

Analysis of ten stocks based on IM model

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Abstract: This paper collects historical daily total return data for the last 20 years for 10 stocks belonging to three or four different industries, one (S&P 500) stock index (11 risky assets in total) and A proxy for the risk-free rate (1-month federal funds rate) designed to aggregate daily data into monthly observations, and based on those monthly observations to calculate all proper optimization inputs alongside the Index Model (“IM”) under five constrains. This paper also presents the results in sheet to make inferences comparisons, inferences and instructions between the sets of constraints for the sensitivity analysis.

1. Introduction

Investors are mainly faced with two major risks when investing: one is the market risk, which affects the development of enterprises and is unpredictable. Common reasons include interest rates, inflation, exchange rates, etc. These risks are not specific to a particular company or industry. The second risk is diversifiable, which also belongs the unsystematic risk and comes from industries, companies, economies, markets, policies, etc. [1] These risks can be mitigated by diversifying investments to reduce risk or loss. And this paper will provide analysis of ten stocks based on the index model under the five constraints.

The originator of the diversification theory is Harry Markowitz in the United States, due to his paper "Portfolio Selection" in 1952 (25 years old) and "Portfolio Selection: Effective Diversification" published in 1959 (32 years old). book, was awarded the Nobel Prize in Economics in 1990. The theory he created has been called "the first revolution in Wall Street". Diversification is spreading risk, which aims at increasing the odds of investment success among different types of investments.[2] Especially in stock investment, diversification is one of the most basic and most widely accepted concepts in investment, while diversification is no guarantee against loss, diversification is an significant factor in achieving long-term financial goals while minimizing risk.[3]

In this paper, the previous researches on investment theory portfolio, investment forecasting, investment risk management, application of Var method, etc. taking China's stock market as an example, are reviewed.

ROY proposed the "Safety-First Portfolio Theory", which selects the variance mean and of the portfolio as a whole, particularly his maximizing portfolio $(E_d) / \sigma$ to select a portfolio (where d is a fixed return). [4] Tobin believes that investors seek an efficient combination of mean-variance of monetary assets, and his main purpose is to illustrate a feasible theory of holding funds. On this basis, he constructed the portfolio selection theory as - n kinds of risky assets and 1 kind of risk-free assets - cash, also known as the famous "Tobin's separation theorem", because all assets are currency assets, so the risk is market risk.[5]

Wuweixing uses Probit and Tobit models to analyze the factors that affect Chinese residents' stock market participation and investment portfolio. It is found that the investment of illiquid assets, especially real estate, significantly affects investors' stock market participation and investment portfolio.” effect or “crowding out” effect. Secondly, investors rarely use the stock market to hedge their future cash flow risks when making investment portfolios, and the increase in wealth increases both the probability and the depth of residents' participation in the stock market.[6] In *Research on the Application of Markowitz Portfolio Theory Model*, Lishanmin used the daily price change data of 824

stocks in the Shenzhen and Shanghai stock markets since their listing to the end of 1998, using a computer to establish a mathematical model to assist in the research, using the Markowitz model, the single index model to calculate the effective combination of specific stock samples at a specific time, it is pointed out that single index model, EGP1 model, EGP2 model have certain deviations in deriving effective portfolio due to the constraints of simplified conditions. Due to the influence of bias, the three simplified models cannot be applied on the basis of daily returns at present. Only the single index model and the EGP1 model can be combined with the application of the Markowitz model in the investment selection based on weekly or monthly returns.[7] On the basis of summarizing foreign theories and methods for risk management of investment portfolio using VaR method and its extended model, hujingsheng establishes a portfolio risk management that is in line with the actual development of China's securities market at this stage and mainly focuses on market risk and liquidity risk. The quantitative model is used, and the empirical research is carried out using the sample data from 1997 to 2003, so as to provide theoretical and methodological basis for the portfolio risk management of Chinese institutional investors.[8]

And based on the Mean-CVaR model, Yulin Zhao studied the influences of investor's preference level on investor's optimal portfolio selection.[9] Determining different confidence levels according to investors' risk preference degrees, and then under the established expected rate of returns, the historical simulation method and Monte Carlo simulation method are used to analyze the historical daily rate of returns data of 18 industries in China.[10] Mahsa Pazyar based on four indicators Treynor, Jensen, Sortino and Omega were calculated and the indicators of Treynor and Jensen in a group on the represented by the performance indicators of modern portfolio were compared with indicators of Sortino and Omega represented by performance indicator of the post-modern portfolio using t- student test , and finally the hypothesis was formulated so that the significant different between the ranking of mutual fund and portfolio was not confirmed.[11]

This paper will take 10 stocks in the S&P500 as an example, use the index Model to analyze the investment return. The following sections will introduce the data and companies, research methods, results analysis, and research conclusions.

2. DATA

This paper use one (S&P 500) equity index and the share price of ten following companies:

NVIDIA (NASDAQ: NVDA) is an artificial intelligence computing company. After the U.S. stock market closed on July 8, 2020, Nvidia's market value surpassed Intel's for the first time, becoming the chip maker with the highest market value in the United States. On May 21, 2020, NVIDIA released its financial statements for the first quarter of 2021, ended April 26, 2020. First-quarter revenue was \$3.08 billion, up 39% from \$2.22 billion. Data center revenue hit a record \$1.14 billion, up 80% from the same period. GAAP gross margin was a record 65.1%.

Cisco Systems, Inc.; NASDAQ: CSCO HKEX: 4333 is a leading provider of Internet equipment, solutions, also the software products primarily used to connect computer networking systems. According to a statement from Cisco Systems, the program is a nonprofit global initiative, and the school does not pay any fees to the company. In the world, cisco Network Technology Institute has more than 10,000 schools, with more than 400,000 students and more than 20,000 teachers.

Intel Corporation NASDAQ: INTC is an American company mainly developing CPU processors, which is the world's largest manufacturer of CPU and personal computer parts, also the first company to launch x86 processors.

Founded on July 18, 1968, by Gordon Moore, Robert Noyce, and Andy Grove, as an integrated electronics company, Intel combined advanced chip design capabilities with industry-leading manufacturing capabilities.

Goldman Sachs (NASDAQ: GS) is a leading international investment bank. Founded in 1869, Goldman Sachs is one of the largest and oldest investment banks in the world. Goldman Sachs ranked 85th on the Forbes 2020 list of the 100 Most Valuable Global Brands published in July 2020.

Us Bancorp (NASDAQ: USB) was founded in 1895 and is the parent company in the United States. Bank N.A., the fifth largest banking institution in the United States. The company provides investment, banking, trust and payment services products to individuals, businesses, government entities and other financial institutions. The company also owns Elavon and Elan Financial Services, which process credit card transactions for merchants, and issue credit card products on behalf of banks small credit unions in the United States.

TD Bank is headquartered in Toronto, Canada, (NASDAQ: TD CN) which serves more than 14 million customers through four businesses in many of the world's leading financial centers: Canadian personal and commercial banking, including TD Canada Trust; Property management including TD Waterhouse's global operations. The company provides products and services to more than 13 million customers worldwide.

Allstate, (NASDAQ: ALL), is the second largest personal insurance and casualty insurance company in the United States, and ranks among the 15 largest life insurance companies in the United States. Allstate is also investing millions of dollars in research to develop safety programs, either directly or through its affiliate, Tech-Cor. Allstate ranked 205 on the 2020 List of the worlds 500 most valuable brands.

Procter & Gamble (NASDAQ: PG) ranks among the world's largest consumer goods companies. P&G has factories and branches in more than 80 countries, operates more than 300 brands of products and sells products in more than 160 countries and regions around the world, with nearly 100,000 employees worldwide, products include hair and beauty, fabrics and home care, baby and home care health care, food and beverages, etc.

Johnson & Johnson is the world's largest diversified healthcare products and consumer care company with products positioned in the nursing, pharmaceutical and medical device and diagnostic markets. The company owns many well-known brands such as Johnson & Johnson, Neutrogena, Kelingjia, Jiao Shuang, Bondi Dakning, and Tylenol.

Colgate-Palmolive was founded in 1806. After more than 200 years of development, it has become a global consumer goods company with sales of 9.4 billion US dollars, and its personal care products have been sold to more than 200 countries and regions around the world, providing high-quality goods to the public in the fields of oral care, personal care, home care and pet food in more than 200 countries, many of them are world famous brands, such as Colgate, palm Ajax. Protex. In October 2019, Interbrand ranked no.66 on the Global Top 100 Brands List.

3. Method

This paper will aggregate the daily data to the monthly observations, and based on those monthly observations, to calculate all proper optimization inputs for the Index Model ("IM"). Using these optimization inputs for IM to find the regions of permissible portfolios (efficient frontier, minimal risk portfolio, optimal portfolio, and minimal return portfolios frontier) for the following five cases of the additional constraints:

The first additional optimization constraint is designed to simulate Rule T of FINRA, which allows broker-dealers to allow their clients to hold positions, 50% and above of it will be funded by the client's account assets:

$$\sum_{i=2}^{11} |w_i| \leq 2 \quad (1)$$

The second additional optimization constraint aims to simulate some arbitrary weight "box" constraints that may be provided by the client:

$$|w_i| \leq 1, \text{ for } \forall i \quad (2)$$

Furthermore, a "free" problem without any additional optimization constraints is used to illustrate the generally allowable portfolio area and efficient frontier in the absence of constraints.

A fourth additional optimization constraint is intended to simulate the typical constraints that exist in the U.S. mutual fund industry: funds are not allowed to hold any short positions, as detailed in Section 12(a)(3) :

$$w_i \geq 0, \text{ for } \forall i \quad (3)$$

Finally, we want to see if there is a positive or negative effect of incorporating generalized indices into our portfolio, for which we want to consider an additional optimization constraint:

$$w_i = 0 \quad (4)$$

3.1. The Index Model

The Single Index Model (SIM) is a simple asset pricing model commonly used in the financial industry to assess the risk and return of stocks. The single-index model assumes that there is only one macro factor that contributes to stock return risk, expressed in terms of returns on a market index, such as the S&P 500. According to the assumptions of the model, the returns of any stock can be decomposed into unpredictable micro-events that affect only the composition of the company, the expected residual returns of individual stocks (represented here by a company-specific factor α), and the returns of macro-events that affect the market. The formula is as follows:

$$r_{it} - r_f = \alpha_i + \beta_i (r_{mt} - r_f) + \varepsilon_{it} \quad (5)$$

RIT is the rate of return on the stock I, and RF is the risk-free rate (the Treasury bill rate).

RMT is the change in the market portfolio during 't' and αI is the alpha or abnormal return of the stock.

βI is a stock's beta coefficient, or reaction to market returns.

Note that RIT-RF is called stock excess return and RMT-RF is called market excess return.

ε_{it} is the residual (random) return, assuming a normal distribution with mean 0 and standard deviation σ_i .

4. Result Analysis

Calculated through the historical data of 10 stocks and combined with the index model, the following data can be calculated including annualized average return, annualized StDev, beta, annualized alpha and annualized residual StDev as shown in Table 1. This paper adopts the method of sensitivity analysis, it can be seen from the Table2 that under Constraint 1, the ROI is 0.1 with the smallest variance and 0.3 with the largest variance while under Constraint 2, the ROI is 0, the variance is the smallest at 10, and the contrast is maximized at 0.15.

Table 1. Stock Data Analysis

	SP X	NVD A	CSC O	INT C	GS	USB	TD CN	ALL	PG	JNJ	CL
annualized average return	7.542 %	32.80 2%	9.714 %	8.905 %	10.82 5%	9.878 %	11.01 0%	10.08 0%	9.437 %	8.464 %	7.105 %
annualized StDev	14.850 %	55.77 4%	30.80 9%	30.50 3%	29.57 2%	23.68 0%	18.13 4%	24.88 4%	14.58 7%	14.78 5%	15.35 0%
beta	1	1.978 7523 78	1.320 5798 18	1.187 5121 88	1.410 0438 41	0.971 1914 85	0.787 0001 03	1.056 2434 91	0.405 1179 84	0.539 8369 75	0.454 4307 62
annualized alpha	0	0.178 7725 85	- 0.002	- 0.000	0.001 8998 88	0.025 5294 24	0.050 7364 83	0.021 1338 54	0.063 8144 42	0.043 9224 88	0.036 7733 05

			4597	5198								
			27	65								
annualized	0.0	47.40	23.76	24.88	20.88	18.78	13.86	19.31	13.28	12.42	13.78	
residual	00	5%	2%	9%	1%	1%	5%	7%	8%	3%	7%	
StDev	%											

Table 2. Stock Data under Minimal Risk or Variance Frontier

Minimal Risk or Variance Frontier									
Constraint1		Constraint2		Constraint3		Constraint4		Constraint5	
Return	StDev	Return	StDev	Return	StDev	Return	StDev	Return	StDev
0.00	0.1560	-0.15	0.4196	-0.20	0.4209	0.09	0.1016	-0.10	0.3710
0.10	0.1555	-0.10	0.3034	-0.15	0.3476	0.10	0.1102	-0.05	0.2754
0.15	0.2065	-0.05	0.2309	-0.10	0.2758	0.15	0.1806	0.00	0.1851
0.20	0.2834	0.00	0.1490	-0.05	0.2069	0.20	0.2766	0.05	0.1465
0.25	0.3775	0.05	0.1016	0.00	0.1657	0.25	0.3834	0.10	0.1069
0.30	0.4802	0.10	0.1055	0.04	0.1016	0.30	0.4944	0.15	0.1741

5. Conclusion

This paper make inferences and comparisons between the sets of constraints and based on the IM models in general under 20 years of daily data of total returns for the S&P 500 index for ten stocks.

The paper conducts the sensitivity analysis to analyze the variance value under different constraints and returns, and provides suggestions for investors to make investment portfolio decisions, which successfully applied the modern portfolio theory in practice.

Although this paper has conducted an in-depth analysis of the historical data of financial market, the model used is relatively simple, and the selected stocks are part of the same industry, which is less representative and needs to be improved.

References

- [1] C. Kenneth Jones. Modern Portfolio Theory, Digital Portfolio Theory and Intertemporal Portfolio Choice[J]. American Journal of Industrial and Business Management,2017,7(7):
- [2] Y.F. Lu The usefulness of investment decision-making of net asset multiple and price-earnings ratio [D]. Shanghai University of Finance and Economics, 1999.
- [3] X. Lin, Y.P. Qian, Y.B. Shu. Optimal Portfolio Selection Considering Relative Returns [J]. Applied Probability and Statistics, 2021, 37(06): 611-626.
- [4] Roy.A. D .1952, "Satety First and the Holding of Assets". Econo metrica, vol, 20, no.3 (july) :431-449
- [5] Tobin, James.1958" Lipudity Preference as Behavior towards Risk" Review of Economic Studies, vol.25, no.1(February)65-86
- [6] W.X. Wu, T.X. Qi. Liquidity, Life Cycle and Portfolio Dissimilarity: An Empirical Analysis of Chinese Investor Behavior Survey [J]. Economic Research, 2007(02): 97-110.
- [7] S.M. Li, P. Xu. Research on the Application of Markowitz Portfolio Theory Model [J]. Economic Science, 2000(01): 42-51. DOI: 10.19523/j.jjkkx.2000.01.006.
- [8] J.S. Hu, R. Wang, C. Ding. Research on the application of VaR method and its extended model in portfolio risk management [J]. Quantitative Economics, Technical and Economic Research, 2005(05):141-150.
- [9] Y.I. Zhao. An Empirical Study on the Chinese Stock Market based on the Mean-CVaR Portfolio Selection Model[J]. World Scientific Research Journal,2021,7(1):

[10] J.X. Wang, M.Y. He. Optimal Portfolio Selection under the Constraints of Variable Coefficient Model CVaR——Based on Non-Extended Statistical Theory [J/OL]. Journal of Henan Normal University (Natural Science Edition), 2022(01):59 -66[2022-02-05].DOI:10.16366/j.cnki.1000-2367.2022.01.006.

[11] Mahsa Pazyar, Mohammad Hassan Janani. Evaluating Mutual Fund Rankings Using Modern and Postmodern Portfolio Theory[J]. Journal of Social Science and Humanities, 2020, 2(10):