach, these same companies were performing better than they had in the six months before the breach. Specifically, on average, the companies had seen share price growth of 4.1% before the breach and 7.4% after, outperforming the NASDAQ by 0.48%.

Understanding SecurityScorecard's Ratings

SecurityScorecard collects and analyzes an enormous volume of digital signals that companies now emit to the world. The signals correspond to cybersecurity risk factors. SecurityScorecard gathers and correlates the signals, running them through its proprietary algorithms and analytics tools to devise a current security rating for each company. It's a dynamic process, with ratings changing over time as companies remediate or neglect security deficiencies.

The resulting ratings, which range from "A" to "F," are based on ten groups of risk factors:

- Network Security, e.g., evidence of hacks that exploit vulnerabilities, such as open access points, insecure or misconfigured SSL certificates, or database vulnerabilities.

- DNS Health, e.g., multiple Domain Name Server (DNS) configuration settings.
- Patching Cadence, i.e., how diligently a company is patching its systems.
- Hacker Chatter, e.g., references to the company taken from a continuous collection of "underground" communications, including hard-to-access or private hacker forums.
- IP Reputation, based on millions of malware signals from commandeered Command and Control (C2) infrastructures worldwide.
- Web Application Security, e.g., Cross-site Scripting (XSS) or SQL injection attacks.
- Cubit Score, SecurityScorecard's proprietary threat indicator that measures a collection of critical security and configuration issues related to exposed administrative portals.
- Information Leak, e.g., sensitive information exposed as part of a data breach or leak.
- Social Engineering, e.g., employees using their corporate account information for services and social networks.
- Endpoint Security, referring to the protection of an organization's laptops, desktops, mobile devices, and all employee devices that access that company's network.

The grid below contains the SecurityScorecard rating for a major entertainment company listed on the New York Stock Exchange (NYSE). In the case of this particular organization, the company has an overall security rating of "A," which translates into a weighted average of 92% for the component risk factors, e.g., "B" for application security, "A" for cubit score, "A" for DNS health and so forth.

Exchange	Vertical	GRADE	Weighted average rating	APPLICATION SECURITY	CUBIT SCORE	DNS HEALTH	ENDPOINT SECURITY	HACKER CHATTER	IP REPUTATION	NETWORK SECURITY	INFORMATION LEAK	PATCHING CADENCE	SOCIAL ENGINEERING
NYSE	Entertainment	A	92	B	A	A	A	A	A	B	A	B	A

Table 1 shows a sampling of 10 companies in the S&P 500, their security ratings, and share price performances. Company #2, for example, a large professional services firm traded on the NYSE, has an overall "A" rating and a 20.48% change in share price over the three months ending August 28, 2020. Over the previous year, the stock was up 22.17%.

Exchange		Sector	GRADE	Weighted average rating	12-week % Change	52-week % Change (8/19 - 8/20)
NYSE	Company #1	Health Care	A	90	14.90%	42.52%
NYSE	Company #2	Information Technology	A	97	20.48%	22.17%
NASDAQ	Company #3	Utilities	A	91	3.80%	11.20%
NYSE	Company #4	Utilities	A	97	40.25%	22.59%
NYSE	Company #5	Financials	A	92	-0.78%	-24.70%
NYSE	Company #6	Information Technology	A	96	18.48%	2.32%
NASDAQ	Company #7	Information Technology	A	93	9.98%	36.30%
NYSE	Company #8	Industrials	A	95	12.27%	13.19%
NASDAQ	Company #9	Utilities	A	92	8.81%	27.04%
NASDAQ	Company #10	Information Technology	A	94	23.40%	57.48%

Table 1 - A snapshot of 10 S&P 500 companies with "A" security ratings from SecurityScorecard and their 12-week and 52-week share price performance

Findings for the Full S&P 500

As can be expected, between August 28, 2019, and August 28, 2020, the 500 stocks in the S&P performed in 500 different ways. The worst performer dropped 69% in share price during the year, versus the highest performer, which gained 212%. Each of these stocks, in turn, has its own SecurityScorecard rating. Figure 1 plots the 52-week percentage change in share price against the weighted average security ratings of each company. The graph shows a slight negative correlation between security rating and stock performance.

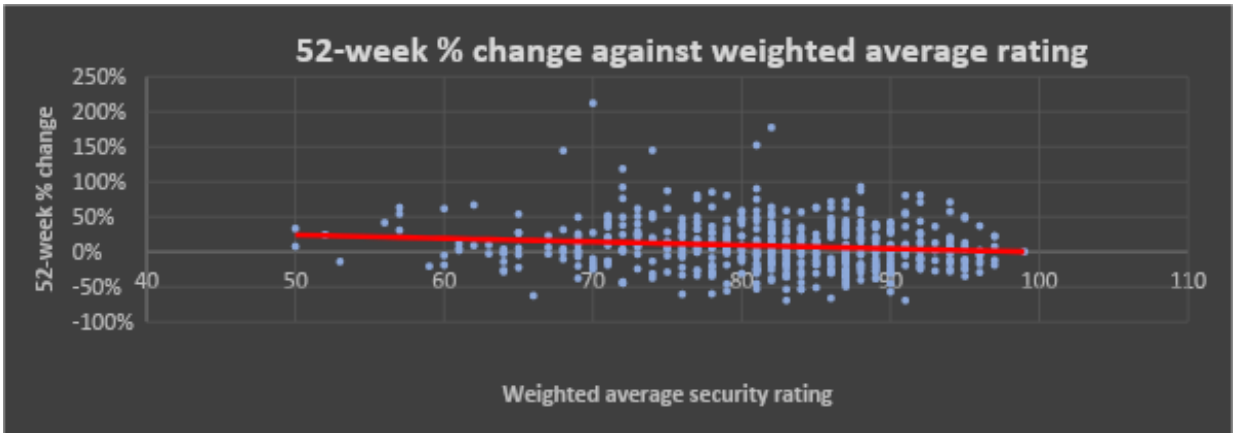

Figure 1 - 52-week percentage change in price for S&P 500 stocks against weighted average security ratings – from 8/28/19 to 8/28/20

Figure 2 looks at the entire S&P 500, sorted by SecurityScorecard letter ratings (A-F). The negative correlation is more apparent here, with the F-rated companies earning an average 24.6% return over 52 weeks, followed by 8.37% for D-rated, 15.47% for C-rated, 6.33% for B-rated, and 4.12% for A-rated companies.

Figure 2 – Average 52-week return on stocks in the S&P 500, sorted by security rating – from 8/28/19 to 8/28/20

One question that arose out of this process was, “Are the outliers affecting the trends?” Were stocks that performed at -69% and 212% distorting the results? By dividing the S&P 500 into 10 deciles of 50

stocks each[1] according to performance, it becomes possible to drop the top- and bottom-performing 10% of stocks. This removes the outliers. Figure 3 shows how the 2nd through 8th deciles correlated with SecurityScorecard letter ratings. Charting this middle 80% of 52-week performers by security rating yields an even more pronounced negative correlation. The A-rated stocks in the middle 8 deciles gained an average of 1.27% in 52 weeks, while the F-rated stocks grew by 20.73%.

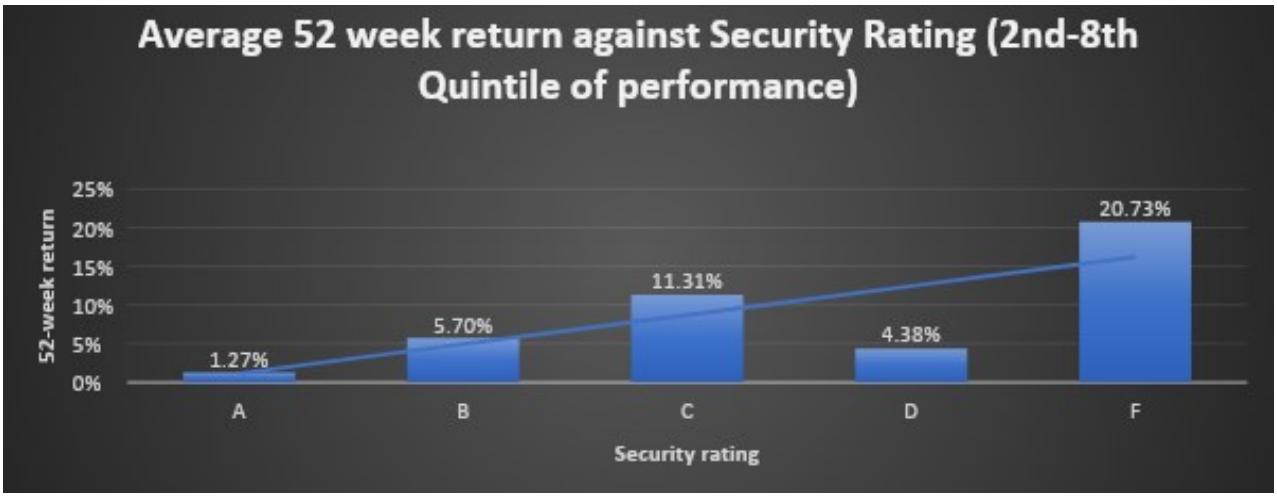

Figure 3 - Average 52-week return on stocks in the 2nd through 8th deciles, i.e., trimming off the top- and bottom-performing 10% of stocks in the S&P 500, sorted by security rating – from 8/28/19 to 8/28/20

Figure 4 tracks the full S&P 500 data set, sorted by performance decile, against weighted average security ratings. The negative correlation is again present. As performance climbs from -43% for the lowest-performing 52-week decile to 78% for the highest-performing decile, the weighted average security ratings decrease slightly, from 82 to 79. The overall downward trend is shown in Figure 4.

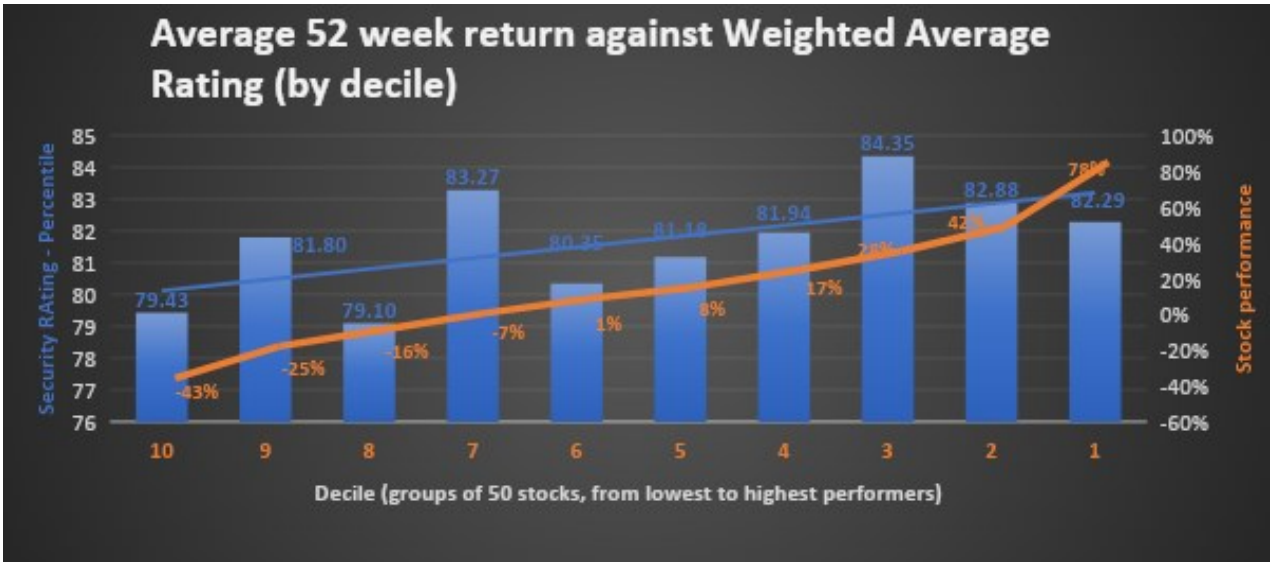

Figure 4 – The weighted average security ratings of stocks in the S&P 500, grouped by decile according to 52-week returns

[1] The S&P 500 actually contains 504 stocks, so each decile did not contain exactly 50 stocks.

Table 2 shows the top 10 and bottom 10 performers in the index, along with the respective weighted average security ratings. The bottom 10, which averaged a -61% return over 52 weeks, had an average rating of 81.6. The top 10 performers, averaging 131% return on stock prices over 52 weeks, had an average security rating of 77.6. What's notable here is how close the ratings are for the two groups, considering the wide divergence in share price performance.

Bottom 10					
Exchange		**Sector**	**Rating**	**Weighted Average Rating**	**52-Week % Change in price**
NYSE	Company #1	Energy	B	83	-69%
NYSE	Company #2	Energy	A	91	-69%
NYSE	Company #3	Travel & Tourism	B	86	-66%
NYSE	Company #4	Travel & Tourism	D	66	-63%
NYSE	Company #5	Energy	C	76	-60%
NYSE	Company #6	Consumer Staples	C	78	-60%
NASDAQ	Company #7	Energy	A	90	-57%
NASDAQ	Company #8	Travel & Tourism	C	79	-56%
NYSE	Company #9	Real Estate | Retail	B	84	-54%
NYSE	Company #10	Energy	B	83	-54%
		Averages		**81.6**	**-61%**
Top 10					
NYSE	Company #1	Health Care	B	88	87%
NYSE	Company #2	Energy	B	81	90%
NASDAQ	Company #3	Technology	C	72	92%
NASDAQ	Company #4	Technology	B	88	93%
NASDAQ	Company #5	Health Care	C	72	119%
NASDAQ	Company #6	Health Care	D	68	144%
NASDAQ	Company #7	Technology	C	74	145%
NYSE	Company #8	Industrials	B	81	152%
NASDAQ	Company #9	Technology	B	82	177%
NASDAQ	Company #10	Technology	C	70	212%
		Averages		**77.6**	**131%**

Table 2 - The top lowest-performing stocks on the S&P 500 over 52 weeks. With their security ratings, compared to the top 10 performers and their ratings

Drilling down further, Figure 5 shows two of the risk factors that comprise the overall security ratings. It plots the 52-week price change by risk factor rating. For example, the "A" rated companies for Patching Cadence averaged a 4% return on share price over 52 weeks, versus the "Fs," which returned 6%. The

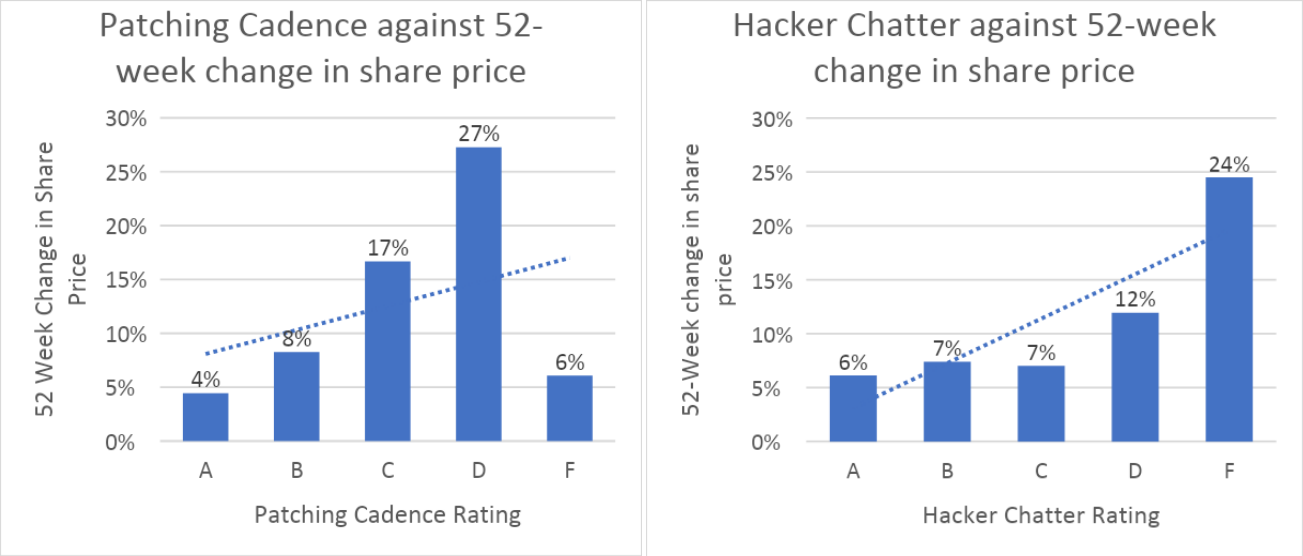

Figure 5 – Ratings for the risk factors of Patching Cadence and Hacker Chatter against 52-week change in share prices for the full S&P 500 index

"Cs" and "Ds" were at 17% and 27%, respectively. For Hacker Chatter, the "As" returned 6% over 52 weeks while the "Ds" and "Fs" returned 12% and 24%, respectively. In this regard, the risk factor components of the overall security rating displayed a similar negative correlation between share price performance and security rating. The higher the rating, the lower the return on share price.

While these results may appear to be counterintuitive regarding the hypothesis of stock price correlation with cybersecurity performance, several factors come into play that make it difficult to determine whether or not this pattern holds consistently over time. One significant variable factor would be timespan, as this report time period covered the COVID-19 stock market crash and subsequent recovery. In tandem, SecurityScorecard measured the cybersecurity ratings of enterprises engaged in rapid work-from-home business continuity efforts—oftentimes having a significant impact on weighted issues, such as endpoint and network security.

Additionally, the largest gains in the S&P 500 subsequent to the COVID-19 crash were led by large technology companies, many of which have an expansive digital footprint that usually contains high vulnerability to IP address ratios, which is not always a direct reflection on the management of corporate infrastructure.

Technology companies were also the first to be able to adapt to the COVID-19 lockdown of society through continued remote operations, whereas many other industries relied on in-person business due to the nature of their operations (such as hospitality, retail, travel, and tourism).

Interpreting Findings for the Full S&P 500

Can any conclusions be drawn from the apparent negative correlation between security ratings and stock performance? It's tempting to say that the correlation means little. Stock performance is unpredictable over a 52-week period, so perhaps there isn't much to infer from the fact that companies with high-performing stocks have low security ratings.

One possibility, however, is that companies that take greater risks may generate higher returns on share prices. They may move faster in the marketplace and pay less attention to their cyber defenses. While they may be at greater risk for a data breach than their better-rated peers on the S&P 500, in the short term, they appear to be reaping the rewards of skimping on cybersecurity.

Another perspective is that the aggregate returns and security ratings are not useful because they are combining too many different types of companies. A financial services firm and a consumer products company might be held to significantly different cybersecurity standards, with the former subject to extensive regulation that mandates strict security controls. A sector-by-sector review might reveal different outcomes from the index-wide approach.

Findings by Industry Sector

Figures 6 through 11 show the same 52-week percentage change in stock price by weighted average security rating for six industry-specific sectors in the S&P 500. Figure 6, for example, plots 52-week percentage change by weighted average security ratings for stocks in the consumer discretionary sector, e.g., airlines, restaurants, and retail. Like the overall index, the consumer discretionary sector shows a negative correlation between security rating and share price growth. Higher-rated stocks earned less than their lower-rated counterparts. The trend in the discretionary sector appears stronger than that of the overall S&P 500.

Dr. Bob Sohval, VP of Data Science at SecurityScorecard, pointed out that “It is interesting to note these figures feature a substantial amount of ‘scatter,’ defined as individual points which do not hover neatly around a straight line. From a data science perspective, it is important to take into consideration the ‘confidence intervals’ for the slope when performing a statistical regression.”

He added, “From the appearance of these graphs, it appears that a 95% confidence interval (CI) will span the range from a negative to a positive slope. While a negative slope might be the expectation value, significant anomalous events outside the world of cybersecurity and financial markets during this period likely obscured any short-term conclusions. While the relatively large CI means that statistically we cannot make a statement that the slope is negative or positive with any certainty, there remains much to unearth in the matter of security ratings as a financial health signal.”

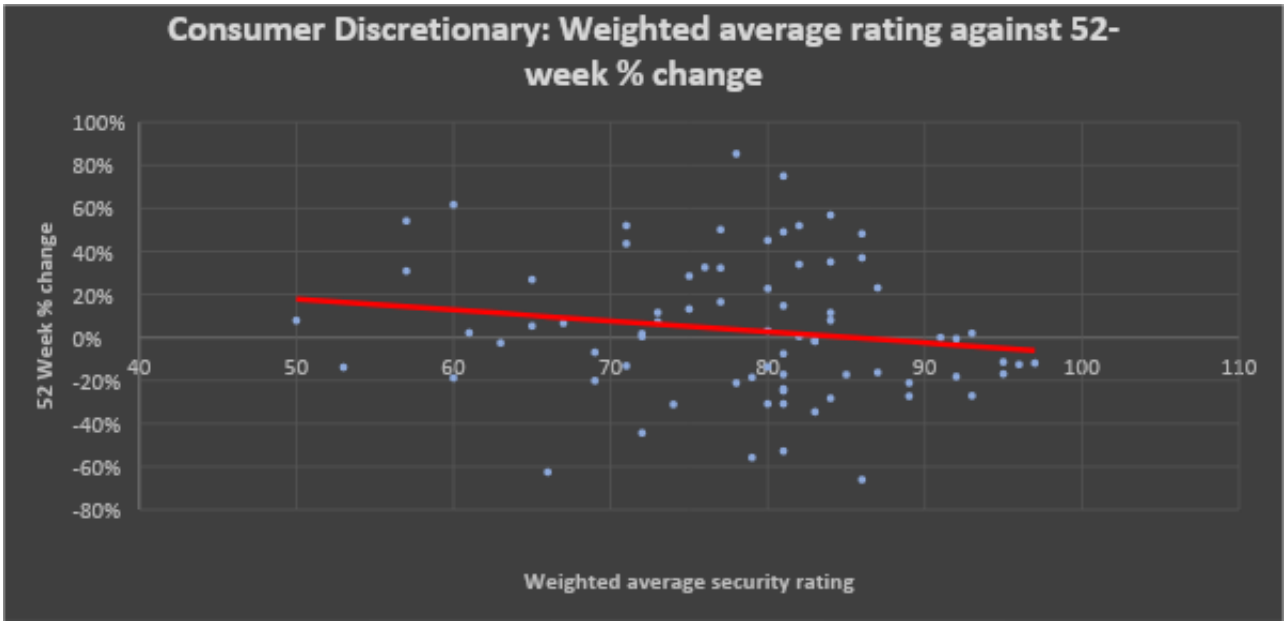

Figure 6 - 52-week percentage change in price for S&P 500 stocks in the Consumer Discretionary sector, against weighted average security ratings – from 8/28/19 to 8/28/20

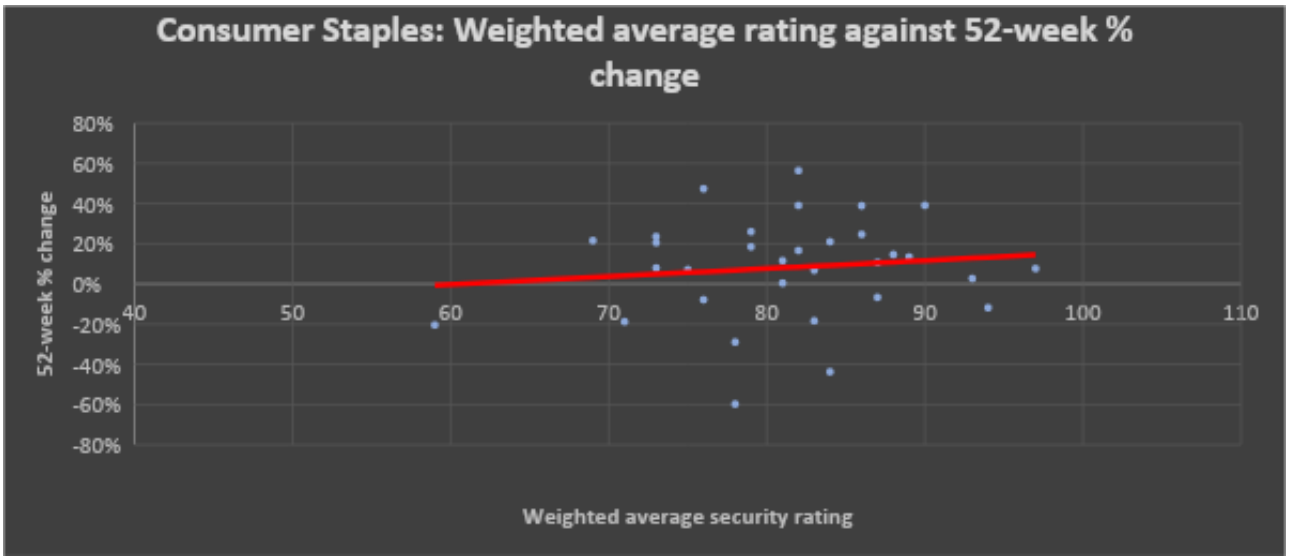

Figure 7 - 52-week percentage change in price for S&P 500 stocks in the Consumer Staples sector, against weighted average security ratings – from 8/28/19 to 8/28/20

Consumer staples, shown in Figure 7, demonstrate a positive correlation, on the other hand. These companies, which are mostly in the consumer packaged goods industry, exhibit a higher 52-week percentage change in share price as their security ratings go up. The financials sector, shown in Figure 8, indicates a similar positive correlation.

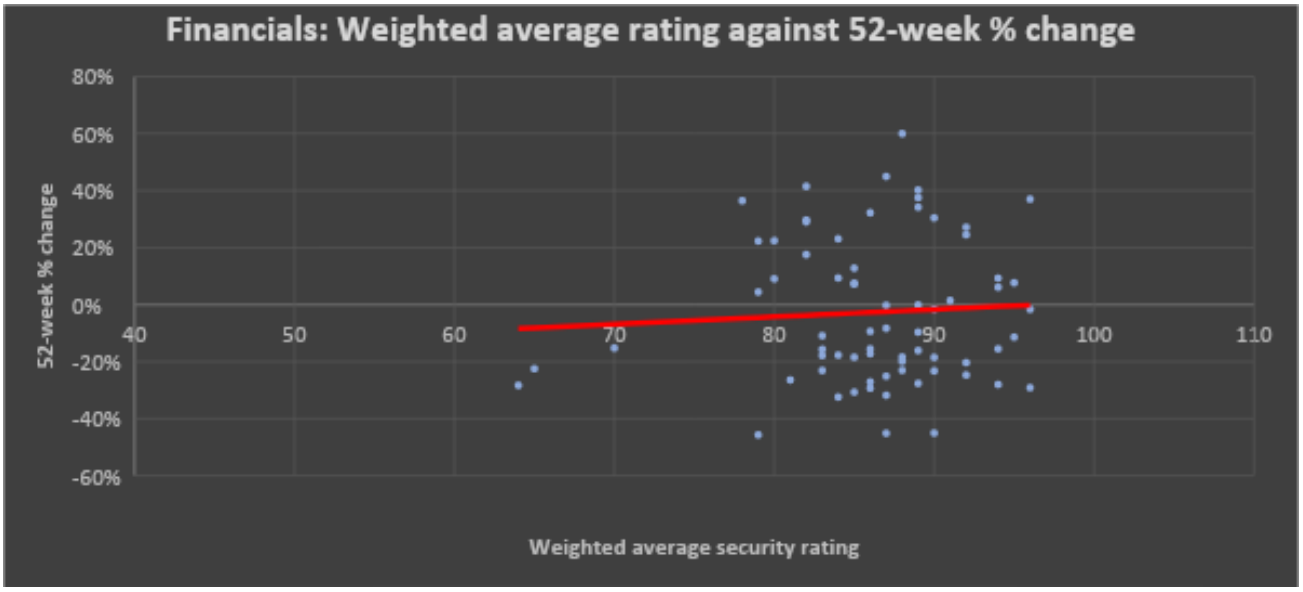

Figure 8 - 52-week percentage change in price for S&P 500 stocks in the Financials sector, against weighted average security ratings – from 8/28/19 to 8/28/20

The energy (Figure 9) and healthcare (Figure 10) sectors have ratings that are negatively correlated with performance. A relatively pronounced trend of negative correlation is evident for the energy sector. The industrial sector, shown in Figure 11, has no apparent trend between the 52-week share price change and security ratings.

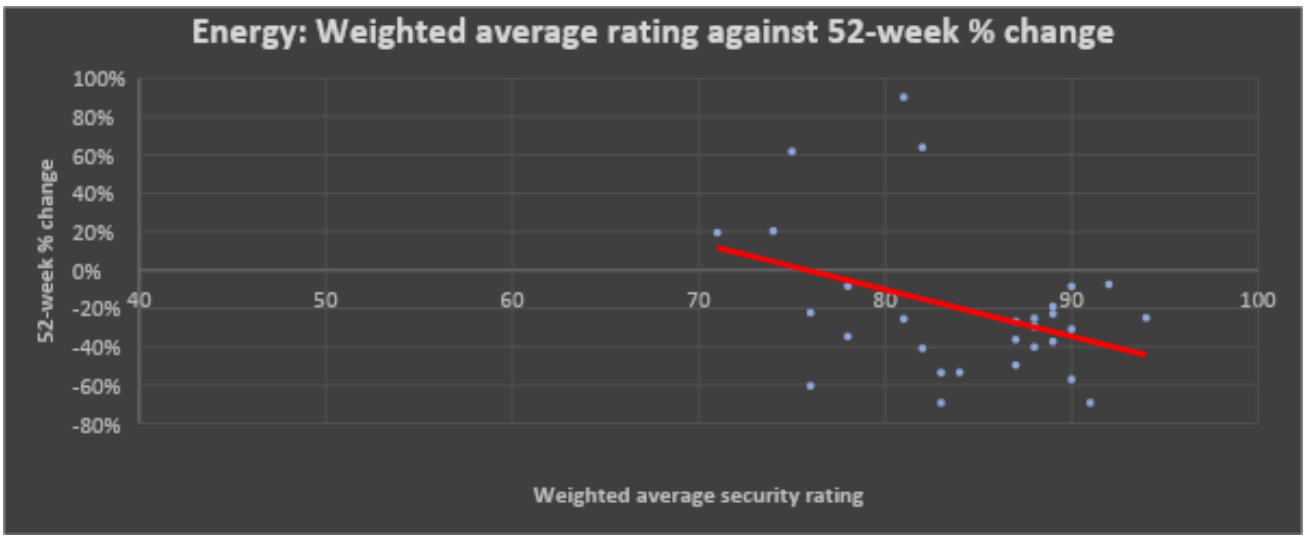

Figure 9 - 52-week percentage change in price for S&P 500 stocks in the Energy sector, against weighted average security ratings – from 8/28/19 to 8/28/20

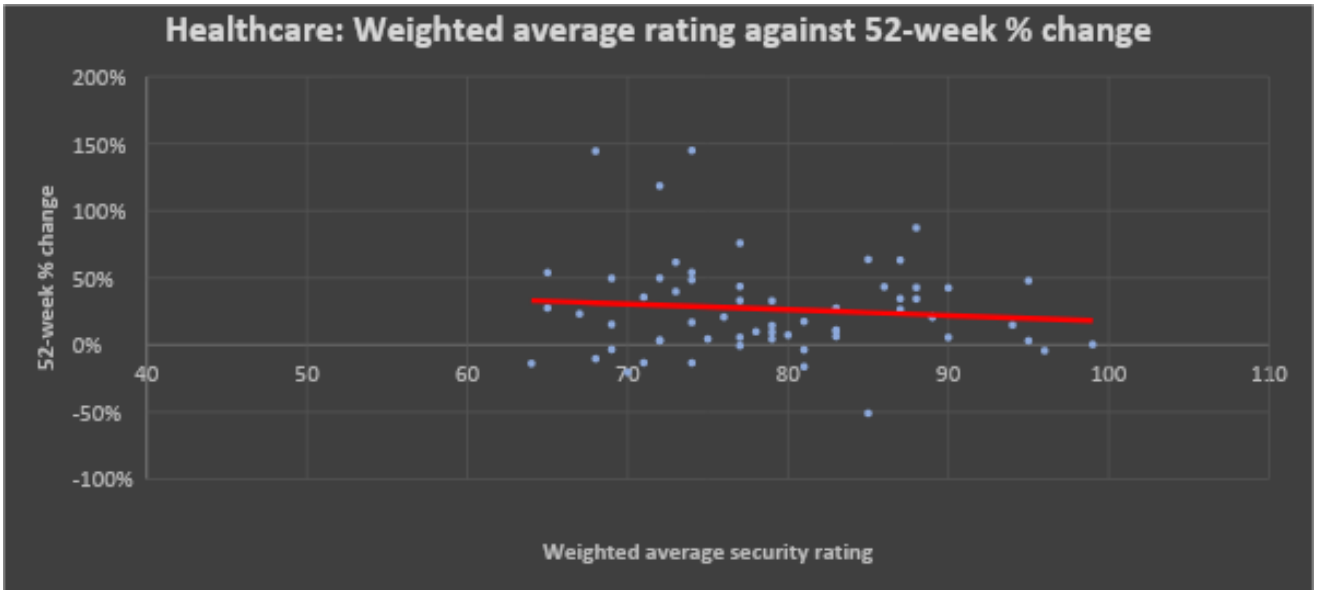

Figure 10 - 52-week percentage change in price for S&P 500 stocks in the Healthcare sector, against weighted average security ratings – from 8/28/19 to 8/28/20

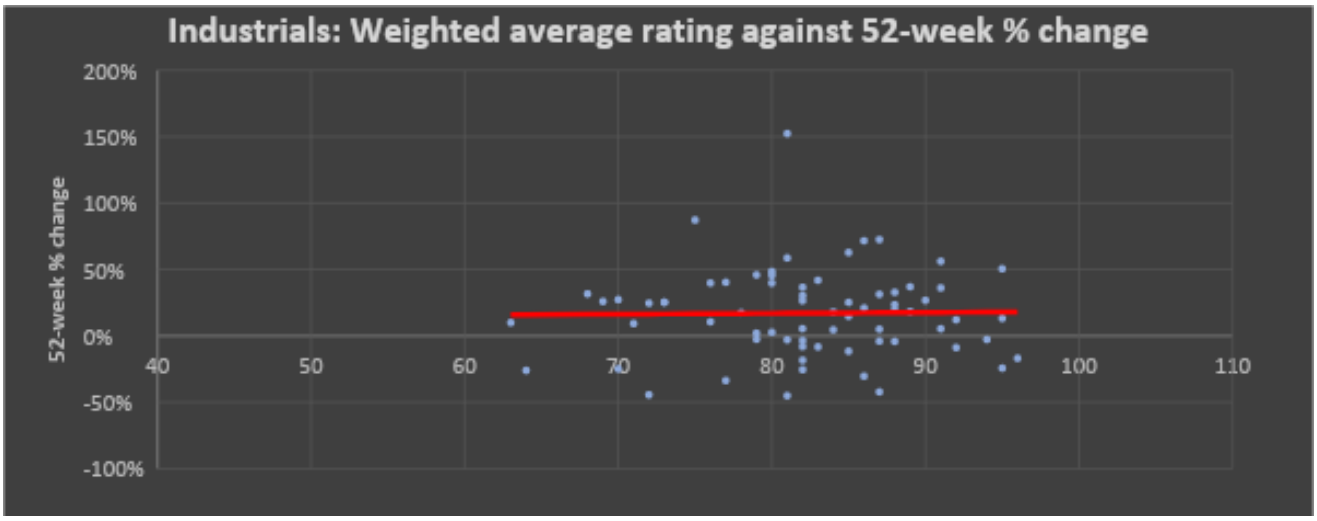

Figure 11 - 52-week percentage change in price for S&P 500 stocks in the Industrials sector, against weighted average security ratings – from 8/28/19 to 8/28/20

Another approach to identifying associations between security ratings and share price change by sector involved examining the top- and bottom-five performing stocks in each sector and comparing their weighted average security ratings. Table 3 displays the lowest-performing five stocks in the consumer discretionary category. They had an average security rating of 76.8.

Exchange	Industry	GRADE	Weighted Average Security Rating	52-Week % Change
NYSE	Travel & Tourism	B	86	-66.08%
NYSE	Travel & Tourism	D	66	-62.54%
NASDAQ	Travel & Tourism	C	79	-55.80%
NYSE	Retail	B	81	-52.80%
NYSE	Retail	C	72	-44.33%
			76.8	**-56%**

Consumer discretionary

Table 3 - The lowest 5 performing stocks in the consumer discretionary category over 52 weeks and their security ratings

Interpreting Findings by Industry Sector

Looking at stock price performance against security ratings by industry sector is revealing. Some sectors, such as finance and consumer staples, are positively correlated. Others are negatively correlated—some quite sharply. These discrepancies between sectors make some intuitive sense. Financial firms tend to make significant investments in security, as reputation is critical for their businesses. It's possible that the reputational aura of strong security carries over into better stock performance. Alternatively, it may be that a high security rating is a proxy for effective management—with better managed firms outperforming those with lower ratings and perhaps less strenuous executive management.

Conclusion

The analysis provided in this paper is relatively basic and coarse-grained and probably doesn't tell the full story. While there are many variables that go into the composition of a company's stock price, such as factors that can be controlled (accounting practices, compliance, management, stewardship), there are factors that are outside of the normal expectations or control that have an equal, if not greater impact (such as pandemics, natural disasters, and rapid deployment of business continuity contingencies).

More sophisticated analyses may discover more striking trends and perhaps even causative factors that explain how a security rating, or a factor contributing to a security rating, drives a stock's performance over time. The cybersecurity rating process is in the early stages of its lifecycle. Exploring connections between stock performance and security ratings is an even newer activity.

Like any single source of information, a cybersecurity rating should not be interpreted at face value as an oracle for predictive stock price movement. There is no magic data feed that will tell an investor which stocks to "buy low" and "sell high." The use of cybersecurity ratings as a stock signal indicator requires a nuanced and contextualized understanding of the macroeconomic environment surrounding the specific corporate entities. The stories behind the financial movements of any major enterprise are

complex and multifaceted, and cybersecurity ratings may prove useful as potential investment signals when correlated with updated business intelligence.

For example, technology companies that were able to adapt to the COVID-19 lockdown through continued remote operations showed decreasing cybersecurity scores due to the rapid implementation of remote workforces and an expanded attack surface, while at the same time, revenue for this industry was increasing rapidly due to the global demand for remote business continuity technologies. In this context, a "low" cybersecurity rating could be a trailing indicator of positive stock movement when correlated with the latest business, industry, marketplace, and geopolitical intelligence.

Conversely, industries such as hospitality and tourism were affected significantly by the COVID-19 lockdowns, as the nature of these industries revolves around in-person services. As these businesses closed, computers were turned off, and the staff that used them could no longer be afforded. The financial losses of the crisis are reflected in the stock prices with significant downward price movements in the hospitality and tourism industry. The cybersecurity ratings of the hospitality and tourism industry during this time increased as a result of fewer devices, endpoints, and IP addresses being online. In this case, a "high" cybersecurity rating could be a trailing indicator of negative stock price movement when correlated with the latest business, industry, marketplace, and geopolitical intelligence.

According to Alex Heid, Chief Research & Development Officer at SecurityScorecard, "As markets recalibrate, enterprise cybersecurity postures adjust to newly deployed work from home environments, and the related incoming risk data plots itself out accordingly, a complete picture will begin to form over time. Surprising patterns will continue to take shape, and the data itself will narrate the next chapter of the story."

It's a promising area for further research, one that may yield valuable insights into forces that affect the performance of share prices across the stock market. Much work remains to be done.

About the Author

Hugh Taylor is Executive Editor of *The Journal of Cyber Policy*. He is a Certified Information Security Manager (CISM) who has written about cybersecurity, compliance, and enterprise technology for such clients as Microsoft, IBM, SAP, HPE, Oracle, Google, and Advanced Micro Devices. Prior to launching his freelance writing career, Taylor served in executive roles at Microsoft, IBM, and several venture-backed technology startups. He has been a lecturer at the University of California and Berkeley's Law School and Graduate School of Information. Books he has written include *Digital Downfall: Technology, Cyber Attacks and the End of the American Republic*, *Event-Driven Architecture: How SOA Enables the Real-Time Enterprise,* and *The Joy of SOX: Why Sarbanes-Oxley and Service-Oriented Architecture May Be The Best Thing That Ever Happened To You*.