

Finance 527Q

Intermediate Finance

Case 4

Team C42

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Question 1 – Influence of inflation and economic growth on asset returns (1/3)

Unconditional

	Stocks	Bonds	Gold	Commodities
mean	0.939%	0.716%	0.773%	0.823%
Sharpe ratio	11.184%	9.307%	5.784%	6.805%

i1g1 – low growth low inflation regime

	Stocks	Bonds	Gold	Commodities
mean	0.747%	1.750%	-0.014%	-0.762%
Sharpe ratio	7.564%	41.320%	-8.108%	-17.862%

i1g2 – high growth low inflation regime

	Stocks	Bonds	Gold	Commodities
mean	1.578%	0.722%	0.490%	0.813%
Sharpe ratio	27.796%	15.424%	4.430%	11.539%

i2g1 – low growth high inflation regime

	Stocks	Bonds	Gold	Commodities
mean	0.865%	0.454%	1.139%	1.200%
Sharpe ratio	5.407%	-3.404%	7.365%	9.310%

i2g2 – high growth high inflation regime

	Stocks	Bonds	Gold	Commodities
mean	0.643%	-0.097%	1.487%	2.091%
Sharpe ratio	5.445%	-22.041%	15.611%	30.994%

Best performance

	High economic growth	Low economic growth
High inflation	Gold, Commodities	
Low inflation	Stock	Bond

Worst performance

	High economic growth	Low economic growth
High inflation	Bond	Stock
Low inflation		Gold, Commodities

Findings

1. **Stock:** performs best in the high growth low inflation regime, worst in the low growth high inflation regime
2. **Bond:** performs best in the low growth low inflation regime, worst in the high growth high inflation regime
3. **Gold:** performs best in the high growth high inflation regime, worst in the low growth low inflation regime
4. **Commodities:** perform best in the high growth high inflation regime, worst in the low growth low inflation regime

Question 1 – Influence of inflation and economic growth on asset returns (2/3)

Best performance

	High economic growth	Low economic growth
High inflation	Gold, Commodities	
Low inflation	Stock	Bond

Worst performance

	High economic growth	Low economic growth
High inflation	Bond	Stock
Low inflation		Gold, Commodities

Interpretation for inflation:

- High inflation rates indicate low purchasing power of money which leads to people's willingness to purchase commodities and reluctance to retain cash or to invest in low-return-low-risk assets. Therefore, the needs for commodities surge, increasing **commodities** returns.
- According to previous studies, although the relationship between stock performance and inflation rates is not clear, it is possible that stock performances surge under high inflation because companies produce commodities and benefit from surge in sales. Also, since the expected return is monthly return, the stock performance is negatively correlated with inflation rate. The lower the inflation, the better **the stock** performance.
- Bond can be seen as a monetary policy of the central bank to help control inflation target. When inflation rates are low, the central bank reduces the interest rates ceteris paribus. Fixed income securities such as bonds will move inversely with interest rates. Therefore, the **bond** yield moves inversely with inflation rates.
- Inflation is related to decrease in money' value. To protect from money value erosion, the demand for gold is stronger. Also, historically, gold and USD are often negatively correlated, therefore gold can be used to hedge the value decreasing of USD. These factors increase the expected return of **gold**.

Question 1 – Influence of inflation and economic growth on asset returns (3/3)

Best performance

	High economic growth	Low economic growth
High inflation	Gold, Commodities	
Low inflation	Stock	Bond

Worst performance

	High economic growth	Low economic growth
High inflation	Bond	Stock
Low inflation		Gold, Commodities

Interpretation for economic growth:

- Economic growth affects the demand for money. For example, lower growth and lower demand for loans means prices of loans, and in this case, interest rates fall. **Bond** yields will then move inversely with interest rates, and thus move inversely with economic growth.
- Because **stocks** are exposed to market risk, their returns are closely related to economic growth. Namely, economic growth stimulates people's need for commodities, in other words, companies' products, thus profits are higher and their stock perform better.
- Meanwhile, **commodities'** returns rise as well. This is because the need for other goods or services surge due to overall surge in consumer needs, and commodities such as oil and metals are used to produce the goods needed. Therefore, the use of commodities and their expected returns increase.
- **Gold** has long been seen as a safe haven and is used to store value of asset classes. For example, when the economy is healthy, normally the gold prices will be low and the expected returns will be high.

Question 2 – Comparison between regimes & entire sample (1/2)

Weight of different assets in different regimes

	unconditional	i1g1	i1g2	i2g1	i2g2
Stocks	31.97%	25.65%	39.27%	88.34%	142.53%
Bonds	42.82%	121.34%	40.63%	-120.72%	-276.13%
Gold	10.53%	-26.53%	11.31%	43.01%	61.24%
Commodities	14.69%	-20.46%	8.78%	89.36%	172.36%
Sharpe Ratio	15.84%	46.91%	35.60%	12.52%	38.20%

<green means higher, orange means lower>

- **i1g1 regime vs. entire sample:** in low growth low inflation regime, the weight of bonds increases, while the weights for other three assets decrease. The investor even ought to short gold as well as commodities under this regime. This is because bonds have best performance in this regime, while gold and commodities have the worst performance.

- **i1g2 regime vs. entire sample:** in high growth low inflation regime, the weights of stocks and gold are slightly higher, while the weights of bonds and commodities are slightly smaller. Compared to the entire sample, the expected returns of four assets are similar to each other. So the weights are quite similar.

Question 2 – Comparison between regimes & entire sample (2/2)

Weight of different assets in different regimes

	unconditional	i1g1	i1g2	i2g1	i2g2
Stocks	31.97%	25.65%	39.27%	88.34%	142.53%
Bonds	42.82%	121.34%	40.63%	-120.72%	-276.13%
Gold	10.53%	-26.53%	11.31%	43.01%	61.24%
Commodities	14.69%	-20.46%	8.78%	89.36%	172.36%
Sharpe Ratio	15.84%	46.91%	35.60%	12.52%	38.20%

<green means higher, orange means lower>

- **i2g1 regime vs. entire sample:** in low growth and high inflation regime, the weights of stocks, gold and commodities are higher, while the weight of bonds is much smaller. In this regime, the Sharpe Ratio of bonds is negative, while the Sharpe Ratio of other three assets are positive. Investor could invest in the optimal portfolio through shorting bonds and longing other three assets.
- **i2g2 regime vs. entire sample:** in high growth high inflation regime, the weight of bonds decreases to -276.13%, while the weights for other three assets increase. In this regime, the Sharpe Ratio of bonds is negative, while the Sharpe Ratio of other three assets are positive. At the same time, gold and commodities performs best during this regime, and that is why MSR consists of more commodities and gold.

Why MSR is different across regimes?

Expected return plays a larger role.

According to mean-variance analysis procedure, volatilities, correlations and mean returns will all lead to the differences in allocation. Since volatilities and correlations are relatively stable, the mean returns play a larger role in the asset allocation. For example, if the expected excess return is negative, the weight of that asset in the MSR portfolio will be negative.

Question 3 – Sharpe Ratios (1/2)

Comparison by row

	Unconditional	i1g1	i1g2	i2g1	i2g2
whole_6.5	15.84%	18.85%	34.95%	6.05%	9.69%
i1g1_6.5	6.61%	46.91%	18.06%	-6.50%	-27.14%
i1g2_6.5	15.60%	20.62%	35.60%	5.54%	6.02%
i2g1_6.5	6.93%	-25.82%	15.70%	12.52%	37.83%
i2g2_6.5	5.02%	-29.81%	11.85%	12.34%	38.20%
static_ew	15.21%	13.82%	34.46%	6.59%	11.00%
tilt_i1g1	12.73%	37.78%	30.97%	-0.26%	-13.37%
tilt_i1g2	15.53%	17.31%	35.29%	6.08%	8.63%
tilt_i2g1	14.66%	5.70%	32.96%	8.36%	19.10%
tilt_i2g2	11.79%	-10.20%	26.60%	11.20%	31.78%
mean	11.99%	9.52%	27.64%	6.19%	12.17%

<green means best performance, orange means worst performance>

- The mean Sharpe Ratio for all different strategies when $A=6.5$ is largest in high growth low inflation regime, while mean Sharpe Ratio is lowest in low growth high inflation regime. Meanwhile, most portfolios have higher Sharpe Ratio in high growth low inflation regime, while most portfolios have lower Sharpe Ratio in low growth high inflation regime.
- The MSR portfolios for different regimes always perform well, although not necessarily the best, in their regimes, so as their tilt portfolios.

Question 3 – Sharpe Ratios (2/2)

Comparison between MSR in different regimes

	Unconditional	i1g1	i1g2	i2g1	i2g2
whole_6.5	15.84%	18.85%	34.95%	6.05%	9.69%
i1g1_6.5	6.61%	46.91%	18.06%	-6.50%	-27.14%
i1g2_6.5	15.60%	20.62%	35.60%	5.54%	6.02%
i2g1_6.5	6.93%	-25.82%	15.70%	12.52%	37.83%
i2g2_6.5	5.02%	-29.81%	11.85%	12.34%	38.20%

Comparison between portfolios if investor could choose only one portfolio in different regimes

	Unconditional	i1g1	i1g2	i2g1	i2g2
static_ew	15.21%	13.82%	34.46%	6.59%	11.00%
tilt_i1g1	12.73%	37.78%	30.97%	-0.26%	-13.37%
tilt_i1g2	15.53%	17.31%	35.29%	6.08%	8.63%
tilt_i2g1	14.66%	5.70%	32.96%	8.36%	19.10%
tilt_i2g2	11.79%	-10.20%	26.60%	11.20%	31.78%

<green means better performance>

- Compared to MSR portfolios in different regimes, Static-EW and other four tilt portfolios' Sharpe Ratios are more stable across regimes, meaning more robust to macroeconomic changes.
- Among five MSR portfolios, MSR for whole sample and MSR in high growth low inflation are positive and more stable than other three MSR portfolios.
- Among Static-EW and four tilt portfolios, Static-EW and Tilt_INF2GRW1's Sharpe Ratios are positive across different regimes and more stable than other three tilt portfolios.

Question 4 – Portfolio Allocation for credible regime forecasting model (1/2)

- **Assumption 1:** Risk Aversion $A = 6.5$
- **Assumption 2:** Since our company has a credible propriety regime forecasting model, we can trust in the forecast of our model for sure. Therefore, the portfolio selection in this question will focus on the highest Sharpe Ratio.

Circumstance 1: Low growth low inflation

	ilg1
whole_6.5	18.85%
ilg1_6.5	46.91%
ilg2_6.5	20.62%
i2g1_6.5	-25.82%
i2g2_6.5	-29.81%
static_ew	13.82%
tilt_ilg1	37.78%
tilt_ilg2	17.31%
tilt_i2g1	5.70%
tilt_i2g2	-10.20%

Market Plan: It is suggested for the firm to choose MSR-INF1GRW1 portfolio.

Compared to other portfolios, its Sharpe Ratio is the highest.

Pitching Portfolio Allocation:

Bonds generates the highest SR and gold and commodities generates the lowest SR.

Stocks	41.45%
Bonds	196.10%
Gold	-42.88%
Commodities	-33.07%
Tbill	-61.60%

Circumstance 2: Low growth high inflation

	ilg2
whole_6.5	34.95%
ilg1_6.5	18.06%
ilg2_6.5	35.60%
i2g1_6.5	15.70%
i2g2_6.5	11.85%
static_ew	34.46%
tilt_ilg1	30.97%
tilt_ilg2	35.29%
tilt_i2g1	32.96%
tilt_i2g2	26.60%

Market Plan: It is suggested for the firm to choose MSR-INF1GRW2 portfolio.

Compared to other portfolios, its Sharpe Ratio is the highest.

Pitching Portfolio Allocation:

Every risky asset has good SR so borrowing to invest is recommended.

Stocks	102.09%
Bonds	105.63%
Gold	29.41%
Commodities	22.83%
Tbill	-159.96%

Question 4 – Portfolio Allocation for credible regime forecasting model (2/2)

Circumstance 3: High growth low inflation

	i2g1
whole_6.5	6.05%
i1g1_6.5	-6.50%
i1g2_6.5	5.54%
i2g1_6.5	12.52%
i2g2_6.5	12.34%
static_ew	6.59%
tilt_i1g1	-0.26%
tilt_i1g2	6.08%
tilt_i2g1	8.36%
tilt_i2g2	11.20%

Market Plan:

It is suggested for the firm to choose MSR-INF2GRW1 portfolio. Compared to other portfolios, its Sharpe Ratio is the highest.

Pitching Portfolio Allocation:

None of the risky assets provide impressive SR especially bonds, so investing heavily in Tbill is recommended.

Stocks	17.73%
Bonds	-24.22%
Gold	8.63%
Commodities	17.93%
Tbill	79.94%

Circumstance 4: High growth high inflation

	i2g2
whole_6.5	9.69%
i1g1_6.5	-27.14%
i1g2_6.5	6.02%
i2g1_6.5	37.83%
i2g2_6.5	38.20%
static_ew	11.00%
tilt_i1g1	-13.37%
tilt_i1g2	8.63%
tilt_i2g1	19.10%
tilt_i2g2	31.78%

Market Plan:

It is suggested for the firm to choose MSR-INF2GRW2 portfolio. Compared to other portfolios, its Sharpe Ratio is the highest.

Pitching Portfolio Allocation:

Bonds have an extremely low SR of -22.04% so shorting bond is recommended.

Stocks	60.92%
Bonds	-118.03%
Gold	26.18%
Commodities	73.68%
Tbill	57.25%

Question 5 – Portfolio Allocation for regime forecasting model (1/2)

Current asset allocation: **MSR-INF1GRW1**

Stocks	Bonds	Gold	Commodities	Tbill
41.45%	196.10%	-42.88%	-33.07%	-61.60%

Since it is expected the probability of being in high inflation high growth next month is $\frac{1}{2}$, while the remaining regimes will occur with probability $\frac{1}{6}$ each. So the suggested asset allocation would be **Tilt-INF2GRW2**

Asset allocation would then be changed to: **Tilt-INF2GRW2**

Stocks	Bonds	Gold	Commodities	Tbill
57.34%	-12.77%	12.28%	38.12%	5.02%

Question 5 – Portfolio Allocation for regime forecasting model (2/2)

Sell the ideas for the allocation to a client:

	Unconditional	i1g1	i1g2	i2g1	i2g2
whole_6.5	15.84%	18.85%	34.95%	6.05%	9.69%
i1g1_6.5	6.61%	46.91%	18.06%	-6.50%	-27.14%
i1g2_6.5	15.60%	20.62%	35.60%	5.54%	6.02%
i2g1_6.5	6.93%	-25.82%	15.70%	12.52%	37.83%
i2g2_6.5	5.02%	-29.81%	11.85%	12.34%	38.20%
static_ew	15.21%	13.82%	34.46%	6.59%	11.00%
tilt_i1g1	12.73%	37.78%	30.97%	-0.26%	-13.37%
tilt_i1g2	15.53%	17.31%	35.29%	6.08%	8.63%
tilt_i2g1	14.66%	5.70%	32.96%	8.36%	19.10%
tilt_i2g2	11.79%	-10.20%	26.60%	11.20%	31.78%

- Interpret to the customers the probability of different regimes according to the regime-forecasting model.
- Though MSR-INF2GRW1 and MSR-
INR2GRW2 have higher Sharpe Ratios, Tilt-INR2GRW2's Sharpe Ratio is more stable. Since we are only 50% sure that high inflation high growth will happen, while other three regimes will occur with the probability 1/6 each. If the regime turns out to continue to be low growth low inflation, choosing MSR-INF2GRW1 or MSR-
INR2GRW2 will lead the company a larger loss. Considering the possibility of different regimes and Sharpe Ratios, it is suggested for the client to choose the portfolio allocation of Tilt-INF2GRW2.