Macroeconomics: an Introduction

Chapter 3

Savings and Investment

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Preview

We learned in Chapter 2 that the total of all investment expenditures in the economy must equal total savings. But how do dollars saved become dollars invested in new plant and equipment? How do firms that want to build new buildings or buy new equipment get together with savers so that a portion of the output of the economy is diverted from the production of consumption goods to capital goods? We find there is a whole industry, financial intermediaries, that specialize in bringing together savers and investors. They assist in the conversion of savings to claims on the firms that use the savings for investment. Those take the form of stocks and bonds. The interest rate emerges as the key price in the markets for these financial instruments. In this chapter you will learn how to find out what the interest rate is and how it is determined by the price of a bond. You will find out how to interpret the relationship between the interest rate on a short term bond and a long term bond and what the yield curve means. The stock market is a major channel between household savings and investment, and very much in the news these days. We will also investigate mutual funds, financial intermediaries which bring stocks and bonds to the small investor. Let's starts by seeing what happens when an airline wants to buy a new Boeing 777.

3.1 The Role of Financial Intermediaries

Imagine that you are the president of Blue Skies Airlines, Inc. and you have decided that Blue Skies should buy a new Boeing 777. The plane will cost $125 million and change. There is one small problem though. Blue Skies only has a few million dollars in its bank account, and those funds are needed to pay fuel bills and the salaries of its employees. How can Blue Skies get enough money to buy this new airplane? It can by

tapping into the savings flows of the economy, and this chapter explains how that actually happens.

Blue Skies Airlines might approach the First National Bank and ask for a loan of $125 million. If First National agrees to make the loan, it will require Blue Skies to sign a contract agreeing to certain conditions. These would include, of course, repayment of the $125 million, called the **principal**, according to a specified time schedule. In addition, the bank would receive periodic interest payments. The **interest** to be paid is expressed as a percentage of the unpaid principal, and that percentage is called the interest rate on the loan.

Blue Skies would also be required to pledge the 777 as collateral, giving the bank the right to take possession of the plane if Blue Skies fails to make interest and principal payments on time. If that happens, Blue Skies is said to default on the loan, and the bank can go to court to enforce its contractual rights, repossessing the aircraft if necessary.

Suppose now that the interest rate on this loan is 10% per year. That means that Blue Skies will pay the bank $12,500,000 in interest the first year (assuming it does not repay any principal during the first year). Why would Blue Skies be willing to pay the bank that much money just so that it can own a new 777? Blue Skies expects to make back the interest cost and more through lower operating costs and more ticket sales. Before making the loan, the First National Bank will study Blue Skies' estimates of cost savings and ticket sales and it will not approve the loan unless it is convinced that the new plane will more than pay for itself. Banks make money by collecting interest on loans, not by owning repossessed airplanes.

But how did the bank get the $125 million to lend to Blue Skies? It borrowed it in much smaller amounts from households in the form of bank deposits. When a household deposits money in a bank account, it is making a loan to the bank. The depositor receives in return a combination of banking services, such as check cashing and access to automatic teller machines, and interest payments. The bank is willing to incur these costs because it lends the money to Blue Skies at a sufficiently high rate of interest to cover its interest payments to depositors and its administrative expenses and still make a profit.

Services That Banks Provide to Savers and Borrowers

Why don't Blue Skies and the households get together and cut the bank out of the deal, sharing the difference between the interest rate that the bank charges Blue Skies and the much lower interest rate that it pays its depositors? They don't because there are valuable services that the bank renders to both borrowers and savers. What are these services?

First, the borrower, Blue Skies, avoids dealing with thousands of different parties and having to negotiate separate loan contracts with each of them. Thus, Blue Skies' transactions costs are reduced by borrowing through the bank. Household savers also enjoy *lower*

transactions costs by using their local bank branch where deposits can be made and withdrawn very quickly without negotiation. The bank performs a retailing function for savings just as the neighborhood supermarket does for food. The bank also offers the household saver three other services: *lower information costs*, *liquidity*, and *diversification*. Let's look at these in turn.

Information about Blue Skies is costly for an individual saver to acquire. Has Blue Skies met its financial obligations in the past? Does the decision to buy another 777 appear to be a sound one? Banks specialize in collecting and analyzing information about borrowers, and certain banks will specialize further is making loans to airlines. It makes sense for savers to let specialists worry about evaluating the risk that Blue Skies might not pay its debts. On the other hand, it is easy for the saver to obtain information about the bank; for example, is it covered by deposit insurance? By dealing with the bank instead of Blue Skies the saver enjoys lower information costs.

Liquidity is the degree to which something of value can be turned into money on short notice and at low cost. A checking account is very liquid because it can be turned into money by simply writing a check or visiting a cash machine. Other deposits, such as certificates of deposit, are less liquid but pay a higher rate of interest. In contrast, the loan to Blue Skies is very *illiquid* since the airline has no obligation to make payments earlier than specified by the contract. But the bank has many such loans on which it is collecting payments, so it can offer liquidity to each of its depositors while making illiquid loans. Banks convert illiquid assets, such a the loan to Blue Skies, into liquid assets for their depositors. Providing this service has some risks, as we see below when we discuss the history of Savings and Loans, but depositors are willing to pay the bank for this valuable service.

Diversification means spreading risk by participation in a basket of investments, and in this case it results from the participation of each depositor in all of the loans that the bank holds, so that failure of any one lender to repay has only a fractional impact on individual depositors. In addition, deposits in US banks are insured by the Federal Deposit Insurance Corporation (FDIC), and banks are subject to regulatory oversight by government agencies. By accepting ultimate responsibility for the obligations of banks to their depositors, the government sector diversifies these risks across the economy. *We have seen the dramatic realization of this in 2008 with the rescue of major banks costing hundreds of billions of dollars!*

Major Types of Financial Intermediaries

Instead of borrowing from a bank, Blue Skies might borrow instead from an insurance company or a pension fund. These are different from banks but are also financial **intermediaries**, firms which pool the savings of households and invest them in other firms. While all financial

intermediaries provide the four fundamental services to households in some degree, each type offers a particular mix of these. Each also combines them with other services which distinguish it. Let's take a brief look at the major types of financial intermediary, in addition to banks, which are important in the U.S. economy today.

Life insurance companies offer savings plans which protect against the possibility that the saver may not live long enough to meet an objective such as putting their children through college. Because life insurance policies typically remain in force for many years, insurance companies do not need to hold highly liquid assets so they can make long-term loans to finance office buildings, airplanes, and ships. The expertise of insurance companies in this type of lending could not be duplicated by an individual, and they hold a diversified portfolio of such loans. Life insurance policies also enjoy tax benefits.

Pension funds accumulate the contributions employers and employees make to retirement plans. Generally, the contributions to such plans are not subject to federal income tax until they are withdrawn, and the income from these savings accumulate tax free as well. Their sheer size, professional management, and long time horizon make it possible for pension funds to engage in highly sophisticated investment strategies that would not be available to the individual employee. Assets of pension funds have grown rapidly in recent decades with the popularity of "defined contribution plans" in which the employee has ownership of funds accumulated in their name. In contrast, the older "defined benefit plans" promised only to pay a specified benefit, usually a fraction of salary at retirement based on years of service.

Mutual funds pool together the savings of many individuals and invest in stocks and bonds. Mutual funds offer low transaction costs, because the saver is making one investment instead of many, and low information costs, because it is easier for savers to get information on one mutual fund than on hundreds of individual stocks and bonds. Mutual fund shares are also extremely liquid. Most mutual funds are "open-end" funds that stand ready to redeem existing shares and sell new ones every day at net asset value, the market value of the fund's portfolio divided by the number of shares. This is possible because mutual funds are permitted to invest only in marketable securities, stocks and bonds for which a market price can readily be determined from recent transactions. Mutual funds also provide a high degree of diversification because they invest in a large number of different securities, often hundreds. However, mutual funds still carry risk since there is a tendency for stocks to fall or rise together. Likewise, bonds tend to all rise or fall in value at the same time, for reasons we will discuss later in this chapter. Thus, a mutual fund cannot eliminate the common "market factor" by diversification.

Mutual funds developed in the 1930s as a way for the individual investor to own part of a large, diversified, and professionally managed

portfolio of stocks and bonds. Over time, the mutual fund industry has developed a staggering array of different types of mutual funds. Some funds invest in a mix of bonds and stocks, others only in stocks of small firms, or stocks of firms in only one industry, or stocks of foreign firms, or only in tax-exempt bonds issued by local governments in one state!

One of the newest and fastest growing financial products is the **variable annuity** which combines features of life insurance, a pension fund, and a mutual fund. The customer chooses from a menu of mutual funds, and the investment earnings are untaxed as long as they remain in the plan. At some date in the future, the accumulated sum is used to purchase an annuity, a stream of payments that continue for life, generally at retirement. The size of the future annuity will depend on the investment results of the mutual fund chosen, so there is risk just as there is in any mutual fund investment. A feature of many plans is a minimum guaranteed payment, regardless of investment results, and that insurance is part of what the customer pays for. There is typically also a death benefit, another insurance feature.

What all financial intermediaries have in common is that they serve as a conduit for the flow of household savings to investment in new capital.

Though the idea of stocks and bonds will be familiar to most readers, we now move on to discuss just what is meant by "stock" and "bond", how we can locate and interpret information about them, and what determines their market value.

Exercises 3.1

A. Explain briefly the role of financial intermediaries in the economy. What are the four fundamental services provided by financial intermediaries that make using them attractive to household savers? Give specific examples of these services in the case of mutual funds.

B. Give several examples of firms in your area that are financial intermediaries. What are the services they offer to savers and borrowers?

C. Find the mutual funds table in the Friday issue of the Wall Street Journal or similar source. What are some of the types of securities that funds invest in? Identify some of the largest "families" of funds. Which types of funds have had the highest and lowest return over the past year?

D. Why would the way that open-end mutual funds operate make it infeasible for them to invest in office buildings and hotels?

E. What features of life insurance, a pensions fund, and a mutual fund are combined in a variable annuity?

3.2 The Stock Market

When you mention the word "investment" most people think of Wall Street and the stock market, not capital investment in new plant and equipment by firms. These are two distinct uses of the same word. When

someone buys 100 shares of Nike Corporation they are making a financial investment. When Nike Corp. builds a new factory or warehouse, it is making a capital investment. We need to be careful not to confuse financial investment by savers with capital investment by firms, although the two kinds of investment are closely related. Both of these “investments” are part of the process of turning household savings into the production and purchase of new capital goods. Both involve taking a risk now in the hopes of earning a larger return later. To develop the concepts of financial investment, let's continue our example of Blue Skies' purchase of a new Boeing 777.

Wall Street

Instead of borrowing from a financial intermediary, Blue Skies could instead raise the money to buy that 777 by selling additional shares in the company. The ownership of a corporation is divided up into equal parts called shares, rather like pieces of a pie. Each share has one vote in the election of the directors who govern the corporation and hire its management. The collective term for shares is "stock." The value of a corporation's shares is established in the stock market which has its center on Wall Street in New York City.

The New York Stock Exchange (NYSE) is located in a very large room, known as the floor of the stock exchange, where the shares of major corporations are traded. The purchase or sale of stock is handled through brokerage firms which act as agents for buyers and sellers. When Jane Johnson places an order with her stock broker to buy 100 shares of Blue Skies, it is transmitted to the broker's representative on the floor of the NYSE. That person takes it to the “specialist” whose responsibility is to make an orderly market in that stock. The specialist tries to match her buy order with a corresponding sell order. The price is where the supply of shares just equals the demand. Each trade is recorded and displayed on the “ticker tape” which is displayed on the wall and on computer monitors and television sets around the world. This “transparency” of the exchange give investors confidence in the integrity of the trading process and the validity of prices. Tourists can watch the action on the floor from the visitors’ gallery. A visit to the NYSE is highly recommended; watching brokers and clerks dashing around the floor in seeming chaos is an experience you will not likely forget. In spite of the apparent disorder, many billions of dollars worth of stock change ownership every day without a hitch.

Shares of smaller corporations have long been traded “over the counter” among brokers in an informal market of “unlisted” stocks. This became what we now call NASDAQ, an electronic market in which offers to buy or sell are displayed on monitors on brokers’ desks, with trades being relayed at light speed over the network. Prices are collected and trades are displayed in ticket tape fashion on screens around the world. Some of the largest corporations do not list on the NYSE, preferring to

have their shares traded on NSDAQ. Examples include Intel, Microsoft, and Apple Computer. With the rapid development of electronic communication, the trading in this market has become highly efficient and transparent. Indeed, electronic trading has started to replace the face-to-face trading of the NYSE and smaller transactions are now largely automated.

Financial markets in the U.S. are regulated by the Securities and Exchange Commission, an agency of the federal government which is much in the news these days. The SEC was established during the Great Depression of the 1930's to curb abuses that many felt contributed to the stock market crash of 1929, practices such as trading by insiders on the basis of privileged information. The Securities Act of 1933 requires that any corporation planning to issue stocks or bonds in interstate commerce file detailed statements with the SEC, which become a matter of public record, and publish a prospectus. Issuers of securities are then required to furnish periodic reports to the SEC and their shareholders disclosing financial results. The guiding principal of SEC regulation is "full disclosure." It is not up to the SEC to guarantee that investments will turn out well, only to insure that investors receive full and accurate information that enables them to assess risks and opportunities. Failure is not a crime, nor is getting rich a crime. But it is a crime to lie to the investing public and it is the responsibility of the SEC to ensure that people do not get by with it.

We are hearing a lot about the SEC these days in the wake of the collapse of major financial institutions in 2008. It seems clear that a wide-ranging review of the powers and effectiveness of the SEC will be forthcoming from Congress, and we may well see the first major overhaul of Wall Street regulation since the 1930s.

To get a feeling for the intensity of activity in the stock market, tune in any of the financial news networks offered by CNN, Fox, or CNBC, and visit some of the web sites that carry market news such as

http://www.cnnfn.com/

http://www.bloomberg.com/

(Mr. Bloomberg is also Mayor of New York City.)

Investment Banking

If shares in Blue Skies are trading at $10 per share on the New York Stock Exchange, then Blue Skies could expect to raise $125 million by selling another 12,500,000 shares. The new shares would be sold through an investment bank which will contract with Blue Skies to purchase all of the new shares at a negotiated price. The investment bank, which is sometimes called an underwriter, will in turn sell those shares to perhaps thousands of different investors, some of whom will be individual households and some of whom will be financial intermediaries.

Not surprisingly, the investment bank is often also a brokerage firm since brokers have n established relationships with potential buyers of stock.

Under the Glass-Steagall Act of 1933 commercial banks, those that take in deposits and make loans, were prohibited from engaging in investment banking in the U.S. The separation of underwriting from ordinary banking was intended to insulate banks, many of which failed during the Depression that followed the stock market crash of 1929, from riskier investment activities. In the 1990's banks were allowed to enter areas of the investment business previously closed to them, as regulators loosened interpretation of the law. Finally Congress, perhaps swept up in the stock market euphoria at the end of the 1990's, repealed Glass-Steagall. With large brokerage firms offering checking to their clients, and banks selling mutual funds in their lobbies, the gulf between banks and investment banking has almost entirely disappeared.

The evolution of investment banking took a dramatic turn in 2008 with the failure of two of the largest investment banks when they were unable to cope with effects of the end of the long-running boom in housing. As the market value of houses fell, the value of collateral underlying mortgages became questionable and investments of these firms became illiquid. Surviving investment banks underwent conversion to commercial banks in order to get access to government funding. This ends the era of independent and free-wheeling investment banking, at least for the foreseeable future.

What Does the Shareholder Get?

What does the buyer of Blue Skies stock get for that $10 per share? The investor gets the legal right to cast one vote per share in the election of directors, and each share participates equally in the future profits of the firm. Stocks offer savers a way of participating in both the rewards and risks of the ownership of firms. If Blue Skies prospers with the help of its new more efficient aircraft, then its profits will soar and the directors will declare a higher dividend payment to shareholders. But if Blue Skies does not prosper for whatever reason, the shareholders may receive smaller dividends, or none at all.

Stocks are quite liquid, since you can sell your shares in Blue Skies at any time for the market price and get your cash in a several days. However, they are risky because the market price can fluctuate. The market price is determined in the stock market and will reflect what investors, as a group, think the future of the firm is worth. When new information is disclosed that affects the firm, the market will react by adjusting the share price up or down accordingly. For example, if you buy Blue Skies stock today and next week the price of jet fuel doubles because of political upheaval in the Middle East, those shares will fall in value because investors fear that higher fuel costs mean smaller profits and therefore smaller dividends in the future.

By owning shares in many types of companies across different industries an investor can mitigate risk through diversification. For example, an oil company would benefit from higher fuel prices, so an investor in Blue Skies can hedge the risk of higher fuel prices by also holding shares of an oil producer. However, the cost of getting information on many different stocks and the broker's fees on small amounts of stock mean that diversification is costly for small investors.

Mutual Funds

As explained in our discussion of financial intermediaries, a mutual fund is a firm that owns the stocks and bonds of other firms. A fund which invests almost entirely in stocks is sometimes called a "stock fund" or "equity fund." Other mutual funds invest primarily in corporate bonds or government bonds ("bond funds"), or a blend of stocks and bonds ("balanced funds"), depending on a fund's stated investment policy. But stock fund is what most people have in mind when they talk about mutual funds. Each share of a fund owns a small fraction of all the stocks that the fund has invested in, thus providing diversification. If the fund holds many stocks across many industries, the degree of diversification may be to the point where buying the fund is like "buying the market."

Mutual funds are an excellent way for new investors to get started in the stock market, but it is important to understand that there is risk not present in a bank deposit which is an obligation of the bank. In contrast, a mutual fund makes no promise of a specific interest payment or of gains from owning stocks or bonds. The price of the shares is "marked to market" at the close of trading every day, and as the market value of the stocks or bonds it holds fluctuates, any gains or losses are immediately reflected in the value of the fund shares. Thus, shareholders in a mutual fund are fully exposed to all the risk of stock market fluctuations.

Hedge Funds

The last two decades has seen the emergence of a new class of investment firms which are in the eye of the financial storm overtaking Wall Street in 2008. These are **hedge funds** which are investment partnerships not subject to the same rules as mutual funds. By limiting participation to a small number of investors both means and experience, they are exempt from regulations designed to protect the small investor. This allows hedge funds to employ investment strategies that mutual funds are not allowed to use, such as borrowing to achieve 'leverage' and selling borrowed stock in a 'short sale' to benefit from a subsequent decline in its price, as well as the use of 'derivatives' such as options that pay if a stock or other asset moves in price in one direction or the other. They can bet on moves in commodities such as oil and since they are not required to mark-to-market or redeem shares on a daily basis they can hold illiquid assets such as real estate. In short, they can do pretty much

anything an individual can do with their own money, but they do so with a pool of funds drawn from a group of wealthy investors. These 'investors' can be institutions such as college endowments and charities. Indeed, participation in hedge funds was credited with much of the growth in endowments at the wealthiest private universities in the last decade.

In 2008 many hedge funds closed their doors as bets on the direction of stocks and bonds and faith in continued rise in house prices undermined strategies based on investing in 'subprime' mortgages. Leverage has proved to be a two-edged sword, causing catastrophic loss when loans must be repaid from a shrunken pool of capital. Hedge funds are likely to undergo scrutiny, not only for the losses suffered by their investors but also because of the suspicion that they contributed to the heavy losses by imprudent risk-taking.

Exercises 3.2

A. Economics.com, an internet company providing forecasts of the economy, has just 'invested' in a new server, while at the same time you have just 'invested' in 100 shares of the company. Discuss how these two investments are different and how they are related.

B. What do we mean by transparency in financial markets? How has the development of the internet made stock trading more transparent?

C. What used to prevent your bank from selling you 100 shares of Apple Computer, and what has changed? Why did this restriction exist? Was it a good idea, in your opinion, to allow banks to become stock brokers?

D. For most of its history Microsoft Corp. never paid a dividend to its shareholders, yet the total market value of its stock was ultimately greater than that of any other corporation on earth. What motivation do people have for buying this stock if it pays no dividends?

E. Identify a story in the news about a major corporation and then check the stock market table to see how the price of the stock reacted to the news. Discuss briefly whether the response of the stock market to this news makes sense. In thinking about your answer, try to determine whether this piece of news had been widely anticipated or came as a surprise.

F. There are far more mutual funds than there are individual stocks in those funds! Can you guess at why this is the case?

3.3 The Anatomy of a Bond

We have already mentioned bonds, and that they are marketable securities that are purchased by financial intermediaries like mutual funds and pension funds as well as by individuals. We are all aware of U.S. Government bonds, but we also know that you cannot buy stock in Uncle Sam! Clearly, bonds must be different from stocks, though both

are investments. Now let's be specific about what a bond is and how the bond market works.

What is a Bond?

A bond is a contract between the issuer of the bond and the owner of the bond. The issuer promises to pay the stated face value of the bond at a specified date in the future called the maturity date. The issuer also promises to make periodic coupon payments until maturity. Upon payment of the face value at maturity, a bond ceases to exist. Thus, a bond is fully described by its issuer, coupon, and maturity date. It is unnecessary to specify the face value of a bond because, by tradition, the price of a bond is always quoted per $100 of face value.

For example, if someone says that they bought the "Safeway 10s of '11 at 109" they mean that they bought the bond issued by the Safeway Corp. that pays a coupon of $10 per year and matures in 2011, and they paid $109 per $100 of face value for it. That bond would actually be available only in units of $1,000 face value, so one bond would cost the buyer $1,090. Some bonds are "callable" at the discretion of issuer at an earlier date than the maturity date. It is important when buying bonds to find out if the bond is callable or has special features that may affect its value (for example, "convertible" bonds may be exchanged for stock under certain conditions).

Notice that the market price of the Safeway bond in this example is more than its face value, $109 vs. $100. What determines the price of a bond? Supply and demand, of course! Bonds are supplied both by issuers such as the Safeway Corp. and by investors who already own bonds but wish to sell. Bonds are in demand from investors including both individuals and financial intermediaries. Buyers and sellers interact in the market place, bidding prices up or down until the quantity of bonds supplied equals the quantity demanded. The Safeway bond trades at $109 because investors are willing to pay that much for Safeway's promise to pay $10 each year until 2001 and then repay the principal or face value of $100. Note that there is no necessary equality between face value and market price.

A bond combines some of the characteristics of a loan with some of those of a stock. Like a loan, a bond is a promise by the borrower to make payments at specified dates in the future. However, the issuer promises to pay whomever owns the bond rather than a specific lender. Bonds, like stocks, are bought and sold at prices determined in the marketplace. As mentioned in the previous section, stocks and bonds together make up the class of marketable securities. When a bond is sold by one investor to another, the new owner then is entitled to all payments promised under the terms of the bond.

What if the Issuer Fails to Pay?

If the issuer fails to pay the coupon or principal on time, then the bonds are declared in default and the bondholders may take legal action against the issuer through a trustee who is appointed to represent them. A firm that goes into default may be liquidated (disbanded and its assets sold) under bankruptcy law, and the rights of the bondholders to receive a share of the proceeds will be considered by the court along with the rights of other creditors. While bondholders are entitled to be paid before stockholders, both are vulnerable if the firm fails. The possibility of default is referred to as credit risk. There is never an absolute guarantee that the bondholders will receive what they were promised when the bonds were issued. It is therefor important for investors to consider credit risk before purchasing a bond.

Since it is costly for investors to evaluate credit risk, it is not surprising that issuers of bonds are typically governments and very large corporations that are relatively well known and perceived to be good credit risks. Smaller borrowers who are less well-known usually borrow directly from financial intermediaries, particularly from commercial banks, which specialize in evaluating credit risk. In the 1980s it became briefly fashionable for poorer credit risks to issue bonds and these were dubbed “junk bonds”. Some of these bond issues turned out to deserve their nickname and went into default, usually resulting in losses to the bondholders. But many junk bonds paid off handsomely for those who held on to them. Today, this sector of the bond market is more frequently referred to as the “high yield bonds”, reflecting the premium interest rate paid to compensate for higher credit risk, and the buyers are generally financial intermediaries who specialize in evaluating these securities.

How is the Coupon Determined?

Returning to our favorite airline, Blue Skies could raise the $125 million it needs if it could issue 1,250,000 bonds with face value of $100 each at a price of $100. But will investors be willing to pay $100 for these bonds? That depends on the size of the coupon and their confidence that Blue Skies will be able and willing to make the promised payments. It is customary to set the coupon on a newly issued bond so that the bond will sell at par, which means that the market value of the bond *on the date of issue* is equal to its face value.

The less confidence investors have in the borrower, the higher is the coupon required to induce investors to pay $100 for the new bond. Blue Skies is competing for the investor's dollar with other borrowers and it will have to be prepared to pay a higher coupon than borrowers who are perceived to be better credit risks with a lower risk of default. For example, if firms having the highest credit ratings, such as General Electric and IBM, are paying a coupon of $8, Blue Skies may find that it needs to offer a substantially larger coupon, perhaps $10, to sell its bonds at par.

Interest is payment for the use of money, so the coupon on a bond is interest. When Blue Skies issues a $100 bond at par with a coupon of $10 it is paying $10 in interest to the bondholders or, equivalently, an interest rate of 10% per year. That interest rate is not set by Blue Skies Airlines but by the marketplace where Blue Skies must compete with other borrowers for investors' dollars.

If all goes well at Blue Skies, bondholders will receive a coupon payment of $10 each year during the life of the bond and then the face value payment of $100 on the maturity date. Of course, unexpected events such as a jump in fuel costs or a decline in airline travel could force Blue Skies to default on its bonds. In that case, bondholders may not receive all the payments promised them. On the other hand, the bondholders will *never receive more* than the promised coupons and face value, even if Blue Skies prospers well beyond the most optimistic expectations. Rather, it is the shareholders who reap all the gain from a good business climate. Thus, the bondholder gives up participation in the risks and rewards of ownership for the right to receive specified payments.

Exercises 3.3

A. Locate the table called "NEW YORK EXCHANGE BONDS" in the *Wall Street Journal* or other business newspaper. Each bond is identified by the name of the company that issued it, the coupon rate in percent, and maturity year, in that order. Find the AT&T bond with the maturity furthest in the future. What are the coupon, maturity year, and price (under the column heading "close") of that bond? What is AT&T promising to pay a purchaser of this bond? Now locate bonds with substantially larger coupons than that paid by AT&T. Are these corporations as well known as AT&T?

B. Some bonds are denoted "cv" meaning they are convertible into stock, and they frequently carry a lower coupon. Why would that make sense?

C. Locate a bond with an "f" after the year. This denotes a bond that has defaulted on coupon payments. What is the bond market lingo for such bonds (see notes to the bond table), and how does a bond having this designation seem to relate to the price quoted on that bond?

3.4 Interest Rates and Bond Yields

The interest rates paid on a loan or bond is a key variable in macroeconomics because interest is an important part of the cost of new capital goods, like airplanes, and new durable consumer goods, like cars and houses. If the interest rate facing Blue Skies were 15% instead of 10%, its management might decide not to buy that Boeing 777 since the profit the plane produces may no longer be sufficient to cover a higher interest cost. Clearly, a sharp rise in the interest rate would reduce the demand for many kinds of products and therefore affect the economy very significantly. On the other hand, a droop in interest rates would stimulate demand and give the economy a boost. This is the reason why economists and business managers pay close attention to interest rates and look for any indications of a change in interest rates.

The Benchmark for All Interest Rates

What is the interest rate today? First of all, there isn't just one interest rate in the economy. Blue Skies will pay a higher interest rate than a borrower that is perceived to be a better credit risk, such as General Motors. The interest rate paid by the borrower with the very lowest credit risk will be the lowest, and thus can serve as a benchmark for all interest rates. That borrower is the U.S. government.

The federal government is the largest borrower in the U.S. economy. Through the U.S. Department of Treasury, the federal government has sold about $200 billion in *additional* bonds to investors each year during the past decade. It already owes well over $5 trillion in the form of bonds outstanding, measured at face value. In spite of being so heavily in debt, the U.S. government is still considered to be the best possible credit risk, with the chance of default being effectively zero. Why? Because unlike any other borrower, the federal government has the power to raise taxes if necessary to make good on its promises. Treasury bonds are also the most liquid of all marketable securities because they trade in huge volumes every day and almost continuously around the clock somewhere in the world. All interest rates paid by private borrowers on loans and bonds of the same maturity are higher than that paid by the Treasury, the difference depending on credit quality, and they all move with the rate on Treasuries.

The interest rate on "Treasuries" or “T bonds” is therefore the benchmark interest rate for the whole economy and is often referred to as *the* interest rate. There is one exception to the rule that the U.S. Treasury pays the lowest interest rate. Bonds issued by state and local governments, referred to as municipal bonds, are generally exempt from federal income tax and state income tax in the state where they were issued. For that reason municipal bonds pay an even lower interest rate than Treasuries, but they are a good investment only for people in the

highest income tax brackets. The interest rate on Treasuries is nevertheless the benchmark rate which municipals follow.

How to Find Out What the Interest Rate Is Today

How can we find out what the benchmark interest rate on Treasury bonds is today? It is easy to get that information from the financial pages of major newspapers. Look for a table with the heading "TREASURY BONDS, NOTES AND BILLS." Treasury notes are simply bonds with ten or fewer years to maturity when issued, and Treasury bills mature in less than one year from issue. Each line of the table consists of six pieces of information describing one bond.

To illustrate, on December 31, 1998 the two Treasury notes maturing in one year were quoted in *The Wall Street Journal* as follows:

GOV'T BONDS & NOTES

Rate	Maturity	Bid	Ask	Chg	Ask Yld.
5 5/8	Dec 99n	100:30	101:00	....	4.59
7 3/4	Dec 99n	102:31	103:01	-1	4.60

The "Rate" is the coupon as a percent of face value, so 7 3/4 means the note pays a coupon of $7.75 per year per $100 of face value. Even though T bonds and notes generally have a face value of $1000, it is traditional to quote them as if they came in $100 amounts (think of a $1000 bond as a bundle of ten $100 bonds). "Maturity" is the month and year of payment of the face value, while "n" means that the security is a note as defined above. "Bid" and "Asked" are respectively the price you can sell a bond for and the price you have to pay for one, in dollars and 32nds of a dollar per $100 of face value. The bid-ask spread, the difference between these, is the mark-up that a bond dealer earns trading T bonds. "Change" is the price change from yesterday in 32nds of a dollar. Finally, "Ask Yld." stands for yield to maturity, which we will now discuss.

The Yield to Maturity

To understand the concept of yield to maturity we need to look at these two notes from the perspective of an investor. Imagine that you have an extra $1,000 from summer earnings that you wish to invest for one year so you can travel next summer. How would you choose between these two notes? At first it might seem that you would want to buy the note with the higher coupon, but you want to take into account the fact that it is more expensive. What is the right way to evaluate the two notes? All you care about these notes is how much your investment will be worth next year, and you will take the bond that grows your money

the fastest. How much *extra* will you have a year from now per dollar invested today? Yield to maturity answers that question.

The yield to maturity on a bond is the percentage by which the investor's money grows from the date of purchase to maturity date, expressed at an annual rate. For sake of brevity it is customary to just say "yield." Now in the case of a one year bond it is easy to calculate the yield because we need only take the amount the investor will earn during the year and divide by the price paid for the bond, then multiply times 100 to express the result as a percentage. The formula for yield is written:

$$\text{yield} = \frac{\text{amount gained}}{\text{price}} \bullet 100\%$$

What is the amount that the investor gains during the year? It is the amount received at the end of the year, the face value of $100 plus the coupon, minus the price paid for the bond at the beginning of the year. The formula for the yield on a one year bond may be expressed then as:

$$\text{yield} = \frac{\text{face value} + \text{coupon} - \text{price}}{\text{price}} \bullet 100\%$$

$$= \frac{\$100 + \text{coupon} - \text{price}}{\text{price}} \bullet 100\%$$

For example, the first one year T note listed above pays a coupon of 5 5/8, or $5.625 per year, and the asked price is $101 per $100 of face value. The amount gained is therefore $100 + $5.625 - $101 which equals $4.625. So the yield is

$$\text{yield} = \frac{\$100 + \$5.625 - \$101}{\$101} \bullet 100\%$$

$$= \frac{\$4.625}{\$101} \bullet 100\%$$

$$= 4.58\%$$

For the second bond the ask price is $103:01 or $103.03125 per $100 of face value and the coupon is $7.75 per year, so the yield is

$$\text{yield} = \frac{\$100 + \$7.75 - \$103.03}{\$103.03} \bullet 100\%$$

$$= \frac{\$4.72}{\$103.03} \bullet 100\%$$

$$= 4.58\%$$

Notice that our calculated yields on both bonds disagree slightly with those quoted from the *Wall Street Journal* above. For the first bond our yield is .01%, or 1 "basis point," lower and for the second bond two basis points lower. These small discrepancies are due to technical details that arise from the fact that the annual coupon is actually paid in two installments spaced six months apart.

Notice, too, that the two notes have the same yield (differing slightly according to the *WSJ*), and it would be surprising if they didn't. Why? Two bonds maturing at the same date must have the same yield, because all that matters to investors is how rapidly their money grows. If the two bonds had different yields, nobody would buy the one with the lower yield and its price would fall relative to other bond until the yields were equalized. The fact that there is a very slight difference in the yields on these two notes is again due to technical issues which can account for a difference of a couple of basis points.

The Coupon on a New Bond

Now suppose that the Treasury had wanted to sell new one year notes on December 31, 1998. Recall that it is customary to set the coupon rate on a bond so that it sells at par ($100) when issued. What is the required coupon rate such that the new note will offer investors the same yield as do existing one-year notes? It should be pretty clear that the coupon rate must be equal to the current market yield, but let's use the formula for yield, specifying a price of $100 and then solving for the coupon, to verify this. Inserting the desired price of $100, the yield formula becomes:

$$\text{yield} = \frac{\$100 + \text{coupon} - \$100}{\$100} \bullet 100\%$$

$$= \frac{\text{coupon}}{\$100} \bullet 100\%$$

We now solve for the coupon, given a market yield of 4.60%:

$$\text{coupon} = \frac{\text{yield}}{100\%} \bullet \$100$$

$$= \frac{4.60\%}{100\%} \bullet \$100$$

$$= \$4.60$$

This result says that a bond will sell at par only if its coupon rate is equal to the yield on comparable bonds already observed in the market. In our example, existing one year notes yield 4.60%, so the Treasury must be prepared to offer a coupon of $4.60 on the new one year note if it is to sell at par. In practice, the coupon rate is rounded to eighths,

quarters, or halves. In this case, the coupon would be set at 4 5/8 or 4.625 so the new bond would sell at close to, but slightly above, par.

What does this result tell us about the history of the two one-year T notes in the table? First, neither is a newly issued note since new notes are priced at par. Keep in mind that these two notes may have been issued years ago, but on this date they are effectively one year bonds because they will mature in one year. The coupon rate tells us what the yield was on each note on the day it was issued. Evidently, the second note was issued at a time in the past when interest rates were considerably higher than in 1998, a time when yields were closer to 8% than to 5%. Note that an original buyer would have paid only $100 for a bond now worth about $103.

We have established that the U.S. Treasury would have had to pay an interest rate of about 4.60% if it had wished to borrow money for one year at the end of 1999, because that was the yield on existing one year bonds then. That rate also established a minimum for the interest rates that other borrowers had to pay on that date to borrow for one year.

Exercises 3.4

A. Why is the bid price of an individual bond lower than the asked price? What are some factors that might influence the size of the spread between the bid and asked prices?

B. Why would it be surprising if two Treasury bonds of the same maturity had different yields, say 5% on one and 6% on another?

C. Look again at the one year bonds quoted in the text above. Why do they both sell at above par? Why does one sell for a higher price than the other when they are both guaranteed by the U.S. government? What do you infer has happened to interest rates since they were issued?

D. Find the table of U.S. Treasury bond quotations in a newspaper and identify the one year bonds or notes. Then:

1. Compute the yield on each and compare the results with the "Ask Yield" quoted in the paper.
2. Explain the price differences between these bonds.
3. What would you conclude has happened to interest rates since these bonds were issued? Explain briefly.
4. If the Treasury issued a new one year bond on this date to sell at par, what coupon rate would it have to offer?

3.5 What Happens When Interest Rates Change?

Even if the U.S. Treasury may be depended on to pay its debts, owning T bills, notes, or bonds is not free of risk. This is because future interest rates are uncertain, creating what economists call interest rate risk. This risk takes on two forms.

Fluctuations in interest rates expose holders of long term bonds to “price risk,” because the market value of existing bonds depends on the

interest rate. Holders of short term bills and notes, on the other had, are exposed to "income risk," because they cannot be sure what interest rate will be available to them when they receive their face value payment and wish to reinvest. Income risk is also referred to as reinvestment risk or rollover risk.

Price Risk

Let's consider first price risk and see how the market value of a bond will fluctuate during its lifetime as the interest rate changes. Imagine that the Treasury did issue new one year notes on December 31, 1998 with a coupon of 4 5/8 (to produce a yield of 4.6% at a price close to par). Anyone who bought that note and held it to maturity in December 1999 would indeed earn that 4.6%. But what about an investor who sells it before the maturity date?

For example, what if the one year interest rate had jumped to 5.6%, an increase of one full percentage point, the next business day? Obviously, investors would no longer be willing to pay $100 for a note with a coupon of 4 5/8 if other notes yield well over 6%. Clearly, the note will be worth *less* than the $100, the price it sold for a day earlier.

The new market price is found by solving the yield formula,

$$\text{yield} = \frac{\$100 + \text{coupon} - \text{price}}{\text{price}} \bullet 100\% ,$$

for the price of the note, given coupon and yield, which gives us

$$\text{price} = \frac{\$100 + \text{coupon}}{1 + \text{yield}/100\%}$$

Given the coupon of 4 5/8 and a new yield of 5.6% for our example, the new market price of the note the next day is:

$$\text{price} = \frac{\$100 + \$4.625}{1 + 5.6\%/100\%}$$
$$= \frac{\$104.625}{1.056} = \$99.08$$

Our buyer has taken a loss of about $1 on the bond. This note that was worth $100 yesterday is worth only about $99 today. Let's try to see intuitively why the market price of the note drops to $99. No one will be willing to buy this note now unless they can earn 5.6% on it, because that is the yield available now on alternative one year bonds. With the price reduced to $99 a buyer would gain almost $1, or about 1% of the price, from appreciation in the value of the note from $99 now to $100 at maturity. In addition, a buyer will collect the coupon of $4.625, roughly

another 4.6% on the price paid for the note. This gives a buyer paying $99 today a total return of about 5.6%, and that is the yield available on other bonds of the same maturity.

Looking again at the formula for yield, we can see how yield is always made up of two components, one due to change in the value of the bond from now to maturity, the other due to coupon income:

$$\text{yield} = \frac{\$100 - \text{price}}{\text{price}} \bullet 100\% + \frac{\text{coupon}}{\text{price}} \bullet 100\%$$

In words: yield to maturity equals price appreciation yield plus coupon yield.

By "price appreciation" we mean the increase (or decrease if negative) in value of a bond or note from today until maturity, in this case from $99 today to $100. If this note were not selling at a discount of about $1 from par, producing the additional 1% yield from price appreciation, no one would be willing to purchase it since it is paying a coupon of only $4.625 when the prevailing yield in the market is 5.6%. But the unlucky person who bought the note yesterday at par, suffers a loss of that $1.

From this example we learn that the general principle relating bond prices to interest rates is this:

When the interest rate rises, the value of existing bonds falls.

When the interest rate falls, the value of existing bonds rises.

This inverse relationship between bond prices and interest rates comes from the fact that coupon payments from an existing bond are fixed. When competing yields rise, those fixed coupons are worth less. We see then that price risk arises from fluctuations in interest rates: when interest rates rise, bond holders suffer losses, but when interest rates fall, they enjoy price gains.

Income Risk

Let's suppose that instead of buying a note or bond, our investor purchased a security that carries almost no price risk at all, a Treasury bill. The reason that there is very little price risk in buying a T bill is that the bill matures in a very short time. The most popular maturity for T bills is 90 days, about a fourth of a year. Because a T bill's life it so short, it pays no coupon at all. Since the coupon yield is therefore zero, the yield on T bills must be entirely price appreciation yield. It also follows that T bills cannot sell at par, rather they must sell at a discount from par since that discount is the sole source of the investor's yield. For example, if a 90-day T bill trades at $99, then the investor will gain $1, or about 1%, over a period of about one quarter of a year. The yield on T

bills is always expressed at an annual rate, so in the case of the 90 day bill we multiply by four, obtaining a yield of about 4% in our example.

We began by claiming that there is hardly any price risk for T bills because they reach maturity so quickly. We saw that if the yield on one year notes rises by 1% that the price drops by about $1. You can easily see that if the yield on 90 day bills rises by 1% then the price falls by only about 25 cents. Indeed, a one-day T bill would have no price risk at all, maturing at full face value that next day, assuming that one day is the shortest period one would wish to invest.

While the buyer of a T bill need not fear variation in price, there is no guarantee of a fixed income stream after the bill matures. Consider a college student who is investing a gift of $1,000 that will be used to pay tuition one year from now. She has no concern that she will need the money sooner. If the student buys a one year T note then she knows exactly how much she will have at the end one year because the coupon and face value payments are known with certainty. On the other hand, if she buys a 90 day T bill she will have to reinvest the face value in 90 days, and the interest rate then may be higher or lower than what it is now. Indeed, if she continues to invest in 90-day bills, she will have to reinvest three times during the year at rates that are not known until reinvestment takes place.

We see then that the buyer of a T bill faces another form of interest rate risk, namely income risk, uncertainty about the income stream that will be earned in the future as the proceeds from maturing bills are reinvested or "rolled over," at whatever interest rate prevails at that time in the future.

Exercises 3.5

A. The U.S. Treasury issues T bills in maturities of 90 and 180 days weekly, and for 360 days less often. If you wanted to buy a 30 bill, are you out of luck, or will you be able to find one?

B. Suppose a one-year T bond with a coupon of $6 is quoted today at $98.

1. What are the coupon yield and the price appreciation yield on this bond?

2. Tomorrow, the one year interest rate changes to 6%. What will be the new price of the one-year T bond in the previous question, and how much has the price changed? Why?

3.What are the coupon yield and price appreciation yield?

C. Look again at the two one-year T notes whose prices and yields are quoted in Section 3.4. Calculate the coupon yield and price appreciation yield on each.

D. On January 30, 1991 the two Treasury notes maturing in one year were quoted as follows.

Rate	Maturity	Bid	Ask	Ask Yld.
11 5/8	Jan92n	104:17	104:19	6.71
8 1/8	Jan92n	101:09	101:11	6.71

1. Calculate the coupon yield and the price appreciation yield for each.
2. What would have happened to the price of each if on the next business day the prevailing yield in the market on one-year T bonds had fallen to 5%?

3.6 The Relationship Between Bond Yield and Price

The yield to maturity on bonds with maturity greater than one year is more complicated to calculate, but a few basic relationships are easy to see. If the bond sells at par ($100), then the only component of yield is the coupon yield and that is just the coupon rate. For example: a bond maturing in 2030 bearing a coupon of $6 and selling at an asked price of 100 has a yield to maturity of 6%. The maturity date is irrelevant for calculating yield to maturity if the bond is selling at par. If the bond is selling at a discount from par, then there is a positive price appreciation component that will be averaged over the life of the bond. Conversely, a price premium over par will reduce the yield to maturity below the coupon yield since the investor will give up that premium during the remaining life of the bond. Exact computations are complex, and go beyond the scope of an introduction, but some "rules-of-thumb" allow us to make ball-park approximations and can help us understand the relation between yield and price for longer term bonds.

Two Useful Approximations

In April 1996 the "6 of 26" (meaning the Treasury bond maturing in 2026 bearing a coupon of $6 per year) was quoted at $89. This means that the buyer (and any subsequent owners) of this bond were going to receive price appreciation of $11 during its thirty years of remaining life. That price appreciation was going to add roughly 0.4% per year to the yield, since the appreciation averages $.37 per year and .37/89 = .004.

An exact calculation would have to take into account compounding over 30 years, and use mathematics that goes beyond the scope of this book, so this approach is intended only as a rough approximation. The coupon yield on this bond was about 6.7% (6/89 = .067). Thus, according to these rough calculations, the yield to maturity for this bond was about 7.1%, consisting of the coupon yield of 6.7% plus the price appreciation yield of 0.4%. The exact yield to maturity, properly accounting for compound interest over the 30 years, was actually 6.9%. Not a bad error considering the simplicity of our method!

Another way to approximate the relationship between the price and yield of a long term bond makes use of the formula for the price of a

bond of infinitely long maturity. Such bonds are called consols, and have existed in Britain for a long time but never the U.S. A consol pays the stated coupon forever, never reaching maturity! The price of a consol is given exactly by:

$$\text{consol price} = \frac{\text{coupon}}{\text{yield} / 100\%}$$

For example, if a consol pays a coupon of $6 and the yield is 6.9% then the price is

$$\text{consol price} = \frac{\$6}{.069} = \$89$$

Notice that this very close to the actual price of the thirty year bond with a coupon of $6 when its yield was 6.9% in April 1996. That suggests that the face value payment is far enough in the future so that from a mathematical viewpoint a thirty year bond is a virtual consol. This formula again makes clear the inverse relation between yield and price; when yield goes up, we are dividing the fixed coupon by a larger number and the result must be smaller.

Furthermore, using the formula for the price of a consol and a simple algebraic result discussed in the next chapter, we have the following useful rule-of-thumb:

For long term bonds, the percent change in price is approximately the negative of the percent change in yield, the approximation being more accurate for small changes.

To see how this works, on May 2, 1996 the price of the 30 year T bond fell a horrendous 52 32nds, or $1.625, from 88:22 the prior day to 87:02. That was a one day loss of 1.83% for owners of that bond. On the same day, the yield rose from 6.90% to 7.04%. Is the relationship between the rise in yield and the fall in price consistent with the above approximation? To apply the approximation we need to calculate the percentage change in the yield. What we are after is not the difference between 6.90% and 7.04%, which is 0.14 percentage points, but rather the percentage change between 6.90 and 7.04 which is (7.04-6.90)/6.90 = .0203 or 2.03%. The percentage change in price was very nearly the percentage change in yield, but the opposite sign, as the approximation predicts.

This approximation result helps us understand why long term bonds are subject to greater price risk than are shorter term bonds, notes, or bills. A dramatic example is the 30 year T bond in the example above. That bond had been issued only three months earlier, in February 1996. During that short time, its market value had fallen from $100 (of course

it had been issued at par) to only 87:02 or $87.06! The unfortunate buyers had already lost 13% of their investment in just three months! Long-term interest rates had moved sharply higher during that time, from 6% to about 7%. While that is not a large change in yield, only about 1 percentage point, it is a large *percentage* change in yield, (7-6)/6 or about 17%, and we now know that it is the *percentage change* in yield that matters in determining the price change. Note that the rule-of-thumb is not very accurate for changes this large, but does give a useful indication of magnitude. When interest rates rose by 1%, the price of this existing bond had to fall sufficiently to give potential buyers another 1% yield *per year for the next 30 years*. Although shorter term interest rates also moved higher during that three month period, shorter term bonds and notes suffered much smaller losses. Why? Recall that a one year bond need fall only $1 in price to boost the yield by 1%, while 90-day T bills were already reaching maturity at par.

In practice, long term interest rates do not change as rapidly as do short term interest rates, as we shall see in the next section. Nevertheless, actual price fluctuations are greater the longer the term to maturity; greater for bonds than for notes, and greater for notes than for bills. While subject to price risk, a long-term bond does provide safety from income risk, because the stream of income payments are fixed for the life of the bond. This is why bonds are often purchased by people who are saving for retirement, and by pension funds, since they want to be able to count on a stream of income over many years in the future.

One important caveat: the purchasing power of that income stream will depend on future inflation, which cannot be accurately foreseen. But that is another story which we will save for Chapter 4.

Exercises 3.6

A. Find one, 5, and 30 year U.S. Treasury bond quotations in the newspaper and write down coupon, price and yield to maturity for each. Show how the yield can be broken down into coupon yield and price appreciation yield components for each of the three, using the rough rule-of-thumb developed in this section. How well does the formula for the price of a consol account for the prices of the three bonds, given their quoted yields? Can you explain why the consol approximation works better for some maturities than others?

B. Now compare two days' tables of U.S. Treasury bond quotes, noting the price and yield changes from the prior day, or from several days ago. How does the yield change seem to vary with maturity? How does the price change vary with maturity? Use the consol approximation to account for the price change, given the yield change, of one year, 5 year, and 30-year T bonds? Does the success of this seem to be related to the maturity? If so, why?

C. What is the formula for the yield on a consol, given its coupon and price? Use this result to find the yield on a consol paying $5 per year and selling for $50.

3.7 The Behavior of Interest Rates in the U.S.

Yields on U.S. Treasury bills and bonds are watched closely by economists, executives, and investors as the benchmarks for all interest rates in the economy.

As explained above, the most popular maturity for T bills is 90 days, so the yield on the "90-day bill" has become the benchmark short term interest rate. Recall that the T bill yield is expressed at an annualized rate, so it is directly comparable to other interest rates.

The T bond with the longest term to maturity is the thirty year T bond and the yield on this "long bond" serves as the benchmark for long term interest rates. The yield on the 90 day T bill and the yield on the 30 year T bond are plotted together in Figure 3.1 for the period 1960-2002.

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Tips on Reading a Chart

The time period covered by the chart in Figure 3.1 is indicated along the bottom, the horizontal or “x” axis. It begins in 1947 and ends with2002. Each interest rate, expressed in percent per year, is measured on the vertical or “y” axis. Each line in the chart is one kind of interest rate, one variable that we plotting in the chart, and a line is constructed by connecting individual points, one at each calendar quarter. All we see is the line connecting the points, not the points themselves. The line showing the history of the short-term T bill rate, is dashed and light blue in color display, wile the long-term T bond rate is the solid dark blue line. Check your understanding of what the chart shows by reading off some values at different dates. For example, in late 1992 the short-term rate was about 3% and the long-term rate was about 7.5%. While the raw numerical data are quarterly, the chart presents the information in too compressed a form for us to read off individual data points accurately. The usefulness of a chart like this is that it enables us to see patterns of behavior over time, and often that leads us to draw important conclusions. One chart is worth a thousand numbers!

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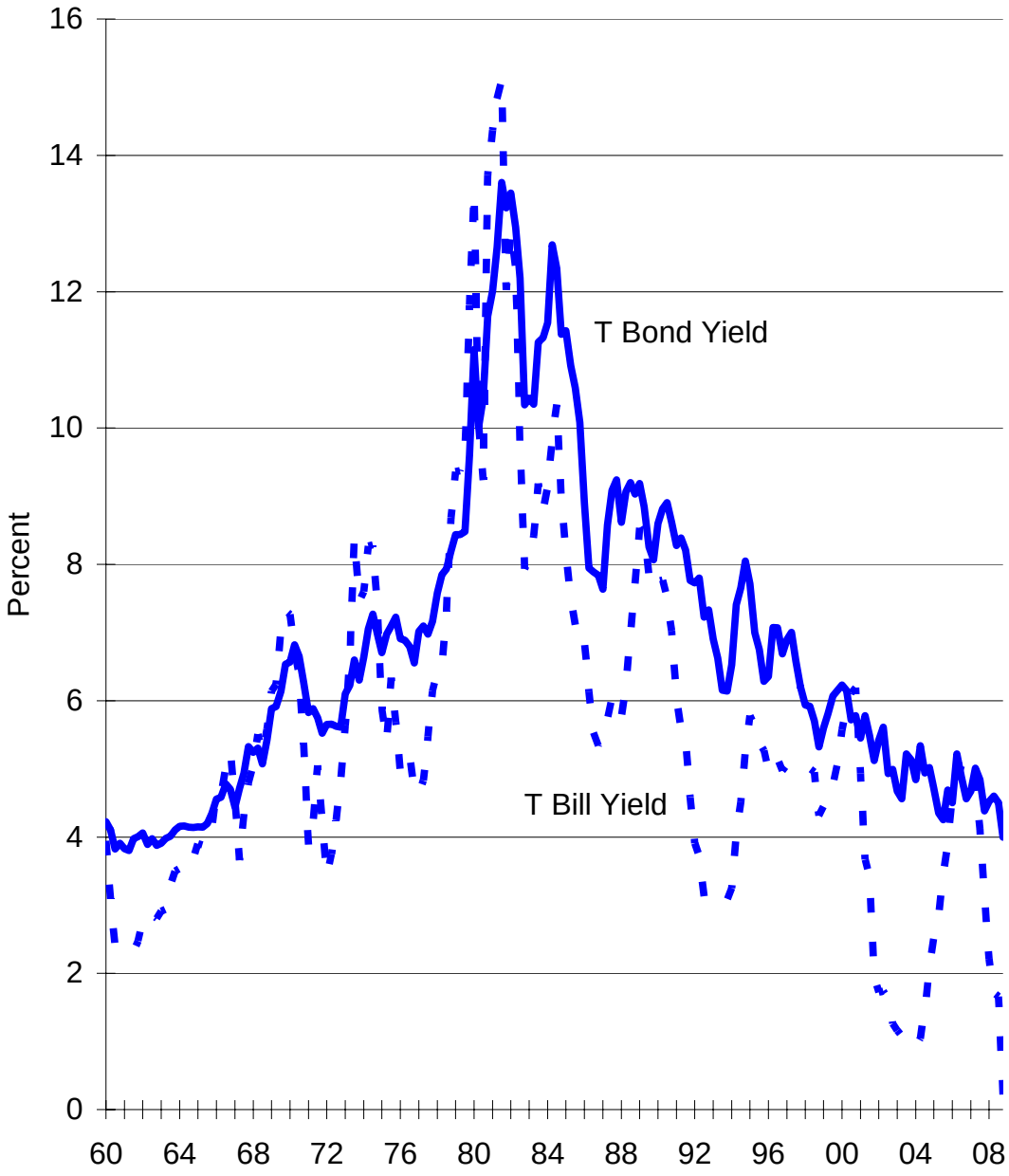
Figure 3.1: Short Term and Long Term Interest Rates



Some Observations from Fig. 3.1

Several important facts about the behavior of interest rates can be seen in Figure 3.1:

1. Long and short-term interest rates are not the same.

They often differ by a percentage point or even more, as we see in the chart. Why aren't the yields on bills and bonds just the same? After all, both promises to make future payments by the U.S. Treasury, so they have the same minimal credit risk. Most fundamentally, they differ because they differ in their time horizons. In one case, the Treasury promises to deliver a stream of dollars over a long time period, and in the other it promises to deliver one payment in the near future. Those promises have different values to investors.

An analogy with commodity futures may be helpful. The "Futures Prices" table in the Wall Street Journal or other financial section shows prices of commodities like wheat and copper for delivery on specific dates in the future. Notice that the price of wheat for delivery next month is very different from the price of wheat for delivery next year. There is a fundamental difference between those two bushels of wheat based on the time the wheat is delivered to the buyer. A bushel of wheat delivered next year cannot be made into bread next month!

Similarly, bills and bonds differ fundamentally in their time dimensions, one a promise to pay income over a short time period, the other over a long time period. We should not be surprised that their yields differ.

Another way to think about why the short term yield differs from the long term yield is that bills and bonds represent very different exposures to interest rate risk; bills being vulnerable to income risk and bonds to price risk. Depending on investors' attitudes towards these risks, we can expect systematic differences between short and long term interest rates.

2. Interest rates have varied greatly, creating large gains and losses at different times for bond owners.

From the very low levels seen after World War II, both long and short term interest rates marched upward with occasional dips, reaching an historic peak in 1981 at "double digit" levels. From what we now know about the inverse relationship between bond yields and bond prices, it is clear that most of the period from 1947 to 1981 was one of huge price losses for owners of long term bonds. That was a period when holders of T bills were much better off than holders of bonds. Rolling over their portfolio every 90 days, the owner of bills enjoyed rising income with almost no price risk!

But the period since 1981 has seen a dramatic but not complete reversal of that experience. By 2002 the T bill yield had dropped back below 2%, a level not seen since the 1950's and one that seasoned market observers had never expected to see again. Holders of short-term

securities have been experiencing the downside of income risk during this period. Meanwhile, owners of long-term bonds enjoyed stunning price appreciation after 1981, as the yield on T bonds in half or more. Today yield on the long term T bond is back to the levels of the 1960's.

3. The long-term rate is usually higher than the short-term rate.

The difference between the long-term rate and the short-term rate is called the bond-bill *spread*. The fact that the spread is usually positive (the long term rate is above the short term rate) has been interpreted by economists to mean that, on balance, buyers of long term bonds require additional compensation, called a risk premium or "liquidity premium," to induce them to bear price risk. The spread between T bond and T bill yields is charted below in Figure 3.2 along with the T bill yield. A risk premium is not the only reason why there is a spread, as we see below, but we can take the average spread over time as an estimate of the risk premium. It is about 1% pre year in the form of a higher yield on bonds than on bills.

4. The long-term interest rate varies less and moves more slowly than does the short-term interest rate.

The much greater volatility of short-term interest rates as compared to long-term rates is one of the best-established empirical regularities in the historical record, not only in our economy but across countries, and it is one that has long fascinated economists. It is part of a broader question: what determines the relationship between short and long term interest rates? We have already mentioned differences in risk, and in the next section we will explore the role of investors' expectations about the future.

Exercises 3.7

A. What were short and long term interest rates at their lowest and highest points during the period covered by Figure 3.1 and when did those extremes occur?

B. How well did investors in long term bonds do in the decade 1972 to 1982? How well in the decade 1982 to 1992? Finally, how well during the decade since 1992? Compare these experiences with those of someone who invested in T bills during those decades.

3.8 The Term-to-Maturity Structure of Interest Rates

Why is the short-term interest rate today one number and the long-term rate another? Why do they tend to move together over time, yet the variability of the long rate is much less than that of the short rate? The key to understanding the term-to-maturity structure of interest rates is in thinking about the choice that an investor faces in the bond market.

The Expectations Theory

An investor in Treasury securities always has the choice between two strategies. The first is to buy a long-term bond with a known yield to maturity and hold it to maturity. The second strategy is to buy a 90-day bill and reinvest the face value every 90 days at the short-term rate that prevails when the old bill matures. Under the second strategy, the investor will earn the average of whatever short term rates turn out to be in the future. This suggests that investors compare the yield on long term bonds with what they *expect* short term yields to *average* over the life of the bond. The fact that an average changes more slowly than the variable being averaged helps explain the slower movement in long-term rates as compared to short-term rates that we saw in Figure 3.1. The idea that long-term interest rates reflect expectations of future short term interest rates is called the expectations theory of the term-to-maturity structure of interest rates.

Thus, the spread between long and short-term interest rates that we observe in the market reflects the decisions made by investors, given their attitudes towards interest rate risk and their expectations about the future direction of interest rates. The average level of the spread reflects a normal risk premium, but when the spread is unusually large it is reflecting the expectation by investors that short term interest rates will rise in the future. When the spread is unusually small or negative, it reflects the expectation that short-term interest rates will fall.

For example, if the T bill yield today is 5% and investors expect that it will remain at that level, then the long term interest rate will be about 6%, consisting of the expected short-term rate of 5% plus the risk premium of 1% included in long-term rates. Alternatively, if investors expect short-term interest rates to rise sharply in coming years, averaging 7%, they certainly would not buy a bond yielding only 6%, but would require a long term yield reflecting that expectation plus a risk premium, or about 8%.

Does the Theory Work?

How can we test the expectations theory? The test of any theory is to derive a prediction from the theory and then see if we find that prediction confirmed or refuted by experiment or experience. The expectations theory implies, that variation in the spread between T bond and T bill rates around its average should help to forecast the direction of the T bill yield, assuming that investors actually have some ability to forecast the direction of interest rates. If the spread is a predictor of the direction of the T bill rate, then that supports the theory. If it is not a predictor, then either the theory is wrong, or investors cannot predict the direction of T bill yields. Unlike chemistry or other laboratory sciences, we cannot do an experiment, but can only rely on historical experience in testing the theory.

In Figure 3.2 we see a chart of the T bill yield and the between the T bond and T bill yields spread (solid black line). Do we see the theory working in practice in this chart? Indeed, we see that:

A negative spread has anticipated major declines in the T bill yield, and a large positive spread has usually anticipated major rises.

The spread was at its most negative in 1981 when the T bond yield was about 2% points *below* the T bill yield. At that point investors were willing to accept a long term yield well below the T bill yield because they did not expect high T bill yields to last long. And they were right - T bill yields fell sharply during the next several years! Figure 3.2 shows that other low points in the spread in 1966, 1969, 1973-74, 1989, and 2000 also successfully anticipated subsequent declines in short term rates.

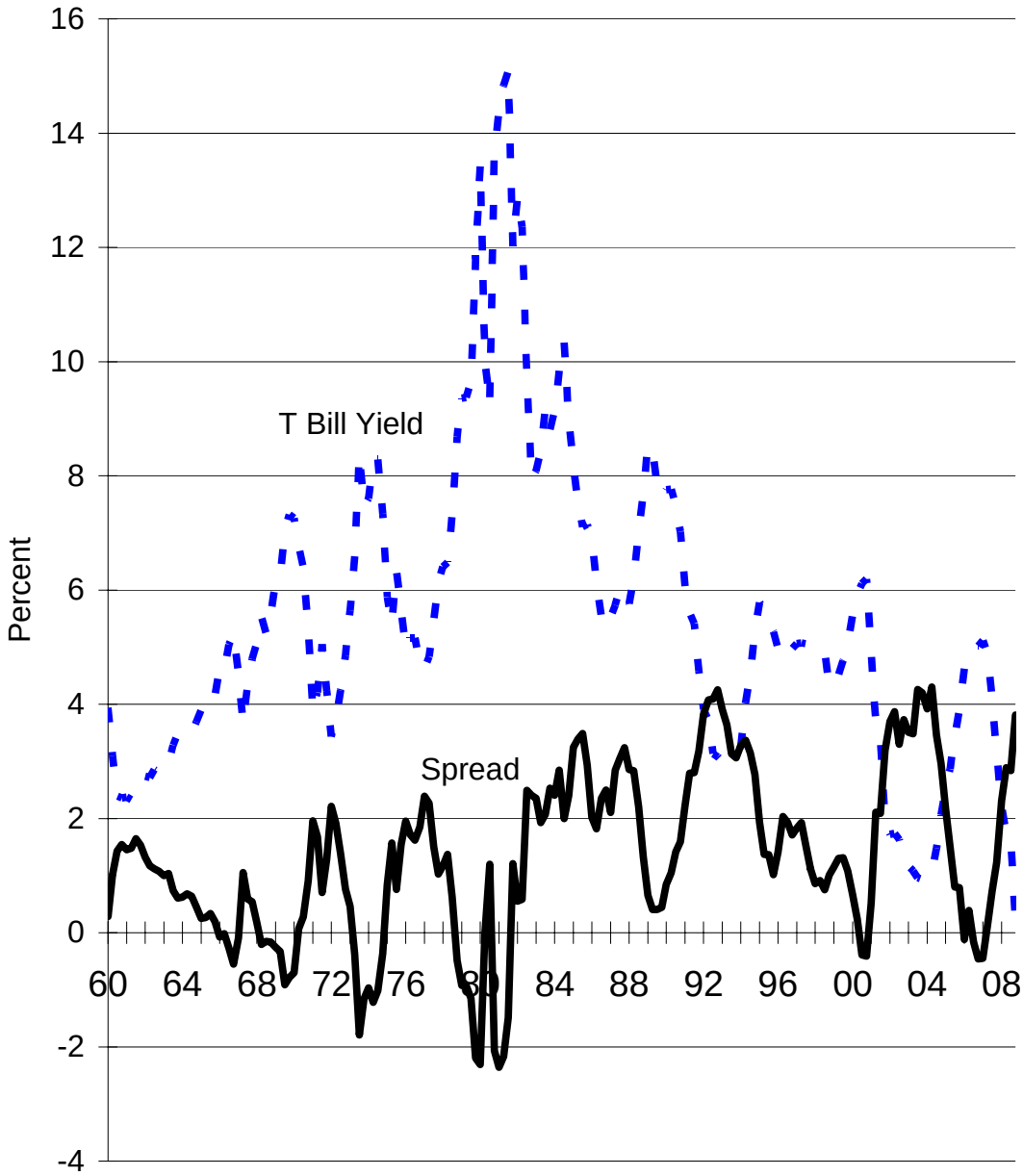
Notice too that peaks in the Bond-Bill spread in 1961, 1967, 1972, and 1977 anticipated major upswings in the T bill yield. But investors were not always right! The spread was positive and large from 1983 through 1987, indicating that investors expected that rates, which had already fallen dramatically, would rebound upward. Instead, rates did not rebound, but continued to fall.

By 1993 the spread was unusually large again; to be persuaded to buy a 30 year bond in 1993, investors required a bond yield 4 points above the yield on T bills! That tells us that investors expected short term rates to rise shaply, and rates did rebound sharply in 1995.

What about the post-9/11 period? The shock and uncertainty surrounding that event, along with monetary policy to cushion that shock, caused the dramatic decline in the T bill rate that we see in Figure 3.2. But long term rates did not decline in tandem, so by 2002 the spread was very large. Evidently the market was anticipating rebounding rates in 2003 and beyond.

One last observation from Figure 3.2. Note that the spread has been larger more of the time since 1982 than before. This may be entirely due to continued expectations that interest rates will tend to move upward in the future, but it may also be due to investors requiring a larger risk premium than they did before they experienced the huge price losses of the 1970s.

Figure 3.2: The Yield on U.S. T Bills and The Bond-Bill Spread



The Yield Curve

When we want to make a more detailed study of the term-to-maturity structure of interest rates, a very useful graphical tool is the yield curve, a plot of yield on the y-axis against maturity on the x-axis at a point in time.

Figure 3.3 shows what the yield curve looked like at the end of 2000, 2001, 2007 and 2008. The data used to construct the curves are the yields on the 90 day T bill and T notes or bonds of maturities 1, 2, 5, 10, 20, and 30 years. When there is not a bond of the exact maturity desired, we take one near that maturity, making use of the smoothness of the relationship. The points are then connected to make the curve. Note that the time intervals between the maturities plotted in Figure 3.3 are not equal.

We can make some observations about yield curves that hold pretty consistently over time.

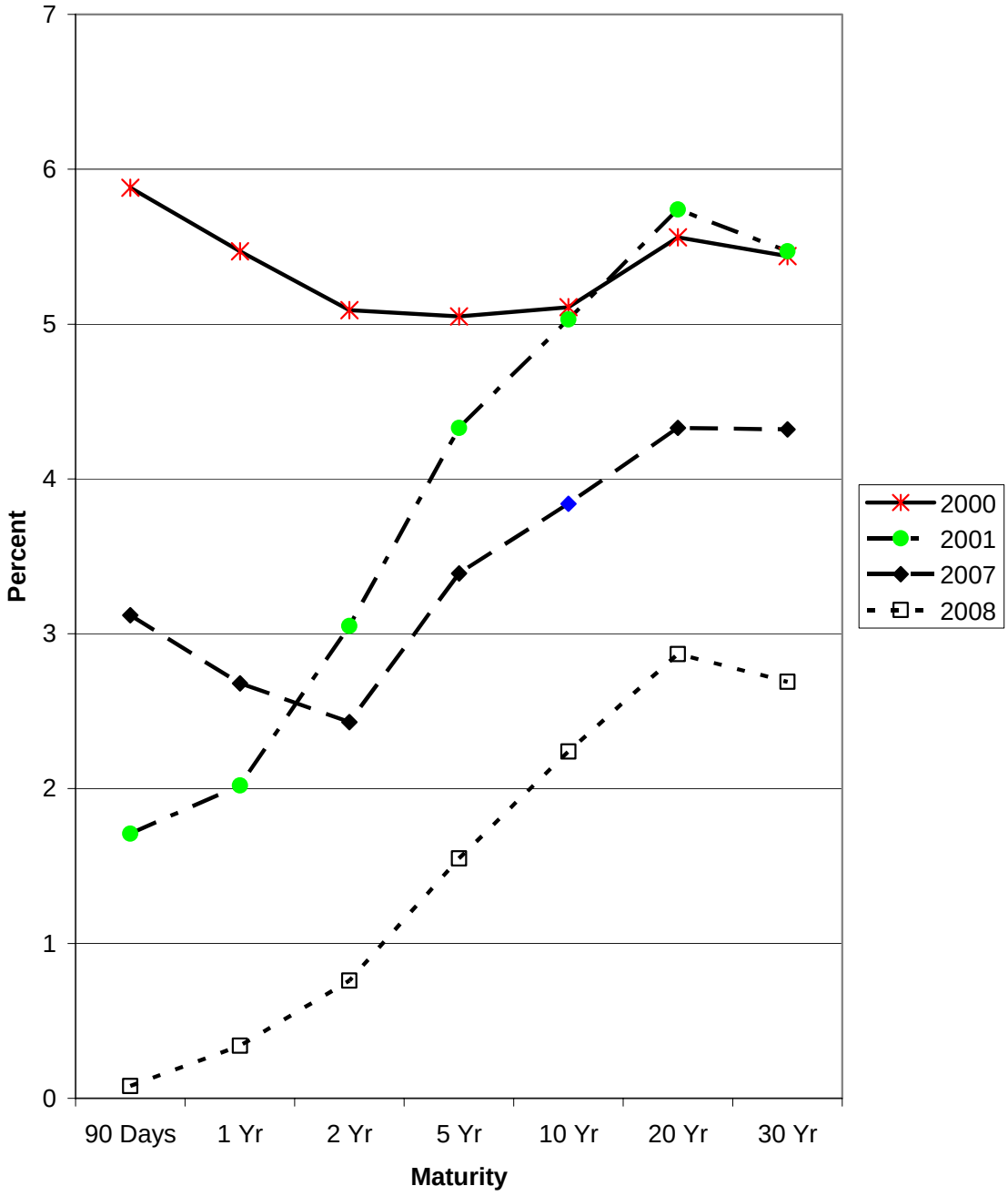
Recall that the spread between the bond yield and bill yield is positive most of the time, and that positive spread corresponds to an upward slope in the yield curve as we go from 90 days to 30 years. But in Dec 2000 the yield curve was downward sloping, reflecting the expectation that short rates would fall. And they did, too, as we see in the yield curve for 2001. The usual upward slope of the yield curve reflects the positive risk premium in long-term interest rates. In fact, downward sloping yield curves are so unusual that they are called an "inverted yield curve." When that condition is observed, it is often a harbinger of a downturn in economic activity, for reasons we will discuss later in the book. Another time we saw a downward slope was at the end of 2007, but only at the short end of the curve. Evidently, the market expected rates to fall in 2008, and did they ever! As we see in the fourth curve, for 2008 we see 90 day bill yields at barely above zero! The last time this happened was during World War II. The market expects rates to rise somewhat in 2009, but not very high because even the 30 year yield is less than 3%!

Each yield curve dips at the long end, the 30 year yield being a bit below the 20 year. We can think of that dip as resulting from the fact that investors who want to go very long are limited by the lack of any Treasury bond longer than 30 years. So there is some scarcity value for the longest bonds available.

Usually the yield curve flattens out at longer maturities. This reflects the fact that investors might have a reason to think interest rates will rise sharply next year, but they simply have no basis for predicting a sharp rise 20 years from now.

The yield curve is basic tool of bond investors and can be found in a financial newspaper, or under 'Market Data/Bonds and Rates at bloomberg.com.

Figure 3.3: The Yield Curve



Exercises 3.8

A. Pick out several dates from Figure 3.2 when investors apparently expected short term interest rates to fall, and several when they apparently expected them to rise. Were they proved right or wrong? What is the spread today? What is the forecast of investors today?

B. Have there been major moves in short-term interest rates that were *not* anticipated by investors? If so, investors do not anticipate all future moves in short-term interest rates. Does that fact constitute evidence against the expectations theory? Does the theory imply that investors can forecast all future changes in short-term rates?

C. Using the bond table from the newspaper or internet, plot the yield curve by free hand, or use graphing software. Connecting the points as in Figure 3.3 produces a kinked yield curve. What do you think that a complete yield curve, with all maturities plotted, would be kinked? Sketch what you think the complete yield curve might look like by freehand, and explain the reasoning behind your interpolation.

End