

MONEY and BANKING: ECON 3115

Revised, Fall 2011

Professor Benjamin Russo

email: brusso@ uncc.edu

Chapter 5: Behavior of Interest Rates

Outline

- I) Preliminaries
- II) The Quantity Demanded of Bonds and the Demand for Bonds
- III) How Does a Change in Bond Price Affect the Quantity Demanded of Bonds?
- IV) The Bond Demand Graph
- V) The Bond Supply Graph
- VI) Bond Market Equilibrium
- VII) Shifts in Bond Demand and Supply and Fluctuations in the Price of Bonds (the Interest Rate)
- VIII) The Fisher Equation (again)
- IX) Impatience, Saving, and the Demand for Bonds

I) Preliminaries

1) The Interest Rate

A) The first part of Chapter 5 (pages 91-108) shows how the market interest rate is determined in the “bond market.” Here's the good news: We will cover only this first part of Chapter 5. The second part of Chapter 5 shows how the market interest rate is determined in the “money market.” The bond and money markets are two sides of the same coin, so there is no need to cover both. Therefore, we will *not* cover the second part of Chapter 5: You are not responsible for that material.

B) In Chapter 4, we distinguished between the opportunity cost of bonds and an interest rate on a *specific* bond [recall, we treated a bank deposit as the best alternative to bonds. The interest rate on the bank deposit was the bond's opportunity cost]. We referred to the opportunity cost as “the” market rate of interest. And we referred to interest on the specific bond as the bond's Yield to Maturity (YTM). We used the market rate of interest to derive the present value of the bond, and we used the bond's present value to derive its YTM.

C) Chapter 4 treated the market interest rate as a constant exogenous parameter: In other words, Chapter 4 did not attempt to explain the endogenous determination of the market interest rate. It's time to *explain* the determination of the market interest rate. Why? Ignoring risk, the market interest rate is the cost of capital to borrowers, as well as a large influence on savers' incentive to save. Thus, the market interest rate plays a crucial role in economic activity. This chapter presents the modern economic theory of the market interest rate.

D) It's tiresome writing “market interest rate” over and over, so let's just call it ‘the interest rate.’

E) To explain the interest rate, we now lump all “nominal assets,” such as bonds and bank deposits into a single category, and call this uber-category “bonds.” Let's lump all the other “real assets” into a single category, which for the lack of a better name, we call ‘real assets.’ Real assets include things like common equity (stocks), commodities - such as gold - and real estate.

F) What's the bottom-line difference between bonds and real assets? Well, the face values of bonds are “nominal,” that is, their nominal values are constant. Usually contractually promised income streams from bonds, such as bond coupon payments, are also constant in nominal terms. Thus, bonds often are referred to as “fixed income” securities. Because the face values and income streams of bonds are fixed in nominal value, inflation reduces bonds' real values. Real

assets do not have face values: They have only market values. And, just as important, economic history shows that in the long run the *real* market values of real assets are not eroded by inflation. This is the reason real estate used to be called an "inflation hedge."¹

G) This distinction between nominal and real assets is a major re-orientation from our earlier work. In Chapter 4 we contrasted two nominal assets, a specific bond and a bank deposit account. The bank deposit was the best alternative, so the bond's opportunity cost was the interest rate on the bank deposit. But now, to minimize complications we are combining all nominal assets, including bank deposits and the specific bond, into one overarching type, which we label "bond." The best alternative to this nominal asset is the real asset, so the **opportunity cost of the bond** is the rate of return that could have been earned *on real assets*.

H) A bond is a nominal asset. Recall that inflation drives a wedge between the nominal interest rate and the expected real interest rate: The nominal interest rate is i_t , but the real interest rate is $i_r \equiv i_t - \pi^e$. Which interest rate does the theory of interest explain? The answer is both. But once you understand what determines the nominal interest rate, what determines the real interest rate follows immediately. The nominal interest rate and the real interest rate are connected like a tree to its roots: when you plant the roots, you plant the tree. Likewise, holding π^e constant, in order for the real interest rate to change, the nominal rate must change. Because of this perfect correlation between the nominal and real interest rates (except for inflation) it does not matter which we explain. We will focus on the nominal interest rate because that is the one we confront in everyday life. Once you understand what determines the nominal interest rate, simply subtract π^e to get the real interest rate.

I) Recall that at any moment in time the (nominal) interest rate on a bond is necessarily inversely correlated with the bond's price: if the former goes up, the latter must decline. This is so because the Yield to Maturity on a bond and the its price are opposite sides of the same coin. Consider a one-period discount bond whose *current* price is P_t and whose future cash flow is CF . The bond's Yield to Maturity is $i_t = \frac{CF}{P_t} - 1$. The lower is P_t the higher i_t must be. Because of this necessary one-to-one inverse relationship between the interest rate on a bond and the bond's price, it is possible to explain the determination of the interest rate by studying the determination of the price of bonds. Modeling the price of bonds is easier than modeling the interest rate, so Chapter 5 develops a market model of the price of bonds.

2) The Actual Rate of Return versus the Expected Rate of Return

A) Recall that in Chapter 4 we distinguished between the interest rate and the rate of return by saying the rate of return is backward looking (ex post) and the interest rate is forward looking (ex ante). To explain the determination of the interest rate, we must now distinguish between two types of rates of return. In particular, distinguish between the *actual* rate of return, which is ex post, and the *expected* rate of return, which is ex ante. The actual rate of return is the rate of return earned during a previous period of time. The expected rate of return is the rate of return lenders believe they will earn in the future.

B) The way that a change in the price of bonds affects the *actual* rate of return is opposite to the way a change in bond prices affect the *expected* rate of return. E.G., a decline in current bond

¹ These days real estate is called a disaster.

prices, P_t , reduces the *actual* rate of return, but increases the *expected* rate of return. This is very important to understand. To understand the difference in response, assume there are two types of lenders, Current Bond Owners (*CBOs*) and Prospective Bond Owners (*PBBs*). To simplify assume *CBOs* and *PBBs* are *mutually exclusive*: *CBOs* plan not to buy bonds in the future. *PBBs* do not currently own bonds, but plan to buy bonds in the future.

a) Let RoR_t be the actual rate of return earned by *CBOs*. RoR_t is *ex post*, that is, earned during a previous time period. Suppose a discount bond was purchased in time period $t-1$. Let P_{t-1} be the price paid for that discount bond. P_t is the current price of the bond. $RoR_t = \frac{P_t}{P_{t-1}} - 1$. Note how RoR_t is affected by a decline in P_t : It should be clear that RoR_t declines. Because RoR_t declines if P_t declines, lower bond prices make *CBOs* worse off.

b) Let $E\{RoR_{t+1}\}$ be the *Expected* rate of return on a bond that *PBBs* plan to buy (in period t), but do not yet own. Also assume that *PBBs* plan to re-sell the bond next year (in period $t+1$). $E\{RoR_{t+1}\}$ represents *PBBs*' *subjective expectation* (beliefs) of the future return that would be earned if the bond is bought today and re-sold next year. Of course, no one knows what future bond prices will be. So it is important to emphasize that $E\{RoR_{t+1}\}$ depends on subjective expectations of the future bond price, $E\{P_{t+1}\}$.

Thus, for a discount bond bought today and re-sold at $t+1$, $E\{RoR_{t+1}\} \equiv \frac{E\{P_{t+1}\}}{P_t} - 1$.

Note how $E\{RoR_{t+1}\}$ is affected if P_t declines: It should be clear that $E\{RoR_{t+1}\}$ increases. Because $E\{RoR_{t+1}\}$ increases if P_t declines, lower bond prices make *PBBs* better off.

c) Thus, *ceteris paribus*, a decline in P_t makes RoR_t decline, but makes $E\{RoR_{t+1}\}$ increase! Saying the same thing differently, an *increase* in the current *interest rate*, i_t , makes RoR_t decline, but makes $E\{RoR_{t+1}\}$ increase. In general, higher interest rates hurt current bond owners but help prospective bond owners.

C) What about lenders who already own bonds *and* also plan to buy bonds in the future? They may be better or worse off, depending on the maturities of the bonds they already own, and depending on the maturities of bonds they may buy, and how long they plan to keep them. We ignore this complication, because it does not add anything to our understanding of how i_t is determined. You can find out more on the topic by looking up the term 'duration' in a finance text (or simply Google it).

D) To simplify the discussion, from now on for any bond that matures in one, or two, or any number of years in the future, represent the expected rate of return by dropping the time subscript, and writing, simply, $E\{RoR\}$.

II) The Quantity Demanded of Bonds and the Demand for Bonds

1) We assume the market for bonds is perfectly competitive. In perfectly competitive markets, supply and demand determine equilibrium prices. This section studies bond buying behavior. Recall from economics principles courses that there is an important distinction between "*quantity demanded*" and "*demand*." The quantity demanded for any commodity is a *specific* numerical amount buyers would

purchase at a *specific* price. In contrast, demand for a commodity is the entire set of quantities demanded corresponding to the set of all possible prices. E.G. of quantity demanded: If the price new cars is \$20,000, buyers would purchase 15 million new cars. E.G. of demand: $Q_d = 25 \cdot 10^6 - 500 \cdot P$. Demand is the *relationship* between quantity demanded and car prices. The demand curve (see below) is the graph that shows this relationship.

2) Bonds are demanded by savers and speculators. Savers are economic agents with a surplus of funds: savers' funds exceed their current consumption. A specific example is a household saving for retirement. Speculators are kind of tricky, because they demand bonds when buying bonds suits them, and supply bonds when selling bonds suits them. Speculators are agents who expect bond prices to change, and who, based on that expectation, are willing to buy or sell bonds in hopes of earning capital gains. A speculator who expects bond prices to increase in the near future, and is willing to take risk, demands bonds. A speculator who expects bond prices to decline in the near future, and is willing to take risk, sells bonds. The household sector's choice of how much to save has a permanent effect on the price of bonds. In contrast, speculators have only temporary effects. Therefore, we focus here on the way savers affect bond demand.

3) **Holding bond price constant**, what determines the demand for bonds? Savers' demand for bonds depends on their budgets and their preferences for risk and for current versus future consumption.² The fundamental reason savers buy bonds is because they expect to earn a *relatively* competitive income from bond ownership. Thus, the expected *relative* rate of return on bonds is one determinant of the demand for bonds. The other variables that determine bond demand are the relative risk of return on bonds, the relative liquidity of bonds, and savers' wealth. Here's why each of these variables affect bond demand:

A) *Expected relative rate of return on bonds*, $E\{RoR\}$:

a) Expected returns are crucial. The reason savers buy bonds, in the first place, is for the future income savers expect bonds to deliver.

b) However, as always, owning a bond has an opportunity cost, namely the expected rate of return on the best alternative asset. So what matters is the expected rate of return on bonds *relative* to the expected rate of return on alternative assets. Recall, from earlier discussion, that the best alternative to a bond is a real asset. Therefore, bond price constant, if the expected rate of return on bonds increases relative to the expected rate of return on real assets, the quantity demanded of bonds rises. From now on, think of the familiar symbol $E\{RoR\}$ as the expected *relative* rate of return on bonds.

c) If the **expected relative rate of return on bonds increases**, by substituting some bonds for some real assets, savers can expect to earn an increased return on their portfolios, so the **demand for bonds increases**.

B) Relative risk or return on bonds:

a) Bonds are "risky" because they may lose value if they default or if interest rates increase unexpectedly. Speaking very generally, the average amount that RoR deviates from $E\{RoR\}$ is a simple and useful measure of these risks. E.G., if the average

² Saver preferences for current versus future consumption is called "impatience to consume" and is discussed in Section IX.

deviation between RoR and $E\{RoR\}$ is, say, 1%, then it would be unusual for bonds to lose more than 1% of their value. If the average deviation is 15%, it would not be unusual for bonds to lose 1% of value, or even 14%. So a bond with an average deviation of 15% is much riskier than a bond with average deviation of 1%.

b) The average saver is risk averse. Therefore, if the **risk of return on bonds declines** relative to the risk of return on real assets, bond price constant, savers reduce the risk they face by substituting bonds for real assets, and the **demand for bonds increases**.

C) Relative liquidity of bonds: An illiquid asset is relatively hard to sell quickly unless the seller reduces the price. Therefore, savers prefer liquidity. Bond price constant, an **increase in bond liquidity** relative to liquidity on real assets, leads savers to substitute bonds for real assets, and **bond demand increases**.

D) Wealth and income: Bond price constant, an increase in household wealth and income increases quantity demanded of assets in general, so quantity demanded for bonds increases. Note that **wealth and income increases during economic expansions**, so **bond demand increases** when the economy expands.

III) How Does a Change in Bond Price Affect the Quantity Demanded of Bonds?

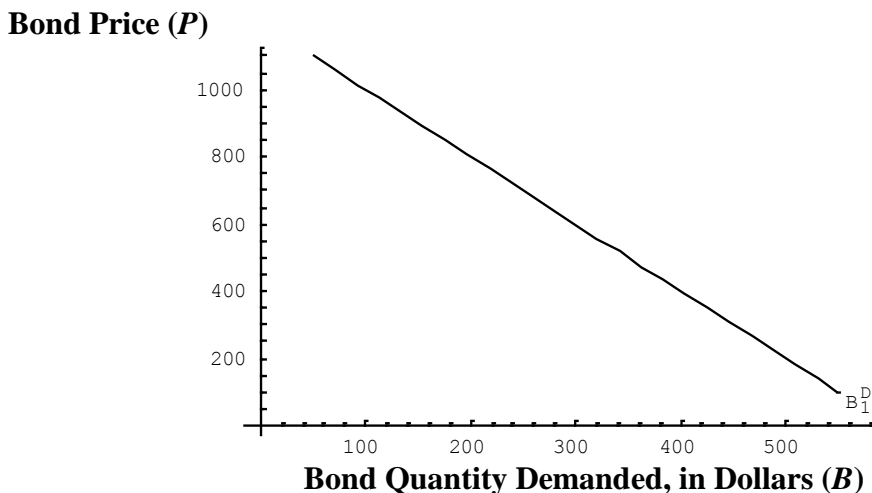
The previous section discussed how variables other than bond price affect demand for bonds. Next consider how the price of bonds affects quantity demanded, if all other variables are constant. Recall from earlier discussion that, all else constant, the lower is the current price of bonds, P_t , the higher is $E\{RoR\}$. This is clear for a one period bond, because $E\{RoR_{t+1}\} \equiv \frac{E\{P_{t+1}\}}{P_t} - 1$. In turn, the higher is

$E\{RoR\}$, the larger is the quantity demanded of bonds. Thus, if P_t goes down, $E\{RoR\}$ goes up, and quantity demanded rises: There is a negative relationship between bond price and the quantity demanded of bonds. When we say a demand curve is stationary, or "fixed," we mean its location does not change: the curve does not shift left or right. The negative relationship between bond price and bond quantity demanded is traced out by moving along a fixed demand curve, as the bond price changes, *ceteris paribus*.

IV) The Bond Demand Graph

1) The graph below shows bond demand. Demand refers to the entire set of prices (from 0 to 1,100) and all the corresponding quantities demanded (from 0 to 580).³ In contrast, the quantity demanded at the specific price of \$600 is about \$300 worth of bonds. Quantity demanded $P = \$200$ is about \$500 worth of bonds. All else constant, a decline in P from \$600 to \$200 causes quantity demanded to increase from about \$300 to \$400 dollars worth of bonds: This is a movement along a fixed demand curve.

³ Quantities are given in dollar units: 300 on the horizontal axis means \$300 dollars worth of bonds.



2) If a variable other than price changes, then the quantity demanded at each price changes, so the demand graph shifts its location left or right. The discussion is simpler if we focus on rightward shifts (increases) in demand. Any of the following changes in non-price variables causes the quantity demanded of bonds to increase, *at each price*, shifting the entire bond demand curve to the right:

- A) An increase in the bond's $E\{RoR\}$, bond price constant
- B) A decrease in the bond's relative risk of return, bond price constant
- C) An increase in the bond's relative liquidity, bond price constant
- D) An increase in savers' wealth, bond price constant

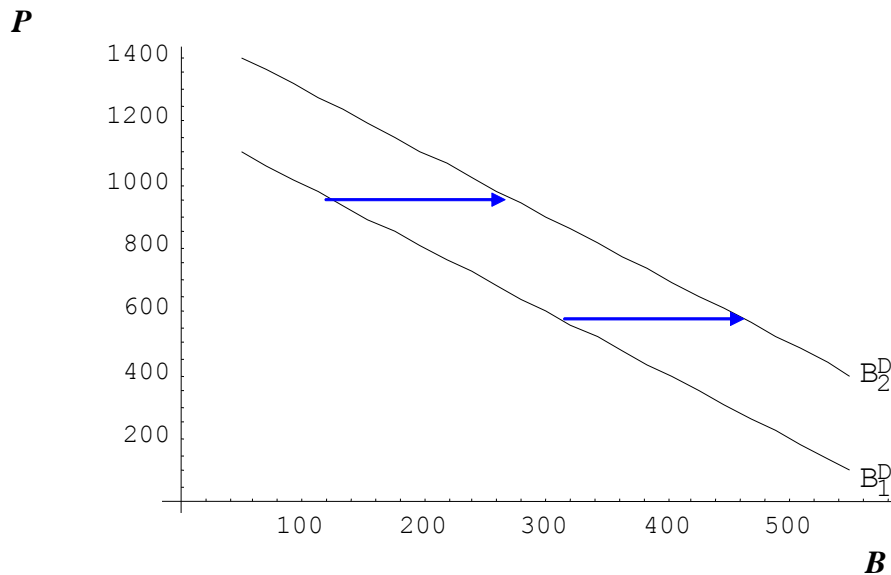
3) But that ain't all. A total of three different factors cause $E\{RoR\}$ to increase (price held constant)!

A) Decline in expected future inflation, π^e : If π^e declines, savers must believe that the real value of dollars will erode less quickly in the future. Thus, ceteris paribus, a decline in π^e means $E\{RoR\}$ must have increased.

B) Decline in expectations of the rate of return on alternative assets: The expected rate of return on real assets is the opportunity cost of owning bonds. Thus, ceteris paribus, a decline in the expected rate of return on real assets means $E\{RoR\}$ is larger.

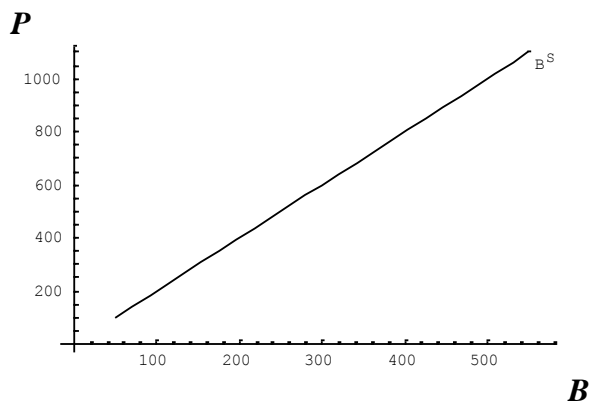
C) Decline in expectations of the future interest rate: If the interest rate declines in the future, the future price of bonds must increase. Thus, ceteris paribus, a decline in savers' expectations of the future interest rate means $E\{RoR\}$ increases.

4) The next graph shows the effect of an increase in $E\{RoR\}$ on the demand for bonds.



V) The Bond Supply Graph

- 1) The supply of bonds is the relationship between the quantity supplied of bonds and the price of bonds. That is, bond supply is the entire set of quantities supplied and prices traced out by a supply curve.
- 2) Bonds are supplied by borrowers, who are, in general, economic agents with a shortage of funds. I.E., borrowers' funds are temporarily less than their consumption. Specific examples are firms who wish to invest in real capital and governments whose tax collections fall short of government spending.
- 3) As well, *central banks* sometimes add to the supply of *government* bonds, and sometimes central banks decrease the supply. Note that Mishkin's textbook does not discuss these central bank effects on bond supply. Instead, the text discusses the central bank's role in the second part of Chapter 5, in the "Money Market" section. The bond market and the money market are two sides of the same coin, so we will not discuss the money market. Therefore, unlike the textbook, we discuss the central bank's role in the context of bond supply.
- 4) What is the relationship between P and the quantity supplied of bonds? All else constant, an increase P means the interest rate on bonds has decreased. This interest rate is the cost to firms of investing in real capital, so an increase in P lowers the cost of capital. Lower capital costs, in turn, increase the incentive for firms to invest in real capital. Firms sell bonds to finance the increase in investment. Thus, *ceteris paribus*, if P increases, the quantity supplied of bonds increases along a fixed supply curve: the bond supply curve has a positive slope. See the next graph.



- 5) But what causes the bond supply curve to shift to the left or shift to the right? That is, what variables

cause changes in the quantity supplied of bonds, *P held constant*? The answers are:

- A) Expected profitability of real investment opportunities
- B) π^e
- C) The government's budget
- D) Monetary policy

6) Explanations:

A) Expected profitability of real investment opportunities: A large source of bond supply originates in business investment in real capital. Business investment in real capital refers to spending on factories, machinery, *R&D*, etc. Holding *P* constant, if expected profitability of these real investments increase, say because productivity increases, firms tend to increase investment spending. In this case, firms must increase borrowing, so the quantity supplied of bonds increases.

a) Expected profitability of investment opportunities is strongly affected by economic activity. If economic activity slows, business firms tend to become pessimistic about profits, causing borrowing and the supply of bonds to decline. In economic expansions, businesses tend to become more optimistic, increasing the supply of bonds.

b) Note that the supply of bonds can be affected *temporarily* by changes in the expected future interest rate. E.G., this could happen if borrowers' current expectation of the future interest rate declines. These borrowers may reduce borrowing today, and wait to borrow until after the interest rate declines, to finance spending at the lower interest rate. However, this affects only the *timing* of borrowing, not the actual *amount*. Because changes in expected future interest rates do not change the net amount of borrowing over time, the theory of interest ignores the effect on supply from a change in expected future interest rates.

B) *P* constant, an increase in π^e decreases the real interest rate firms expect to pay, so borrowing and bond supply increase.

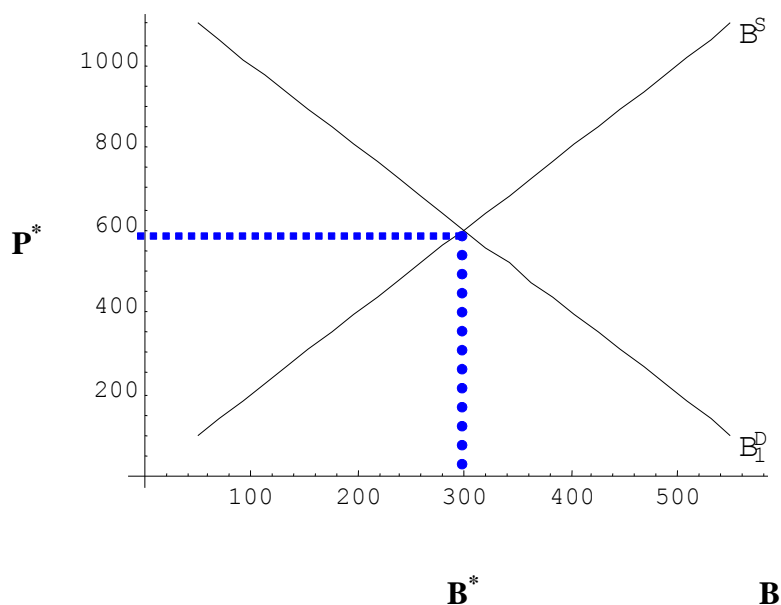
C) Suppose the government's budget initially is balanced (tax revenue equals government spending). *P* constant, if taxes decline, and/or government spending increases, the government must borrow by selling bonds, so bond supply increases.

D) If the central bank undertakes an expansionary monetary policy, it buys government bonds on the open market: *P* held constant, bond supply declines. Alternatively, if the central bank undertakes a contractionary policy it sells government bonds on the open market. *P* held constant, bond supply increases. Thus, central bank Open Market Operations shift the supply curve.

VI) Bond Market Equilibrium

Equilibrium *P* is established where bond demand equals bond supply. The next graph shows the bond market in equilibrium. \mathbf{P}^* and \mathbf{B}^* are the respective equilibrium price and quantity. Recall that *P* and the interest rate are opposite sides of the same coin. Therefore, the equilibrium interest rate also is established where bond demand equals bond supply, but this is implicit, and not directly shown in the graph:

P



VII) Shifts in Bond Demand and Supply and Fluctuations in the Price of Bonds

1) Variables that cause bond supply and demand to shift cause P^{α} to change. These variables are:

A) Demand shifters

- $E\{RoR\}$
 - π^e
 - the expected rate of return on alternative assets
 - the interest rate expected in the future
- relative risk of return
- relative liquidity
- wealth and income

B) Supply shifters

- expected profitability of investments
- π^e
- government borrowing
- central bank Open Market Operations

2) The text book describes four important applications in which changes in demand and supply shifters cause P^* to change. Read the applications carefully. We will not cover them in class.

3) The book does not discuss how contractionary or expansionary monetary policy affects P^* (and, thereby, the interest rate). We will. To see how this works in the U.S., suppose the Fed undertakes an expansionary policy, which is designed to decrease the interest rate (in order to encourage the economy to expand). To accomplish this, the Fed buys government bonds. This has a number of effects:

A) When the Fed buys government bonds, the supply of bonds declines (think of the Fed as a black hole where bonds disappear into the subterranean canyons of the Federal Reserve Building). This shifts the supply curve to the left. As a result the equilibrium price of bonds increases, so the equilibrium interest rate declines. Practice drawing a graph of the bond market to show this.

B) It is useful to understand how the expansionary monetary policy usually affects the money

supply. The Fed pays for the bonds by issuing banks new bank reserves, which commercial banks lend, increasing checkable deposits and the money supply.

VIII) The Fisher Equation (again)

Ceteris paribus, an *expected* increase in π would cause a decline the expected rate of return, $E\{RoR\}$, in real terms. The decline in real $E\{RoR\}$ will decrease savers' demand for bonds, shifting the bond demand curve to the left. At the same time, the decline in real $E\{RoR\}$ means that the cost of real capital is lower, so borrowers will benefit by increasing borrowing. This increases borrowers' supply of bonds, shifting the bond supply graph to the right. The net result of these two shifts is that the increase in expected inflation reduces P^* , increasing the equilibrium nominal interest rate, i_t . In the long run, i_t increases nearly one-for-one with π^e . This explains the Fisher equation, $i_t \equiv i_r + \pi^e$.

IX) Impatience, Saving, and the Demand for Bonds (material not discussed in the textbook)

1) Savers buy bonds. But some households, similar in every way to other households, save less than average. The difference reflects the fact that some households' preferences for current consumption are higher than others. Economists call this preference "impatience to consume." More generally, some countries tend to be less patient, and save less, than others.

2) E.G., technology and the structure of markets are similar in many ways in Japan and in the U.S., yet the U.S. saves a much smaller fraction of its income. Americans tend to be impatient, so they tend to consume a larger fraction of their incomes soon after incomes are received. The Japanese tend to be more patient, in the sense that they are more willing to put off consuming their incomes to the future, so they save more. In fact, for a long time now the Japanese (and more recently, Chinese) have been lending to the U.S., in effect financing U.S. impatience.

3) The Japanese save higher fractions of income than Americans. Therefore, as a fraction of *GDP*, bond demand tends to be higher in Japan than in the U.S, and interest rates in Japan tend to be lower than in the U.S. The conclusion is that a nation's willingness to save helps determine the interest rate.