Objectives:

- Analyse the long-run determinants of the price level and the rate of inflation;
- Understand the link between inflation and nominal interest rates;
- Discuss the social costs of inflation.

I. The Price Level: Definition and Measurement. (chapter 2, section 2-2)

1. Definition: *The price level (P) is the average price of final goods and services produced, or purchased, within the economy during some period.*

P is measured by an **index** calculated as a weighted average of individual prices in the current year relative to their level in a base year.

There are two main price indices:

- the **Consumer Price Index [CPI];**
- the **GDP Deflator.**

2. The CPI.

The CPI measures the prices of consumer goods and services using **base-year** weights (a ***Laspeyres*** index, a fixed-weight index).

CPI in 2009 with base year of 2002:

$$CPI_{2009} = \frac{\sum P_{2009} Q_{2002}}{\sum P_{2002} Q_{2002}}$$

CPI includes **all consumer** goods and services

- include **both** domestically produced and imported
- **exclude** goods and services not used by consumers (for example locomotives, maintenance of locomotives)

3. The GDP Deflator

GDP deflator uses **current**-year weights (a ***Paasche*** index, a changing-weight index).
GDP deflator = nominal GDP/real GDP;
GDP Deflator in 2009 with base year of 2002:

$$GDP\ Deflator_{2009} = \frac{\sum P_{2009} Q_{2009}}{\sum P_{2002} Q_{2009}}$$

GDP deflator includes **all domestic** goods and services.

Note:
a *Laspeyres* index (CPI) **overstates** the rate of inflation.

a *Paasche* index (GDP Deflator) **understates** it

Example: legal services and computers

In practice – the rates of inflation calculated with the two indices are fairly close.

Differences between CPI and GDP deflator:

- CPI uses **base-year** weights; GDP deflator uses **current-year** weights;
- CPI includes only **consumer** goods and services; GDP deflator includes **all** output;
- GDP deflator does **not** include imported goods; CPI includes **both** domestic and imported goods

4. The rate of inflation = rate of change of a price index.

Example:

2008 CPI = 114.1; 2007 CPI = 111.5 (on a base of 100 in 2002)

$$\text{Rate of inflation (2007-08)} = \frac{(114.1-111.5)}{111.5} \times 100 = 2.3\%$$

Canadian inflation facts:

Measured by the percentage change in the CPI, the annual inflation rate has been positive in every year since 1953.
The average annual rate of inflation by decade peaked in the 1970s at 7.4%.

1970s	7.4%.
1980's :	6.5%
1990's :	2.2%
2000-2011:	2.3%

II. Money: Nature, Functions, and Control.

1. Definition: *Money is a stock of assets directly used in transactions*.

General definition: The money stock consists of the value of currency [notes + coins] in circulation plus the value of all checking deposits at financial institutions.
These – liquid assets, which can be used in transactions

Several definitions of money are used:

B – monetary base = currency plus chartered bank deposits at the Bank of Canada
M1: currency in circulation, demand deposits and other chequing deposits at chartered banks

More general definitions: include saving and notice deposits, term deposits etc.

What money is **NOT**:

- Money is **NOT** the same as **income**: income is a **flow** of purchasing power, while money is a **stock** of purchasing power.

- Money is **NOT** the same as **wealth**: while both money and wealth are stocks, wealth is a broader concept which includes **all** assets - including money, bonds, equities, real estate, personal property etc.

2. Functions of Money.

- ***Medium of exchange*** (what we use to buy goods and services; "legal tender")

- ***Unit of account*** (how prices are quoted and debts recorded; no alternative)

- ***Store of value*** (one of a number of ways a way of transferring purchasing power from present to the future)

3. Types of Money.

- ***Fiat*** (no intrinsic value, e.g. paper money)
- ***commodity*** (intrinsic value, e.g. Gold standard - when gold was the commodity.)

How fiat money evolves:
- initially people use pure gold, but verification is difficult;
- to reduce verification costs specialists convert gold into gold coins - their fee is called

seigniorage;

- to reduce the weight carried around the govt. takes your gold and issues gold certificates - banknotes. It promises to convert certificates for gold without limit;
- government issues more certificates than gold it gets; still promises to exchange certificates for gold; seigniorage increases;
- government stops exchanging banknotes for gold but makes the money legal tender; seigniorage increases further.

4. Control of the Quantity of Money.

- Is the responsibility of Canada's **central bank** - the **Bank of Canada.**
- Decisions - are the responsibility of **the Governor of the Bank of Canada** with input from the Federal **Minister of Finance** and constitute the govt's **monetary policy**.
- The main method of control of the money supply is through ***open market operations*** - purchase or sale of outstanding govt. bonds by the Bank of Canada;
- the Bank of Canada
  - **increases** the money supply by **buying** bonds from the public
  - **decreases** the money supply by **selling** bonds to the public.

III. <u>The Quantity Theory of Money (QTM).</u>

1. Transactions and the Quantity Equation

The size of **money stock** [*M*] required to transact the purchase and sale of a given **flow of output** depends on three factors:

- The **volume of output** per period [***Y***]
- The **price** of a typical unit of output or the GDP Deflator [***P***]
- The **[income]** ***velocity of circulation of money***: the number of times each period a unit of *M* is used to purchase output, or is received as income, each period [***V***].

The Quantity Equation:

$$M V = P Y$$

Note: The quantity equation is an **identity** - a relationship which is "true by definition" - because we defined velocity [*V*] to meet this equation.

Example:

Assume there is single final good: beer; 100 bottles sold daily; price $1.25 each; $50 of money

in circulation:

$$P=\$1.25,\ Y=100,\ M=50$$

So:

$$V = \$125/\$50 = 2.5$$

2. QTM as a theory of Nominal GDP.

We can use the Quantity Theory of Money as a theory of nominal GDP. We assume:

(i) income velocity **constant**: $V = \overline{V}$
(ii) the nominal money supply is **exogenous:** $M = \overline{M}$

So:

$$\overline{M}\overline{V} = PY$$

Conclusion: Given constant velocity, the quantity of money (*M*) determines nominal GDP (*PY*): a change in the quantity of money (*M*) causes a proportionate change in nominal GDP (*PY*).

3. QTM as a theory of the price level and inflation.

The idea is as follows. In the long run, the level of output does not depend on the quantity of money in the economy. We will discuss this in more detail later. So

$$Y = \overline{Y}$$

Assume constant velocity. Then *M* determines nominal output (*PY*).

P is the ratio of nominal to the constant real output:

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

Conclusion: For given values of velocity and real GDP, the price level (*P*) varies directly with the money stock (*M*): a change in *M* causes a proportionate change in *P*.

The equation is in absolute terms. It says that if real GDP and velocity are constant, the price level changes one for one with the money supply.

In actual economies real GDP changes over time; velocity may also change. So it is useful to express the quantity theory equation in terms of percentage change. To do this, we use a very simple and easy to remember formula:

The percentage change of a product of two variables =
the sum of percentage changes of these variables

So:

the percentage change of MV = the percentage change of M plus the percentage change of V

Using this formula:

$$\%\Delta\overline{M} + \%\Delta\overline{V} = \%\Delta P + \%\Delta\overline{Y}$$

Rearranging terms we obtain the expression for the inflation rate, $\%\Delta P$:

$$\%\Delta P = \%\Delta\overline{M} + \%\Delta\overline{V} - \%\Delta\overline{Y}$$

Assuming, constant velocity: $\%\Delta\overline{V} = 0$

$$\%\Delta P = \%\Delta\overline{M} - \%\Delta\overline{Y}$$

Here $\%\Delta\overline{M}$ is the rate of growth of the money suppy and $\%\Delta\overline{Y}$ is the rate of growth of output.

Conclusion: For a given rate of economic growth, and assuming constant velocity, the higher is the rate of growth of the money supply, the higher is the rate of inflation.

Evidence:
across countries - Fig. 4-2
US - decades - Fig. 4-1

IV. Inflation and Nominal Interest Rates.

1. Real vs nominal interest rates.

i = nominal interest rate, or the cost of borrowing/ reward to lending, measured in dollars;
r = real interest rate, or the cost of borrowing/reward to lending, measured in goods.

If π = the actual inflation rate ($\pi=\%\Delta P$), then the realized (or ex post) real interest rate (r) can be calculated as follows (using the exact formula):

$$1 + r = \frac{1 + i}{1 + \pi}$$

Example: Suppose you lend \$100 for a year at a nominal interest rate of 10% (i =0.10). Over the year prices rise 6% (π = 0.06). At the end of the year you receive repayment of principal and interest in the amount of \$110. However, the \$110 you receive at the end of the year has a purchasing power equivalent to \$103.77 (= \$110/1.06) at the beginning of the year. Thus, the real interest rate, or real reward for lending, is 3.77% (r =0.0377).

The approximate formula (in the book):

$$r \approx i - \pi$$

Notes:
The approximation error - small in Canada;
The formula is ex post: after the inflation rate is known

2. The Fisher Effect.

Ex-ante and ex-post real interest rate.

Ex-ante real interest rate is the real interest rate expected at the time of transaction.
At the time of transaction the inflation rate – unknown, so need to form expectations about inflation.

So: ex-ante real interest rate is, using the approximate formula:

$$r=i-\pi^e$$

At the time of the transaction, ex-ante real interest rate is unknown.

Ex-post real interest rate is the realized interest rate, after inflation has taken place.

Economist Irving Fisher hypothesized that when borrowers and lenders have some expectation of future inflation (π^e), the nominal interest rate will adjust to "compensate" for expected inflation and to ensure the achievement of a given real interest rate.

$$i = r+\pi^e$$

Conclusion: For a given real interest rate (π^e),) the nominal interest rate (*i*) will rise by one point for each one-point rise in the expected rate of inflation (π^e),).

Evidence of Fisher effect: See Fig. 4-3 and Fig. 4-4 in Case Study, pp. 103-104

V. Demand for money

1. Demand for money is demand for the purchasing power: for M/P
2. According to the quantity theory of money, demand for money depends on income

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

Let k=(1/V). Then

$$\frac{M}{P} = kY$$

But this does not take into account that holding money is costly

Cost: the interest that could have been earned by holding bonds or saving accounts

Interest foregone: the *nominal* interest rate.

$$\frac{M}{P} = L(i, Y)$$

Use Fisher equation: $i = r+\pi^e$

$$\frac{M}{P} = L(r + \pi^e, Y)$$

Demand for money depends on income, the real interest rate and expected inflation.

VI. The Welfare Costs of Inflation.

1. Expected inflation.

a) non-tax effects

(i) "shoeleather cost" - more frequent trips to the bank as people hold lower money balances;

(ii) "menu costs" - costs of changing nominal prices
- need to change prices more often - higher costs of changing prices;
- higher variability of relative prices - less efficient pricing system.

(iii) inconvenience of living in a world in which the dollar - the "measuring stick" we use in economic decisions and financial planning- is constantly changing in value.

b) tax effects.

(i) taxation of capital gains - nominal gains are taxed when only real gains should be taxed

(ii) taxation of interest income - nominal interest is taxed rather than real interest, reducing the after-tax return on savings when inflation (and nominal interest) is high.

Under a non-indexed tax system, the <u>after tax</u> real return on savings is:

$$\text{Non-indexed after tax } r = i(1-t)-\pi$$

Where t is the tax rate paid on interest earnings.

So: the higher is the inflation rate, the lower is the after-tax real return on savings.

If the tax system is fully indexed for inflation, then the after-tax real yield would be

$$\text{Indexed after tax } r = (i-\pi)(1-t)$$

And the real return on savings would be unaffected by inflation.

(iii) government tax grab - if income tax brackets and exemptions/deductions are not fully adjusted for inflation, the real tax burden rises.

2. Unexpected inflation.

Ex post return/payment - different than ex-ante (e.g. non-indexed pensions, mortgages).
Debtors gain, creditors lose when inflation is higher than anticipated.
Largest category of debtors – households with mortgages
Largest category of creditors - individuals with non-indexed pensions

Unexpected inflation benefits debtors, hurts creditors.

3. Variability of inflation.

Empirically: higher inflation means higher variability of inflation.
Higher variability of inflation means higher uncertainty, investments become more risky and so investment falls

4. Problems with low inflation.

(a) Difficult to reduce real wages if workers resist nominal wage decreases;
(b) Creates a lower bound on the real interest rate (nominal interest rate cannot be negative).
This is the major problem in the Great Recession

5. Dangers (?) of deflation.

Households delay purchases since they expect prices to be lower in the future

VII. Inflation in the Great Recession

- with weak economy – inflation was low
- zero bound on interest rates – limited traditional monetary policy.

Traditional monetary policy – operates by lowering nominal interest rates.
For a given inflation rate, this lowers the real interest rate

$$r \approx i-\pi$$

Consumption and investment depend on the real interest rate.

Since the nominal interest rate cannot be negative, the real interest rate $r > -\pi$

Real interest rate must be higher than **minus** the inflation rate.

So: the higher is the rate of inflation, the lower can be the real interest rate.

Some economists argued that we should aim for a higher rate of inflation (around 3-4%). But there is little support for this proposal