



## ECON 2152 Textbook - khan

Intermediate Macroeconomic Theory and Policy I (The University of Western Ontario)

## CHAPTER 1: INTRODUCTION

### WHAT IS MACROECONOMICS?

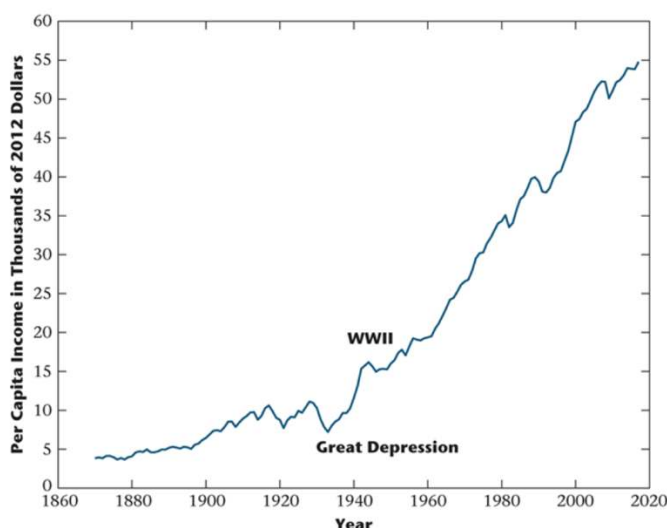
- Macroeconomics is the study of the behaviour of large collections of economic agents
- Focuses on the:
  - o Aggregate behaviour of consumers and firms
  - o Behaviour of governments
  - o Overall level of economic activity in individual countries
  - o Economic interactions among nations
  - o Effects of fiscal and monetary policy
- Distinction between micro and macro
  - o Macro deals with the overall effects of economics of the choices that all economic agents make
    - Rather than the choices of individual consumers/firms
  - o The economic models used by macro consists of:
    - Descriptions of consumers and firms
    - Their objectives and constraints
    - Their interactions
      - Which are built up from micro principles
  - o These models are typically analyzed and fit to data using methods similar to micro
- Two main focuses:
  - 1) Long-run growth**
    - o The increase in a nation's productive capacity and average standard of living that occurs over a long period of time
  - 2) Business cycles**
    - o The short-run up and downs, or booms and recessions, in aggregate economic activity

### GROSS DOMESTIC PRODUCT, ECONOMIC GROWTH, AND BUSINESS CYCLES

#### AGGREGATE ECONOMIC ACTIVITY

- **Gross domestic product (GDP)** - The quantity of goods and services produced within a country's borders during some specified period of time
  - o Represents the aggregate quantity of income earned by those who contribute to production in a country
- PER CAPITA REAL GDP FOR CANADA

Figure 1.1 Per Capita Real GDP for Canada, 1870–2017  
(2012 dollars)



- 
- Two Observations:
  1. Sustained growth in per capita real GDP during 148 year period (1870-2017)
    - a. Average income of a Canadian was \$3800 (in 1870, in 2021 \$) and grew to \$55,000 (in 2012)
    - b. Became **16 times richer** in real terms over 148 years
  2. The growth during 1870-2017 was **not steady**
    - a. The fluctuations in economic growth are business cycles
- Two Key and unusual business cycle events in Canadian economic history:
  1. **The great depression**
    - a. Real GDP per capita dropped from a peak of \$11,120 to \$7,218 per person
      - i. Decline about 35%
        1. Increase to \$16,174 (124% from 1933)
  2. **World war 2**
    - a. Per capita output increased greatly
      - i. A major recession in early 1920
      - ii. A subsequent boom (before great depression)

#### FUNDAMENTAL MACROECONOMIC QUESTIONS:

1. What causes sustained economic growth?
2. Could economic growth continue indefinitely, or is there some limit to growth?
3. Is there anything that governments can or should do to alter the rate of economic growth?
4. What causes business cycles?
5. Could the dramatic decreases and increases in economic growth that occurred during Great depression and World War 2 be repeated?

6. Should governments act to smooth business cycles?

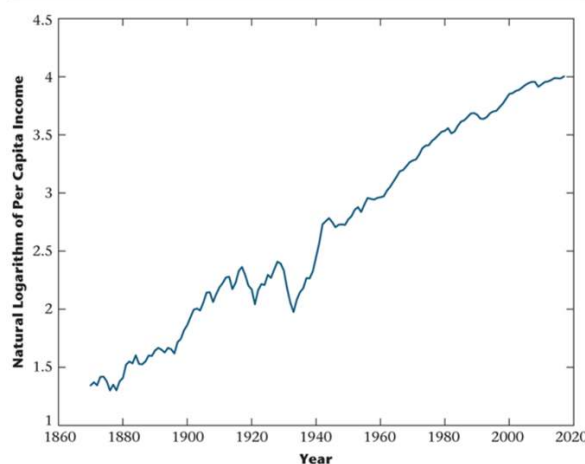
GROWTH RATE

- **Growth rate** =  $g_t = (y_t / y_{t-1}) - 1$

$$g_t = \frac{y_t}{y_{t-1}} - 1.$$

- 
- If  $g_t$  is small
  - $\log (g_t + 1) \approx g_t$
  - OR
  - $\log \left( \frac{y_t}{y_{t-1}} \right) \approx g_t$
  - 
  - OR
  - $\log y_t - \log y_{t-1} \approx g_t$
  -
- The slope of the graph of the natural logarithm of a time series is a good approximation to the growth rate of when the growth rate is small
  - Changes in the slope represent changes in the growth rate of real per capita GDP
  - 1870–2017, growth in per capita real GDP has been “roughly” constant at about 1.8% per year

Figure 1.2 Natural Logarithm of Per Capita Real GDP

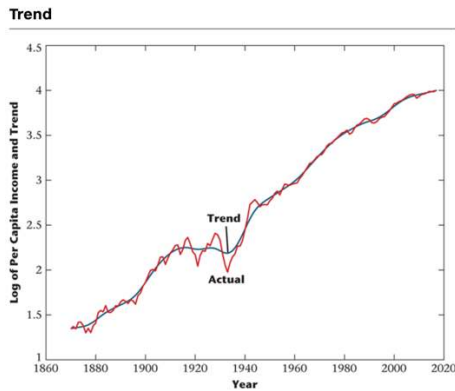


TIME SERIES: TWO COMPONENTS

- **Growth or trend**
  - Trend is the smoother **blue line**

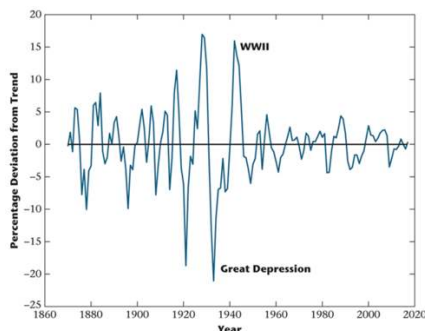
- o Actual real per capita GDP is the **red line**
- **Business cycle**
  - o Deviations of real per capital GDP from a smooth trend fit to the data
    - The difference between red line and blue line

Figure 1.3 Natural Logarithm of Per Capita GDP and



## PERCENTAGE DEVIATIONS

- Great depression and world war 2 represent enormous deviations from trend
  - o Great depression: -20%
  - o World war 2: 15%
  - o After world war 2: +/- 5%
  - o 2007-2008 recession: 3.5%
  - o 1981-1982 recession: more than 5%



## MACROECONOMIC MODELS

- Experimentation is a productive and growing activity
  - o But might be impossible
- All economic models are abstractions and not completely accurate description
- **Purpose:** to capture the essential features of the world needed for analyzing a particular economic problem
- **To be useful:** a model must be simple but that leaves out realistic features

- Ex. road maps are guides but does not capture curvature of earth but it does not limit its usefulness
- **BASIC STRUCTURE** OF TYPICAL MACRO MODEL
  1. The consumers and firms that interact in the economy
  2. The set of goods that consumers want to consume
  3. Consumer's preferences over goods
  4. The technology available to firms for producing goods
  5. The resources available
- Two additional features:
  1. The **goals** of the consumers and firms
    - a. How will consumers and firms behave given the environment?
    - b. They **Optimize** - do the best they can given the constraint they face
  2. Specify how **consistency** is achieved in terms of the actions of consumers and firms
    - a. Economy must be in **equilibrium**
    - b. **Competitive equilibrium** - assume goods are bought/sold on markets in which consumers and firms are price-takers (actions have no effect on market prices)
      - i.  $\text{Quantity supplied} = \text{Quantity demanded}$
- When to begin asking questions:
  - Have a working economic model
  - With a specification of the economic environment
  - Optimizing firms and consumers
  - A notion of equilibrium
- **The first experiment**
  - Determine whether the model economy will grow
    - Working through mathematics of model, graphical analysis, running the model on computer, etc.
  - Will it grow in a manner that comes close to matching the data?
    - If **not**, why and determine if whether to refine model or abandon it
- Once satisfied with the model, can start running experiments on models for which we do NOT know the answers
  - Ex. how historical growth performance would have differed in Canada had the level of government spending been higher?
  - Would aggregate economic activity have grown at a higher or a lower rate?
  - How would this have affected the consumption of goods? Would economic welfare have been higher or lower?

## MICROECONOMIC PRINCIPLES

- Changes in government policy will generally alter the behaviour of consumers and firms in ways that significantly affect the behaviour of the economy as a whole
- Macroeconomic behaviour is the **sum** of many microeconomic decisions
- Best way to construct a macroeconomic model is to work our way up from decision making at the microeconomic level
- To confidently predict the effects of a policy change in terms of aggregate behaviour, we must analyze how the change in policy will affect individual consumers and firms
  - o Example:
    - We must analyze how the change in policy will affect individual consumers and firms
    - Then, aggregate these decisions to arrive at a conclusion consistent with how the individuals in the economy behave
- **The rational expectations revolution (1970)**
  - o Introduced more microeconomics into macro
  - o The argument that macroeconomic policy analysis could be done in a sensible way only if microeconomic behaviour is taken seriously
    - Expressed by Robert E. Lucas, Jr., in a journal article published in 1976
  - o His argument is often referred to as the **Lucas critique**

#### DISAGREEMENTS IN MACROECONIMICS

- The Solow growth model is widely accepted framework for understanding the economic growth process, and
  - o **Endogenous growth models**, which model the economic mechanism determining the rate of economic growth
    - Well received by most macroeconomists
- Controversy concerning business cycle theory and role of government in smoothing business cycles over time
- Business cycles can be differentiated according to whether they are **Keynesian or non-Keynesian**
  - o Traditional old Keynesian models are based on the notion that **wages and prices are sticky in the short run**, and do not change sufficiently quickly to yield efficient outcomes
    - Government intervention through monetary and fiscal policy can correct the inefficiencies that exist in private markets
  - o 1970's theories of business cycle
    - **Real business cycle theory:** government policy aimed at smoothing business cycles is at best ineffective and at worst detrimental to economy's performance

- **New Keynesian models** include sticky wages and prices, but use micro tools that all modern macroeconomists use

#### WHAT DO WE LEARN FROM MACRO ANALYSIS

- 1. What is produced and consumed in the economy is determined jointly by the economy's productive capacity and the preferences of consumers**
  - a. A one-period model of the economy
- 2. In free-market economies, there are strong forces that push these economies toward socially efficient economic outcomes**
  - a. Unregulated economy people by selfish individuals could result in a socially efficient state of affairs is surprising
- 3. Unemployment is painful for individuals, but it is a necessary evil in modern economies**
  - a. There is always unemployment in a well-functioning economy
  - b. Economically efficient for workers to be well matched with jobs, in terms of skill
    - i. If individual spends more time looking for a job, might increase chance of a good match
- 4. Improvements in a country's standard of living are brought about in the long run by technological progress**
  - a. Growth in the standard of living of average person will come to a stop unless there are continual tech improvements
- 5. A tax cut is not a free lunch**
  - a. There are circumstances under which a current tax cut will have no effects whatsoever, the private sector is no wealthier, and there is no change in aggregate economic activity
- 6. What consumers and firms anticipate for the future will have an important bearing on current macroeconomic events**
  - a. Two-period models
    - i. Consumers save for future consumption needs
    - ii. Firms invest in plant and equipment to produce more in future
  - b. Consumers and firms are forward looking in ways that matter for current aggregate economic activity and for government policy
- 7. Money takes many forms, and having it is much better than not having it. Once we have it, changing its quantity does not matter in the long run**
  - a. A one-time increase in the money supply, brought about by the central bank, has no long-run effect on any real economic magnitudes in the economy; it will only increase all prices in the same proportion
- 8. Business cycles are similar, but they can have many causes**
  - a. All of these theories shed some light on why we have business cycles and what can be done about them



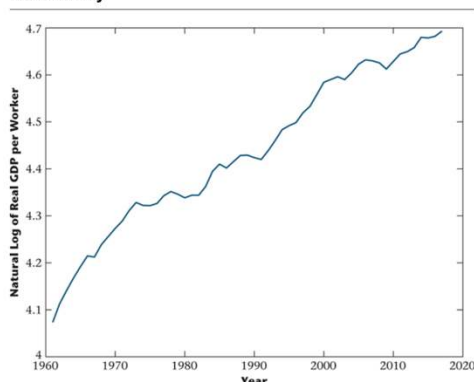
9. **Countries gain from trading goods and assets with each other, but trade is also a source of shocks to the domestic economy**
  - a. free trade allows a country to exploit its comparative advantage in production and thus make its citizens better off
  - b. Integration of world financial and goods markets implies that events in other countries can cause domestic business cycles
10. **In the long run, inflation is caused by growth in the money supply**
  - a. **Inflation:** the rate of growth in the average level of prices, can vary over the short run for many reasons
  - b. The rate at which the central bank (bank of Canada) causes the stock of money to grow determines what the inflation rate is
11. **Two key relationships concerning macro variables involve the short run tradeoff between output and inflation, and the relationship between the nominal interest rate and inflation**
  - a. **Phillips curve:** a positive relationship appears to exist between the deviation of aggregate output from trend and the inflation rate
    - i. Unstable empirical relationship
  - b. **Fisher relation:** a positive correlation between nominal interest rates and the inflation rate
  - c. **Neo-fisherism:** a theory that explains inflation as resulting from the nominal interest rate setting of the central bank

## PRODUCTIVITY GROWTH

- **Average labour productivity** = quantity of aggregate output produced per worker =  $Y/N$

- o  $Y$  = aggregate output
- o  $N$  = employment

Figure 1.5 Natural Logarithm of Average Labour Productivity



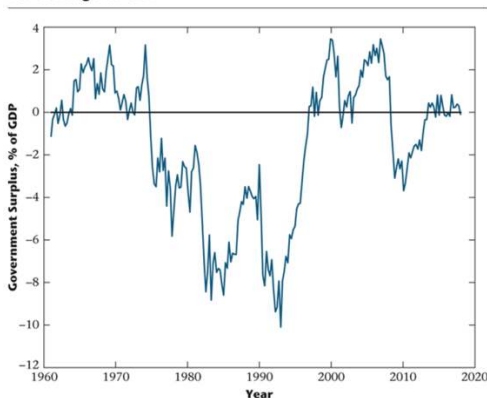
- - o Key feature: total factor productivity grew rapidly during the 1960s and 1990s, but slowed from 1970-1980 and after 2000s
- Cause for productivity slowdown: reflect a measurement problem
- A productivity slowdown could also reflect the introduction and adoption of new technology

- The adoption of new technology can actually **reduce productivity** in the short run, as **people have to learn** how to integrate technological advances into production processes
- **Learning takes time**, and **detracts from measurable output**

## GOVERNMENT SPENDING AND GOVERNMENT SURPLUS

- Increases government activity causes a **crowding out** of private economic activity
  - The government competes for resources with the rest of the economy
- If the size of the **government increases**, then through several economic mechanisms, there is a reduction in the quantity of spending by private firms on new plant and equipment and there is a reduction in private consumption expenditures
- **Government surplus** or total **government saving**: the **difference** between what the **government collects in taxes** and **what it spends**
  - Including expenditures on goods and services and transfer payments like employment insurance

Figure 1.6 The Total Government Surplus in Canada, as a Percentage of GDP



- - Total government surplus in Canada
    - Positive government surplus from 1961-mid 1970
    - Negative gov surplus from 1975 to late 1990
- **Government deficit**: the negative of the government surplus
  - Largest gov deficit was over 10% of GDP in early 1990
  - Gov deficit following the last recession in 2008-2009
    - Fell because:
      - Without any change in government policy, transfer payments like employment insurance benefits generally increase during a recession
      - Without any change in tax rates, tax revenues decrease during a recession
  - Since then, gov surplus has been close to 0

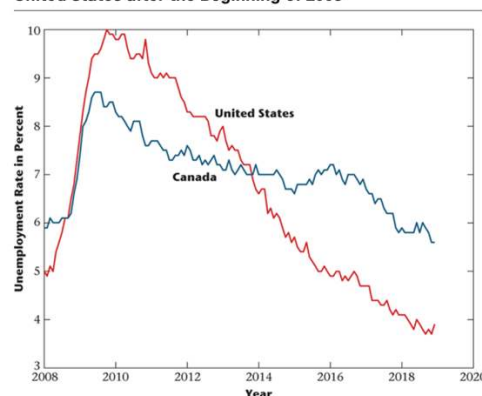
## DIFFERENCE BETWEEN INDIVIDUAL AND GOVERNMENT

- When the government accumulates debt by borrowing from its citizens, then this is debt that we as a nation owe to ourselves
  - o If the deficit is due to a **decrease in taxes**, then the government debt that is issued to finance the deficit will have to be **paid off ultimately by higher future taxes**
    - Thus, running a deficit in this case implies that there is a **redistribution of the tax burden from one group to another**; one group has its current **taxes reduced** while another has its **future taxes increased**
      - The two groups may be the same, resulting in no consequence of the deficit
      - **Ricardian equivalence theorem**: government deficits do not matter under some conditions

## UNEMPLOYMENT

- The phenomenon of unemployment need not represent a problem
- Two models of search and unemployment
  1. Basic “one-sided” search model, in which the unemployed must decide on a “**reservation wage**” - the wage at which they are willing to accept a job offer
  2. Based on the work of Nobel Prize winners Peter Diamond, Dale Mortensen, and Christopher Pissarides
    - a. Allows us to explain the determinants of labour force participation, the unemployment rate, the vacancy rate (the fraction of firms searching for workers to hire), and market wages
- Unemployment rates in Canada and USA

Figure 1.7 Unemployment Rates in Canada and the United States after the Beginning of 2008



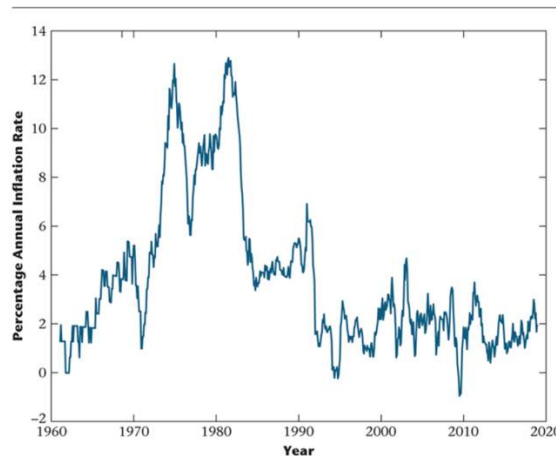
- o
- o 2008 is when most recent recession began
- o **Before recessions** unemployment rate in Canada was higher by 1-2% than USA
  - Due to measurement error, more generous employment insurance benefits in Canada, and the different composition of sectoral output in Canada

- **After recession**
  - USA: unemployment rate rose 5%
  - Canada: unemployment rate rose 2.5%
- **At the end of 2018:**
  - Unemployment rate in Canada was 1.7% higher than in the US
- Why US rate decreased faster than CAN
  - World oil prices fell beginning in 2014, and since the Canadian economy is more dependent on oil and gas production than the U.S. economy, this change led to more unemployment in Canada than in the United States
  - Since Canada was not as severely impacted by the global financial crisis as the United States and did not experience significant financial dysfunction during the crisis, the Canadian economy was able to recover from the crisis faster than the U.S. economy (and normally the unemployment rate is higher in Canada than in the United States)

## INFLATION

- **Inflation:** the rate of change in the average level of prices
- **Price level:** the average level of prices
  - One measure:
    - Consumer price index
      - The price of a set of goods bought by the 'average' consumer
- Inflation in Canada

Figure 1.8 Inflation in Canada



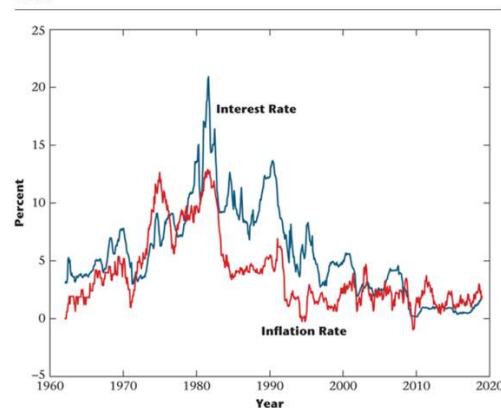
- 
- Low from early 1960 – early 1970
- Reaching peaks of more than 12%/year in mid 1970 and early 1980s
- Declined steadily and averaged about 2% since early 1990s
- 1991: agreement between bank of Canada and department of finance

- Inflation targeting was adopted in Canada
- Since 1990, target has been 2% inflation
- **Success**, inflation stayed within 1-3% range
- Inflation Issues in other countries (not too severe in Canada)
  - Inflation is too low relative to central bank's inflation target

## INTEREST RATES

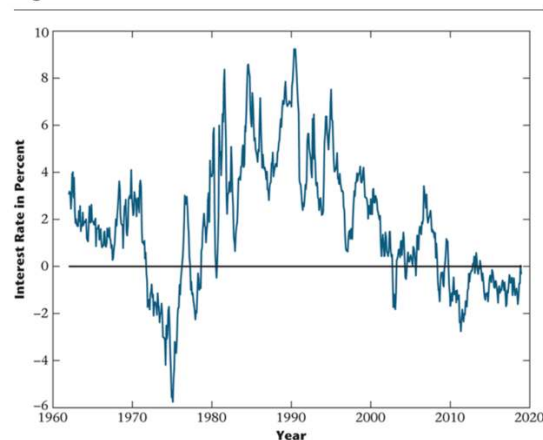
- Affects many private economic decisions, particularly the decisions of consumers as to how much they will borrow and lend, and the decisions of firms concerning how much to invest in new plant and equipment
- Movements in interest rates are an important element in the economic mechanism by which monetary policy affects real magnitudes in the short run
- Nominal interest rate

Figure 1.9 The Nominal Interest Rate and the Inflation Rate



- - 1962: nominal interest rate was 3%
  - 1980: high of more than 20%
  - 2018: declined on trend to 2%
- **The real interest rate:** the nominal interest rate – the expected rate of inflation
  - The rate that a borrower expects to have to repay, adjusting for the inflation that is expected to occur over the period of time until the borrower's debt is repaid
- Nominal interest rate tends to rise and fall with the inflation rate
  - Therefore, as the inflation rate rises, the nominal interest rate will tend to rise along with it
- **Real interest rate**

Figure 1.10 Real Interest Rate

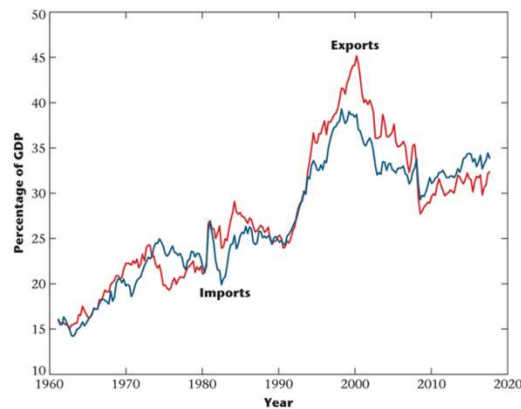


- 
- Plots of estimate of the real interest rate, which is the nominal interest rate minus the actual rate of inflation
- 1975: -5%
- Since late 1970s: has been positive
  - Except in 2002
- Interest rates were low because:
  - There were fundamental changes in demand for and/or supply of lending
  - Wide agreement that some fluctuations were caused by BOC's policy in attempt to smooth ups and downs in aggregate economic activity
    - Attempts to reduce real interest rates when economic activity is low, and to raise them when economic activity is high
- Effects of monetary policy on real economic activity - unemployment, employment, and real GDP, for example - are temporary

#### TRADE AND THE CURRENT ACCOUNT SURPLUS

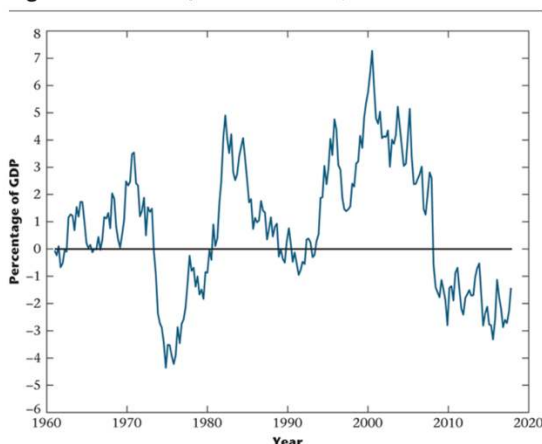
- Technology for transporting goods and information across countries has advanced
- Government-imposed impediments to trade have been **reduced**, Canada has become a more open economy
  - Trade in goods and in assets between Canada and the rest of the world has increased
- Exports and imports

Figure 1.11 Exports and Imports of Goods and Services for Canada, as Percentages of GDP



- - Exports:
    - 1961: increased about 16% of GDP
    - 2000: increased to 45%
    - 2018: decreased to 32%
  - Imports:
    - 1961: increased about 16% of GDP
    - 2000: increased to 39%
    - 2018: decreased to 34%
  - More trade could also expose a given country to the transmission of business cycle fluctuations from abroad
    - 2008-2009 recession decreased world trade
- **Net exports** of goods/services
  - Net exports = Exports – imports
  - When negative
    - The quantity of goods and services purchased abroad by domestic residents is greater than the quantity of domestic goods and services purchased by foreigners
    - To finance this, residents of Canada and/or the Canadian government must be borrowing abroad
  - Two reasons why its not bad to have negative net exports
    1. Might make sense for a country to borrow in short run to smooth aggregate consumption over time
    2. Might make sense if foreign borrowing is used to finance additions to nation's productive capacity, allowing for higher future living standards
  - What accounts for movements over time?
    - When the government increases its spending, holding taxes constant, this will increase the government deficit, which needs to be financed by increased government borrowing
    - Increases in domestic income, which tend to increase imports, and increases in foreign income, which tend to increase exports

Figure 1.12 Net Exports for Canada, 1961–2018



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- Canada had a current account deficit for most of this period (the current account surplus was usually negative)
- But the current account moved into surplus in the late 1990s, with a deficit opening up again during the last recession

## BUSINESS CYCLES

- The comovements in aggregate time series (the qualitative features of how aggregate time series move together) are similar across different business cycle events
- 1981-1982 recession thought to have monetary causes
  - Bank of Canada, along with other central banks in the world, was acting to bring inflation down from high levels, and some argue that a side effect of this monetary tightening was the 1981-1982 recession
- 2007-2008 recession originated from US
  - The negative effects on other countries was transmitted to the Canadian economy through international trade in goods and assets
- However, in real business cycle theory, attempts by policymakers to smooth business cycles are counterproductive, while New Keynesians argue that monetary and fiscal policy should play an active role in stabilizing real GDP

## CHAPTER 2: MEASUREMENT

### MEASUREMENT

- Two key elements in economics are **measurement and theory**
- Measurements of the performance of the economy motivate macroeconomists to build simple models that can organize our thinking about how the economy works



## MEASURING GDP

- **GDP**: the dollar value of final output produced during a given period of time within the borders of Canada
  - o Published on a quarterly basis by Statistics Canada as part of the National Income and Expenditure Accounts (NIEA)
- 3 approaches to measuring GDP
  1. **Product approach**
  2. **Expenditure approach**
  3. **Income approach**
- **Intermediate good**: a good that is produced and then used as an input to another production process
  - o Coconuts sold to a restaurant (used in the dishes)
- **After-tax profits = total revenue - wages - interest - cost of intermediate inputs - taxes**

## PRODUCT APPROACH

- Aka value-added approach
- GDP is calculated as the sum of value added to goods and services in production across all productive units in the economy
- **To calculate value added:**
  - o **ADD** the value of all goods produced in the economy **MINUS** the value of all intermediate goods used in production
  - o Considered double counting if you do not subtract intermediate goods

## EXPENDITURE APPROACH

- GDP as total spending on all final goods and services production in the economy
- **Total expenditure = GDP = C + I + G + NX**
  - o Where
    - C - consumption
    - I - investment
    - G - government expenditure
    - NX - net exports (total exports - total imports)

## INCOME APPROACH

- To calculate GDP:
  - o **ADD** all incomes received by economic agents contributing to production
  - o Income includes: profits made by firms and compensation of employees, corporate profits, net interest, net income of farm operators and unincorporated businesses, taxes less subsidies on factors of production, taxes less subsidies on products, government business enterprise profits before taxes, inventory valuation adjustment, and depreciation

- Depreciation is taken out when we calculate profits, so it needs to be added back in
- **Income-expenditure identity:** the quantity on the left-hand side of the identity is aggregate income, and right-hand side is the sum of the components of aggregate expenditure
  - Used to explain fluctuations in production of goods and services and spending

## INVENTORY INVESTMENT

- Consists of any goods that are produced but are not consumed during current period
  - Finished goods
  - Goods in process
  - Raw materials
- **Value-added approach**
  - Included in the total value of the goods
- **Expenditure approach**
  - Included in the investment
- **Income approach**
  - Included in inventories to the producers profits

## WHAT DOES GDP LEAVE OUT?

- GDP is intended to be a measure of the quantity of output produced and exchanged in the economy as a whole
  - Sometimes as a measure of aggregate economic welfare
- Two problems:
  1. Aggregate GDP does not take into account how income is distributed across the individuals in the population
  2. GDP leaves out all nonmarket activity, such as work from home
    - i. Ex. eating at home doesn't count in GDP
- GDP might be an inaccurate measure of welfare
  - Two problems with GDP as a measure of aggregate output
    1. Economic activities in the **underground economy** are not counted in GDP
      - a. Included any unreported economic activity
      - b. Ex. illegal drugs
      - c. Quantity per Canadian is \$2789 in December 2018
    2. How government expenditures are counted
      - a. Most of what government produces is not sold at market prices
      - b. Ex. how do you value bridges, roads, etc.

- c. **Solution:** to value government expenditures at cost, the payments to all of the factors of production that went into producing the good or service

## COMPONENTS OF AGGREGATE EXPENDITURE

- CONSUMPTION
  - o The largest expenditure component of Canadian GDP
  - o Accounting for 58.1% of GDP in 2017
  - o **Consumption:** expenditure on consumer goods and services during the current period, and the components of consumption are durable goods, semidurable, nondurable and services
    - Durable: appliances, furniture
    - Semidurable: clothing, footwear
    - Nondurable: food, fuel
    - Services: haircuts, hotel
  - o Note: a purchase of a used car or other used durable good is not included in GDP, BUT the services provided in selling the item would be included
- INVESTMENT
  - o **Investment:** expenditure on goods that are produced but not consumed during that current period
    - Two types:
      1. **Fixed investment:** production of capital, such as plant, equipment, housing and intellectual property products
        - i. **Non-residential investment:** adds to plant, equipment, and software to make up capital stock
        - ii. **Residential investment:** housing, it produces housing services
      2. **Inventory investment:** goods that are essentially put into storage
  - o Investment is much more variable than consumption or GDP, and some components of investment also tend to lead the business cycle

## NET EXPORTS

- In 2017, Canada ran a trade deficit in goods/services with the rest of the world
  - o Net exports were negative
  - o Exports were 31.1% of GDP in 2017; imports were 33.4% of GDP
  - o Thus, trade with the rest of the world in goods and services is very important to the Canadian economy

## GOVERNMENT EXPENDITURES

- Consist of expenditures by federal, provincial, and municipal govts on final goods/services
- In 2017, worth 24.5% of GDP
  - o Main components in 2017:
    - 20.7% - gov consumption
    - 3.8% - gov investment
- Government spending (NIEA) is only expenditures on final goods/services
  - o Does not include **transfers**: money transfers from one group to another
  - o Not included in GDP

## NOMINAL AND REAL GDP AND PRICE INDICES

- **Price index**: weighted average of the prices of a set of goods/services produced in the economy over a period of time
- **Price level**: average level of prices across all goods and services in the economy
- If we can measure inflation rate, we can also determine how much of a change in GDP from one period to another is purely nominal how much is real
  - o **Nominal change**: change in GDP that occurred only because price level changed
  - o **Real change**: GDP is an increase in physical quantity of output

## CALCULATIONS

- **Nominal GDP** =  $GDP_1 = Q_1P_{1(ORANGES)} + Q_1P_{1(APPLES)}$
- **Ratio of nominal GDP** =  $GDP_2 / GDP_1$
- **Change in nominal GDP** =  $(GDP_2 / GDP_1 - 1) \times 100$ 
  - o =  $(\text{ratio nominal GDP} - 1) \times 100$
- **REAL GDP (use base year prices)** =  $Q_1P_{1(ORANGES)} + Q_2P_{1(APPLES)}$
- **Ratio of REAL GDP** =  $g_1 = RGDP_2 / RGDP_1$ 
  - o  $g_2$  = using base year 2 prices =  $RGDP_2 / RGDP_1$
- **Change in real GDP** =  $(\text{ratio real GDP} - 1) \times 100$ 
  - o Aka percentage increase in GDP
- **Chain-weighting** =  $g_c = \sqrt{g_1 \times g_2}$ 
  - o Gives the percentage growth rate in real GDP from year 1 to year 2
  - o **Real GDP** using chain weighting
    - Year 1 dollars:
      - $GDP_1 = X$
      - $GDP_2 = GDP_1 \times g_c$

- Year 2 dollars:
  - $GDP_2 = x$
  - $GDP_1 = GDP_2 / g_c$

## MEASURES OF THE PRICE LEVEL

Two common measures

### 1. Implicit GDP price deflator

a. **Implicit GDP price deflator** = (nominal GDP / real GDP) x 100

### 2. Consumer price index (CPI)

a. A fixed-weight price index, takes quantities in a base year as being typical goods bought by average consumer

b. **Current year CPI** = (cost of base year quantities at current prices / cost of base year quantities at base year prices) x 100

i.

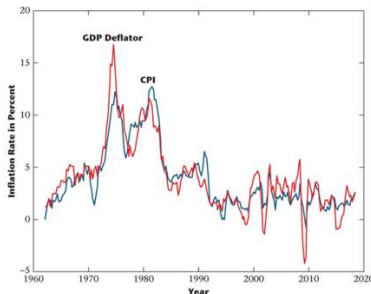
$$\text{Current year CPI} = \frac{\text{Cost of base year quantities at current prices}}{\text{Cost of base year quantities at base year prices}} \times 100$$

c. Percentage increase in CPI from year 1 to 2

i.  $CPI_2 - CPI_1$

## DIFFERENCES BETWEEN INFLATION RATES CALCULATED USING IGDPD AND CPI

Figure 2.2 Quarterly Inflation Rate Calculated from the CPI (blue line) and the Implicit GDP Price Deflator (red line), 1962-2018



- The two measures track each other but there are often substantial differences between the two

## PROBLEMS WITH MEASURING REAL GDP AND PRICE LEVEL

### 1. Relative prices change over time

- a. Introduces severe bias in how CPI measures inflation
- b. When items increase in price, consumers buy those that are cheaper
- c. The **assumption** when computing CPI: consumers do not change buying habits with price changes
  - i. FALSE
  - ii. Thus, goods that become more expensive are given a higher weight than they should have in the CPI
- d. Government

- i. Transfer payments:
    - 1. An upward bias in CPI inflation would also commit the federal government to higher transfer payments
  - ii. Income tax
    - 1. Upward bias in CPI inflation causes tax revenues to fall, increasing the government deficit
- 2. Changes in the quality of goods over time**
  - a. Due to higher quality, some of the increase in price represents the fact that the buyer is receiving more in exchange for their money
    - i. Ex. 1950 car vs 202 car
  - b. NIEA does not compensate for changes in quality over time, growth in real GDP will be biased downward and inflation will be biased upward
- 3. Measured GDP takes account of new goods**
  - a. If the NIEA does not correctly take account of the fact that the new goods are introduced
    - i. Ex. smartphones (initially at very high prices)
  - b. This could bias downward the measure of real GDP growth and bias upward the measure of the inflation rate

#### SAVINGS, WEALTH, AND CAPITAL

- **Flow:** a rate per unit time
- **Stock:** the quantity in existence of some object at a point in time
- SAVINGS
  - o Start with what the private sector has available to spend
    - **Private disposable income =  $Y^d = Y + NFP + TR + INT - T$** 
      - $Y$  - GDP
      - NFP - net factor payments from abroad
      - TR - transfers from gov to private sector
      - INT - interest on gov debt
      - T - taxes
      - G - government expenditures
  - o **Private sector saving ( $S^p$ )**
    - What it has available to spend minus what it consumes
    - **Private sector saving:  $S^p = Y^d - C = Y + NFP + TR + INT - T - C$**
    - Private savings, which is not used to finance domestic investment, is either lent to the domestic government to finance its deficit or is lent to foreigners
  - o **Government saving ( $S^g$ )**
    - **Government saving =  $S^g = T - TR - INT - G$**
    - Government saving = government surplus = - government deficit
  - o **Government deficit**

- **Government deficit =  $D = -S^g = -T + TR + INT + G$**
- **National saving**
  - Represents additions to the national wealth (the stock of assets held by the country as a whole)
  - Sum of private saving and government saving
  - **National saving =  $S = S^p + S^g = Y + NFP - C - G$** 
    - Since income-expenditure identity gives  $Y = C + I + G + NX$
    - Substitute Y into national savings
    - $S = C + I + G + NX + NFP - C - G$ 
      - **$S = I + NX + NFP$**
    - Thus national saving must equal  $^{\wedge\wedge\wedge}$ 
      - Side note:  $NX + NFP = CA$  (current account surplus)
        - **$S = I + CA$**
- $S = I + CA$ 
  - National Wealth is accumulated in two ways
    1. Investment (I)
      - a. The addition to the nation's **capital stock**
      - b. **Capital stock:** quantity of plants, equipment, housing, inventories in existence in an economy at a point in time
    2. Current account surplus
      - a. **Current account surplus:** A measure of the balance of trade in goods and services with the rest of the world
      - b. Implies that Canadian residents are accumulating claims on foreigners
        - i. If goods are flowing from Canada to other countries, then these goods must be paid for with a transfer of wealth from outside Canada to Canadian residents
      - c. CA is a flow and quantity of claims at a point in time is a stock

## LABOUR MARKET MEASUREMENT

- **Employed:** worked part-time or full-time in the past week
- **Unemployed:** not employed during the past week but actively seeking work within the last four weeks
- **Not in the labour force:** neither employed or unemployed
- **Labour force = employed + unemployed**
- **Unemployment rate = number unemployed / labour force**
  - Useful as a measure of **labour market tightness:** degree of difficulty firms face in hiring workers
  - Two ways to mismeasure:

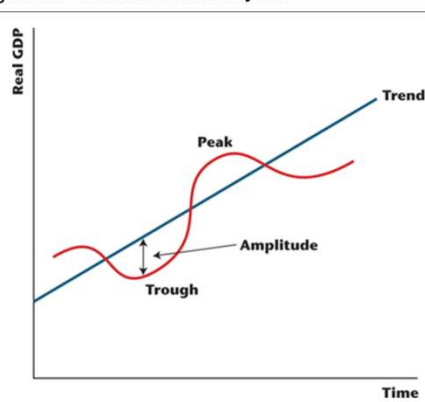
1. **Discouraged workers** are not counted in the labour force, have stopped searching for work but actually want to be employed
2. Does not adjust for how intensively the unemployed are searching for work

- **Participation rate** = labour force / total working age population
- **Employment/population ratio** = employment / total working age population

## CHAPTER 3: BUSINESS CYCLE MEASUREMENT

### REGULARITIES IN GDP FLUCTUATIONS

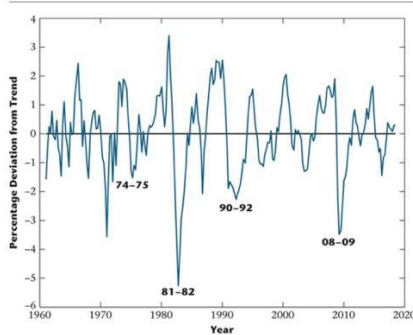
Figure 3.1 Idealized Business Cycles



- 
- Turning points:
  - o **Peak:** relatively large positive deviation from trend
    - **Boom:** a series of peaks from trend
  - o **Trough:** large negative deviation from trend
    - **Recession:** series of troughs
      - 1974-1975
        - o Mild >2%
      - 1981-1982
        - o Relatively severe 5%+
        - o Caused by monetary tightening
      - 1990-1992
        - o Moderate 2%
      - 2008-2009
        - o 3%+
        - o Caused by a global financial crisis
        - o Comovement similar to 1981-1982 recession



Figure 3.2 Percentage Deviations from Trend in Real GDP, 1961–2018

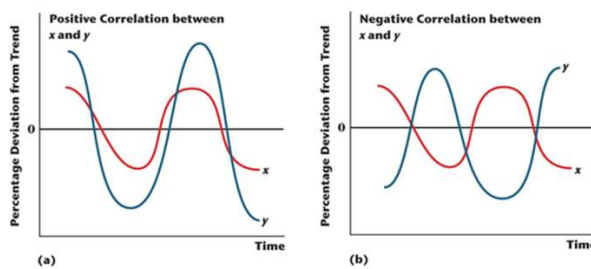


- **Amplitude:** the maximum deviation from trend
  - **Frequency:** number of peaks that occur per year
- Observations from graph 3.2:
  - Deviations from trend in real GDP are **persistent**
    - When real GDP is above trend, it tends to stay above trend, and when it is below trend, it tends to stay below trend
      - Allows for short term future predictions
  - 1. The time series of deviations from trend in real GDP is **quite choppy**
  - 2. There is **no regularity in the amplitude** of fluctuations in real GDP about trend
    - i. Some peaks/troughs are large, some are small
  - 3. There is **no regularity in the frequency** of fluctuations in real GDP about trend
    - i. The length of time between peaks and troughs in real GDP varies considerably
  - Thus, Long-term forecasting is difficult

## COMOVEMENT

- **Comovement:** how aggregate economic variables move together over the business cycle
- **Time series:** sequential measurements of an economic variable over time
- Typically look at two time series at a time
  1. Transform these two by removing trends and let  $x$  and  $y$  denote percent deviations from trend
  2. Look for a pattern of **positive correlation** or **negative correlation**
    - i. **Positive:**  $x$  is high when  $y$  is high OR  $x$  is low when  $y$  is low
    - ii. **Negative:**  $x$  is high when  $y$  is low OR  $x$  is low when  $y$  is high

Figure 3.3 Time Series Plots of  $x$  and  $y$



3.

- Scatter plot
  - o Each point is an observation for a particular time period
  - o Correlation is determined by the slope of a straight line that best fits the points in the scatter plot
    - A) positive correlation
    - B) Negative correlation
    - C) zero correlation
- **Procyclical:** deviations from trend are positively correlated with deviations from trend in real GDP
- **Countercyclical:** deviations from trend are negatively correlated with deviations from trend in real GDP
- **Acyclical:** neither procyclical or countercyclical

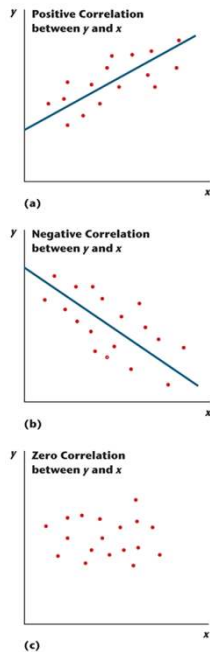
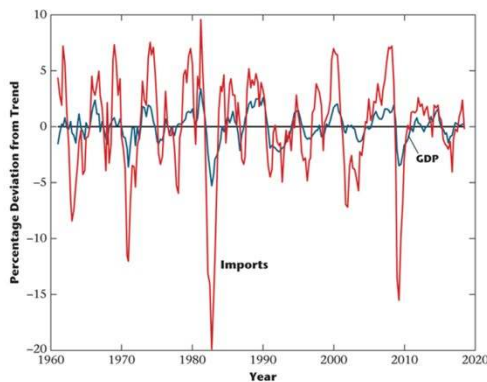
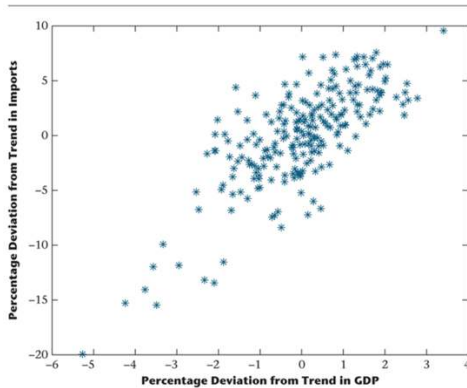


Figure 3.5 Imports and GDP for Canada, 1961–2018



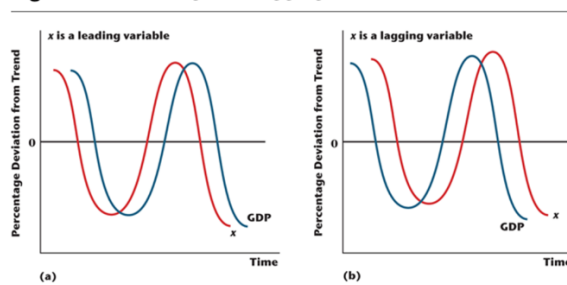
- 
- When GDP is high (low) relative to trend, imports tend to be high (low) relative to trend

Figure 3.6 Scatter Plot of Imports and GDP for Canada, 1961–2018



- 
- Observations of percentage deviations from trend in imports versus percentage deviations from trend in GDP
- **Important fact:** deviations from trend in imports and GDP are positively correlated
- **Correlation coefficient:** a measure of the degree of correlation between two variables
  - o Between -1 and 1
  - o Perfectly positively correlated = 1
  - o Perfectly negatively correlated = -1
  - o Uncorrelated = 0

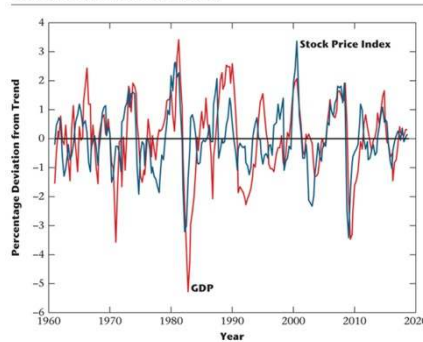
Figure 3.7 Leading and Lagging Variables



- 
- o **Leading variable:** an economic variable that helps to predict future real GDP
  - Timely information on leading variables can be used to forecast real GDP
  - The construction and use of an index of leading economic indicators
    - Such an index is a weighted average of macroeconomic variables
    - Useful information for forecasters, particularly with respect to the turning points in aggregate economic activity
    - Stock price index:
      - o Stock prices tend to quickly reflect info about the state of the macroeconomy

- Stock prices tend to be a leading variable

Figure 3.8 Percentage Deviations from Trend in Real GDP and the TSE Composite Index.



- **Lagging variable:** an economic variable that past real GDP helps to predict
- **Coincident variable:** an economic variable that neither leads nor lags
- **Standard deviation:** a measure of cyclical variability
  - Measured by standard deviation of the percentage deviations from trend

## COMPONENTS OF GDP

Figure 3.9 Percentage Deviations from Trend in Real Consumption and Real GDP for Canada, 1961–2018

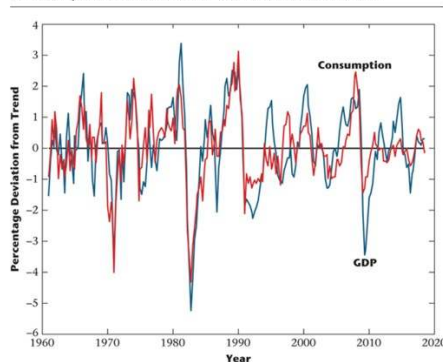
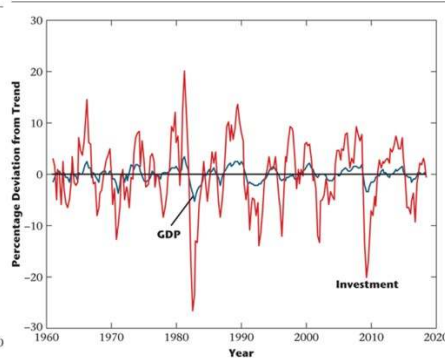


Figure 3.10 Percentage Deviations from Trend in Real Investment and Real GDP for Canada, 1961–2018

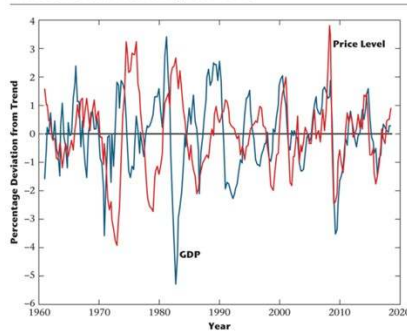


- 3.9
  - Real aggregate consumption and real GDP
  - Highly positively correlated (0.78 correlation), two time series move very closely together
  - Consumption is procyclical, no visible lead/lag thus coincident, and less variable than GDP
  - Standard deviation of the percentage deviation in real consumption is 83%
- 3.10
  - Investment is procyclical, coincident, and more volatile than GDP
  - Highly correlated (0.81)
  - Standard deviation from trend in investment is 509%

## PRICE LEVEL AND INFLATION

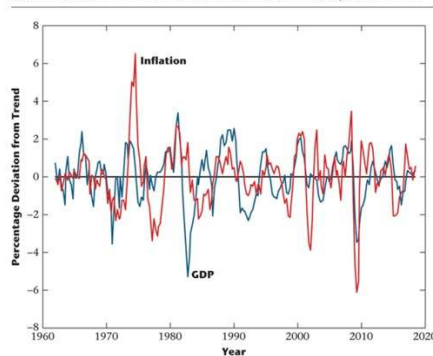
- 1950, observed there was a negative relationship between rate of change in money wages and unemployment
- **Phillips curve**: captures a positive relationship between the rate of change in a money price (the money wage) and the level of aggregate economic activity

Figure 3.11 Percentage Deviations from Trend in the Price Level and Real GDP, 1961–2018



- Percentage deviations in price level and in real GDP
  - Correlation is -0.009 which is basically 0, no correlation

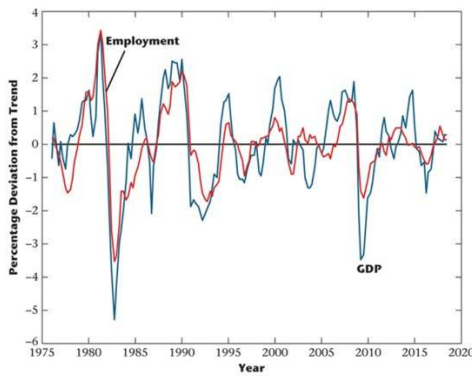
Figure 3.12 Percentage Deviation from Trend in Real GDP, and Deviation from Trend in the Inflation Rate, 1961–2018



- Percentage deviation in inflation rate and in real GDP
  - Correlation is 0.38, positive correlation
  - Conforms to conventional views on Phillips curve
- If central bank tries to control inflation, it'll affect the correlation between inflation and real economic activity

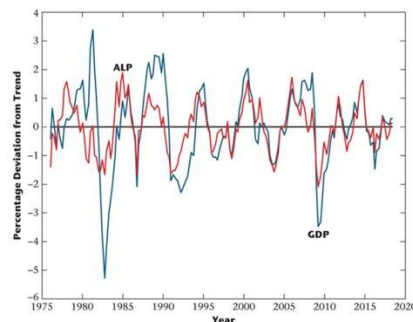
## LABOUR MARKET VARIABLES

Figure 3.14 Percentage Deviations from Trend in Employment and Real GDP for Canada, 1976–2018



- Percentage deviations in employment and real GDP
    - Employment is procyclical, lagging and less variable than GDP
    - Correlation is 0.79
    - Standard deviation for employment being 80% of that for real GDP
- Market **real wage**: purchasing power of the wage earned per hour worked for the average worker
  - Measured from average wage for all workers / price level
  - Empirical evidence indicates real wage is procyclical
    - No data as it is too difficult to measure
      - Labour force changes over business cycle which bias's the correlation
  - No evidence if real wage is leading or lagging
- **Average labour productivity: (Y/N)**
  - Where
    - Y – aggregate real output
      - Real GDP
    - N – total labour input
      - Total employment

Figure 3.15 Percentage Deviations from Trend in Average Labour Productivity and Real GDP



- - Percentage deviation in average labour productivity and real GDP
    - ALP is procyclical, coincident, and less volatile

- Correlation is 0.66
- Standard deviation is 64% of that for real GDP

## SUMMARY

**Table 3.1 Correlation Coefficients and Variability of Percentage Deviations from Trend**

	Correlation Coefficient (GDP)	Std. Dev. (% of S.D. of GDP)
Consumption	0.78	83%
Investment	0.81	509
Employment	0.79	80
Average labour productivity	0.65	64

**Table 3.2 Summary of Business Cycle Facts**

	Cyclical	Lead/Lag	Variability Relative to GDP
Consumption	Procyclical	Coincident	Smaller
Investment	Procyclical	Coincident	Larger
Employment	Procyclical	Lagging	Smaller
Real wage rate	Procyclical	?	?
Average labour productivity	Procyclical	Coincident	Smaller

## CHAPTER 4: CONSUMER AND FIRM BEHAVIOUR: THE WORK-LEISURE DECISION AND PROFIT MAXIMIZATION

### THE REPRESENTATIVE CONSUMER

## CHAPTER 4: CONSUMER AND FIRM BEHAVIOUR

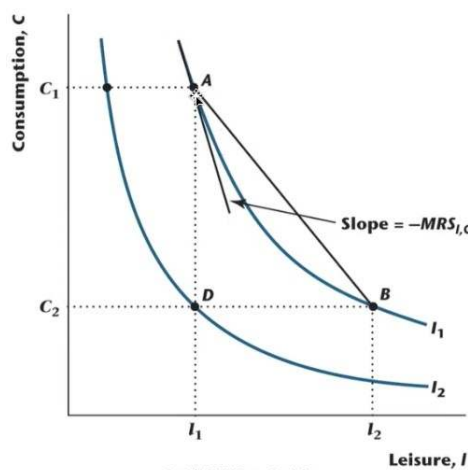
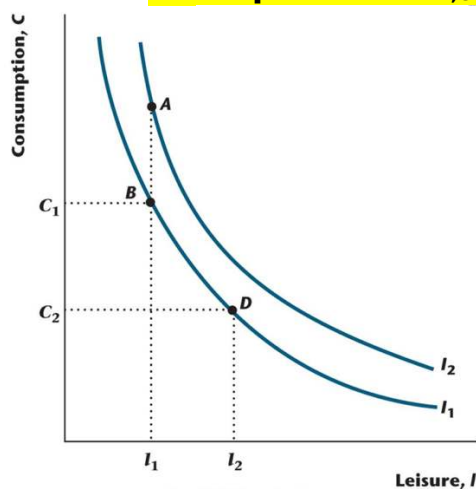
## LABOUR SUPPLY

### Representative consumer

- Consumer's preferences over consumption and leisure as represented by indifference curves
- Consumer's budget constraint
- Consumer's optimization problem: making himself or herself as well off as possible given his or her budget constraint
- **Goal**: The goal is to choose consumption and leisure. The consumer wants to make himself or herself as well off as possible while respecting his or her budget constraint
- 

### Indifference curves

- An indifference curve **slopes downwards** (more is preferred to less)
- An indifference curve is **convex** (bowed in toward the origin) (because of preference for diversity in his or her consumption bundle)
- The **slope** is the **negative of the marginal rate of substitution**
  - o **Slope =  $-MRS_{L,C}$**



- Shows two indifference curves
  - o Each represents a set of consumption bundles among which the consumer is indifferent
  - o Higher indifference curves represent higher welfare

### Labour-leisure choice model (Labour supply)

- **Substitution effect**: work more hours if \$/hr increases
- **Income effect**: work less hours if \$/hr increases
- **Substitution effect = income effect**: work the same hours if \$/hr increases

### Backwards bending labour supply





	x	y
S	↓	↑
I	↓	↓
+A+G	↓	?

- $U = U(C, L)$

W: hourly wage

- The opportunity cost of leisure
- W is the price of leisure

$N^S$ : hours worked (**labour supply**)

C: consumption

- A numeraire good
  - o Everything in the model is counted in this
  - o  $P_x = 1$

L: leisure

- X VARIABLE
- Primary variable of interest

$\Pi$  ( $\Pi$ ): dividend income

T: lump sum tax

H: total hours

h:  $N^S + L$

K: capital

### Consumers Budget constraint model

- $C = wN^S + \Pi - T$

- o Consumption = total wage income + dividend income - taxes
- Expenditure  $\leq$  Income [ALWAYS THE CASE]
  - o However, this model looks at Expenditure = Income
- Exp = Inc
- **Consumer's Time constraint**

- o  $N^S + L = h$

- $N^S = H - L$
- Sub into budget constraint

- Now,  $C = w(H-L) + \Pi - T$

- **BUDGET CONSTRAINT:  $C + wL = wH + \Pi - T$**

- o In this case, everything on the right is exogenous
  - $\Pi, T, H, w$
- o Everything on left is endogenous (choice variable)
  - $C, N^S, L$

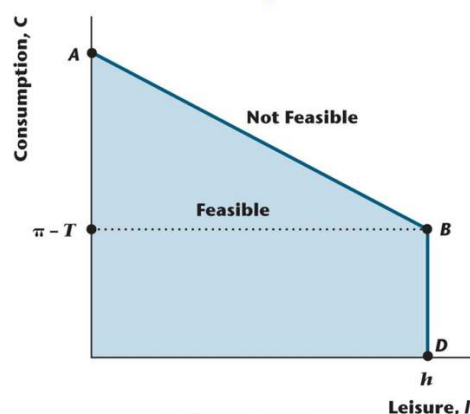
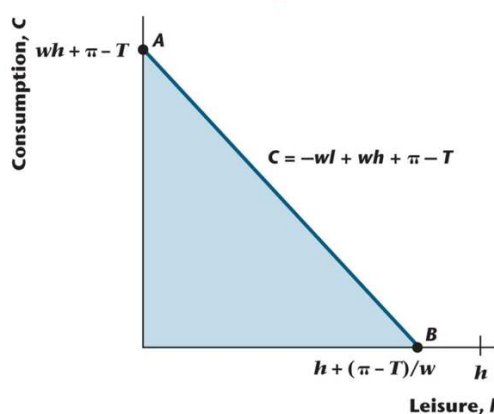
- The maximum potential income (I):  $wH + \Pi - T$

- o W is the price of leisure
- o 1 is the price of C

$$C = w(H-L) + \Pi - T$$

$$C + wL = wH + \Pi - T$$

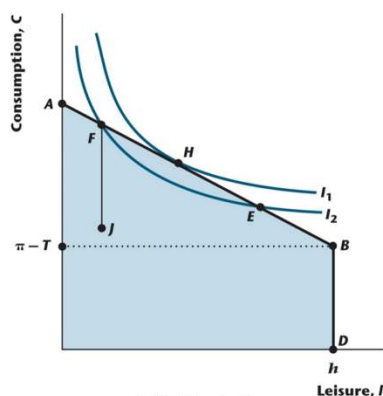
Representative Consumer's Budget Constraint  $T > \pi$  Representative Consumer's Budget Constraint  $T < \pi$



### Consumer optimization

- Consumer chooses the consumption bundle that is **on their indifference curve** that is **tangent to budget constraint**
- **Implies:** the marginal rate of substitution of leisure for consumption **equals** the real wage

### Consumer Optimization



- Optimal
- Points inside cannot be optimal
- Points on the indifference curve also cannot be optimal (EX. F and E)
- The optimal bundle cannot be at the rightmost side (kink) of the budget constraint (where  $L=h$ )

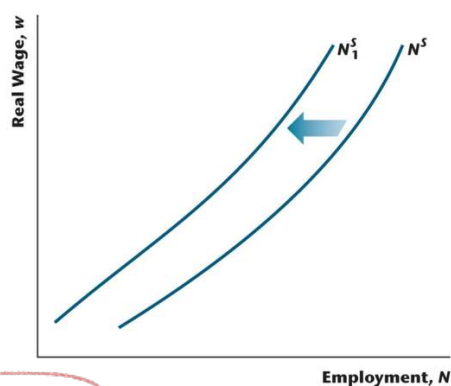
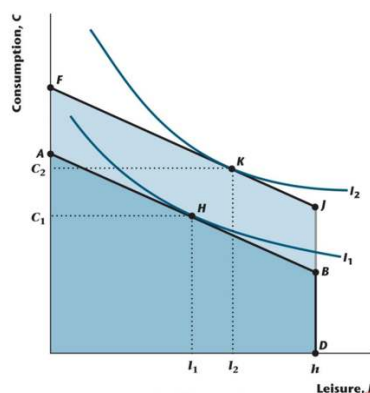
↑  
unrealistic.

### Real dividends or taxes change for the consumer

- Assume consumption and leisure are both normal goods
- An **increase** in dividends or a **decrease** in taxes will cause the consumer to **increase consumption** and reduce the quantity of labour supplied (increased leisure)
  - o The **labour supply curve shifts to the left** when dividend income increases or taxes fall
  - o Because of a positive income effect on leisure

↘ income effect.

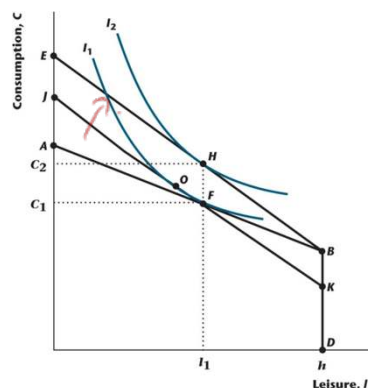
## An Increase in the Consumer's Dividend Income Effect of an Increase in Dividend Income or a Decrease in Taxes



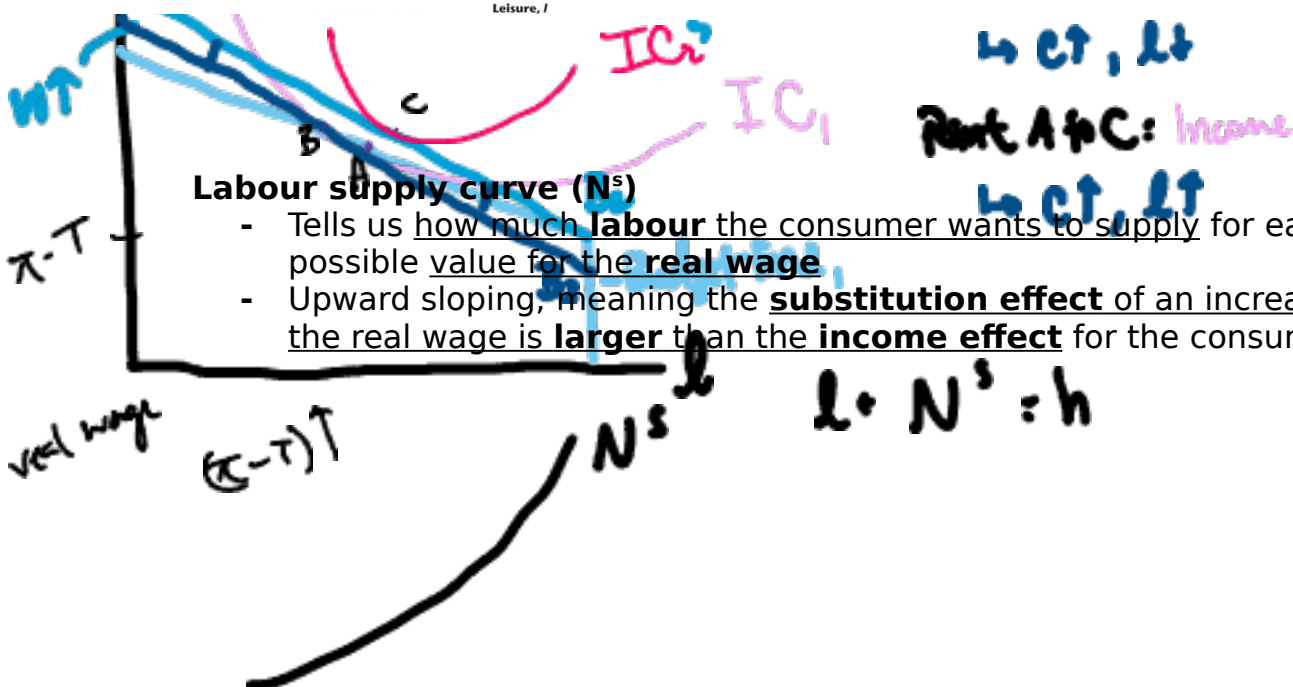
### An increase in the market real wage rate

- Has income and substitution effects
- **Substitution effect:** the price of leisure rises, so consumer substitutes from leisure to consumption (Consumption increases)
- **Income effect:** the consumer is effectively more wealthy, and since both goods are normal, consumption increases and leisure increases
- **Conclusion:** consumption must rise, but leisure may rise or fall

### Increase in the Real Wage Rate—Income and Substitution Effects

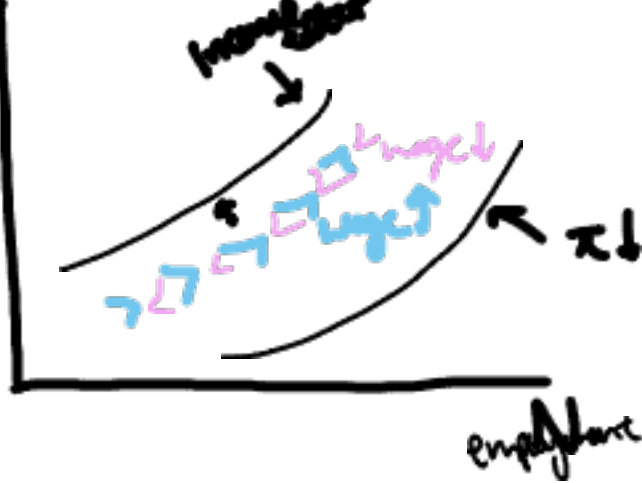


- Shifts budget constraint from **ABD to EBD**
- The kink remains fixed and budget constraint becomes **steeper**
- **Substitution effect:** **F to O**
- **Income effect:** **O to H**



### Labour supply curve ( $N^S$ )

- Tells us how much labour the consumer wants to supply for each possible value for the real wage
- Upward sloping, meaning the **substitution effect** of an increase in the real wage is **larger** than the **income effect** for the consumer



Function:

- Plug in inputs (variables outside the model) [exogenous]
- To see what happens to the variables [endogenous]

**Example:**

$$U = U(c, l) = c^{1/3} l^{2/3}$$

- $\Pi = 30, T = 10, H = 50, w = 2$ 
  - o Maximum leisure = h
  - o Maximum consumption =  $wh + \Pi - T = 100 + 30 - 10 = 120$
  - o Minimum consumption =  $\Pi - T = 30 - 10 = 20$
- X-intercept: spent all money on x
- Y-intercept: spent all money on y
- The slope of the budget constraint

o **Slope = w**

$$\square -P_l / P_c = -w / 1 = -w$$

**Tangency**

- **Slope of IC = slope of BC**

- $MRS_{lc} = -P_l / P_c$ 
  - o  $-MU_l / MU_c = -w$
- $MRS_{lc} = -2/3 (c^{1/3})(l^{-1/3}) / 1/3 (c^{-2/3})(l^{2/3})$ 
  - o  $= c^{1/3} / c^{-2/3} = c^{3/3} = c$
  - o  $= l^{-1/3} / l^{2/3} = l^{-1/3-2/3} = l^{-1} = 1/l$

-  **$MRS_{lc} = -2c / l$**

- $-2c / l = -w$
- $C = wl / 2$
- Plug ^ into budget constraint
  - o  $(wl/2) + 1wl = wH + \Pi - T$
  - o  $3/2 (wL) = WH + \Pi - T$
- $L = 2(wH + \Pi - T) / 3w$ 
  - o  $= 2 \times 120 / 3 \times 2 = 40$
- $C = wH + \Pi - T / 3$ 
  - o  $= 120 / 3 = 40$
- $N^s = H - L = 50 - 40 = 10$

$$\frac{-2/3 \cdot c^{1/3} \cdot l^{-1/3}}{1/3 \cdot c^{-2/3} \cdot l^{2/3}} = -2 \frac{c^{1/3} l^{-1/3}}{c^{-2/3} l^{2/3}}$$

$$= -2 \frac{c^{1/3+2/3} l^{-1/3-2/3}}{1} = -2 \frac{c^{3/3} l^{-3/3}}{1} = -2 \frac{c}{l}$$

$$-w \cdot \frac{-2c}{l} \Rightarrow c = \frac{wl}{2}$$

**Experiment**

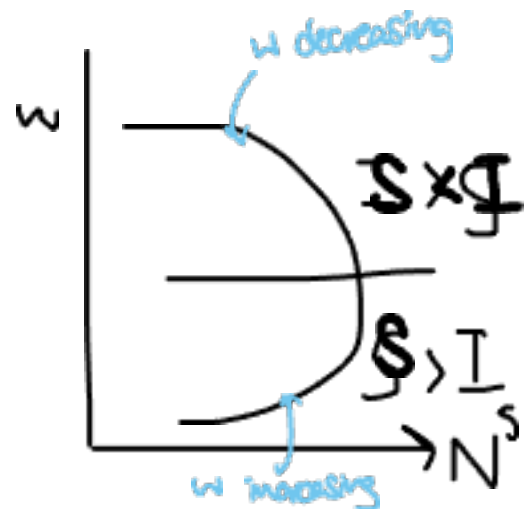
- 1)  $\Pi$  goes up (or  $T$  goes down)

- **Total effect:**
- C and L goes **up**
- $N^S$  goes **down**
  - L and  $N^S$  always move opposite directions
- Slope did not change
  - No substitution effect
- **THUS, INCOME EFFECT**

2) If  $w$  increases from 2 to 3 ( $w=3$ )

- The y-int **increases**
- The x-int stays the same (h)
- **income effect:**
  - Both goes up, because both are normal goods
- $W$  increases:
  - $N^S$  increases if sub > inc
  - Labour supply is upward sloping
- $W$  decreases:
  - $N^S$  decreases if sub < inc
  - Labour supply is downward sloping

	C	L	$N^S$
S	↑	↓	↑
I	↑	↑	↓
Total	↑	?	?



**Bundle A**

- $L = 40$
- $C = 40$
- $N^S = 10$

**Bundle C:**

- $L = 2(3 \times 50 + 30 - 10) = 340 / 9 = 37.78$

- $C = (3.5 + 30 - 10) / 3 = 170 / 3 = 56.67$
- $N^S = 50 - 37.78 = 12.22$

### Finding Bundle B:

- $U_B = U_A = 40^{1/3} 40^{2/3} = 40$
- $MRS_{LC}^B = -w^{new} = -3$
- $-2c/l = -3$ 
  - o Simplify,  $C = 3/2(l)$
- Plug into  $U_B$ 
  - o  $U_B = 3/2(l)^{1/3} l^{2/3} = 4 = U_A$
- $(3/2)^{1/3} l = 40$
- $L = 40 / (1.5)^{1/3} = 34.94$
- $C = (3/2) \times 34.94 = 52.41$
- $N^S = 50 - 34.94 = 15.06$

	C	L	N <sup>S</sup>
A	40	40	40
B	52.41	34.94	15.06
C	56.67	37.78	12.22

Sub: A to B

Inc: B to C

	C	L	N <sup>S</sup>
SUB	+12.41 <del>+40 - 52.41</del>	-5.06 <del>-40 - 34.94</del>	+5.06 or -24.94
INC	+4.26 <del>+52.41 - 56.67</del>	+2.84 <del>+34.94 - 37.78</del>	-2.84 or -2.84
TOTAL (+)	+16.67	-2.22	+2.22 or -27.78

## LABOUR DEMAND

### Firm's problem

- 1) Profit maximization
- 2) Production function
  - o Factors of production
    - Capital (physical)
      1. Output: how much capital we can produce
    - Labour
  - o Total factor productivity (TFP)
    - $Y = zF(K, N^d)$

### Representative's firm

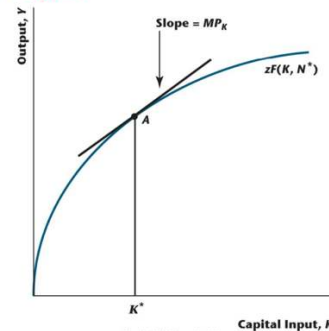
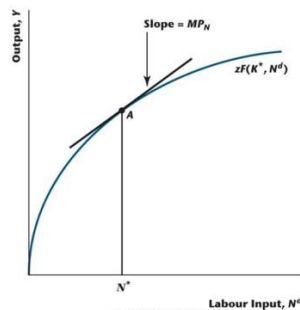
- **Goal:** The firm's goal is to maximize its profits by choosing the quantity of labour to hire, with the quantity of capital being fixed
- **Marginal product** is diminishing because:
  - o The cost advantage diminishes for each additional unit of labour produced

- **Marginal product of labour curve** is the **firm's labour demand curve** because:
  - o A firm maximizes profits for the quantity of labour input that implies marginal product of labour equals wages

### Properties of the firm's production function

- Constant returns to scale
- **Output increases** with **increases** in either the **labour input or the capital input**
- The marginal product of labour decreases as the labour input increases
- The marginal product of capital decreases as the capital input increases
- The marginal product of labour increases as the quantity of the capital input increases

Production Function, Fixing the Quantity of Capital, and Varying the Quantity of Labour      Production Function, Fixing the Quantity of Labour, and Varying the Quantity of Capital



### Profit maximization

- First understand: optimization happens when **marginal benefit = marginal cost (MB=MC)**
  - o If  $MB > MC$ , do more
  - o If  $MB < MC$ , do less
- Denote profit with  $\pi$  ( $\Pi$ )
- $\Pi(N^d) = TR(N^d) - TC(N^d)$
- Optimization:
  - o Find Derivative to find slope
    - Make it equal to 0
  - o  $d\Pi/dN^d \mid dTR/dN^d - dTC/dN^d = 0$
  - o  $dY/dN^d - dwN^d/dN^d = 0$
  - o  **$NP_N = w$**

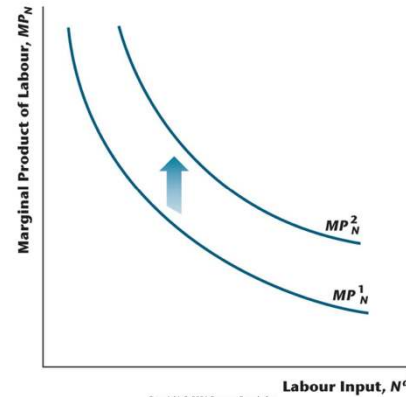
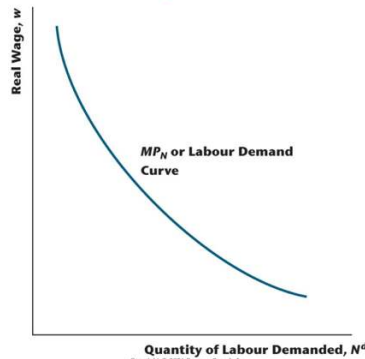
### Labour demand (pic 1)

- **$MP_N = w$**
- Marginal product of labour curve IS the labour demand curve of the profit maximizing firm
- Firms hire labour up to the point where  $MP_N = w$

### Increased capital (pic 2)

- Marginal product of labour increase when the quantity of capital used increases

The Marginal Product of Labour Curve Is the Labour Demand Adding Capital Increases the Marginal Product of Labour Curve of the Profit-Maximizing Firm



### Total factor productivity

- An increase in total factor productivity has two effects:
  - o More output is produced given each quantity of the labour input
    - The production function shifts upward
  - o The marginal product of labour **increases** for each quantity of the labour input
- When total factor productivity **increases**, marginal product of labour schedule **shifts to the left**

### Revenue, variable costs, and profit maximization

- $Y = zF(K, N^d)$  is the firm's revenue
- $wN^d$  is the firm's variable cost
- Profits are the difference between the former (beginning) and the latter (end)
- **Maximized profits** are at the point where **marginal revenue = marginal cost**
  - o  $MP_N = w$
- Maximized profits are the distance AB or ED

Extra notes:

- **Gross national product**
  - o  $GNP = GDP + NFP$  (Net factor payments to Canadian residents from abroad)
- **Perfect complements**: Two goods that are always consumed in fixed proportions
- **Consumption bundle**: A given consumption leisure combination
- When the proportional tax on wage income is imposed
  - o the substitution effect



- is for a **decrease in consumption** and is for an **increase in leisure**
- the income effect
  - is for a **decrease in consumption** and is for a **decrease in leisure**

## CHAPTER 5 - A CLOSED ECONOMY ONE PERIOD MACRO MODEL

### INTRO

- **Closed economy:** an economy that does not trade with the rest of the world
- **Open economy:** an economy that trades with the rest of the world

### GOVERNMENT

- It wants to purchase a given quantity of consumption goods,  $G$ , and finances these purchases by taxing the representative consumer
- Governments provide many different goods and services
  - Roads, bridges, national defence
- Economists generally agree that government has a special role to play in providing **public goods**
  - **Public goods:** goods that are difficult/impossible for private sector to provide
    - Ex. National defence
- Output is produced (goods from private sector)
  - Government purchases an **exogenous** amount,  $G$ , of this output
  - Remainder is consumed by representative consumer
- **Exogenous variable:** determined outside the model
  - Government spending is exogenous
- **Endogenous variable:** determined by the model itself
- **Government budget constraint:  $G = T$**
- FISCAL POLICY
  - The government's choices over its expenditures, taxes, transfers, and borrowing
  - Governments choices are very limited
    - Cannot borrow to finance government expenditures
      1. Because there is no future in which to repay debt
  - Government budget deficit ( $G - T$ ) is always zero

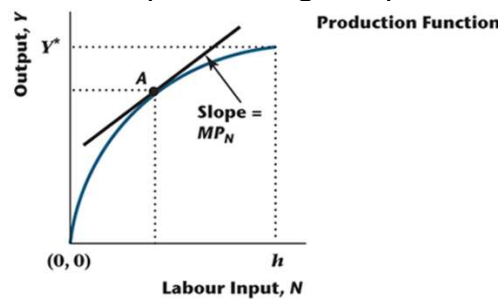
### COMPETITIVE EQUILIBRIUM

- **Exogenous variables:**  $G$ ,  $z$ , and  $K$ 
  - Government spending, total factor productivity, capital stock
- **Endogenous variables:**  $C$ ,  $N^s$ ,  $N^d$ ,  $T$ ,  $Y$ , and  $w$ 
  - Consumption, quantity of labour supplied, quantity of labour demanded, taxes, aggregate output, market real wage
- Process of running experiments to determine how changes in exogenous variables will change the endogenous variables



- 
- **Competitive equilibrium:** state of economy in which prices and quantities are such that behaviour of price-taking consumers and firms is consistent
- **Competitive:** all consumers and firms are price takers
- **Equilibrium:** actions of all consumers and firms are consistent
- **Market clearing:** supply equals demand in particular markets
- A competitive equilibrium is achieved when
  - o The quantity of labour the consumer wants to supply is equal to the quantity of labour the firm wants to hire
  - o Given exo variables  $G$ ,  $z$ , and  $K$
- Consumer's supply of labour is determined by taxes,  $T$  and dividend income,  $\Pi$ 
  - o  $T$  must satisfy government budget constraint
  - o  $\Pi$  ( $\Pi$ ) must be equal to profits generated by firm
- FOLLOWING MUST BE SATISFIED:
  - 1) Representative consumer chooses  $C$  (consumption) and  $N^S$  (labour supply) to make themselves as well off as possible subject to their budget constraint, given  $w$  (real wage),  $T$  (taxes), and  $\Pi$  (dividend income)
    - a) Aka: representative consumer optimizes given their budget constraint which is determined by  $w$ ,  $T$ , and  $\pi$
  - 2) Representative firm chooses  $N^d$  (labour demand) to maximize profits, with maximized output  $Y = zF(K, N^d)$  and maximized profits  $\Pi = Y - wN^d$ 
    - a) In equilibrium, profits that representative firm earns must equal dividend income that is received by consumer
  - 3) The market for labour clears,  $N^d = N^S$
  - 4) Government budget constraint is satisfied,  $G = T$
- Important property:
  - o Income-expenditure identity
    - $Y = C + G$
    - Comes from  $Y = C + I + G + NX$ 
      1. In this economy, there is no investment and  $NX$  is 0
- Representative consumer's budget constraint ( $C = wN^S + \Pi - T$ ) =
  - o  $C = wN^S + Y - wN^d - G$ 
    - Because in equilibrium,  $\Pi = Y - wN^d$  and  $T = G$
- PRODUCTION TECHNOLOGY OPERATED BY REPRESENTATIVE FIRM
  - o In competitive equilibrium,  $N^S = N^d = N$
  - o Refer to  $N$  as employment
  - o **From production function**
    - i) Output is  $Y = zF(K, N)$
    - Graphed for a given capital stock  $K$

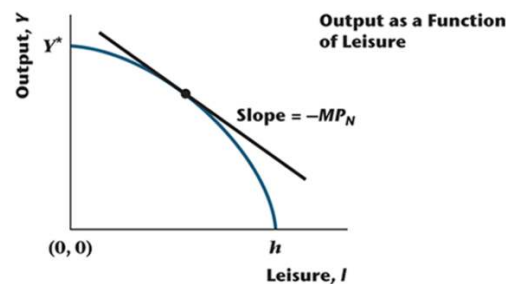
1. Maximum of  $h$  hours,  $N$  can't be larger than  $h$
2. Thus, maximum output that can be produced is  $Y^*$
3. Slope = marginal product of labour  $MP_N$



(a)

### Output as a function of leisure

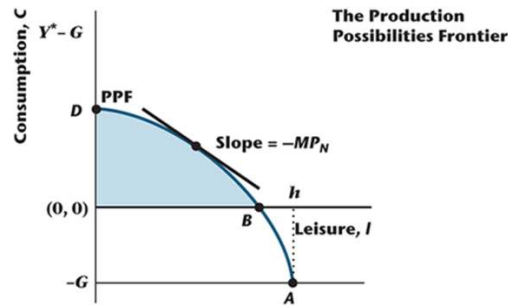
- Mirror image of production function
- Graphed using, in equilibrium,  $N = h - l$ 
  1. Sub in  $N$  into i)
  2. ii)  $Y = zF(K, h-l)$ 
    - Relationship between output  $Y$  and leisure  $l$
    - Given exo variables  $z$  and  $K$
  3. Slope = - marginal product of labour ( $-MP_N$ )



(b)

### The production possibilities frontier

- Same graph as b) but shifted down by amount  $G$
- $C = Y - G$ 
  1. Substitute  $Y = C + G$  into ii)
  2. iii)  $C = zF(K, h-l) - G$ 
    - Relationship between  $C$  and  $l$
    - Given exo variables,  $z$ ,  $k$ , and  $G$
  3. Slope =  $-MP_N$ 
    - Aka **marginal rate of transformation**: rate at which one good can be converted technologically into another
    - $MRT_{l,c}$  = marginal rate of transformation of leisure into consumption
      - $MRT_{l,c} = MP_N = -\text{slope of PPF}$
- **Production possibilities frontier (PPF)**: the boundary of a set that describes what consumption bundles are technologically feasible to produce

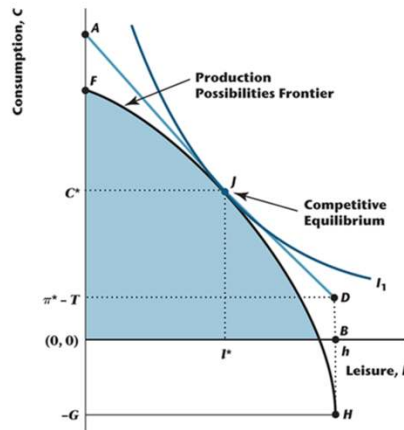


(c)

1. All points on and inside the PPF are technologically possible in economy
2. Captures tradeoff between leisure and consumption
3. Points under x-axis are not feasible for economy

## Competitive equilibrium

Figure 5.3 Competitive Equilibrium



- Representative firm chooses labour input to maximize profits in equilibrium by setting  $MP_N = w$ 
  1. So in equilibrium minus the slope of PPF must equal to  $w$ 
    - Since,  $MRT_{l,c} = MP_N = w$  in equilibrium
- Firm chooses labour demand equal to  $h-l^*$  and produces  $Y^* = zF(K, h-l^*)$  from the production function
- Maximized profits for the firm are  $\pi^* = zF(K, h-l^*) - w(h-l^*)$ 
  1. Total revenue - cost of hiring labour
- DB is equal to  $\pi^* - G = \pi^* - T$ 
  1. From government budget constraint  $G = T$
- ADB is the budget constraint the consumer faces in equilibrium
  1. Since slope of AD is  $-w$  and length of DB is consumer's dividend income - taxes
    - Dividends being the profits that firm earns and distributes

- Since  $J^*$  represents competitive equilibrium production point
  1.  $C^*$  is quantity of consumption goods produced
  2.  $h-l^*$  is quantity of labour hired
    - then,  $C^*$  is also quantity of consumption goods that representative consumer desires and  $l^*$  is leisure desired
- Implies an indifference curve must be tangent to AD at point J
  1. Marginal rate of substitution of leisure for consumption for consumer is equal to real wage
  2.  $MRS_{l,c} = MRT_{l,c} = MP_N$ 
    - Aka, marginal rate of substitution of leisure for consumption = marginal rate of transformation = marginal product of labour

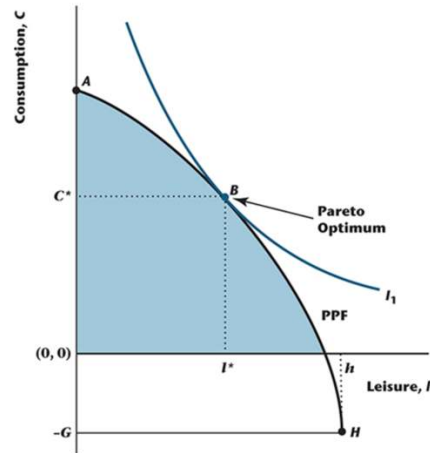
## OPTIMALITY

- Connection between competitive equilibrium and economic efficiency
  - Two important reasons:
    1. Illustrate how free markets can produce socially optimal outcomes
    2. Proves to be much easier to analyze a social optimum than a competitive equilibrium
- **Pareto-optimality:** a competitive equilibrium is pareto-optimal if there is no way to rearrange production or reallocate goods so that someone is made better off without making someone else worse off
  - Focus solely on how production is arranged to make representative consumer as well off as possible
    - However, some people are very poor and very rich
      - May not be able to make poor better off without making rich worse off
  - **To construct:** device of fictitious social planner
    - Does not deal with markets
    - Can order representative firm to hire given # labour and produce # goods
      - Planner has power to coerce consumer into supplying # labour
    - Produced goods are taken by planner,  $G$  is given to government, remainder is allocated to consumer
    - **The planner's problem:**
      - To choose  $C$  and  $l$ , given technology for converting  $l$  into  $C$ , to make consumer as well off as possible
      - To choose a consumption bundle that is on or within the PPF and that is on the highest indifference curve for consumer

focus on  
firm maximality  
profit  
competitive  
equilibrium  
2nd welfare  
theorem  
pareto  
optimal  
focus on consumer  
well-off

- Very similar to the consumer's problem of making themselves as well off as possible
- Only difference: budget constraint of consumer is straight

Figure 5.4 Pareto-Optimality



- - $MRS_{l,C} = MRT_{l,C} = MP_N$
  - Pareto optimum and competitive equilibrium are identical
- First and second welfare theorem:
  - **First fundamental theorem of welfare economics:** under certain conditions, a competitive equilibrium is pareto-optimal
  - **Second fundamental theorem of welfare economics:** under certain conditions, a pareto optimum is a competitive equilibrium
  - These theorems are useful in that they can simplify analysis of models. In the closed-economy one period macroeconomic model, the second welfare theorem allows the competitive equilibrium to be determined by finding the point where an indifference curve is tangent to the PPF

## SOURCES OF SOCIAL INEFFICIENCIES

What causes competitive equilibrium to fail to be pareto-optimal?

- Many factors can result in inefficiency in market economy
  1. **Externalities:** any activity for which individual firm/consumer does not take account of all associated costs and benefits
    - a. Can be positive or negative
    - b. Root cause of market failure
    - c. Too costly/impossible to set up a market to buy/sell the benefits/costs associated with externality
    - d. Ex. pollution (negative)
      - i. The negative externality that is produced in form of pollution costs to neighbours is not reflected in companies profits
      - ii. They do not take into account pollution externality when deciding # labour and # chemicals

- iii. They will tend to produce more chemicals than socially optimal

**e. Positive**

- i. A benefit other people receive which no one is compensated
- ii. Ex. beautiful architectural building
  - 1. Costly to build
  - 2. Benefits the public with fine architecture
- iii. Leads to social inefficiencies

**2. Distorting taxes:** a tax that creates a difference between effective prices faced by buyers/sellers of some good

- a. Ex. if government purchases were financed by proportional wage income tax rather than lump-sum tax
- b. For each unit of real wage income, representative consumer pays  $t$  units of consumption goods to gov
  - i.  $t$  is tax rate
  - ii. Wage income is  $w(-t)(h-l)$
  - iii. Effective wage for consumer is  $w(1-t)$
  - iv. When consumer optimizes, set  $MRS_{l,c} = w(1-t)$
  - v. Firm optimizes, set  $MP_N = w$
- c. In competitive equilibrium:
  - i.  $MRS_{l,c} < MP_N = MRT_{l,c}$
- d. The tax drives a wedge between marginal rate of substitution and marginal product of labour

**3. Monopoly power**

- a. **Firms may not be price-takers**
- b. If a firm is large relative to market
  - i. Can use its monopoly power to restrict output, raise prices, increase profits
  - ii. Monopoly power tends to lead to underproduction relative to what is socially optimal

- Two questions:

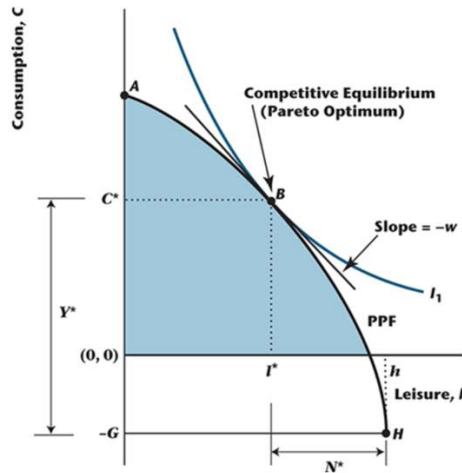
- 1. Why should we analyze an economy that is efficient in the sense that a competitive equilibrium for this economy is pareto-optimal?
  - a. An economic model with inefficiencies will behave like an economic model without inefficiencies
  - b. Modelling all inefficiencies would add clutter
- 2. A second question that arises concerning real-world social inefficiencies is whether Adam Smith was completely off track in emphasizing the tendency of unrestricted markets to produce socially efficient outcomes

**HOW TO USE MODEL**

- The competitive equilibrium is at point B
  - o Indifference curve,  $I_1$ , is tangent to PPF
    - Equilibrium quantity of consumption is  $C^*$

- Equilibrium quantity of leisure is  $l^*$
- Quantity of employment is  $N^* = h - l$
- Quantity of output is  $Y^* = C^* + G$
- Real wage,  $w$ , determined by -slope of PPF or -slope of indifference curve,  $I_1$ , at point B

Figure 5.5 Using the Second Welfare Theorem to Determine a Competitive Equilibrium

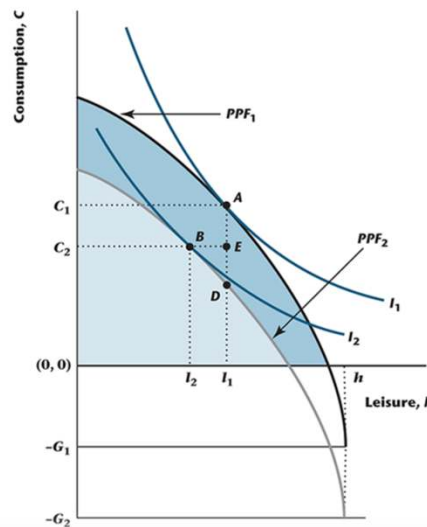


#### WORKING WITH THE MODEL: EFFECTS OF A CHANGE IN GOV PURCHASES

- Government spending
  - o Increase in  $G$ , from  $G_1$  to  $G_2$ 
    - Shifts PPF, from  $PPF_1$  to  $PPF_2$
    - Shift down is by same amount  $G_2 - G_1$  for each quantity of leisure,  $l$
    - There are negative income effects on consumption and leisure, so that both  $C$  and  $l$  fall, and employment rises, while output (equal to) increases
    - Slope of PPF unchanged
    - Since  $G=T$ , taxes must increase by same amount
      - Reduces consumer's disposable income
    - Negative income effect on consumption and leisure



Figure 5.6 Equilibrium Effects of an Increase in Government Spending



- - Equilibrium employment is  $N_1 = h - I_1$
- Initial equilibrium real wage is -slope of indifference curve at point A
- New equilibrium point is now B
  - Consumption and leisure are both lower
    - They are normal goods
  - Since **leisure falls**, employment ( $N_2 = h - I_2$ ) must rise
    - Thus, **quantity of output must rise**
- Income-expenditure identity
  - Change in **C** = change in **Y** - change in **G**
  - Private consumption is **crowded out**: decreases; refers to what happens to private expenditures when government spending increases
    - Not completely crowded out because increase in output
  - Change in G is distance AD
  - Change in C is distance AE
- **Negative income effect on leisure** and therefore a **positive effect on labour** supply
  - larger government reduces private consumption through a negative income effect produced by the higher taxes required to finance higher government spending
- The **real wage must fall**
  - as we know that **equilibrium employment rises**, and the representative firm would hire more labour only in response to a reduction in the market real wage
- Business cycle effects:
  - Employment is procyclical

- Consumption and the real wage are procyclical, but the model predicts that consumption and the real wage are countercyclical in response to government spending shocks

#### WORKING WITH MODEL: CHANGE IN TOTAL FACTOR PRODUCTIVITY

- Increases in total factor productivity increase consumption and aggregate output but there is an ambiguous effect on employment
  - opposing income and substitution effects on labour supply
  - increase in total factor productivity generates both an income effect and a substitution effect
    - short run typically means a year or less
    - long run typically means ~~more than a year~~

Figure 5.7 Increase in Total Factor Productivity

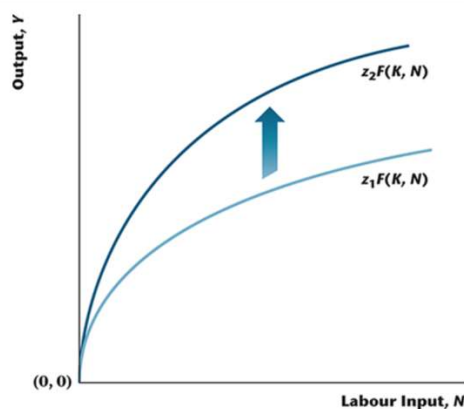
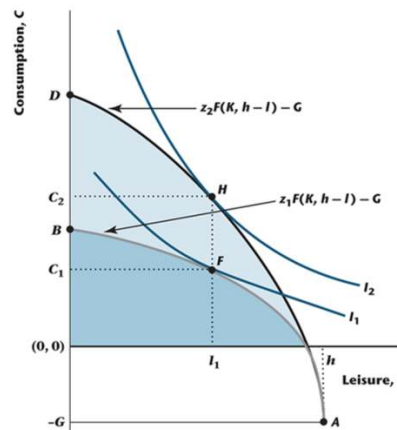


Figure 5.8 Competitive Equilibrium Effects of an Increase in Total Factor Productivity

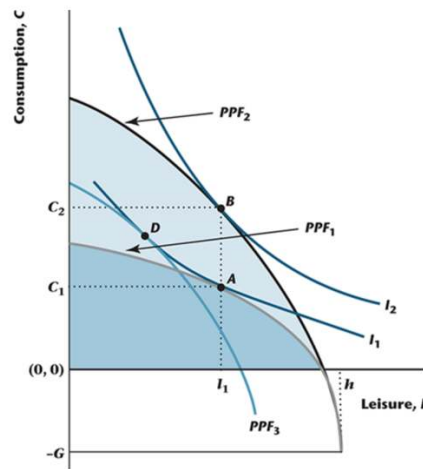


- Effect of an increase in  $z$  is to shift the production function up
  - more output to be produced given the quantity of labour input but it also increases the marginal product of labour for each quantity of labour input
  - slope of the production function increases for each  $N$
  - $z$  increases, from  $z_1$  to  $z_2$
  - We can show exactly the same shift in the production function as a shift outward in the PPF in 5.8 from  $AB$  to  $AD$
  - the tradeoff between consumption and leisure has improved, in that the new PPF is steeper for any given quantity of leisure
- Equilibrium effects of increase in  $z$ 
  - Tangency between the new PPF and indifference curve  $I_2$
  - **Consumption increases**,  $F$  to  $H$ 
    - $C_1$  to  $C_2$
  - **Leisure may increase or decrease** *sub effect*
    - In this ex. it remained the same at  $l_1$
  - **Increase in aggregate output**
  - Employment is unchanged
  - PPF steeper at  $H$  than  $F$

▪ **Real wage must increase in equilibrium**

- Income and substitution effect

Figure 5.9 Income and Substitution Effects of an Increase in Total Factor Productivity



○

○  $PPF_2 : C = z_2 F(K, h-l) - G$

- $PPF_1$  is the original PPF, and it shifts to  $PPF_2$  when  $z$  increases from  $z_1$  to  $z_2$
- The initial equilibrium is at point A, and the final equilibrium is at point B after  $z$  increases
- Example:  $PPF_3$ 
  - Shift  $PPF_2$  down by constant
  - Equation:  $C = z_2 F(K, h-l) - G - C_0$
  - $PPF_3$  tangent to initial indifference curve  $I_1$
  - Taking consumption away from consumer for pure substitution effect of increase in  $z$
  - Substitution effect
    - A to D
    - substitution effect is for consumption to increase and leisure to decrease, so that hours worked increase
  - Income effect:
    - D to B
    - income effect is for both consumption and leisure to increase

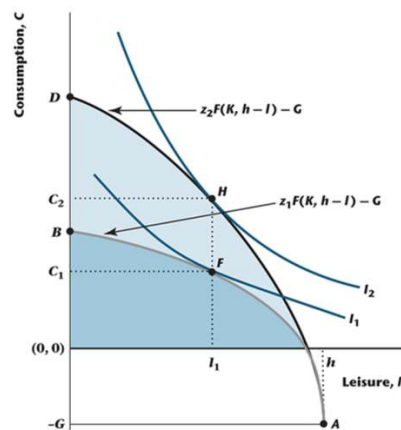
- Real wage increase

1. Substitution effect involves increase in  $MRS_{l,c}$  (indifference curve get steeper) moving from A to D
  2.  $PPF_2$  is  $PPF_3$  shifted up by fixed amount
    - a. Quantity of leisure is higher at point B than at point D
    - b. PPF is steeper at B than at D
    - c. So  $MRS_{l,c}$  also increases in moving from D to B
- THUS, the real wage, which is equal to the marginal rate of substitution in equilibrium, must be higher in equilibrium when  $z$  is higher

- Increase in total factor productivity
  - o Increase in marginal productivity of labour, increases the demand for labour by firms, driving up the real wage
  - o the welfare of the representative consumer must increase
    - representative consumer must consume on a higher indifference curve when  $z$  increases
    - THUS, total factor productivity unambiguously increase the aggregate standard of living

## INTERPRETATION OF MODEL'S PREDICTIONS

Figure 5.8 Competitive Equilibrium Effects of an Increase in Total Factor Productivity



1. Story about long-term economic effects of long-run improvements in technology, like those that occurred since world war 2
  - o Some key observations from post-World War II Canadian data are that **aggregate output has increased** steadily, **consumption has increased**, the **real wage has increased**, and **hours worked** per employed person have remained roughly **constant**
    - ambiguous effects on hours worked as, if income and substitution effects roughly cancel each other out over the long run
2. In terms of short-run aggregate fluctuations
  - o Three key business cycle facts are that consumption is procyclical, employment is procyclical, and the real wage is procyclical
  - o Our model predicts that in response to an increase in  $z$ 
    - aggregate output increases
    - consumption increases
    - employment may increase or decrease
    - real wage increases
  - o Model is consistent with procyclical consumption and real wage (moving in same direction as output when  $z$  changes)
  - o For model to be consistent with data, substitution effect must dominate the income effect, so consumer wants to increase

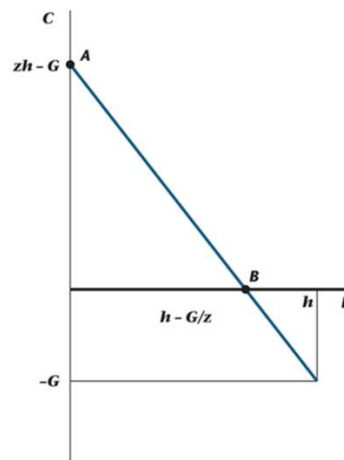
quantity of labour supplied in response to an increase in market real wage

- **Real business cycle theory:** views total factor productivity shocks as the most important cause of business cycles
  - o May seem to contradict long-run evidence
  - o Real business cycle theorists argue most of short-run variation in labour supply is due to intertemporal substitution of labour: substitution of labour over time in response to real wage movements
    - Ex. worker chooses to work harder now when they view as wage as temporarily high

#### DISTORTING TAX ON WAGE INCOME, TAX RATE CHANGES, AND LAFFER CURVE

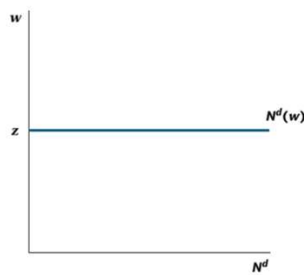
- Distorting taxes imply that a competitive equilibrium is not pareto-optimal
- The form that the **Laffer curve** takes in the Canadian economy is of key importance for the effects of tax rate changes on labour supply and on tax revenue for the government
- SIMPLIFIED ONE-PERIOD MODEL WITH PROPORTIONAL INCOME TAXATION
  - o Assume output is produced only with labour as an input
  - o  $Y = zN^d$ 
    - Y denotes aggregate output
    - $N^d$  denotes firms labour input
    - z denotes total factor productivity
    - With only one factor of production, labour, we have continued to assume that there is constant returns to scale in production
      - increasing by a factor x increases output Y by the same factor x
  - o Can write PPF as  $C = z(h-l) - G$

Figure 5.12 The Production Possibilities Frontier in the Simplified Model



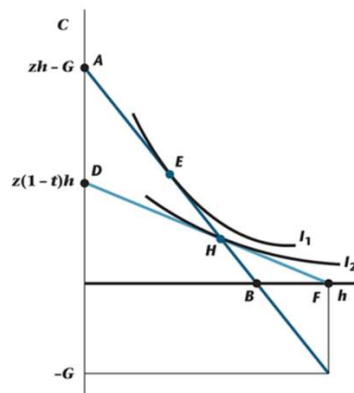
- - point A, the representative consumer takes zero units of leisure and then consumes the maximum amount of consumption possible,  $zh - G$
  - point B the consumer consumes zero and works  $G/z$  units of time [with  $l = h - (G/z)$ ] so as to supply the government with  $G$  units of goods
- To purchase  $G$  units of goods, gov imposes tax on consumer's wage income
  - Assume the only tax in economy
  - Letting  $t$  denote the tax rate, the consumer will pay in taxes to the government
  - Consumer's budget constraint:  $C = w(1-t)(h-l) + \Pi$ 
    - Or = after-tax wage income plus dividend income
- Profit maximization
  - Profits given by:
    - $\Pi = Y - wN^d = (z-w)N^d$
  - firm chooses to make  $\pi$  as large as possible, given  $z$  and  $w$
  - is the profit that the firm makes for each unit of labour input
    - $z > w$ : positive profits for each unit of labour
      - Want to hire infinite labour
    - $z - w < 0$ : negative profits for any quantity of labour
      - Want to hire no labour
    - $z = w$ : profits are zero, no matter what
      - Indifferent on how much labour to hire
      - the firm's demand curve for labour, denoted by is infinitely elastic at the wage

Figure 5.13 The Labour Demand Curve in the Simplified Model



- 
- Equilibrium wage must be  $w=z$
- Zero profits in equilibrium or  $\Pi=0$
- Consumer's budget constraint:  $C = z(1-t)(h-l)$
- In equilibrium:
  - 1) Consumer chooses consumption  $C$  and leisure to satisfy their budget constraint
  - 2) Markets clear, in turn imply government's budget constraint is satisfied since government spending = total tax revenue

Figure 5.14 Competitive Equilibrium in the Simplified Model with a Proportional Tax on Labour Income



- Point H: Competitive equilibrium
- Point E: Pareto optimum
- AB as the PPF
- Budget constraint faced by consumer in equilibrium is DF
- Tax rate,  $t$ , adjusts so point on DF that consumer chooses is at point H
  - DF and AB intersection
- Indifference curve cuts PPF, since AB is steeper than DF
  - $z > z(1-t)$
- Pareto optimum, E, is different from competitive equilibrium, H
  - Income tax distorts private decisions, competitive equilibrium is not socially efficient

- Welfare loss measured by how much better off consumer is at point E than at H
    - H on lower indifference curve than E
- Consumption and output must be higher and leisure lower at point E than at point H
  - Indifference curves cannot cross
  - Gives consumers disincentive to work
    - Lowers aggregate consumption and aggregate output

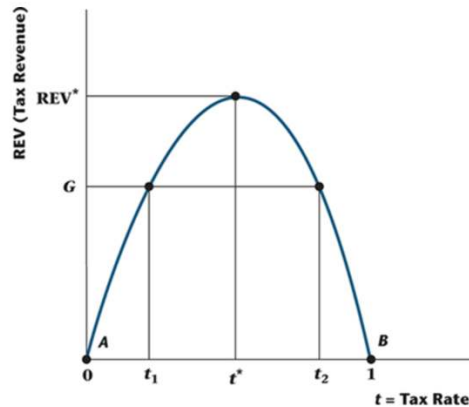
## INCOME TAX REVENUE AND THE LAFFER CURVE

- Ask how much income tax revenue the gov could generate for each tax rate,  $t$ , taking into account quantity of labour that consumers want to supply at that tax rate
- Determine equilibrium tax rate to finance gov expenditures
- $C = z(1 - t)(h - l)$
- Derive function  $l(t)$ 
  - Describes quantity of leisure consumer chooses if after-tax real wage is  $z(1-t)$ , taken  $z$  is given
  - Tax revenue gov can collect is
    - $REV = tz(h-l(t))$ 
      - REV denotes total revenue from income tax
      - Tax base:  $z(h-l(t))$ 
        - The quantity traded in market of object being taxed
        - In this case, # labour in units of consumption goods
    - Depends not only on tax rate but the size of the tax base
      - Which depends on the tax rate
    - If the tax base does not change when  $t$  increases, then tax revenue will increase when the tax rate increases
      - But Possible for tax revenue to go down when  $t$  increases
        - Occurs when  $t$  increases,  $l(t)$  increases sufficiently that a declining tax base offsets the effect of an increase in the tax rate on REV so that REV falls when  $t$  increases
        - Substitution effect must be larger than income effect
      - a large disincentive to work due to a higher income tax rate



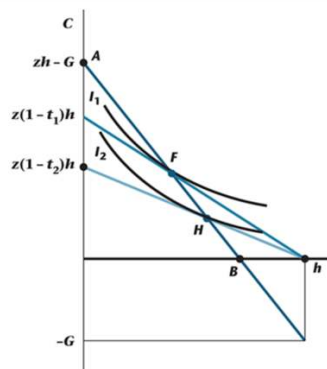
## - LAFFER CURVE

Figure 5.15 A Laffer Curve



- 
- Any curve that shows quantity of tax revenue generate by gov as function of tax rate
- How curve looks depends on details of labour supply behaviour for all possible after-tax real wage rates
- tax rate  $t$  is zero, then tax revenue must be zero
  - point A
- tax rate the consumer will not work and the tax base will be zero
  - point B
- Maximum amount of tax revenue at  $t^*$
- In equilibrium:  $G = tz)h-l(t)$
- **$G < REV^*$** : then it is impossible for the government to collect enough tax revenue to finance its spending
  - Two possible equilibrium tax rates at  $t_1$  and  $t_2$ 
    - $t_1 < t_2$
    - low tax rate and high tax rate

Figure 5.16 Equilibria with High and Low Tax Rates



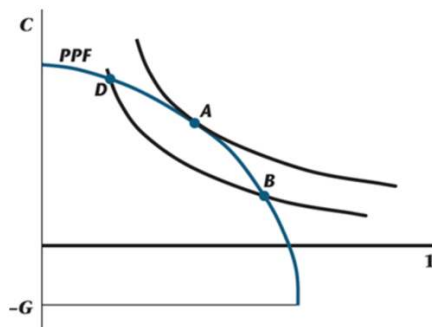
- 
- Low tax rate  $t_1$  at point F
- High tax rate  $t_2$  at point H
  - Point F must be on higher indifference curve than point H
    - Consumer is better off in equilibrium with low tax rate

- Sensible gov would never choose higher tax rate
- Quantity of consumption,  $C$ , is higher
- Quantity of labour supplied,  $h-l$ , is higher
- Leisure  $l$  is lower
- Aggregate output ( $Y = C+G$ ) is higher in the low-tax-rate equilibrium than in the high-tax-rate equilibrium

### KEYNESIAN STICKY WAGES AND PRICES

- **Stickiness:** wages, in terms of money change infrequently, due to costs of negotiating wage contracts
  - Common for wage rates to be fixed for a year at a time
- Suppose price of consumption goods in terms of money is  $P$ , and the nominal wage rate is  $W$ , while the real wage rate is  $w = W/P$ 
  - Assume  $W$  is fixed
  - Assume  $P$  can go up/down
    - If gov increases  $G$ ,  $P$  increases (vice versa)
- $W/P$  is not economically efficient real wage

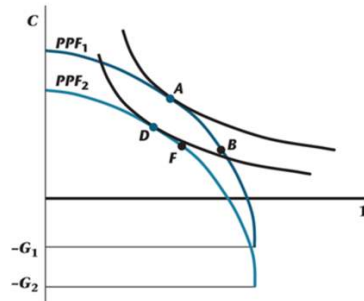
Figure 5.17 Short Run Equilibrium with Sticky Wages and Prices



- - Economically **efficient real wage is -slope of PPF at point A**
    - Where prices and wages are completely flexible
  - In Keynesian model, equilibrium could be at point B
    - Firm maximizes profits given real wage, hiring up to point where marginal product of labour is equal to real wage
    - Market real wage must equal -slope of PPF
    - Point B is an equilibrium in which there is Keynesian unemployment, that is there is an excess supply of labour at the market real wage
  - Market real wage  $W/P$  could also have point D in equilibrium
    - Lower than efficient real wage
    - Firm chooses how much labour to hire, consumer is working more at market real wage than they would like to
    - Keynesian interpretation of this situation is that the economy is overheating—more is produced than is efficient
- What happens in Short-run equilibrium at B and D?

- **Point B** in the figure, given excess supply in the labour market, the nominal wage would tend to fall, and firms would hire more labour, until the economy reached A in the long run
- **Point D** the short run the consumer is working more than he or she wants to work, which puts upward pressure on the wage  $W$ , which rises, and firms hire less labour
- Keynesian viewpoint: long run is too long to wait
  - 'in long run, we are all dead'
  - short run, provided macroeconomic policymakers can make decisions, implement them, and policy actions can have their full effects more quickly than wages can adjust, policy may be able to improve matters
- Real wage at point B is inefficiently high bank raise P
  - Lowers real wage and return economy to efficiency at point A
- Optimal policy for bank to reduce P at point D
  - Raises real wage and returns economy to point A

Figure 5.18 An Increase in Government Spending with Sticky Wages and Prices



- Gov spending increases, shifts  $PPF_1$  to  $PPF_2$
- Real wage falls, we know that in the new short-run equilibrium, on  $PPF_2$ , minus the slope of  $PPF_2$  at the new equilibrium must be smaller than minus the slope at B
- If P falls sufficiently that new equilibrium is at point F
  - consumption could increase—consumption is not crowded out
  - equilibrium would shift from A to D, and output would increase, but consumption would fall
- **Government spending multiplier**: ratio of change in output to change in government spending
 
$$\frac{\Delta Y}{\Delta G}$$
  - $\frac{\Delta Y}{\Delta G} < 1$
  - If equilibrium shifts from B to F
    - Then  $\frac{\Delta Y}{\Delta G} > 1$ , as  $Y = C + G$ , and consumption has increases
- Keynesian economies in which wages and prices are sticky, changes in government spending can potentially cause large

changes in output and cause consumption to increase, because the change in spending can simultaneously correct an inefficiency in the economy

## CHAPTER 9: TWO-PERIOD MODEL: CONSUMPTION SAVINGS DECISION AND CREDIT MARKETS