In this chapter, look for the answers to these questions:

- 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?

Introduction

- This chapter introduces the quantity theory of money to explain one of the Ten Principles of Economics from Chapter 1: 
  
  \textit{Prices rise when the govt prints too much money.}

- Most economists believe the quantity theory is
The Value of Money

- $P$ = the price level (e.g., the CPI or GDP deflator)
- $P$ is
  - $1/P$ is
- 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

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
- 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
Money Demand (MD)

- Refers to

- Depends on

- Thus, quantity of money demanded is __________________ related to the value of money and ____________ related to $P$, other things equal.

(These "other things" include real income, interest rates, availability of ATMs.)
The Money Supply-Demand Diagram

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

The Money Supply-Demand Diagram

The Effects of a Monetary Injection

Suppose the Fed increases the money supply.
A Brief Look at the Adjustment Process

Result from graph: Increasing MS causes $P$ to rise.

How does this work? Short version:

- At the initial $P$, an increase in MS causes
  - People get rid of their excess money by spending it on g&s or by loaning it to others, who spend it.
  - Result:
    - But supply of goods

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

Real vs. Nominal Variables

- Nominal variables

  Examples: nominal GDP, nominal interest rate (rate of return measured in $), nominal wage ($ per hour worked)

- Real variables

  Examples: 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

- Relative price of CDs in terms of pizza:

Relative prices are measured in ______________, so they are real variables.
Real vs. Nominal Wage

An important relative price is the real wage:
\[ W = \text{nominal wage} = \text{price of labor}, \text{ e.g., } \$15/\text{hour} \]
\[ P = \text{price level} = \text{price of g&s, } \text{ e.g., } \$5/\text{unit of output} \]

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

The Classical Dichotomy

- **Classical dichotomy:**
  - Hume and the classical economists suggested that if central bank doubles the money supply, Hume & classical thinkers contend:
  - all nominal variables
  - all real variables

The Neutrality of Money

- **Monetary neutrality:** the proposition that doubling money supply causes all nominal prices to double; what happens to relative prices?
- Initially, relative price of cd in terms of pizza is
  \[ \frac{\text{price of cd}}{\text{price of pizza}} = \frac{15/\text{cd}}{10/\text{pizza}} = 1.5 \text{ pizzas per cd} \]
- After nominal prices double,
  \[ \frac{\text{price of cd}}{\text{price of pizza}} = \frac{30/\text{cd}}{20/\text{pizza}} = \text{______ pizzas per cd} \]
The Neutrality of Money

- Similarly, the real wage $W/P$
- quantity of labor supplied
- quantity of labor demanded
- total employment of labor
- The same applies to employment of capital and other resources.
- Since employment of all resources is __________, total output is also unchanged by the money supply.

MONEY GROWTH AND INFLATION

The Neutrality of Money

- Most economists believe the classical dichotomy and neutrality of money describe the economy in the long run.
- In later chapters, we will see that monetary changes can have important short-run effects on real variables.

MONEY GROWTH AND INFLATION

The Velocity of Money

- Velocity of money:

- Notation:
  - $P \times Y = \text{nominal GDP} = (\text{price level}) \times (\text{real GDP})$
  - $M = \text{money supply}$
  - $V = \text{velocity}$
- Velocity formula:
The Velocity of Money

Example with one good: pizza.

In 2008,

\[ Y = \text{real GDP} = 3000 \text{ pizzas} \]
\[ P = \text{price level} = \text{price of pizza} = $10 \]
\[ P \times Y = \text{nominal GDP} = \text{value of pizzas} = $30,000 \]
\[ M = \text{money supply} = $10,000 \]

\[ V = \text{velocity} = \]

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ACTIVE LEARNING 1

Exercise

One good: corn.

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

\( V \) is constant.

In 2008, \( MS = $2000, \ P = $5/\text{bushel} \).

Compute nominal GDP and velocity in 2008.
U.S. Nominal GDP, M2, and Velocity (1960=100) 1960-2007

Velocity is fairly stable over time.

The Quantity Equation
Velocity formula: \( V = \frac{P \times Y}{M} \)
- Multiply both sides of formula by \( M \):
- Called the quantity equation

The Quantity Theory in 5 Steps
Start with quantity equation: \( M \times V = P \times Y \)
1. \( V \) is stable.
2. So, a change in \( M \) causes
3. A change in \( M \), money is neutral, \( Y \) is determined by
4. So, \( P \) changes by
5. Rapid money supply growth causes rapid inflation.
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 $2100$.


Answers

- If real GDP is constant, then
  - Economic growth increases # of transactions.
Hyperinflation

- Hyperinflation is generally defined as

- Recall one of the Ten Principles from Chapter 1: 
  \textit{Prices rise when the government prints too much money.}

The Inflation Tax

- When tax revenue is inadequate and ability to borrow is limited, govt may print money to pay for its spending.
- Almost all hyperinflations start this way.
- \textbf{inflation tax}:

  - In the U.S., the inflation tax today accounts for less than 3% of total revenue.

The Fisher Effect

- Rearrange the definition of the real interest rate:

  - The real interest rate is determined by saving & investment in the loanable funds market.

  - So, this equation shows how the nominal interest rate is determined.
The Fisher Effect

- 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

This relationship is called the Fisher effect after Irving Fisher, who studied it.


The Fisher Effect & the Inflation Tax

- 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:

- But inflation is a general increase in prices of the things people buy and

- In the long run,

U.S. Average Hourly Earnings & the CPI

- Shoeleather costs: the resources wasted when inflation encourages people to reduce their money holdings

- Menu costs:
The Costs of Inflation

- **Misallocation of resources from relative-price variability:**
  Firms don’t all raise prices at the same time, so relative prices can vary… which distorts the allocation of resources.

- **Confusion & inconvenience:**
  Inflation changes the yardstick we use to measure transactions. Complicates long-range planning and the comparison of dollar amounts over time.

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**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?

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 off inflation to get the after-tax real interest rate for both cases.
A Special Cost of Unexpected Inflation

- Arbitrary redistributions of wealth
  
  Higher-than-expected inflation

  Debtors get to repay their debt with dollars that aren’t worth as much.

  Lower-than-expected inflation

  High inflation

  So, these arbitrary redistributions are frequent when inflation is high.

The Costs of Inflation

- All these costs are quite high for economies experiencing hyperinflation.

- For economies with low inflation (< 10% per year), these costs are probably much smaller, though their exact size is open to debate.
CONCLUSION

- This chapter explains one of the Ten Principles of economics:
  *Prices rise when the govt prints too much money.*

- We saw that

- In later chapters, we will see that money has important effects in the short run on real variables like output and employment.