CHAPTER 6
MONEY GROWTH AND INFLATION

CONTENTS

- How does the money supply affect inflation and nominal interest rates?
- Does the money supply affect real variables like real GDP or the real interest rate?
- How is inflation like a tax?
- What are the costs of inflation? How serious are they?

The Value of Money

- P = the price level
  (e.g., the CPI or GDP deflator)
  P is the price of a basket of goods, measured in money.
- $1/P$ is the value of \$1, measured in goods.
- Example: basket contains one candy bar.
  - If P = \$2, value of \$1 is 1/2 candy bar
  - If P = \$3, value of \$1 is 1/3 candy bar
- Inflation drives up prices and drives down the value of money.

The Value of Money

- Inflation is increases in the price level.

- Inflation is prices going up and drives down the value of money.

The Quantity Theory of Money

- Developed by 18th century philosopher David Hume and the classical economists
- Advocated more recently by Nobel Prize Laureate Milton Friedman
- Asserts that the **quantity of money determines the value of money**
- We study this theory using two approaches:
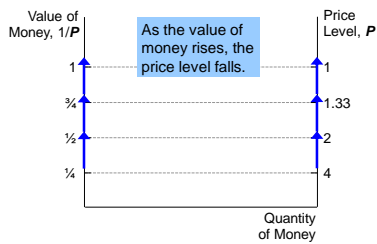 1. A supply-demand diagram
  2. An equation

Money Supply (MS)

- In real world, determined by Federal Reserve, the banking system, consumers.
- In this model, we assume the Fed precisely controls MS and sets it at some fixed amount.
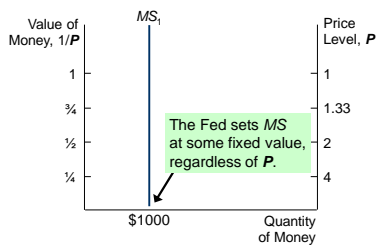
Money Demand (MD)

- ***Refers to how much wealth people want to hold in liquid form.***
- Depends on ***P***

- Thus,
  - MD ↑↓ value of money
  - MD ↑↑ P (other things equal)

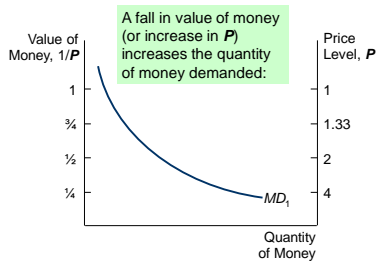 (These "other things" include real income, interest rates, availability of ATMs.)

The Money Supply-Demand Diagram

Value of Money, 1/***P***

1	As the value of money rises, the price level falls.	1
¾		1.33
½		2
¼		4

Price Level, ***P***

Quantity of Money

The Money Supply-Demand Diagram

Value of Money, 1/***P***

MS₁

1		1
¾		1.33
½	The Fed sets *MS* at some fixed value, regardless of ***P***.	2
¼		4

$1000

Price Level, ***P***

Quantity of Money

The Money Supply-Demand Diagram

A fall in value of money (or increase in **P**) increases the quantity of money demanded:

Value of Money, 1/**P**

Price Level, **P**

1 — 1
¾ — 1.33
½ — 2
¼ — 4

MD_1

Quantity of Money

The Money Supply-Demand Diagram

P adjusts to equate quantity of money demanded with money supply.

MS_1

Value of Money, 1/**P**

Price Level, **P**

1 — 1
eq'm value of money → ¾ — 1.33 eq'm price level
½ — 2
A
¼ — 4

MD_1

$1000 Quantity of Money

The Effects of a Monetary Injection

MS_1 MS_2

Value of Money, 1/**P**

Price Level, **P**

Suppose the Fed increases the money supply.

Then the value of money falls, and **P** rises.

¾ — 1.33
½ — 2
eq'm value of money → ¼ — 4 eq'm price level
A
B

MD_1

$1000 $2000 Quantity of Money
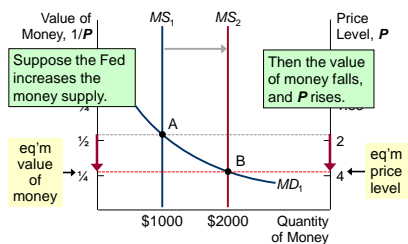
?? Tại sao NHTW cung thêm tiền thì mức giá tăng
Nguồn tiền cung tăng lên, phát sinh thêm nhu cầu tiêu dùng => consumption tăng và người dân muốn gửi tiền vào ngân hàng, mua chứng khoán => tăng investment ==> tăng AD nhưng SRAS không thay đổi vì firms không thể thích ứng nhanh với thị trường

A Brief Look at the Adjustment Process

How does this work? Short version:

- At the initial **P**, an increase in MS causes excess supply of money.
- People get rid of their excess money by spending it on g&s or by loaning it to others, who spend it. Result: increased demand for goods.
- But supply of goods does not increase, so prices must rise.

(Other things happen in the short run, which we will study in later chapters.)

Real vs. Nominal Variables

- **Nominal variables** are measured in monetary units.
  Ex: nominal GDP,
  nominal interest rate (rate of return measured in $)
  nominal wage ($ per hour worked)

- **Real variables** are measured in physical units.
  Ex: real GDP,
  real interest rate (measured in output)
  real wage (measured in output)

Real vs. Nominal Variables

Prices are normally measured in terms of money.

- Price of a compact disc: $15/cd
- Price of a pepperoni pizza: $10/pizza

A relative price is the price of one good relative to (divided by) another:

- Relative price of CDs in terms of pizza:

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$15/cd}{\$10/pizza} = \boxed{1.5 \text{ pizzas per cd}}$$

Relative prices are measured in physical units,
so they are real variables.

Real vs. Nominal Wage

An important relative price is the real wage:

W = nominal wage = price of labor, e.g., $15/hour

P = price level = price of g&s, e.g., $5/unit of output

Real wage is the price of labor relative to the price of output:

$$\frac{W}{P} = \frac{\$15/hour}{\$5/unit\ of\ output} = 3\ units\ output\ per\ hour$$

The Classical Dichotomy

- **Classical dichotomy**: the theoretical separation of nominal and real variables
- Hume and the classical economists suggested that *monetary developments affect nominal variables but not real variables.*
- If central bank doubles the money supply, Hume & classical thinkers contend
  - all **nominal** variables—including prices— will **double.**
  - all **real** variables—including relative prices— will remain **unchanged.**

The Neutrality of Money

- **Monetary neutrality**: the proposition that changes in the money supply do not affect real variables
- **Doubling money supply causes all nominal prices to double; what happens to relative prices?**
- Initially, relative price of cd in terms of pizza is

$$\frac{price\ of\ cd}{price\ of\ pizza} = \frac{\$15/cd}{\$10/pizza} = 1.5\ pizzas\ per\ cd$$

The relative price is unchanged.

- After nominal prices double,

$$\frac{price\ of\ cd}{price\ of\ pizza} = \frac{\$30/cd}{\$20/pizza} = 1.5\ pizzas\ per\ cd$$

The Neutrality of Money

- **Monetary neutrality**: the proposition that changes in the money supply do not affect real variables
- Similarly, the real wage W/P remains unchanged, so
  - quantity of labor supplied does not change
  - quantity of labor demanded does not change
  - total employment of labor does not change
- The same applies to employment of capital and other resources.
- Since employment of all resources is unchanged, total output is also unchanged by the money supply.

The Velocity of Money

- **Velocity of money**: the rate at which money changes hands
- Notation:
  P x Y = nominal GDP
       = (price level) x (real GDP)
  M = money supply
  V = velocity
- Velocity formula:

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

V constant, Money supply increases, which variable increases P or M?
=> price level increases as it is a nominal variable

The Velocity of Money

Velocity formula: $V = \dfrac{P \times Y}{M}$

Example with one good: pizza.
In 2012,

  Y = real GDP = 3000 pizzas

  P = price level = price of pizza = \$10

P x Y = nominal GDP = value of pizzas = \$30,000

  M = money supply = \$10,000

  V = velocity = \$30,000/\$10,000 = 3

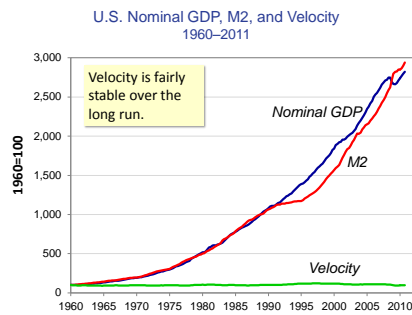*The average dollar was used in 3 transactions.*

Exercise

One good: corn.

The economy has enough labor, capital, and land to produce Y = 800 bushels of corn.

V is constant.

In 2008, MS = $2000, P = $5/bushel.

Compute nominal GDP and velocity in 2008.

U.S. Nominal GDP, M2, and Velocity
1960–2011

Velocity is fairly stable over the long run.

Nominal GDP

M2

Velocity

1960=100

3,000
2,500
2,000
1,500
1,000
500
0

1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010

The Quantity Equation

Velocity formula: $V = \dfrac{P \times Y}{M}$

- Multiply both sides of formula by M:
  $$M \times V = P \times Y$$
- Called the **quantity equation**

The Quantity Theory in 5 Steps

Start with quantity equation: M x V = P x Y

1. V is stable.
2. So, a change in M causes nominal GDP (P x Y) to change by the same percentage.
3. A change in M does not affect Y: Money is neutral, Y is determined by technology & resources.
4. So, P changes by same percentage as P x Y and M.
5. Rapid money supply growth causes rapid inflation.

The Quantity Theory in 5 Steps

Start with quantity equation: M x V = P x Y

The quantity theory of money says that the elasticity of the price level with respect to the money supply is ONE!.

ACTIVE LEARNING **2**
Exercise

One good: corn. The economy has enough labor, capital, and land to produce Y = 800 bushels of corn. V is constant. In 2008, MS = $2000, P = $5/bushel.

For 2009, the Fed increases MS by 5%, to $2100.

a. Compute the 2009 values of nominal GDP and P. Compute the inflation rate for 2008–2009.

b. Suppose tech. progress causes Y to increase to 824 in 2009. Compute 2008–2009 inflation rate.

sản lượng tăng, cung tiền tăng, lạm phát tăng thấp hơn ~~tốc độ tăng cung tiền~~
sản lượng không tăng, cung tiền tăng, lạm phát tăng bằng tốc độ tăng cung tiền

Summary and Lessons about the Quantity Theory of Money

- If real GDP is constant, then
  inflation rate = money growth rate.
- If real GDP is growing, then
  inflation rate < money growth rate.
- The bottom line:
  - Economic growth increases # of transactions.
  - Some money growth is needed for these extra transactions.
  - Excessive money growth causes inflation.

Hyperinflation

- Hyperinflation is generally defined as inflation exceeding 50% per month.
- Massively excessive growth in the money supply always causes hyperinflation.

Hyperinflation in Zimbabwe

Large govt budget deficits led to the creation of large quantities of money and high inflation rates.

date	Zim$ per US$
Aug 2007	245
Apr 2008	29,401
May 2008	207,209,688
June 2008	4,470,828,401
July 2008	26,421,447,043
Feb 2009	37,410,030
Sept 2009	355

Sign posted in public restroom

The Inflation Tax

- When tax revenue is inadequate and ability to borrow is limited, govt may print money to pay for its spending.

- The revenue from printing money is the **inflation tax**: printing money causes inflation, which is like a tax on everyone who holds money.

Correcting Variables for Inflation:
Very important! Real vs. Nominal Interest Rates

The nominal interest rate:
- the interest rate <u>not</u> corrected for inflation

The real interest rate:
- corrected for inflation

Real interest rate
= (nominal interest rate) – (inflation rate)

The Fisher Effect

- Rearrange the definition of the real interest rate:

$$\text{Nominal interest rate} = \text{Inflation rate} + \text{Real interest rate}$$

- The real interest rate is determined by saving & investment in the loanable funds market.
- Money supply growth determines inflation rate.
- So, this equation shows how the nominal interest rate is determined.

The Fisher Effect

Nominal interest rate	=	Inflation rate	+	Real interest rate

- In the long run, money is neutral, so a change in the money growth rate affects the inflation rate but not the real interest rate.
- So, the nominal interest rate adjusts one-for-one with changes in the inflation rate.
- This relationship is called the **Fisher effect** after Irving Fisher, who studied it.

The Fisher Effect & the Inflation Tax

Nominal interest rate	=	Inflation rate	+	Real interest rate

- The inflation tax applies to people's holdings of money, not their holdings of wealth.
- The Fisher effect: an increase in inflation causes an **equal** increase in the nominal interest rate, so the real interest rate (on wealth) is unchanged.

The Costs of Inflation

- The inflation fallacy: most people think inflation erodes real incomes.
- But inflation is a general increase in prices of the things people buy <u>and</u> the things they sell (e.g., their labor).
- In the long run, real incomes are determined by real variables, not the inflation rate.

The Costs of Inflation

- **Shoeleather costs**: the resources wasted when inflation encourages people to reduce their money holdings
  - Includes the time and transactions costs of more frequent bank withdrawals
- **Menu costs**: the costs of changing prices
  - Printing new menus, mailing new catalogs, etc.

The Costs of Inflation

- **Tax distortions**: bóp méo thuế

  Inflation makes nominal income grow faster than real income.

  Taxes are based on nominal income, and some are not adjusted for inflation.

  So, inflation causes people to pay more taxes even when their real incomes don't increase.

  trả thuế dựa vào mức thu nhập danh nghĩa, không tính đến tác động của lạm phát => bóp méo thuế, đóng thuế nhiều hơn khi thu nhập thực tế không thay đổi

ACTIVE LEARNING 3
Tax distortions

You deposit $1000 in the bank for one year.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

a. In which case does the real value of your deposit grow the most? real interest rate =10%

case 1: interest income =100 tax =25
case 2: interest income =100 tax =50

Assume the tax rate is 25%.

b. In which case do you pay the most taxes?

c. Compute the after-tax nominal interest rate, then subtract inflation to get the after-tax real interest rate for both cases.

case 1: nominal =0.75x10%=7.5%
        real=7.5-0=7.5
case 2: nominal =0.75x20%=15
        real=15-10=5%

ACTIVE LEARNING 3
Summary and lessons

Deposit = $1000.   Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

Inflation…
- raises nominal interest rates (Fisher effect) but not real interest rates
- increases savers' tax burdens
- lowers the after-tax real interest rate

A Special Cost of Unexpected Inflation

- **Arbitrary redistributions of wealth**
Higher-than-expected inflation transfers purchasing power from creditors to debtors: Debtors get to repay their debt with dollars that aren't worth as much.
Lower-than-expected inflation transfers purchasing power from debtors to creditors.
High inflation is more variable and less predictable than low inflation.
So, these arbitrary redistributions are frequent when inflation is high.

SUMMARY

- To explain inflation in the long run, economists use the quantity theory of money. According to this theory, the price level depends on the quantity of money, and the inflation rate depends on the money growth rate.
- The classical dichotomy is the division of variables into real and nominal. The neutrality of money is the idea that changes in the money supply affect nominal variables but not real ones. Most economists believe these ideas describe the economy in the long run.

SUMMARY

- The inflation tax is the loss in the real value of people's money holdings when the government causes inflation by printing money.
- The Fisher effect is the one-for-one relation between changes in the inflation rate and changes in the nominal interest rate.
- The costs of inflation include menu costs, shoeleather costs, confusion and inconvenience, distortions in relative prices and the allocation of resources, tax distortions, and arbitrary redistributions of wealth.

_____

_____

_____

_____

_____

_____

_____