Lecture 8: Money and inflation  
(chapter 7)

1) Definitions:
   Def: money: stock of assets that can be readily used to make transactions.

   Includes:
   currency  (used for transactions)
   and demand deposits (checking accounts - write check to make transaction, similar to currency, is very liquid
   Call this: M1 = currency and demand deposits

   other forms fairly easily converted to liquid form
   M2 = M1 + saving accounts
   M3 = M2 + larger time deposits

   Serves 3 functions:
   1) medium of exchange, not need double-coincidence of wants
   2) store of value - hold on and spend tomorrow (worry about rise in price)
   3) unit of account- way of measuring price of goods and wealth. Nominal terms v. real terms.

   Fiat money: no intrinsic value, valued because others will accept it for transactions
   (not commodity money - gold)

   Control quantity of money supply: central bank (federal reserve)
   By open market operations: Fed uses dollars to buy government bonds from public, increases quantity of dollars in circulation. (Detail later chapter)

2a) Quantity theory of money

   Idea: since people hold money to buy goods, more transactions means more money will hold.

   Define velocity:
   velocity = Price x Transactions / Money supply
   \[ V = P \times T / M \]

   Top is value of transactions in dollars: number of dollars that change hands.
   Bottom is number of dollar bills that exists. Dollars circulate and get used for multiple transactions.
Velocity is rate at which money circulates in economy. Number of times a dollar bill chances hands in a year.

Rearrange:
\[ M \times V = P \times T \]

Example:
Right side: \( PT = 0.5\$/loaf \times 60 \text{ loaves/year} = 30\$/\text{year} \)
Suppose are \( M=10\$ \) in economy, then velocity must be:
\[ V = \frac{PT}{M} = \frac{(30\$/\text{year})}{(10)} = 3 \text{ times per year} \]
This is an identity: defined velocity so is true. Useful because tells us if one variable changes, then so must at least one of others.

It is more useful to write in form with output not transactions:
\[ M \times V = P \times Y \]
If assume velocity is constant, then becomes a theory of what determines price level, not just identity:
\[ M \times V-bar = P \times Y \]

Combine with theory that \( Y \) is determined by \( K \) and \( L \), unaffected by changes in \( M \) as long as prices are flexible:
\[ M \times V-bar = P \times Y-bar \]
Then if change \( M \), will translate into a proportional change in \( P \).
If Fed increases money supply, is more dollars chasing same number of goods, so price will rise.

Can write in percent change terms, just like with growth accounting:
\[ \%\Delta M + \%\Delta V-bar = \%\Delta P + \%\Delta Y \]
Suppose change \( M \), where is no change in \( V \) or \( Y \) so suggests: \( \%\Delta M = \text{inflation} \)

Conclusion: Quantity theory of money says if money supply increases, then price level will rise proportionately.

b) Money demand approach

More theory behind quantity theory.
Money demand function: why people hold: to make transactions to buy good.
Think that if higher income, more goods want to buy, more purchasing power you want.
Write: \( M^d = k \times P \times Y \)
where \( k \) is a constant. Says nominal money demand is proportional to nominal income (represent number of transactions)

Can write in real terms: \( M^d/P = kY \)
where \( M^d / P \) is real money demand, measured in units of goods can buy with the money, real purchasing power.

Also have money supply, set by government. \( M^s = M \).

for equilibrium, need \( M^s = M^d \)
\[
M = k \ P \ Y
\]

Can view quantity equation as the result of a special case of such a money demand function:
Rearrange: \( M / k = P Y \),
equals \( M V = P Y \) if take \( V = 1/k \)

3a) Inflation and the interest rate

nominal interest rate: rate paid by bank, \( i \)
real interest rate: increase in your purchasing power, \( r \)

write: \( r = i - \pi \)
or \( i = r + \pi \)

Says nominal interest rate can change for two reasons: a change in the real interest rate and inflation

Can combine this with earlier theory:
1) Know real interest rate is set in financial market at level that equates saving and investment
2) Know quantity theory says inflation determined by money supply equal money demand
3) So now can say how money supply increase will affect nominal interest rate:

If MS rise by 1 percent, inflation will be on percent, so nominal interest rate will be one percent above real interest rate.

b) Two interest rates, and Fisher effect:

When borrower and lender agree on nominal interest rate, they do not know what inflation rate will be over the term of the loan.

Make distinction:
ex ante real interest rate: when loan is made, before know inflation: and
ex post real interest rate; actual real r, after know inflation

Make decision based on what expect inflation to be:
\[ \pi^e = \text{expectation of inflation} \]

So ex ante real \( r = i - \pi^e \)
and ex post real \( r = i - \pi \)

When agree to make a loan in financial market, have a real interest rate willing to pay. Name a nominal interest rate by adding the expected inflation on to this real interest rate have in mind.
So the real interest rate talking about is the ex ante one.
If wanted to compute afterward what real interest rate someone was willing to pay, take nominal interest rate, then subtract not actual inflation but that persons expected inflation.
Hard to get at expectations, but are important.

Can write:
Fisher effect: \( i = r + \pi^e \)
Is a one-for one relationship between expected inflation and nominal interest rate.

c) Evidence for theories: Show graphs for class discussion

d) Classical Dichotomy:

Suggests a dichotomy between two parts of the economy.
Classical model focuses on real variables in units of goods:
1) real quantities like output, consumption, investment, government expend measured in units of goods.
2) relative prices measured in units of goods, like real wage and real interest rate.
In chapter 2-5 discussed how these real variables determined.

This chapter talks about nominal variables - in units of money, like nominal money supply, price level.

Changes in money supply will affect nominal variables only, not real side of the economy.
4) Seigniorage - inflation tax:

Can analyze inflation as a tax. Tax on all people holding on to currency.

With undeveloped financial markets, it is hard for government to pay for a
deficit by selling its bonds. One alternative is to borrow from foreign banks
or sell bonds abroad.
Another alternative is to print the money it needs, since it controls the money
printing presses.
Def: Seigniorage: the real output that a government obtains by printing money
and spending it.
Increase money supply will lead to rise in inflation. So whoever was holding
money, the price level will rise, and money in pocket can buy less - lose
real value. Is like a tax on all money holdings.

An Example:
1) Suppose government doubles money supply from 100 billion $ to 200
   billion $. Know from quantity theory that price level double, say from 1$
   per loaf of bread to 2$ per loaf.

2) What is real value of the extra government purchases: have extra 100
   billion $, means can buy extra 100billion/2 = 50 billion loaves of bread.

3) What is the value of the inflation tax on holders of money: With their 100
   billion $, used to be able to buy 100billion/1 = 100 billion loaves of bread.
   Now with price = 2$/loaf, with their 100 billion $ can only buy 100billion/2
   = 50 billion loaves. So gave up 50 billion loaves of bread because were
   holding money.

Occurs in US but is small. 1980-1985, US had average inflation of 7%,
meaning seigniorage averaging 0.3% of GNP.
But in Argentina 1980-85, inflation was 274 %, with seigniorage equal to 4% of
GNP. Bolivia, 500% inflation and 6.2 percent of GNP.
5a) **Interest Rate and the demand for money:**

Will expand money demand to consider effect of interest rate. Money hold in pocket does not earn interest. But if put in savings account, while can't use it for transactions, can collect interest on it. So in making choice about whether to hold cash or savings account, influence by how high the interest rate is you are missing.

Which interest rate: real or nominal. Nominal interest rate is the opportunity cost of holding money.

Show why:
- Interest get on bank = i.
- Interest get on cash = 0.
- Opportunity cost = i - 0 = i.

Another way to see in real terms:
- if alternative asset pays real return r.
- Money pays real return = -\( \pi^e \).
- So lost real interest, opportunity cost = r - (-\( \pi^e \)) = i by fisher relation.

Say quantity of money demanded depends on the price, opportunity costs, here is nominal interest rate, so write money demand

\[
\frac{M^d}{P} = L(i,Y)
\]

some function of i and Y, but still rise in M raises P proportionately. Use ‘L’ as name for this function because it represents ‘liquidity’ of your assets:

Rise in i means lower MD, Rise in Y raises MD

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**b) Future money and current prices:**

equilibrium: \( M^s = M^d \)

\[
\frac{M}{P} = L(i,Y)
\]

rewrite: \( \frac{M}{P} = L(r + \pi^e, Y) \)

So real money demand depends on expected inflation.

Quantity theory says today’s money supply determines today’s price level. Still true: if real r and Y constant, price moves proportionately with money supply.
But nominal interest rate not constant. Depends on expected inflation, which depends on expected future changes in money supply.

So can have case where is no change in money supply now - tight monetary policy. But people expect money supply will increase in future. This can affect price level today. Expected inflation will impose a cost on people holding money, so money demand goes down. To keep real money supply equals real money demand, price level will rise.

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<th>6a) Social cost of inflation</th>
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<td>Usually, inflation imposes noticeable cost only if is unexpected.</td>
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<td>If wage contract was set, but have burst of unexpected inflation, then real wage will fall. Then will be poorer.</td>
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<td>Also affects financial market, if set interest rate in nominal terms. If unexpected inflation, the ex-post real interest rate will be lower than planned. Means lender will be getting lower real return than expected, penalized. But Borrower benefits, is paying less in real terms than expected.</td>
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<td>For example, have student loans, with a set interest rate. If inflation suddenly jumped, real value of my interest payments becomes less.</td>
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<td>If inflation was expected, then not much cost:</td>
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<td>Wage contract can be specified for nominal wage to increase with price level, so real wage not affected.</td>
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<td>Same for loan contracts.</td>
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<th>b) Hyperinflation: very high level of inflation</th>
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<td>Costs: not willing to hold money even for a short period, because lose its value, so not use money for transactions. Use barter - very inefficient. Or use dollars. Menu costs - have to change price tags couple times a day</td>
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<td>Causes why print so much money:</td>
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<td>need seigniorage to pay bills.</td>
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<td>Tax collection hard - soviet system not collect tax revenue. And much black market activity, paying no taxes. Firms not willing to pay taxes. Seigniorage easy way to collect taxes, even on black market holders of money.</td>
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<td>Solution: cut government deficit by raising taxes or cutting spending. then not need seigniorage. Then cut money supply growth.</td>
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