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:
  
  *Prices rise when the govt prints too much money.*

- Most economists believe the quantity theory
The Value of Money
- \( P \) = the price level
  (e.g., the CPI or GDP deflator)
  
  - 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

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 the real world, determined by the Fed, the banking system, and consumers.
- In this model, we assume
Money Demand (MD)

- Refers to
- Depends on
- Thus, quantity of money demanded

These "other things" include

The Money Supply-Demand Diagram

![Diagram](chart)

The Money Supply-Demand Diagram

![Diagram](chart)
Suppose the Fed increases the money supply. People get rid of their excess money by spending it on goods or by loaning it to others, who spend it. Result: increased demand for goods. But supply of goods.

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

**Real vs. Nominal Variables**

- **Nominal variables**

- **Real variables**
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

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 Classical Dichotomy

- Classical dichotomy:
  - Hume and the classical economists suggested
  - If central bank doubles the money supply, Hume & classical thinkers contend:
    - all nominal variables
    - all real variables
The Neutrality of Money

- **Monetary neutrality:**

- 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,
  \[
  \frac{\text{price of cd}}{\text{price of pizza}} = \frac{\_\_\_\text{$/cd}}{\_\_\_\text{$/pizza}} = \_\_\_ \text{ pizzas per cd}
  \]

The Neutrality of Money

- Similarly, the real wage \( \frac{W}{P} \)
  - 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

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.
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:

---

**Example with one good: pizza.**

In 2012, 
\[ Y = \text{real GDP} = 3000 \text{ pizzas} \]
\[ P = \text{price level} = \text{price of pizza} = \$10 \]
\[ P \times Y = \text{nominal GDP} = \text{value of pizzas} = \$30,000 \]
\[ M = \text{money supply} = \$10,000 \]
\[ V = \text{velocity} = \]

---

**Active Learning 1**

**Exercise**

One good: corn.

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

\( V \) is constant.

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

Compute nominal GDP and velocity in 2008.
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,
3. A change in \( M \)
4. So, \( P \) changes by
5. Rapid money supply growth causes rapid inflation.
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.


Active Learning 2

Summary and lessons about the quantity theory of money

- If real GDP is constant,
- If real GDP is growing, then
- The bottom line:
  - Economic growth increases # of transactions.

Hyperinflation

- Hyperinflation is generally defined as

  - Recall one of the Ten Principles from Chapter 1: 
  *Prices rise when the government prints too much money.*
Hyperinflation in Zimbabwe

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

<table>
<thead>
<tr>
<th>date</th>
<th>Zim$ per US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 2007</td>
<td>245</td>
</tr>
<tr>
<td>Apr 2008</td>
<td>29,401</td>
</tr>
<tr>
<td>May 2008</td>
<td>207,209,688</td>
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<tr>
<td>June 2008</td>
<td>4,470,828,401</td>
</tr>
<tr>
<td>July 2008</td>
<td>26,421,447,043</td>
</tr>
<tr>
<td>Feb 2009</td>
<td>37,410,030</td>
</tr>
<tr>
<td>Sept 2009</td>
<td>355</td>
</tr>
</tbody>
</table>

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.

**inflation tax:**

- In the U.S., the inflation tax today accounts for

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 Fisher Effect

- In the long run, money is neutral: a change in the money growth rate

- So,

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

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**U.S. Nominal Interest & Inflation Rates, 1960–2013**

The close relation between these variables is evidence for the Fisher effect.

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**The Fisher Effect & the Inflation Tax**

\[
\text{Nominal interest rate} = \text{Inflation rate} + \text{Real interest rate}
\]

- The inflation tax applies to people’s holdings of money, not their holdings of wealth.
- The Fisher effect: an increase in inflation causes
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

The Costs of Inflation

- Shoeleather costs:
  - 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:**

  Complicates long-range planning and the comparison of dollar amounts over time.

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

- Arbitrary redistributions of wealth

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

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.