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(2004-2012)

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Figure 3a: Regime switching figure from 1914 to 2002

As can be seen, the inflation regime stays at regime 1 for several decades. There is a slight jump in the 1970’s but it ends up resolving

to stay the same. This is different from other RS models because the regimes are being constructed using data as early as 1914. During times of high inflation volatility, they are much more volatile during the early 1900’s than what is considered a typical inflation shock post-1950. This means that the conditions to be in regime 2 are quite stringent and consequently regime 2 is not experienced for any significant duration of time post-1950.

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Figure 3b: Cumulative Returns of model and benchmarks from 2004-2012; without rebalancing

Figure 3c: Cumulative Returns of model and benchmarks from 2004-2012; with rebalancing

-Used S\&P500 data, Minimum Monthly Return of 0.005, Regime Switching model constructed from 1914

Similarly to the 1983-1991 graph, this graph shows that the inflation-hedged portfolio can produce aggressive returns and performs well during stable inflation periods as well. Looking at the rebalanced diagram, the financial crisis of 2008 caused troughs in all the portfolios but the inflation-hedged portfolio had the lowest trough and had the highest value coming out of the crisis. The inflation rate during the crisis was slightly negative and one would think that investing in assets with high inflation betas would cause a negative affect but this effect is either not present or is minute.

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(1983-1993)

Figure 1 (1983-1993): Cumulative Returns of model and benchmarks from 1983-1993; with rebalancing

-Used S\&P500 data, Minimum Monthly Return of 0.005, Regime Switching model constructed using data starting from 1914

This graph demonstrates the performance of various portfolios during the transition from 1986 to 1987 where US inflation rates rose from a low of 1.1% to a high of 4.5%. Because the inflation Hedged portfolio consists of stocks with high inflation betas, the portfolio price goes up when the inflation rate jumps as opposed to the standard MVO portfolio which suffers a sharp drop in price, specifically when the inflation rate jumps from 1.5% to 3.8% in 4 months. As can be seen, the inflation- hedged portfolio also outperforms the standard MVO portfolio at the end of the time frame. This corresponds to the Gulf War, which caused a mild increase in inflation rates. This event is significant because although crude oil prices doubled from $20 to $40, the inflation rate did not vary as much. This marked the end of the strong correlation between oil prices and inflation rates. This is a key reason why time series data for commodities such as oil prices was not used to construct the regime switching model for inflation.

As is expected the modified Sharpe Ratio is much higher for the inflation-hedged portfolio while the regular Sharpe Ratio is much higher for the regular MVO portfolio. However, the difference in the two measure between both the portfolios is different by a factor of 100 as the sharp ratio for the inflation-hedged portfolio is higher than the modified Sharpe Ratio for the standard MVO portfolio.

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(1983-1991)

Figure 2a: Regime Switching Figure for 1950 to 1981

-Used S\&P500 and NYSE data, Minimum Monthly Return of 0.005, Regime Switching model constructed using data starting from 1914

-The changes in Regime show that inflation regime 1 was the dominant regime until the 1970’s. Then Regime 2 took over, which corresponds to the 1973 oil crisis when inflation rates to over 12% during the course of 1974. They returned back to regular levels but shot up again during 1979.

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Figure 2b: Non-rebalanced

Figure 2c: Rebalanced

Looking at the figure we can see that over the 8 years, the inflation-hedged portfolio performs better than the standard MVO portfolio.Note that the sharp drop in portfolio value at around 56 months corresponds to Black Monday when stock markets around the world crashed. It is not completely apparent as to why the inflation-hedged portfolio perform better but testing over many time intervals and desired return constraints has shown that the inflation-hedged portfolio does not perform poorly compared to standard MVO and they in fact often follow similar cumulative return graphs.

It is interesting to note that the rebalanced portfolio is outperformed by the the non-rebalanced portfolio for both the inflation-hedged portfolio and standard MVO. This may also be a result of black Monday where the the returns used for reoptimization are overly pessimistic and do not accurately represent the expected return of an asset over the next time period.

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Table1: Modified Sharpe Ratios from 1983-1987,1987-1991

Table2: Sharpe Ratios from 1983-1987,1987-1991

Looking at theses two table is very interesting because it is immediately apparent that the modified Sharpe ratio is as normal, much better for the inflation-hedged portfolio than for standard MVO. This is for the time period from 1987-1991, which is the more useful time period to look at due to there not being a short-term return anomaly, as is the case from 1983-1987 due to the crash. However, the Sharpe ratios for both portfolios are very close in value an in fact, the inflation-hedged portfolio is slightly better even. This is a promising result because it shows that the Inflation-Hedged Portfolio has the potential to perform superiorly in terms of our custom risk measure, the modified Sharpe ratio, while maintaining an acceptable level of the conventional risk measure: the Sharpe ratio.

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(1990-1998)

Figure 4b: Cumulative Returns of model and benchmarks from 1990-1998; without rebalancing

Figure 4c: Cumulative Returns of model and benchmarks from 1990-1998; with rebalancing

Used S\&P500 and NYSE data, Minimum Monthly Return of 0.005, Regime Switching model constructed

These two graphs show the standard MVO portfolio and the inflation-hedged portfolio performing similarly over the time period of 1990-1998.

This time period was relatively dull in terms of inflation rate changes.

Table1: Modified Sharpe Ratios for 1990-1994,1994-1998

Table2: Sharpe Ratio for 1990-1994, 1994-1998

The converse of what is normally expected happens in these two tables. In comparison to the standard MVO portfolio, the inflation-hedged portfolio has a more negative and consequently inferior modified Sharpe ratio, while possessing a less negative and consequently superior Sharpe ratio.