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Alpha Algorithms Based on the Ability of Repaying Current Debt and the Level of Research and Development

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Abstract: This paper explores two alphas to predict stock price movements based on companies' financial health and innovation capabilities. The first alpha, How-Much-You-Can-Pay-Back (HMUCPB) Alpha, utilizes the ratio of Operating Income to Short-Term Debt to assess a company's ability to repay current debts. The second alpha, R&D Alpha, examines the ratio of Research and Development Expenses to Operating Expenses alongside returns generated from R&D investments to evaluate a company's innovation performance. Findings indicate that while HMUCPB Alpha lacks precision in forecasting due to evolving financial complexities, the R&D Alpha demonstrates strong predictive power and practical relevance in today's technology-driven market. This work emphasizes the importance of incorporating R&D metrics into investment decision-making to achieve more profitable outcomes.

Keywords: Debt repayment, R&D investment, Stock price prediction, Financial analysis, Stat Arb.

1. Introduction

In an evolving financial market environment, investors are constantly looking for innovative ways to improve their portfolio performance. Traditional financial indicators, while valuable, often fail to synthesize company's operational health and growth potential. As companies face increasing financial pressures and innovation need, new ways to assess stock performance have emerged. One such method is to analyze a company's ability to manage its debt, which can provide insight into its financial stability. In addition, as technological advances become key to competitive advantage, assessing a company's investment in R&D has become an important predictor of long-term success.

Current research has explored various financial ratios and their impact on stock prices, but there is still a gap in understanding how some specific metrics directly impact market performance. While some studies have emphasized the importance of these factors individually, there is a lack of comprehensive strategies that combine these factors to effectively predict stock performance.

This work addresses these gaps by introducing two alpha strategies: How Much Can You Pay Back (HMUCPB) alpha and R&D alpha. HMUCPB alpha evaluates a firm's ability to repay short-term debt and provides a measure of financial stability in times of market stress. R&D alpha assesses

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a firm's ability by analyzing R&D expenses as a percentage of operating expenses and the corresponding financial returns to assess the effectiveness of a company's R&D investments.

2. Data

2.1. Data Universe

Stocks are chosen from sectors that possess potentials and values of keep consistent R&D program and we intentionally select stocks from the following four sectors so that we could industrially neutralize the effect from different sectors' different level of R&D, make our formation of alpha more reasonable:

(1) Healthcare: PFE, JNJ, MRK, GILD, AMGN, BMY, LLY, BIIB, PG. This sector includes companies known for their significant investments in R&D to develop new drugs and medical technologies.

(2) Material: NEM, SHW, APD, ECL, FCX, PPG. Companies in this sector invest in R&D to improve materials and processes.

(3) Information Technology: APPL, IBM, MSFT, AMZN, INTC, CSCO, CRM. This sector includes companies that are leaders in technological innovation and spend heavily on R&D.

(4) Automobile: TSLA, GM, F, TM, APTV. This sector consists of companies that are heavily investing in R&D for advancements in automotive technology, including electric vehicles.

2.2. Data Sets

The data sets include:

Income Statement Data: Ebit, R&D Expense, Operating Expense
Balance Sheet Data: Short-term Debt, Long-term Debt, Total Liabilities
Cash Flow Data: Interest Expense, Income Tax Expense
Equity Data: Common Stock Shares Outstanding,
Market Data: Adjusted Closing Price, Opening Price, Closing Price.

2.3. Data Sources

There are two main data sources, Alpha Vantage and Yahoo Finance.

First, Alpha Vantage, a provider of free APIs for financial data, includes data such as company overview, balance sheet, income statement, trade volume, opening/ closing price etc. Using the API key and accessing stock data via HTTP requests, the historical data will be returned in JSON or CSV format.

Second, Yahoo Finance, a comprehensive financial news and data platform, provides users with free stock quotes, market news, portfolio management tools, and international market data, etc. It is a good tool to supplement the missing data of Alpha Vantage.

2.4. Date Range

This essay uses data ranging from year 2014 to current year of 2024 because data further before 2014 might be outdated and the period does not possess a close relation to debt and R&D structure in recent years.

(1) In-sample Data (2014/01/01~2021/12/31): The eight-year span provides a comprehensive historical dataset, allowing for the capture of various market cycles, trends, and patterns. This duration helps ensure the robustness of the models by including both bullish and bearish market conditions.

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(2) Out-sample Data (2022/01/01~2024/3/28): We purposedly reserve the most recent two and a half year (23% of the total data) as out of sample data as the most recent data available is included to ensure that the models are validated against current market conditions.

Additionally, data from 2011-2014 are used for "delay" purposes.

3. Modeling

3.1. How Much You Can Pay Back Alpha

Operating Income directly reflects how much of the profits and accessible capital can be utilized by companies [1], and by dividing it with companies' Short-Term Debt (Current Debt that should be collected in 1 year), it will demonstrate the company's financial pressure [2-4]. Meanwhile, we normalize the impact of different scales of these two factors from different companies by dividing them with each with Market Capitalization and Total Liabilities [1, 5]. Namely, the raw alpha can be shown as follow:

$$Raw\ Alpha = \frac{Operating_{Mearketing}^{Income} Capitalization}{Short\ Term_{Total}^{Debt} Liabilities} \tag{1}$$

The higher the ratio is, the better financial situation and monetary resources companies have, which would mean a more promising and positive development of companies and reflect on their stock prices.

To further clarify the logics of raw alpha, it is considered that companies that have a higher absolute value of Operating Income to Short Term Debt ratio will take higher proportions of investors' capital resources. By using demean mechanism, reasonable allocation of funds will be achieved for short and long stocks based on their alpha output and signs in front, which neutralized risks by such hedging strategy. Therefore,

$$Alpha\ 1 = demean(Raw\ Alpha) \tag{2}$$

$$HMUCPB\ Alpha = PC(Alpha\ 1) \tag{3}$$

where demean mechanism finds the difference between the value and the market average and Equation (3) provides a more representation of the proportions of investors' capital resources, and their formula are given by

$$demean(value) = value - \frac{sum\ of\ values}{number\ of\ stocks} \tag{4}$$

and

$$PC(value) = \begin{cases} value > 0, \dfrac{value}{sum\ of\ positive\ values} \\ value = 0, \quad value = 0 \\ value < 0, \dfrac{value}{sum\ of\ negative\ values} \end{cases} \tag{5}$$

Additionally, this alpha only considers the ability for the company to cover their short-term debt, making the impact of their financial status on the stock price become more rapidly reflected, which increases the sensitivity of the alpha.

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3.2. R&D Alpha

With further specified thinking, the attention and investment paid by a stock company on the R&D section could effectively reflect the financial situation and future development of the company, since companies with strong R&D backgrounds (usually being signaled with high technological investment, recognizable products, patents etc.) often signaled with a high intrinsic value and a stable profit as research from Investopedia explains that the profitability and share prices of technology companies are ultimately driven by the productivity of their R&D efforts [6-8]. Meanwhile, it also need to judge whether those efforts are reasonable and effective.

First, by analyzing how much R&D Expense, in each fiscal year, the company has and comparing it to the company's Operating Expense, it will reflect how much the degree of recognition on R&D the company's inner management has. Specifically, the larger the gap between the R&D Expense and Operating Expense, the more attention and investment is paid by the company. If the ratio of $\frac{R\&D\ Expense}{Operating\ Expense}$ becomes low, it may indicate the poor financial situation, reduced innovation potential, economic uncertainty, etc. Admittedly, when the company changes strategies or structures, the difference of two may be low as well, but we consider it as a kind of risk and will averse it due to the uncertainty of the future after the strategy shift.

Second, by evaluating how much return is created compared to the R&D Expense (how much is invested), the efficiency and the rate of realization (turning into profits) of the company's R&D input can be quantified and compared with each other [9]. We decided to rank it because this quotient will always be positive, but that does not mean every company's R&D return is in good shape. Specifically, if the ratio of Earnings to R&D Expense is high, this would mean an effective research process and a good "turn-into-profit" performance, which we will be able to see the rank after we use each company's quotient of Earnings/R&D Expense minus the average value of all quotients. By comparing in this way, we can find out which companies have R&D returns in a really good shape.

Therefore,

$$Raw\ Alpha = \frac{R\&D\ Expense}{Operating\ Expense} \times IN\left(\frac{earnings - delay(earnings, 3)}{delay(R\&D\ Expense, 3)}\right) \tag{6}$$

where

$$IN(value) = demean(value\ within\ the\ same\ industry) \tag{7}$$

$$delay(value, a) = value\ from\ a\ years\ ago \tag{8}$$

$$Alpha\ 1 = demean(Raw\ Alpha) \tag{9}$$

$$\text{R\&D } Alpha = PC(Alpha\ 1) \tag{10}$$

By combining 1) the degree of recognition and investment in R&D and 2) the value of R&D Expense input, we aim to utilize the company's R&D level as well as the financial situation revealed from it to predict the stock price movement and construct our portfolio.

3.3. Analysis

To evaluate the performances of alpha outcomes, the following four aspects of statistics will be calculated to recorded: Annualized Return, Annualized Volatility, 0-benchmark IR, Max Drawdown, %Profitable Day.

Two normal execution costs are added and considered in the process of our trading, which are commission cost ($0.01 per share), transaction costs (Bid-ask Spread: 0.03% of the trade value) and Market Impact (0.11% of the trade value). The execution costs are only considered in combination

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alpha, since we concentrate more on the role and impact of each factor when we focus on HMUCPB alpha and R&D alpha and when we think about combination the real-world application is more concerned.

4. Implementation

The following part are the ran results from the alphas based on the real stock price changes for our in-sample data.

4.1. How Much You Can Pay Back Alpha

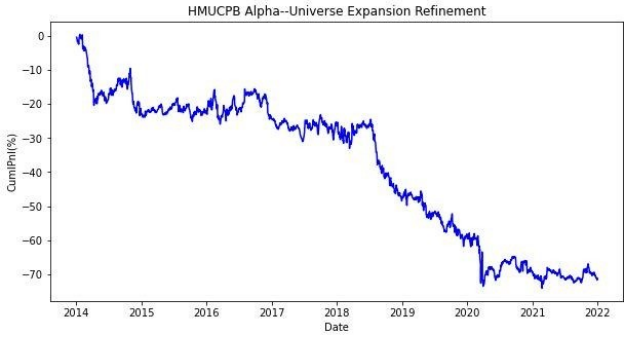

Figure 1: Cumulative PnL (%) of Original HMUCPB Alpha

The historical performance of the HMUCPB Alpha strategy, as depicted in figure 1 spanning from 2014 to 2022, shows a consistent downward trajectory. The cumulative PnL steadily declines with no significant periods of sustained recovery, indicating that the strategy has faced persistent challenges over this time frame.

From 2014 to 2016, the strategy shows some fluctuations, with a few brief recovery attempts, but overall, it remains a negative trend. The significant drop in performance around 2018 and the continued decline through 2019 and 2020 suggest that the strategy was heavily impacted by external market conditions or inherent weaknesses in the alpha formulation. The period around the onset of the COVID-19 pandemic (early 2020) appears to exacerbate the strategy's performance issues, resulting in one of the steepest declines observed in the entire chart.

Table 1: Performance Statistics of Original HMUCPB Alpha

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
-8.90%	10.82%	-0.82	74.52%	49.40%

As table 1 shows, the strategy shows an annualized return of -8.9%, indicating a consistent failure to generate positive returns over the analyzed period. This negative return aligns with the downward trajectory observed in the cumulative PnL, highlighting persistent underperformance. The annualized volatility of 10.82% suggests that the strategy experienced moderate risk levels. However, the negative returns imply that the strategy's risk was not well-compensated, leading to poor overall outcomes. The information ratio of -0.82 further underscores this point, indicating that the strategy generated returns significantly below the benchmark per unit of risk taken. This negative ratio highlights inefficiencies in the strategy's ability to convert risk into positive returns. The maximum drawdown is relatively moderate compared to the overall decline, indicating that the strategy had few, if any, periods of recovery strong enough to reverse the negative trend.

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4.2. R&D Alpha

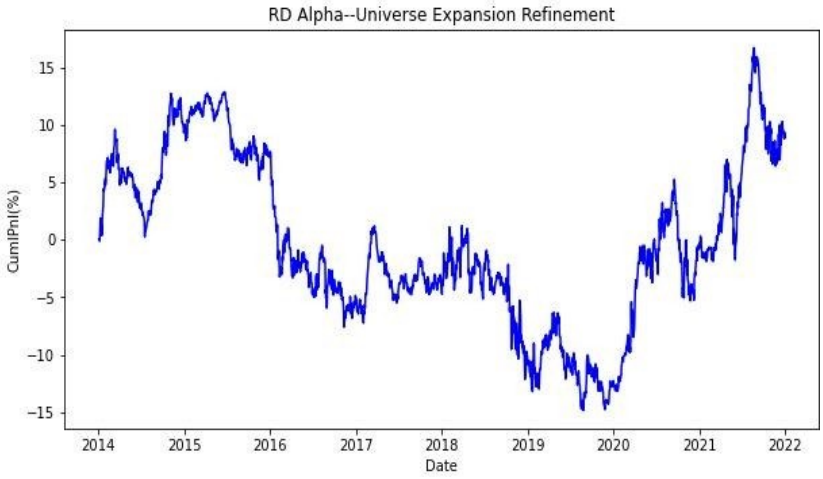

Figure 2: Cumulative PnL (%) of Original R&D Alpha

Figure 2 shows fluctuations from the beginning to 2020, with significant volatility and periods of decline. However, from 2020 onwards, the strategy shows an upward trend, culminating in strong performance through 2020 and 2021.

Table 2: Performance Statistics of Original R&D Alpha

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
1.11%	9.58%	0.12	27.52%	50.79%

As table 2 shows, key performance metrics indicate that the strategy achieved an annualized return of 1.11%, reflecting medium performance relative to the market. The annualized volatility of 9.58% indicates a moderate level of risk, aligning with the observed fluctuations. The information ratio of 0.12 demonstrates the strategy's efficiency is not very well. The maximum drawdown of 27.52% underscores periods of underperformance, but the overall trend shows resilience and recovery. The strategy maintained profitable days at 50.79%, indicating a consistent ability to generate gains on more than half of the trading days.

5. Refinement

5.1. How Much You Can Pay Back Alpha

5.1.1. Long-term Debt Refinement

By analyzing out that the reason of significant loss is due to “fever rise” debts among American com panies, we realize that the ability to pay back short-term debts is not only related to companies' oper ating income, but also the available cash and capital it acquires from new debts. Thus, we incorporat e this realization into our HMUCPB Alpha refinement by adding the consideration of Long-Term D ebt as Equation (11) shows. A higher increment of Long-Term Debt indicates a higher potential for the company to cover their more urgent short term debt, which is the ability measured by the alpha.

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$$\begin{cases} Raw\ Alpha = \dfrac{Operating\ Income/Mearket\ Capitalization}{Shor\ Term\ Debt/Total\ Liabilities} \times \dfrac{Long\ Term\ Debt - delay(Long\ Term\ Debt,1)}{Total\ Liabilities} \\ Alpha\ 1 = demean(Raw\ Alpha) \\ HMUCPB\ Alpha = PC(Alpha\ 1) \end{cases} \tag{11}$$

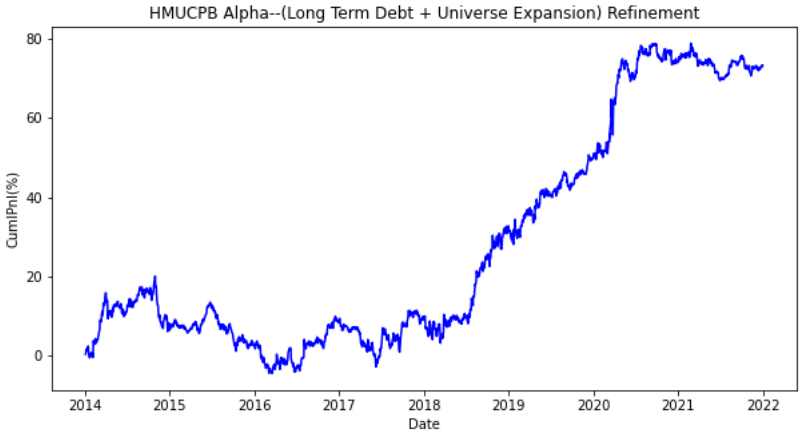

Figure 3: Cumulative PnL (%) of HMUCPB Alpha with Long-term Debt Refinement

In figure 3, the strategy didn't work very well before 2018 but demonstrated a remarkable recovery starting from 2019. It shows that HMUCPB alpha is more useful in times of economic downturn, such as the economic downturn caused by the COVID-19 pandemic. At this time, the company's dependence on debt was strengthened, that is, the solvency will more accurately reflect the company's performance.

Table 3: Performance Statistics of HMUCPB Alpha with Long-term Debt Refinement

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
9.15%	11.36%	0.81	24.87%	51.98%

As table 3 shows, the strategy's annualized return stands at 9.15%, a modest figure that reflects both the challenges faced and the resilience shown over time. The annualized volatility of 11.36% suggests a middle level of risk, aligning with the observed performance fluctuations. A high information ratio of 0.81 indicates that the strategy has effectively generated returns above the benchmark per unit of risk, demonstrating strong risk-adjusted performance. The maximum drawdown of 24.87% highlights a period of underperformance, underscoring the strategy's exposure to market downturns.

5.1.2. Stock-specified Return Volatility Refinement

In order to reduce annualized volatility, we divide the output of our raw alpha for each stock with its own volatility of weekly return. This way we could further decrease the risks in transactions. The refined alpha is shown as follow:

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$$\begin{cases} Raw\ Alpha = \dfrac{Operating\ Income\ /\ Mearket\ Capitalization}{Shor\ Term\ Debt\ /\ Total\ Liabilities} \\ Alpha\ 1 = Raw\ Alpha / Stocks'\ WeeklyReturn\ Volatility \\ Alpha\ 2 = demean(Raw\ Alpha\ 1) \\ \text{HMUCPB}\ Alpha = PC(Alpha\ 2) \end{cases} \tag{12}$$

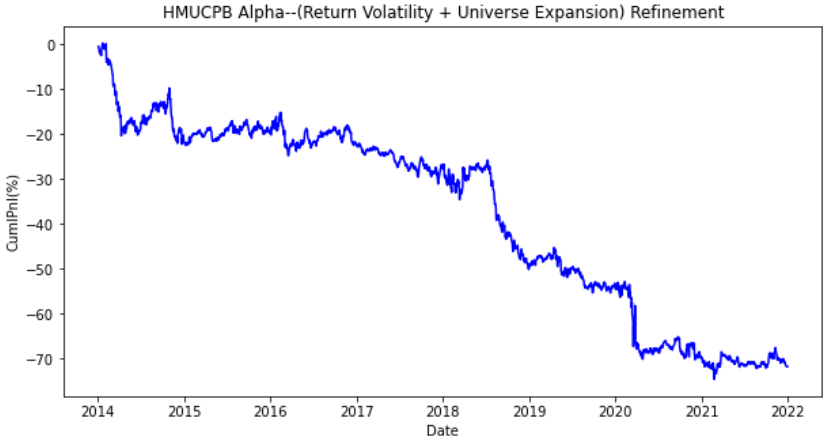

Figure 4: Cumulative PnL (%) of HMUCPB Alpha with Stock-specified Return Volatility Refinement

As figure 4 shows, although the overall line is still trending downward, the volatility has been greatly reduced, which indicates the success of the Stock-specified Return Volatility Refinement.

Table 4: Performance Statistics of HMUCPB Alpha with Stock-specified Return Volatility Refinement

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
-8.97%	9.42%	-0.95	74.88%	48.66%

As shown in table 4, the strategy achieved an annualized return of -0.02%, which reflects the challenges in outperforming the market. The annualized volatility of 10.14% is lower compared to previous versions, indicating improved stability and risk management. The information ratio of -0.002 suggests that the strategy ineffectively generates returns above the benchmark per unit of risk. The maximum drawdown of 32.84% highlights periods of underperformance, emphasizing the need for continued refinement in risk management practices. Despite these challenges, the strategy maintained profitable days at 49.36%, indicating a balanced ability to generate gains across trading days.

5.2. R&D Alpha

5.2.1. Stock-specified Return Volatility Refinement

To reduce the return volatility and risks in transactions, we applied refinement using same intuition applied in part 5.1.2. The refined alpha is shown as follow:

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$$\begin{cases} Raw\ Alpha = \frac{R\&D\ Expense}{Operating\ Expense} \times IN\left(\frac{eaitda - delay(eaitda,3)}{delay(R\&D\ Expense,3)}\right) \\ Alpha\ 1 = Raw\ Alpha\ /Stocks'\ Weekly\ Return\ Volatility \\ Alpha\ 2 = demean(Alpha\ 1) \\ \text{R\&D Alpha=PC(Alpha 2)} \end{cases} \quad (13)$$

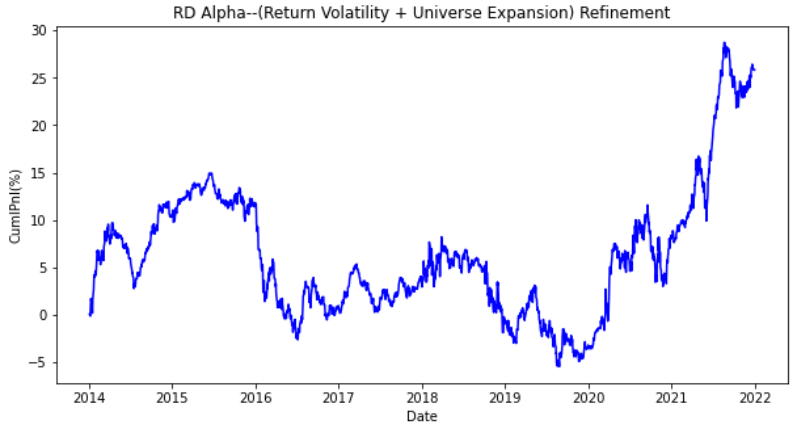

Figure 5: Cumulative PnL (%) of R&D Alpha with Stock-specified Return Volatility Refinement

Compared with figure 2, figure 5 shows lower volatility and higher return, showing a success of the refinement.

Table 5: Performance Statistics of R&D Alpha with Stock-specified Return Volatility Refinement

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
3.23%	7.48%	0.43	20.06%	51.84%

As table 5 shows, the R&D Alpha strategy achieved an annualized return of 3.23%, indicating strong performance relative to market benchmarks. The annualized volatility of 7.48% reflects a lower risk level compared to previous versions, signifying improved stability and risk management. However, the maximum drawdown of 20.06% highlights periods of significant underperformance, emphasizing the need for further refinement in risk management practices. Despite these challenges, the strategy maintained profitable days at 51.84%, indicating a consistent ability to generate gains over half of the trading days.

6. Final Selection

To find the optimal alpha, we combine the refinements so that the two refinements of HMUCPB alpha generates 4 strategies and the one refinements of R&D alpha forms 2 strategies. Based on IR, we can select the most suitable alpha by comprehensively considering the risks and benefits.

All the strategies below consist of the original alpha, Long-term Debt (LD) refinement and Stock-specified Return Volatility (RV) refinement:

Table 6: Performance Statistics of All HMUCPB Alphas

Strategy	Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
Original	-8.90%	10.82%	-0.82	74.52%	49.40%

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Table 6: (continued)

LD	9.15%	11.36%	0.81	24.87%	51.98%
RV	-8.97%	9.42%	-0.95	74.88%	48.66%
LD+RV	9.21%	10.36%	0.89	20.15%	52.38%

Table 7: Performance Statistics of All R&D Alphas

Strategy	Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
Original	1.11%	9.58%	0.12	27.52%	50.79%
RV	3.23%	7.48%	0.43	20.06%	51.84%

6.1. HMUCPB Alpha

In selecting the optimal alpha for HMUCPB, we primarily evaluated the strategies based on the Information Ratio (IR), which measures risk-adjusted returns. Table 6 reveals that the "LD+RV" combination strategy stands out with the highest Information Ratio of 0.89, indicating it offers the best return for the level of risk taken. This strategy also has the highest annualized return of 9.21%, while maintaining a relatively low maximum drawdown of 20.15%, suggesting strong risk management. Although the "LD" combination also shows a high return (9.15%), its maximum drawdown is higher at 24.87%, implying much higher risk. Therefore, considering the Information Ratio, return, and drawdown, the "LD+RV" strategy was chosen as the optimal alpha for HMUCPB due to its superior balance of return and risk. And its cumulative PnL is shown in figure 6.

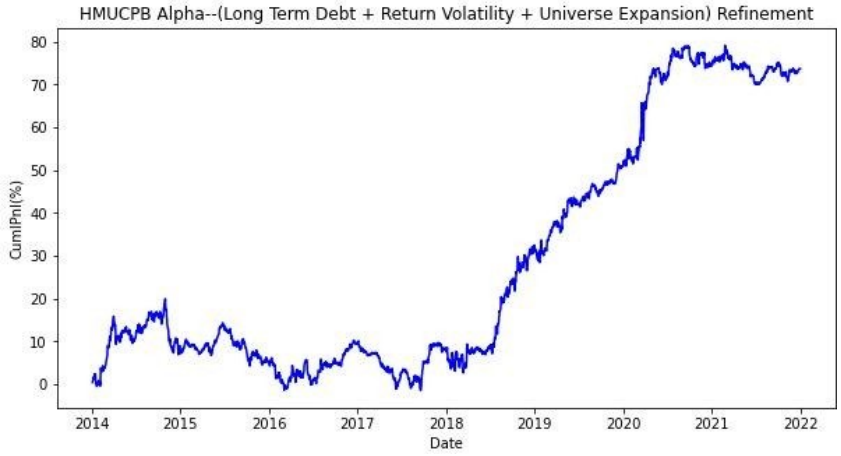

Figure 6: Cumulative PnL (%) of Final HMUCPB Alpha with Long Term Debt and Stock-specified Return Volatility

6.2. R&D Alpha

For the R&D alpha, the strategy selection is again driven by the Information Ratio (IR) to ensure a favorable balance between risk and return. As shown in table 7, the "RV" (Return Volatility) refinement stands out with the highest IR of 0.43. This indicates that the "RV" strategy provides an efficient risk-adjusted return compared with the original R&D alpha. The annualized return for this strategy is 3.23%, with an annualized volatility of 7.48%, which is relatively low and reflects controlled risk levels. Additionally, the maximum drawdown of 20.06% is moderate, ensuring that losses are kept within a manageable range. As shown in figure 5, the cumulative PnL graph further supports this choice, showing a consistent upward trend from 2020 onwards, demonstrating the

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strategy's robustness. Given these factors, the "RV" refinement is selected as the optimal alpha strategy for R&D, offering the best combination of return and risk control.

6.3. Optimal Weight Combination Alpha

We hope to combine the two alphas by giving each of them weights that match their standard deviations and the mean of their daily returns to maximize the Information Ratio of the new alpha. Namely, we have $\alpha_c = w_1 \times \alpha_1 + w_2 \times \alpha_2$, where w_1 and w_2 are the weights assigned to each alpha. Meanwhile, we let m_1 be the mean of daily returns of HMUCPB alpha, m_2 be the mean of daily returns of R&D alpha, and m_c be the mean of daily returns of the combined alpha, while σ_1 be the standard deviation of HMUCPB alpha, σ_2 be the standard deviation of R&D alpha, and σ_c be the standard deviation of the combined alpha; let c_{12} be the correlation coefficient of between HMUCPB alpha and R&D alpha.

We have:

$$\begin{cases} m_c = w_1 \times m_1 + w_2 \times m_2 \\ \sigma_c = \sqrt{{w_1}^2 \times {\sigma_1}^2 + {w_2}^2 \times {\sigma_2}^2 + 2 \times w_1 \times w_2 \times c_{12}} \\ IR_c = \frac{m_c}{\sigma_c} \end{cases} \quad (14)$$

where $w_1 + w_2 = 1$.

Then, solving Equation (14) using LaGrange multiplier method.

Based on this methodology, we will utilize the data from the previous year to calculate the optimal weights for each alpha to combine for the current year. For the first year that we have relevant data in (year of 2014), we default this year's weight for both alpha to be equal (0.5: 0.5).

For the Optimal Weight Combination Alpha, we substitute the two alphas we select in the end which perform best in the above section into the formula, αc = w1α1 + w2α2, as α1 and α2 respectively in order to best control the return and risk at the same time.

Table 8: Performance Statistics of Final Optimal Weight Combination Alpha

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
5.97%	8.18%	2.59	18.28%	52.60%

As shown in table 8, this strategy generates a moderate annualized return of 5.97% with a volatility of 8.18%, which indicates reasonably good risk-adjusted returns, while the information ratio of 2.59 further proves this idea. Meanwhile, the 18.28% maximum drawdown and 52.60% profitable days suggest moderate downside risk and a relatively stable return. And its cumulative PnL is shown in figure 7.

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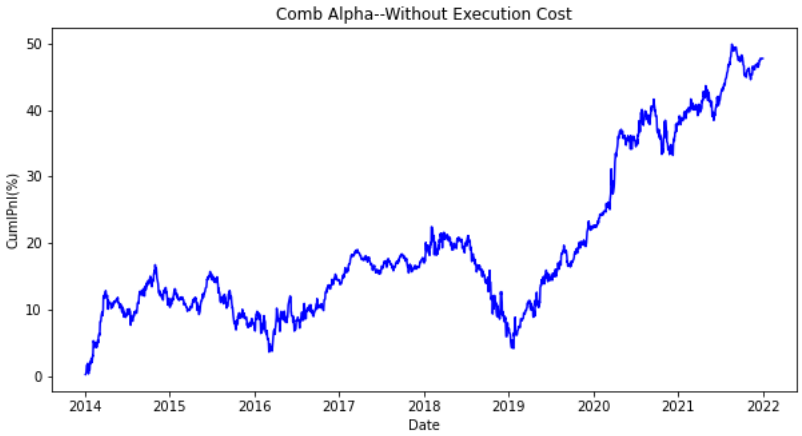

Figure 7: Cumulative PnL (%) of Final Combination Alpha

Figure 7 shows a fluctuation periods from mid-2014 till 2018 as both two alphas' outcomes in that period is not strongly profitable and are both fluctuating. However, from 2019 to 2022, there is an obvious growth in return because both alphas generate profits and the optimal combination incorporate considerations of lowering risk instead of simply pursuing high profits.

Then, consider the execution cost:

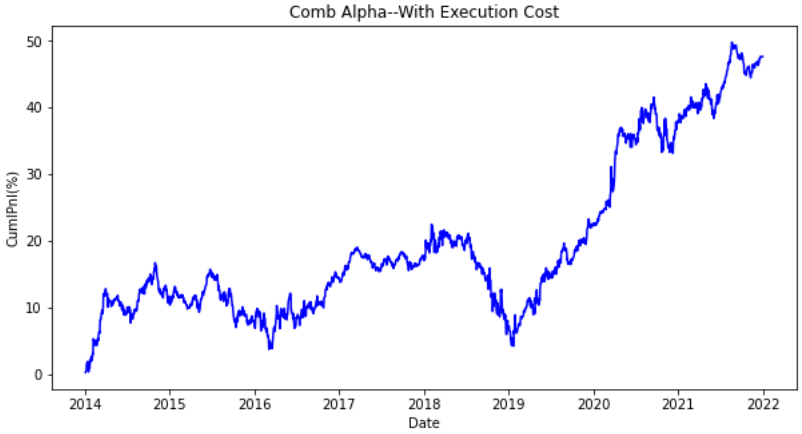

Figure 8: Cumulative PnL (%) of Final Combination Alpha with Execution Cost

Table 9: Performance Statistics of Final Optimal Weight Combination Alpha with Execution Cost

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
5.95%	8.16%	2.59	18.25%	52.60%

As figure 8 and table 9 show, the overall performance after considering execution cost is slightly influenced by the additional cost with a similar movement and pattern shown in the performance above (without execution cost).

7. Out of Sample

In this section, out-of-sample data will be substituted to test the future applicability of alphas.

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7.1. HMUCPB Alpha

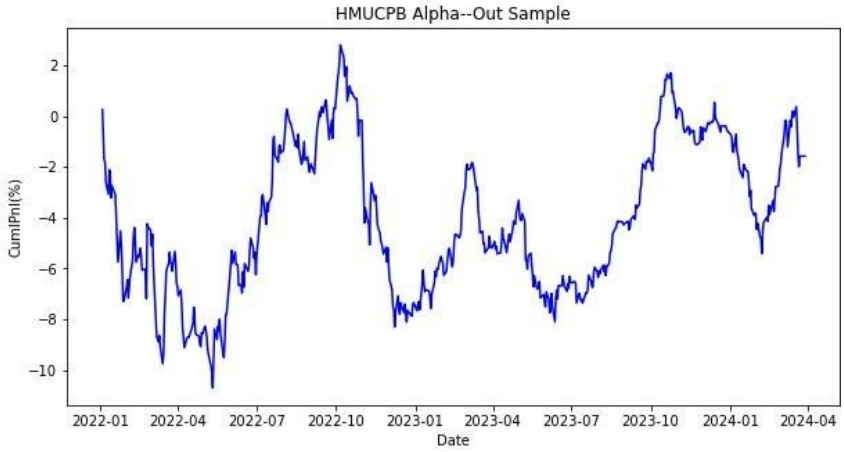

Figure 9: Cumulative PnL (%) of Final HMUCPB Alpha with Out-of-sample Data

Figure 9 clearly illustrates the periods of decline, particularly during early 2022 and late 2022, where the strategy experienced sharp drawdowns. While there were some recovery phases, they were not sustained, leading to an overall negative performance. The lack of consistent positive performance suggests that the strategy's parameters, which may have been effective in-sample, did not translate well to the out-of-sample environment. This could be due to changes in market conditions, sector performance, or other external factors that were not adequately accounted for in the strategy's design.

Table 10: Performance Statistics of Final HMUCPB Alpha with Out-of-sample Data

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
-0.62%	7.99%	-0.08	11.50%	48.04%

As table 10 shows, key performance metrics highlight the difficulties faced during this out-of-sample period.

The annualized return of -0.62% indicates that the strategy was unable to generate positive returns, reflecting a challenging market environment or potential inefficiencies in the strategy's adaptation to new conditions. The annualized volatility of 7.99% suggests a moderate level of risk, consistent with the observed fluctuations in performance. The information ratio of -0.08 further underscores the strategy's struggles, as it indicates that the strategy failed to generate returns above the benchmark per unit of risk. The maximum drawdown of 11.50% highlights the significant periods of underperformance, further emphasizing the strategy's challenges during this period. Additionally, the strategy maintained profitable days at only 48.04%, indicating that the vast majority of trading days resulted in losses.

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7.2. R&D Alpha

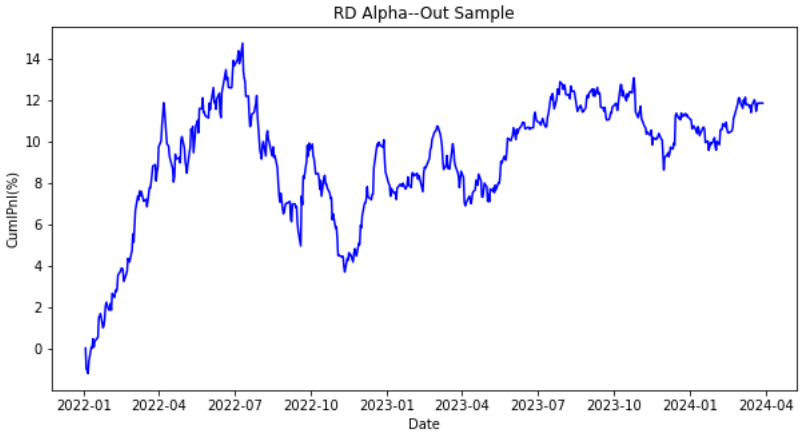

Figure 10: Cumulative PnL (%) of Final R&D Alpha with Out-of-sample Data

As figure 10 shows, the upward trajectory during the first half of 2022 can be attributed to favorable market conditions or successful stock selections that aligned well with the strategy's underlying factors, such as R&D expenditure and financial health metrics. However, the subsequent volatility and drawdowns suggest that the strategy may have faced challenges in adapting to changing market dynamics or sector-specific downturns, which impacted its overall performance. Specifically reflected from the figure, it is the fluctuating section from late 2022 to late 2023. But the overall positive return indicates a decent performance of the alpha operation.

Table 11: Performance Statistics of Final R&D Alpha with Out-of-sample Data

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
5.26%	7.08%	0.74	11.44%	51.60%

As table 11 shows, the R&D Alpha strategy achieved an annualized return of 5.26%, indicating a medium level of performance. The annualized volatility of 7.08% is moderate, reflecting a balance between risk and return. The information ratio of 0.74 suggests that the strategy generated a decent return above the benchmark, with moderate level of risks. The maximum drawdown of 11.44% highlights periods of underperformance during mid-latter 2022, which is not outstanding but acceptable relatively comparing with its returns and volatility. The strategy maintained profitable days at 51.60%, which is not really high, indicating that while the strategy was profitable, it was so on a balanced amount of loss- profitable days

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7.3. Optimal Weight Combination Alpha

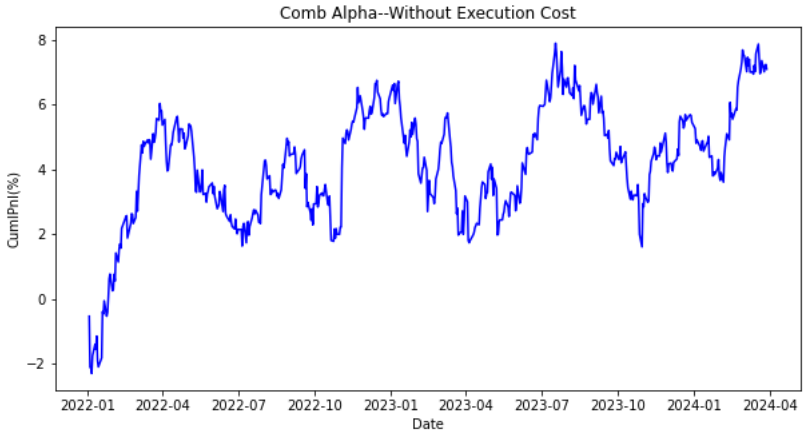

Figure 11: Cumulative PnL (%) of Final Combination Alpha with Out-of-sample Data

Figure 11 reveals the strategy's struggle to achieve sustained growth. The increase from early 2022 to mid-2022, gives out a well-performed trading operation as nearly a 10% of return rate is generated in a small time period (less than half a year). The latter part of the fluctuation shows a messy and inconsistency of achieving a substantial and steady long-term gain.

Table 12: Performance Statistics of Final Combination Alpha with Out-of-sample Data

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
3.15%	6.30%	0.50	6.28%	54.09%

As table 12 shows, the Combination Alpha strategy achieved an annualized return of just 3.15%, which is far from ideal. The annualized volatility of 6.30% suggests that the strategy operated with moderate risk, but the returns did not justify the level of volatility experienced. The information ratio of 0.50 highlights the inefficiency of the strategy in generating returns above the benchmark per unit of risk taken. The maximum drawdown of 6.28% underscores significant periods of underperformance, which is although covered in the period of severe fluctuation, still affected the overall returns. Additionally, the strategy maintained profitable days at 54.09%, indicating a balanced days of loss and profits, affected by the latter fluctuation and the exceeding part of profits than loss is attributed to the early to mid-2022 periods' gain.

Then, consider the execution cost:

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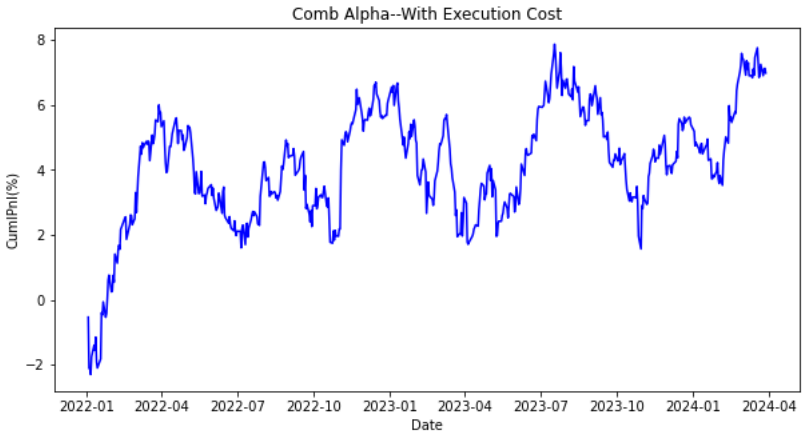

Figure 12: Cumulative PnL (%) of Final Combination Alpha with Out-of-sample Data and Execution Cost

Table 13: Performance Statistics of Final Combination Alpha with Out-of-sample Data and Execution Cost

Annualized Return	Annualized volatility	Information Ratio	Max Drawdown	%Profitable Days
3.10%	6.29%	0.49	6.30%	53.91%

As figure 12 and table 13 show, the addition of executing cost minorly influence the returns of all time as it accompanies with each trade. However, the overall pattern and movement remain consistent with outcomes reflected without executing cost.

8. Conclusion

In this research, based on companies' ability to repay current debt, "How-Much-You-Can-Pay-Back" (HMUCPB) alpha is developed and refined. Based on companies' investment and efficiency level of Research and Development, R&D alpha is developed and refined. The two alphas, or algorithms, and their combination were introduced as outcomes in metrics format to predict the price changes of different stocks, further coming up with the optimal hedging strategy of trading stocks. The study found that while HMUCPB Alpha encountered problems in predicting stock prices correctly, especially during market downturns, R&D Alpha is more accurate in estimating prices. This indicating a promising research value in utilizing R&D evaluation to link with companies' stock performance.

The purpose of the study is to provide investors with stable tools of evaluating and predicting stock prices movement. The result indicates that the R&D alpha performs better and steadier than the debt-repayment-based approach in terms of generating positive returns. In addition, potential future study direction could be to incorporate better combined approaches, expanding the stock universe and refining economic intuitions to improve the current alphas.

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