Bloomberg Market Concepts - Module 3

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Fixed Income: The Roots of the Bond Market

Fixed Income Introduction

Fixed income is another term for the bond market, and while the bond market may rarely make headlines, it plays a crucial role in setting the price of borrowing and lending for governments, businesses, and consumers. The interplay between bond prices, bond yields, inflation, and creditworthiness forms the foundation for determining interest rates. In this module, we will examine how the bond market came to be, identify the key factors that drive it, and understand the role of central bankers in setting interest rates. We will also explore the concept of yield, how and why the yield curve moves, and what those movements imply. You will discover how the bond market became the largest and most complex financial market in the world, and how it serves a vital public function. We will describe how yields facilitate comparison across the vast diversity of securities in the market, explore how government bond yields serve as benchmarks for other investments, and examine how the bond market acts as a source of discipline for government borrowing. Additionally, we will investigate when, why, and how central banks make interest rate decisions, and how bond valuation is influenced by creditworthiness, inflation expectations, and central bank policy. Finally, we will discuss the importance of the yield curve to governments, businesses, and consumers, and interpret the implications of major shifts in the yield curve.

Size of the Bond Market

Fixed income is a fancy term for borrowing and lending. Bonds are effectively tradable IOU notes that represent loans from investors to borrowers, typically governments or corporations. The fixed income market is the largest financial market in the world. As of the end of 2016, there were over $101 trillion worth of traded bonds in existence globally. This figure exceeds even the world GDP at the time, which was approximately $79 trillion. It also far surpasses the size of the global stock market; for comparison, the total value of world stock markets was only about $65 trillion.

If we look at Bloomberg's encyclopedia of bonds, specifically the fixed income search function known as SRCH, we find that at the end of 2016, there were approximately 2.1 million government and corporate bonds in existence worldwide. By aggregating the total market value of these bonds, we can calculate that the global bond market was worth $101 trillion. Let's focus on U.S. government debt. The U.S. Treasury had 1,086 actively traded bonds and bills outstanding, accounting for $14 trillion of the global bond market—making it the largest single segment. As we will see repeatedly, the U.S. government bond market plays a critical role in global finance. Next, we can filter the global total of 2.1 million bonds to focus specifically on the corporate bond segment, and then further refine this to isolate U.S. corporate bonds. The U.S. dollar-denominated corporate bond market is the second-largest segment globally, with $8 trillion in bonds outstanding.

History of the Bond Market

The fact that the United States accounts for approximately one-fifth of the global bond market is one of the main reasons for the dollar's central role in the international currency system. Despite its immense

size today, the bond market—like the foreign exchange (FX) market—is a relatively recent development. It emerged in the post–World War II era, driven by interest rate liberalization and the removal of capital controls. These changes made it easier for governments to borrow, thereby laying the foundation for the modern global bond market.

The largest segment of the global bond market is the government bond market, also known as the sovereign debt market. Historically, governments issued bonds only to finance limited expenditures such as war and justice. For example, the Bank of England was founded in 1694 specifically to finance the Royal Navy. With the rise of the welfare state and the expansion of social safety nets, government spending as a share of GDP has increased dramatically. Advanced economies now allocate a significant portion of their budgets to healthcare, education, and other public services. In the United States, government spending as a percentage of GDP has more than tripled—from 13% in the early 20th century to over 40% a century later. In parts of Europe, this figure is even higher; for instance, government spending accounts for more than half of Denmark's GDP.

Government Budget Deficits

Let's visualize U.S. government tax receipts and expenditures using a chart, such as the one produced by the Bloomberg function `BUDG`. In this chart, the orange line represents government outlays (spending), while the white line represents tax receipts. When the orange line appears above the white line, it indicates that the government is spending more than it collects in taxes. This shortfall is known as a budget deficit. Although budget deficits may appear unsustainable, they are not uncommon. For example, France has run a budget deficit every single year since 1972.

From the 1940s to the 1970s, U.S. government taxation and spending patterns were relatively erratic. The last time the United States ran a meaningful budget surplus was during the Clinton administration, when the country benefited from the post–Cold War peace dividend and strong tax revenues driven by the dot-com boom. In contrast, in the aftermath of the 2008 financial crisis, the U.S. government ran the largest absolute budget deficit in global history, as it took aggressive fiscal measures to stabilize the financial system.

Government Indebtedness

If we type *Treasury securities* into a financial terminal, we can retrieve the total amount of U.S. government debt as reported by the Federal Reserve over time. The rise in U.S. government debt began to enter the public consciousness around 1989, when the national debt reached $2 trillion. This growing concern led a U.S. real estate developer to install the U.S. National Debt Clock near Times Square in Manhattan as a public reminder of the country's expanding fiscal obligations.

The U.S. National Debt Clock began counting down—not up—during the Clinton surplus years around 2000, as it was originally designed to highlight rising debt rather than falling debt. With debt declining at the time, the clock was unplugged and covered with a red, white, and blue curtain. When government debt began rising again in 2002, the curtain was lifted and the clock was turned back on. On September 15, 2008, investment bank Lehman Brothers collapsed, triggering the global financial crisis. Just two weeks later, on September 30, 2008, the debt clock ran out of digits when the national debt surpassed $10 trillion. A new clock had to be constructed to accommodate the additional figures. But this raises a critical question: who lent Uncle Sam several trillion dollars, and why?

Foreign Owners of Government Debt

We can explore the ownership of U.S. government debt securities by entering *sovereign debt ownership* into a financial terminal and selecting the `DEBT` function. Navigating to the "Foreign Holders" tab and clicking the pie chart icon reveals a visual breakdown of non-U.S. holders of U.S. government bonds. As of the end of 2016, out of the $14 trillion in actively traded U.S. government debt, approximately $6 trillion was held by foreign entities, while $8 trillion was owned domestically by U.S. investors. Among foreign holders, Japan

and China each owned roughly $1 trillion in U.S. government bonds.

Now that we know who owns U.S. government bonds, the next question is: why do they hold such large quantities? Two key reasons lie in the world of currencies. Since major currencies began to float freely in 1971, many countries have found it necessary to accumulate large war chests of foreign exchange (FX) reserves. These reserves are used to defend currency pegs or to deter speculative attacks. At the same time, some countries have deliberately sold their own currencies and purchased U.S. government bonds as a way to weaken their exchange rates, making their exports more competitive on the global market.

Countries that need foreign exchange (FX) reserves often use U.S. Treasuries as a safe and highly accessible place to park their capital. U.S. government bonds are widely regarded as the safest financial assets on Earth. This perception is rooted in the United States' strong creditworthiness, as the U.S. government possesses the legal authority to tax the citizens and businesses of the wealthiest nation in the world. Additionally, the United States enjoys what is often called the "exorbitant privilege" of issuing the world's reserve currency. This means it can ultimately repay its obligations either by raising taxes or by printing more of its widely trusted currency. U.S. government bonds are also the most liquid tradable assets globally and are naturally denominated in U.S. dollars. Conveniently, the foreign exchange market is also centered around the U.S. dollar. These factors combine to make U.S. government bonds the proverbial piggy bank for the world.

We can illustrate the role of U.S. government bonds as a destination for foreign exchange (FX) reserves by examining the correlation between two key indicators: the total amount of global FX reserves (plotted on the right-hand Y-axis) and foreign ownership of U.S. government debt (on the left-hand Y-axis). Between 2002 and 2014, the global surge in FX reserves was mirrored by a corresponding rise in foreign holdings of U.S. government bonds. This relationship helps explain the rapid growth of the U.S. government bond market. On one side, the U.S. has been running large fiscal deficits that require substantial borrowing. On the other, foreign governments have been seeking safe, liquid assets in which to park their expanding FX reserves—making U.S. Treasuries a natural choice.

It's not just governments that use U.S. government bonds as a safe place to park foreign exchange reserves—private investors also turn to U.S. Treasuries as a safe haven during periods of market turmoil. A widely accepted indicator of such turmoil is the VIX volatility index, often referred to as the "fear gauge" of global markets. When the VIX is high, investors are fearful; when it is low, markets are seen as complacent. Bond prices move inversely to bond yields—a relationship we will explain in more detail later. Historically, when fear spiked during several major crises over a 25-year period, investors rushed to buy U.S. government bonds, causing yields to fall. This behavior was observed during the Russian debt default crisis in 1998, the dot-com bust in 2002, the global financial crisis in 2008, and the Greek debt crisis in 2010. In the summer of 2011, political brinkmanship in Washington, D.C. led to the downgrade of U.S. government debt, with the country losing its prized AAA credit rating. This event also triggered market volatility, a spike in the VIX, and a sharp drop in U.S. bond yields as investors fled to safety.

Corporate Bonds

Of the 2.1 million tradable bonds in existence globally, corporate bonds represent the other major segment—and like the modern government bond market, they are a relatively recent development. In 1980, only a few hundred U.S. corporations had access to the bond market. Today, if we exclude government bonds from our bond search, we find that approximately 1.6 million of the 2.1 million outstanding bonds are corporate issues. Given that there are far more large companies than there are sovereign governments, the corporate bond market exhibits a much greater diversity of issuers. Just as the U.S. government alone has 1,086 outstanding bonds, many individual corporations also issue a wide array of bonds to meet their financing needs.

Take IBM, for example. We can load the company by typing `IBM` into a financial terminal and selecting the appropriate security. By navigating to the company overview and selecting the `CAST` function, we can access IBM's capital structure. This display includes the parent company and all of its subsidiaries, including oper-

ations in countries such as Argentina and France. At the bottom of the screen, a bar chart illustrates how the parent company's financing is divided between shareholders (equity) and lenders (debt). By clicking on the "Security Detail" tab and drilling down, we can view a complete list of IBM's outstanding bonds—revealing the company's active presence in the corporate debt market.

Why do companies borrow in the corporate bond market? There are two main reasons. First, in almost all countries, there is a favorable tax treatment for debt financing. Interest payments on debt reduce a company's taxable profits, thereby lowering its tax bill. Since corporate tax rates exceed 20% in many advanced economies, financing through debt can offer significant cost savings compared to equity financing. Second, companies can often borrow for longer terms in the bond market than they can from banks. Traditional banks are generally less willing to offer long-term loans to corporations, making the bond market a more attractive source of stable, long-duration capital.

The Structure of a Bond

Now that you understand why the bond market exists and who the main borrowers are, let's zoom in and examine how an individual bond works. A bond is essentially an IOU—a debt instrument that promises to make regular fixed payments, known as coupons, over the life of the loan. At the end of the loan term, the bond also pays a large final amount called the principal, or face value.

To visualize bond payments, let's take the example of Rwanda. We can load the country, view its bonds, select one, and then type `debt distribution` into the command line to access the `DDIS` function. In mid-2013, Rwanda joined the government debt market by issuing its first bond, borrowing $400 million. The repayment schedule for Rwanda's debut bond is depicted in a bar chart showing the timing and amounts of future payments. This fixed schedule of payments is what gives rise to the term "fixed income." Rwanda committed to paying $27 million in annual coupon payments and the full $400 million in principal in 2023. The reason the coupon payment in 2013 was only $13.5 million is that the bond was issued halfway through the year. Likewise, since the bond matures in mid-2023, the final year also includes a partial interest payment of $13.5 million in addition to the full principal repayment. Altogether, bondholders who lent the original $400 million to Rwanda in 2013 would receive a total of $670 million over the bond's 10-year lifespan—reflecting the interest compensation for their investment.

Introducing Bond Yields

Now that we know how much Rwanda borrowed in 2013 and what its repayment schedule looks like, we can begin to think about how bond yields are calculated. We will explore this in greater detail later, but in brief, the approach is similar to how a credit card company calculates the annual percentage rate (APR). In the case of Rwanda's bond, an APR calculation reveals an effective annual interest rate of approximately 7%. However, unlike fixed loans, bonds are bought and sold in the open market at prices determined by supply and demand. Because of this, the bond's market price fluctuates over time, and this price becomes the main input in yield calculations. As a result, the APR—or yield—for future holders of the bond changes depending on the price they pay to acquire it.

Newcomers to finance often misunderstand the term "fixed income," mistakenly thinking it implies a fixed APR or that bond prices are fixed. It does not. "Fixed income" simply refers to the fixed repayment amounts promised by the bond—typically regular coupon payments and a principal repayment at maturity. Even then, those payments are only fixed if the borrower actually fulfills them. The latest calculation of a bond's effective interest rate is known as the yield. The primary input to the yield is the bond's current market price, which fluctuates based on investor sentiment, interest rate expectations, and credit risk. The other input is the stream of remaining repayments that have yet to occur. As time passes and more of the bond is repaid, the number and value of future repayments decrease. The yield is calculated based on both the bond's current price and these future cash flows. Throughout this module, we will use the term "yield" to refer to this concept. The beauty of yield is that it allows us to compare the kaleidoscopic diversity of the world's 2.1 million bonds on a consistent and standardized basis.

Relationship Between Yields and Price

Generally speaking, the lower the agreed purchase price for a bond, the greater the APR or Yield, as a smaller upr sum results in the same fixed amount of repayments down the road. With the price of a bond goes down, the APR, for the yield, goes up, and when the price of a bond goes up, the APR or yield goes down.
Let's move beyond the theoretical playground and examine the inverse relationship between bond price and yield in the real world. One of the clearest ways to demonstrate this relationship is by graphing the price and yield of a special type of instrument known as a perpetual bond. In the case of perpetual bonds—where the principal is never repaid and only coupon payments continue indefinitely—the relationship between price and yield is mathematically exact. Because the cash flows are fixed and extend forever, any change in the price directly and inversely affects the yield, making them perfect mirror images of each other.

Winners and Losers from Bond Yields

Who benefits and who suffers when yields—or interest rates—change? When yields are high, prospective lenders are generally pleased, as they receive relatively more in repayments for the loans they provide. On the other hand, prospective borrowers are disadvantaged, since they must agree to repay more in order to secure a loan. Conversely, when yields are low, borrowers benefit by securing cheaper financing, while lenders earn less on the money they lend. Thus, changes in yields shift the balance of advantage between borrowers and lenders.

Bond Yield Calculation

Yields play a central role in bond valuation. They allow investors to assess the return on a bond relative to its price and remaining cash flows. To fully understand how yields are used in practice, we must first explore how they are calculated and the factors that cause them to move.

Illustration of a Bond Yield

First, how are bond yields calculated? Let's think in terms of a pot of gold at the end of a rainbow. Imagine that your Aunt Mary gives you \$80 for your 15th birthday. You want to save this money to buy a bike in three years' time.

Your sister just turned driving age and would like to buy a used car. She is asking her family for loans. If you lend your sister the \$80, she promises to give you \$90 back, spread over time. \$10 back next year. \$10 back the year after. Then \$70 back in three years' time when she plans to get a job. Your mother would rather you deposit your \$80 gift in Ledyard Bank to earn interest. Ledyard Bank is offering a \$4.53% per year interest, which option makes you richer in three years? Which option leads to the bigger pot of gold at the end of the rainbow?

How big would the pot be if you deposited \$80 in Ledyard at a 4.53% interest rate for three years? Let's visualize the money changing hands. To begin with, you hand over \$80 to the bank. We can depict that initial deposit as a negative cash flow of $-\$80$. At the end of year one, you would earn 4.53% interest on the \$80 balance, which amounts to $\$80 \times 0.0453 = \$3.624$. Your new balance would therefore be $\$80 + \$3.624 = \$83.624$. In year two, you would again earn 4.53% interest, this time on the new balance of \$83.624. That is, $\$83.624 \times 0.0453 \approx \$3.788$. Adding this to your previous balance gives you $\$83.624 + \$3.788 = \$87.412$. In the third year, you would earn 4.53% interest on the \$87.412 balance, or $\$87.412 \times 0.0453 \approx \$3.960$. Adding that gives a final balance of approximately \$91.372 after three years. This process is an example of compound interest, where you earn interest not only on your original deposit but also on the interest from previous years.

You then withdraw your original deposit along with the accumulated interest payments of approximately \$3.60, \$3.80, and \$4.00 over the three years. Therefore, if you had deposited the money in Ledyard, you would end up with a final balance of approximately \$91.40.

How big would the pot be if you lent the money to your sister instead? You begin by handing your sister $80. At the end of year one, she gives you $10. At the end of year two, she gives you another $10. Finally, at the end of year three, she settles the loan by repaying the remaining $70. Suppose you deposit both $10 payments in Ledyard Bank as soon as you receive them. We will treat each of these deposits as separate contributions to an interest-bearing account at Ledyard, where they will grow independently at the bank's interest rate.

Let's take the first $10 payment. If deposited in Ledyard Bank at the end of year one, it would grow to approximately $10.50 by the end of year two. By the end of year three, it would further grow to about $10.90. Now consider the second $10 payment, received at the end of year two. This deposit would grow to a rounded $10.50 by the end of year three. Finally, recall that your sister also repays the remaining $70 at the end of year three. Since this payment is received at the very end, it does not have any time to accumulate interest in Ledyard Bank.

So how much did you end up with by lending $80 to your sister? The first $10 deposit grew to approximately $10.90, the second deposit became roughly $10.50, and she repaid the remaining $70 at the end of year three. Altogether, this gives a total pot of gold of $10.90 + $10.50 + $70 = $91.40.

Provided that you believe your sister will repay you in full, and assuming that Ledyard Bank will still be around when it comes time to withdraw your money, the final pot of gold is the same in both cases. You initially parted with the same $80, and through different paths, ended up with approximately $91.40 in each scenario. You are therefore entirely indifferent between lending to your sister under the agreed terms and depositing $80 in Ledyard at a 4.53% interest rate. In fixed income terminology, the yield on the loan to your sister is 4.53%. That's all a bond yield is—the equivalent interest rate on a bank account that would provide an identical pot of gold at the end of the rainbow.

How to Guess a Bond Yield

But how did we know that 4.53% would make you indifferent between lending to your sister and depositing the money in the bank? One approach is simple guesswork. Let's demonstrate. Imagine you've grown up and left home. You win the lottery and take home a million dollars after taxes. Soon after, your brother approaches you and asks for a loan to buy a boat.

He is looking to borrow one million dollars and agrees to repay you in installments: $100,000 next year, another $100,000 the year after, and finally $1,100,000 in three years' time when he expects to receive an inheritance. It's the weekend, and Ledyard Bank is closed, so you don't know the current interest rate that would help you decide whether to lend your brother the money or not. But your brother doesn't know the first thing about fixed income, and he's pressing you for an answer. So, what should you do? One approach is to determine what deposit rate would make the total pot of gold at the end of three years the same, regardless of whether you choose to lend him the money or deposit it in the bank. If, come Monday morning, you discover that the bank is offering a rate above this breakeven rate, you should deposit the money. If the rate is below it, you should lend to your brother.

Let's suppose the bank is offering a 5% interest rate. Using the same methodology from the previous example—where you deposited $80 at 4.53% interest—you now deposit $1,000,000 at 5% interest. Over three years, this deposit would grow to approximately $1,157,625.

What if you lent to your brother, using a bank deposit rate of 5% to evaluate the interim repayments? In this case, you would deposit each interim payment in Ledyard Bank at 5% interest, treating each one as a separate deposit. Each repayment from your brother—$100,000 in year one and another $100,000 in year two—would begin compounding from the time it is received until the end of year three.

You would end up with a total of approximately $1,315,250.

Assuming you trust your brother and the bank equally, you should lend the money to your brother if Ledyard offers only a 5% interest rate, since you would end up with a larger pot of gold than the bank would give you. This means that we have not yet correctly guessed the yield on the loan to your brother. Let's try a higher guess.

What if the bank paid 15% interest? In this case, you would end up with approximately $1,520,875.

What if you lent to your brother while using the elevated bank deposit rate of 15% to evaluate the interim repayments? As before, you would deposit each interim payment in Ledyard Bank, but this time at a 15% interest rate.

You would end up with approximately $1,347,250.

Assuming you trust your brother and the bank equally, you should deposit the money at Ledyard if the bank offers a 15% interest rate, since you would end up with a larger pot of gold than if you lent the money to your brother. It now appears that we have overshot in our guesses of the yield on the loan to your brother. Our 5% guess was too low, and our 15% guess was too high.

Let's make our next guess 10%. If the bank paid 10% interest and you deposited the money, you would end up with approximately $1,331,000.

What if you lent to your brother using a 10% bank deposit rate to evaluate the interim repayments? As before, you would deposit each interim payment in Ledyard Bank, but this time at a 10% interest rate.

You would end up with approximately $1,331,000.

Success—you would end up with the same size pot of gold by depositing the money at Ledyard Bank at a 10% interest rate as you would by lending it to your brother under the agreed terms. This means you have now identified the precise deposit rate at Ledyard above which you should choose to park your money at the bank, and below which you should instead choose to lend to your brother. So, what's the takeaway? If you know the loan terms and have enough time, you can estimate the bond yield by trial and error. Fortunately, there's a shortcut: you can extract the yield on a bond directly from its terms using either the `IRR` (Internal Rate of Return) function in a spreadsheet or by simply reading the yield from a financial terminal like Bloomberg using the `YAS` (Yield and Spread) function.

Shortcut to Calculating Bond Yields

Let's demonstrate the `YAS` shortcut using the Rwanda example. In May 2013, Rwanda borrowed $400 million and agreed to make annual interest payments of $27 million. Since the ten-year bond was issued halfway through 2013, there were smaller $13.5 million interest payments in both the first and final year. The $400 million principal is scheduled to be repaid in full in 2023. When this bond was sold to the public in May 2013, it had a yield of 7%. Let's now visualize why an investor would be indifferent between depositing $400 million in a bank paying 7% annually until 2023 and lending to Rwanda on these exact terms.

Let's use the same methodology from the previous example, where you deposited $1 million instead of lending it to your brother. Now, imagine that you deposit $400 million in the bank at a 7% annual interest rate instead of lending it to Rwanda. By 2023, you would end up with approximately $786 million. This total consists of the original $400 million deposit and the compounded interest accumulated over the ten-year period.

Now let's see how much you'd end up with if you lent the $400 million to Rwanda and deposited the coupon repayments at 7% per year, using the method outlined previously. Over the ten-year period, you would earn approximately $386 million in compound interest from banking the separate coupon payments as they are received. In addition, you would receive the full $400 million principal repayment in 2023. Altogether, this

results in a total of $786 million by 2023.

Therefore, you would be indifferent between lending to Rwanda while reinvesting the coupon payments at 7% and depositing the full amount into a bank account paying 7% annual interest. In both cases, you would end up with $786 million in 2023. This confirms that the yield on the bond is 7%. This equivalent bank deposit rate—also known as the bond yield—can be calculated for any bond using the Bloomberg Yield and Spread function, `YAS`. As you can now appreciate, this shortcut saves a great deal of time and effort.

If we type `Rwanda` into the Bloomberg command line, select the Rwandan government, choose the relevant bond, and then pull up the `YAS` function, we can see that the yield on the bond at the time it was issued was 7%. Bloomberg did the hard work for you. So now you know what a bond yield is and where to find it. It's simply the interest rate on an equivalent bank account for the duration of the bond.

Deciphering Bond Yields

Think of bond yields, therefore, as nothing more than advertised deposit rates displayed in the window of a bank. The key difference is that the rates available to new buyers of a bond will fluctuate as the price of the bond changes. You can peer into the metaphorical window of the bank for all the major economies of the world by using the `WB` function on Bloomberg. `WB` does not stand for "window of bank," but rather for "World Bond Markets." The column highlighted in blue shows nothing more than the advertised deposit rates for the governments of the world, assuming you were to buy their bonds.

Bond Valuation Drivers

Now let's see what makes bond yields move. There are two key drivers: credit risk and macroeconomics.

Before you lend someone money, you consider how likely you are to get your money back. Despite being called fixed income and having a rigid repayment schedule, bonds ultimately rely on the borrower's ability and willingness to repay. The income is hardly fixed if you don't get repaid. In fact, sometimes even governments default on their bonds, as we will see.

Let's demonstrate the relationship between creditworthiness and yield. We begin by visualizing the cash flows on an imaginary bond. The price paid for the bond is depicted as a negative number at the outset, representing the initial investment. The bars on the right represent the chronological repayments. This bond pays back $10 per year in coupon payments, and in the final year, it returns the $100 principal along with the final $10 coupon. In total, the $100 upfront investment will deliver $200 over the course of ten years. Using the methodology outlined earlier, we would find that the yield on this bond is 10%.

Now imagine that you believe the borrower will go bust at the end of year eight. This means that you, the lender, expect to receive only $80 instead of the full $200 over the ten-year period. Naturally, this belief would lead you to pay less for the bond today. Bond prices in the present reflect expectations about future repayment likelihood. However, when calculating a bond's yield, the assumption is that the income is truly fixed—that all promised repayments will be made in full. Therefore, notwithstanding your concerns about the borrower's solvency, the yield calculation assumes you will receive the full cash flows, even if you pay a lower price upfront. In this example, if solvency fears drive the bond price down from $100 to $50, the resulting yield rises to 24%. Receiving the same promised cash flows for a lower initial investment translates to more bang for your buck.

Now imagine that you believe the borrower will go bust at the end of year four. In this case, you are willing to pay even less for the bond, since you expect to receive only $40, assuming the company remains solvent for just the next four years. Suppose, due to the extreme risk, you are willing to pay only $20. The calculated yield would now be significantly higher—approximately 54.4%. Why? Because you are paying far less for the same promised $200 in future cash flows. Of course, it is very unlikely that the full $200 will actually materialize. When bond investors—which, in the world of bonds, is simply a formal term for lenders—begin

to doubt the creditworthiness of a borrower, yields tend to rise sharply.

Let's observe how the correlation between poor creditworthiness and high yield plays out in the real world for government bonds. There are many historical examples of sovereign defaults. One of the largest recent cases is Argentina, which defaulted on $132 billion of debt in 2001. Other notable examples include Cuba in 1986, Ecuador in 2008, and Côte d'Ivoire (Ivory Coast) in 2011.

Let's return to the World Bond Markets, or `WB` function, to examine the yields of major government bonds. These yields partly reflect the market's view on the likelihood that the debts will be repaid. If the market believes a government may have difficulty meeting its obligations, the price of that government's bonds will fall, and the resulting yield will rise. This, in turn, makes future borrowing more expensive for the government. In this way, the bond market serves as a mechanism to instill fiscal discipline in governments.

While democracies typically face their electorate every few years, governments with outstanding bonds face the bond market every trading day. Bond yields can be viewed as a continuous verdict on a government's handling of the economy and its perceived creditworthiness. Elevated bond yields may pressure a government into enacting budget cuts or tax increases—both of which are often unpopular with voters. For this reason, creditors can be deeply unpopular with governments and are sometimes referred to as *bond vigilantes*. These market participants can exert enough influence to cost politicians their jobs. As President Bill Clinton's fiscal advisor, James Carville, famously remarked in 1993: "I used to think that if there was reincarnation, I wanted to come back as the president or the pope or as a .400 baseball hitter. But now, I would like to come back as the bond market. You can intimidate everybody."

Credit Risk Factors

To keep tabs on a government's creditworthiness, investors commonly monitor three key metrics. Each of these has the potential to push investors to demand higher yields during government bond auctions. In many cases, a government debt crisis will involve more than one of these factors. The three metrics are: government debt as a proportion of GDP, the government's budget deficit as a proportion of GDP, and the aggressiveness of the repayment schedule. Let's begin with debt-to-GDP.

Debt/GDP

When a government borrows to build infrastructure such as a bridge, dam, or hospital, the associated spending contributes to GDP, as discussed in the economic indicators module. However, when the government later repays that debt, the repayments are not counted as part of GDP. These repayments simply reflect the return of money previously borrowed to purchase goods and services, meaning the GDP growth from that activity has already occurred. Thus, while borrowing and spending by the government can stimulate GDP growth in the short term, future debt repayments act as a drag on growth. The greater the debt as a proportion of GDP, the larger the repayments required, and therefore, the greater the long-term drag on the economy.

Let's take a look at the World Country's Debt Monitor, or `WCDM` function. On the far right of the screen, we can observe government debt as a proportion of GDP for several countries. There is no universally accepted threshold of debt-to-GDP above which the bond market is guaranteed to panic. However, historical examples show that investor confidence can deteriorate rapidly. One such example is Greece in 2010. If we chart the Greek debt-to-GDP ratio and overlay the yield on Greek ten-year bonds, we see that debt-to-GDP spiked to over 160% in 2011, and Greek bond yields peaked at 35% that same year. During this period, Greece faced significant difficulty attracting buyers at its government bond auctions.

There are many examples of governments that have successfully managed high debt burdens. A classic case is the United States, where government debt rose to 110% of GDP by the end of the Second World War. However, during the economic boom of the 1960s, the U.S. steadily reduced its debt. The debt-to-GDP ratio

ultimately bottomed out at around 30% in the mid-1970s.

Greece in 2017 still had a high debt-to-GDP ratio of 182%, but Japan—the world's third-largest economy—had the highest debt-to-GDP ratio of any country at 235%. If we now examine the World Bond Market, we see that Greece in 2017 continued to have a relatively high ten-year bond yield of about 7%, while Japan's ten-year bond yield was approximately 0%. As we saw in the currencies module, Japan implemented a series of policies that involved printing more yen and purchasing government bonds in an effort to stimulate inflation. These policies helped keep government bond yields low, despite Japan's high debt-to-GDP ratio. This course of action was not available to the Greek government, since it does not control the issuance of euros and therefore could not print its own currency.

Deficit/GDP

A second major indicator of creditworthiness is the extent to which a government is living beyond its means, as measured by the budget deficit as a proportion of GDP. Let's return to the Debt Monitor, `WCDM`, and switch the far-right column from debt-to-GDP to deficit-to-GDP. Investors do not only consider the absolute debt burden in relation to GDP—they also evaluate the size of the government's budget funding gap that must be filled by the bond market. The deficit-to-GDP ratio is calculated by taking the annual government budget deficit, dividing it by GDP, and expressing the result as a percentage. Since a surplus is positive and a deficit is negative, governments running deficits will have negative deficit-to-GDP ratios. In plain terms, this means the government is spending more than it collects in taxes and must rely on borrowing from the bond market to finance the shortfall.

The higher the deficit as a percentage of GDP, the faster the government is accumulating new debt. Over time, this results in a larger share of the government's budget being allocated to interest payments. To compensate for the increased risk, investors typically demand higher yields. In extreme cases, the bond market may even refuse to finance the budget deficit. However, there is no strict threshold for the deficit-to-GDP ratio that will trigger such a reaction. That said, when the Greek deficit reached 16% of GDP in 2009, investors took notice, and by 2011, Greek bond yields had surged to 30%.

Repayment Schedule

The third aspect commonly considered when evaluating a government's creditworthiness is the aggressiveness of the debt repayment schedule. This is essentially a more formal way of asking whether, from a timing perspective, the borrower is likely to have the necessary cash available when the repayments fall due.

Governments can choose to borrow either short-term or long-term. Generally, borrowing over the short term attracts a lower annual interest rate, as it poses less risk to the lender. This makes short-term borrowing attractive to governments, as it reduces their immediate interest payments. There is, however, a significant drawback. Consider the analogy of a student who uses credit cards as a source of cash. He applies for a credit card offering zero interest for one year. When that year ends, he transfers the balance to another credit card that also promises no interest on transferred debt. This strategy only works as long as he can continue finding credit card companies willing to offer zero-percent interest. Eventually, lenders may begin to doubt his ability to repay and start demanding higher interest rates. The same logic applies to governments. The downside of relying heavily on low-interest short-term debt is that lenders may suddenly lose confidence and demand very high yields. This is exactly what happened with Greece during its debt crisis.

Let's see this concept applied in the context of government bonds. The `DDIS` function displays the debt distribution and repayment schedule for any government. Historically, the United Kingdom has chosen the safer path of long-term borrowing. Because long-term borrowing involves greater risk for the lender, this option is typically available only to the most creditworthy countries.

Let's now look at an example of a government traditionally reliant on short-term borrowing. At the time shown, the United States was the opposite of the United Kingdom—favoring short-term debt over long-term

obligations.

By borrowing in the short term and regularly refinancing its debt, the U.S. government takes advantage of the lower interest rates typically available to short-term borrowers. One might wonder whether the United States fears that investors could suddenly pull the rug out from under it. The answer is no. The foundation of U.S. creditworthiness lies in two key strengths: the ability to print the world's reserve currency and the power to tax a very wealthy economy. This is what sets the United States apart from an overextended consumer who has maxed out a credit card.

For less creditworthy countries, borrowing in the short term is particularly risky, as it requires large near-term repayments. Such governments have repeatedly faced difficulties in the government bond markets as a result. During the Asian financial crisis of the late 1990s, countries like Thailand, South Korea, and Indonesia all fell into this trap, suffering severe consequences from their reliance on short-term debt.

Let's illustrate how Greece fell into this trap by using the `DDIS` chart for Greece, which shows the debt repayment schedule both before the crisis emerged and after the first major International Monetary Fund (IMF) bailout. The columns on this chart display Greece's repayment obligations following the initial bailout. Notice that, post-bailout, the bulk of the debt was scheduled to be repaid far in the future. If we now plot the repayment profile as it appeared shortly before the 2010 debt crisis and spike in bond yields, the picture is quite different. At that time, Greece was heavily reliant on short-term debt. As we saw earlier from the yield chart, the bond market effectively pulled the rug in 2010. It was the IMF's initial bailout that repaid the short-term debt—the yellow bars—and converted it into long-term debt—the large blue bar on the far right of the chart.

Credit Risk Indicators

We have just reviewed three credit risk factors that can trigger a debt crisis. Investors commonly monitor two key credit risk indicators to detect early signs of trouble: credit ratings and credit default swaps. Let's begin with credit ratings.

Credit Ratings

There are several credit rating agencies that assess and assign ratings to bonds, each with its own rating system. Take Standard & Poor's, for example: the highest level of creditworthiness is denoted by a rating of `AAA`, while the lowest rating, `D`, indicates default. According to an S&P analysis, 7.5% of bonds rated `BBB` defaulted within ten years, whereas 94% of bonds rated `CCC` or lower defaulted within the same period. Given this predictive power, it is helpful that over 120 countries have their government debt rated by one or more credit rating agencies. Here is a ratings table of developed markets. We can sort the Standard & Poor's ratings by clicking the relevant column header. Unsurprisingly, most developed markets hold high ratings—except for Greece, which had the lowest rating among the group. Due to the strong predictive quality of government bond ratings, investors pay close attention when these ratings change.

Let's type `sovereign ratings` into the Bloomberg command line and select the `CSDR` function. At any given moment, this provides a list of the most recent changes to government bond credit ratings. A green rating indicates a recent upgrade to that rating, while a red rating indicates a recent downgrade.

Rating agencies also assign credit ratings to corporate bonds. Lower-risk, higher-rated corporate bonds with a rating of at least `BBB-` or above are classified as *investment grade*. Higher-risk, lower-rated corporate bonds—those rated `BB+` or below—are classified as *non-investment grade*. These are also referred to as *speculative*, *high yield*, or simply *junk* bonds.

The track record of credit rating agencies is decidedly patchier for corporate bonds than it is for government bonds. A notable example is the American energy company Enron, which collapsed in 2001 in what was, at the time, the largest corporate bankruptcy in U.S. history. Just a year prior, Enron was praised by *Fortune*

magazine. Let's pull up Enron's credit rating profile using the CRPR function. From 1995 through October 31, 2001, Enron maintained an investment-grade rating of BBB+. However, just 33 days later, on December 3, 2001, Standard & Poor's downgraded Enron to D, indicating default. Enron had gone bust.

Credit Default Swaps

Since the Enron debacle, a new instrument known as a credit default swap (CDS) has become increasingly popular as an alternative to relying solely on credit ratings. CDSs function as a form of insurance against the risk of governments or corporations defaulting on their debt obligations.

Credit default swaps (CDSs) often provide a more timely warning of impending default than credit ratings, as they are based on real-time pricing in traded markets. The higher the CDS spread, the greater the perceived risk of default. In the case of Lehman Brothers, the spike in CDS spreads preceded the company's collapse. Its credit rating went from A during the CDS spike to SD (selective default) only after the actual default occurred. The ratings agency acted after the fact, not in advance. While CDSs can offer earlier signals than traditional ratings, they are not always accurate predictors. For example, during the 2008 financial crisis, shortly after the failure of investment bank Bear Stearns, the CDS spreads of both Goldman Sachs and Morgan Stanley spiked sharply as investors questioned their solvency. However, both firms ultimately survived and remain active today.

Since the early 2000s, credit default swaps have also become available on government bonds. To explore government CDS data, we can type sovereign CDS into the Bloomberg command line and select the Sovereign CDS Monitor, SOVR. This screen provides real-time information on sovereign credit default swap spreads. As with credit ratings, we can see that in 2017, Greece once again ranked lowest in creditworthiness, as indicated by the highest CDS spread on this separate measure.

CDS spreads are intended to reflect the intrinsic probability of default. In this case, the white line on the chart shows the calculated probability that Greece would default within five years of any given point in time, based on Bloomberg's fundamental sovereign risk model. Shortly before the first bailout in 2010, the model indicated a greater than 50% probability of default. Following the restructuring, as discussed earlier, Greece's short-term debt was converted into longer-term obligations. While the country's economic fundamentals remained weak, the likelihood of defaulting on debt repayments was reduced due to continued financial support from the European Union and the International Monetary Fund. As a result, CDS spreads decreased.

Macroeconomics

The other major driver of bond valuation is the macroeconomic environment. It influences yields through changes in short-term interest rates and inflation.

Short-Term Interest Rates

Let's begin with short-term interest rates. We will demonstrate the relationship between U.S. government bond yields and the yields on other bonds by visualizing a hypothetical bond—an imaginary, utopian ten-year government bond. Imagine that the debt issued by this utopian government is perceived to be just as safe as U.S. government debt, and that U.S. government bonds are currently yielding 4%. The bar chart illustrates the chronological repayments on the utopian bond. Since utopian government bonds carry no credit risk, their yield should match that of U.S. government bonds. The price that equates the yield of the utopian bond to 4% is $1.

Now imagine that the Federal Reserve in the United States cuts short-term interest rates. As a result, the yield on the ten-year U.S. government bond decreases from 4% to 3%.

Since both the utopian bond and the U.S. government bond have the same risk profile, they should, in theory, offer the same yield. As a result, the price of the utopian bond would quickly rise to bring its yield in

line with that of the U.S. government bond. Specifically, its price would rally from $1,000 to approximately $1,222 in order to reduce the yield from 4% to 3%.

Now suppose the Federal Reserve in the United States raises short-term interest rates, causing the yield on the ten-year U.S. government bond to rise from 3% to 5%.

Of course, investors would choose the higher-yielding U.S. government bond. As a result, they would sell the utopian bond until its yield rose to match the new 5% benchmark. This selling pressure would reduce the price of the utopian government bond from $122.50 to approximately $108.

What's going on here? Think about what happens when you buy a book online. You go to `Amazon.com` and find the book you want. You are then presented with two options: buy a copy directly from Amazon for $17.95, or purchase it from another vendor for $16.75. If both books are in the same condition, you would naturally choose the cheaper one. However, you might be willing to pay the small premium to buy directly from Amazon if you're concerned that the smaller vendor may not deliver the book reliably. If, on the other hand, Amazon offers the lower price, you wouldn't hesitate to buy from them. The reliability of ordering from Amazon forces other vendors to keep their prices competitive. When other vendors are priced below Amazon, the discount is usually modest. In this example, you could pick up the same new book for $1.20 less from the smaller vendor. This is because Amazon is such a dominant player in the book market that third-party vendors must constantly monitor whether their prices remain competitive. If they don't, their business would quickly dry up. Welcome to the world bond market. Amazon is the Federal Reserve. Books are bonds. Other vendors are other bond issuers. And book prices are yields. Because yields are simply the inverse of bond prices, this yield competition phenomenon is just price competition—masked by the jargon of the bond market.

Inflation

The other major macroeconomic factor that affects bond valuation is inflation. With a few exceptions, inflation has a corrosive effect on the price of fixed income instruments, including U.S. government bonds. Recall how Federal Reserve Chair Paul Volcker reduced inflation through a series of aggressive rate hikes. As shown in the chart from the currencies module, there has been a general correlation between inflation and U.S. government bond yields over the past 60 years. When inflation was high, yields were also high, as inflation eroded the real value of bond payments. Let's now demonstrate why this erosion occurs by once again visualizing an imaginary bond.

Let's examine the cash flows of a single ten-year bond. Even if the government repays the full amount of the promised fixed income, inflation—the silent enemy—will erode the purchasing power of both the coupon and principal payments. Suppose you expect no inflation at all and are therefore willing to pay $100 today for this stream of fixed income payments. In that case, the effective annual interest rate, or yield, would be 6.3%.

Now, imagine that inflation is running at 5% per year. This would erode the purchasing power of both the coupon payments and the principal repayment on the bond, with later repayments being more heavily affected due to the compounding effect of inflation over time. As a result, you would naturally be willing to pay less for the bond today. While the bond still returns $150 in nominal terms, the real purchasing power of those payments would feel more like $106 after accounting for inflation. Since yield is calculated by comparing the price you pay today to the total nominal cash you receive over time, this lower purchasing price—say, $80—implies that you are receiving the same cash flows for a lower upfront cost. In yield terms, this translates to a higher effective annual interest rate—specifically, 10.2%.

Now imagine that inflation were even higher—at 10% per year. This would make you even less willing to pay the same $150 in future repayments. In real terms, that $150 would feel like only $80 in purchasing power. If you were only willing to pay, say, $60 today for this stream of repayments, the yield would rise even further—to approximately 15.9%. Why? Because you would be paying significantly less for what appears to be the same nominal cash flows. It is for this reason that bond yields are referred to as *nominal* rather

than *real*. Yield calculations do not adjust for inflation; they reflect the return based on the nominal cash received, not its purchasing power.

We have just shown that inflation is bad news for bondholders or lenders, such as savers and insurance companies. On the flip side, borrowers tend to benefit from rising inflation. Imagine you have a 30-year fixed-rate mortgage requiring you to pay $1,000 per month for the next three decades. Now consider the impact of inflation: your employer would likely be compelled to increase your salary over time to keep up with the rising cost of living, while your $1,000 monthly mortgage payment would remain unchanged. In this case, the borrower benefits, as inflation effectively reduces the real burden of the mortgage debt. The monthly payments become less of a financial strain over time, assuming the borrower's income rises with inflation. In a deflationary or low-inflation environment, however, the real value of bond payments is not eroded, and lenders are content. Meanwhile, the debt burden on borrowers, such as homeowners, feels heavier, as it is not "inflated away." It's no surprise, then, that governments—almost all of which are borrowers—tend not to mind a little inflation.

Fixed Income: Central Bankers and Interest Rates

Central Bank Mandates

Recall the Amazon analogy, where we demonstrated that good old-fashioned price competition links all bond deals to government bond yields. Now let's consider how governments set short-term bond yields in the first place. This is the mechanism through which they attempt to guide the economy toward slow and steady growth.

One of the primary goals of central banks in setting interest rates is to protect the currency from inflation and to shield the economy from the harmful effects of runaway inflation or deflation, as discussed in the currencies module. This is why the central banks of most advanced economies adopt a 2% inflation target, as we saw earlier. Let's turn to the story of *Goldilocks and the Three Bears*. Her goal was to eat porridge that was just the right temperature—not too hot and not too cold. Similarly, for central banks, the economic "porridge" is just right when inflation is subdued, providing a stable environment for businesses and consumers. The porridge is too hot when inflation is high, typically driven by excessive economic growth. The porridge is too cold when there is deflation, usually caused by a lack of economic growth.

Inflation

Central banks are especially fearful of the porridge getting too hot. Once inflation takes hold, it becomes difficult to control. This is largely because inflation is psychological—once expectations of rising prices become ingrained, they are hard to reverse. Let's demonstrate this vicious cycle in practice. Imagine that workers begin to expect steep increases in the prices of consumer goods. In response, they demand higher wages to maintain their purchasing power. This causes companies' wage expenses to rise sharply, prompting them to increase prices in order to protect their profit margins. As prices rise, workers anticipate even more inflation and demand further wage increases. This leads to even higher company costs and, in turn, more price hikes. And so the cycle continues.

The Cato Institute, a Washington, D.C.-based think tank, estimates that there have been 56 recorded episodes of runaway inflation. The most extreme cases are often driven by war. This makes intuitive sense—during wartime, governments frequently resort to printing money to finance armies and purchase weapons. For instance, during World War I, the major European powers spent approximately 50% of their GDP on the war effort. Meanwhile, shortages of basic goods such as food led to a situation where more money was chasing fewer goods. This dynamic is the essence of inflation. As shown in this table, major wars involving the United States have historically been accompanied by periods of high inflation.

If you thought those numbers were bad, consider Germany's experience shortly after World War I. At its peak, Germany suffered from 24,300% inflation per month. This means that a piece of candy costing two

cents at the start of January would cost approximately $4.88 by the end of the month. Even more extreme was Zimbabwe's hyperinflation in November 2008. According to some sources, inflation peaked at 89.7 sextillion percent—that is, 89,700 million million million percent. In practical terms, this meant that prices were multiplying every hour.

Every bond investor must understand how inflation can ravage bond markets. To explore this, let's examine inflation measures across a handful of advanced economies—namely the United States, France, Canada, and Japan. Inflation became a major issue in the 1970s, particularly after the 1971 collapse of the Bretton Woods agreement, which gave governments greater latitude to alter their currency exchange rates. Previously fixed exchange rates had helped to contain inflation, but their removal introduced greater volatility. Compounding the issue were the oil shocks of 1973 and 1979, which caused sharp spikes in oil prices. Since oil was a major input cost in the industrial economy, these shocks fueled broad-based inflation. As a result, bonds performed poorly from 1945 through the early 1980s. Ever since, wary bond investors have remained vigilant—closely monitoring for any signs of rising inflation.

Cautious bond investors can type `global economy` into the Bloomberg command line, select the `GEW` function, and review the latest inflation figures for dozens of countries in a single table. Recall that high inflation erodes the value of fixed income payments, which drives down bond prices and pushes yields higher.

Deflation

While hyperinflation is spectacular and damaging, central banks are equally fearful of the porridge getting too cold. As we saw in the currency module, deflation can also trigger a vicious cycle. When price declines become ingrained, consumers begin to defer purchases in anticipation of even lower prices. This leads to declining revenues for companies, which ultimately forces them to lay off workers. Since wages and salaries make up a significant portion of GDP, a shrinking workforce reduces overall demand. In response, companies lower prices further to maintain sales, reinforcing consumers' incentives to delay big-ticket purchases. This causes revenues to fall even more, prompting additional layoffs—and so the deflationary cycle continues.

Central Bank Decision Making

How do central bankers test the temperature of the porridge to detect emerging inflation or deflation risks? The main gauges they rely on are various inflation readings and the output gap, which measures the slackness or tightness in the economy. Let's begin with inflation measures.

Central banks closely monitor the inflation statistics discussed in the economic indicators module. There are three primary measures they focus on. First, the GDP deflator, which comes from the quarterly GDP report. Second, the Consumer Price Index (CPI), which is less accurate but reported more frequently on a monthly basis. Third—and the Federal Reserve's preferred gauge—is Core Personal Consumption Expenditures (Core PCE), which excludes the volatile prices of food and energy items, such as cereal and oil-based products.

But there's a catch—these datasets are historical. Relying on them is akin to steering a car while looking in the rearview mirror. Since central bankers aim to anticipate and prevent future problems, it would be far more useful if they could see the road ahead. Unfortunately, predicting future inflation rates is much harder than observing past ones. As we saw in the economic indicators module, one source of inflation expectations comes from investment bank analysts, who estimate future CPI figures for many countries. However, these estimates are only updated periodically, making it difficult to determine whether a recent change in inflation is just a temporary blip or the start of a longer-term trend. Wouldn't it be helpful if there were a more real-time source of inflation forecasts?

Fortunately, such a tool exists. Since 1997, the United States has offered an instrument known as Treasury Inflation-Protected Securities—*TIPS* for short. Recall that the prices of most fixed income instruments are eroded by inflation. TIPS are the exception. Instead of offering fixed nominal payments, TIPS compensate

the lender for inflation, using the Consumer Price Index (CPI) as a reference. By comparing the price of a TIPS bond with the price of a similar non-inflation-protected Treasury bond, investors can infer inflation expectations. The higher the expected inflation, the greater the demand for TIPS relative to regular bonds. As a result, the yield difference between the two bonds—known as the *breakeven inflation rate*—widens with rising inflation expectations.

If we type `inflation breakeven rates` into the Bloomberg command line, we can access the `ILBE` function, which allows us to estimate inflation expectations using the TIPS method. Let's examine long-term inflation expectations over the next 30 years by comparing two countries: Mexico and Italy. At the time the screen was captured, investors expected inflation in Mexico to average 4.51% per year over the following 30 years. In contrast, expectations for Italy were significantly lower—just 1.19% per year over the same period. While this may sound like a small difference, even modest variations in inflation expectations can compound over time and become highly corrosive to bond prices. It's no surprise, then, that bond investors remain vigilant and watch closely for any signs of inflation.

The Output Gap

The other main temperature gauge used by central bankers is the *output gap*, which measures the difference between an economy's potential output and its actual output. Economic tightness—when output is close to or above potential—frequently coincides with inflation. Conversely, slackness—when output falls below potential—often corresponds with deflation. Central banks rely on the output gap as a key indicator to detect emerging inflationary or deflationary pressures in the economy.

The white line represents the potential output of the U.S. economy, measured in billions of dollars. This metric is estimated by a government agency both historically and into the future. It reflects the level of goods and services that would be produced if the U.S. economy were operating at full capacity—making optimal use of labor and capital, with neither slackness nor overheating. The yellow line shows the actual output of the U.S. economy. The output gap is typically expressed as a ratio: the difference between actual output and potential output, divided by potential output. When the yellow line falls below the white line, there is a negative output gap. This indicates economic slack, and the central bank will be vigilant for signs of deflation. When the yellow line rises above the white line, there is a positive output gap. This reflects economic tightness, and the central bank will be on guard for inflationary pressures. A major negative output gap occurred in the aftermath of the 2008 global financial crisis, triggering widespread fears of deflation.

Once central bankers have pored over a wide range of inflation statistics, examined the output gap, and studied other relevant data sources, they must decide whether to cool the porridge, heat the porridge, or leave it unchanged.

Central Bank Toolkit

Once central bankers have made a decision, what tools do they have at their disposal? They can alter the money's supply in many ways. One way that we saw in the currencies module is to print vast amounts of money. We will focus on two tools that they commonly use, adjusting short term interest rates and making public statements about interest rate policy. Let's begin with short term interest rates.

Short-Term Interest Rates

Here we observe the short-term interest rates set by four of the most influential central banks: the Federal Reserve (U.S.), the Bank of England (U.K.), the European Central Bank (ECB), and the Bank of Japan. Short-term interest rates are one of the most powerful tools central banks use—particularly to address a positive output gap, which typically coincides with inflationary pressures. When short-term interest rates rise, depositing cash becomes more attractive relative to spending or investing. This discourages consumption and investment, thereby slowing economic growth and helping to contain inflation.

By pulling up the FOMC function, we can see that the Federal Open Market Committee meets eight times per year to set short-term interest rates. At any given point in the year, this screen displays the announced policy interest rates for meetings that have already occurred. For upcoming meetings, the corresponding rows remain blank. FOMC decisions are of tremendous importance to fixed income investors because, as we will see, they directly influence short-term government bond yields. If we bring up the main Bloomberg News headline feed by typing NH into the command line, we can clearly observe the significance of these decisions—evidenced by the torrent of headlines that accompany each of the eight Fed meetings. This level of attention is not surprising, especially when we revisit the Amazon analogy: government bond yields are akin to Amazon's book prices. Accordingly, pricing across the entire $101 trillion global bond market is influenced by the actions of the FOMC.

Let's examine how the manipulation of short-term interest rates by a central bank has, in the past, helped steer the economy back onto the right track. Recalling the output gap chart we viewed earlier, we can now overlay the federal funds rate—the short-term interest rate directly controlled by the Federal Reserve.

The output gap helps explain many of the Federal Reserve's rate decisions over recent decades. In the booming late 1980s, the economy was tight, and interest rates were raised. During the early 1990s recession, slack emerged in the economy, prompting the Fed to cut rates sharply. As the dot-com boom began in the late 1990s, the economy tightened once again, and rates were increased. Following the dot-com bust in 2002, economic slack returned, and rates were cut accordingly. In the mid-2000s real estate boom, the economy was running at full capacity, and the Fed responded with steep rate hikes. Then came the collapse of Lehman Brothers, and interest rates were cut to near zero. This unprecedented spell of near-zero rates was designed to help close the substantial output gap that followed the crisis. You now have a better sense of when and why the Federal Reserve adjusts short-term interest rates.

Statements

As expectations underpin all market prices, another powerful tool that central bankers have at their disposal is the ability to communicate their intentions regarding future interest rate moves. Simply discussing the timing or direction of a potential rate change can significantly impact bond yields. Any statement that deviates—however slightly—from market expectations can move yields immediately. Investors often go so far as to place a new Federal Reserve statement side-by-side with the previous one to identify even the smallest wording changes, as these can signal a shift in monetary policy.

If we type FOMC statements into the Bloomberg command line and select the FOMS function, we can access a comparison of successive FOMC statements, with the precise differences between them clearly highlighted.

Knowing this, the Federal Reserve Chair can use carefully crafted language to influence interest rates—just as Ben Bernanke did in 2013. To observe the impact, we can type ten year yield into the Bloomberg command line and select USGG 10YR, which brings up the Generic 10-Year U.S. Government Bond Yields. This function provides a long-term time series of 10-year yields. Next, we can graph the yield from the start of 2012 through the end of 2014 and reset the y-axis to begin at zero. In May 2013, Bernanke hinted that the Fed's program of purchasing bonds with central bank money might soon be reduced—a process known as tapering. This implied a decline in demand for Treasuries, which would lower their prices and push yields higher. Following his remarks, the yield on the 10-year U.S. government bond nearly doubled, rising from 1.6% to 3% over the subsequent four months.

Short-Term Interest Rate Estimates

Given the power of short-term interest rates to influence the yields on all bonds—as illustrated by the Amazon book price analogy—it would be incredibly useful to know what the market believes the Federal Open Market Committee (FOMC) will do next. Fortunately, federal funds futures provide exactly that insight. These instruments allow investors to observe market expectations for upcoming FOMC decisions regarding

interest rates.

The futures and options markets enable us to estimate the probability of specific future FOMC decisions. By typing `interest rate probability` into the Bloomberg command line and selecting the World Interest Rate Probability function (`WIRP`), we can view a list of upcoming FOMC meetings along with the market-implied probability of a rate hike, cut, or no change at each meeting. The accompanying chart illustrates how these probabilities have evolved over time for a given meeting. At the time the screen was captured—February 2, 2017—the federal funds target rate was set between 0.50% and 0.75%. The red line represented the probability of a rate cut at the next FOMC meeting on March 15, which the futures and options markets estimated at 0%. The white line showed a 68% probability of no rate change, while the blue line indicated a 32% probability of a rate hike. Together, these three probabilities added up to 100%.

Now let's examine the `WIRP` function on March 14, 2017—the day before the FOMC meeting. By this point, market participants were almost certain that the Federal Reserve would raise interest rates the following day. On this occasion, the market was correct: the Fed did indeed increase rates on March 15, 2017. At that time, the U.S. economy was emerging from recession, and the Federal Reserve was considered "in play," meaning it was actively adjusting monetary policy. Over the next two years, the economy remained relatively stable, supported by favorable geopolitical conditions. But what did a Fed announcement look like a few years later, following a change in leadership at the central bank?

Let's take a look at the `WIRP` function in the lead-up to the March 20, 2019, Federal Reserve announcement. First, consider the probabilities on February 5, 2019, which was one week after the previous FOMC meeting. At that point, the market assigned a 99% probability to no change in interest rates. Six weeks later, on the day before the announcement, the `WIRP` screen showed that the probability of no change had increased slightly to 99.2%. In other words, the market's expectations remained essentially unchanged. After the announcement, we can observe the updated FOMC rate on the platform. Even though the Fed left interest rates unchanged, it still issued a statement outlining its views and providing forward guidance on future monetary policy.

Fixed Income: The Yield Curve

Defining the Yield Curve

Now that we understand the factors that drive bond yields and how central banks set interest rates, we are ready to explore the yield curve—a visual representation of the cost of borrowing over different time horizons. To begin, let's bring up two Bloomberg screens side by side for comparison.

First, let's type `world bond markets` into the Bloomberg command line and select the `WB` function to view the yields on the most important government bonds. Next, we bring up the yield curve by typing `yield curve` and selecting the `GC` (Graph Curves) function. This displays the United States Government Yield Curve. The x-axis represents bond maturities, ranging from one month to thirty years. The y-axis represents the bond's yield—the annual interest rate an investor would earn by holding that bond to maturity. It is important to note that the x-axis of the yield curve does not represent the passage of time, but rather different bonds with varying maturities. This chart simply plots the yields on various U.S. government bonds at the same point in time.

At this point in time, the two Bloomberg screens show that two-year U.S. Treasury yields are 0.416%, five-year yields are 1.574%, ten-year yields are 2.402%, and thirty-year yields are 3.192%. The first observation from this data is that the yield curve is upward sloping—also referred to as having a positive slope. This means that shorter-maturity bonds, shown on the left of the curve, have significantly lower yields than longer-maturity bonds on the right. This upward slope reflects fundamental risk considerations. Long-term debt is more expensive for borrowers because it carries greater risk for lenders. Over a longer horizon, there is a higher probability that the borrower may default. Additionally, lenders are more exposed to the corrosive

effects of inflation, which can erode the real value of future interest and principal payments.

In addition, inflation becomes increasingly difficult to predict the further into the future one looks. To illustrate this, let's pull up the Economic Forecast function (`ECFC`) once more and examine the inflation forecast for the United States as of mid-2017. As shown, analysts estimated that inflation for 2017 would fall between 1.5% and 3.7%. For 2019, however, the forecast range was broader—ranging from a low of 1.8% to a high of 4.5%. Now imagine the uncertainty surrounding inflation over a 30-year horizon. It is no surprise, then, that 30-year bonds tend to offer higher yields than two-year bonds to compensate investors for this greater uncertainty.

Term Premium

The difference between the yield on longer-maturity bonds and shorter-maturity bonds is known as the *term premium*. It represents the extra yield that investors demand for holding longer-term bonds, which carry greater uncertainty and risk. On the screen shown, the ten-year to three-month term premium is 2.374 percentage points. This value is calculated as the yield on the ten-year U.S. Treasury bond minus the yield on the three-month Treasury bill.

Bond Yield Forecasts

As we saw in the Economic Indicators module, investors maintain economic forecasts using the `ECFC` function. In the Currencies module, we examined how analysts maintain currency pair forecasts using `FXFC`. Similarly, analysts also maintain estimates for bond yields. By typing `bond yield forecasts` into the Bloomberg command line and selecting the `BYFC` function, we can access these projections. Taking the United States as an example, the `BYFC` screen displays forecasted yields across the entire curve, including the Federal Funds target rate, three-month rates, two-year rates, five-year rates, ten-year rates, and thirty-year rates.

Ripple Effects of the Yield Curve

To newcomers in finance, the yield curve may appear obscure—but in reality, it is fundamental. The yield curve represents the cost of borrowing, and as such, it reverberates throughout financial markets and the global economy. We previously caught a glimpse of this through the Amazon analogy: when the Federal Reserve alters the left-hand end of the yield curve—short-term interest rates—it affects prices and yields across the entire $101 trillion bond market. Let's now examine how the yield curve impacts corporations, consumers, and the broader world economy. We begin with the corporate impact.

Corporate Impact

Almost all corporate investment projects span multiple years. As a result, they are typically financed through medium- or long-term borrowing to align the funding with the project duration. Lenders to corporations face many of the same risks as those lending to governments: rising short-term interest rates and rising inflation—both of which reduce the market value of outstanding bonds. However, lenders to companies also face an additional risk—the elevated probability that the company may default. This is because corporations are generally less creditworthy than sovereign governments. Consequently, corporate bonds usually offer higher yields than government bonds of the same maturity. This difference in yield is known as the *spread*. The spread measures how much more a business must pay to borrow money compared to the government.

Let's demonstrate what is meant by the term *spread*. We begin by pulling up the U.S. government yield curve—type `yield curve` into the Bloomberg command line and select the `GC` (Graph Curves) function. Next, we add the yield curve for breakfast cereal manufacturer Kellogg by typing `Kellogg` into the curve selector. Now let's examine the two curves more closely. The blue line represents the yield curve for Kellogg, which has many outstanding corporate bonds of varying maturities. The *spread* is simply the gap between the two curves at each maturity point. At the 30-year maturity, Kellogg's bond is trading at a yield of 5.0%, while the 30-year U.S. Treasury bond is trading at 3.2% at the same time. Therefore, the spread at the

30-year point is 1.8 percentage points—or 180 basis points—commonly referred to in the market as 180 *bips*.

Now let's observe what happens when the government yield curve shifts. We overlay both the current U.S. government yield curve and Kellogg's corporate yield curve with their respective curves from one year earlier. When we examine the spread between the government and corporate yield curves, we notice that although both curves rose significantly over the one-year period, the spread between them remained relatively constant.

Let's examine the yields at the 30-year maturity point on the right-hand side of the chart. In year one, the 30-year U.S. government bond yielded 3.0%. By year two, this had increased by 0.2 percentage points to 3.2%. In the same period, Kellogg's 30-year bond yield rose from 4.8% to 5.0%, also a 0.2 percentage point increase. The spread between the two yields was therefore 1.8 percentage points in year one and remained 1.8 percentage points in year two. This illustrates how government yield curves underpin the cost of borrowing for corporations. When the cost of borrowing for the government changes, corporate borrowing costs often change as well. And when companies borrow and initiate large-scale projects, the result is economic growth. In this way, the yield curve plays a direct role in influencing GDP growth by regulating the cost of corporate borrowing.

In this chart, the white line represents the yield on the U.S. government 10-year bond, while the orange line represents the overall yield on U.S. corporate debt. The x-axis shows the passage of time. The gap between the white and orange lines is known as the *corporate spread*. When the corporate spread increases, it is referred to as a *widening*, *cheapening*, *steepening*, or *underperforming* of corporate bonds. Conversely, when corporate spreads decrease, it is referred to as a *tightening*, *richening*, *flattening*, or *outperforming*.

Consumer Impact

We saw earlier the disproportionate importance that housing plays in the U.S. economy and in shaping consumer behavior. Most homebuyers in the United States take out 30-year fixed-rate mortgages, and these mortgages are typically priced off the yield on 10-year U.S. government bonds. To explore this relationship, let's pull up the 10-year U.S. government bond yield going back to the late 1990s. Next, we plot the effective interest rates on 30-year mortgages over the same period. The white line represents the yield on 10-year government bonds, while the orange line represents the prevailing interest rate on 30-year fixed-rate mortgages. The chart clearly reveals a consistent spread between the two, demonstrating how government bond yields influence the cost of long-term home loans. Because mortgage rates affect housing affordability, government bond yields influence the level of activity in the housing market. As we saw earlier, when people purchase homes, they typically spend heavily on goods such as furniture and home improvement materials—contributing to GDP growth. There is also a second-order effect: eventually, a surge in demand from new buyers may drive home prices upward, making existing homeowners feel wealthier. This perceived increase in wealth often leads to greater consumer spending on discretionary items like vacations and dining out. After all, why save for retirement when the value of your home is skyrocketing?

Global Impact

Trade is not the only force that causes the world's economies to move in the same direction—yield curves also play a significant role. If we plot the 10-year government bond yields of several advanced economies, we observe a strong correlation among them. The fact that government bond yields tend to move in sync implies that economic conditions across countries are often stimulated or depressed simultaneously. This synchronization amplifies the global transmission of monetary policy and financial conditions.

Fixed Income: Movements in the Yield Curve

The Yield Curve in Motion

U.S. government bond yields—and therefore bond prices—are primarily driven by short-term interest rates and inflation expectations. As we've seen, creditworthiness is largely a non-issue in the case of U.S. Trea-

suries. This means that investors can make profitable trades by accurately predicting the Federal Reserve's next policy moves and future inflation trends. With this understanding, let's now turn to the concept of the yield curve in motion.

Let's begin by examining how the central bank influences the left-hand side of the yield curve. Imagine the left-hand end of the yield curve as a jack and the right-hand end as a hot air balloon. The left-hand side is anchored by the Federal Reserve's short-term interest rate decisions. It moves directly in response to changes announced at FOMC meetings. When the Fed adjusts its policy rate, it effectively raises or lowers the jack—shifting the base of the curve.

Let's take a look at how the federal funds target rate has moved in tandem with the left-hand side of the yield curve over the 40 years since President Nixon ended the dollar's convertibility to gold. The chart shows the rate set by the FOMC throughout that period. The federal funds rate—the overnight interest rate—is effectively the yield on a bond with a 24-hour maturity. As we discussed earlier, short-term interest rates are a key tool that central bankers use to regulate the economic temperature—their metaphorical porridge. For example, in 1989, the Fed's target rate peaked at 9.7%, reflecting tight monetary policy aimed at cooling economic overheating.

If we now pull up the yield curve from 1989, we observe that the short-term yield was 9.7%—matching the federal funds target rate at that time. By 1993, the Federal Reserve had cut the target rate to 3%, and correspondingly, the short-term yield on the 1993 yield curve was also 3%. Following the financial crisis, the Fed reduced rates to near zero at the end of 2008. As expected, the yield curve from late 2008 shows that the short-term yield was close to 0%. This confirms what we now understand: the left-hand end of the yield curve is essentially determined by the federal funds target rate.

What about the right-hand end of the yield curve—the metaphorical hot air balloon? Unlike the left-hand end, this part of the curve is less straightforward, as there is no single driver of the 30-year yield. Instead, it is shaped by market beliefs about long-term economic fundamentals, including future interest rates, GDP growth expectations, demographic trends, borrowing demand, and the global supply of lending. Among these, one of the most powerful forces influencing long-term yields is entrenched inflation expectations. Since inflation is highly corrosive to bond values over long horizons, investors demand compensation for this risk. To summarize: the left-hand end of the yield curve is primarily determined by short-term interest rates, while the right-hand end is strongly influenced by long-term inflation expectations.

Predicting Yield Curve Movements

Predicting how the yield curve will move is aided by two key indicators. As we saw earlier, Bloomberg provides tools to view market expectations for both short-term interest rates and inflation. The `WIRP` function shows implied forecasts for future Federal Reserve policy decisions, helping to anticipate movements on the left-hand side of the yield curve. The `ILBE` function, on the other hand, reveals market-based inflation expectations, offering insight into the right-hand side of the curve. When you step back, forecasting both ends of the yield curve essentially comes down to predicting its gradient—that is, the slope of the curve from short to long maturities.

Let's decipher what the gradient of the yield curve reveals about the bets and beliefs of bond investors. Bond traders seek to profit by anticipating macroeconomic trends and central bank actions. They tend to sell bonds in anticipation of rising inflation and interest rate hikes, and they buy bonds when expecting declines in inflation and future rate cuts. For example, if interest rates are currently low and inflation expectations suddenly increase, the yield curve will steepen. In this sense, the yield curve functions as a massive, real-time economic indicator—albeit more complex to interpret than straightforward gauges like the Purchasing Managers' Index (PMI). The collective bets being placed on interest rates and inflation become evident when the yield curve adopts a clearly steep, flat, or inverted shape. To explore this further, let's examine the shape of the yield curve from the period surrounding the 2003 Iraq War through to the 2008 financial crisis—starting with September 30, 2003, shortly after the beginning of military action in Iraq.

Steep Yield Curve

When investors anticipate an economic boom, inflation expectations tend to rise, and bond investors begin to expect increases in short-term interest rates. However, recall that the shortest-term interest rates are effectively tethered to the federal funds target rate—depicted earlier using the jack metaphor. These short-term rates only move when the Federal Reserve actually changes its policy rate. In contrast, the long end of the yield curve—represented by the hot air balloon—is shaped by the free market. Long-term bond yields are determined by unconstrained bond trading, which allows investors to express their views about the future path of interest rates and inflation. As a result, the long end of the curve often moves in advance of the Fed's actions. The short end is anchored in the present by policy decisions, while the long end reflects the market's forward-looking expectations.

This yield curve is from late 2003, a period during which the U.S. economy was recovering from the dot-com bust and consumers appeared largely unconcerned by the ongoing Iraq War. Bond investors, however, anticipated that the Federal Reserve might soon need to raise short-term interest rates to keep inflation in check. Expecting these rate hikes, new investors were reluctant to buy bonds that could lose value as rates rose. As a result, bond investors demanded higher yields on long-term bonds, causing the long end of the yield curve to rise. Meanwhile, short-term rates remained low, as the Fed had not yet acted—keeping the short end anchored. The result was a very steep yield curve, a classic signal of an accelerating economy.

Flat Yield Curve

By 2006, the U.S. economy had gained significant momentum, and property prices were soaring. As expected, Federal Reserve Chair Ben Bernanke raised short-term interest rates, causing the "jack" on the left-hand side of the yield curve to rise. With economic conditions strong and short-term rates relatively high, many bond investors began to position themselves for a potential slowdown. They anticipated that the Fed would eventually cut rates to stimulate the economy. Since bond prices rise when yields fall, investors sought to lock in gains by aggressively purchasing long-term bonds in advance of the expected rate cuts. This surge in demand for long-term bonds pushed down yields at the far end of the curve, offsetting the natural upward slope of the yield curve—and resulting in a flat yield curve.

Inverted Yield Curve

As fears of an economic downturn mounted throughout 2006, Federal Reserve Chair Ben Bernanke halted further interest rate hikes. Bond investors, free to express their views on what the Fed might do next, began betting that rate cuts were imminent. As a result, they purchased medium- and long-term bonds, which tend to benefit most when interest rates fall. This wave of demand for longer-duration bonds led to an inversion of the yield curve by the end of 2006—widely regarded as a financial omen. Under normal conditions, the yield curve slopes upward to reflect inflation expectations and term risk. An inverted yield curve, by contrast, signals that investors are largely unconcerned with inflation and are aggressively buying long-term bonds in anticipation of monetary easing. At the time, the short end of the curve remained elevated—trapped above 5%—as it reflected the Fed's most recent rate levels. The divergence between short-term and long-term yields created the inversion.

In this instance, the bond investors who had aggressively purchased long-term bonds were exactly right. Shortly thereafter, Federal Reserve Chair Ben Bernanke began cutting U.S. short-term interest rates—from 5.25% in the summer of 2007 all the way down to 0.25% by December 2008—as the financial crisis unfolded. The phrase "credit crunch" entered the public vocabulary in mid-2007, nearly six months after bond investors had already inverted the yield curve. What began as a credit crunch escalated into a full-scale crash in October 2008 and eventually culminated in the Great Recession of 2009. The bond market's dark forecast, we now know, had been issued back at the end of 2006—long before the crisis fully emerged in the headlines.

The Yield Curve as an Economic Indicator

Yield curve inversion is an incredibly telling signal. It serves as a powerful economic indicator in its own right—often warning of "icebergs ahead" in the economy. However, it is also a subtle and complex signal, one that requires a solid understanding of fixed income markets before it can be properly interpreted.

You can spot economic "icebergs" yourself by monitoring the term premium—the difference between the yield on 10-year U.S. government bonds and the yield on 3-month Treasury bills. When the term premium turns negative, it indicates that the yield curve is inverted. As of mid-2017, the U.S. yield curve had inverted seven times since 1970. Each inversion served as a warning sign that bond investors expected a significant slowdown in the economy.

If we overlay real GDP growth with the historical U.S. yield curve, we observe that the economy experienced six pronounced downturns since 1970—and each was preceded by a yield curve inversion. These downturns include the first oil crisis in the early 1970s, the second oil crisis in the late 1970s, the early 1980s recession, the early 1990s recession, the early 2000s dot-com bust, and the late 2000s Great Recession. It is worth noting that the yield curve inversion in 1998 was the only false positive during this period. It was triggered by the Russian government's debt default; however, the impact on global financial markets was cushioned by the momentum of the dot-com boom. Six out of seven times, yield curve inversion correctly anticipated a recession. So pay close attention the next time the U.S. yield curve inverts.

The `GC3D` function is an extension of the `GC` (Graph Curves) function, with a third axis—time—added. This enhancement enables users to visualize how the yield curve has steepened or flattened over a given time horizon. In this example, we have selected the U.S. government yield curve over a four-year period. The resulting 3D plot displays the x-axis as bond maturity, the y-axis as yield, and the newly introduced z-axis as time. The colorful surface that spans the chart represents the shape and movement of the yield curve across this timeframe. Through this lens, changes in the curve's steepness or flatness become visually apparent. Portions of the curve with red peaks indicate periods of steepening, while the green valley visible in mid-2016 reflects widespread deflationary fears at that time. Portfolio managers routinely monitor the `GC3D` function to ensure they are not caught off guard by significant curve movements—especially yield curve inversions.

Conclusion

To sum up, here are the five key takeaways from this module on fixed income: First, increased government spending and borrowing have fueled the growth of the fixed income market. Most governments run fiscal deficits and are therefore dependent on the bond market to finance their activities. Second, poor creditworthiness, high inflation, and rising interest rates all drive bond prices lower and bond yields higher. Among these, inflation is considered public enemy number one by bond investors, as it erodes the value of fixed repayment streams. Third, central banks manage expectations about interest rates to avoid the destructive cycles of inflation and deflation. Their goal is to maintain price stability and sustainable growth. Fourth, by setting short-term interest rates, central banks influence the cost of borrowing for governments, businesses, and consumers through their effect on the yield curve. Fifth, the yield curve's shape reflects both present-day policy and future expectations. The left-hand end is anchored by the central bank's current interest rate, while the right-hand end is determined by investor beliefs about the long-term economic outlook. The slope of the yield curve thus reveals the direction in which the central bank is trying to steer the economy. From an early age, we understand that being in debt carries risk. The bond market is simply a global marketplace for borrowing and lending. Ironically, there is nothing truly "fixed" about fixed income. As U.S. statesman Benjamin Franklin once remarked, *"Time is money."* The yield curve simply puts a price tag on the time value of money.