

# Fin\_G04

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## Introduction

This report introduces a diversified portfolio that we recommended for Japanese investors. Our research applies the Capital Asset Pricing Model (CAPM) regression to introduce a series of diversified portfolios that we have found ideal, especially for typical Japanese individual investors. We have split up our CAPM regression into 3 different portfolios for different risk appetites and preferences.

## ETFs

When constructing the portfolios, there are altogether 4 categories of Exchange-Traded Funds (ETFs) that we take into consideration:

- Real Estate Investment Trusts (REITs) ETFs
- Commodities ETFs
- Stock ETFs
- Bond ETFs

We use a Pie Chart to visualize our specific allocations in the portfolio itself (Figure 1).

### Selected ETFs by categories

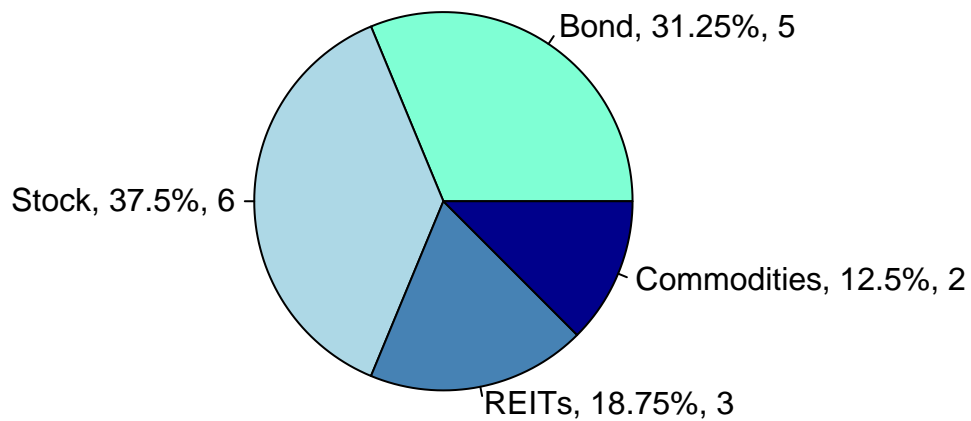


Figure 1: Selected ETFs by categories

In the following four tables, we describe the specific information of the ETFs under each category and make a short description for each of them in one or two sentences (Figure 2 - 5).

<b>ETFs</b>	<b>Descriptions</b>
1343 JT Equity	<ul style="list-style-type: none"> <li>● Provide exposure to Japanese REITs Equities in 61 underlying holdings in Japan.</li> </ul>
VNQ US Equity	<ul style="list-style-type: none"> <li>● Invest in stocks issued by real estate investment trusts (REITs), companies that purchase office buildings, hotels, and other real property;</li> <li>● Track the return of the MSCI US Investable Market Real Estate 25/50 Index. Appropriate for helping diversify the risks of stocks and bonds in a portfolio.</li> </ul>
VNQI US Equity	<ul style="list-style-type: none"> <li>● Invest in stocks in the S&amp;P Global ex-U.S. Property Index, representing real estate stocks in more than 30 countries;</li> <li>● Provide a convenient way to get broad exposure across international REITs equity markets.</li> </ul>

Figure 2: REITs ETFs

<b>ETFs</b>	<b>Descriptions</b>
IAU US Equity	<ul style="list-style-type: none"> <li>● Have exposure to the day-to-day movement of the price of gold bullion. Convenient, cost-effective access to physical gold.</li> </ul>
BCI US Equity	<ul style="list-style-type: none"> <li>● Seek to outperform a broad-market commodity index through the active management of the fund's collateral. The index includes 26 commodity futures with maturities of 1-3 months;</li> <li>● Consist of gold and other commodities, and diversifies well with the IAU Equity.</li> </ul>

Figure 3: Commodities ETFs

ETFs	Descriptions
1306 JT Equity	<ul style="list-style-type: none"> <li>● Provide physical exposure to Japanese Equities, to all 2178 underlying holdings in various sectors such as industrial and information technology;</li> <li>● Track the TOPIX Gross Total Return Index JPY.</li> </ul>
VOO US Equity	<ul style="list-style-type: none"> <li>● Invest in stocks in the S&amp;P 500 Index, representing 500 of the largest U.S. companies;</li> <li>● Offer high potential for investment growth;</li> <li>● Share value rises and falls more sharply than that of funds holding bonds.</li> </ul>
VO US Equity	<ul style="list-style-type: none"> <li>● Provide a convenient way to match the performance of a diversified group of medium-size companies in various sectors such as technology, healthcare;</li> <li>● Track the performance of the CRSP US Mid Cap Index, which measures the investment return of mid-capitalization stocks.</li> </ul>
VSS US Equity	<ul style="list-style-type: none"> <li>● Provide a convenient way to get broad exposure across developed and emerging non-U.S. small-cap equity markets around the world;</li> <li>● Track the performance of the FTSE Global Small Cap ex US Index.</li> </ul>
VGK US Equity	<ul style="list-style-type: none"> <li>● Hold stocks of companies located in: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.</li> <li>● Track the performance of the FTSE Developed Europe All Cap Index, which measures the investment return of stocks issued by companies located in the major markets of Europe.</li> </ul>
VWO US Equity	<ul style="list-style-type: none"> <li>● Invest in stocks of companies located in emerging markets around the world, such as China, Brazil, Taiwan, and South Africa, with high risk but high returns and growth;</li> <li>● Track the return of the FTSE Emerging Markets All Cap China A Inclusion Index.</li> </ul>

Figure 4: Stock ETFs

<b>ETFs</b>	<b>Descriptions</b>
AGG US Equity	<ul style="list-style-type: none"> <li>• Have broad exposure to U.S. investment-grade bonds;</li> <li>• Track the investment results of an index composed of the total U.S. investment-grade bond market.</li> </ul>
SCHP US Equity	<ul style="list-style-type: none"> <li>• Track the total return of an index composed of inflation-protected U.S. Treasury securities;</li> <li>• Have simple access to the U.S. Treasury Inflation Protected Securities (TIPS) market.</li> </ul>
VCSH US Equity	<ul style="list-style-type: none"> <li>• Invest primarily in high-quality (investment-grade) corporate bonds.</li> </ul>
BNDX US Equity	<ul style="list-style-type: none"> <li>• Have broad exposure across major bond markets outside of the U.S.;</li> <li>• Track the performance of the Bloomberg Global Aggregate ex-USD Float Adjusted RIC Capped Index (USD Hedged).</li> </ul>
VWOB US Equity	<ul style="list-style-type: none"> <li>• Provide a convenient way to get additional exposure to emerging market government bonds;</li> <li>• Track the performance of Bloomberg USD Emerging Markets Government RIC Capped Index.</li> </ul>

Figure 5: Bond ETFs

Our Bond and Stock ETFs cover markets both within and outside of the US. To be more specific, our Bond ETFs focus on low cost, while investing in high-quality corporate bonds as well as some government bonds and treasuries that track the performances of specific indexes. Moreover, our Stock ETFs contain investments across various popular sectors, from financial services to healthcare and technology industries. For instance, the Vanguard S&P 500 ETF (VOO) holdings include *Apple Inc*, *Microsoft Corp*, *Berkshire Hathaway Inc*, and *Johnson & Johnson*. All of these careful selections are beneficial to contribute toward providing diversification for our portfolio and minimizing the overall risk. Last but not least, considering that we are targeting Japanese individual investors, we also included specific Japanese Stocks and REITs ETFs for this localized portfolio design.

Furthermore, we think it is worth mentioning that from our preliminary observations, it seemed that IAU and BCI (Commodities ETFs in Figure 3) are similar to IAU being a 100% gold ETF and BCI having 11% weightage in gold. However, after further inspection through our calculations, the correlation between these two is only 0.2435, implying that they are not highly correlated (Figure 6).

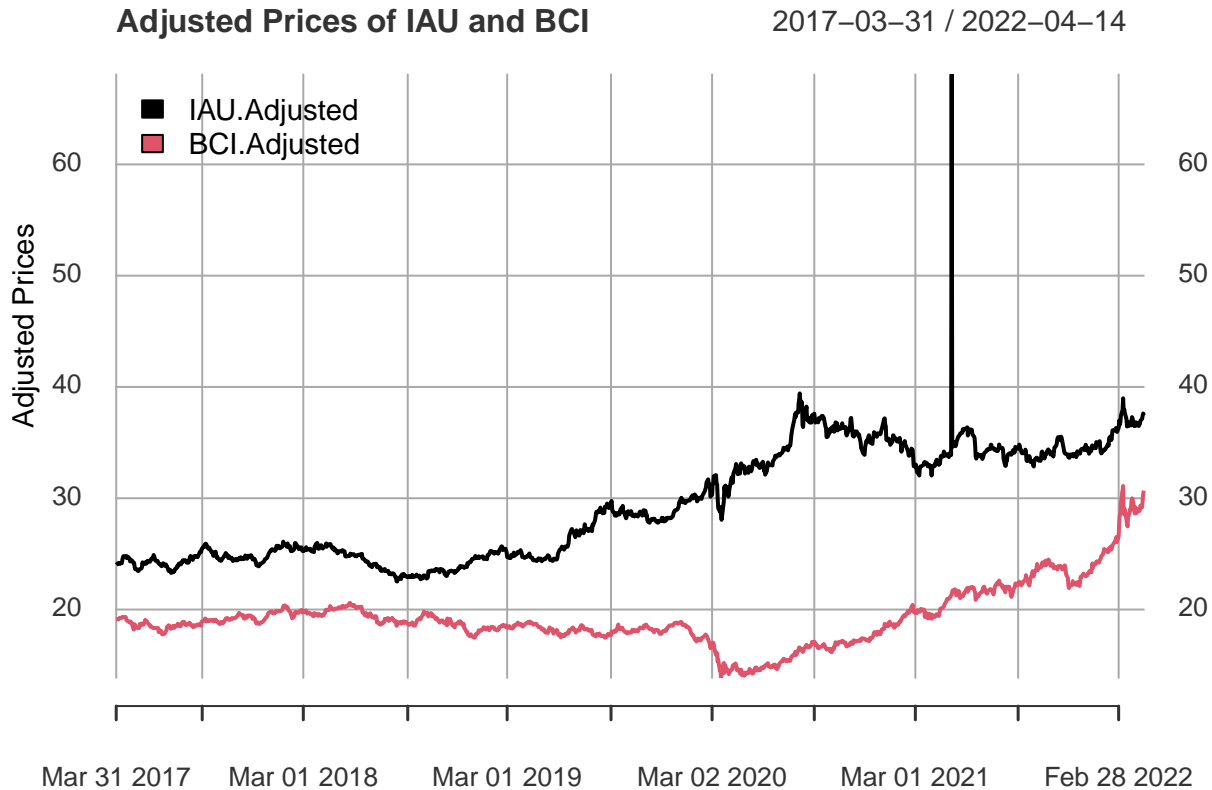


Figure 6: Adjusted prices of IAU and BCI

## Findings

*Note: All the calculations below stand for daily rates or returns, unless clearly stated as annualized.*

### Portfolio Shorting

To start, our portfolios have used negative weights, or “shorting,” as a mechanism within them. This is because we would get a better return on risk. As a comparison, we use the tangent portfolio of the efficient portfolio frontier for only constrained longs versus unconstrained to see additional returns at the same level of risk.

Here are the statistics:

Sharpe Ratio of Tangency Portfolio without shorting: **1.051074**;

Sharpe Ratio of Tangency Portfolio with shorting: **1.16193**.

## Risk-free Rate

Now that we have confirmed that we would use shorting as a tool to create our optimal portfolio, we would determine our risk-free rate using the *Treasury Yield 10 Years*. As of the day of writing this report, the rate is **0.0253**.

$$\text{Risk-free Rate} = (0.0253 + 1)^{\frac{1}{365}} - 1 = 0.0000685$$

## Efficient Frontier

In order to get a better grasp of all the important and relevant information, we then plot out the actual Efficient Frontier to take a look at our ETFs, as well as our potential returns for risk (Figure 7).

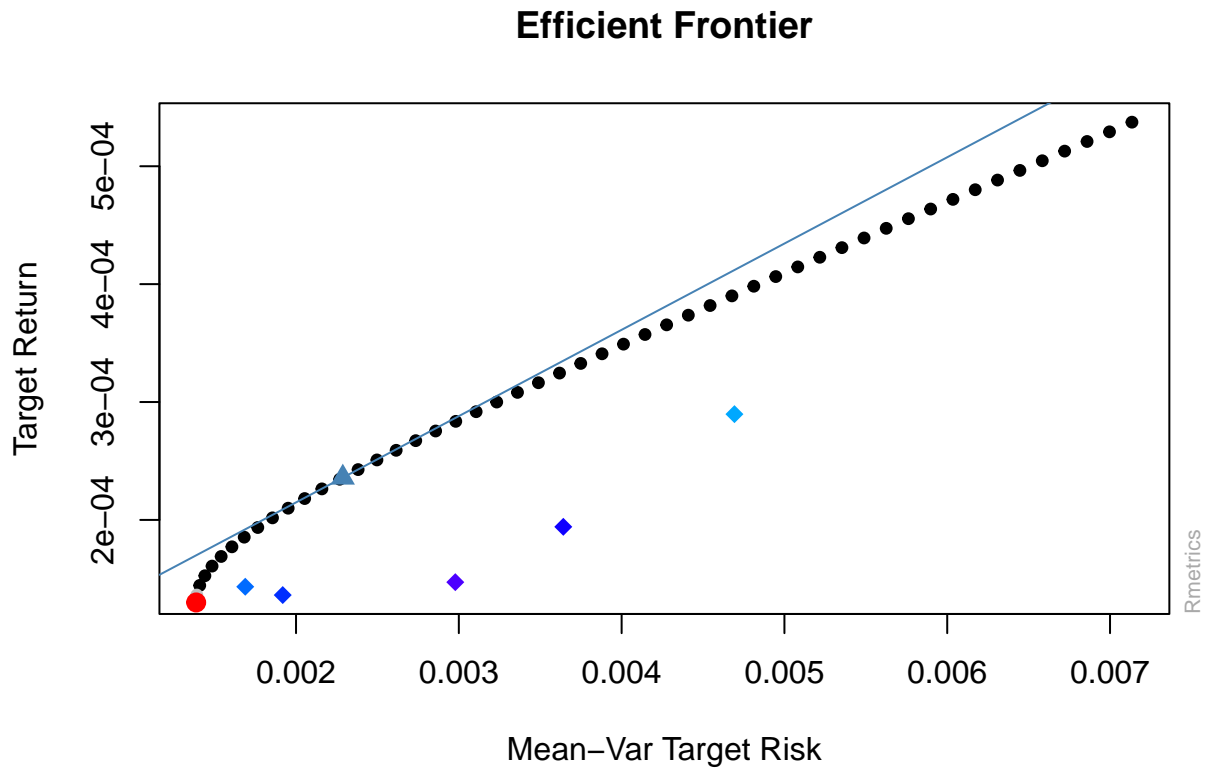


Figure 7: Efficient Frontier

## Sharpe Ratio

Lastly, we plot out the potential Sharpe Ratio to make sure that what we can get from the chosen ETFs is useful to us (Figure 8).

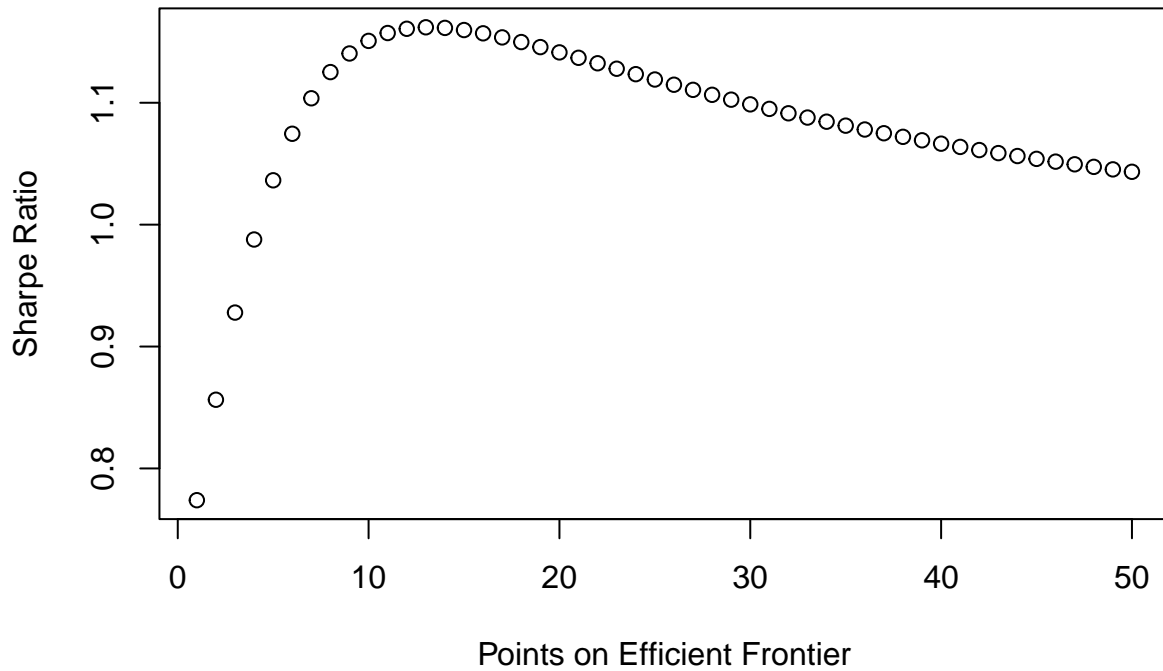


Figure 8: Sharpe Ratio

## Our Portfolio

*Note: All the calculations below stand for daily rates or returns, unless clearly stated as annualized.*

Risk is the amount of variation in the returns of a holding. However, using risk alone is a poor indicator of valuation for stock and hence we go with the Sharpe Ratio, which guides us in our valuation in terms of the risk-return relationship. From the portfolios with the highest Sharpe Ratio, we can then select our desired levels of risks to get the weights of our portfolio.



Table 2: Weights of Low-Risk Portfolio

	Weights
AGG US Equity	-0.17569
SCHP US Equity	0.16630
VCSH US Equity	0.11783
BNDX US Equity	0.60293
VWOB US Equity	0.15937
1306 JT Equity	0.01592
VOO US Equity	0.02163
VO US Equity	0.10180
VSS US Equity	0.04217
VGK US Equity	-0.07535
VWO US Equity	0.01612
1343 JT Equity	0.03226
VNQ US Equity	-0.00318
VNQI US Equity	-0.03610
IAU US Equity	0.07270
BCI US Equity	-0.05871

### Low-risk level Portfolio for Investors

Firstly, we have our low-risk level portfolio, which is also our optimal tangency portfolio. This is considered our low-risk portfolio as there is only an allocation of **12.2%** of stocks equity. In addition, with an annual risk of **3.68%**, the daily risk is

$$3.68\% \times \sqrt{252} = 0.0023 = 0.23\%$$

Thus, we can see that there is a good Sharpe Ratio of **1.16193**, which is the highest Sharpe Ratio available among all of our portfolios. On a daily basis, we have an average return of **0.024%**, and a  $\sigma$  of **0.23%**. Specifically, Table 2 displays our weights for each asset in this low-risk portfolio.

Table 3: Weights of Medium-Risk Portfolio

	Weights
AGG US Equity	-0.45558
SCHP US Equity	0.56657
VCSH US Equity	-0.41378
BNDX US Equity	0.54671
VWOB US Equity	0.49087
1306 JT Equity	-0.00183
VOO US Equity	-0.00311
VO US Equity	0.27378
VSS US Equity	0.13411
VGK US Equity	-0.22899
VWO US Equity	0.04502
1343 JT Equity	0.09573
VNQ US Equity	0.01253
VNQI US Equity	-0.07274
IAU US Equity	0.20645
BCI US Equity	-0.19573

### Medium-risk level Portfolio for Investors

Next, we have our medium-risk level portfolio. By calculation, the annual risk is **8%**, and a daily risk of **0.5%**. This is considered our medium-risk level portfolio as we have an allocation of **21.9%** in stock equities.

From here, we can see that the Sharpe Ratio is **1.083181**. While lower than that of our low-risk portfolio, it is still a positive Sharpe Ratio which yields good results. On a daily basis, we have an average return of **0.041%**, and a  $\sigma$  of **0.5%**. Specifically, the weights for this medium-level portfolio are shown in Table 3.

Table 4: Weights of High-Risk Portfolio

	Weights
AGG US Equity	-0.64851
SCHP US Equity	0.84247
VCSH US Equity	-0.78022
BNDX US Equity	0.50795
VWOB US Equity	0.71938
1306 JT Equity	-0.01407
VOO US Equity	-0.02016
VO US Equity	0.39232
VSS US Equity	0.19748
VGK US Equity	-0.33488
VWO US Equity	0.06495
1343 JT Equity	0.13948
VNQ US Equity	0.02336
VNQI US Equity	-0.09800
IAU US Equity	0.29864
BCI US Equity	-0.29018

### High-risk level Portfolio for Investors

Lastly, our high-risk portfolio is calculated with an annual risk of **11.2%**, and a daily risk of **0.7%**. This is considered to be our high-risk portfolio as we have an allocation of **28.6%** in stock equities.

From here, we can see that there is a Sharpe Ratio of **1.045304**. Similar to the medium-risk portfolio we made, the Sharpe Ratio is not as high as our low-risk portfolio, however, it is still outperforming the market. On a daily basis, we have an average return of **0.05%**, and a  $\sigma$  of **0.7%**. Specifically, Table 4 shows the weights of this high-risk portfolio.

## Conclusion

We have used 16 different ETFs with varying correlations to form an efficient portfolio for different risk appetites. By using more than 15 ETFs that have low correlation, we lower our idiosyncratic risk to a minimum, and have only our systematic risk left. Though we have different portfolios, our group recommends pushing the low-risk portfolio out to potential individual customers, as it has the greatest Sharpe Ratio, thus, the greatest return to risk rate.