

**The Power of Large Language Models:
A ChatGPT-driven Textual Analysis of Fundamental Data**

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Abstract

In this study, we examine the effect of stale, factual information on stock price formation, utilizing Shikiho, the Japan Company Handbook, as a pivotal data source. The breadth and depth of information offered by Shikiho, covering all listed Japanese companies, and compiled by independent journalists, are unmatched by other market data sources. Our innovative approach involves the use of large language models, specifically ChatGPT, to interpret the business implications within Shikiho's corporate descriptions and future projections. The interpreted data serves as a basis to classify firms into positive and negative outlook groups, which are further quantified into confidence scores. These scores inform the construction of an equity portfolio. Benchmarking the portfolio's performance against relevant risk factors suggests that the market may not fully absorb the factual information encapsulated in Shikiho's text. These observations prompt a deeper inquiry into market efficiency, the role of public information in price discovery.

Keywords: Stale information, ChatGPT, LLM, Return predictability, Text Analysis, Shikiho

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Introduction

In our research, we investigate whether 'stale,' publicly available information can predict stock returns. We employ a unique approach that leverages both Shikiho, a comprehensive and neutral Japanese corporate handbook, and ChatGPT-3.5, a large language model by OpenAI. Shikiho is chosen for its exhaustive and unbiased coverage of all listed stocks in Japan, providing an ideal platform for this study. It's important to note that the comprehensiveness and neutrality of Shikiho are unparalleled, as there exists no equivalent data source with such reliable attributes in other markets around the world.

We use ChatGPT-3.5 to scrutinize the text from Shikiho, and we assign confidence scores based on inferred business conditions for each stock. We categorize the portfolios into groups with either a positive or negative outlook based on these scores. Our study spans from 2007 to 2022 and reveals that portfolios with a positive outlook generally exhibit positive abnormal returns, whereas those with a negative outlook typically show negative returns. Intriguingly, we find that higher confidence scores (meaning the textual data is 'clear' rather than 'ambiguous') are correlated with higher alpha, thus challenging conventional beliefs about market efficiency.

Unlike prior research that indicates price reversals in response to stale news (Tetlock (2012)), our findings suggest more complex patterns. Tetlock's study primarily focuses on streaming news and observes market responses to the most recent updates, even when similar content has been reported earlier. However, their analysis falls short in considering the 'attention effect' that streaming news often garners. News, especially in a streaming format, has the ability to draw investors' attention and thus can have a disproportionate impact on market movements. In contrast, our study utilizes Shikiho, which provides comprehensive stale information, allowing us to capture market reactions in a context free from the attention effects that skew the outcomes in streaming news settings.

Contrary to Tetlock's (2012) assertion that novice investors often react impulsively to news, irrespective of its freshness, leading to temporary market overreactions, our study explores a different aspect. We focus on stale and unremarkable news presented in Shikiho's quarterly outlook statements. This allows us to observe investor behavior devoid of the attention effect or rapid news propagation. Our results reveal a nuanced pattern: stocks with positive outlooks in Shikiho show sustained long-term positive market reactions, while those with negative outlooks experience an initial downturn followed by a flat long-term performance. This suggests that investors may be underreacting to positive stale news and showing a short-term overreaction to negative stale news.

Data: Leveraging Shikiho for Comprehensive Equity Analysis

We utilize data from Shikiho, a reputable publication by Toyo Keizai Inc. that has been providing extensive coverage of all listed stocks in Japan since 1936. Shikiho is unique for its neutrality and reliability, as its data is collected by neutral journalists rather than company or sell-side analysts. This makes it a trusted source for both individual and professional investors. Shikiho offers an unparalleled, comprehensive view of the Japanese stock market, making it ideal for studying investor reactions to stale news and enabling cross-sectional stock comparisons. Its extensive historical data aids in identifying temporal changes in corporate behavior and industry trends.

A particular section in Shikiho focuses on earnings assessments and outlooks, providing a concise yet rich commentary on each company. The text, written in Kanji characters, offers

nuanced insights about a company's fundamentals in a compact form, exemplifying the efficiency of these symbols in delivering comprehensive information.

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Figure 1: Excerpt from Shikiho page for Kyokuyo Co. Ltd

This figure illustrates a page excerpt from the Shikiho company handbook, featuring a detailed snapshot of the financial performance and business outlook of Kyokuyo, a Japanese fisheries company. The encircled section is the focal point of our sentiment analysis, encompassing a succinct evaluation of the company's earnings and future projections, expertly assessed by Tokyo Keizai journalists. The page layout provides a comprehensive overview of the company's financial health, offering a list of major shareholders, a concise summary of sales, profits, and dividends for the past three years, and forward-looking earnings estimates.

Methodology: Data Processing and Analysis Using ChatGPT

We begin our study by collecting PDF files from Shikiho's handbooks, covering every listed company in Japan from January 1, 2007, to December 31, 2022. This amasses a dataset of 64 issues over 16 years, totaling 241,712 files. We then employ OpenAI's GPT-3.5-turbo via the ChatGPT API for natural language processing. The model is given specific instructions to label the text as 'positive' or 'negative,' estimate the confidence of this judgment, and list the reasoning behind it.

By looking at the response of the ChatGPT reveals that ChatGPT not only identifies explicit cues but also captures nuanced meanings in the text. The model's ability to discern subtle implications sets it apart from traditional, dictionary-based content analysis methods, proving its robustness and adeptness in nuanced interpretation.

Here is an example.

Original Shikiho Text of Co Kyokuyo Co. of Jan. 2007 (translated into English):

[Decrease] Increase in purchase prices. Rising prices of raw materials such as shrimp directly hit the processed goods. Even though sales are posted with Atka mackerel, the contribution to profit is small. The low market conditions for mackerel in the first half are painful. This results in a decrease in business profit. There are extraordinary profits from the sale of land. In the fiscal year ending March

2008, overseas bases will be fully operational and will be added. Aiming for profit improvement.

[Mid-term] No expansion measures other than overseas processing and sales. In September 2006, a sushi factory was established in Thailand. Exports to the United States for Christmas demand, and trial sales in Europe (monthly sales of 300 million yen). In China, frozen foods are expanded from the Qingdao base

ChatGPT's response.

"Judgment: Negative / Confidence: 80% / Reasons: The word 'decreased profits' suggests poor performance. Terms such as 'rising purchase prices,' 'shrimp and other raw materials directly hit processed goods,' and 'mackerel market conditions are low' indicate difficult market conditions for raw materials and products. Expressions like 'small profit contribution even if sales are recorded in Atka mackerel' also imply challenging performance. Phrases like 'overseas bases are in full swing, aiming for profit improvement' suggest potential for performance improvement through overseas expansion, but it also indicates that concrete results have yet to emerge. The expression 'no expansion strategy' raises concerns about future growth."

Performance Evaluation: Abnormal Returns and Calendar Time Portfolios

In our study, we employ ChatGPT to analyze and categorize the outlook statements contained within Shikiho's quarterly reports as either "positive" or "negative." The AI model further self-evaluates the confidence level of each categorization (as shown above), assigning them to three distinct tiers: high, median, and low confidence. This results in a nuanced classification system, giving us six unique metrics: Positive (High), Positive (Median), Positive (Low), Negative (High), Negative (Median), and Negative (Low). Leveraging these metrics, we construct Long/Short Portfolios to examine market performance corresponding to each category.

We evaluate the performance of stocks based on Shikiho reports through two key metrics: Abnormal Return and Calendar Time Portfolio. For calculating Abnormal Return, we segment stocks into eight portfolios based on ChatGPT's sentiment classification and confidence levels. These portfolios are then compared against the TOPIX index to derive abnormal returns, assessed at intervals of 5, 20, and 60 business days post-Shikiho publication.

Table II summarizes the results. Our analysis yields insights into stock market behavior following Shikiho publications. At one-week, one-month, and one-quarter intervals, stocks with positive outlooks show positive abnormal returns, gaining statistical significance in the longer term. This suggests that the market underreacts to positive outlook, and gradually incorporating Shikiho's stale positive information. In contrast, stocks with a negative outlook show a prompt market reaction, which later attenuates, signaling a market overreaction. We also find a strong correlation between ChatGPT's confidence scores and the magnitude of abnormal returns. High confidence scores, indicating clear outlooks, correlate with stronger abnormal returns.

Table II
Average Stock Performance Subsequent to the Shikiho Publication, 2007-2022

This table presents the performance of stocks following the publication of Shikiho financial reports at three distinct time horizons: one week (Panel A), one month (Panel B), and one quarter (Panel C). Day 0 is marked as the first business day after the Shikiho release. Performance is evaluated using two metrics: excess returns and buy and hold abnormal returns (BHAR). Excess returns are computed by subtracting the risk-free rate from the equal weighted portfolio return corresponding to each category within the given observation period. Buy and Hold Abnormal returns, based on Buy and Hold returns, are computed by deducting the return of the Tokyo Stock Price Index (TOPIX) over the corresponding interval. For uniformity and comparability, all returns are annualized. 'N' represents the cumulative number of stocks classified into each category over the entire sample period. ** denotes statistical significance at the 1% level.

Confidence	N	Positive		N	Negative	
		Excess Return	BHAR		Excess Return	BHAR
Panel A		Stock Performance One Week Post-Shikiho Performance				
All	159,771	0.438	0.090	67,562	-0.007	-0.356 **
Above Median	34,417	0.561	0.212	22,390	-0.038	-0.386 **
Median	69,551	0.461	0.112	33,860	0.001	-0.347 **
Below Median	55,803	0.338	-0.011	11,312	0.067	-0.281 **
Panel B		Stock Performance One Month Post-Shikiho Performance				
All	159,771	0.131	0.102 **	67,562	-0.022	-0.050
Above Median	34,417	0.181	0.153 **	22,390	-0.023	-0.051
Median	69,551	0.142	0.114 **	33,860	-0.013	-0.041
Below Median	55,803	0.086	0.058	11,312	-0.009	-0.037
Panel C		Stock Performance One Quarter Post-Shikiho Performance				
All	159,771	0.092	0.068 **	67,562	0.035	0.011
Above Median	34,417	0.106	0.082 **	22,390	0.041	0.018
Median	69,551	0.097	0.074 **	33,860	0.041	0.017
Below Median	55,803	0.076	0.052 **	11,312	0.032	0.008

In Calendar Time Portfolio analysis, we classify stocks based on their confidence scores and evaluate performance using four standard asset pricing models: CAPM, FF3, FF4, and FF5. (Table III). We also assess a long-short portfolio, targeting 'Above Median Positive' vs. 'Above Median Negative'.

In the calendar-time portfolio analysis, the 'Above Median' confidence subgroup within the 'positive outlook' category yields a statistically significant alpha, robust across various models. This implies a potential for superior returns, confirming that Shikiho's stale information is not fully absorbed into stock prices immediately. The effects are more pronounced in smaller firms. Our results collectively highlight the market's asymmetric response to Shikiho's stale information, emphasizing the profitability of investment strategies based on these insights.

Table III
Portfolio Abnormal Returns Based on Shikiho Outlook Groups between 2007-2022

This table provides a synopsis of the abnormal returns for calendar-time portfolios, which are categorized according to the outlook interpretations derived from Shikiho reports. Each quarter, in sync with the publication of Shikiho, stocks are classified into two groups: 'Positive Outlook Group' and 'Negative Outlook Group', based on the outlook assessment conducted by ChatGPT. Each outlook group is further segmented into 'Above Median', 'Median', and 'Below Median' subgroups relative to their respective confidence scores. The performance of these portfolios, computed using an equal-weighted method, is then evaluated via four asset pricing models: the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Fama-French 4-Factor Model with Momentum (FF3+Mom), and the Fama-French 5-Factor Model (FF5). Additionally, a long/short trading strategy is laid out, which involves taking long positions in the 'Above Median' confidence subgroup within the Positive Outlook Group, while simultaneously shorting the 'Above Median' confidence subgroup within the Negative Outlook Group. Trades are executed based on the closing prices on the first business day after Shikiho's release, and the portfolio remains untouched for a span of 20 business days until the subsequent Shikiho publication. The Alphas in the table are annualized, and the corresponding t-stats are displayed beneath the respective coefficients. Single (*) and double (**) asterisks signify statistical significance at the 5% and 1% levels, respectively.

	Positive Outlook			Negative Outlook			L/S
	Abv Median	Median	Below Median	Abv Median	Median	Below Median	
N	34,417	69,551	55,803	22,390	33,860	11,312	56,807
CAPM α	0.175 **	0.136 **	0.082 *	-0.028	-0.013	-0.018	0.203 **
	4.053	3.318	2.123	-0.666	-0.337	-0.468	6.913
FF3 α	0.152 **	0.115 **	0.062 **	-0.045	-0.029	-0.036	0.198 **
	6.976	5.748	3.346	-1.688	-1.370	-1.559	7.664
FF3+MOM α	0.153 **	0.115 **	0.063 **	-0.046	-0.030	-0.036	0.200 **
	7.074	5.796	3.376	-1.706	-1.400	-1.568	7.793
FF5 α	0.159 **	0.120 **	0.065 **	-0.047	-0.029	-0.035	0.205 **
	7.356	6.029	3.516	-1.793	-1.418	-1.570	8.173

Conclusion

Our study uniquely employs stale, neutral, and comprehensive data from Shikiho, coupled with state-of-the-art language models like ChatGPT, to investigate delayed market responses to business outlooks. By focusing on Shikiho, we successfully eliminate attention effects that might distort findings. Our key results show that the market underreacts to positive stale information, implying incomplete assimilation into stock prices. Conversely, negative stale information is fully accounted for but leads to temporary undervaluation due to novice traders' short-term trading at the time of Shikiho issuance. Intriguingly, we find that the market reaction, whether positive or negative, is more pronounced for stocks that ChatGPT classifies with high confidence. This suggests that the market responds more strongly to clear, unambiguous information.

References

Tetlock, P. C., 2011, All the News That's Fit to Reprint: Do Investors React to Stale Information?, *Review of Financial Studies*, 24, 1481-1512.