

## 4. Money

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### Outline

- What is money?
- Price level (Quantity theory of money)
- Real interest rate
- Costs of inflation
- Demand for money
- Money supply
- Seigniorage

### What is money?

Money: anything generally accepted in payment for G&S or in repayment of debts.

What constitutes money in Canada?

### What is money?

#### Functions of money

1. Medium of exchange: most important (definition). Promotes efficiency: leads to specialization (producing few goods) by eliminating high transaction cost (time spent trying to exchange G&S) because people does not need to satisfy double coincidence of wants (find somebody who has what one wants and wants what one has).

### What is money?

2. Unit of account: agreed measure for stating prices. It comes for being widely accepted. Promotes efficiency: fewer prices needed.
3. Store of value or asset: store of purchasing power over time. Money special because most liquid.

Liquidity: relative ease with which an asset can be converted into the medium of exchange.

### What is money?

#### Semantics

- Do not use money to denote other things.

#### Qualities (history)

1. Durable. Commodity money: a commodity valued in its own.
2. Divisible.
3. Easily verifiable (counterfeit proofed). Seigniorage: revenue raised through the creation of money.

## What is money?

### 4. Convenient.

Convertible paper money: claim to commodity money.

Fiat money: established as money by decree.  
Intrinsically worthless. Works by "faith" and not by decree.

## Price level (Quantity theory of money)

Velocity of money (V): average times per year a dollar is spent in buying G&S produced in the economy. Number of times a dollar changes hands in a year.

## Velocity

- By definition, use nominal GDP as a proxy for total transactions.

$$V = \frac{P \times Y}{M}$$

Then,  
where

$P$  = price of output (GDP deflator)  
 $Y$  = quantity of output (real GDP)  
 $P \times Y$  = value of output (nominal GDP)

## Price level (Quantity theory of money)

Fisher equation of exchange (actually an identity)

$$VM = PY$$

Assumption: V is constant → Fisher's quantity theory of money.

If M doubles, P·Y (nominal GDP) doubles.

If Y constant, if M doubles, P doubles.

Amount of money determines price level.

## Fisher equation in % form

$$\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$$

The quantity theory of money assumes

V is constant, so  $\frac{\Delta V}{V} = 0$ .

## The quantity theory of money, cont.

$\pi$  (Greek letter "pi")  $\pi = \frac{\Delta P}{P}$

denotes the inflation rate:

The result from the preceding slide:

$$\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$$

Solve this result for  $\pi$ :

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

## The quantity theory of money, <sup>cont</sup>

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

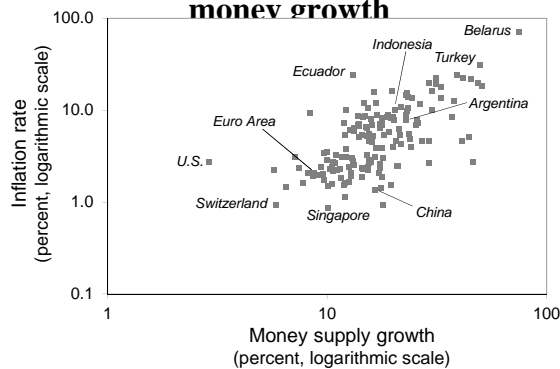
- Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.
- Money growth in excess of this amount leads to inflation.

## Confronting the quantity theory with data

The quantity theory of money implies countries with higher money growth rates should have higher inflation rates.

*Are the data consistent?*

## International data on inflation and money growth



## Price level (Quantity theory of money)

**Question:** Assume  $V$  is constant. The Bank of Canada believes that GDP will grow at 3% this year and wants an increase in prices of 2%. How much should it increase the money supply?

## Real interest rate

People save for smoothing consumption: how much consumption do I need to give up tomorrow for consuming more today or vice-versa? But they agree on a nominal interest rate.

$$\text{Nominal interest rate } i = r + \pi^e$$

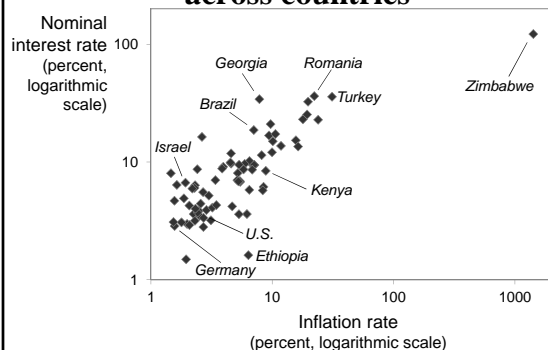
where  $\pi^e$  expected inflation. (Fisher equation)

## Inflation and interest rates

- Nominal interest rate,  $i$   
not adjusted for inflation
- Real interest rate,  $r$   
adjusted for inflation:

$$r = i - \pi$$

## Inflation and nominal interest rates across countries



## Properties of growth rates

1. If a variable is the product of two variables, its growth rate is the sum of their growth rates.
2. Conversely, if a variable is the quotient of two variables, its growth rate is the subtraction of their growth rates

## Real interest rate

- real interest rate  $r = i - \pi$
- Nominal price of a (financial-IOU) asset: B
- Real price: B/P (purchasing power of asset)
- Nominal interest rate = rate of change in B
- Real interest rate = rate of change in B/P

## Real interest rate

- Ex-ante real interest rate  $r = i - \pi^e$  decided by supply and demand of loanable funds.
- Actual (realized) inflation rate  $\pi$ .
- Ex-post real interest rate  $r = i - \pi$ .
- If  $\pi = \pi^e$ , ex-ante = ex-post.
- **Question:** what happens if inflation is higher than expected?

## Real interest rate

- If  $\pi > \pi^e$ , ex-post < ex-ante. Lenders hurt: receive less than expected in real terms.
- If  $\pi < \pi^e$ , ex-post > ex-ante. Borrowers hurt: need to pay more than expected in real terms.

## The social costs of inflation

...fall into two categories:

1. costs when inflation is expected
2. costs when inflation is different than people had expected

## Costs of inflation

### Unexpected inflation

- Redistributes wealth between
  - lenders and borrowers.
  - workers and employers,
  - renters and landlords, etc.

## Costs of inflation

### Expected inflation

1. **Shoe-leather cost (def.):** cost of reducing money balances to avoid the inflation tax. Increases cost of holding money → people keep less money → go to the bank more often
2. **Menu cost (def.):** cost of changing prices. Firms change posted prices more frequently.

## Costs of inflation

3. Changes relative prices because some prices are more flexible than others (micro. inefficiencies in resource allocation)
4. Changes taxes we pay in real terms: nominal income increases → fall into a higher tax bracket → pay more taxes in real terms.
5. Hurts individuals with fixed income (pensions?)

## One benefit of inflation

- Nominal wages are rarely reduced, even when the equilibrium real wage falls.  
This hinders labor market clearing.
- Inflation allows the real wages to reach equilibrium levels without nominal wage cuts.
- Therefore, moderate inflation improves the functioning of labor markets.

## Costs of inflation

### Importance

- Costs of expected inflation are small when  $\pi < 10\%$ .
- Costs important when  $\pi > 10\%$ . Other problem: the higher  $\pi$ , the more variable and unpredictable →
  - Redistributions of wealth more likely.
  - Higher uncertainty.

## Costs of inflation

Why do politicians worry that much?

1. Argument related to an open economy (discussed later)
2. Fear of the creep-up effect

## Costs of inflation

**Hyperinflation:** Inflation greater than 50% at month → approx. 13,000% at year (Germany in the 20's, ...)

## Hyperinflation

- All the costs of moderate inflation described above become **HUGE** under hyperinflation.
- Money ceases to function as a store of value, and may not serve its other functions (unit of account, medium of exchange).
- People may conduct transactions with barter or a stable foreign currency.

## What causes hyperinflation?

- Hyperinflation is caused by excessive money supply growth:
- When the central bank prints money, the price level rises.
- If it prints money rapidly enough, the result is hyperinflation.

## A few examples of hyperinflation

country	period	CPI Inflation % per year	M2 Growth % per year
Israel	1983-85	338%	305%
Brazil	1987-94	1256%	1451%
Bolivia	1983-86	1818%	1727%
Ukraine	1992-94	2089%	1029%
Argentina	1988-90	2671%	1583%
Dem. Republic of Congo / Zaire	1990-96	3039%	2373%
Angola	1995-96	4145%	4106%
Peru	1988-90	5050%	3517%
Zimbabwe	2005-07	5316%	9914%

## Costs of inflation

- Goal in Canada: 2%. Does not need to be that low (my view). Cutting inflation is costly.
- Once sacrifice is made, no point in going back → should not let inflation  $\Delta$  again.
- What 2% and not 0%? Inflation suffers from inflation.

## Problems with measurement

CPI exaggerates inflation.

Two reasons:

- Fails to adjust for improvements in quality.
- Does not take into account commodity substitution

Canada: CPI overstates inflation by about 0.7%

US: slightly over a 1%.

## Money demand

*In real terms,*

- $M/P$  = **real money balances**, the purchasing power of the money supply.

## Demand for money

### Quantity theory of money demand

- Money is a medium of exchange
- Demand is a function of real output  
 $(M/P)^d = k \cdot Y$ .
- Rearranging  $M \cdot 1/k = PY$
- Comparing with equation of exchange,  $V=1/k$

## The Classical Dichotomy

**Real variables:** Measured in physical units – quantities and relative prices, *for example:*

- quantity of output produced
- real wage: output earned per hour of work
- real interest rate: output earned in the future by lending one unit of output today

■ **Nominal variables:** Measured in money units, *e.g.,*

- nominal wage: Dollars per hour of work.
- nominal interest rate: Dollars earned in future by lending one dollar today.
- the price level: The amount of dollars needed to buy a representative basket of goods.

## The Classical Dichotomy

- **Classical dichotomy:** the theoretical separation of real and nominal variables in the classical model, which implies nominal variables do not affect real variables.
- **Neutrality of money:** Changes in the money supply do not affect real variables.  
 In the real world, money is approximately neutral in the long run.

## Demand for money

### (Keynes') Liquidity preference theory of money demand

- Money = medium of exchange + asset.
- $(M/P)^d$  = positive function of  $Y$  and return relative to that of other assets (difference in returns).

	Nominal terms	Real terms
Other assets	$i$	$r = i - \pi^e$
money	$0$	$-\pi^e$

## The money demand function

$$(M/P)^d = L(i, Y)$$

$(M/P)^d$  = real money demand, depends

- negatively on  $i$   
 $i$  is the opp. cost of holding money
- positively on  $Y$   
higher  $Y \Rightarrow$  more spending  
 $\Rightarrow$  so, need more money

## Demand for money

- depends negatively on real interest rate and expected inflation.

Let us assume  $(M/P) = k Y L(i)$ ;

$$M(1/(kL(i))) = PY.$$

- Comparing with the equation of exchange

## Demand for money

- $V(i) = 1/(k L(i))$ .
- Conclusions of quantity theory remain (partially) true:
  - $Y$  and  $i$  constant  $\rightarrow \Delta M \rightarrow \Delta P$ ; but
- $Y$  and  $M$  constant  $\rightarrow \Delta i \rightarrow \Delta P$ 
  - $\Delta r \rightarrow \Delta P$
  - $\Delta \pi^e \rightarrow \Delta P$

## Money market

- Supply (exo---rigid): determined by the Central Bank
- Demand for money: downward sloping  
 $M = k PY L(i)$
- Price: nominal interest rate
- If the CB increases (decreases) the supply,  $i$  decreases (increases)

## Chapter Summary

Nominal interest rate

- equals real interest rate + inflation rate
- the opp. cost of holding money

Money demand

- depends only on income in the Quantity Theory
- also depends on the nominal interest rate (Liquidity Preference Theory)
- if so, then changes in expected inflation affect the current price level.

## Chapter Summary

Costs of inflation

- *Expected inflation*  
shoe leather costs, menu costs,  
tax & relative price distortions,  
inconvenience of correcting figures for  
inflation
- *Unexpected inflation*  
all of the above plus arbitrary redistributions  
of wealth between debtors and creditors

## Chapter Summary

### Hyperinflation

- caused by rapid money supply growth when money printed to finance govt budget deficits
- stopping it requires fiscal reforms to eliminate govt's need for printing money

## Chapter Summary

### Classical dichotomy

- In classical theory, money is neutral--does not affect real variables.
- So, we can study how real variables are determined w/o reference to nominal ones.
- Then, money market eq'm determines price level and all nominal variables.
- Most economists believe the economy works this way in the long run.

## 4.b Money supply

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## Money supply

1. **Banks**
2. **Central Bank**
3. **Measures of money (on your own)**
4. **Tools (to change the base)**
5. **Money supply**
6. **Multiplier**
7. **Seigniorage**

## Summary

- how the banking system “creates” money
- Ways the Central Bank can control the money supply, and why the Central Bank can't control it precisely

## . Banks

- Two kinds of financial intermediaries:
  - brokers and dealers (commission), and
  - others (banks): borrow and lend.

## Banks

- **Balance sheet** = list of assets and liabilities.
- Assets = liabilities + capital.
- Banks: liabilities = sources of funds; assets = uses of funds.
- **T-account** = simplified balance sheet that only lists changes due to some event.

## Banks

- Required reserve ratio (RRR): fraction for deposits that banks are required to hold as reserves.
- **Reserves** = currency + deposits with Central Bank.
- **Excess reserves** = additional reserves.
- Canada: RRR = 0 since 1995.

## Central Bank (CB)

- Part of the Government but independent
- Functions:
  1. Bank of banks
  2. Regulatory agency of the financial system;
  3. Conducts monetary policy
  4. Bank of the government

## Central Bank

- Bank of Canada (B of C) balance sheet
  - Assets: Securities (gov.), Discount loans, others
  - Liabilities: Bank of Canada notes outstanding (C), Banks deposits (R), Government deposits, others

## Central Bank

- **Monetary base (B)** = the sum of Bank of Canada notes outstanding plus banks deposits (high powered money)  
$$B = C + R.$$
- CB knows B just by looking at its balance sheet.

## Measures of money

- Four measures: M1, M2, M3 and M2+ (country specific)
- M2 broader than M1, M3 broader than M2: includes less liquid assets.
- All watched b/c do not always move together

## Tools ( to change B)

1. **Open Market Operations (OMOs):** purchase or sale of government securities by CB: most important
2. **Reserve required ratio (rr).** Seldom used: too powerful and banks resent it.
3. **Deposit-switching**
4. **Discount policy. Discount (Bank) Rate:** interest rate at which the CB lends to private banks.

## Tools

- B of C does not use discount policy as a tool of monetary policy; so
- The term **bank rate** in Canada has a different meaning.

### Tools

- Banks that have more reserves than they need lend them to banks that do not have enough reserves in the **overnight funds market**; price = **overnight (interest) rate**.
- Because B of C controls M, it controls the overnight rate (usually a range).

### Tools

- **Bank rate (Canada)**: maximum that B of C allows the overnight rate to reach
- Announcements of the Bank Rate = announcements of the B of C's policy intentions ("persuasive" intent).

### Tools

How does the Bank control the overnight rate?

- Price ( $P_b$ ) and return of an asset ( $i$ ) are inversely related. Suppose an asset pays  $F$  one year from now
$$P_b \cdot (1 + i) = F.$$
$$(1 + i) = F/P_b.$$
- Higher  $P_b$ , lower  $i$ .
- If the Bank sells bonds,  $P_b \downarrow$
- Question: is the Bank increasing or decreasing the amount of money?

### Tools

- When  $P_b \downarrow$ ,  $i \uparrow$  and  $M \downarrow$ ; and vice-versa.
- Money market (not in the financial sense) and bonds market are two sides of the same coin: two ways of looking at the same thing.

### Tools

- CB can control  $M$  or  $i$  but not both at the same time: if it fixes  $M$ ,  $i$  will follow; and vice-versa.
- $M$  and  $i$  = instruments of monetary policy.
- Tools affect instruments, instruments affect goals (growth, inflation, unemployment, etc.)

### Banks' role in the money supply

- The money supply equals currency plus demand (checking account) deposits:
$$M = C + D$$
- Since the money supply includes demand deposits, the banking system plays an important role.

### A few preliminaries

- **Reserves (R):** the portion of deposits that banks have not lent.
- A bank's liabilities include deposits, assets include reserves and outstanding loans.
- **100-percent-reserve banking:** a system in which banks hold all deposits as reserves.
- **Fractional-reserve banking:** a system in which banks hold a fraction of their deposits as reserves.

### Banks' role in the money supply

- To understand the role of banks, we will consider three scenarios:
  1. No banks
  2. 100-percent reserve banking (banks hold all deposits as reserves)
  3. Fractional-reserve banking (banks hold a fraction of deposits as reserves, use the rest to make loans)
- In each scenario, we assume  $C = \$1000$ .

### SCENARIO 1: No banks

With no banks,  
 $D = 0$  and  $M = C = \$1000$ .

### SCENARIO 2: 100-percent reserve banking

- Initially  $C = \$1000$ ,  $D = \$0$ ,  $M = \$1,000$ .
- Now suppose households deposit the \$1,000 at "Firstbank."
  - After the deposit:  
 $C = \$0$ ,  
 $D = \$1,000$ ,  
 $M = \$1,000$
  - **LESSON:** 100%-reserve banking has no impact on size of money supply.

FIRSTBANK'S balance sheet	
Assets	Liabilities
reserves \$1,000	deposits \$1,000

### SCENARIO 3: Fractional-reserve banking

- **LESSON:** in a fractional-reserve banking system, banks create money.

FIRSTBANK'S balance sheet	
Assets	Liabilities
reserves \$200	deposits \$1,000
loans \$800	

The money supply now equals \$1,800:

- Depositor has \$1,000 in demand deposits.
- Borrower holds \$800 in currency.

### SCENARIO 3: Fractional-reserve banking

- Suppose the borrower deposits the \$800 in Secondbank.
- Initially, Secondbank's balance sheet is:
  - Secondbank will loan 80% of this deposit.

SECONDBANK'S balance sheet	
Assets	Liabilities
reserves \$160	deposits \$800
loans \$640	

### SCENARIO 3:

#### Fractional-reserve banking

- If this \$640 is eventually deposited in Thirdbank,
- then Thirdbank will keep 20% of it in reserve, and loan the rest out:

THIRDBANK'S balance sheet	
Assets	Liabilities
reserves \$128	deposits \$640
loans \$512	

#### Finding the total amount of money:

Original deposit	= \$1000
+ Firstbank lending	= \$ 800
+ Secondbank lending	= \$ 640
+ Thirdbank lending	= \$ 512
<hr/>	
+ other lending...	

Total money supply =  $(1/rr) \times \$1,000$   
where  $rr$  = ratio of reserves to deposits

In our example,  $rr = 0.2$ , so  $M = \$5,000$

#### Money creation in the banking system

*A fractional reserve banking system creates money, but it doesn't create wealth:*

*Bank loans give borrowers some new money and an equal amount of new debt.*

#### Money supply

- **Money multiplier** ( $mm$ ): amount by which a change in B is multiplied to determine the change in M

$$M = mm \cdot B$$

#### Money supply

Using algebra.

$$R = rr \cdot D$$

$$D = R/rr$$

- $(1/rr)$  is called **simple deposit multiplier** = 5 in this case.
- The smaller  $rr$ , the larger the multiplier---the more money banks create.

#### Money multiplier

- CB knows (and can change) the B
- If it knows the value of the multiplier, it can control M;
- but the multiplier does not depend only on the  $rr$  (a variable controlled by the CB).
- People cash money and banks hold excess reserves.

## Money multiplier

$$M = D + C = (1 + cr) D$$

(1)

where D = deposits and

cr = C/D (assumed to be stable).

## Money multiplier

$$B = R + C = RR + ER + C = (rr + e + cr) D$$

(2)

where RR = required reserves,

ER = excess reserves, and

e = ER/D

Solving for D IN (2)

$$D = B / (rr + e + cr)$$

and substituting into (1)

$$M = B \cdot (1 + cr) / (rr + e + cr)$$

## Money multiplier

- Thus, multiplier equals

$$mm = (1 + cr) / (rr + e + cr).$$

- **Question:** In December 1998,

B = C\$33.2 billions

M1 = C\$88. billions

Calculate mm1

## Money multiplier

- Factors that affect the multiplier:

1. rr: negatively related.

**Question:** What happened to the mm1 as rr changed from 10% to 0%?

## Money multiplier

2. cr: negatively related. Negatively related to wealth, financial institutions, interest rates,...

Positively related to underground economy and illegal activities

3. e: negatively related.

- CB knows rr; estimates e and cr → CB estimates multiplier: imperfect control of M.

## Money multiplier

- Between 1946 and 1978, M2 multiplier (mm2) grows slowly.
- Dramatic increase from 1978 to 1991: (partly) due to ATMs: dramatic decrease in cr (from 20% in 1946 to 8% in 1991) → ↑mm.
- Graph does not show what happened to mm2 since rr = 0.

### Seigniorage

$$G = T + \Delta\text{Debt} + \Delta M$$

- To spend more without raising taxes or selling bonds, the govt can create money.
- **Seigniorage** = revenue raised through creation of money. Causes inflation
- **inflation tax**: inflation similar to a tax on people holding money

### Seigniorage

$$G = T + \Delta\text{Debt} + \Delta M$$

**Seigniorage** = revenue raised through creation of money (inflation tax)

- Poor countries prone to inflation b/c poor tax collection system → deficit → 1) borrow → credit rating falls → 2) “print money”.  
“Persistent important deficits are inflationary”

### Seigniorage

- Condition: a CB controlled by the government.
- $\Delta M$  enough to allow the economy to grow  $\Delta M$  → seigniorage = small % of government revenue.

### Seigniorage

How does seigniorage work?

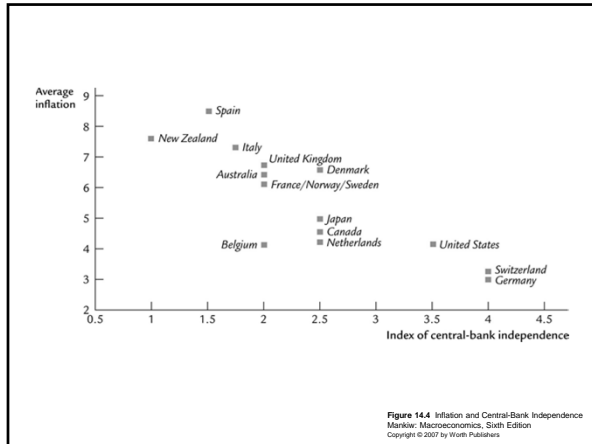
- B of C buys a building worth \$3m million dollars — Pays seller with a check against itself — Seller deposits check =  $\Delta R (= \Delta M)$
- B of C can pay real G&S with an accounting statement. B of C part of gov.

### Seigniorage

- CB says **yes** to “printing money”: governments sell securities to the CB → gov account is credited → funds are used to obtain G&S → suppliers deposit these cheques =  $\Delta R (= \Delta M)$
- governments can obtain G&S by accumulating debt (never paid) with CB (part of the gov)
- CB changes M by buying or selling these securities (OMOs). CB always a big creditor of government.

### Seigniorage

- CB says **no** to “printing money” → CB sells the securities on behalf of government: deposits are transferred from banks to government: no change in B → no change in M.
- Independence: ability to control M (ability to say **no**)



## Chapter Summary

1. Fractional reserve banking creates money because each dollar of reserves generates many dollars of deposits (considered money)
2. The money supply depends on the:
  - monetary base
  - currency-deposit ratio
  - reserve ratio
3. A CB can control the money supply with:
  - open market operations
  - the reserve requirement
  - the discount rate