Thematic Investing

Mike Yunke Gan

August 4, 2021

Abstract

In this report, I first introduced Thematic Investing by covering the "What-Why-How" questions. Then, I went through the criteria for a good theme, and selected my top 5 themes according to these criteria. In addition, I went into details about my stock selection criteria and gave my top 3 stock (i.e., NIO/Samsung/Tesla) out of Lei's list. Further more, I used portfolio optimization to maximize portfolio risk-adjusted thematic factor score to derive the weights for those 3 stocks. After backtesting the performance of my portfolio from Apr 2020 to July 2021, I found that my portfolio has higher Sharpe Ratio compared to NIO/Samsung/Tesla alone, which is a very intuitive representation of the way I constructed my portfolio. The portfolio optimization process and implementation code can be found here. The following two questions from Lei are answered in this report:

- **Macro-level Trends/Themes Identification:** what are the top 5 themes?
- **Stock Selection & Portfolio Construction:** what are the top 3 stocks that will benefit from the themes and how to assign weights to them?

1 Thematic Investing

In this section, I'll introduce the definition, rationale, and process of Thematic Investing.

1.1 What is Thematic Investing?

Thematic Investing is one of the most popular investment styles used in the investment community, which aims to identify intuitive macro-level trends/themes, and then invests in stocks that may benefit from the materialization of those trends.

1.2 Why Thematic Investing?

For a thematic investor, the aim is definitely to make a profit. However, thematic investors should also be aware of **the fundamental function of investment**, which is, *on a macro level, allocating resources to places where capitals are needed most to boost real economy growth and improve human beings' life quality.* A thematic investment is good if it makes money. However, in my opinion, it's great (meaning efficient and stable) if it makes money and at the same time fulfills its social responsibility. For example, an investment in renewable energy theme is great if it makes money and also helps to fight climate change.

1.3 How to Implement Thematic Investing?

When implementing thematic investing, it's common to consider a two-step process (See Figure 1):

1. **Top-down:** Identify potential macro-level trends or themes
2. **Bottom-up:** Select relevant stocks and construct portfolios

2 Macro-level Trends/Themes Identification

In this section, I'll first introduce some criteria for a good theme, and then list the top 5 themes from my perspective. Finally, many other interesting themes will also be listed.

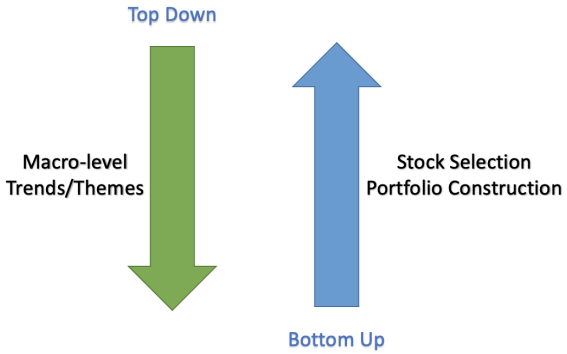

Figure 1: Thematic Investing Process

2.1 Criteria: What Makes a Good Theme?

1. **Significance:** A good theme should be likely to significantly affect global economies, across geographies and sectors.
2. **Accessibility:** There should be enough publicly-traded companies with exposure to this theme, which makes it accessible to investors.
3. **(Bonus) Long-term Time Frame:** It would be great if a theme can last for a long time, like multi decades, which means there's a long runway to invest in it.

2.2 Mike's Top 5 Themes (See Table 1 for Their Criteria)

- **Clean & Renewable Energy**
  Reason: climate change; energy transformation to tackle the greenhouse effect; Biden's clean energy policies; global consensus to reduce GHG emissions
- **Artificial Intelligence**
  Reason: automation & robotics for higher efficiency and lower cost; autonomous vehicles; technological advancements to (partly) replace human beings with machines/robots
- **Semiconductors**
  Reason: fundamental components of electronic devices, enabling technology advancements in communications, computing, healthcare, transportation, as well as other applications
- **Electric Vehicles**
  Reason: automobile with clean & renewable energy; climate change; clean energy transformation; political policies
- **Reopening**
  Reason: global economic recovery after the COVID-19 pandemic; political, fiscal, and monetary policies to help return to normal (this is more like a short-term theme due to COVID-19)

Theme	Significance	Accessibility	Long-term Time Frame
Clean & Renewable Energy	Yes	Yes	Yes
Artificial Intelligence	Yes	Yes	Yes
Semiconductors	Yes	Yes	Yes
Electric Vehicles	Yes	Yes	Yes
Reopening	Yes	Yes	No

Table 1: Mike's Top 5 Themes and Their Criteria

2.3 Interesting Themes

- Climate Change / Environment / Clean & Renewable Energy / Decarbonization Technologies
- Artificial Intelligence / Robotics & Automation / Autonomous Vehicles
- SaaS / Cloud Computing / Cybersecurity
- Electric Vehicles / Space Communication & Travel
- Semiconductors / Microprocessors
- Healthcare / Bio-technology / Vaccine
- Reopening / COVID-19 / Stay-at-home / Go-out
- Cryptocurrency / Fintech
- Urbanization
- Infrastructure
- Inflation
- Tax Rate

3 Stock Selection and Portfolio Construction

In this section, I'll first talk about my stock selection criteria, and then give my top 3 stocks in Lei's list as well as the reasons for choosing them. Finally, I'll apply a quantitative approach, i.e., portfolio optimization, to assign weights and construct my portfolio.

3.1 Lei's List

- Tesla / GM / BYD / Xpeng / NIO / Li Auto
- LG / Samsung Electronics / CATL / Infineon / Cree

3.2 Mike's Stock Selection Criteria

1. I want exposure to different themes (as many as possible) to enable enough growth potential
2. I want exposure across countries to be able to share growth across geographies and at the same time have the benefit of diversification
3. I want exposure in industry leaders because I believe they always have the greatest people of their industry, they are the most innovative which makes them long time industry leaders, and thus they're likely to share the majority of the profits going to their industry

3.3 Mike's Top 3 Stocks

- **Tesla**
  Reason: Related to themes like clean energy, electric vehicles, renewable energy electronics (e.g., batteries and solar panels); industry leader world-wide, with factories in China, Europe, and U.S.; benefit from Biden's clean energy policies.
- **Samsung Electronics**
  Reason: Related to themes like semiconductors, telecommunications, and other electronics (e.g., appliances, integrated systems); multinational industry leader headquartered in South Korea, with branches in other countries like U.S.; a major contributor to South Korea's GDP.
- **NIO**
  Reason: Related to themes like electric vehicles and renewable energy; industry leader in China with more cars sold compared to Xpeng and Li Auto as of Feb 2021; benefit from the high demand in Chinese market, as well as Chinese government's intention to decrease carbon emissions.

	NIO	Samsung	Tesla
weight	1.74%	66.67%	31.59%

Table 2: Mike's Weights of NIO/Samsung/Tesla

3.4 Portfolio Optimization: A Quantitative Approach to Assign Weights

After deciding my investment universe, I'll apply a quantitative approach called portfolio optimization to assign weights to the stocks in my investment universe and construct my portfolio - please find the final weights in Table 2 and notice that they can be intuitively explained by the objective function I'm trying to optimize. For better illustration purpose, I'll also backtest my investment strategy with historical data from Yahoo Finance, and then evaluate its performance using different metrics, e.g., Sharpe Ratio and Maximum Drawdown.

3.4.1 What is Portfolio Optimization?

Portfolio optimization is a subarea of Operations Research - it tries to select the best portfolio from the set of all possible portfolios within consideration, according to some objective function. A portfolio optimization problem consists of the objective function it wants to optimize (minimize or maximize), the variables it wants to optimize w.r.t, and the constraints of these variables.

3.4.2 Backtesting Details

- **Investment Universe:** NIO, Samsung Electronics, Tesla
- **Data Source:** Yahoo Finance
- **Date Range:** March 2019 - July 2021
- **Strategy Performance Evaluation Period:** Apr 2020 - July 2021
- **Rebalance Frequency:** Monthly (rebalance portfolio at the end of each month)
- **Backtesting Method:** 1-year lookback in-sample training period to estimate portfolio covariance matrix; 1-month look forward out-of-sample testing period to test strategy performance; apply rolling window scheme (see Figure 2).

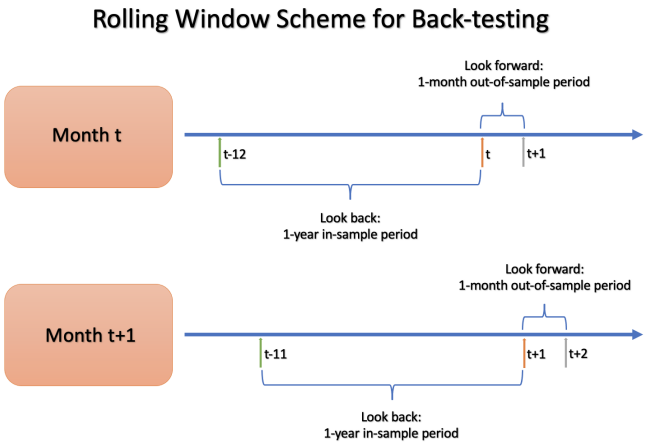

Figure 2: Rolling Window Scheme

Companies / Themes	Electric Vehicles	Clean & Renewable Energy	Semiconductors
NIO	1	0.5	0
Samsung	0	0	1
Tesla	1	1	0

Table 3: Simplified Thematic Factor Scores

3.4.3 Quantify Thematic Factor Scores

As is shown in Table 3, I apply a simple way to assign thematic factor scores to Tesla, NIO, and Samsung. The way is, 1) give a thematic factor score of 1 if a stock has direct exposure on this theme. 2) give a factor score of 0.5 if a stock has significant but indirect exposure on this theme. Admittedly, there are other more sophisticated ways to assign thematic factor scores, e.g., apply Machine Learning/Deep Learning/Natural Language Processing models to perform Sentiment Analysis and compute thematic factor scores out of social media and news reports data. However, our approach is reasonable for illustration purpose.

3.4.4 Portfolio Optimization Specification

$$\begin{aligned} \max_{w_1,w_2,w_3} \quad & \frac{\sum_{i=1}^{3}\sum_{j=1}^{3} w_i f_{ij}}{\sqrt{\sum_{i=1}^{3}\sum_{j=1}^{3} w_i w_j \sigma_{ij}}} \\ \text{s.t.} \quad & w_1 + w_2 + w_3 = 1 \\ & w_i \geq 0 \quad (i = 1, 2, 3) \\ & w_i \leq 2/3 \quad (i = 1, 2, 3) \end{aligned} \tag{1}$$

Mathematically, my portfolio optimization problems can be specified as shown above, where w_1, w_2, w_3 are the weights of NIO, Samsung, and Tesla in my portfolio, respectively. f_{ij} is the thematic factor score of stock i on theme j. For example, f_{23} is the thematic factor score of Samsung on Semiconductors, which is 1 as can be found in Table 3. $\Sigma = (\sigma_{ij})$ is the portfolio covariance matrix, which measures the movements and co-movements between stock returns, estimated using return data from in-sample period.

- **Objective Function:** we can optimize different objective functions, but in this report, I'll just give an example by **maximizing the risk-adjust thematic factor scores**. $\sum_{i=1}^{3}\sum_{j=1}^{3} w_i f_{ij}$ is the thematic factor score of my portfolio, and $\sqrt{\sum_{i=1}^{3}\sum_{j=1}^{3} w_i w_j \sigma_{ij}}$ is the ex ante volatility of my portfolio.
- **Optimization Variables:** in this example, I want to figure out the stock weights, so the weights w_1, w_2, w_3 of NIO/Samsung/Tesla are the variables I want to optimize w.r.t.
- **Constraints:** Three constraints are imposed: 1)fully-invested: the weights of Tesla/Samsung/NIO sum up to 100%; 2)long-only: the weights are non-negative; 3)diversification: the weight of an individual stock can't be greater than 66.7%, which is twice of the average weight 33.3%.

3.4.5 More about the Backtesting Process

The rolling window scheme is used to backtest the performance of my investment strategy - please refer to Figure 2 for a graphic illustration. To provide more details, when t is "2020-03-31" (the first end-of-month date used), I estimate the portfolio covariance matrix using return data of the 1-year in-sample period from "2019-03-29" to "2020-03-31", then get portfolio weights of NIO/Samsung/Tesla from the portfolio optimization problem, and next test the investment strategy performance in the 1-month out-of-sample period from "2020-04-01" to "2020-04-30" - this completes my first cycle. Then I move to next end-of-month date which is "2020-04-30", select the new in-sample period as from "2019-04-30" to "2020-04-30" to estimate portfolio covariance matrix, get portfolio weights from the portfolio optimization problem, and test the investment strategy performance in the new out-of-sample period from "2020-05-01" to "2020-05-29". Similarly, I'll just move on to next end-of-month date and repeat

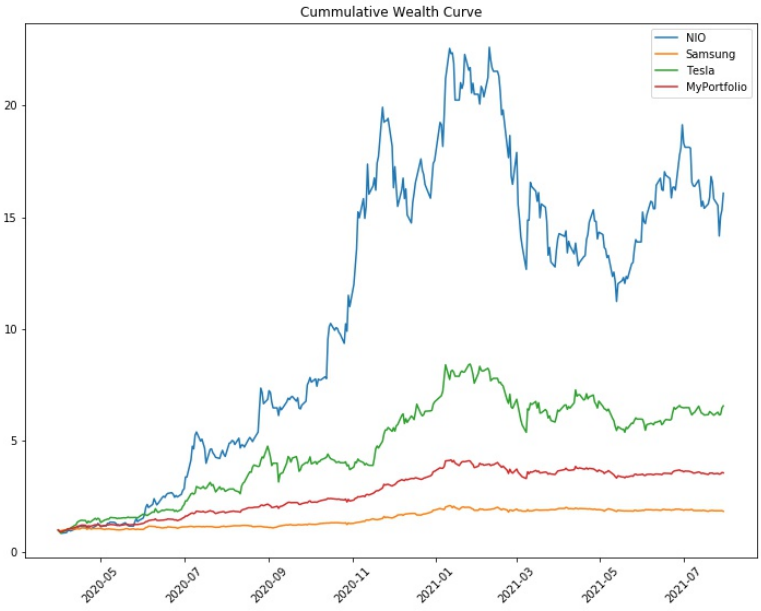

Figure 3: Cumulative Wealth Curve

Performance	Sharpe Ratio	Annual Return	Annual Volatility	Maximum Drawdown
My Portfolio	2.89	98.96%	34.17%	20.21%
NIO	2.69	243.62%	90.44%	50.32%
Samsung	1.68	48.8%	28.87%	13.69%
Tesla	2.33	161.95%	69.4%	36.25%

Table 4: Performance Evaluation

the process until "2021-07-30", whose outputted portfolio weights are shown in Table 2. Please notice that, since I only rebalance the portfolio at the end-of-month dates, portfolio weights stay unchanged between two consecutive end-of-month dates.

3.4.6 Strategy Performance and Analysis

As is shown in Table 4, "My Portfolio" has a Sharpe Ratio of 2.89, higher than NIO/Samsung/Tesla alone. This high Sharpe Ratio is reasonable because, if we take a look at our portfolio optimization specification, I'm trying to maximize risk-adjusted thematic factor scores. Since intuitively we can think thematic factor score is in direct proportion to return, risk-adjusted thematic factor score is in direct proportion to risk-adjusted return, which is the Sharpe Ratio. As is shown in Table 2, as of July 2021, to achieve highest possible Shape Ratio, the portfolio optimizer is trying to assign as lower weights to NIO as possible, because of NIO's extremely high volatility. It tries to assign the highest weights possible to Samsung which comes with significantly lower volatility, and the rest of the weights is assigned to Tesla in order to enhance portfolio return. Overall, this is a very intuitive representation of my choice - to maximize portfolio's risk-adjusted thematic factor score.

3.4.7 GitHub Link

All data and source code can be found at https://github.com/ykgan96/ThematicInvesting.

4 Conclusion

In this report, I started by introducing Thematic Investing with the "What-Why-How" questions. Then, I went through the criteria for a good theme, and selected my top 5 themes according to these criteria. In addition, I went into details about my criteria to select stocks and gave my top 3 stock (i.e., NIO/Samsung/Tesla) out of Lei's list. Further more, I used portfolio optimization to maximize risk-adjusted portfolio thematic factor score to derive the weights for those 3 stocks selected. After backtesting the performance of my portfolio from Apr 2020 to July 2021, I found that my portfolio has higher Sharpe Ratio compared to NIO/Samsung/Tesla, which is a very intuitive representation of the way I constructed my portfolio.