International Monetary Policy
4 Money supply [1]

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Lecture topic and references

- In this lecture we explain the key determinants of money supply and the instruments use by Central banks to influence it

- Mishkin, Chapters 14

What's Money Supply?

▶ Money supply can have different definitions, according to what we consider to be used for transactions

▶ In this course we will assume the following:

$$\text{Money Supply} = \text{Currency} + \text{Deposits}$$

$$M^s = C + D$$

▶ Credit-debit cards allow savers to use deposits for their transactions, on top of currency

▶ One could consider also less liquid assets as part of Money Supply

The Monetary Base

- ▶ In order to understand the Money Supply one must understand first the Monetary Base

- ▶ Start from considering the central bank's balance sheet.

Federal Reserve System	
Assets	Liabilities
Government securities	Currency in circulation
Discount loans	Reserves
International Reserves	

The Monetary Base

▶ Define Monetary Base (MB) as the Central Bank liability

Monetary Base = Currency + Reserves

$$MB = C + R$$

▶ Part of the management of money supply goes through the MB

▶ Different channels for changing the MB:

1. Buying treasury bonds on primary markets (*Treasury Channel*)
2. Running Open Market Operations (*Banking Channel*)
3. Providing Discount Loans (*Banking Channel*)
4. Buying-selling international reserves (*Foreign Channel*)

▶ Let's understand them one at the time

1. Treasury Channel

- ▶ The treasury channel is active when central banks are legally or implicitly committed to buying *newly issued* treasury bonds

- ▶ This means that the government will be able to finance any fiscal deficit, as the central bank will intervene and provide money whenever necessary

- ▶ This channel can be a serious source of excessive inflationary pressures

- ▶ In most countries this channel is formally prohibited, for the sake of monetary policy independence: separate who creates money from those who spend it

2. Banking Channel - OMO

▶ Suppose that the central bank (CB) buys (sells) securities from the private sector. This means that it will offer (withdraw) money in exchange

▶ An expansionary (contractionary) monetary policy will expand (contract) the central bank balance sheet, affecting the MB

▶ Suppose CB buys securities for 100 $

Banking System		
Assets		Liabilities
Securities	-$100	
Reserves	+$100	

Federal Reserve System		
Assets		Liabilities
Securities	+$100	Reserves +$100

2. Banking Channel - OMO

▶ Under a monetary policy expansion, CB buys securities and credits an equal amount on the reserve account that the counterpart has by the CB

▶ A monetary policy contraction works on the other way around, CB contracts its balance sheet

▶ OMOs are run by central banks on a daily basis, not just for changing the monetary policy stance but also simply to make sure that the demand for reserves by the system is always met (more on this later)

2. Banking Channel - Discount Loans

- ▶ Commercial Banks can demand for a loan directly to the central bank, if they cannot (or don't want to) raise funds from the private sector

- ▶ This facility allows the CB to inject liquidity directly towards specific institutions, instead of increasing the monetary base for the entire system

- ▶ The downside of this operation is that an institution demanding funds directly on the discount window might provide a negative signal to the markets

- ▶ The reserves provided to the system with this channel are called Borrowed Reserves. The other are simply non-borrowed reserves. The MB is hence divided into borrowed and non-borrowed MB

2. Banking Channel - Discount Loans

- ▶ In terms of the accounting, the mechanism is the same as with OMOs, apart that the counterpart of an increase in reserves will be an increase in the balance sheet item "Discount Loans"

Banking System		Federal Reserve System	
Assets	Liabilities	Assets	Liabilities
Reserves +$100	Discount +$100 loans	Discount +$100 loan	Reserves +$100
	(borrowing from Fed)	(borrowing from Fed)	

- ▶ Note, unlike OMOs, it is the private sector that decides indirectly whether the MB will expand, as the CB has already committed to providing loans upon request at the discount rate

3. Foreign Channel

▶ Under fixed exchange rates central banks engage in buying-selling of foreign currency in order to stabilize the exchange rate

▶ As CB withdraws (offers) foreign currency it will have to pay (withdraw) domestic currency in exchange. This will affect the MB

▶ The accounting mechanism will be the same. The counterpart of an increase in reserves will be an increase in the balance sheet item "International Reserves", rather than "Securities"

▶ We'll talk about the foreign channel once we study international economics

Exercise 1 on Monetary Base

▶ Suppose that initially central bank owns 100 in T bonds, 0 in discounted loans and 150 in international reserves. Out of this, 200 were issued as currency, the rest are held by the private sector as reserves

▶ Suppose that the CB intervenes with OMOs buying T bonds for 50. The counterpart will be credited 50 on his reserves account

▶ Show the initial balance sheet situation and how it is affected by the monetary operation. What is the final effect on the monetary base?

Exercise 2 on Monetary Base

► Suppose that initially central bank owns 100 in T-bonds, 0 in discounted loans and 150 in international reserves. Out of this, 200 were issued as currency, the rest are held by the private sector as reserves (same as above)

► Suppose that the CB intervenes with OMOs selling T-bonds for 20. The counterpart will pay in cash. At the same time a commercial bank arrives at the discount window and demands a loan for 50, which will be credited on his reserve account

► Show the initial balance sheet situation and how it is affected by the monetary operation. What is the final effect on the monetary base?

Money Supply

▶ So far we have seen how CBs can control the Monetary Base. But what we were after is actually the Money supply!

▶ Remember:

$$\text{Monetary Base} = \text{Currency} + \text{Reserves}$$

$$\text{Money Supply} = \text{Currency} + \text{Deposits}$$

▶ This means that understanding the relation between MB and M^S requires deciphering the relation between reserves and deposits

▶ It turns out that when CB increases Reserves by 1 \$, Deposits (and hence M^S) will increase by a multiple of the same amount. Let's see why

Deposit Creation

▶ Start from the increase in MB achieved through, say, OMOs

▶ Call $r = 0.10$ the reserve requirement, i.e. the share of deposits that commercial banks must deposit as reserves at the CB for precautionary reasons

▶ Assume that the counterpart in the OMO is the First National Banks. It will receive an extra 100 \$ on its reserves. But its deposits have not increased, so it can provide a loan for the entire amount (no excess reserves)

First National Bank		Liabilities
Assets		
Securities	-\$100	
Loans	+\$100	

Deposit Creation

▶ The firm receiving this loan from the First National Bank will deposit this check on it own bank account, say at Bank A. Assume that the entire amount is deposited, no cash is held

▶ Bank A will experience an increase in deposits for 100 $. 10 % of this will have to go in reserves, leaving an available 90 $ for new loans

▶ But this new loan implies exactly the same mechanism: some Bank B will receive an extra deposit of 90 $, out which 81 $ will be given as new loans and the remaining for required reserves

▶ This mechanism multiplies the initial effect triggered by the CB: the deposit base will increase by a multiple of the initial injection of liquidity through the OMO

Deposit Creation

Bank A		Bank A			
Assets	Liabilities	Assets		Liabilities	
Reserves +$100	Checkable +$100 deposits	Reserves +$10		Checkable +$100 deposits	
		Loans +$90			

Bank B		Bank B			
Assets	Liabilities	Assets		Liabilities	
Reserves +$90	Checkable +$90 deposits	Reserves +$9		Checkable +$90 deposits	
		Loans +$81			

Deposit Creation

Bank	Increase in Deposits ($)	Increase in Loans ($)	Increase in Reserves ($)
First National	0.00	100.00	0.00
A	100.00	90.00	10.00
B	90.00	81.00	9.00
C	81.00	72.90	8.10
D	72.90	65.61	7.29
E	65.61	59.05	6.56
F	59.05	53.14	5.91
.	.	.	.
.	.	.	.
.	.	.	.
Total for all banks	1,000.00	1,000.00	100.00

Deposit Creation

▶ CB has increased MB by 100 \$

▶ Mathematically, Deposits increase by

$$100 + (1 - r)100 + (1 - r)^2 100 + (1 - r)^3 100 + ... =$$

$$= 100 \sum_{i=0}^{\infty} (1 - r)^i = \frac{1}{r} 100$$

▶ Note that $1/r$ is bigger than one, given that r is smaller than one. $1/r$ is the simplified money multiplier

$$\Delta D = \frac{1}{r} \Delta R$$

▶ This is not the full money multiplier, since we are assuming no excess reserves and no money kept as cash

Money Multiplier

▶ Now that you have an idea of the mechanism, let's derive the real multiplier

▶ Call r as the ratio of deposits that banks must keep as Required Reserves

▶ Call e as the ratio of deposits that banks want to keep as Excess Reserves

▶ Call c as the proportion of deposits that people want to keep as cash rather than deposits (note: c can also be bigger than one, r and e not)

Money Multiplier

$$MB = C + R = c \cdot D + r \cdot D + e \cdot D = (c + r + e) \cdot D$$

$$M^S = C + D = c \cdot D + D = (c + 1) \cdot D$$

Combine the two, substitute out D, get

$$M^S = m \cdot MB = \frac{c + 1}{c + r + e} \cdot MB$$

$$\Delta M^S = \frac{c + 1}{c + r + e} \cdot \Delta MB$$

Since $r + e < 1$, $m > 1$. This is the Money Multiplier

Money Multiplier

▶ To derive the full multiplier, call ΔMB the increase in reserves after a monetary policy expansion

▶ Bank 1 will receive this extra reserves. Since has no extra deposits, can lend the entire amount

▶ The recipient of this amount will keep $\frac{c}{1+c}\Delta MB$ of this amount loan in cash, and will deposit $\frac{1}{1+c}\Delta MB$ in Bank 2 (remember, $C = c \cdot D$, so $C + D = \Delta MB$)

▶ Bank 2 will provide a new loan for the amount of $\frac{1-r-e}{1+c}\Delta MB$. The recipient of this loan will keep the share $\frac{c}{1+c}$ in cash and deposit the remaining in Bank 3, and so on

Money Multiplier

▶ If you solve the math you get

$$\Delta M^s = \Delta Deposits + \Delta Cash$$

$$= \frac{1}{1+c}\Delta MB\sum_{i=0}^{\infty}\left(\frac{1-r-e}{1+c}\right)^i + \frac{c}{1+c}\Delta MB\sum_{i=0}^{\infty}\left(\frac{1-r-e}{1+c}\right)^i =$$

$$= \Delta MB\frac{1}{c+r+e} + \Delta MB\frac{c}{c+r+e} =$$

$$= \frac{c+1}{c+r+e}\Delta MB$$

Money Multiplier

▶ At this point you should be able to see what it is meant my *endogeneity* of the money supply: The CB does not have full control of money supply, since it partially depends on the agents' behavior, which depends on the economic environment.

▶ The CB can control the MB and the reserve ratio r. But e and c are under the control of agents, so Money Supply can vary for reasons independent on the CB

▶ Additionally, the MB itself is not fully perfectly controlled by the CB, as the discount window works at the discretion of borrowers, whenever they have funding needs

Money Multiplier

- ▶ How does the multiplier depend on parameters?

- ▶ m decreases in r and e: the more banks keep as reserves and the less the multiplication can work, as banks are providing fewer loans

- ▶ m decreases in c: the higher the share of wealth that agents keep as cash and the less money is available for loans to start a multiplicative process

- ▶ A banking panic can cause a substantial reduction in money supply: a hike in c and e can cause a sharp collapse in money supply, making any expansion of the MB ineffective

Money Multiplier

Consider possible values for our parameters

c	r	e	m	
0,2	0,1	0,1	3,00	
0,2	0,3	0,1	2,00	Central Bank increases r
0,2	0,1	0	4,00	Banks hold no excess reserves
0,2	0,1	0,4	1,71	Banks increase excess reserves

Exercise 1 on the Money Multiplier

- ▶ Consider a situation where there is no reserve requirement and banks do not hold excess reserves. The capital to deposit ratio is equivalent to 1, that is, wealth is divided half-half into deposits and cash

- ▶ Consider a monetary expansion of the monetary base through OMO for 10. Bank 1 obtains an extra 10 on its reserve account

- ▶ Bank 1 will provide a loan to a depositor of Bank 2, which will provide a loan to a depositor of Bank 3,...

Exercise 1 on the Money Multiplier

▶ Compute the balance sheet items for each bank and then compute the multiplier. What is the overall effect on the money supply?

▶ What do you expect to happen as c goes to infinity (say, increases to 10000)?
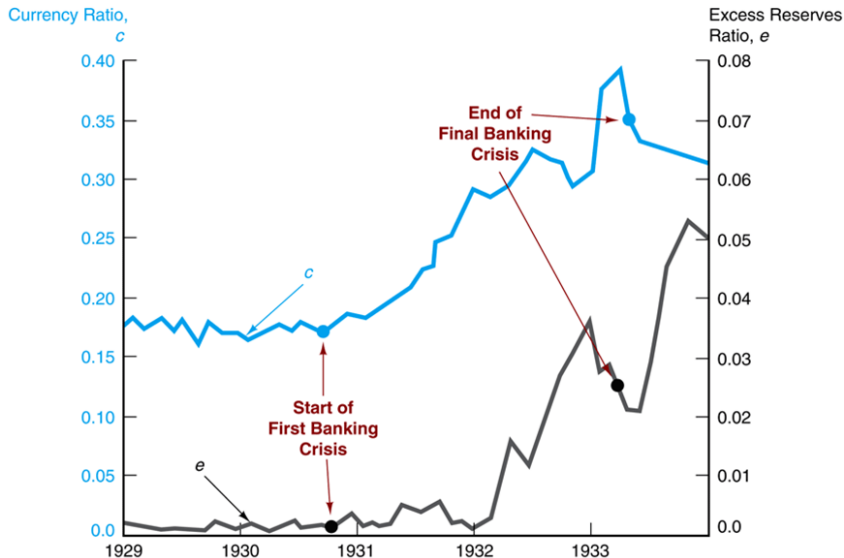
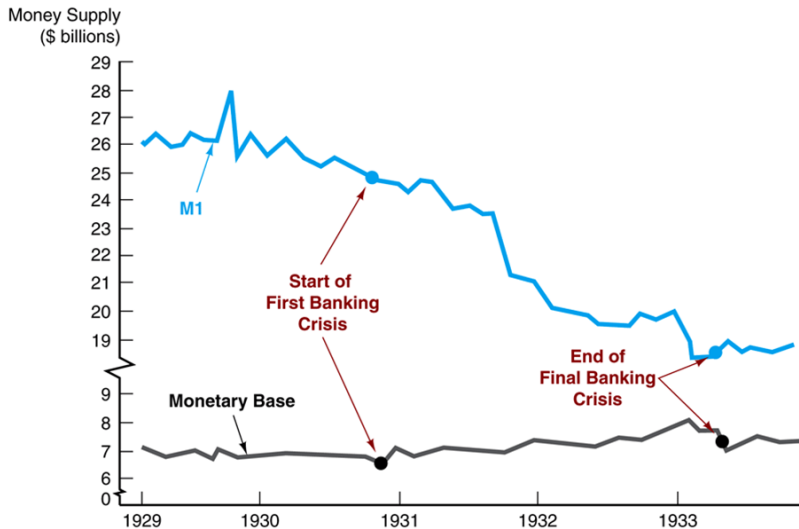# Exercise 1 on the Money Multiplier

$c = 1$ $r = 0$ $e = 0$

	New Loan	Extra Deposit	Extra Cash
Bank 1			
Bank 2			
Bank 3			
Bank 4			
	…	…	…

Money Multiplier

Money Multiplier

Plan for the Future

▶ So far we have seen what the goals of central banking are and the tools that they control. But we still have a long way to cover from monetary tools till monetary goals

▶ In the next lecture we do the following step: understand how the management of the monetary base affects a very special interest rate: the interbank rate