I. Introduction

What is Macroeconomics?

*The study of the structure and performance of the aggregate economy

Different Schools of Thought

Economists often disagree on how to analyze or study the Economy

Major schools of thought in Economics include:

Classical, Keynesian, Austrian, Neo-Classical, New Keynesian, Monetarist, Marxian, Ecological, Feminist, and more

Common Questions

* What influences economic growth?
* What affects unemployment?
* Why does the economy fluctuate?
* How do government policies affect the economy?
* Are some groups affected differently than others?

Goals

1. To analyze the effects of potential government policies

2. To monitor the economy and make optimal decisions at the individual level

Two Broad Types of Analysis

*Theoretical

*Empirical

Model Evaluation

1. Are the assumptions realistic?

2. Is it understandable and manageable enough to be used in studying problems?

3. Does it have implications that can be tested using available data?

4. When the implications and the data are compared, are they consistent?

Normative vs Positive Statements

Positive economics: what are the effects of a policy?

Normative economics: should a policy be implemented?

*Normative statements are about value judgments

*This course focuses on positive economics, learning a variety of tools to analyze economy and make predictions

*With the analysis you create using these tools, you and others will make normative judgments

*It is important to think about the normative implications of your analysis

Key Variables & Terms

GDP
Capital good
Depreciation
Value added
Intermediate goods and services
Final goods and services
National income accounting
Income-expenditure identity
GNP
Current Account
Private disposable income
Savings
Wealth
Budget deficit
Stock
Flow
Price index
GDP deflator
CPI

Nominal
Real
Inflation
Interest rates
Expected real interest rate
Use-of-saving identity
Net foreign assets
Net factor payments from abroad
Net exports
National saving
Fundamental identity of national
Income accounting
Consumption

II. Measurement & Accounting

Remember some common questions asked in macroeconomics:

e.g., What influences economic growth? What affects unemployment?

In order to answer these, and other questions, it is important to have good measures – accurate & consistent data.

System of National Accounts (SNA)

*Used to compile accurate and systematic measures of aggregate economic activity of a nation or jurisdictional area.

*Sets up standardized measurement of macroeconomic variables based on a set of accounting principals.

*One of the common macroeconomic measures generated using the System of National Accounts is GDP.

"Economic growth in Canada is forecast to pick up gradually and average 2¼% over the projection." (Source: Bank of Canada Monetary Policy Report, October 2024)

What growth are they referencing?

*GDP is one of the most commonly cited measures of economic activity

*changes in GDP are frequently used as a yardstick for growth.

GDP (Gross Domestic Product): the market value[§] of all final goods and services produced in an economy during a fixed period of time.

[§]market value: the value of good(s) at market prices.

How is GDP calculated?

Three Ways to Measure GDP

1. The Product Approach

Sum all final goods and services produced in the economy at their market value.

Note: final output excludes intermediate production to avoid double counting.

Intermediate goods and services: those used up in the production of final goods and services within a fixed period of time.

Value added (of a producer): the value of it's output minus the value of it's inputs purchased from other producers.

Example:

Imagine an economy produced one pizza and that pizza is purchased within the year. The pizza parlour buys flour from a mill for $5 and sells the pizza for $25. The flour mill bought wheat from the farmer for $3 to make the flour.

$25 -Pizza
$5 -Flour
$3 -Wheat

Because Pizza is the only final product, GDP=$25.
(If you came up with GDP=$33, you would be double counting intermediate goods/services and GDP would be incorrect.)

Alternative Calculation:

Value Added (Product) Approach

25-5=20 from pizza parlour
5-3=2 from flour mill
3-0=3 from farmer

Summing all value added in the economy gives us the same thing: GDP=3+2+20=25

2. The Expenditure Approach

sum all final goods and services purchased in the economy

Pizza example:

GDP=total spending=1pizza=$25

Detailed Expenditure Approach

Personal Consumption Expenditure (C)
- Durable goods
- Semi-durable goods
- Nondurable goods
- Services

Investment (I)
- Residential Construction
- Nonresidential Construction, Machinery & Equipment
- Intellectual Property Products (IPP)
- Business Inventory Investment

Government Expenditures (G)
- Government Purchases of Goods and Services
- Government Investment

Net exports (NX)
- exports – imports

Statistical Discrepancy

Income Expenditure Identity:

$$\boxed{GDP = C + I + G + NX}$$

3. The Income Approach

Sum all income received by workers, the government and firms (wages, taxes, and profits)

Pizza Economy Example:

*Pizza parlour pays a wage of $5 to it's one employee, pays $5 to the mill for flour, and pays $5 in taxes.

*Mill pays an employee $1.75, pays $3 to the farmer for wheat, and pays $0.25 to government in taxes.

*Farmer pays $0.05 tax. So....

parlour profits = sales-wages-inputs(flour)-taxes
= $25 - $5 - $5 - $5
= *$10*

flour mill profits = sales-wages-inputs(wheat)-taxes
= $5 - $1.75 - $3 - $0.25
= *$0*

farm profits = sales - taxes
= $3 - $0.05
= *$2.95*

GDP using the income approach is:

wages: $5.00 + $1.75=$6.75
taxes: $5.00 + $0.25 + $0.05=$5.30
profits: $10.00 + 0 + $2.95 = $12.95

GDP = $6.75 + $5.30 + $12.95 = $25.00

Detailed Income Approach

Labour Income
Corporate Profits
Interest and Investment Income
Unincorporated Business Income
(total=net national income at factor cost)

Indirect Taxes less Subsidies
(total=net national income at market prices)

Capital Consumption Allowances/Depreciation

Statistical Discrepancy

Fundamental Identity of National Income Accounting:

Total Production = Total Expenditure = Total Income

This is true by definition.

No matter which approach we use, product, income or expenditure, we have the same GDP.

Each method for measuring GDP gives us a different perspective on which components contribute the most to an economy's production activities within a given time frame

Issues of Measurement: GDP

Does anyone have any concerns with these measurements of production?

Questions you might ask:

-is GDP comparable across countries?
-does it measure progress accurately?
-what about costs of resources?
-what about costs of pollution (dirty air, water, etc.)?
-do these GDP measures adequately capture quality or value?
-what about happiness?
-should GDP include home production?
-what about unpaid child care?

Some economists argue in favour of the commodification of goods and services for which markets may be missing.

Others have argued against commodification of household production.

GDP measures "value", but how accurate is the total value if half of it is omitted from the equation? And what if the unmeasured portion grows faster/slower than the measured portion?

Economists are concerned about the adequacy of our measures of GDP, and this has led to a series of studies and some alternative (satellite) systems which have begun addressing many of the concerns listed here.

Further Elements of SNA

GNP (Gross National Product): the total market value of production by all of the national factors of production

What is the difference between GDP and GNP?

NFP (Net Factor Payments): income earned abroad by Canadian factors minus income earned in Canada by foreign factors.

GNP = GDP + NFP

Saving Identities & Formulas

Saving = current income - current spending

Yd = private disposable income
= the income that households have to spend
= income received from all sources, less taxes
= GDP + NFP + TR + INT – T
where INT is interest on government debt, TR is net transfers, and T is Tax

Yd = Y + NFP + TR + INT – T

Private Saving:

Spvt = private disposable income – consumption

Spvt = Yd – C
= (Y + NFP + TR + INT – T) – C

Government Saving:

Sgovt = net gov't income – gov't purchases
Sgovt = (T – TR – INT) – G

if Sgovt<0 then gov't has a budget deficit

National Saving:

$$S = Spvt + Sgovt$$
$$= (Y + NFP - T + TR + INT - C) + (T - TR - INT - G)$$

$$S = Y + NFP - C - G$$

National Saving = total income – total spending of economy

Recall that **Y = GDP = C + I + G + NX**, so...

$S = Y + NFP - C - G$

$S = (C + I + G + NX) + NFP - C - G$

$$\boxed{\mathbf{S = I + NX + NFP}}$$

International Components in Savings

CA (Current Account): payments received from abroad less payments made to foreign countries by the domestic economy

$$CA = NX + NFP$$

so

$$S = I + CA$$

Now we have

$S = Spvt + Sgovt = I + CA$

so

$Spvt = I + (- Sgovt) + CA$

This is the uses-of-saving identity

Saving Vs Wealth (Measurement Type)

Stock Variable: calculated at point in time

Flow Variable: calculated over (within) a period of time

Wealth: the difference between an agent's assets & liabilities

National Wealth
= total wealth of all residents of a country
= domestic physical assets + net foreign assets

net foreign assets
= foreign financial & physical assets – foreign liabilities

Further Measurement Issues

Real versus Nominal Variables

Nominal Variable: a variable measured in terms of current market values

Real Variable: a variable measured in terms of a base unit

Accounting for Inflation

Inflation rate: percentage increase in the price level over a specific period of time

$$\pi_{t+1} = \frac{P_{t+1} - P_t}{P_t} = \frac{\Delta P}{P_t}$$

Where

- π is the inflation rate
- P_{t+1} is the price level in period t+1 and
- P_t is the price level in period t

How is inflation measured?

Price index: measure of the average level of prices for some specified set of goods and services relative to the prices in a specified base year.

Three Commonly Used Indices:

1. **GDP deflator**: price index that measures the overall level of prices of goods & services included in GDP.

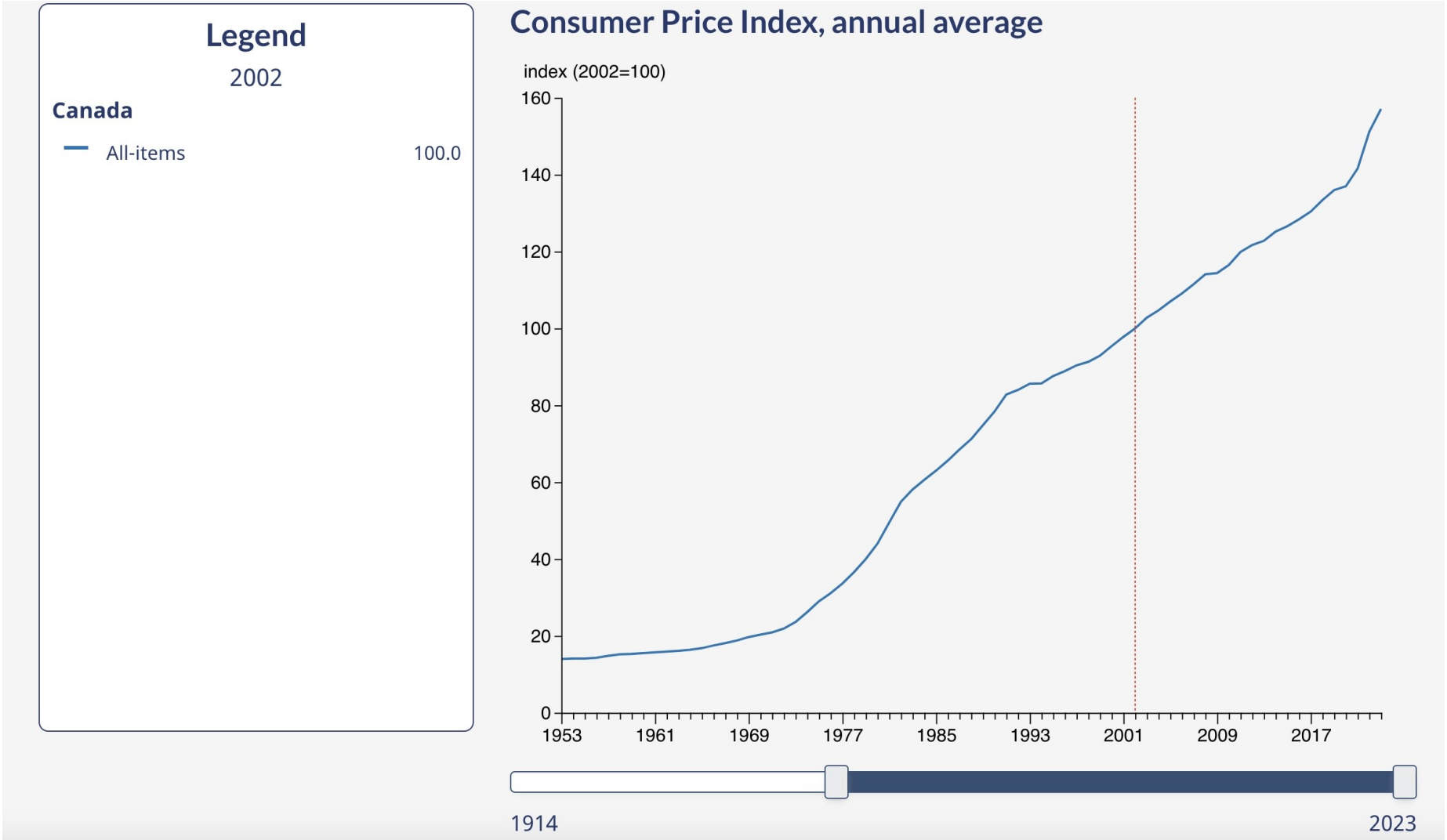
GDP deflator = nominal GDP/ real GDP

Example: Real GDP Calculation with GDP deflator

Suppose we have the following two product, two year economy

Product	*Quantity Year 1*	*Quantity Year 2*	*Price Year 1*	*Price Year 2*
e-Bicycles	10	30	$5,000	$3,000
Cars	100	150	$10,000	$12,000

2. **CPI (Consumer Price Index)**: measures changes in prices of subset of consumer goods, a fixed "basket" of goods, relative to a base reference period



Source: Statistics Canada's Consumer Price Index Data Visualization Tool, Price Trends 1914 to today, using Table 18-10-0005-01 Consumer Price Index, annual average, not seasonally adjusted, accessed at https://www150.statcan.gc.ca/n1/pub/71-607-x/2018016/cpilg-ipcgl-eng.htm

3. **Chain Fisher Volume Index**: a combination index which changes the base price and chains across time.

2001 Statistics Canada began to used chain Fisher volume indexes.

The fisher volume index process is as follows:

1. Calculate Fixed Weighted or *Laspeyres Volume Index*. This index covers a 1 year change with prices fixed at the earlier of the two years.

Laspeyres index = $\frac{\text{GDP in year t+1 at year t prices}}{\text{GDP in year t at year t prices}}$

2. Calculate Current Weighted or *Paasche Volume Index*. This index covers a 1 year change with prices fixed at the later (most current) of the two years.

Paasche index = $\frac{\text{GDP in year t+1 at year t+1 prices}}{\text{GDP in year t at year t+1 prices}}$

3. Calculate the Fisher Volume Index. This is the geometric mean of the previous two.

Fisher Volume index= [(Laspeyres index)(Paasche index)]$^{1/2}$

The chained fisher volume index (for a difference of more than1 year) is determined by multiplying subsequent indexes.

Ex/ for year 3 it is: (year 1 to 2)×(year 2 to 3).

These indexes give the real growth of GDP between the periods indicated, and as such Real GDP in subsequent periods should be calculated by multiplying the chain Fisher index by the initial (base) year GDP (previous periods are the product of the base year GDP and the inverse of the chain fisher index).

Issues with Consumer Price Indexes & “real” GDP

1. Basket becomes outdated

2. Goods may have not existed then & do now

3. Historical measures of real GDP often have to be recalculated for any comparison

Exercise:

1. Download annual nominal & real GDP from Statistics Canada over multiple years

(Table number, 36-10-0222-01, formerly CANSIM 384-0038)

2. Plot these series across time using software of your choice. What do you observe?

3. Now try this for another country of your choice (use the World Bank Data Bank). What do you observe?

Interest Rates

Interest rate: rate of return promised by a borrower to a lender

Nominal interest rate (i): the rate which is agreed upon between the borrower & lender.

Real interest rate (r): the rate at which the real value of the asset (loan value) increases over time.

The relationship between nominal and real interest rates can be characterized by

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

When nominal interest rates and inflation are typically low, real interest rates can be approximated by

$$r \approx i - \pi$$

If we are in a period of high inflation and low constant interest rates, is it better to borrow or to lend?

Since we typically don't know what inflation will be until the next period is realized, we need to use expected values.

The expected real interest rate is approximated by the nominal interest rate minus expected rate of inflation.

$i - \pi^e$

III. Economic Frameworks

Basic Graphing

We frequently graph in Economics

Often, our graphs are two dimensional – describing relationship(s) between two variables

Lets suppose he have a theory suggesting that as the price of Carrots rises, we demand fewer carrots (our Carrot demand decreases)

That is the theory expressed in words. We might then say: demand for carrots is a function of the price of carrots.

Algebraically we might write: $C^D = f(P_C)$

where C^D is the quantity of carrots demanded, P_c is the price of carrots, and f is unspecified

To simplify, we might assume that f is a linear function, representing a linear relationship that looks something like: $C^D = f(P_C) = a + b^* P_C$

Our theory suggests that the relationship is negative. But how do we graph it?

Since Economists typically put price on the vertical axis, we should transform this consumption demand equation to isolate price on the left hand side

$C^D = a + b*P_C$

or (exchange left and right sides)

$a + b*P_C = C^D$

so (then subtract a from both sides)

$b*P_C = -a + C^D$

(divide both sides by b)

$$P_c = \overset{+}{\frac{-a}{b}} + \overset{-}{\frac{1}{b}} C^D$$

Now we map this equation into the C-P space.

$$P_c = \frac{-a}{b} + \frac{1}{b} C^D$$

intercept

slope

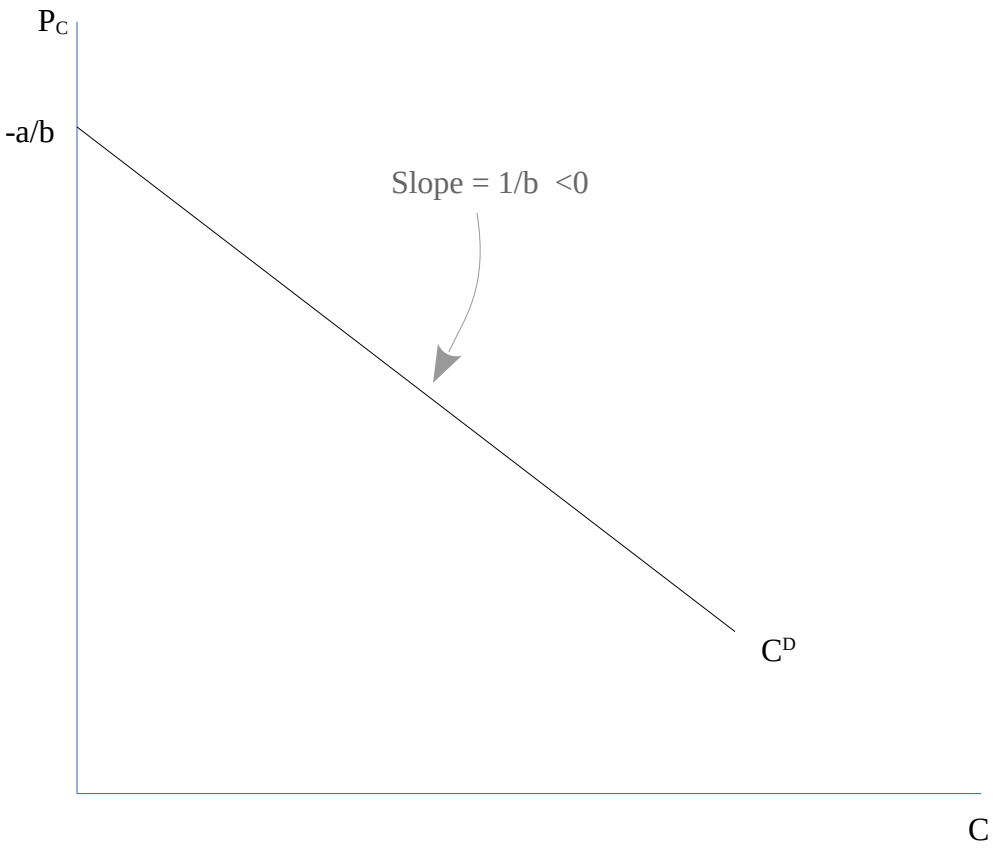
When mapping an equation into a cartesian plane, keep in mind that whatever is pre-multiplying by C (the horizontal variable) is the slope of this line.

(Recall, slope is rise/run. The change in P given a change in C)

So the slope is 1/b, a negative number since b<0

Whatever is not multiplied by our horizontal variable (C) is the vertical intercept (the value when C is set to 0). If b<0 then the intercept will be positive as long as a is positive. (So, we would assume a>0 because prices are not negative)

Graphically, our theory on the relationship between C and P_C (as expressed in our equation) should look something like this:



Modelling Concepts

Model: a disciplined framework to represent theories, test hypotheses, and to evaluate choice/policy outcomes

Models are based on theories about how the economy functions and how agents in the economy behave

Economic models are typically depicted using mathematical and/or statistical expressions

Economic models are constructed to represent the economy (or parts of the economy) in a simplified way

Moreover, economic models are designed specifically to enable us to test hypotheses about economic behaviour and economic relationships

Economists usually classify economic analyses into two broad categories: Theoretical and Empirical

However both Theoretical and Empirical analyses are based on theory; both formalize theory with models, and both test hypotheses.

Theoretical analysis typically employs mathematical expressions to formalize economic theory (through a set of algebraic equations governing behaviour, constraints, economic structures and institutional rules). Solutions to these models are then used to make predictions that we can test (testable predictions)

Empirical analysis is also founded on theory but is focused on using data as well as mathematical and statistical techniques to test hypotheses generated by economic theory and estimate the magnitude of relationships

Any study may contain both Theoretical *and* Empirical analysis.

Indeed, most empirical analysis contains some theoretical component. And many theoretical papers include some empirical or quantitative component.

Economic analyses often following a common pattern:

1. Describe the research question and what motivates this question (what are you trying to answer and why?)

2. Explain the theoretical framework in which you will aim to answer this question (& test the hypotheses). This step includes explaining (in words) your theory on the underlying behaviours, constraints and economic structure

3. Formalize the theory mathematically and/or statistically

Typically, you would construct a set of algebraic expressions to characterize the behaviours, constraints and structures and institutional rules in/of the economy

These sets of equations are used to construct predictions (e.g. predictions of relationships between variables which help to answer our research questions) which can then be tested against/using data.

In an empirical framework, you would present statistical equation(s).

Often, empirical analysis is conducted on a reduced form solution to a structural model.

4. Calibrate or Estimate the model to obtain quantitative estimates and test hypothesis using the data.

5. Interpret the outcomes of the model & calibration/estimation with respect to your research question. What can you say in response to your question? What caveats do you need to state regarding the limitations of your work?

Simple example:

1. Research question and Motivation
We want to understand the relationship between training programs and wages.
Question: Is job training associated with higher wage outcomes?
The motivation is that if training programs improve wages, it may be a good policy to use to help households earn more.

2. Theoretical framework: Economic theory suggests that training (like other forms of human capital) improves the productivity of workers, so each unit of labour will have a higher marginal product. If we are operating in a perfectly competitive market, profit maximizing firms will pay workers their marginal

product. Using a market clearing framework we predict that additional training will increase the marginal product of labour, increase labour demand at any given wage, and increase both equilibrium wage and employment.

3. Formalize the theory (this is a very simple linear example of labour demand & supply curves, derived from the underlying behavioural relationships –we'll discuss the underlying utility and profit maximization decisions later as they are often the first thing presented to formalize & characterize underlying behaviour)

Max Utility → $N^S = a + bWage + cTraining$

Max Profit → $N^D = d + gWage + kTraining$

What does the model predict is the equilibrium relationship between Training & Wage?

We can solve the system of equations to obtain the predicted equilibrium relationship

Market clearing condition: $N^S = N^D$

$$a + bWage + cTraining = d + gWage + kTraining$$

$$\rightarrow \quad Wage = \frac{(d-a)}{(b-g)} + \frac{(k-c)}{(b-g)} Training$$

$$Wage = \alpha + \beta\ Training$$

In an empirical framework, you would present statistical equation(s) by denoting the uncertainty (with an error term), and the data type that would be used to estimate the relationship (with a subscript).

$$Wage_c = \alpha + \beta\ Training_c + u_c$$

Where c represents country, and u is the error term.

4. In a theoretical analysis you might discuss the qualitative predictions and calibrate a-k to generate quantitative predictions (some theoretical papers also contain estimation). In an empirical analysis, you might use data and statistical

methods to obtain a quantitative estimate of β. Learn about these techniques in advanced Economic Theory and Econometrics courses

5. Interpretations, Caveats and Limitations: You can make a statement about what your model suggests the relationship to be, and policy implications thereof

Here, you might use some of the model evaluation criteria to help frame the caveats and limitations (Are there assumptions that aren't realistic, and does that impact the results? Is the model understandable and manageable? Are the data reasonable to test the assumptions? Is the model consistent with the data?), we might note some of the concerns that arise via our model evaluations –this model is limited by the assumptions of our perfectly competitive market clearing framework. Are these limitations likely to be major issues? More on Caveats and Limitations of Economic Analysis will be discussed in advanced courses. In particular, correlation does not imply causation. (So finding that higher training correlates with higher wages, does not imply that training causes wage increases).

Note, you may hear the terms structural and reduced form used in economics. You will not be tested on this terminology in 102, it might help to define it.

Structural Model: the set of algebraic expressions that represent the economic theory (the underlying behaviours, constraints, and institutional rules). Structural parameters refer to the parameters that characterize those structural relationships.

Reduced form: characterizes the relationship without detailing the specific components of the relationship between variables. Usually does not have a direct interpretation. Reduced form solutions typically isolate the predicted outcome of interest on the left hand side

Throughout this course we will illustrate concepts using simple examples, often employing a basic market clearing, perfectly competitive markets framework. But there are a multitude of different types of models, which may be more/less appropriate depending on the context/question.

There are several broad classes of models and choices you can make when designing your model.

We typically classify models according to regularities they are designed to explain, or the type of market we face

Examples of commonly used model classifications are:

Treatment of Information
e.g. full information vs missing/asymmetric information

Time Dimension
e.g. static vs dynamic

Treatment of State Dependency
e.g. deterministic vs stochastic

Type of Agent(s)
e.g. representative agent vs more than one type of agent

Scope
e.g. Partial vs General Equilibrium

Market Functionality
e.g. market clearing vs non-clearing models

Which class of models would be more appropriate to study business cycle or recession duration, Static or Dynamic?

Modern macroeconomic models are frequently Dynamic models

Macroeconomic models are also frequently designed with Stochastic and General Equilibrium frameworks

Many non-equilibrium, non-market clearing models are also popular – e.g. search & matching models

A once popular way to introduce macroeconomic modelling to 1st and 2nd year students was to use the IS-LM model (this GE model is presented in many text books). However, many macroeconomists have concerns about the basic IS-LM, and its usefulness given that it is not a dynamic model, & given its treatment of some markets/ behaviours. We won't cover IS-LM in this course

Model Elements

Variable: refers to an item (e.g. price, interest rates, consumption, investment, GDP) that can take on different possible values

Variables represent both the inputs to models, and the outputs from models

Two broad types of variables:

Endogenous: determined within the model

Exogenous: determined outside of the model

Parameters: characterize the strength and direction of relationships between variables. (the a, b, g's and α, β, ɣ's)

In theoretical models, parameters are sometimes calibrated, but they can also be estimated, as they are in empirical models

Estimation is conducted by applying the model to data, to determine (and test) the predicted relationship between variables

Building Macroeconomic models

Macroeconomic models are typically built by incorporating several components of the economy (the components that are important for understanding the relationship between the variables of interest, and the behaviours that govern those relationships)

Economic components are often framed in the context of **markets** (e.g., labour, goods, financial, etc.), market **participants** (e.g., buyers, sellers, regulators), &or **outcomes** (e.g., prices, quantities, aggregates, and distributions).

We typically aim to predict outcomes by modelling the behaviour of the **participants** (e.g., sellers' supply, buyers' demand)

In order to do that, we need to understand their preferences/ objectives, as well as the environment and constraints in which they function (in which they make decisions)

Production processes or production functions are a key component that helps us understand firms' supply decision (how much they wish to sell in the goods market), but also firms' demand for inputs (e.g. labour and capital) in those respective markets

Factors of production: inputs such as capital, labour, raw materials, land and energy utilized by the producers in the economy.

How much of each factor do firms want?

Aggregate Production Function

Y=A×(K,N)

where

Y=real output produced

A=a multiplicative productivity effect

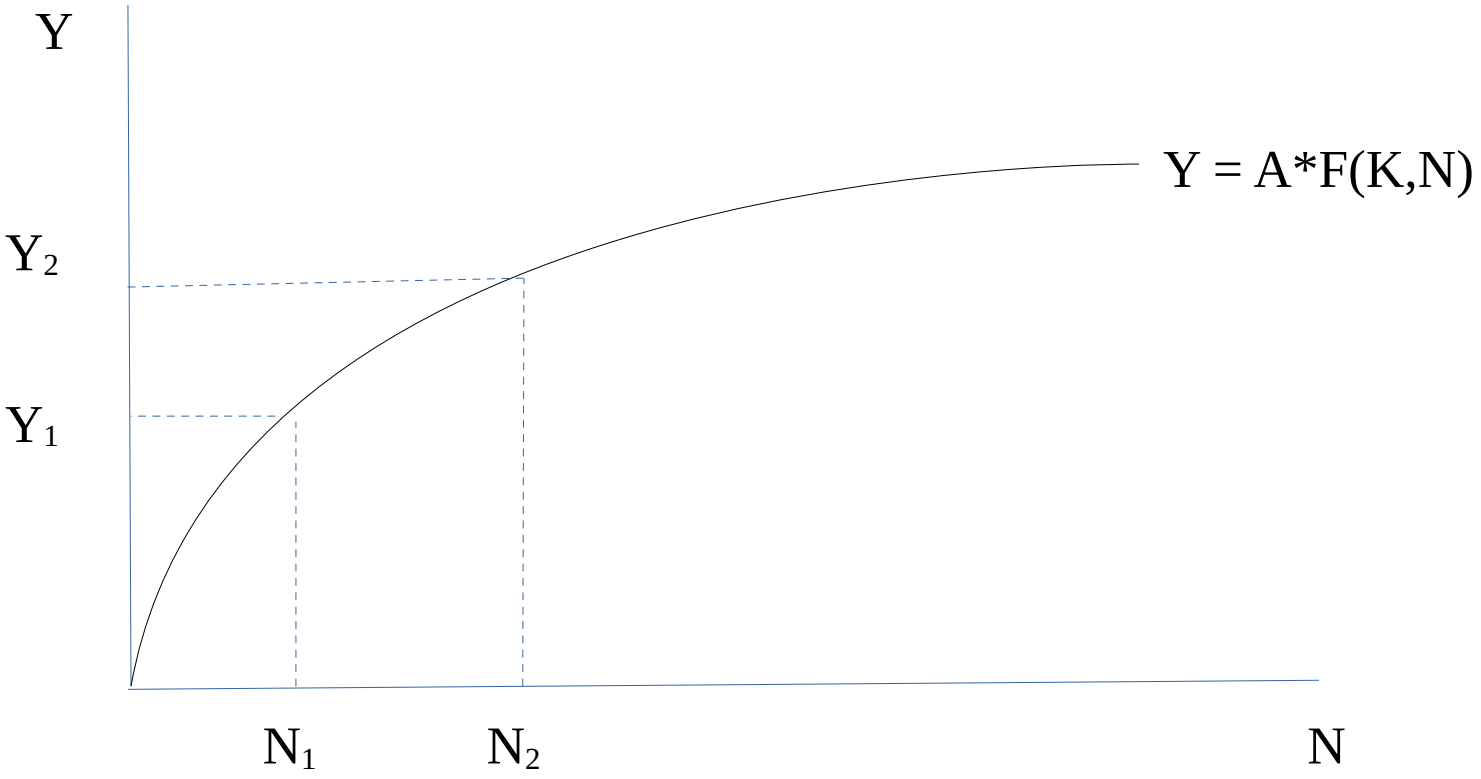
K=quantity of capital used

N=the number of workers employed

F=a function specifying how much output is derived from given quantities of input K & N

*Given the production function above, we can graph changes in output due to changes in one, or the other of the inputs.

Ex/ Graph of Production given various N



Firms objective: Profit Maximization

Profit maxing quantities of N & K determined by:

*Marginal Product of Labour (MPN)
=the increase in output resulting from a one unit increase in labour
$=\Delta Y/\Delta N$

*Marginal Product of Capital (MPK)
=the increase in output resulting from a one unit increase in capital
$=\Delta Y/\Delta K$

*Relative Prices

TFP – Total Factor Productivity

A is generally calculated using the “known” factors of Y and F(K,N)

if Y=A×F(K,N) then $A = \frac{Y}{F(K,N)}$

The level of A is important in firms’ decision making, and factor markets, because it influences MPK and MPN

Many models use a function $F(K,N) = K^{0.3}N^{0.7}$

as this function has been determined by some empirical studies to fit the production data well.

Note: The form of this function is called Cobb-Douglas

$Y=AK^{\alpha}N^{1-\alpha}$ where $0< \alpha <1$

α = capital owners' share of income from production

$1-\alpha$ = labour owners' share of income from production

Productivity growth: the percentage change in TFP (A) from one period to the next

*Changes in A as known as supply shocks or productivity shocks

*Positive supply shocks increases the amount of output that can be produced for given quantities of labour and capital. (& vice versa)

*Changes in A are important for predicting changes in factor markets and understanding & predicting aggregate outcomes