ECO402: Intermediate Macroeconomics

Financial Markets I

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Questions:

- When you get a raise, typically does the amount of cash you hold and/or the monthly balance in your checking (not savings) account go up or down?
- If interest rates go up, would you hold more money in cash and/or checking accounts?
- If you make a loan to a friend for $1,000 with the agreement that they pay you back $1,050 in a year i.) Who owns the loan? ii.) What was the price of the loan? iii.) What was the annual interest rate on the loan?
- Suppose you're an expert forgery artist and you've counterfeited a large amount of $20 bills. You purchase $1,000 worth of long term treasury bonds from a friend. You intend to just sit on the bonds and do nothing with them for a while. What has happened to the supply of money (both real and fake) in the economy as a result of this transaction?
- How do you think the central bank controls the money supply based on the previous example?

1 The Demand for Money

- **Stock variable:** a variable that is measured at a specific point in time and its value depends on accumulation and depreciation over time.
- **Flow variable:** a variable that is measured over an interval (say a year or an hour). Stocks are the accumulation of flows.

Money: The most liquid asset. Can readily be used to pay for transactions. Currency and checkable deposits at a bank. A consumer's money holdings is a **stock** variable.

Income: What you earn from work plus what you receive in interest and dividends. It is a **flow** variable.

Saving: The part of after tax income that is not spent. It is a **flow** variable.

Wealth: The value of all your financial assets minus all your financial liabilities. It is a **stock** variable.

Financial assets that can be used directly to buy goods are called money. Money includes currency and checkable deposits. Money is also a stock. It is an asset that pays no interest. The measured sum of currency and checkable deposits is called **M1**.

Now assume that agents in our economy can only hold money and bonds. Bonds are an asset that pay a positive interest rate, **i**. Also, there is a transaction cost for turning bonds into cash. If you were to hold only money then you would not get any interest from your wealth. If you were to hold only bonds it would be costly when you needed money for transactions. Therefore two variables determine the level of money and bond holdings:

- *Level of Transactions:* If you typically spend \$3,000 per month you would typically want to have about two months (\$6,000) worth of spending on hand and the rest in bonds.

- *The interest rate on bonds:* The only reason you would want to hold bonds is that they pay interest. If bonds paid no interest you would hold money because that is more convenient.

1.1 Deriving the Demand for Money

We will refer to the **demand for money** as M^d. Let P be the price of the homogeneous good and Y be output. Finally let $L(i)$ be the **liquidity preference**, a function of the interest rate.

$$M^d = PYL(i)$$
$$(-)$$

As we have already stated, higher interest rates on bonds will make consumers want to hold less of their wealth in money. An increase in either the price level or output will increase the demand for money.

2 Determining the Interest Rate: I

For now, we will assume that checkable deposits do not exist and that currency is the only form of money. We will assume that the central bank chooses a fixed money supply $M^S = M$. Then equilibrium in financial markets requires that money supply equal money demand.

$$M = PYL(i)$$

The equilibrium relation can be seen graphically in (1a). The equilibrium interest rate is where money supply intersects money demand.

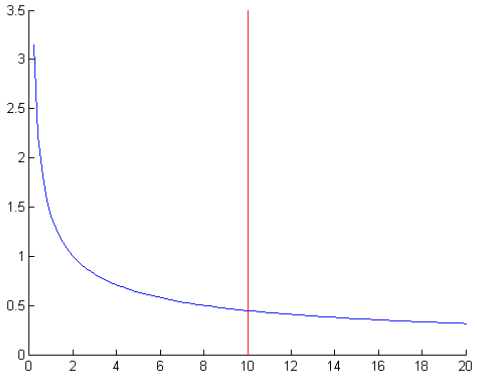
Now suppose that nominal GDP increases. This increases the level of transactions in the economy thus shifting the money demand curve upwards as now households want to hold more money at any given interest rate to help cover expenditures. This is illustrated in (1b). An increase in nominal income leads to an increase in the nominal interest rate.

Now consider the case where the central bank wants to increase the money supply as in (1c). Notice that an increase in the money supply decreases the interest rate. This decrease in the interest rate leads to an increase in the quantity of money demanded so that it equals money supply.

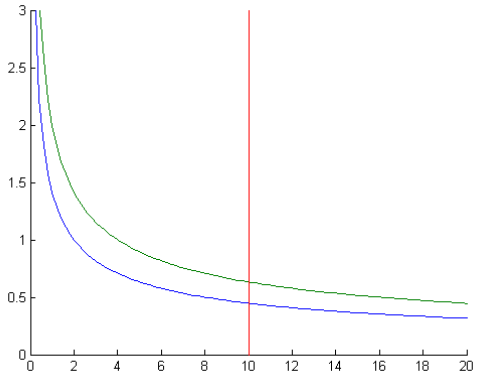
2.1 Monetary Policy and Open Market Operations

Open Market Operations: When the Fed buys and sells bonds to change the money supply. If the Fed buys bonds it pays for them with money it is adding to the economy, this is said to be a **expansionary open market operation**. If the Fed sells bonds it takes money out of circulation, this is referred to as a **contractionary open market operation**.

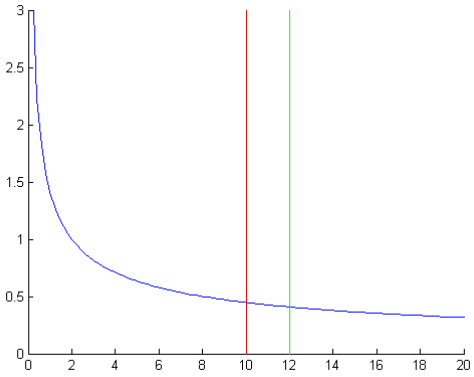
The Supply and Demand for Money



(a) Vertical axis is the interest rate, horizontal axis is quantity of money held. Red line is money supply and blue curve is money demand.



(b) Vertical axis is the interest rate, horizontal axis is quantity of money held. Red line is money supply, blue curve is money demand, and green line is money demand after the increase in nominal income.



(c) Vertical axis is the interest rate, horizontal axis is quantity of money held. Red line is money supply, blue curve is money demand, and green line is the increased money supply.

Figure 1

Central banks bond holdings are considered assets, and the total money supply in the economy is considered a liability to the central bank.

Equilibrium in the bond market directly determines the prices of bonds, not the interest rate. The nominal interest rate can be inferred by the equilibrium bond price. Suppose the economy only has one type of bond, and let's suppose it's a government bond with a **face value** of $100 and a **maturity** of one year, meaning it pays $100 a year from now. A bond

like this in the United States would be called a **Treasury Bill**. Let the price of the bond today be P_B. If you buy a bond today the rate of return a year from now is:

$$i = \frac{\$100 - \$P_B}{\$P_B}$$

So if the price of a bond is \$99 the interest rate is \$1/\$99 or about 1%. What is the interest rate if the price of a bond is \$90?

We can also rearrange the above formula to calculate the price of a bond given the interest rate:

$$P_B = \frac{100}{1+i}.$$

What this says is that the price of a bond is equal to the present value of its future payment.

Next consider expansionary monetary policy:

- The central bank purchases bonds in the bond market.
- The demand for bonds increases as a result so prices increase.
- This causes the interest rate on bonds to go down.
- And the Fed has also increased the money supply with the money used to purchase the bonds.

Discussion: What would happen with a contractionary open market operation?

What have we learned so far?

- The interest rate is determined by the equality of the supply and demand for money.
- By changing the supply of money the central bank can affect the interest rate.
- The central bank changes the money supply by conducting open market operations, the buying and selling of bonds.

- Buying bonds increases the money supply so these are called expansionary because they expand the money supply.
- Selling bonds reduces the money supply so these are called contractionary because they contract the money supply.

Be aware that modern central banks generally choose an interest rate to target and change the money supply to meet that target rather than choosing a money supply target. The process of selecting an interest rate can be approximated as a linear rule for the nominal interest rate.

$$i_t = \rho_t + \pi_t + \phi_\pi(\pi_t - \pi^*) + \phi_x x_t$$

Let's break this down: ρ_t is the **real interest rate** it is the real return of the asset. π^* is the interest rate that the central bank is targeting. x_t is the percentage **output gap** or the percentage deviation of real output from its **natural level** at time t, we will examine these concepts in more detail in future sections, for now just think of it as a "maximum occupancy" for the economy. Finally ϕ_π and ϕ_x are the intensities that the central bank responds to deviations from target of inflation and output.

3 Determining the Interest Rate: II

We now relax the assumption that currency is the only form of money in the economy. We allow money to include checkable deposits which are supplied by private banks.

3.1 What do Banks Do?

Financial Intermediates: Formal institutions that receive funds from individuals and firms and use those funds to buy assets or make loans to other individuals and firms.

Therefore, from the perspective of the banks, the assets they hold are the loans they

have granted and the financial assets they own. Deposits received, on the other hand, are liabilities for the financial intermediary.

- Banks receive funds from individuals and firms who either deposit funds directly or have funds sent to their checking account. At any point in time, the account holders can write checks or withdraw up to the full amount of their account balances. So the liabilities of a bank are equal to the value of the checkable deposits.

- As a result, banks keep some of these funds on hand as **reserves**. Reserves are kept for three reasons:

  - On any given day some depositors withdraw cash from their accounts and others deposit. These need not be equal so banks will hold some on hand to ensure they can meet the demand for withdraws.

  - On any given day people with accounts at the bank will write checks to people with accounts at other banks. Additionally, people at other banks will write checks to people with accounts at the bank. These flows need not be equal either and the bank may end up owing more to other banks than it has received so the bank will need to keep reserves for this as well.

  - Finally banks are required by law to hold a certain ratio of their deposits as reserves. In the United States that ratio is 10%. Banks are allowed to use the other 90% to make loans and buy bonds.

- Loans represent about 70% of a banks' non-reserve assets and bonds make up the rest. For the purposes of this unit we will assume that banks only hold bonds and do not make loans as the distinction between the two is not important for the model we are building.

We depart from the model used in the previous section and assume that not all of the central bank money is held as currency by the public, some of it is held as reserves by banks.

Table 1: Balance Sheets of Banks and Central Banks

Central Bank

Assets	Liabilities
Bonds	Central Bank Money =Reserves +Currency

Banks

Assets	Liabilites
Reserves Loans Bonds	Checkable Deposits

- The demand for central bank money is determined by the demand for currency by consumers plus the demand for reserves by banks.
- The supply of central bank money is controlled by the central bank, they choose the level.
- The equilibrium interest rate is the interest rate that clears the market for central bank money, ie that there is no excess demand/supply for central bank money.

3.2 The Demand for Money

We will assume that the overall money demand is the same as before:

$$M^d = PYL(i)$$
$$(-)$$

Now the question is how much is held in currency versus checkable deposits? Currency is more convenient for small and/or illegal transactions while checks are more convenient for large transactions. Checking accounts are also safer than holding cash in your wallet or keeping it taped on the back of paintings.

Assume people hold a fixed proportion of their money in currency and the rest as checkable deposits.

$$CU^d = cM^d$$

$$D^d = (1-c)M^d$$

Where CU^d is the demand for currency and D^d is the demand for checkable deposits.

3.3 The Demand for Reserves

Let R be the amount of reserves, D the the total amount of checkable deposits, and θ be the (required) reserve ratio. Then:

$$R = \theta D$$

If people want to hold D^d in deposits then banks must hold θD^d in reserves, so plugging in for D^d then the demand for reserves R^d is:

$$R^d = \theta(1-c)M^d$$

3.4 The Demand for Central Bank Money

Let H^d be the demand for central bank money, also referred to as the monetary base. It is simply the sum of CU^d and R^d. If plug in for these with their identities we get:

$$
\begin{aligned}
H^d &= cM^d + \theta(1-c)M^d \\
&= [c + \theta(1-c)]M^d \\
&= [c + \theta(1-c)]P * Y * L(i)
\end{aligned}
$$

3.5 Determination of the Interest Rate

Let H be the supply of central bank money. It is controlled completely by the central bank. The equilibrium condition is that the supply of central bank money be equal to the demand for central bank money $H = H^d$.

$$H = [c + \theta(1-c)]P * Y * L(i) \tag{1}$$

Discussion: What is the term in the brackets equal to when $c = 1$? What about when $c = 0$? What role does θ play?

4 The Federal Funds Market

We can also look at the supply and demand for bank reserves. The supply of reserves equals the supply of central bank money minus the demand for currency by the public.

$$H - CU^D = R^D$$

Federal Funds Market: The market where banks lend their excess reserves to banks that need more reserves.

Federal funds rate: The interest rate charged in the federal funds market.

Because the central bank can control H they can dictate the federal funds rate, which is why it is what people are most interested in when looking at US monetary policy.

5 The Money Multiplier

The equilibrium condition (1) was based on the supply and demand for central bank money. But we could also look at it as the overall money demand and money supply by dividing the bracketed term on both sides:

$$\frac{1}{c+\theta(1-c)}H = P * Y * L(i)$$

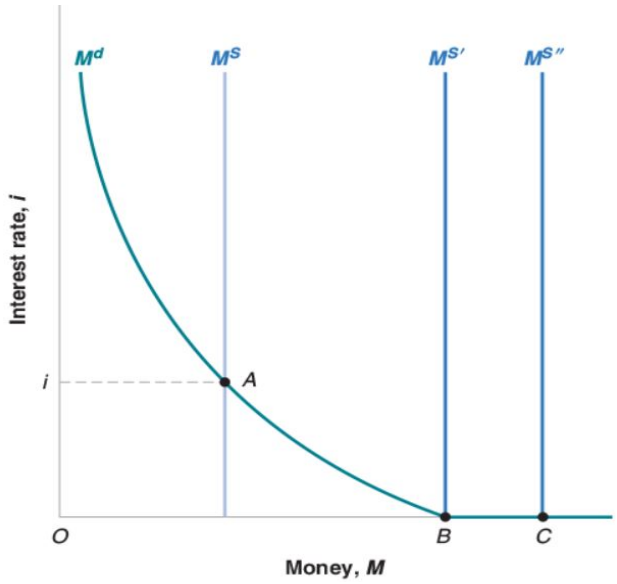
Note that the right hand side is what we have called the overall demand for money. The left hand side is the overall supply of money. Notice that the only difference between this equation and the one in an economy without banks is that there is a constant term being multiplied by the central bank money. This term must be greater than or equal to one, and so it is sometimes called the **money multiplier**.
Central bank money is also sometimes referred to as high powered money or the monetary base.

6 The Liquidity Trap

Till now, we have learned that by choosing the supply of central bank money, the central bank can choose the interest rate it wants:

- If it wants to increase the interest rate, it decreases the amount of central bank money.
- If it wants to decrease the interest rate, it increases the amount of central bank money.

Now the question is, can the interest rate be lowered indefinitely to negative? Actually, when the interst rate is lowered down to zero, monetary policy cannot decrease it any further. Monetary policy no longer works and the interest rate is stuck at zero, a constraint that is known as the zero lower bound. At this point, the economy is said to be in a **liquidity trap**.



Now suppose the central bank increases the money supply through an open market operation in which it buys bonds and pays for them by creating money. As the interest rate is zero, people are indifferent to how much money or bonds they hold. People now want to hold fewer bonds and more money at the same zero interest rate because of the convenience money provides as a medium of exchange.

7 Further Readings (And Listenings)

Blanchard and Johnson Chapter 4

Vox: The Greek crisis: 9 questions you were too embarrassed to ask (Dylan Matthew June 30, 2015)

Joe Stiglitz: How I Would Vote in the Greek Referendum (June 29, 2015)

Planet Money: Why We Left the Gold Standard (2011)