Lecture 10

Money and Inflation in the Long Run

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Economic Growth and
Economic Fluctuations

Three market arenas

Goods and Services Market

- Households, government and the rest of the world demand goods and services
- from firms and the rest of the world who supply those goods and services

Labor market

- Firms and government demand labor
- from households who supply labor

Money market

- Households and the rest of the world supply funds
- to other households who demand funds to finance various purchases, especially housing (and other expensive items)
- to firms who demand funds to finance investment expenditures
- to government who demands funds to finance budget deficits
- and to the rest of the world

The Money Market

- **Of the three market arenas described on the previous page, the only one we have not discussed yet is the money market.**
- **Money is the set of assets in an economy that people regularly use to buy goods and services from other people**
- **Money has three functions in the economy:**
  - **Medium of exchange – buyers give money to sellers in exchange for goods and services**
  - **Unit of account – the measure people use to post prices and record debts**
  - **Store of value – people can use money to transfer purchasing power from the present to the future**
- **Liquidity is the ease with which an asset can be converted into the economy's medium of exchange.** For example, a checking account is more liquid than a money market account because:
  - a checking account can be quickly converted into currency, whereas
  - a money market account cannot be converted as easily because there are limits to the number of checks a money market account holder can write in a month

The Federal Reserve System

- **The Federal Reserve (Fed) serves as the nation's central bank.**
  - **It is designed to oversee the banking system.**
  - **It regulates the quantity of money in the economy.**
- **The primary elements in the Federal Reserve System are:**
  1. the Board of Governors
  2. the 12 Regional Federal Reserve Banks
  3. the Federal Open Market Committee

- **Of the seven members of the Fed's Board of Governors, Chairman Ben Bernanke is the most important.**
- **The chairman directs the Fed staff, presides over board meetings and testifies about Fed policy in front of Congressional Committees.**

"Helicopter Ben" Bernanke

The Functions of the Fed

- **The Fed has three primary functions.**
  1. **The Fed regulates banks to ensure they follow federal laws intended to promote safe and sound banking practices**
  2. **The Fed acts as a lender of last resort – makes loans to banks when they find themselves in trouble**
  3. **The Fed controls the money supply – primarily through open-market purchases and sales of U.S. government bonds**
     - To increase the money supply, the Fed buys bonds from the public
     - To decrease the money supply, the Fed sells bonds to the public
- **The Federal Open Market Committee (FOMC) serves as the main policy-making organ of the Federal Reserve System.**
  - The FOMC is made up of the members of the Board of Governors and the presidents of the regional Federal Reserve banks
  - The meetings are chaired by the Chairman of the Board of Governors
- **The FOMC meets about every six weeks to review the economy and determine the course of monetary policy – i.e. they decide how much money to supply to the economy**

How the Fed Controls the Money Supply

- **The Money Supply is equal to the sum of deposits inside banks and the currency in circulation outside of banks**

Measures of Money

- **C** – currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions
- **M1** – the sum of currency, traveler's checks, demand deposits and other checkable deposits
- **M2** – the sum of M1, savings deposits, small-denomination time deposits and balances in retail money market mutual funds.
  - "savings deposits" include money market deposit accounts
  - "small denomination" refers to amounts under $100,000
  - M2 does not include individual retirement account (IRA) and Keogh balances

- **The Federal Reserve controls the money supply by:**
  1. increasing or decreasing the **required reserve ratio**
  2. increasing or decreasing the **interest rate** it pays **on reserves**
  3. increasing or decreasing the **discount rate**
  4. buying or selling government bonds on the **open market**

Bank Balance Sheet

- **Consider a bank's balance sheet.**
- **A bank's assets consist of:**
  - **Loans** – the most important asset of a bank
  - **Reserves** – vault cash and deposits with the Fed
- **A bank's liabilities consist of:**
  - **Deposits** – most important liabilities of a bank
  - **net worth ≡ assets – liabilities**

- "Net worth" is also called "bank capital."
- Bank capital mostly consists of shareholders' equity.
- When a bank suffers a loss on its portfolio of loans, the loss is also subtracted from the bank's capital.
  - The two sides of the balance sheet remain equal.
  - Owners of the bank are punished for the losses. Not depositors.

- The examples below simplify the discussion by setting the bank's net worth to zero. In practice, the bank would be closed if its net worth were zero.

The Required Reserve Ratio

- **The balance sheet of a bank:**
  - the sum of assets must equal
  - the sum of liabilities

Assets		Liabilities	
Reserves	20	100	Deposits
Loans	80	0	Net Worth
Total	100	100	Total

- **If the Fed has set the required reserve ratio at 20 percent and if the bank receives $100 in deposits, then:**
  - it holds $20 in reserve as vault cash or as deposits at the Fed
  - the other $80 can be used to make loans
- **The required reserve ratio determines the amount of money that is created from a deposit**
- **Imagine that there's only one bank in the economy, that bank receives $100 in deposits, that the required reserve ratio is 20 percent and the Fed pays no interest on reserves.**
  - The bank loans out $80, but when those $80 are used to make a purchase, they will be ultimately be deposited with the bank
  - So the bank will hold $16 of that new $80 deposit in reserve (20 percent of $80 is $16) and loan out the other $64
  - Since those $64 will be deposited with the bank, the bank will hold $12.80 of that $64 deposit in reserve and loan out the other $51.20

Creation of Money

- **The process described above continues until $400 worth of new deposits are created from the initial $100 deposit.**

Assets		Liabilities	
Reserves	100	500	Deposits
Loans	400	0	Net Worth
Total	500	500	Total

- The fact that there's more than one bank in the economy need not concern us. The assets and liabilities of our example's one bank represent the sum of the assets and the sum of the liabilities of all of the banks in the economy
- **The key thing to notice is that there is a relationship between:**
  - **the initial deposit ($100)**
  - **the total deposits created from that initial deposit ($500) and**
  - **the required reserve ratio (20 percent)**
- **The $100 initial deposit is 20 percent of the $500 in total deposits created**

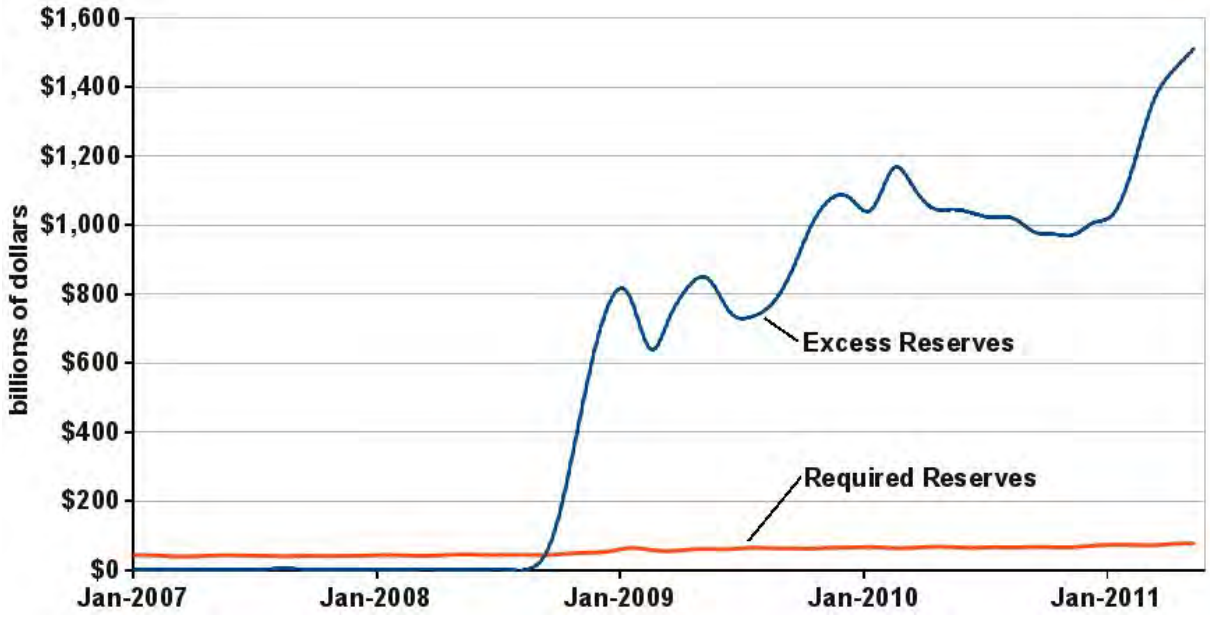
$$\text{money multiplier} = \frac{1}{\text{required reserve ratio}}$$

- **The Money Multiplier is the multiple by which deposits can increase for every dollar increase in reserves.**
- The Money Multiplier in this example is 5

Money Supply and the Required Reserve Ratio

- **What would happen if the Fed reduced the required reserve ratio?**
- **To continue the previous example, imagine that the Fed lowers the required reserve ratio to 10 percent.**
  - The bank now only has to hold in reserve $50 of the $500 worth of deposits and it has $50 in excess reserves.
  - So it loans out those $50 in excess reserves,
  - but those $50 will be ultimately be deposited, so the bank will hold $5 of that new $50 deposit in reserve and loan out the other $45
  - This process will continue until $500 in new deposits are created
- **Recall that the Money Supply is equal to the sum of deposits inside banks and the currency in circulation outside of banks**
- **So by lowering the required reserve ratio, the Fed can increase the money supply**
- **Conversely, if the Fed raises the required reserve ratio, it would decrease the money supply** – banks would cease to make new loans until enough outstanding loans were repaid that the bank has excess reserves to loan out

Required Reserves and Excess Reserves



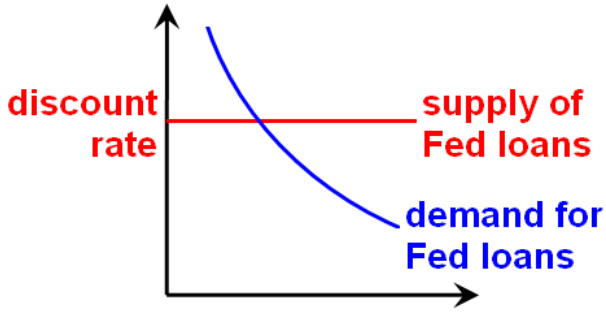
Source: Federal Reserve Statistical Release H.3, Table 1.

Money Supply and the Interest Paid on Reserves

- In response to the recent financial crisis, Congress authorized the Fed to pay interest on reserves. The Fed began paying interest in October 2008.
- **When the Fed pays interest on reserves, a bank with excess reserves can make new loans or leave the excess reserves on deposit at the Fed.**
- If the Fed pays a high interest rate on reserves, banks will hold more excess reserves. If the interest rate is low, banks will make more loans.
- **Note that paying interest on reserves reduces the money multiplier.**
- What's the purpose of paying interest?
  - When the Fed makes a loan to a bank at the discount window (see below), the bank will have excess reserves.
  - If the Fed does not pay interest, the bank will lend out its new excess reserves and push interest rates below the Fed's target level.
  - The Fed could push interest rates back up by selling some of its bonds (see below), but – if many banks borrow from the Fed – then the Fed will run out of bonds to sell before interest rates return to target level.
  - **Paying interest on reserves enables the Fed to lend to many troubled banks without altering the Fed's target interest rate or triggering a round of hyperinflation** (see below)**.**

Money Supply and the Discount Rate

- **the discount rate is the interest rate banks pay when they borrow from the Fed**
- **the money supply increases as banks borrow more from the Fed, since banks use the loans from the Fed to make loans themselves**
- **The discount rate is the cost of borrowing**
  - Banks borrow less when the discount rate is high
  - Banks borrow more when the discount rate is low
  - The discount rate is the price of a loan



- The Fed rarely uses the discount rate to control the money supply. The discount rate cannot be used to control the money supply with great precision, because its effects on banks' demand for reserves are uncertain.
- **Moral Suasion – pressure exerted by the Fed on member banks to discourage them from borrowing heavily from the Fed.**
- After all, the Fed regulates the banking system and no sane bank manager would want Fed regulators examining every detail of the bank's business

Money Supply and Open Market Operations

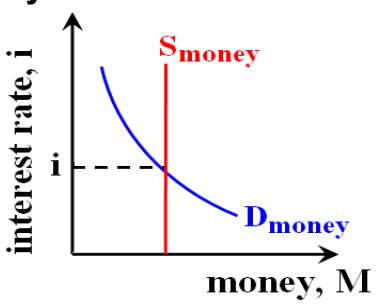
- **The main way the Fed conducts monetary policy is through purchases and sales of government bonds**
- **So let's say the required reserve ratio is 10 percent**
- **and let's say the Fed sells Jane Q. Public a $10 bond and that to pay for the bond, Jane writes a check to the Federal Reserve**
  - **that sale reduces the Fed's assets** (bond holdings) **by $10**
  - **there's no change in Jane's <u>total</u> assets, but her deposits at her bank decline by $10**
  - **her bank passes $10 to the Fed by reducing its reserves at the Fed**
  - **the bank's liabilities fell by $10 and its assets also fall by $10**
- **Notice that the bank now has a deficit of reserves, so it must further reduce its deposits by another $90 by "calling in loans"** (it ceases to issue new loans until over $90 in outstanding loans have been repaid)
- **By selling Jane a $10 bond, the Fed reduces the money supply $100**
  - the Money Supply is equal to the sum of deposits inside banks and the currency in circulation outside of banks
  - total bank deposits have fallen by $100 – through a $10 reduction in Jane's deposits and a $90 reduction in deposits created through loans

Money Supply and Open Market Operations

- **An open market sale of government bonds**
  - results in a decrease in bank reserves and
  - **results in a decrease in the money supply** – equal to the money multiplier times the value of bonds sold (which is equal to the change in bank reserves)
- **An open market purchase of government bonds**
  - results in an increase in bank reserves and
  - **results in an increase in the money supply** – equal to the money multiplier times the value of bonds purchased (which is equal to the change in bank reserves)
- **Open market operations are the Fed's preferred means of controlling the money supply because:**
  - they can be used with some precision
  - are extremely flexible and
  - are fairly predictable

Supply and Demand for Money

- **If the Fed chose a quantity target for the money supply, then a vertical supply curve would represent the quantity of money that the Fed chooses to supply regardless of the resulting interest rate**
- **But this isn't what the Fed does.**
- **When you hear about the Fed in the news you** (usually) **hear that the Fed has raised or lowered the Federal Funds Rate**
  - banks with excess reserves lend to banks in need of reserves
  - the Federal Funds Rate is the interest rate banks are charged when they borrow reserves from other banks
  - the Fed's buys and sells government bonds through its open market operations to keep the Federal Funds Rate at the level it has set
  - **the money supply is implicitly determined by:**
  - **the choice of Federal Funds Rate** (which affects all other interest rates in the economy)
  - **the demand for money**
- To introduce the relationship between money and interest rates, we'll focus on the case where the Fed directly chooses the money supply.



The Demand for Money

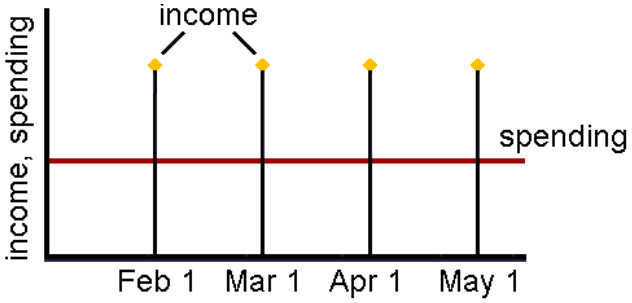
- **people hold money because it facilitates the purchase goods and services, but when you hold money you forgo the interest you could have received by holding interest bearing assets**
- **The interest rate is opportunity cost of holding money, so our main interest in studying the demand for money is:**
  - **How much of your financial assets you want to hold in the form of money,** (which does not earn interest)**,**
  - **versus how much you want to hold in interest-bearing assets?**
- **In this lecture, we'll examine two theories that seek to explain why the demand for money is a decreasing function of the interest rate:**
  - **transactions motive –** this theory focuses on how money facilitates the purchase of goods and services
  - **speculation motive** – this theory focuses on forecasts of future interest rates
- Both theories predict that:
  - people will want to hold less money when the interest rate on interest bearing assets is higher
  - people will want to hold more money when the interest rate on interest bearing assets is lower

The Transactions Motive

- **There's a trade-off between:**
  - **the liquidity of money** and
  - **interest income offered by other assets** – the interest rate is the opportunity cost of holding money
- **For simplicity, we'll assume that there's only one alternative financial asset to money – government bonds – and that there is no inflation.**
- **We'll also assume that:**
  - a typical household's income arrives once a month, but
  - the typical household spends the same amount each day
  - spending over the month is exactly equal to income for the month

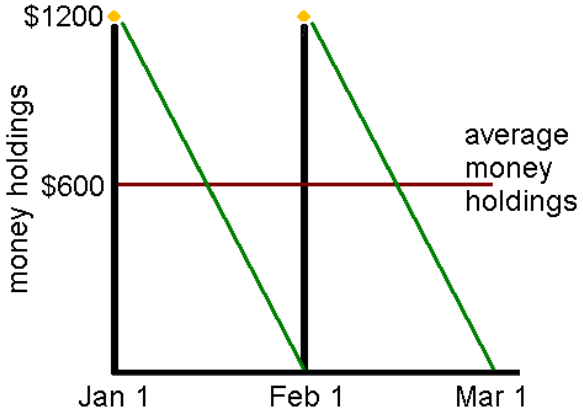
Non-synchronization of Income and Spending

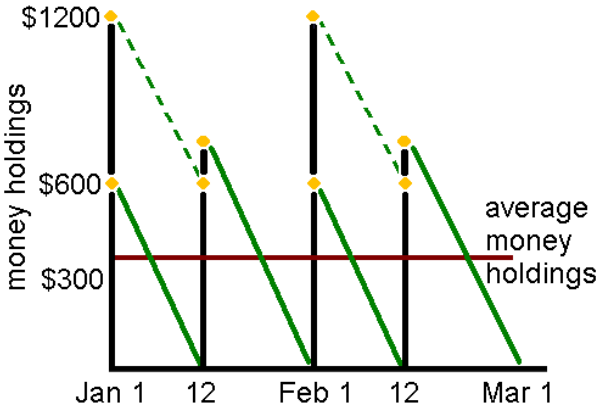
- **The assumptions above imply a mismatch between the timing of money inflow and the timing of money outflow**
- **Income arrives once a month, but spending takes place continuously**



Money Management and the Transactions Motive

- Consider a household that receives a $1200 paycheck at the beginning of the month
- The household could deposit the entire $1200 paycheck into a checking account at the start of the month and run the balance down to zero by the end of the month.
- The household's average monthly money holdings would be $600





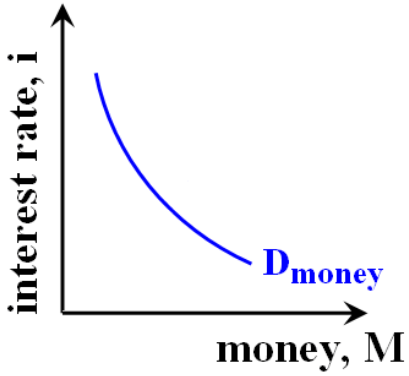
- The household could also deposit half of the paycheck ($600) into a checking account and use the other half to buy $600 in bonds
- Shortly before mid-month, the household could sell the bonds and deposit the $600 and the interest earnings into the checking account
- Average money holdings in this case would be slightly higher than $300

Optimal Balance in the Transactions Motive

- **Why not hold the entire paycheck in bonds** (where it earns interest) **and make transfers from bonds to money every time the household wants to make a purchase?**
- **If there were no cost to transferring the bond into money and if there were no cost involved in making the necessary trips to the bank, then the household would never hold money for more than an instant.**
- **At the very least however, there's a cost in terms of lost time and convenience. These are *figuratively* called shoeleather costs** (since more frequent trips to the bank wear out your shoes more quickly)
- **Switching wealth from bonds to money more often:**
  - **earns the household a higher level of interest income, but**
  - **increases shoeleather costs**
- **The optimal balance is the level of average money holdings that earns the household the most profit after taking into account:**
  - **the interest earned on bonds and**
  - **the cost paid for switching from bonds to money**

Optimal Balance in the Transactions Motive

- **A higher interest rate:**
  - corresponds to a lower optimal money balance
  - people want to take advantage of the high return on bonds, so they choose to hold very little money
- **A lower interest rate:**
  - corresponds to a higher optimal money balance
  - people choose to hold more money because interest rate is too low to make frequent transfers from bonds to money worthwhile



- **The Speculation Motive that we will examine below also explains why the quantity of money that households choose to hold**
  - falls when interest rates rise and
  - rises when interest rates fall
- **In other words, the Speculation Motive also provides an explanation of the downward sloping money demand curve.**

The Speculation Motive

- **Consider a risk-free bond at a price of $100 that pays a $5 return.**
- **If the price of the bond remains constant, then the "yield" on the bond will remain at 5 percent.**
- **But what if another risk-free bond is offered at a price of $100, but this other bond offers a $10 return?**
  - Since both bonds are risk-free it would be preferable to hold the bond that offers a 10 percent rate of return.
  - So the demand curve for the bond that pays a $5 return will shift inward and drive the price of the bond that pays a $5 return to $50.
  - Why $50? Because at a price of $50, the **rate of return** (the interest rate) is equalized across bonds – i.e. $5 is 10 percent of $50

$$\text{rate of return} = \frac{\text{return on bond (in dollars)}}{\text{price of bond (in dollars)}}$$

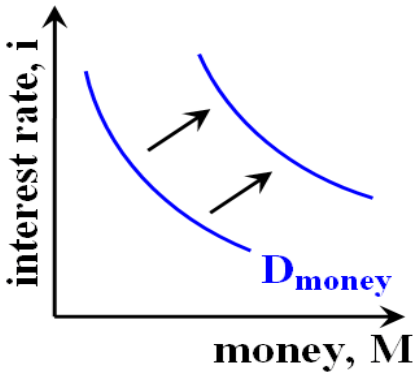
- **If rates of return are high and you expect them to fall, you will buy bonds and hold lower money balances – you are speculating that the price of the bond will rise.**
- **If rates of return are low and you expect them to rise, you will sell bonds and hold higher money balances – you are speculating that the price of the bond will fall.**

The Total Demand for Money

- **The total quantity of money demanded is the sum of the demand for checking account balances and cash by both households and firms**
- **The quantity of money demanded at any moment depends on:**
  - **the interest rate** – a higher interest rate raises the opportunity cost of holding money and thus reduces the quantity of money demanded
  - the **total dollar volume of transactions made** which depends on:
    - **the total number of transactions and**
    - **the average transaction amount**

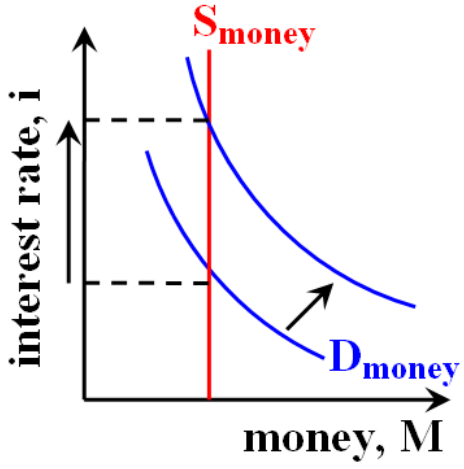
Transactions Volume – Output and Prices

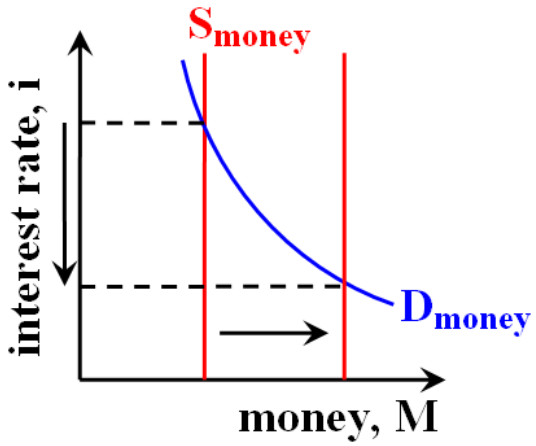
- **the money demand curve shifts out when:**
  - **output (income) rises – the total number of transactions rises** – to purchase the higher amount of goods and services produced when output rises individuals need more to hold more money
  - **the price level rises – the average dollar amount of each transaction rises**, so individuals need more money to make each transaction



Money and Interest Rates

- **If the money demand curve shift out** (due either to higher GDP or a higher price level)**, then:**
  - **the equilibrium interest rate will rise**
  - **ceteris paribus** – so long as the money supply remains constant





- **If the Fed increases the money supply, then:**
  - **the equilibrium interest rate will fall**
  - **ceteris paribus** – so long as the money demand curve remains unchanged

The Quantity Theory of Money

- **The quantity theory of money asserts that:**
  - **the quantity of money available determines the price level**
  - **the growth rate of the quantity of money available determines the inflation rate – the percentage increase in the price level** (in the U.S.. the inflation rate averaged about 2 percent per year during the 1990s)
- **The quantity of money available is closely related to the number of dollars exchanged in transactions.**
- **The quantity equation links Money and Transactions:**

money	×	velocity	=	price	×	transactions
M	×	V	=	P	×	T

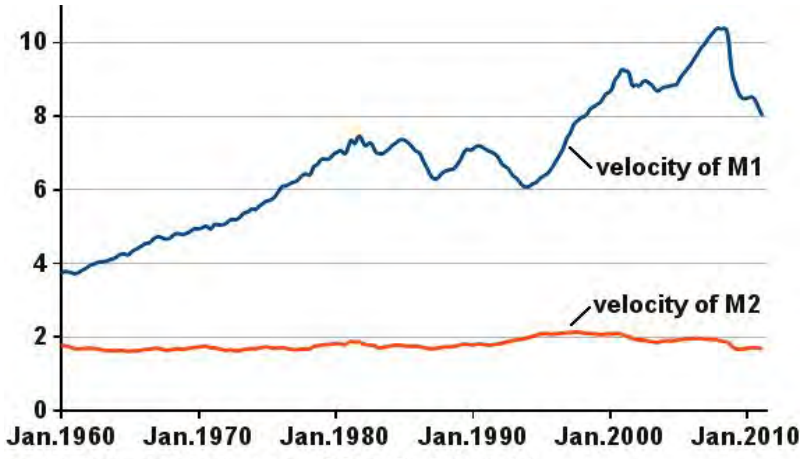
- the version of velocity given here is the transactions velocity of money – the rate at which a dollar bill circulates in the economy
  - **If the economy only produces hamburgers and the economy produces** (and therefore sells) **100 hamburgers per year, then there are 100 transactions in the economy every year.**
  - **If the price of a hamburger is $1 and there are quantity of money available in the economy is $20, then the velocity is 5 per year – each dollar bill changes hands five times per year**

The Quantity Equation

- **In practice, it's difficult to measure the number of transactions conducted in a year.** As we observed above however, the number of transactions increases when output (income) rises, **so the dollar value of transactions is roughly proportionate to the dollar value of output.**
- **with a definitional change we can rewrite the quantity equation as:**

money	×	velocity	=	price	×	output
M	×	V	=	P	×	Y

- the version of velocity here is the income velocity of money – the number of times a dollar enters a person's income in a year
- **We'll assume that velocity is constant, but this might not be a good assumption**



source: Federal Reserve H.6 and BEA NIPA Table 1.1.5

Money Demand and the Quantity Equation

- **When we introduced the demand for money we examined the demand for nominal money balances** – holdings of dollar bills
- **however, our ultimate goal is to analyze the way in which money affects the economy, so it's convenient to express the quantity of money in terms of the quantity of goods and services money can buy**
  - For example, if you hold a nominal money balance of $50 and the price of a hamburger is $2, then you can buy 25 hamburgers
  - the 25 hamburgers is your real money balance
  - **real money balances** are equal to M/P
- using the assumption that velocity is constant, $\overline{V}$, **we can use the quantity equation to derive a simple demand function for real money balances:**

$$M \cdot \overline{V} = P \cdot Y \quad \Rightarrow \quad \frac{M}{P} = \frac{Y}{\overline{V}} \quad \Rightarrow \quad \mathbf{(M/P)_D = kY} \qquad \text{where: } \overline{V} = 1/k$$

- **The money demand function we just derived states that the economy's demand for real money balances is proportionate to GDP –** which is consistent with the demand function described earlier
- The interest rate doesn't appear in this demand function, but don't worry. We'll put it back in later.

Money, Prices and Inflation

- **Nominal variables are variables measured in monetary units**
  - Nominal GDP is the total value of final goods and services produced in a country in a given period – it is measured in terms of the price level that prevailed during that period
- **Real variables are variables measured in physical units**
  - Real GDP figures can be used to measure differences in output levels over time, because the prices used to calculate Real GDP are constant over time

♦ ♦ ♦

- **Recall that the quantity theory of money asserts that the quantity of money available determines the price level**
  - If velocity is constant: $\overline{V}$
  - If the levels of physical capital, human capital, labor and technology determine the level of output, then real GDP, at a given moment in time is constant: $\overline{Y}$
  - Then the quantity equation becomes:

$$M \cdot \overline{V} = P \cdot \overline{Y}$$

  - and the quantity of money available determines the price level and nominal GDP, $P \cdot Y$

Money, Prices and Inflation

- **Recall also that the quantity theory of money asserts that the growth rate of the quantity of money available determines the inflation rate – the percentage increase in the price level**
- **To see this, we'll use our calculus tricks:**

$$M(t)\cdot V(t) = P(t)\cdot Y(t) \quad \Rightarrow \quad \frac{\dot{M}}{M}+\frac{\dot{V}}{V}=\frac{\dot{P}}{P}+\frac{\dot{Y}}{Y}$$

$$\%\Delta \text{ money} + \%\Delta \text{ velocity} = \%\Delta \text{ prices} + \%\Delta \text{ output}$$

  - **The percentage change in the quantity of money available is under the control of the Fed.**
  - **We've assumed that velocity is constant, so the percentage change in velocity is zero.**
  - **The percentage change in prices is the inflation rate.**
  - **The percentage change in output depends on the growth rate of the factors of production and technological progress.**
- **So the inflation rate depends on the rate of growth of output and the growth rate of the money supply.**
- **The quantity theory of money therefore implies that the Fed has the ultimate control over the inflation rate.**

The Fisher Equation

- **If you saved $100 by purchasing a one-year government bond that provides a $10 return** (i.e. a 10 percent rate of return)**, then will you be $10 richer at the end of the year?**
- **Not necessarily.**
  - **If the inflation rate was 15 percent, then your end-of-year $110 would not be able to buy as much as the beginning-of-year $100**
  - **In fact, your purchasing power would have fallen by 5 percent**
  - **Only if the inflation rate was <u>less</u> than 10 percent, would your end-of-year $110 be worth more than the beginning-of-year $100**
- **nominal interest rate – rate of return that you receive on a government bond or other financial asset**
- **real interest rate – the percentage change in your purchasing power that you receive after accounting for inflation**

$$\text{real interest rate} = \text{nominal interest rate} - \text{inflation rate}$$

$$r = i - \pi$$

- **the real interest rate is the difference between the nominal interest rate and the rate of inflation**

The Real Interest Rate

- **the real interest rate, r, is NOT the rental rate on capital, BUT the two concepts are related to each other.**
  - the real interest rate is expressed as a percentage
  - the rental rate on capital is expressed in dollars (per unit of capital)
- **Lecture 3 mentions a normal rate of return on capital, which equals** (or exceeds) **the real interest rate on risk-free government bonds**

$$\text{normal rate of return on capital} = \frac{\text{rental rate on capital (in dollars)}}{\text{purchase price of capital (in dollars)}}$$

- **Since firms hire capital until the rental rate on capital equals the price of output times the marginal product of capital, i.e.** $p \cdot MPK$**,**
  - an increase in the price of output will not affect the normal rate of return on capital
  - so long as the purchase price of capital increases at the same rate as the price of output
- **the real interest rate therefore corresponds to the normal rate of return on capital and should be fairly constant**
- **in the long run, the real interest rate should only change if the marginal product of capital changes**

The Real Interest Rate

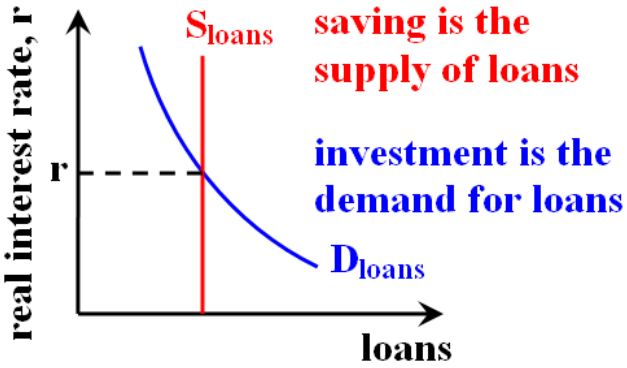
- **So what would cause the marginal product of capital to change?**
- **As we saw in the lectures on economic growth the marginal product of capital shifts outward when:**
  - the stock of human capital increases
  - the labor force increases
  - the level of technology increases
- **We also saw that** – for given levels of the stock of human capital, the labor force and the level of technology – **the marginal product of capital is a decreasing function of the stock of physical capital**
  - an underdeveloped economy – i.e. an economy with less capital per unit of effective labor – will have a higher marginal product of capital and a higher real interest rate than
  - a more developed economy – i.e. an economy with more capital per unit of effective labor – since the more developed economy will have a lower marginal product of capital

♦ ♦ ♦

- **Since the real interest rate reflects** $p \cdot MPK$**, the real interest rate determines how much capital firms wish to hire:**
  - Firms invest less in new capital when the real interest rate is higher
  - Firms invest more in new capital when the real interest rate is lower

The Real Interest Rate

- **Since investment in new capital is a decreasing function of the real interest rate, we can draw a downward sloping investment demand schedule**
- **In the lectures on economic growth, I asserted that the saving rate is exogenous and does not depend on the real interest rate**
  - if the saving rate is exogenous, then the supply of loanable funds needed to finance new investment would be represented by the vertical line in the graph shown below
  - if the saving rate depends on the real interest rate, then the supply of loanable funds would have the usual upward slope
- **In a closed economy, the equilibrium interest rate adjusts to ensure that saving equals investment.**
- I've asserted that firms use loans to finance capital investment, but similar supply and demand schedules describe other sources of finance.

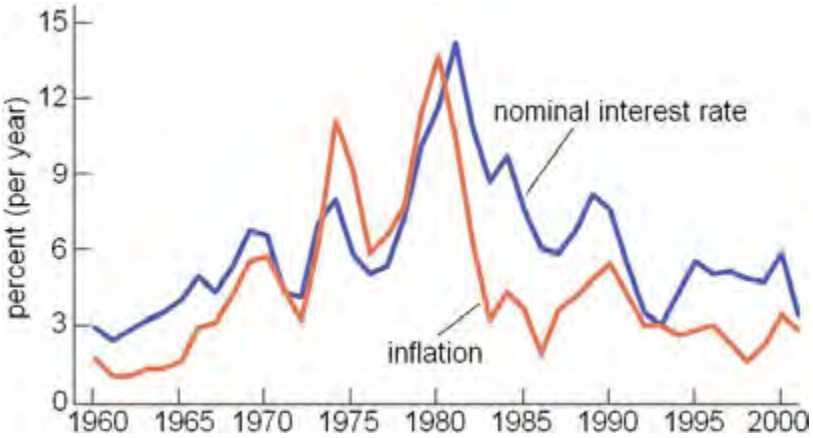


The Fisher Effect

- **Rewriting the Fisher Equation:**

$$i = r + \pi$$

shows that the nominal interest rate can change for two reasons:
  - because the real interest rate changes or
  - because the inflation rate changes
- **since the real interest rate is fairly constant, there should be a one-to-one adjustment of the nominal interest rate to the inflation rate**



- **the figure above illustrates the Fisher Effect – a one percentage point increase** (decrease) **in the inflation rate <u>should</u> increase** (decrease) **the nominal interest rate by one percentage point**

The Fisher Effect

- **So why isn't there a perfect correlation between the nominal interest rate and the inflation rate?**
  - one explanation is a shift in the marginal product of capital
  - a better explanation involves expectations

Two Real Interest Rates: Ex-Ante and Ex-Post

- **when a borrower and a lender agree on a nominal interest rate, they do not know what the inflation rate will be over the term of the loan**
- **so they try to predict what the inflation rate will be based on:**
  - past inflation rates and
  - the statements and behavior of the Fed
- **the ex-ante real interest rate is the nominal interest rate minus the expected inflation rate:** $i - \pi^e$, where π^e is the expected inflation rate
- **the ex-post real interest rate is the nominal interest rate minus the actual inflation rate:** $i - \pi$, where π is the actual inflation rate
- **Since the nominal interest rate can only adjust to expected inflation, the Fisher Effect is more precisely written as:**

$$i = r + \pi^e$$

The Demand for Money

- **When we discussed the Transactions Motive and the Speculation Motive, we saw that the demand for money is a decreasing function of the nominal interest rate – the opportunity cost of holding money**
- **When we discussed the Quantity Theory of Money we derived a demand for money that depends on income**
- **So, in general, the demand for real money balances is a function of the nominal interest rate and income:**

$$(M/P)_D = L(i, Y)$$

where L is used to denote the demand for the liquid asset – money

- **Equating the supply of real money balances to the demand for real money balances and using the Fisher Equation, we can write:**

$$M/P = L\left(r + \pi^e, Y\right)$$

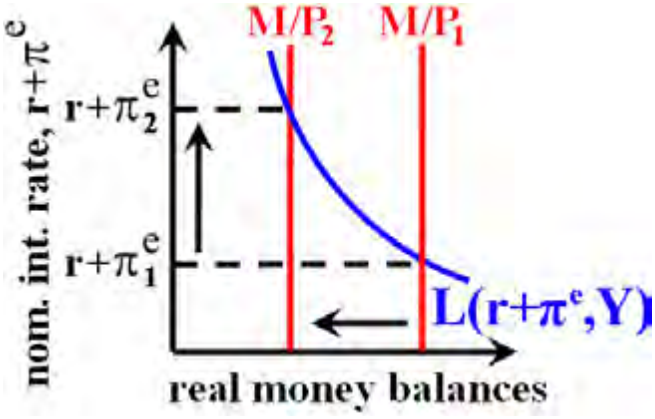
- **The equation above tells us that when the nominal interest rate and output are held constant, the quantity of money available will determine the price level – as the Quantity Theory of Money asserts**
- **However, this is not the end of the story …**

The Demand for Money

- **The nominal interest rate is not constant over time. It depends on expected inflation which depends on:**
  - the rate of money growth
  - past inflation rates and
  - the behavior and statements of the Fed
- **So the price level depends not just on today's money supply, it also depends on the money supply that is expected to prevail in the future**
- **For example, if the Fed were to announce that it would increase the money supply *next year*, then:**
  - people would expect higher inflation
  - nominal interest rates would rise *today* and
  - people would *immediately* reduce their holdings of real money balances
- **Today however, the Fed still has not increased the money supply, so the only way the level of real money balances can fall is if the price level rises**
- **The expectation of future inflation causes inflation – in the form of an immediate increase in the price level.**

The Demand for Money

- **Below is a graphical illustration of how the expectation of inflation causes inflation** (discussed in the previous slide)**:**



- **Remember that we're discussing money and inflation in the long run.**
- **In the long run, the real interest rate is fairly constant, but inflationary expectations can change.**
- In Lecture 12 (when we discuss the money market in the short run), we'll assume that – in the short run – inflationary expectations are constant and allow the real interest rate to change.

The Costs of Inflation

- **shoeleather costs – the resources wasted when inflation encourages people to reduce their money holdings** (and make more frequent shifts from interest-bearing assets, like bonds and savings accounts, into money)
- **menu costs – the costs of adjusting prices**
  - During periods of high inflation, it is necessary to update price lists and other posted prices more frequently
  - This is a resource-consuming process that takes resources away from other productive activities
- **relative price variability** –
  - if a firm issues a new catalog every January and the annual inflation rate is 12 percent, then the real price of the firm's products relative to other products will be 12 percent lower at the end of the year
  - Since inflation distorts relative prices, consumer decisions are distorted and markets are less able to allocate resources to their best use
- **tax distortions – inflation exaggerates the size of capital gains**
  - If you were to buy a stock for $100 today and sell it for $112 a year from now, you would have to pay a tax on your $12 capital gain
  - but if the inflation rate over the year were 12 percent, then your capital gain merely reflects inflation. Nonetheless, you get taxed anyway.

The Costs of Inflation

- **confusion and inconvenience** –
  - inflation erodes the real value of the unit of account because dollars at different times to have different real values
  - inflation therefore makes it more difficult to compare real revenues, costs and profits over time
- **arbitrary redistribution of wealth** –
  - When inflation is unexpected, ex-post real interest rates are lower, thus transferring wealth from lenders and to borrowers
  - Such transfers redistribute wealth in a way that has nothing to do with either need or merit

So why would a central bank ever allow its country to endure hyperinflation?

- **One reason why countries may experience hyperinflation – a rate of inflation that exceeds 50 percent per month – is because the government receives revenue from printing money**
- **Another reason is because disinflation – the process of reducing inflation – can cause high unemployment in the short-run** (we'll discuss this more in Lecture 14)

Monetary Neutrality

- **On the last page, I wrote that disinflation can cause unemployment in the short-run. Can it cause unemployment in the long run? NO.**
- **In the long run, the level of unemployment depends on the natural rate of unemployment., which is caused by:**
  - frictional unemployment and
  - structural unemployment

- **In this lecture, we also saw that the quantity of money available determines the price level and Nominal GDP**
- **Can the quantity of money available or the rate of growth of the money supply ever affect Real GDP? Yes, but only in the short run.**
- **In the long run, physical capital, human capital, labor and technology determine Real GDP – the level of output**

- **monetary neutrality – In the long run, the money supply does not affect real economic variables – such as output and the level of employment**

The Classical Dichotomy

- **According to the classical dichotomy:**
  - different forces influence real and nominal variables
  - changes in the money supply affect nominal variables but not real variables

- **Most economists believe that the classical dichotomy holds in the long run, but not in the short run**
- **As we'll see in Lectures 12, 13 and 14, the economy is subject to fluctuations in the short-run which can be affected by** (or caused by) **changes in the money supply**