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Book

Bond performance measures and valuations : a primer for the inexperienced investor

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Bond Performance Measures and Valuations

A Primer for the inexperienced investor

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Abstract

Several bond performance measures, some being relative, while others absolute can be utilised by bondholders to monitor the value of their investment. The scope of this report is to highlight some of these key metrics that one may adopt to determine whether a debt instrument in an investment portfolio is appropriate for the needs and characteristics of the investor. Most valued measures of investment performance relate to estimations of yields. Spread measures show their usefulness as a guide to how bonds rank in comparison to their peers or to a "risk-free" instrument. Given that bonds are sensitive to changes in interest rates, the report also refers to other attributes as duration and convexity. The report concludes by displaying examples of how such estimations could be applied to determine the performance of both individual bonds and a portfolio of debt instruments.

Keywords: investment, bonds, yields, spread, risk-free, duration, portfolio

Contents

Executive Summary

Building on a previous report[2] published by the Central Bank of Malta, which focused on the concepts and dynamics of fixed income, this report delves deeper into the necessary estimations and valuations that are undertaken to grasp the nature of fixed income investing. Fundamental knowledge alone is not enough to render an investor the desired returns. The estimation of the income of a bond in comparison to the associated risk, is the starting point. Although bonds are often thought to be a safe investment, they nevertheless carry risk which is borne by the bondholder. Concepts to measure both risk and return are exhibited with examples. Price sensitivity to a change in secondary market yields is also a vital consideration as it is particularly useful to measure the potential impact on a bond's value following a change in market interest rates.

Different bonds are issued with diverse coupon rates. These also come at different prices and interest returns due to underlying market factors that may cause the market prices to trade at a discount, at par, or at a premium. The purchase price of bonds would have an impact on their valuation to the bondholder. Therefore, understanding and comparing how the value of the investment given by market measures in relation to a benchmark asset, is highly useful.

A good forecast of market interest rates is the basis to guide a portfolio manager or investor on how they can position the portfolio accordingly. Anticipating market interest rate movements entails careful analysis and inevitable assumptions of such changes in the future. The terms yields, spreads, and duration are explained in relation to the necessary valuations, to aid the investor assess the strength of a single investment or a portfolio. All measures have their individual importance at delivering a complete review to the investor. However, caution is warranted as measures rely on forecasts which often entail a degree of uncertainty to such expectations.

[2] *An Introductory Overview of the Bond Market (Borg et al, 2020).*

1.0 Introduction

Making well-informed investment decisions requires ongoing analysis through several key metrics which are aligned to personal circumstances (capital potential, age, etc.) and risk appetite. The main objective is to maximise risk-adjusted returns based on some parameters which account for the investor's profile.

Debt securities allow entities to fund their activities through different investor types in exchange for a return on investment[3]. However, debt securities come with different risk-return profiles. The rule of thumb implies that the higher the risk an investment offers the higher the return should be. It is then up to the investor's judgement to identify whether the bonds chosen for their portfolio suits their risk appetite.

The focus of this report is to provide essential insights to support investors in their decision making through evaluating and analysing such debt securities[4]. It is fundamental that investment decisions are taken upon reliable information from accurate measures, and not mere speculation. Investors need to be equipped with the necessary knowledge on how to value investments and decide which investment instruments are appropriate to them. This would better protect investors and lead to a better functioning of the secondary market for local securities.

The introduction is set out in Section 1.0 whilst Section 2.0 outlines some useful yield measures that can be employed to evaluate different bond returns to the bondholder. Section 3.0 explains yield spreads over other benchmark yields, where the selected benchmark yield is usually one that reflects a risk-free gauge of market interest rates. Concepts of price sensitivity to yield changes are explored in Section 4.0. The fifth section explains the basis and concepts to create the right portfolio according to the amount of risk one is willing to take following careful research and considerations. Section 6.0 shows how one can value their investments, highlighting concepts such as market value, book value, amortisation cost, capital gains or losses, and interest income. The seventh section applies all the measures to a hypothetical portfolio to portray their practical use while explaining procedures to evaluate the prospective strengths and weaknesses of the portfolio. Section 8.0 concludes the report, emphasising the importance of making sound investment decisions with the proper tools and estimations that would enable the investor to see the potential if an investment opportunity should present itself.

All figures in these reports, unless stated otherwise, are hypothetical and thus do not relate to any actual securities on the market.

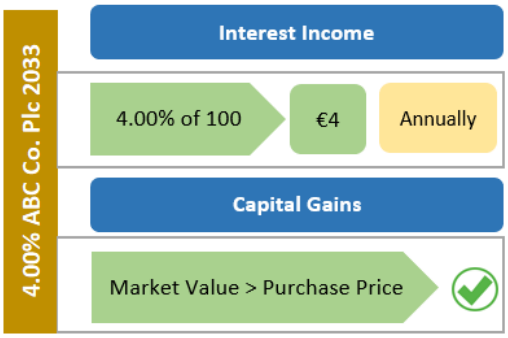
[3] The term "debt securities" shall be used interchangeably with "bonds" throughout the remainder of the report.

[4] The theory and analysis applied throughout this report focuses on fixed income bonds.

2.0 Return of a Bond

A **bond** has two types of **return**: **interest income** and **capital gains**. The interest income is dependent on the **coupon** assigned to that bond, which is the annual percentage interest on a par value of €100 per unit of holdings.

Chart 2.1 – ABC Bond Return



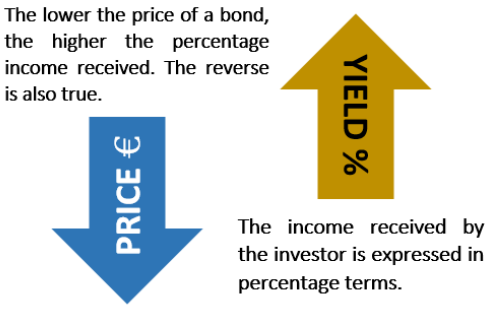
Source: Author's Illustration

Capital gains may be realised only when the asset is **sold.** However, the return is not guaranteed to the holder and depends on the price of the bond at the time of sale. Gains are dependent on the **market value** given at a point in time against the bond's **purchase price**. Any opportunity for capital gains that may be present throughout the lifetime of the bond is foregone if the bond is held until its maturity.

Chart 2.1 illustrates the return of ABC Company's issued bond, titled "4.00% ABC Co. Plc 2033". A coupon of 4.00% means that it would return 4.00% of €100 annually. The gross (before tax) interest income received would be €4.00 per bond, when the bond is held for a period of one year.

2.1 Price and Yield

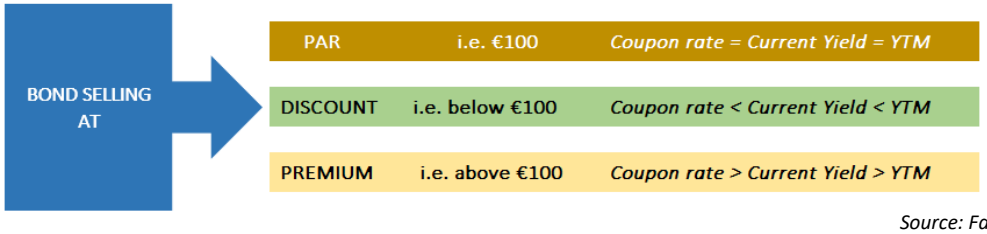
Chart 2.2 – Price vs. Yield Relationship



Source: Author's Illustration

The **yield**[5] reflects the **total potential proceeds** earned from the capital invested. The yield is inversely related to the price of the bond, meaning that when the yield increases the price declines proportionally, and vice versa. At issuance, bond ABC's yield is equal to its established coupon rate when bought at a par value of €100, therefore at 4.00%. Should the investor purchase this bond at €95, at maturity the issuer will still pay out to the holder of such bond the par value (€100). This would mean that the bond will generate a higher yield than the coupon (4% coupon plus the extra €5 to reach the €100 par value. Conversely, a purchase price above par would mean a drop in the yield dependant on the difference in the price premium to return to a value at maturity of €100. This inverse relationship is further portrayed in Chart 2.2 above and Chart 2.3 below.

Chart 2.3: Par, Discount and Premium Yield Relationship

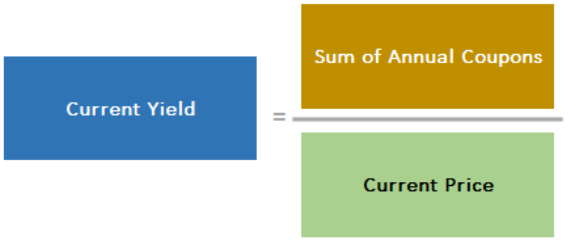


Source: Fabozzi (2006)

[5] Reference can be made to our preliminary report in this series for supplementary information on the bond characteristics.

The **current yield** measures the **annual interest return** based on the security's going market price. Accordingly, it can fluctuate higher or lower from the stipulated coupon set on the bond, again affecting whether the bond trades at a discount, premium or par value. This measure disregards capital gains or losses for bonds bought at a discount or a premium, that are held till maturity (Fabozzi, 2013). Chart 2.4 shows the main components involved in the estimation of the current yield.

Chart 2.4: Current Yield Components



Source: Author's Illustration

The most employed measure of return is the **Yield to Maturity (YTM)** which **values the return of a bond until its redemption date.** The YTM is regarded as a better yield measure when compared to the current yield convention. However, its primary drawback is its assumption of coupon payments being reinvested at a rate of interest equal to the estimated YTM. Nevertheless, the YTM measure still provides an adequate indication of return if held till maturity.

2.2 Yield on Option Bonds

For callable bonds[6], both YTM and yield to call figures are measured. By assuming that the bond will be called on a specific date, the estimation for the yield to call is then calculated at the call price. Both the **call price** and the **call dates** are pre-specified in a **call schedule** issued in the prospectus.

The yield on a puttable bond[7] is calculated up till the first **put date**. This would equate to the present value (PV) of cash flows up until that date to the bond's price plus the accrued interest.

[6] Callable bonds give the issuer the right, but not the obligation to redeem the bond within a pre-specified timeframe within the bond's indenture, known as the call period.

[7] Puttable bonds give the holder the right, but not the obligation to demand early repayment of the principal which is allowed on one or more prespecified dates.

3.0 Measuring Risk

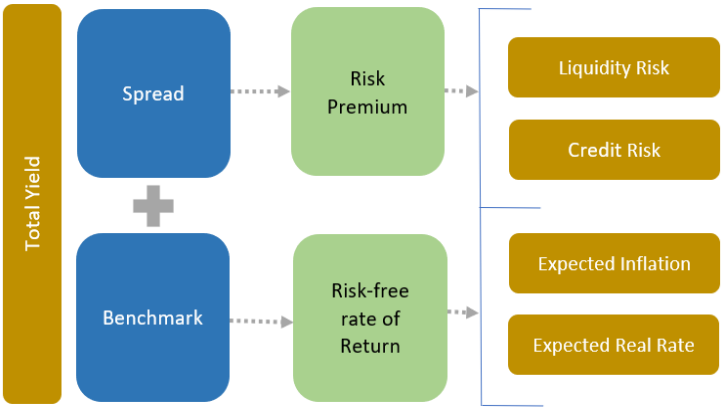
Many types of risks are present when investing in fixed income securities. The inherent risk in bonds is **interest rate risk**, which effects the price change of the bond when interest rates fluctuate.

To compare risk profiles of bonds one must start at determining a **"risk-free" rate**, in which, contrary to what the name implies, carries what is considered as the **baseline risk** within the market.

3.1 Spread Measures

The spread is the difference between the yield of a bond and that of another which is considered by the market as the benchmark risk-free rate. The risk-free rate is an estimate that incorporates different factors within the economy, namely **inflation expectations** and **expected real exchange rates** as depicted in Chart 3.1.

Chart 3.1: Spread Composition



Source: Choudhry and Lizzio (2015); Author's Representation

The spread difference relates also to a mixture of other elements which can be directly attributable to either the bond itself or its issuer. A positive spread over the selected benchmark represents a premium paid to investors to provide compensation for the additional risk than that offered by the benchmark[8].

These factors would include additional risks posed by the issuer and the bond, such as **credit risk** and **liquidity risk**. Credit risk means the risk of default. Credit rating agencies are established to examine the credit risk of issuers of bonds through in-house criteria against a pre-set fee. The ratings given by these agencies facilitate investors to classify bonds into risk categories with associated rates of return. As per Chart 3.1 above, a higher associated credit risk would result in a widening of spread resulting in a higher yield to compensate for the risk. Liquidity risk refers to the level of accessibility to purchase or sell a bond on the market thus giving an indication to a bondholder the relative ease with which a bond can be liquidated.

There are other different types of spread measures that can provide further analysis into a bond's performance, such as nominal spread, zero-volatility spread, interpolated spread, and option-adjusted spread, amongst others. This report will focus only on the nominal and interpolated spread measures.

[8] Further explanations can be found in Borg et al. (2020).

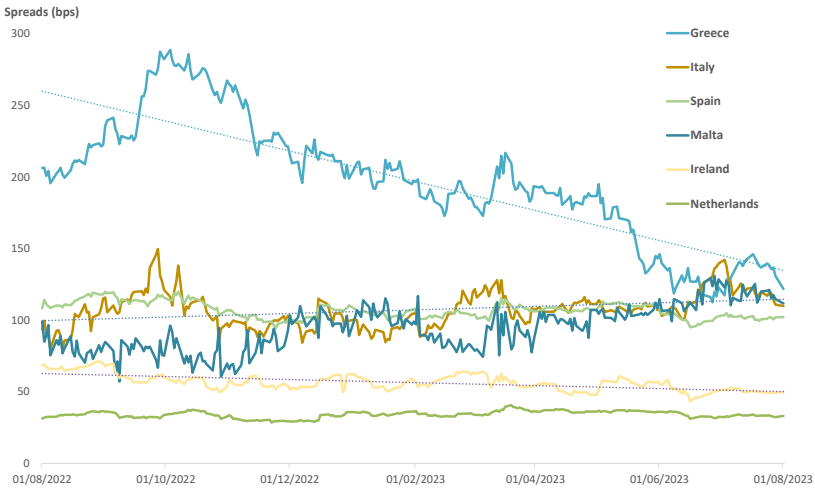
3.2 Nominal Spread

The nominal spread, known also as the **G-spread** is calculated by plotting similar termed yield curves on each other. The difference between the two yields is the G-spread which represents the premium offered to investors in compensation for the added risk that a bond would carry over the baseline risk.

A selection of euro area sovereign yields with a 5-year term to maturity over the corresponding EU benchmark[9] are illustrated in Chart 3.2 below. A downward trend in spreads can be interpreted as an increase in relative interest from investors which may emanate from lower credit risk or even a higher yield by the benchmark bond. In contrast, an upward sloping G-spread could typically indicate that the bond is becoming riskier when compared to the benchmark. Credit ratings may give a better indication of the credit worthiness of the issuer and of the strength of the investment. A list of the credit ratings by major agencies are explained in Borg et al. (2020).

Chart 3.2 gives a practical interpretation of the movement in spreads. The decline in the Greek G-spread during the period under review, may reflect better economic conditions and reforms applied to reduce banking sector and sovereign risks. The country has been recently upgraded to investment grade by one of the four major credit rating agencies and one notch below investment grade by two other agencies.[10] Italy's spread moved in line with that of Greece up till March 2023, after which it stabilized till mid-June and increased thereafter, reflecting political and macroeconomic developments. Although the G-spreads of Spain and Ireland also exhibited a downward trend, it was more subdued as these spreads were at a somewhat lower level. Malta's G-spread is seen moving in a tight range mainly exhibiting the prevailing positive market conditions. The spread of the Netherlands over the EU benchmark remained broadly stable.

Chart 3.2: Comparison of Selected EU Countries 5-Year G-Spreads



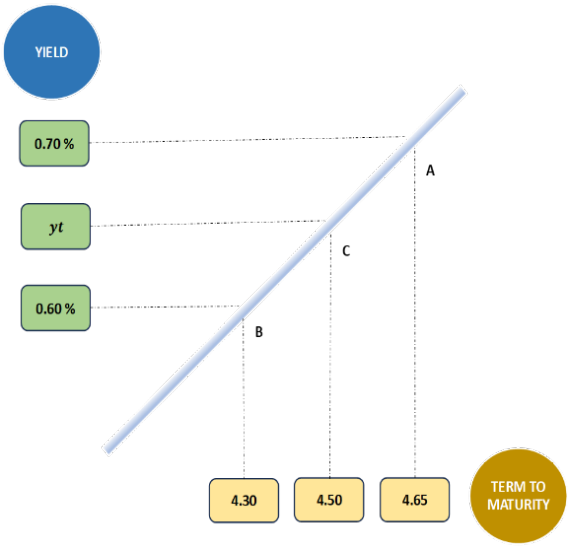
Source: Bloomberg/Central Bank of Malta

[9] The German government bond market (Bund market) is large and liquid with a AAA credit rating (denoting a high degree of creditworthiness, reflective of a very low risk of default), allowing the Bunds to achieve a benchmark status.

[10] DBRS – BB Low, stable [08.09.2023]; Fitch – BB+, stable, [27.01.2023]; Moody's – Ba1-, stable, [15.09.2023}, stable; S&P – BB+, positive, [21.04.2023].

3.3 Interpolated Spread

Chart 3.4: Interpolated Spread



Source: Author's Depiction

Interpolations can be performed to estimate yields to the desired maturity by using the closest two benchmarks. The common benchmark used to measure the Interpolated spread or more commonly referred to as the **I-spread** is the swap rate[11] (James and Donald, 2019). The benchmark rate is subsequently linearly interpolated, as illustrated in Chart 3.4, to match the maturity of the bond. Equation (3.1) in Appendix A is used to derive this rate.

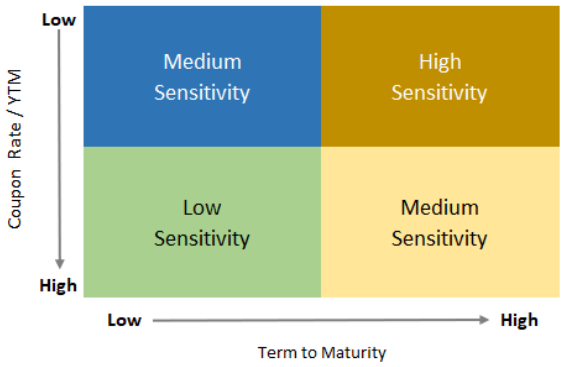
Assuming that no swap rate is available with a term to maturity of 4.50 years (bond C), the closest swap rates with term-to-maturities (bond A – 4.65 years and bond B – 4.30 years) are used to interpolate the desired rate.

The equivalent swap rate is based on a linear calculation of the two data points, which in our example are 0.60% and 0.70%. Therefore, assuming the yield of the 4.50-year bond is that of 0.98%, the I-spread over the benchmark is equivalent to 0.98% less the calculated interpolated rate of 0.66% i.e., 32bps.

[11] The swap rate refers to the fixed element of a floating-for-fixed interest rate swap.

4.0 Duration

Chart 4.1: Duration



Source: Authors' Illustration

Duration estimates a bond's **price sensitivity in relation to changes in interest rates.** This calculates a line approximate change in price for every 100 basis-point (1%) shift in the market interest rate. Duration is dependent on the maturity, yield, and coupon. The measure can also be estimated for an entire portfolio of bonds, thereby measuring the sensitivity of the portfolio to a 1% change in YTM.

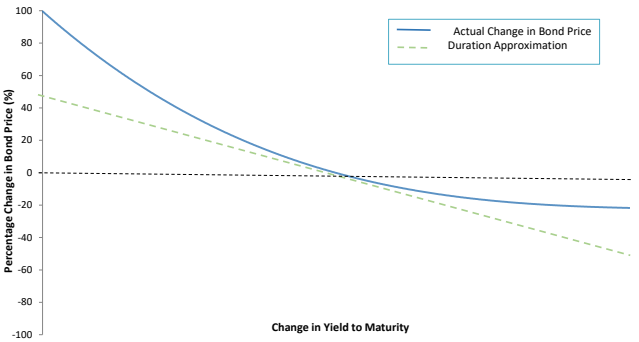
A higher coupon rate bond ensues a lower duration, given that a larger part of the return is being paid prior to maturity. The higher coupon produces larger cash flows, keeping all else constant. Each payment will therefore have a greater contribution to the total return, having a larger weight on its cash flows and a relatively lower weight to the principal payment[12]. A zero-coupon bond has a duration equal to the maturity term. Duration is inversely related to the bond's YTM and has a similar relationship with duration as does the coupon rate.

A long-term maturity bond will have a higher duration than that of a shorter-term bond because of heightened volatility in a changing interest rate environment, and therefore more sensitive to fluctuations in interest rates.

4.1 Application

In a scenario where interest rates go up by 1%, a bond with duration of 2 will decline in price by approximately 2%. It follows that bonds with a lower duration would be more attractive in the case of an expected increase in yields. Conversely, an anticipated fall in yields would make a higher duration bond more appealing as the price would increase and may render opportunities for capital gains.

Chart 4.3: Duration Approximation and Actual Change in Price



Source: Bodie, Kane and Marcus (2014); Authors' Representation

Duration is an essential gauge for investors, though not a perfect one. An investor must recognise that this is only effective for small changes in yields and serves only as an approximation. The real price change of a bond is duration plus its ***convexity***. This limitation is illustrated in Chart 4.3 and is further explored in Section 6.0.

[12] The principal amount has a significant impact given that it is the largest and last cash flow, with the longest time until payment.

5.0 Bond Selection

Careful bond selection is a hard yet very essential task for any investor which depends on a several factors that may also be specific to the investor, such as risk appetite. The selection may not be limited to debt securities but may be extended to different asset classes suitable for a portfolio.

5.1 Risk-Return Appetite

The risk appetite is the aptitude towards accepting a certain amount of return dependent on a specific risk level. Different investors would prefer different bonds that would offer diverse returns. As theory implies, the lower the risk, the lower the return, and conversely, with more risk one would expect a higher comparable return. The levels of risk and return would however be conditional on the investors' preferences. To be able to fully understand the risk being taken, the investor is advised to research the available investment options.

5.2 Research

The study for corporate issues would go into the specifics of the company's financials, performance ratios, and forecasts of the business' financials. Financial statement analysis can reveal a lot of valuable insights, such as the company's recurring cash flows, overheads, profit margins, past dividend payments, debt leverage ratio and a timeline of its past performance.

Expanding the research to the networks and channels used by the company would be wise as these allow for transactions, logistics, communication, and many other important processes to be carried out for company's functionality. Furthermore, the many stakeholders and their actions also affect the returns to a company's shareholders. On the other hand, there are other events a company may be subject to that are out of its control such as the industry size, business competition, etc. which also hold significant information.

For sovereign issuers, the study would delve deeper into the macroeconomic aspect, such as the size of the economy and growth rates, macroeconomic policies, governance indicators, interest rate policies, law and order, political stability, etc.

As mentioned earlier in this report, this research can be widely facilitated through a credit rating obtained from a reputable rating agency. This way, the investor may assess the credit risk associated with the issuer and compare with other issuers.

5.3 Diversification

The concept of diversification allows for an investor to have many different types of bonds within their portfolio. By holding the debt of different borrowers, exposure to specific risks are dispersed.

There are different kinds of diversification strategies that one may adopt to reduce the risk in a portfolio. One such kind is international diversification. Buying instruments issued by different countries and regions may help lower geographical risk exposure, as one country might pose a higher risk than another which would be reflective through the assigned credit ratings. The portfolio can also mitigate against a country specific event, such as a natural disaster, through this type of diversification. One can also consider not tying up all funds within the same

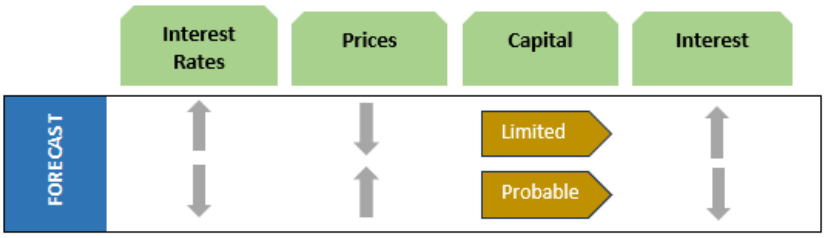
industry of operation and include different asset classes with different return timeframes. Diversifying a portfolio should improve risk-adjusted returns and if done correctly, eliminates firm-specific risks (Bodie, Kane and Marcus, 2014).

5.4 Forecasting

Performance of bonds relies primarily on the movements in interest rates and thereby the events that affect them. Thus, an accurate forecast of yield movements would be invaluable to portfolio managers. However, forecasting is a complex task that relies on multiple assumptions. Therefore, in the absence of perfect foresight, forecasts contain a certain degree of uncertainty and errors arising from the imperfection of models used in forecasting and from circumstances that could not have been anticipated and hence be accounted for. Albeit no forecast is likely to be precise, it nevertheless provides an informed basis to strategical investment decision-making. The yield forecasts guide the investor in the decision-making on whether to invest in longer- or shorter-termed maturities.

For instance, longer-term assets become more attractive if yields are forecasted to drop in the future, as prices will go up by a larger degree due to their high duration, thereby creating an opportunity for capital gains. The magnitude of this income would depend on the scale of the drop in the rate (Mishkin and Eakins, 2015). Conversely, if the forecast would suggest that interest rates were to rise, lower duration bonds would then be more attractive in reducing the adverse impact, as the portfolio would decrease in its market value. This is all summarised in Table 5.1 below.

Table 5.1: Forecasting Scenarios



Source: Author's Illustration

6.0 Valuations

The two main values assigned to a bond are referred to as the **nominal value** or **market value**. The **nominal or face value** is the price set at its issuance and to be repaid to the bondholder when it reaches maturity. This is usually set at par of €100. The **market value** of a security could be higher or lower than its nominal value as it is the price, determined through the interplay of the relevant market forces, multiplied by the nominal value of bonds traded.

6.1 Book Price, Amortised Price, and Amortisation

The **book price** is the price by which the investor has bought the bond. This can be either higher, equal to, or lower than the par value. The price of a bond, whether trading at a discount or at a premium, is being **amortised**[13] daily until maturity, to deduce the new daily book price and book value of the security. Therefore, **amortisation** depends on the amount between the par value and adding any premiums or subtracting any discounts at which the bonds were bought until reaching face value at maturity. This will lead to the **amortised price** of the bond, which is the book price after amortisation has been applied.

6.2 Capital Measures and Capital Gains

Table 6.1: Capital Gains/Loss Calculation

MARKET PRICE	BOOK PRICE	CAPITAL GAIN/LOSS PER UNIT
102.00	100.00	2.00
100.00	100.00	-
99.75	100.00	-0.25

Source: Authors' Calculations

Unrealised gains and **losses**[14] are results of fluctuations in prices against the book price as shown per unit in Table 6.1. These gains or losses are realised through the sale of the asset. The individual gain or loss estimated would then be multiplied by the number of units held within the respective asset to derive the full amount of the realised gain or loss in the portfolio.

6.3 Interest Income

Interest income is the amount paid through the coupon rate over the life of a financial instrument. Details of such income would be prespecified in the bond indenture, which are usually fixed or floating. Simple interest income over a period is the principal amount and the coupon applied. An example is given in Table 6.2, where the simple interest due for the lifetime of the bonds is calculated in the final column. This example, however, does not consider the amortisation cost of individual bonds and is thus referred to as the gross interest income. Net interest income would deduct the amortisation from the total interest estimated over the lifetime of the bond to arrive to a net figure. Additionally, one would also need to account for tax (if any) to be paid on interest income.

Table 6.2: Calculation of Simple Interest Income

COUPON	MATURITY IN YEARS	COUPON x YEARS	NOMINAL HOLDINGS	SIMPLE INTEREST DUE TILL MATURITY
5.45%	3.00	0.1635	5,000	817.5

Source: Aurthors' Calculations

[13] The writing off of the initial cost of the asset.

[14] The term "unrealised" implies that the profits or losses are not yet actual, but only giving a snapshot of the current valuation of the bond at that point. For profits or losses to be crystallised, the asset needs to be sold.

7.0 Portfolio Management

Portfolio management may vary depending on the investor and their individual profile both in terms of risk preference and other characteristics such as age, tax bracket, employment, etc. Portfolio management is needed even in efficient markets as its purpose is primarily to customize a portfolio to the investors' characteristics, preferences, and needs, while optimising returns (Bodie, Kane and Marcus, 2014). A hypothetical fictitious portfolio is presented in Table 7.1 to show how the measures explained in this report can be applied.

7.1 Portfolio Application

The portfolio consists of 14 bonds, 7 of which are corporate issues and 7 sovereign debt securities. For simplicity, all are fixed-rate conventional bonds and assumed to have been bought at par. Their coupon, maturity year, credit rating and holdings are shown in the relevant columns. Investing in bonds provides a steady income stream from interest payments. However, one should also account for the diversity of industries underlying such bonds. Similarly, different credit ratings can give indications of the risk these securities pose to the investor. For corporate bonds, for example, different industries are associated with different risks. The Hospitality industry, for instance, is tourism dependent which may be affected by a number of other factors such as seasonality and popularity as well as specific shocks. For example, the Covid-19 pandemic severely affected tourism across the globe putting many businesses operating in this sector under severe stress. Sovereign bonds are dependent on geography, political tensions and economic performance, which are usually reflected in credit ratings. This also applies to corporates and their country of operation. To this end, one should always be aware of the risks related to the bond before making selections to the pool of assets in the portfolio.

Coupons differ for several reasons, such as different issuers' credit ratings, or if being the same issuer, the timing of issuance and the term-to-maturity would also influence the coupon offered. A longer maturity would mean it will take the investor longer to bring back their initial investment and therefore would usually require a higher rate of return. This is known as the term premium.

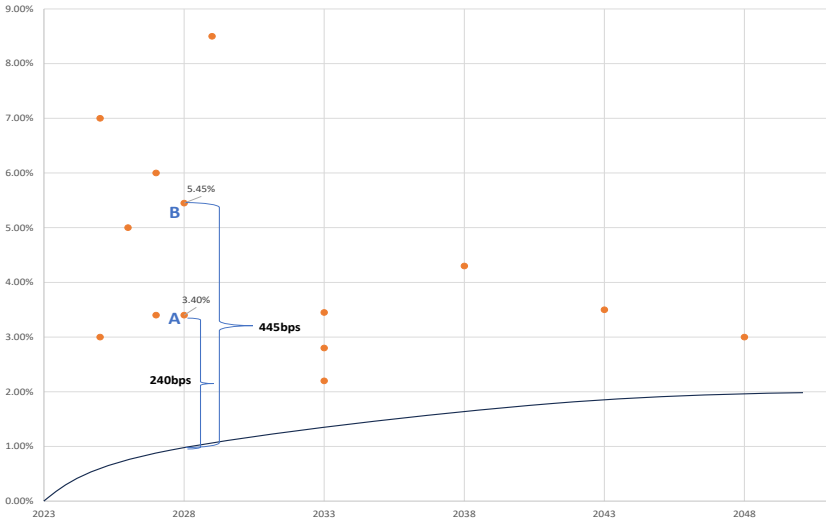
TYPE OF BONDS	GEOGRAPHY	INDUSTRY	COUPON = YIELD	CREDIT RATING	MATURITY YEAR	HOLDINGS €/$/£
Corporate A	Germany	Financial	5.45%	B+	2028	5,000.00
Corporate B	Spain	Hospitality	6.00%	BBB+	2027	6,000.00
Corporate C	United States	Information Technology	3.40%	A-	2027	10,000.00
Corporate D	China	Information Technology	3.00%	A-	2025	8,000.00
Corporate E	Greece	Retail	7.00%	CC	2025	5,000.00
Corporate F	Italy	Entertainment	8.50%	C	2029	3,000.00
Corporate G	United States	Financial	3.45%	A	2033	10,000.00
Sovereign A	United Kingdom	Government	5.00%	AA	2026	10,000.00
Sovereign B	France	Government	3.50%	AA	2043	9,000.00
Sovereign C	Belgium	Government	3.00%	AA	2048	8,000.00
Sovereign D	Greece	Government	4.30%	BB	2038	5,000.00
Sovereign E	Lithuania	Government	2.80%	A+	2033	5,000.00
Sovereign F	Cyprus	Government	2.20%	BBB-	2033	6,000.00
Sovereign G	United States	Government	3.40%	AA+	2028	10,000.00

Source: Author's Calculations and Representation

As mentioned, the yield on the bonds for the holder of this portfolio are equal to the coupon since all bonds were bought at par value. Assessing the performance of these bonds would require estimating their yields through their market prices. These prices and yields show the investor whether their bonds are trading at a profit or at a loss and therefore, assessing their individual performance on the market, and for the portfolio.

A scatterplot through Chart 7.1 shows these prices and yields, giving a visual representation of credit spreads over a selected risk-free benchmark. These spreads can indicate that the bonds within the portfolio produce higher returns than that of the benchmark due to a premium that compensates the investor for the risk being undertaken, as explained in Section 3.0.

Chart 7.1: Spreads over Benchmark Yield Curve



Source: Authors' Calculations and Representation

As shown above, the benchmark yield curve, at one point stands at 1.00% as opposed to a yield of 3.40% and another of 5.45%, both for 2-year maturity bonds within the portfolio. This means that the two G-spreads are 240bps and 445bps, for bonds labelled as A and B, respectively. Both bonds offer a premium spread over the benchmark yield curve which may be reflective of either different credit

ratings given to the issuers, liquidity constraints of small issues or any other factors which may increase the risk profile of the bond.

7.2 Capital Gains or Losses

Capital gains or losses can now be estimated through these market prices by deducting the book prices, in all cases here, €100. Market prices fluctuate on the secondary market relative to the book price of the portfolio. This means that the unrealised gains or losses also fluctuate, as had been illustrated in Table 6.1.

7.3 Simple and Net Interest Income

Following on Table 6.2 in Section 6, one may estimate the simple interest income for all bonds up until their maturity. This method however does not account for the cost of acquisition which is needed to arrive to a net interest income figure. This cost is synonymous to the amortisation price, that is the difference between the par value and the price at which it was bought. The difference is divided by the number of days left until the bond is redeemed which is then subtracted daily from the simple interest figure.

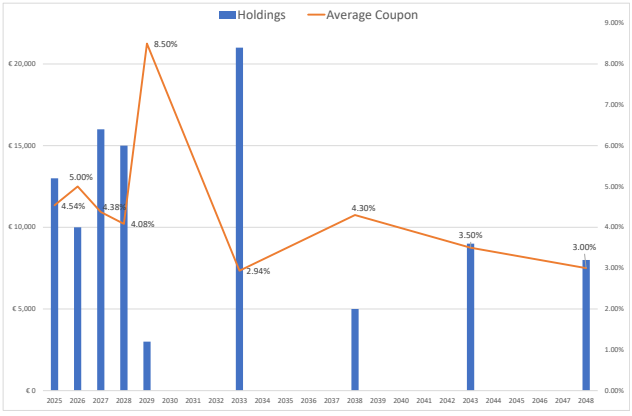
Therefore, the Yearly Net Interest Income is the Simple Interest Income deducting the total amortisation for the period as should be applied throughout the lifetime of the bond.

7.4 Portfolio Maturity Timeline

Maturity ladders are charts that visualise the lifetime of investments within a portfolio. An example is shown in Chart 7.2 which reflects the fictitious portfolio in Table 7.1. This type of analysis aids in maturity diversification of funds as the dispersion of maturities helps keeps a portfolio active and ensures sustained income.

Plotting average coupons on the maturity ladder gives a rough indication of the expected interest income from each group of holdings.

Chart 7.2: Maturity Ladder and Average Coupons



Source: Authors' Calculations and Representation

In this hypothetical portfolio there are multiple years with no maturing bonds. This is not the ideal situation for a well-diversified portfolio in terms of maturity. Filling in the gap years by rolling over investments after their redemption could be a good strategy for the investor to keep the portfolio as active as possible. The highest coupon maturities are set to mature in 2029 which are also lowest in holdings. According to Chart 7.2, in 2033 a large inflow of cash is to be received by the holder of the portfolio as the highest amount of holdings are set to mature within the same year. A preferrable maturity

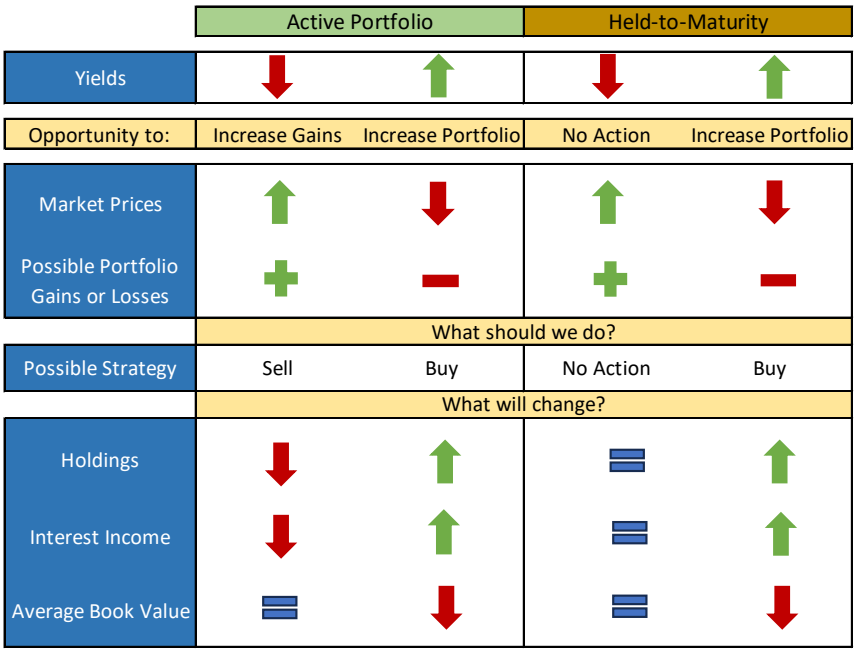
ladder, however, would have holdings staggered across the years with no gap years such as that portrayed in Chart 7.2[15].

7.5 Type of Portfolio and Strategy

The strategy of a portfolio determines if the underlying bond holdings are actively traded or held-to-maturity. A visual summary of the possible strategies, actions taken, and results are presented in Chart 7.3.

The Chart shows the hypothetical actions that one might consider when there is a movement in yields. For example, a fall in bond yields[16] might incentivise the active-portfolio manager to take profits, while the held-to-maturity portfolio manager might take no action. Further explanation of the possible strategies are highlighted in the chart and text below.

Chart 7.3: Portfolio Strategy



Source: Author's representation

The active portfolio is often transacted, by taking on a continual opportunist approach. As presented in the first column, when yields drop market prices will in turn increase giving rise to potential gains made on one's investment through a sell strategy. Consequent to a sell transaction, holdings equivalent to the sale will decrease from the portfolio, together with the future interest income that was to be received from the holdings sold. Sales do not have any effect on book values.

The second column of the active portfolio strategy in Chart 7.3 gives an example of when yields increase. A rise in yields would decrease the value of the bonds' prices on the market. This can translate in lower profits or even losses if the price falls below the book price. Waiting for yields to drop again would give way for more favourable circumstances to actualise gains, as prices would increase widening the said profit margin. However, a rise in

[15] This is to avoid reinvestment risk. An explanation of this is given in the previous report.
[16] Bond yields and prices are inversely related. This is explained in more detail in section 2.1.

yields may also present a different opportunity to increase the portfolio through the purchase of new assets at lower prices. When done so, one may make way for more gains. Purchases would here affect the book value through a weighted average applied on the number of holdings purchased by their respective price as explained in Section 6.0.

An active portfolio has the potential to crystalise gains; however it may run the risk of selling too early. For example, when yields fall and the price of the bond exceeds its registered book price, the investor might be tempted to sell as soon as the bonds come into profit. One could, however, consider a further drop in yields, in order to attempt to maximise the potential gain from the trade. Having a reliable forecast and seeking advice from a professional advisor on when to commit such transactions can better guide the respective investor.

In the Held-to-Maturity portfolio, the same yield dynamics apply. Taking the first column into consideration, a drop in yields would cause an increase in prices which might transpire into unrealised profits. However, holding the assets to maturity suggests that assets are not sold but kept until their redemption. One should be cautious and carry out the necessary due diligence when investing in a bond even if it is being held to maturity. Such prudent analysis should continue even throughout the life of the bond, despite the held to maturity strategy. Supervision on companies in which an interest is taken is to be maintained to anticipate any possibilities of companies defaulting on their obligations. To this end, one should always keep abreast with ongoing updates and news about the companies invested in. Within the same column referred to of this portfolio strategy, when one does not sell or buy more assets for the portfolio, it would imply that holdings remain constant as does the interest income and book value, while no capital gains are realised.

When yields increase and prices drop within a Held-to-Maturity portfolio, a similar course of action as that of an active portfolio presents itself. In such a scenario, one might choose to increase bond holdings at higher yields. This should improve the interest income of the portfolio, while also lowering the book value and thereby improving the amortisation of the portfolio.

One might opt to apply hypothetical positive and/or negative changes in yields to their portfolio, thereby creating a best-, worst- and neutral-case scenario, and a course of action which is compliant with the portfolio strategy chosen. The neutral scenario is the status quo. Whether the best and worst-case scenarios refer to when yields increase, or decrease would also depend on what is the objective of the portfolio. For example, a profit-seeking investor would prefer yields to drop to increase their profit margin, whereas the investor seeking to increase their wealth in assets may prefer a rise in yields to buy at better prices and increase interest income and the overall yield of their investments, as explained above.

Quantifying the changes in a portfolio after assuming a fixed change in yield provides a better understanding of the swing a portfolio may undertake following fluctuations in the market. This is visualised by Table 7.2 below, in which a 100 basis-point positive and negative change were taken to estimate the yield and price changes from the neutral scenario, which is the portfolio at purchase prices. One may note that the gains and losses in the scenarios do not equate in absolute terms due to convexity.

This type of scenario analysis also evaluates the robustness of the portfolio. A portfolio with a higher duration measure could result in more profits or losses while the opposite holds true for a lower duration portfolio making the latter more robust to a movement in yields.

Table 7.2: Portfolio Scenarios

-100bps		Neutral		+100bps	
Market Value	€ 104,009.49	**Market Value**	€ 100,000.00	**Market Value**	€ 93,458.59
Book Value	€ 100,000.00	**Book Value**	€ 100,000.00	**Book Value**	€ 100,000.00
Unrealised Gains/Losses	€ 7,419.21	**Unrealised Gains/Losses**	€ 0.00	**Unrealised Gains/Losses**	-€ 6,541.41
Estimated Net Interest Income	€ 4,044.50	**Estimated Net Interest Income**	€ 4,044.50	**Estimated Net Interest Income**	€ 4,044.50
	€ 11,463.71		€ 4,044.50		-€ 2,496.91

Source: Authors' Calculations and Representation

The market value of the portfolio increased following the drop in yields and conversely decreased after the rise in yields was simulated. This is due to the inverse relationship explained previously between yields and prices. When the market value of the portfolio exceeds the book value, there is an avenue for profit taking, as the portfolio is now worth more than what it was originally bought for. This is the case seen in the negative 100 basis-point change scenario. Conversely, when the going selling price (market value) drops below the original purchase price (book value), the portfolio is at a loss. The discrepancy between the profit and loss after a 100-basis-point shock applied in both scenarios (one positive and one negative) is due to convexity in duration as explained previously in Section 4.0.

In all three scenarios, interest income remained the same, on condition that the book value is unchanged, implying that no transactions (purchases or sales of assets) are effected. As previously explained, interest income is not dependent on the fluctuations of yields in the market but is the result of the coupon and amount owned in holdings.

8.0 Conclusion

The evaluation of the potential performance of a bond is principally measured by the securities' main aspects, which are the price, the coupon interest rate, and its maturity. The analysis of these key components guides the prospective investor to determine whether the instrument is an appropriate one for his/her needs and characteristics.

As mentioned in the report assessing the investment performance over a specified period is also determined by the fluctuations of the asset price in the market, relative to the value at issuance and its book value. Furthermore, certain analytical tools quantify the price sensitivity to changes in interest rates. However, these may be only applicable in the case of minor deviations, and serve only as an approximation.

Other factors which should also be taken into consideration by the investor are certain yield and spread measures. To this effect portfolio managers apply technical and statistical methods to estimate and counteract the potential effects of interest rate movements on the performance of their investment.

In a sense, performance measurement of fixed income securities is an analytical skill that involves various technical calculations allowing the investor to make a more informed decision on a potential investment.

The purpose of this report is to provide local retail investors with some basic knowledge of certain concepts and their related risks. Investors should seek to inform themselves and be aware of the risks involved before investing in a financial instrument. Seeking professional advice for an informed decision is always recommended before making any investment choices.

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Appendix A

Equation (3.1) for Interpolated Spread and Example worked out:

Therefore, inputting the figures from Chart 3.3 to Equation (3.1) yields:

$$y_t = y_0 + [((y_1 - y_0)/(x_1 - x_0)) * (x_t - x_0)] \quad (3.1)$$

where y_t is the Interpolated Yield.

$$\boldsymbol{y_t} = \quad 0.60\% \; + \left[\left(\frac{0.70\% - 0.60\%}{4.65 - 4.30}\right) * (4.50 - 4.30)\right] = 0.66\%$$

Equation (3.2) for Option Adjusted Spread

This can be expressed as:

$$OAS = Z - Spread - Option\ Value\ (in\ basis\ points) \quad (3.2)$$