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**MATH 5230: Risk and Interest Rate Models**

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**IMPACT OF RISING INTEREST RATES ON FIXED INCOME PORTFOLIOS**

**ABSTRACT**

Investors often ignore the impact of interest rates when making investment decisions, whether they increase or decrease, until the rise or fall begin to have a positive or negative impact on their investment. Recently, rising interest rates have made many investors nervous about short-term and long-term fixed income investments, especially its impact on fixed income distribution in diversified investment portfolios.

While there are still uncertainties to the global economic impact, the Feds continue to raise interest rates gradually making it paramount to investigate the effects of rising interest rates and fixed income portfolio and strategies that seek to eliminate interest rate risk (the risk associated with making a loss from a change in interest rates) during rising rates while still potentially benefitting from the investment.

It is very important for investors, portfolio managers, and risk managers to be familiar with the impact of interest rates on investment portfolios. Knowing how to manage a fixed income portfolio when interest rates rise can help mitigate any potential negative effects.

With interest rate as the core focus, this study uses historical data to investigate empirically factors that impact fixed income assets and how they may be affected by the next rise in interest rates. The study aims to determine if there is a positive relationship between increase in interest rates and fixed income portfolio or not, and strategies to mitigate negative impacts if any.

**INTRODUCTION**

There are various factors that determine interest rates:

1. Demand and Supply: When demand for money or credit increases, interest rates rise, and when demand for credit decreases, interest rates fall. Conversely, an increase in the supply of credit lowers the interest rate, and a decrease in the supply of credit raises the interest rate.
2. Inflation: The higher the inflation rate, the higher the likelihood of interest rate hike.
3. Government: Government influences interest rates. The US Federal Reserve (The Feds) often publishes the effect of monetary policy on interest rates. The federal funds rate is the rate at which depository institutions lend their reserves to other banks. This rate eventually affects other interest rates, especially the prime rate which is charged by banks on short term loans to their most credit worthy customers and businesses and the basis for all other rates.

**METHODS**

This study makes use of different set of data gotten from FRED an online database and analysis using excel software and multiple online research.

**DATA ANALYSIS**

Using data gotten from FRED an online database, we analyze the relationship between Fed Funds Effective Rate and Prime rate for a 20-years long period.

From the chart below we can see the very close relationship, different values but the same flow.

**Exhibit 1**

Interest rate hikes tend to reflect a booming economy. The Fed raises interest rates to prevent the economy from growing too quickly or sparking a rise in consumer price index. Interest rates may also be lowered to prevent the economy from contracting or continuing to decline.

And this is true from the analysis of the chart above, we can see that from mid 2004 to mid 2006 interest rate grew from 1.03% to 5.25% and then later from the middle of 2007, interest rate began to decrease until it hit a low of 0.6% at the end of 2008. If we can recall, the period of 2004- 2007, the economy was doing well, houses were selling rapidly, subprime lending was pompous and popular before the decline in real estate values in 2007 began, birthing the Global financial crisis of 2007-2008. An action to raise or lower interest rates usually takes months or years to keep pace with economic growth.

FIXED INCOME PORTFOLIO

A fixed income portfolio consists of investment securities that pay a fixed rate of return until maturity. When the investment matures, the principal of the investment is returned to the investor. Examples of fixed income securities include but not limited to:

Certificates of deposit (CDs)

Government-issued bonds (Municipal bonds)

Corporate-issued bonds

Treasury bills

Bond mutual funds

Fixed income investing primarily aims to generate income from low-risk securities at a fixed (known or specific) interest rate.

Fixed income securities provide insight into why portfolios of fixed income securities are preferred. This is because Fixed income securities not only generate dividends and provide good returns, but also provide a stable income stream with minimal risk.

RISING FED FUNDS RATE AND FIXED INCOME INVESTMENT RATES

Because the federal funds rate indirectly affects short-term interest rates, we use it as a proxy for studying its impact on Fixed Income Investment rates that are attributed to fixed income portfolios. Studying the data for a 20-year period starting November 2001 to November 2021.

Below are Exhibits of Charts showing the relationship between Fed Funds Rate and 11 Fixed Income Investment rates randomly selected to eventually sum up a Fixed Income Portfolio rate which will be further tested in the studies. The charts are done in groups for better visualization and analysis.

The 11 randomly selected Fixed Income Investments are :

1. Moody's Seasoned Aaa Corporate Bond Yield - (DAAA)
2. Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for the United States -(GovtBond)
3. ICE BofA BBB US Corporate Index Option-Adjusted Spread - (BOAbond)
4. 3-Month or 90-day Rates and Yields: Certificates of Deposit for the United States - (CD)
5. Moody's Seasoned Baa Corporate Bond Yield, - (BAA)
6. 10-Year High Quality Market (HQM) Corporate Bond Spot Rate - (HQM)
7. Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity - (BAA10Y)
8. ICE BofA BBB US Corporate Index Effective Yield - (BBBEY)
9. Market Yield on U.S. Treasury Securities at 3-Month Constant Maturity - (TS3MO)
10. ICE BofA AAA US Corporate Index Effective Yield - (AAAEY)
11. Interest Rates, Government Securities, Government Bonds for United States -(INTGSBUS)

Exhibit 2 shows a chart between DAAA, GovtBond, BOAbond, and Federal Funds Effective Rate as FEDFUNDS for a 20-year period.

**Exhibit 2**

The chart shows Certificates of Deposit for the United States – CD going in a very similar direction as the Federal Funds Effective Rate- FEDFUNDS. Meanwhile the ICE BofA BBB US Corporate Index Option-Adjusted Spread – BOA bond is having a somewhat inverse relationship with the Federal Funds Effective Rate- FEDFUNDS as they are moving in opposite directions. To a degree, even though not very clearly, the chart shows a relationship between Moody's Seasoned Aaa Corporate Bond Yield – DAAA, Long-Term Government Bond Yields: 10-year – GovtBond and the Federal Funds Effective Rate- FEDFUNDS.

**Exhibit 3**

Exhibit 3 shows a visualization of the relationship between FEDFUNDS rate and BAA, HQM, BAA10Y, BBBEY. From the above, we can see an inverse relationship between BAA10Y- Moody's Seasoned Baa Corporate Bond Yield Relative to Yield on 10-Year Treasury Constant Maturity and FEDFUNDS rate. BAA, HQM and BBBEY move in a similar direction, somewhat similar to the FEDFUNDS rate asides from around 2007 to 2009 where the FEDFUNDS rate was experiencing a decline and the three investment securities were rising. And between 2009-2015 the three investment securities were constantly experiencing a rise and fall in their rates, meanwhile the FEDFUNDS rate remained at a constant between 0.15 and 0.12.

Exhibit 4 on the other hand shows a chart between FEDFUNDS rate and TS3MO, AAAEY, INTGSBUS.

Exhibit 4

The chart shows the FEDFUNDS rate and Market Yield on U.S. Treasury Securities at 3-Month Constant Maturity - (TS3MO) having a very similar pattern in rise and fall and in fact similar rates. And just like with exhibit 4, there are periods where we see inverse patterns between AAAEY, INTGSBUS in comparison with the FEDFUNDS rate.

Furthermore, we look at the 11 randomly selected Fixed Income investment securities put together to form a Fixed Income portfolio rate. Deeper analysis will test the relationship and the impact of FEDFUNDS rate on this Fixed Income Investment portfolio rate.

FEDFUNDS RATE & PORTFOLIO RATE ANALYSIS

\*FFER-Fed Funds Effective Rate

\*FIIPR- Fixed Income Portfolio Rate

RISING INTEREST RATE AND FIXED INCOME INVESTMENT PORTFOLIOS

Interest rates are critical to fixed income returns. They have an impact on investor's fixed income investment portfolios, like bond portfolios. An improvement in the economy could have two conflicting effects on bond yields. When there’s a rise in interest rates which occur as a result of a booming economy, the prices of bonds fall, inversely, when interest rates experience a decline, bond prices go up. This inverse relationship can seem a little complex at first glance, but a chart can give you a better grasp of it.

Bonds are loans of some sort offered by investors, usually to companies or government agencies. In return, the investor receives interests which are income at a fixed rate for a stipulated time. This fixed rate income remains the same regardless of how market interest rates change.

Usually, bonds are in a competition with each other for the interest income they accrue. When interest rates rise, new bonds carry higher yield and generate more revenue. When interest rates fall, new bonds have lower interest rates, making them less attractive than traditional bonds. The bad news for bond holders is that when interest rates rise, issuers of fixed-rate bonds cannot raise rates to the same level as newly issued bonds because Previous bond rates are fixed in per with their original terms. Therefore, lowering bond prices remains the only way to attract new investors. In retrospect, the original holder of the bond has an asset that has depreciated in value. Also, it doesn't pay regularly the way new bonds in the market do.

**Bond Example**

A $1,000 bond that has 10 years until repayment has been purchased by Investor Jay. When the bond matures, the initial capital of $1,000 will be repaid to him. The interest rate on the bond is a coupon of 5% annually. Meaning that the bond yields a return of $50 annually and he is paid semi-annually. That is $25 coupon payment every six months.

After a year, Investor Jay then decides to sell his bond, but interest rates in the market isn’t exactly what was a year ago. It has risen to 6%. This means that bond investors can get a return of $60 on a $1,000 bond at a rate of 6%. Now Investor Jay’s $50 annual interest isn’t as attractive as a $60 annual interest on the same bond value.

\***New bond**: The investor would make an interest yield of $60 yearly for 10 years. A total of $600.

**\*Investor Jay’s bond**: The buyer would make an interest yield of $50 yearly for 9 years. A total of $450.

To attract a buyer, that is a new investor for Investor Jay’s bond, he will have to sell his bond for $931.23.

How is this value determined?

**How much does a bond go down when interest rates go up?**

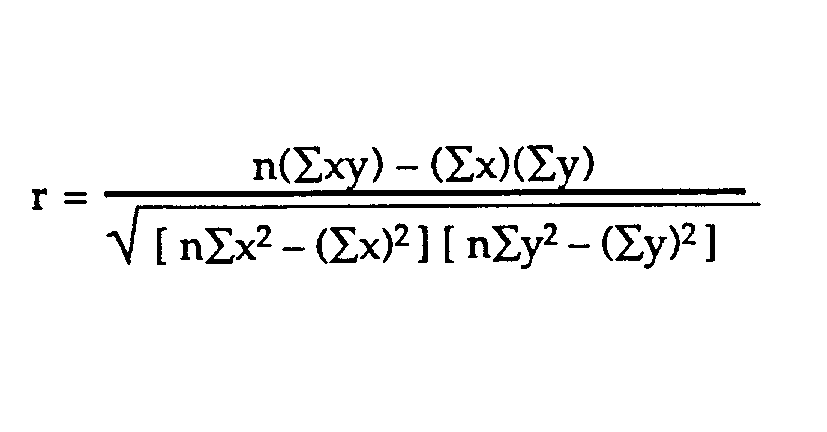
Taking these variables into account and roughly calculating the discount amount is very complicated.

* Current interest rate
* Expected number of coupons or interest payments expected to be received before maturity
* How much is the coupon payment for each bond?
* Future value of bonds (par value)

So if a buyer bought Investor Jay’s $1,000 bond at 5% interest rate, which has 18 months coupon payments left at $25 each, this is how a rise in interest rates affect the bond's market value.

|  |  |
| --- | --- |
| **TODAY'S INTEREST RATE** | **MARKET VALUE** |
| 5% | $1,000.00 |
| 6% | $931.23 |
| 7% | $868.10 |
| 8% | $810.11 |
| 9% | $756.80 |
| 10% | $707.76 |

We can see a clear decline in the market value of the bond as the interest rate rises. Also, using the correlation coefficient in excel, the correlation coefficient between the interest rate and the price is -1. A perfectly negative correlation. Meaning as one goes up, the other goes down and vice-versa.



*Correlation coefficient Formula Source: Stattisticshowto.com*

Suppose the reverse was the case, and the economy is not doing so well causing a fall in interest rates. How will this impact the same bond value?

|  |  |
| --- | --- |
| **DECREASING INTEREST RATE & PRICE** | |
| TODAY'S INTEREST RATE | MARKET VALUE |
| 5% | $1,000.00 |
| 4% | $1,074.96 |
| 3% | $1,156.73 |
| 2% | $1,245.97 |
| 1% | $1,343.46 |
| 1% | $1,395.54 |

From the calculation and the graph, it is evident that decreasing interest rates increases the value of Investor Jay’s bond and the correlation coefficient is -1. Indicating a perfectly negative linear correlation between price and interest rate.

**THE RISK**

Most of the concern over the price impact that rising interest rates have on Fixed Investment portfolios is attributed to interest rate risk. This risk is usually measured by looking at the duration of a fixed income security. “Duration” measures the sensitivity or volatility of a bond to changes in market interest rate. It considers the coupon payments and when the bond is due. Bond duration is shown on a yearly basis to help compare different bond and bond funds. The longer a bond has to mature, the more sensitive it is to changes in interest rates.

For bond investors who believe interest rates are rising, the surest option is to reduce the duration of their bond portfolios. A bond with a duration of 10 can lose about 10% of its value if interest rates should rise by 1%.

Historically, long-term government bonds have the highest interest rate risk. Treasury bonds for example carry only interest rate risk. It does not have any credit risk as it is backed by the US government. Short-term Treasury bonds have lower interest rate risk than long-term Treasury bonds but often also yield lower interests.

Corporate bonds typically yield higher interests than government bonds, and credit spreads reflect the added risk. They come with a default risk that the bond issuer is unable to meet their financial obligation

Remember that some bonds for example: floating-rate bond funds, inflation-adjusted bond funds can adjust their interest payments to increase interest rates.

**CONCLUSION**

A single fixed income investment can provide a stable income stream till maturity and guaranteed payments to maturity, but a fixed income investment alone can be a strict cap on interest rate risk. Bond portfolios such as bond funds, bond ETFs, etc; are diverse and invested in a variety of bonds and other fixed income securities that can help reduce the risk associated with rising interest rates.

For example, a bond with a duration of 10 years and a bond with a duration of 3 years, the second bond will help reduce overall exposure to interest rate risk. A bond fund investing in different types of bonds and amplifying this effect through the variety that bond funds typically offer is a better hedge against rising interest rates than a single bond.

Tracking the market or predicting where interest rates will go may or may not be efficient. Investors can take into consideration different fixed income investing strategies to build a strong fixed income portfolio. The smartest thing investors can do however, is to consciously manage their portfolios to increase their growth potential and limit the negative effects of interest rates. Diversification is the best way to do this, whether your bets are headed in the short or long term. This means building a well-diversified portfolio of high-quality bonds, stocks, cash and cash equivalents that incorporates a well-calculated strategy.

**FUTURE RESEARCH**

I think it is important to further study the negative impact of rising and falling rates on the different investment sectors. If the instable fed funds rate has this much impact on especially fixed securities that is supposed to be fixed, in all sense of the word ‘fixed’, I wonder the impact it has on broader investment sectors.

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