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The Impact of Large-Scale Behavior on the Stock Market

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Abstract

We analyzed earnings reports of mega-cap companies to determine rationality of the stock price reactions with behavioral economics. The objective was to evaluate whether behavioral economics was a viable method for interpreting price action. We compiled the top twenty companies by weight in the S&P 500 and examined their price data after an earnings report was released. The data indicated that price reactions were not always rational and concepts such as negativity bias and herding behavior often affected stock prices negatively. Specifically, the companies we analyzed experienced rational reactions to their earnings reports 40% of the time and most price reactions were irrational to some degree. Furthermore, technology companies showcased clear signs of negativity bias and the outcomes of many of their earnings could not be explained with the Efficient Market Hypothesis.

Keywords: Economics, Behavioral finance, Earnings reports, Stock market

1. Introduction

The US stock market can often be mysterious, risky, and unpredictable. Quantitative concepts in economics have been utilized to predict or understand rational outcomes in the field of financial markets, but due to the ambiguity of the stock market and the impact that hundreds of factors may have, anomalies arose frequently that required explanation from other topics (Fama, 1998). One such topic was behavioral economics, which we analyzed in this paper for how it influenced market prices and affected the decision-making of market participants specifically.

It was proven in previous research that humans often act irrationally and with emotion rather than logic, though the impact of large-scale human behavior had yet to be researched in the financial markets. To advance research in this field, analysis of how humans interact with financial risks and how risk affects decision-making should be completed in more depth. Since behavioral economics offered the foundational concepts of how market participants interacted with risk, we observed its impact in the stock market and if behavioral economics can be used for the interpretation of price action. The research is significant because we analyzed on a large-scale basis if market participants make the same decisions when introduced to new information and how their reactions can impact the decisions of other market participants.

Certain concepts in behavioral economics, such as herding behavior and negativity bias, directly apply to the psychology of individual market participants. Herding behavior in the financial markets occurred when market participants were influenced to make investment decisions solely based on the actions of other market participants rather than by utilizing their own signals or prevailing market fundamentals (Choijil, et al. 2022). For example, investors often feel more compelled to purchase shares of a stock if its price is rapidly increasing versus decreasing even without completing their own analysis. This occurrence would be an example of herding behavior, since investors are making decisions exclusively based on the fact that the price is rising and other participants are buying shares, which is irrational. Negativity bias is the concept that humans tend to focus on negative events more than positive

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events. An example of negativity bias in the stock market is that occasionally, especially when the market is highly unstable, investors often focus on poor economic reports and their effects while showing a lesser reaction to positive news. In addition, the purpose of classifying price reactions to earnings reports as rational/irrational is to determine based on behavioral economics principles if the outcome was expected, and how accurate behavioral economics was in interpreting price action. To evaluate the applications of behavioral economics, we analyzed the impact of high-importance events on stock prices for a relationship and whether a rational result occurred once the news was released.

Our initial hypotheses were that at least 70% of the price reactions to earnings reports should be rational and the Efficient Market Hypothesis (EMH) will accurately interpret most reports. Furthermore, we were expecting to find that behavioral economics concepts can interpret price action whether it is rational or irrational and can be effectively applied to the financial markets. The purpose of the research was to offer insight on the feasibility of applying behavioral economics concepts to interpret price action in the financial markets. Although our research contained certain limitations, such as having twenty data points, methods were utilized for the selection of diverse and reliable data and each data point was researched in depth to enhance its validity. Additionally, we completed analysis on whether companies in certain sectors experience more irrational price action relative to other sectors.

2. Materials and Methods

The main price data was acquired from Yahoo Finance for the companies analyzed in this research. Yahoo Finance provides years of historical price data for thousands of securities, including daily high, low, open, and closing prices. This data was particularly useful for determining the precise stock price reactions of companies on the day after their earnings were released. Furthermore, all of the price data being analyzed was from 2023 in order for overall economic conditions to be similar across different data points and for the timeframe to be roughly the same.

The data that we analyzed for their effect on share prices were earnings reports. Earnings reports typically had the greatest influence on share prices compared to other news and introduced significant amounts of new information regarding the success of a company to the public. For example, when Nvidia's earnings report significantly beat analyst expectations for its earnings and revenue during the Q1 2023 fiscal quarter, its stock price had increased over 20% by the end of the next day. To provide a comparison, major indices such as the S&P 500 typically moved less than 1% up or down in one day. Financial metrics such as revenue and earnings per share (EPS) were some of the most important indicators and when these results exceeded expectations for certain companies, rationally, market participants purchased shares at higher prices and the stock price increased. However, note that although EPS and revenue were two of the most important indicators for earnings report results, they were not the only factors and other metrics such as the outlook given in an earnings call, profit margins, and macroeconomic conditions could also have affected investor reactions. We evaluated the resulting change in a stock price and whether the outcome was rational using the concepts of herding and negativity bias, all stemming from behavioral economics.

The particular companies being used as data points for their earnings report results were the top twenty companies by weight in the S&P 500 index ETF, which has the ticker SPY. The reasoning behind choosing these companies is that they were in a diverse set of industries and there was not a large concentration of them in one sector. If all of the companies being analyzed were in one sector, the data could be skewed because that sector may have experienced, for example, an unusually positive or negative year and led to a positive/negative bias in the price reactions to earnings for reasons external to the research. Only analyzing firms from one sector would also not reveal patterns for the entire market but only for that sector and within the observed timeframe. In addition, if the companies being analyzed were penny stocks (very cheap, risky, and unpredictable), their price reactions to earnings could be extreme and provide data that is not representative of more well-known and safer stocks. Furthermore, since these companies were popular mega-cap companies (market capitalization greater than 200 billion USD) they were more likely to experience a high volume of trading activity after their earnings reports were released which made them less susceptible to moving irrationally for external reasons. This specification in the methodology contributed to acquiring more accurate data that truly represented when the market acted irrationally versus data from relatively unknown small-cap companies (market capitalization below 2 billion USD) that is more likely to be anomalistic.

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3. Results

We analyzed the earnings reports for each of the top twenty companies ranked by weight in the S&P 500 based on four metrics: if they exceeded expectations for their EPS, for their revenue, what the resulting change in the stock price was, and whether the price change was a rational outcome. The corresponding data was displayed in Table 1 below.

First, each of the earnings reports were from quarters of 2023 and were within a few months of each other. The EPS and revenue were described as one of the following: clearly beat analyst expectations, beat, slightly beat, slightly missed, missed, or clearly missed. For EPS, the performance scale followed as such: clearly missed if EPS was reported over 10% below analyst expectations, missed if EPS was reported between 3% and 10% below expectations, slightly missed if it was between 0% and 3% below, slightly beat if it was between 0% and 3% above, beat if it was between 3% and 10% above, and clearly beat if it was over 10% above. For revenue, the performance scale was slightly different: clearly missed if revenue was reported over 3% below expectations, missed if revenue was reported between 1% and 3% below expectations, slightly missed if it was between 0% and 1% below, slightly beat if it was between 0% and 1% above, beat if it was between 1% and 3% above, and clearly beat if it was over 3% above.

Table 1: Expectations and Results for the Top 20 S&P 500 Companies by Weight

Companies	EPS	Revenue	Resulting Price Change	Price Change Rationality
Microsoft	Clearly Beat	Clearly Beat	+3.1%	Rational
Apple	Beat	Slightly Beat	-0.5%	Slightly Irrational
Nvidia	Clearly Beat	Clearly Beat	-2.5%	Irrational
Amazon	Clearly Beat	Beat	+6.8%	Rational
Meta	Clearly Beat	Beat	-3.7%	Highly Irrational
Alphabet	Beat	Beat	-9.6%	Highly Irrational
Eli Lilly	Clearly Beat	Clearly Beat	+3.2%	Rational
Broadcom	Slightly Beat	Slightly Beat	-5.5%	Highly Irrational
JPMorgan Chase	Clearly Beat	Clearly Beat	+1.5%	Slightly Irrational
Exxon	Missed	Beat	-1.9%	Irrational
Tesla	Clearly Missed	Clearly Missed	-9.3%	Rational
UnitedHealth	Slightly Beat	Beat	+6.8%	Rational
Visa	Slightly Beat	Slightly Beat	-0.7%	Slightly Irrational
P&G	Beat	Clearly Beat	+3.5%	Rational
Mastercard	Beat	Slightly Beat	-5.6%	Highly Irrational
Johnson & Johnson	Beat	Beat	-0.9%	Irrational
Merck	Beat	Clearly Beat	+1.9%	Rational
Home Depot	Slightly Beat	Slightly Beat	+5.4%	Slightly Irrational
Costco	Slightly Beat	Slightly Beat	+1.9%	Rational
AbbVie	Beat	Beat	+4.9%	Slightly Irrational

We observed the resulting change in the stock price by taking the closing price of the stock the day after earnings were released or on the same day for companies which reported earnings before the market open. The resulting stock price change was evaluated as having been rational, slightly irrational, irrational, or highly irrational. The price reaction was described as highly irrational if both EPS and revenue were classified as at least beat (shown in Table 1) and the stock price dropped over 3%. The price reaction was

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described as irrational if both EPS and revenue were classified as at least slightly beat and the stock price dropped between 0% and 3%. The price reaction was described as slightly irrational if EPS and revenue were mixed and the stock price dropped between 0% and 3%. Lastly, the price reaction was described as rational if the stock price increased over 3% when EPS and revenue were clearly beat, between 1% and 3% if EPS and revenue were beat, between 0% and 1% when EPS and revenue were slightly beat, between 0% and -1% when EPS and revenue were slightly missed, between -1% and -3% when EPS and revenue were missed, and over a 3% loss when EPS and revenue were clearly missed.

4. Discussion

The results demonstrated that of the twenty companies analyzed, eight experienced a rational reaction to their earnings, five were slightly irrational, three were irrational, and four were highly irrational. Only 40% of the analyzed earnings reports had a rational effect on the share price while the other 60% were at least slightly irrational. Furthermore, the reactions were mostly concentrated on the extremes with 60% of the results having been either rational or highly irrational while less than half of the cases were in between. Below, we examined five of the earnings reports for behavioral patterns that could explain the results and the roles of negativity bias and herding behavior.

Nvidia reported EPS and revenue that clearly exceeded expectations of analysts. Specifically, an EPS of $4.02 was reported while analysts expected $3.37 and a revenue of $18.12 billion was reported versus $16.18 billion expected. Based on these factors, this would be considered an extremely positive earnings report and Nvidia's stock price would be expected to jump. However, Nvidia's price fell 2.5% after a full market day had passed. The reason for the decline was about a statement made regarding export restrictions with the potential to negatively affect sales, which was external to their current EPS and revenue, but should have been a relatively minor factor overall considering that positive growth was reiterated in the same statements. This outcome seems to have been strongly influenced by negativity bias, as the market focused too heavily on one negative component and it overshadowed the substantial positive news regarding EPS, revenue, and sales growth for each segment of the company.

Eli Lilly's earnings report, similarly to Nvidia's, outperformed analyst expectations. In response to the positive news, the stock price increased 3.2% and led to a fairly rational outcome. The price change was in line with economic principles because based on the EMH, market participants should price in the new information and this would lead to an increase in value, which was precisely what happened.

Broadcom's earnings report slightly outperformed analyst expectations but its price fell 5.5% afterward. This was a highly irrational outcome because although Broadcom had not reported results that clearly beat analyst expectations, there were no significant negative features either. It was likely that a form of herding occurred where the price may have initially dropped due to volatility after the earnings were released and led to a chain reaction, which instilled fear and caused other market participants to sell positions at lower prices as Broadcom's price became unstable.

Exxon's earnings were mixed as their EPS missed expectations but revenue beat expectations. The stock price fell 1.9% as a result, which was irrational because it was a large reaction for a firm in the energy sector and mixed results should have led to more neutrality or indecision from market participants. This outcome was likely caused by large-scale negativity bias among investors since more focus was placed on Exxon missing expectations for their EPS even though they beat expectations for revenue, and there were no exceptional circumstances for other financial metrics that could have led to this decline.

Based on their EPS and revenue, Mastercard's earnings were fairly positive and due to the EMH, it was expected that a positive reaction would ensue. However, Mastercard experienced a highly irrational reaction and the stock price fell over 5.5%. It was likely the result of both negativity bias and herding since market participants focused heavily on a lower than expected revenue forecast for the subsequent quarter while the reported EPS and revenue (which both exceeded expectations) were more disregarded. Factoring in the pessimistic revenue forecast, a highly positive result would not be expected either but a combination of clearly positive and clearly negative news should have been more likely to lead to a neutral outcome rather than the strong, negative price reaction that occurred.

The results displayed clear patterns of negativity bias and herding behavior, which may be especially emphasized during corporate earnings season due to increased fear among investors. It was found that humans typically expect

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worse outcomes rather than better ones (Sias, et al. 2023), and this strongly applied to price reactions of earnings reports as participants, on a large scale, had "glass half empty" opinions. Additionally, positive news was often disregarded or underemphasized in the presence of bad news, even if the bad news was of a lesser magnitude.

Through the analysis of each earnings report, we found that negativity bias consistently occurred and it led to pricing inconsistencies. Further supporting this, each of the four highly irrational earnings reports were caused by an unexpected decrease in the share price and there was a clear weight to the downside. Rational price action was the most common reaction and the EMH was able to explain for many of the resulting price changes but failed to demonstrate why, after strongly positive earnings were released, the stock price may still fall in the presence of beneficial information. These results showcase the usefulness of behavior in economics and the integral role it plays in financial markets beyond hypotheses and theoretical ideas.

In addition, the statistics demonstrated that there was an unexpectedly high concentration of tech companies specifically experiencing highly irrational reactions because only 40% of companies in the full dataset (shown in Table 1) were tech companies but 75% of the data points that experienced a highly irrational reaction were tech companies, even though 40% would be the expected value. Furthermore, of the seven tech companies that at least slightly beat expectations for their EPS and revenue, only two actually experienced a positive reaction by the closing price of the next day (Microsoft and Amazon). This information presents the idea that tech companies were affected by negativity bias during these earnings reports in 2023 and considering how often the results were irrational, the EMH could not have explained the reactions merely based on EPS and revenue. In addition, this pattern could be significant with more data as support because it showed that companies in certain sectors were more likely to experience highly irrational reactions to their earnings and this would have created a new factor to be taken into account when analyzing sector-based data in future research.

The data suggested that negativity bias often affected prices, especially in the technology sector, and positive news could have still led to a negative reaction. The EMH did apply to 40% of the cases and the most common result was a rational reaction, but the other 60% were irrational to a degree and the rationality almost seems randomly distributed excluding the slightly higher concentration of rational reactions. Therefore, concepts in behavioral economics can be applied to understand the outcomes of earnings reports but with potentially low accuracy unless numerous factors beyond EPS and revenue were taken into account, such as forecasts, macroeconomic conditions, and other financials.

5. Conclusion

Our results and observations demonstrated that behavioral economics can be useful when interpreting price reactions to earnings reports but also has limitations. The objectives were to determine if concepts in behavioral economics could accurately interpret price action and if the price reactions to earnings reports followed the EMH. The EMH was not very effective in determining the correct price reaction when only taking EPS and revenue into consideration. Less than half of the earnings reports experienced rational reactions and for the EMH to make better interpretations of price action, more factors including economic conditions and forecasts for future EPS and revenue need to be taken into account. However, when taking negativity bias and herding behavior into consideration beyond the EMH, the price action can be interpreted more rigorously and accurately since numerous price reactions in the analyzed data showed signs of these two phenomena, and behavioral economics will be a valuable tool for future price analysis. It was also observed that tech companies had a much greater proportion of highly irrational price reactions and were less likely to experience rational reactions.

Our observations in this paper provided new questions that can be proposed for further analysis. First, analyzing why some earnings reports experienced negativity bias while others did not is an area of important future research. For example, Mastercard in the case study above was observed to have experienced negativity bias in its earnings reaction but why may this have happened to Mastercard and not, for instance, Exxon? Exxon reported mixed results with a lower-than-expected EPS and a better-than-expected revenue, but market participants did not focus as much on the negative EPS news unlike Mastercard's report (which had underwhelming guidance), given by a -1.9% drop in Exxon's stock price while a -5.6% drop in Mastercard's. To engage in this further research, earnings reports with

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specifically mixed results could be compiled into a dataset and analyzed deeper. Analysis of more earnings reports with mixed news would reduce the noise associated with positive or negative reports and would have displayed the pure market response to neutral data.

An additional area of future research could be to determine if companies in certain sectors experience more irrational earnings reactions than in other sectors. In this research, it was found that tech companies experienced a higher proportion of irrational price reactions compared to other sectors and with more optimized data (i.e. analyzing the top 3 companies by S&P 500 weight in each sector and comparing different sectors), more evidence could be found to support the hypothesis that different sectors experience varying levels of irrational price action.

Based on the data presented in this paper, market reactions were typically weighted to the downside unless compelling, positive news was released, and there was significant evidence of an effect of negativity bias on prices. The significance of behavioral economics was evident in the fluctuation of stock prices and gathering substantial amounts of data from past years can provide further guidance for the utilization of behavioral economics in understanding fluctuations and if there were explainable price patterns or if the level of rationality was unpredictable and random.

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