Topic 1: Macro and microeconomics introduction

20 November 2018
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Macroeconomics versus Microeconomics

• **Macroeconomics** is the study of the economy as a whole.
• Its goal is to explain the economic changes that affect many households, firms, and markets at once.
• **Microeconomics** is the study of how individual households and firms make decisions and how they interact with one another in markets.
Macroeconomics

• Macroeconomics is a branch of economics that deals with the performance, structure, and behaviour of the economy as a whole with particular focus on:
  • national income,  
  • unemployment,  
  • inflation,  
  • investment, and  
  • international trade.

• There are two main areas of research:
  • The attempt to understand the causes and consequences of short-run fluctuations in national income (the business cycle),
  • The attempt to understand the determinants of long-run economic growth (increases in national income).

• Macroeconomic models and their forecasts are used by both governments and large corporations to assist in the development and evaluation of economic policy and business strategy.
Macroeconomics and Microeconomics in Master Planning

- Both concepts are relevant and are interlinked
- Electricity assets are capital intensive with long lives
- **Microeconomics** helps understand
  - How cost structures afects the optimal investment path
  - The interaction with customer demand
  - Changes in social welfare
- **Macroeconomic** factors affect operation of business
  - Changes in overall economic growth
  - Government policies, including Government stability
  - Input prices determined in world markets
  - Role of infrastructure development
  - Incentives for exports and foreign direct investment
2. Macroeconomic concepts
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The Economy, Income and Expenditure

• When judging whether the economy is doing well or poorly, it is natural to look at the total income that everyone in the economy is earning.

• For an economy as a whole, income must equal expenditure.

• A measure of the income and expenditures of an economy is Gross Domestic Product (GDP), which measures:
  • An economy’s total expenditure on newly produced goods and services and the total income earned from the production of these goods and services, or
  • The total market value of all final goods and services produced during a given period of time within a country, region, or province.
Important Features of GDP

- The main characteristics of GDP:
  - Output is valued at market-determined prices.
  - Output is usually measured in national currency and dollar terms.
  - GDP records only the output of final goods. We want to “count” production only once.
  - Represents the amount of money needed to purchase a year’s worth of the economy’s production of all final goods
  - Includes all items produced in the economy and sold legally in markets.
- GDP does not include items produced and consumed at home that never enter the marketplace. It does not include items produced and sold illicitly, such as illegal drugs.
Are Grey Markets Included in GDP?

- The grey market usually refers to the flow of new goods through distribution channels other than those authorized or intended by the manufacturer or producer.
- Grey market goods are not generally illegal but avoid taxes.
- It is difficult or impossible to track the precise sales in the grey markets.
- Grey markets are not accounted in the GDP.
- Formal unemployment or partial unemployment is offset by “employment” in the grey markets.
## Ranking of Countries by GDP (nominal) in 2017

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>GDP (millions of USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>19,390,600</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>12,014,610</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>4,872,135</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>3,684,816</td>
</tr>
<tr>
<td>5</td>
<td>United Kingdom</td>
<td>2,624,529</td>
</tr>
<tr>
<td>6</td>
<td>India</td>
<td>2,611,012</td>
</tr>
<tr>
<td>7</td>
<td>France</td>
<td>2,583,560</td>
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<tr>
<td>8</td>
<td>Brazil</td>
<td>2,054,969</td>
</tr>
<tr>
<td>9</td>
<td>Italy</td>
<td>1,937,894</td>
</tr>
<tr>
<td>10</td>
<td>Canada</td>
<td>1,652,412</td>
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<tr>
<td>11</td>
<td>South Korea</td>
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<tr>
<td>12</td>
<td>Russia</td>
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<td>13</td>
<td>Australia</td>
<td>1,379,548</td>
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<tr>
<td>14</td>
<td>Spain</td>
<td>1,313,951</td>
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<tr>
<td>15</td>
<td>Mexico</td>
<td>1,149,236</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>57</td>
<td>Kazakhstan</td>
<td>160,839</td>
</tr>
</tbody>
</table>
The Components of GDP

• **GDP (Y)** is represented as:  \( Y = C + I + G + NX \)

• **Consumption (C):**
  • Is the spending by households on goods and services
  • e.g. buying clothing, food, movie tickets

• **Investment (I):**
  • Is the purchases of capital equipment and installations
  • e.g. factory, homes, etc.

• **Government expenditures (G):**
  • Includes spending on goods and services by local, provincial and federal governments (e.g. roads, police, etc.).
  • Does not include transfer payments, because it is not made in exchange for currently produced goods or services.

• **Net Exports (NX):**
  • Exports less imports.

Countries have placed emphasis on different components of GDP in promoting growth (C, I, G, X)
Real versus Nominal GDP

• Differences between **Real and Nominal GDP**:
  • GDP is the market value of the economy’s current production, referred to as Nominal GDP.
  • Real GDP measures any given year’s total output in “constant” prices.
  • An accurate view of the economy requires adjusting nominal to real GDP, using the GDP Price Deflator.

• The **GDP Price Deflator**:
  • The GDP Price Deflator is a price index that uses a bundle of all final goods and services.
  • It tells us the rise in nominal GDP that is attributable to a rise in prices.
  • Converting Nominal GDP to Real GDP:

\[
\text{Real GDP}_{20xx} = \left( \frac{\text{Nominal GDP}_{20xx}}{\text{GDP deflator}_{20xx}} \right) \times 100
\]
GDP and Economic Well-Being

• **GDP Per Person** tells us the income and expenditure of the average person in the economy.
  - It is a good measure of the material well-being of the economy as a whole.
  - More Real GDP means we have a higher material standard of living by being able to consume more goods and services.
  - It is NOT intended to be a measure of happiness or quality of life.

• Some factors and issues not in GDP that lead to the “well-being” of the economy:
  - Factors that contribute to a good life such as leisure.
  - Factors that lead to a quality environment.
  - The value of almost all activity that takes place outside of the markets, e.g. volunteer work and child-rearing.
Forecasting GDP

• The macroeconomic framework employed for the economic growth projections reflects the **interaction of many important economic variables**.

• It is **difficult and quite different depending on the time horizon**
  
  • In the **short term**, households and businesses make spending decisions (the demand side) based on current financial conditions (e.g., interest rates or the price of goods).
  
  • In the **long term**, the ability to produce goods and services (the supply side) determines the growth potential for any country’s economy.
    
    • Growth potential is influenced by population growth, labour force participation rates, productivity growth, and capital accumulation.
    
    • In developing countries, growth potential is also influenced by progress in building human and physical capital infrastructures, credible regulatory mechanisms, and political stability.

**Forecasts used in Master Planning are generally developed by Government, and often in short term bodies like IMF**
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Definition and Measures of Inflation

- Inflation is an increase in the price level. It deals with the increase in the average of prices and not just significant increases in the price of a few goods.
- The most common measures of inflation are:
  - **Consumer price indices** (CPIs) which measure the price of a selection of goods purchased by a "typical consumer".
  - **Producer price indices** (PPIs) which measure the price received by a producer. This could be "passed on" as consumer inflation, or it could be absorbed by profits, or offset by increasing productivity.
  - **Wholesale price indices**, which measure the change in price of a selection of goods at wholesale, prior to retail mark ups and sales taxes.
  - **Commodity price indices**, which measure the change in price of a selection of commodities.
  - **GDP Deflator** measures price increases in all assets rather than some particular subset.
Causes of Inflation

• There are three major types of inflation:

  • **Demand-pull inflation**: inflation from high demand for goods and low unemployment.

  • **Cost-push inflation**: presently termed “supply shock inflation,” from an event such as a sudden decrease in the supply of oil, which increases oil prices. Producers for whom oil is a part of their costs could then pass this on to consumers in the form of increased prices.

  • **Built-in inflation**: induced by adaptive expectations, often linked to the "price/wage spiral" because it involves workers trying to keep their wages up with prices and then employers passing higher costs on to consumers as higher prices as part of a “vicious circle.” Built-in inflation reflects events in the past, and so might be seen as hangover inflation.
The Costs of Inflation (1/2)

• **Shoe-leather costs**
  - Inflation reduces the real value of money, so people have an incentive to minimize their cash holdings. Less cash requires people to make frequent trips to the bank because they keep their money in interest bearing accounts.
  - Extra trips to the bank and extra bank operations take resources away from productive activities.

• **Menu Costs**
  - During inflationary times, it is necessary to update price lists and other posted prices.
  - This is a resource-consuming process and it introduces noise in the functioning of the economy.

• **Increased variability of relative prices**
  - During times of rising prices, there will be a delay between price increases. While these prices are constant, other prices will be rising. It then generates inefficiencies as it becomes difficult to know exact relative prices because prices change irregularly.
The Costs of Inflation (2/2)

• Tax liabilities
  • With inflation, unadjusted incomes are treated as real gains. Consequently, with progressive taxation, rising nominal incomes are taxed more heavily.

• Confusion and inconvenience
  • With rising prices, it is necessary to constantly make corrections in order to compare real revenues, costs, and profits over time. The time spent making these adjustments could have been spent producing more goods and services.

• Arbitrary redistribution of wealth
  • With unanticipated or incorrectly anticipated inflation, wealth is redistributed between net monetary debtors and creditors. This may result in wealth transfers that would not otherwise be acceptable.

Impact on an owner of an electricity asset will depend on various factors, including exposure to foreign currency. Greater uncertainty in business operation will arise
Annual Inflation Rate (%) Comparison Across Countries
Annual Inflation Rate (%) Comparison Across Countries
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Currency Definition

• A currency is a unit of exchange, facilitating the transfer of goods and services.
  • Coins and paper money are both forms of currency.
  • To facilitate trade between currency zones, there are exchange rates i.e. prices at which currencies (and the goods and services of individual currency zones) can be exchanged against each other.
  • In most cases, each country has monopoly control over the supply and production of its own currency.
    • The control is usually exercised either by a central bank or by a Ministry of Finance. Monetary authorities have varying degrees of autonomy from the governments that create them.
    • Member countries of the European Monetary Union are a notable exception to this rule.
  • Several countries can use the same name, each for their own currency (e.g. Canadian dollars and US dollars), several countries can use the same currency (e.g. the euro), or a country can declare the currency of another country to be legal tender (e.g. Panama and El Salvador).
Exchange Rate Quotes

• Exchange rate is the price to buy and sell currency
  • Exchange rate is terms currency per unit of base currency
  • Base is the currency bought or sold
  • Terms is the pricing currency.
• Example: Euro-dollar quote of $1.1483
  • Base currency (always comes first) is euro
  • Terms currency is dollar
  • Price of 1 euro is $1.1483.
• When the exchange rate increases, the base currency appreciates;
• When the exchange rate decreases, the base currency depreciates.
Historic Exchange Rates – (Dollar/Euro)

Mid-range values since January 1999
Historic Exchange Rates – (Dollar/Kazak Tenge)
What Moves Exchange Rates?

- Exchange rates are determined by supply and demand for currencies.
- Supply and demand for currencies depends on:
  - Macroeconomic conditions – positive news strengthens currency
    - GDP
    - Retail sales
    - Consumer confidence
  - Domestic and foreign interest rates differential
  - Inflows /Outflows of capital
  - Central bank reserves demand (reserve currency issue)
  - Current account surplus/deficit
- Importance of each factor may change over time

These factors affect planning as many costs are denominated in foreign currency
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Definition of Commodities

• The idea behind a commodity is that they are **valuable goods, of uniform quality**, that are produced in large quantities by many different producers across the world.

• Therefore, a commodity is something that is relatively **easily traded**, that can be **physically delivered**, and that **can be stored** for a reasonable period of time.

  – **Commodity markets** are markets where commodities are exchanged, i.e. they are bought and sold in standardised contracts.

  – Examples of commodities include not only minerals and agricultural products such as iron ore, crude oil, ethanol, sugar, coffee, aluminium, rice, wheat, gold, diamonds, or silver, but also so-called “commoditised” products such as personal computers.
Primary and Secondary Commodities

- Some Primary Commodities
  - Coal
  - Coffee
  - Coconut
  - Corn
  - Cashew Nuts
  - Silver, Gold, palladium
  - Copper
  - Meat
  - Natural Gas and LNG
  - Orange
  - Oil
  - Pepper
  - Pineapple
  - Tea
  - Electricity ?

- Some Secondary Commodities
  - Beef processing Industry
  - Brown Sugar Industry
  - Cacao Processing Industry
  - Chicken Meat Processing Industry
  - Coconut Oil Industry
  - Coffee Processing Industry
  - Cooking Oil Industry
  - Corn Feed mill Industry
  - Essential Oils Industry
  - Food Industry (Peanut)
  - Frozen Fish Industry
  - Frozen Shrimp Industry
  - Fruits Processing Industry
  - Green Tea Industry
  - Palm Oil Industry
  - Pineapple Canning Industry
  - Rubber Glove Industry
  - Sugar Cane Industry
  - Wooden Industry
Global Commodity Markets

- **Global commodities are usually traded in a marketplace** which offers integrated electronic markets for side-by-side trading of products in both futures and over-the-counter (OTC) markets, bringing together the world’s buyers and sellers of derivative and physical commodity contracts.

- The most common global commodities are the following:
  - **Energy Commodities**
    - Crude oil and refined oil products such as heating oil and jet fuel, and other products like natural gas (more regional), coal, etc.
  - **Agriculture and Soft Commodities**
    - Cocoa, Frozen Concentrated Orange Juice (FCOJ), coffee, cotton,…
Global Commodity Markets

• A key advantage of global commodity markets is that they reveal a price for the commodities, both spot and forward.

• These price are based on global consensus and not based on individual opinions or expectations, etc.

• They can be translated to each region of the world by computing the netback prices, that is the cost of transportation.

• The cost of transport makes some market global (oil) or others regional (natural gas, starting to be global by means of LNG)

• In the short-term, distortions that unlink markets, for instance, lack of adequate infrastructure to export coal, may make the price of internal coal different from the netback international price, but in the long run (excluding policy issues), prices should converge.

• Unfortunately, there are no liquid forward markets for longer than 5 to 10 years, but for the short-term, market reference is better than ad-hoc forecasts.
Energy Commodities

• **Coal** is a vital fuel for the power generation industry.

• **Oil** was the first form of energy so widely traded, and the fluctuations in the oil markets are of particular political interest.
  - It is tied to the politics of volatile regions
  - Oil is the world’s most actively traded commodity

• **Natural Gas** is one of the leading commodities traded on platforms, in both futures and OTC markets

• **Electricity** is traded through a broad range of futures and OTC products for baseload, peak and off-peak periods.
  - In contrast to natural gas and crude oil, power commodity that cannot be stored. It must be used as it is produced and, therefore, transported within the region in which it is generated, therefore, electricity prices can be volatile.
<table>
<thead>
<tr>
<th>Year</th>
<th>Production (Mil t)</th>
<th>Trade</th>
<th>Change in trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>7,018</td>
<td>1,224</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>6,813</td>
<td>1,214</td>
<td>-0.8%</td>
</tr>
<tr>
<td>2017</td>
<td>6,996</td>
<td>1,244</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Source: Verein Der Kohlenimporteure (German Coal importing association), Annual Report 2018
Primary Trade Flows in Hard Coal 2017

Seaborne trade 1,145 Mill t:
872 Mill t Steam Coal
273 Mill t Coking Coal

Source: Verein Der Kohlenimporteure (German Coal importing association), Annual Report 2018
International Coal Prices can be volatile

$ per tonne, selected markets - source: BP Statistical Review of World Energy 2018
Main Oil Features

• The **largest source of energy** in the world (34.2% of primary energy consumption in 2017)

• The **ultimate fuel for international trade** – easily moved by tanker and pipeline

• **Highly subject to geopolitics** – the OPEC cartel (Middle Eastern countries stability issue)
Volatility and consistency across hubs a key feature of oil prices

$ per barrel, selected markets - source: BP Statistical Review of World Energy 2018
Oil Market Prices Are Not Always Stable

- Recent oil **price rises are triggered by many factors**, but mostly macroeconomic. A combination of demand growth, tight supply and rising costs mainly explains the rise:
  - Substantial **growth in demand** led by China
  - **Supply disruptions** due to different facts – Middle East, Iraq, Iran, Russia, Nigeria, hurricanes in the Mexican Gulf Coast
  - **Underinvestment in refining** – capacity not keeping pace with demand growth – linked to low oil price in 1990’s
  - Inflow of **speculative money**.
Oil Market Prices Affect Other Markets

• **Oil market prices** have **impacts** on:
  • Electricity prices
  • Major macroeconomic variables
  • Sectors’ productivity

• **Oil market prices** may have also additional **effects on emerging countries**:
  • Income and expenditure
  • Access to the energy resources
  • Inflationary and recessionary effects
  • Fuel switching
Natural Gas/LNG Main Features

- Natural Gas is the **third largest source of energy** in the world after oil and coal (23.35% of primary energy consumption in 2017)
- **Largely landlocked** when it comes to international trade
- Liquefied Natural Gas (LNG) is **difficult to store by comparison to Oil and Coal** and entails an energy loss of between 15 and 30% for liquefaction, shipping and re-gasification, as LNG must be cooled to −165 degrees Celsius for movement by ship
- **Three-quarters of remaining natural gas reserves** are located in the former Soviet Union and the Middle East
- **LNG will play an increasingly important role globally** as it enables cost effective gas transportation over long distances – connecting high-demand markets with vast reserves far away
- **LNG business is expected to become a more important fuel** if price trends are supportive and there is sufficient infrastructure to allow expanded market share
Natural Gas Trade

Source: BP Statistical Review of World Energy, 2018
Gas prices from 1987 to 2017 at selected locations

US Dollars per MBTU

Source: BP Statistical Review of World Energy, 2018
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Output - the production function

- The **production function** is a mathematical expression which relates the quantity of factor inputs to the quantity of outputs that result.

- **Total product** is simply the total output that is generated from the factors of production employed by a business.

- **Average product** is the total output divided by the number of units of the variable factor of production employed (e.g. output per worker employed or output per unit of capital employed)

- **Marginal product** is the change in total product when an additional unit of the variable factor of production is employed. For example marginal product would measure the change in output that comes from increasing the employment of labour by one person, or by adding one more machine to the production process in the short run.
Output in the short run

• The **short run** is defined in economics as a period of time where at least **one factor of production is assumed to be in fixed supply** i.e. it cannot be changed.

• In **many industries the quantity of capital inputs** (e.g. plant and machinery) **is fixed** and production can be altered by suppliers through changing the demand for variable inputs such as labour, components, raw materials and energy inputs

• Same concept with a **generation plant**

• In the short run, the **law of diminishing returns** states that as we add more units of a variable input (i.e. labour or raw materials) to fixed amounts of land and capital, the change in total output progressively reduces
Output – marginal productivity

• What happens to **marginal product** is linked directly to the productivity of each extra worker employed.

• At **low levels of labor input**, the fixed factors of production - land and capital, tend to be under-utilized which means that **each additional worker will have plenty of capital to use** and, as a result, **marginal product may rise**

• In most manufacturing industries such as motor vehicles, freezers and DVD players, it is straightforward to measure the volume of production from labor and capital inputs that are used. But in many service or knowledge-based industries, where much of the output is “intangible” or perhaps weightless we find it harder to measure productivity
Costs - Opportunity Cost and Accounting Cost

• **Economic cost = opportunity cost <> Accounting cost**
  
  • Normal profits reflect the opportunity cost of using funds to finance a business. If you decide to put USD 200,000 of your personal savings into a new business, then those funds could easily have earned a fairly risk-free rate of return by being saved in a bank deposit account.

  • The rate of interest on that USD 200,000 can be seen as the minimum rate of return in order to keep going in the long run

• **Accounting cost is an historic cost**: It is not reflecting the real opportunity cost.

• **Opportunity cost is continuously changing**.
Average and marginal cost in the short run

• In the short run, because at least one factor of production is fixed, output can be increased only by adding more variable factors
• Fixed costs are business expenses that do not vary directly with the level of output i.e. they are treated as independent of the level of production.
• Variable costs are costs that vary directly with output.
• A change in fixed costs has no effect on marginal costs. **Marginal costs relate only to variable costs**
Average and marginal cost in the short run

- **Average fixed cost (AFC)** = total fixed costs divided by output
- **Average variable cost (AVC)** = total variable costs (TVC) / output (Q)
- **Average total cost (ATC)** = total cost (TC) / output (Q)

- **Marginal cost** is the change in total costs from increasing output by one extra unit.
- The **law of diminishing returns** implies that the marginal cost of production will rise as output increases
Average Fixed Costs decline with output in the short run

Example - production with fixed costs of $20,000
Short run costs of production – If a marginal cost is below average cost then average must be falling. Even if MC is rising, AC fall is MC<AC. For this reason, MC curve intersects the AC curve at the lowest point of the AC curve.
Long Run Average and Marginal Cost

• In the long run, all factors of production are variable.

• Long run marginal cost (LRMC) refers to the cost of providing an additional unit of service or commodity under assumption that this requires investment in capacity expansion. LRMC pricing is appropriate for best resource allocation.

• The Long Run Average Cost (LRAC) curve of a firm shows the minimum or lowest average total cost at which a firm can produce any given level of output in the long run (when all inputs are variable).

• Innovation, technology change affect the LRMC and LRAC.

• LRAC curve is derived from a series of short run average cost curves. It is also called the 'envelope curve' since it envelops all the short run average cost curves. The same for LRMC.
Average and marginal cost. Long Run Costs
Average and marginal cost and profit maximization

- **Profit** measures the return to risk when committing scarce resources to a market or industry.

- **Normal profit** - is defined as the minimum level of profit required to keep the factors of production in their current use in the long run. Normal profits reflect the opportunity cost.

- **Sub-normal profit** - is any profit less than normal profit (where price < average total cost).

- **Super-normal profit** - is any profit achieved in excess of normal profit.

- When firms are making **abnormal profits**, there is an incentive for other producers to enter the market to try to acquire some of this profit. Abnormal profit persists in the long run in imperfectly competitive markets such as oligopoly and monopoly.
Average and marginal cost and profit maximization

• Profits are maximized when marginal revenue = marginal cost
• Once marginal cost is greater than marginal revenue, total profits are falling
Average and marginal cost. Firm profit maximization

- Supernormal profit at price $P_1$ and output $Q_1$
- Normal profit at $Q_2$ where $AR = AC$

Costs

Output ($Q$)

$Q_1$ $Q_2$

$MR_1$ $AR_1(demand)$

$SRMC$ $SRAC$

$AC_1$ $AC_2$
Economies and Diseconomies of Scale

• The nature of the returns to scale affects the shape of a business’s long run average cost curve.

• **Economies of scale are the cost advantages exploited by expanding the scale of production in the long run.** The effect is to reduce long run average costs over a range of output.

• Conversely when LRAC rises, the firm experiences diseconomies of scale, and, if LRAC is constant, then the firm is experiencing constant returns to scale.

• There are **many different types of economy of scale.** Depending on the characteristics of an industry or market, some are more important than others.
Examples of Economies of Scale

• **Technical economies of scale**: (these relate to aspects of the production process itself):
  
  • Expensive capital inputs: Large-scale businesses can afford to invest in expensive and specialist machinery.
  
  • Specialization of the workforce: Within larger firms the production process can be split into separate tasks to boost productivity.
  
  • Learning by doing
  
  • Marketing economies of scale and monopsony power
  
  • Managerial economies of scale
  
  • Financial economies of scale
  
  • Network economies of scale

• **External economies of scale**, which can occur outside of a firm but within an industry – for example:
  
  • Creation of a better transportation network
  
  • Development of research and development facilities in local universities that benefit nearby businesses
Economies of Scope

- **Economies of scope** occur where it is **cheaper to produce a range of products rather than specialize** in just a handful of products.

- A company’s management structure, administration systems and marketing departments may be capable of carrying out these functions for more than one product.

- In the publishing industry there might be cost savings to a business from using a team of journalists to produce more than one magazine.

- Expanding the product range to exploit the value of existing brands is a good way of exploiting economies of scope.
Diseconomies of Scale

• **The minimum efficient scale**

  • The minimum efficient scale (MES) is best defined as the scale of production where the internal economies of scale have been fully exploited.

  • The MES corresponds to the lowest point on the long run average cost curve and is also known as an output range over which a business achieves productive efficiency.

  • The MES is not a single output level but a range of output levels where the firm achieves constant returns to scale and has reached the lowest feasible cost per unit in the long run.

  • In industries where the ratio of fixed to variable costs is high, there is scope for reducing average cost by increasing the scale of output. This is likely to result in a concentrated market structure in which economies of scale may act as an effective barrier to the entry of new firms because existing firms have achieved cost advantages and they then can force prices down in the event of new firms coming in
Economies and Diseconomies of Scale and Scope (VI)

- Increasing return to scale – economies of scale – falling LRAC
- Decreasing returns – diseconomies of scale
Presentation context

1. Introduction
2. Macroeconomics
   I. Gross Domestic Product
   II. Inflation
   III. Currency and Exchange Rate Systems
   IV. Commodity Markets
3. Microeconomics
   I. Cost Assessment
   II. Value of Loss Load (VoLL)
   III. Social Welfare
Value of Lost Load (VoLL)

• VOLL is the value placed on electricity that it is not supplied
• Can also be seen as the value placed by customers on security of supply – that is what they’d be willing to pay to avoid a disruption in their electricity service

• But … what is its value?
• Due to the high short-run inelasticity of demand and the fact that most of customers do not see the price signal instantaneously, spot markets cannot readily reveal a value for the lost load in case of shortfall.
• Generally, wholesale markets are capped considering the VoLL in order to avoid extremely high prices
  • A single value is applied often considering factors other than likely customer costs
Value of Lost Load (VoLL) (II)

• Value of Lost Load can be measured based in two different ways:
  
  – VoLL based on willingness to accept (WTA): It is the amount of money that electricity users would admit (paid for the company in charge) as compensation if there was a failure in the electricity supply.
  
  – VoLL based on willingness to pay (WTP): It is the amount of money that electricity users would pay in order to have electricity supply when there is a failure in the electricity supply.
  
• WTA tends to be higher than WTP due to consumers, especially residential and small ones, are typically not willing to pay for improving the service. For this reason WTA is more used in terms of security supply.
Value of Lost Load (VoLL) (III)

- VoLL is a complex index which depends on many factors:
  - **Area**: VoLL depends on each country and the activities which take place in it. It means that VoLL cannot be generalized among different countries. However developed countries tend to have a higher VoLL than countries under development.
  - **Customer**: VoLL differs considerably among customer classes. These classes can be classified primarily in residential, small and medium commercial and industrial customers. Secondarily it is possible to narrow down in sectors like agriculture, mining, construction, etc.
  - **Time dependence**: The season, the day of the week and the time of the day affect the VoLL. VoLL tends to be higher at weekends and evenings for residential customers and it has the opposite behavior for commercial and industrial customers.
  - **Advance warning interruptions**: VoLL changes considerably whether there is a warning of the outage or there is not. When outages are known in advance VoLL is lower because customers are able to make adjustments.
  - **Frequency of the load shedding**: VoLL is higher as higher the frequency is considering that outage durations do not vary.
  - **Duration of the load shedding**: VoLL is affected by outages’ duration. The longer the outage is the higher the VoLL is if the frequency does not change.
  - **Type of load**: Different loads have different VoLLs depending on their importance.
Value of Lost Load (VoLL) (IV)

- There are 4 different ways to calculate VoLL:

  - **Revealed Preference Method**: The VOLL is estimated based on the behavior of customers in the past. This information is gathered via observations. Customer:

  - **Stated Preference Method**: The VOLL is estimated based on surveys and interviews to customers where they are asked about hypothetical situations in the future.

  - **Macroeconomic Analysis**: The VOLL is calculated here estimating the value of loss of production for non-residential customers or the leisure time for residential customers. It is possible to use the following formulas:
    - \( \text{VoLL} = \frac{\text{Annual Gross Value Added}}{\text{Annual Consumption}} \)
    - \( \text{VoLL} = \frac{\text{Annual Electricity Bill}}{\text{Annual Consumption}} \)

  - **Case study**: The VOLL in this approach is calculated using data from previous outages and it is usually used to check the accuracy of the previous methods.
Value of Lost Load and Planning

• VoLL is a **key parameter** in planning as it is a key proxy of demand behaviour.

• VoLL **offers utilities tangible numbers** that can be used in balancing the cost of outages against the cost of investing in the network to ensure system adequacy and security.

• Due to its high cost, usually a **key objective in least-cost** Planning is to minimise the invoking of VoLL through capacity addition and dispatch.

• The value of supply losses can be expressed as a **Customer Damage Function (CDF)**.

• Typically CDF varies by group:
  - Residential
  - Small and medium commercial/industry
  - Large commercial/industrial
Typical profiles for VoLL (I)

- Small and medium C/I
- Large C/I
- Residential

$$/kW interrupted vs. Outage Duration
How to compute the VoLL (I)

- **Loss**(i) ($/kW) = f(duration, season, time of day, notice) for class of customer I
- The variability in estimates of the value of reliability gives planners a great deal of freedom in their choice of parameters for system models. A wide range of estimates of VOLL ($2,400 to $20,000) can be deemed justified by some source in the literature.
- A basic estimate of VOLL can be found by dividing gross domestic product by total energy consumed.
- In the United States this ratio is approximately $2,500/MWh.
- This estimate does not account for many effects including the additional damages due the unexpected nature of electricity outages, and at best provides a lower bound for more reasonable estimates.
How to compute the VoLL (II)

• **Surveys**: Customer surveys provide the tool that researchers and utilities most prefer for the evaluation of reliability.

• The simplest form of survey directly asks consumers to estimate the costs they incur for given outage conditions. A direct survey may be a weak instrument because impacts may be intangible and monetary losses difficult to identify.

• **Two types of surveys** attempt to help the respondent quantify her valuation.
  
  • **The Preparatory Action Method** asks consumers to choose from a list the mitigating actions that they would take to avoid an outage of varying characteristics. The cost of the mitigating actions taken is used as the cost of the outage.

  • **The Contingent Ranking Methodology** presents consumers with a set of possible electrical service plans. The choices vary in rates, number of outages and duration of outages. The consumer ranks the different plans, and from the ranking the consumer’s preferences and valuations can be inferred.

• All types of surveys ask questions that consumers are not used to answering, so their results must be viewed as a rough estimate of consumer costs at best.
## EU estimates of VOLL and price caps, 2016 (€/MWh)

<table>
<thead>
<tr>
<th>Country</th>
<th>Day ahead</th>
<th>Intra-day</th>
<th>Balancing</th>
<th>VOLL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>3,000</td>
<td>9,999</td>
<td>4,500</td>
<td>n.a</td>
</tr>
<tr>
<td>Denmark</td>
<td>3,000</td>
<td>No cap</td>
<td>5,000</td>
<td>2,933-36,800</td>
</tr>
<tr>
<td>Croatia</td>
<td>3,000</td>
<td>No OTC cap</td>
<td>No cap</td>
<td>n.a</td>
</tr>
<tr>
<td>France</td>
<td>3,000</td>
<td>9,999</td>
<td>9,999</td>
<td>26,000</td>
</tr>
<tr>
<td>Germany</td>
<td>3,000</td>
<td>9,999</td>
<td>No cap</td>
<td>n.a</td>
</tr>
<tr>
<td>Ireland</td>
<td>3,000</td>
<td>3,000</td>
<td>n.a</td>
<td>11,018</td>
</tr>
<tr>
<td>Italy</td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Poland</td>
<td>350</td>
<td>No cap</td>
<td>350</td>
<td>1,250-2,100</td>
</tr>
<tr>
<td>Portugal</td>
<td>180</td>
<td>180</td>
<td>No cap</td>
<td>3,000</td>
</tr>
<tr>
<td>Spain</td>
<td>180</td>
<td>180</td>
<td>No cap</td>
<td>n.a</td>
</tr>
<tr>
<td>Sweden</td>
<td>3,000</td>
<td>No cap</td>
<td>5,000</td>
<td>2,800-7,600</td>
</tr>
</tbody>
</table>

Source: European Commission, 2016
Estimating the VoLL and Master Planning

- Detailed studies of VoLL are not always undertaken to support Master Planning.
- As aim of the Planning is to meet future demand at least cost, a key aim is for capacity to be brought on line specifically to avoid any expected outages.
- However, VoLL could be invoked in scenario analysis or as a transitional impact – for example:
  - Extremely dry year in a system dominated by hydro.
  - In short term for a system currently experiencing high shortage of supply.
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   III. Social Welfare
Concept of social welfare

• Very **difficult concept** – many views across the world, cultures, religions, sciences, etc … even within the economic field

• Welfare economics focuses on the **optimal allocation of resources** and how this affects social welfare

• Focuses on **efficiency and equity**

• Social welfare increases if the utility of any of its members increase and none decrease (the "Pareto principle"). But
  
  • What is Utility?
  
  • How we can compare utility across society members?
  
  • How we can compare the utility of one person getting some good compared to other person getting the same good?

---

**No clear consensus even within the economic profession**
Utility and demand

• Demand for a good results from **Utility Maximization** of the members of a society.
• The Constrained Utility Maximization is based on
  • Preferences (indifference curves), and
  • Budget sets.
• A utility function is a mathematical representation $U = f(X_1, X_2, X_3, \ldots)$
  • Where $X_1, X_2, X_3$ and so on are the goods consumed by the individual,
  • And $f(\cdot)$ is some mathematical function.
Utility curves

\( Q_{CD} \)
(quantity of CDs)

\( Q_M \)
(quantity of movies)

Points A, B, and C are plotted on the graph.
Utility curves

\[ Q_{CD} \] (quantity of CDs)

“A” and “B” both give 2 “utils” and lie on the same indifference curve

“A” and “B” both give 2 “utils” and lie on the same indifference curve

\[ Q_M \] (quantity of movies)
Utility curves

$Q_{CD}$ (quantity of CDs)

$Q_M$ (quantity of movies)

Bundle “C” gives higher utility than either “A” or “B”
Bundle “C” gives 4 “utils” and is on a higher indifference curve.
“A” and “B” both give 2 “utils” and lie on the same indifference curve.

Bundle “C” gives higher utility than either “A” or “B”.

Bundle “C” gives 4 “utils” and is on a higher indifference curve.
Supply and demand (I)

- The **utility function**, $U = QMQC$,

- Take the partial derivative of the utility function with respect to $QM$ to get the **marginal utility** of movies.

\[ MU_{QM} = \frac{\partial U}{\partial Q_M} = Q_C \]

- Normally, preferences exhibit diminishing marginal utility - if we have a lot of this good, the desire for this good is smaller than for other goods we do not have -
Supply and demand (II)

- **Marginal rate of substitution**—slope of the indifference curve is called the MRS, and is the rate at which consumer is willing to trade off the two goods.
- Direct relationship between MRS and marginal utility.
- MRS shows how the relative marginal utilities evolve over the indifference curve.

\[
MRS = -\frac{MU_M}{MU_C} = -\frac{Q_C}{Q_M}, \text{ when } U = Q_M Q_C
\]
Supply and demand (III)

• The **budget constraint** is a mathematical representation of the combination of goods the consumer can afford, given income.

• Assume there is no saving or borrowing.

• In the example, denote:
  
  • $Y = $Income level
  • $PM = $Price of one movie
  • $PC = $Price of one CD

$$Y = P_M Q_M + P_C Q_C$$
Demand curve

$Q_{CD}$ (quantity of CDs)

$Q_M$ (quantity of movies)
This indifference curve is not utility-maximizing, because there are bundles that give higher utility.
This indifference curve gives much higher utility, but is not attainable.
This bundle of goods gives the highest utility, subject to the budget constraint.
This indifference curve is not utility-maximizing, because there are bundles that give higher utility.

This indifference curve gives much higher utility, but is not attainable.

This bundle of goods gives the highest utility, subject to the budget constraint.
Supply and demand (IV)

• Thus, the marginal rate of substitution equals the ratio of prices:

\[ MRS = - \frac{MU_M}{MU_C} = - \frac{P_M}{P_C} \]

• At the optimum, the ratio of the marginal utilities equals the ratio of prices. But this is not the only condition for utility maximization.

• The second condition is that all of the consumer’s money is spent
Supply and demand (V) - Substitution and income effects

- A change in price consists of two effects:
- **Substitution effect**—change in consumption due to change in relative prices, holding utility constant.
- **Income effect**—change in consumption due to feeling “poorer” after price increase.

**KEY:** Find a hypothetical budget line with the new price ratio just tangent to the original IC.
Demand curve

\[ Q_{CD} \text{ (quantity of CDs)} \]

\[ Q_M \text{ (quantity of movies)} \]
Initial utility-maximizing point gives one \((P_M, Q_M)\) combination.
Raising $P_M$ gives another $(P_M, Q_M)$ combination with fewer movies demanded.
Raising $P_M$ even more gives another $(P_M, Q_M)$ combination with even less movies demanded.
Raising $P_M$ gives another $(P_M, Q_M)$ combination with fewer movies demanded.

Raising $P_M$ even more gives another $(P_M, Q_M)$ combination with even less movies demanded.

Initial utility-maximizing point gives one $(P_M, Q_M)$ combination.
At a high price for movies, demanded $Q_{M,3}$.
At a somewhat lower price for movies, demanded $Q_{M,2}$.
Demand curve for movies

At an even lower price for movies, demanded $Q_{M,1}$

Demand curve for movies
Demand curve for movies

Various combinations of points like these create the demand curve.
Demand curve

At a high price for movies, demanded $Q_{M,3}$

Various combinations of points like these create the demand curve.

At a somewhat lower price for movies, demanded $Q_{M,2}$

At an even lower price for movies, demanded $Q_{M,1}$

Various combinations of points like these create the demand curve.

Demand curve for movies
Supply and demand (VI) – Supply Curves

• We can do a similar drill on the supply side of the market. Firms have a production technology (we might write it as)

\[ Q_M = f(L_M, K_M) \]

• We can construct isoquants, which represent the ability to trade off inputs, fixing the level of output.

• Firms also have an isocost function, which represent the cost of various input combinations.

• Firms maximize profit (minimize cost) when the marginal rate of technical substitution equals the input price ratio.

• Marginal Revenue=Marginal cost at the profit-maximizing level of output.
Supply and demand (VII) – Supply Curves

• In equilibrium, we horizontally sum individual demand curves to get aggregate demand.

• We also horizontally sum individual supply curves to get aggregate supply. A firm’s supply curve is the MC curve above minimum average variable cost.

• **Competitive equilibrium** represents the point at which both consumers and suppliers are satisfied with the price/quantity combination.
Supply curve for movies

Demand curve for movies

Supply curve
Demand curve for movies

Supply curve of movies

Intersection of supply and demand is equilibrium.
Elasticity of demand (I)

- A key feature of demand analysis is the **elasticity of demand**. It is defined as:
  \[ \varepsilon_D = \frac{\Delta Q_D}{\Delta P} \]

- That is, the **percent change in quantity demanded divided by the percent change in price**.
- Demand elasticities are:
  - **Typically negative** number.
  - **Not constant** along the demand curve (for a linear demand curve).
  - It is easy to define other elasticities (income, cross-prices, etc.)
  - **Some good are price-inelastic** (electricity in short-term for instance), other are very sensible to its price (entertainment)
- **Elasticity depends on**:
  - Possibilities of substitution
  - Time horizon
  - Available income to spend on this good.
Elasticity of demand (II)

- There are two extremes:
  - A good is considered perfectly elastic when the price elasticity of demand approaches infinity. This implies that the demand for the product is unlimited at the market price - the demand curve is horizontal.
  - A good is considered perfectly inelastic when the price elasticity of demand equals zero. This implies that changes in price have no effect on the quantity demand of a good - the demand curve is vertical.
Elasticity of demand (III)

• Cross price elasticity measures the responsiveness of demand for good X following a change in the price of good Y (a related good). We are mainly concerned here with the effect that changes in relative prices within a market have on the pattern of demand.

• With cross price elasticity we make an important distinction between substitute products and complementary goods and services
  • Substitutes: With substitute goods such as brands of cereal or washing powder, an increase in the price of one good will lead to an increase in demand for the rival product
  • Complements: With goods that are in complementary demand, such as the demand for DVD players and DVD videos
Elasticity of supply (I)

- Price elasticity of supply measures the relationship between change in quantity supplied and a change in price.
  - If supply is elastic, producers can increase output without a rise in cost or a time delay.
  - If supply is inelastic, firms find it hard to change production in a given time period.
- In Short-run it depends on availability of stocks and spare capacity.
- In Long-run, availability of capital and the conditions for expansion.
- Elasticity of supply is quite related to the features of the supply curve.
Elasticity of supply (II)
Social Surplus (I)

• Each point on the demand curve represents a “willingness-to-pay” for that quantity.
• Each point on the supply curve represents the marginal cost of producing it

• **Consumer surplus** is the benefit that consumers derive from a good, beyond what they paid for it.

• **Producer surplus** is the benefit derived by producers from the sale of a unit above and beyond their cost of producing it.

• **The total social surplus**, also known as “social efficiency,” is the sum of the consumer’s and producer’s surplus. Social efficiency represents the net gain from trade to consumers and producers.
Demand curve for movies

Supply curve of movies

The surplus from the next unit is the difference between the demand and supply curves.

Surplus area

\[ P_M \]

\[ Q_M \]

\[ P^* \]

\[ Q^* \]
Surplus area

This area represents the social surplus from producing the first unit.
Demand curve for movies

Supply curve of movies

Social efficiency is maximized at $Q^*$, and is the sum of the consumer and producer surplus. The area between the supply and demand curves from zero to $Q^*$ represents the surplus.
The surplus from the next unit is the difference between the demand and supply curves.

Providing the first unit gives a great deal of surplus to “society.”

Social efficiency is maximized at $Q^*$, and is the sum of the consumer and producer surplus.

The area between the supply and demand curves from zero to $Q^*$ represents the surplus.

This area represents the social surplus from producing the first unit.
Social Surplus (II)

- Relatively inelastic demand
- Relatively elastic demand
- Outward Shift in Supply (Higher consumer surplus)
Social Welfare maximization (I)

- The basic welfare economics problem is to find the theoretical maximum of a social welfare function, subject to various constraints such as the state of technology in production, available natural resources, national infrastructure, and behavioral constraints such as consumer utility maximization and producer profit maximization. In the simplest possible economy this can be done by simultaneously solving seven equations. This simple economy would have only two consumers (consumer 1 and consumer 2), only two products (product X and product Y), and only two factors of production going into these products (labour (L) and capital (K)). The model can be stated as:

maximize social welfare: \( W = f(U_1, U_2) \) subject to the following set of constraints:

- \( K = K_x + K_y \) (The amount of capital used in the production of goods X and Y)
- \( L = L_x + L_y \) (The amount of labour used in the production of goods X and Y)
- \( X = X(K_x, L_x) \) (The production function for product X)
- \( Y = Y(K_y, L_y) \) (The production function for product Y)
- \( U_1 = U_1(X_1, Y_1) \) (The preferences of consumer 1)
- \( U_2 = U_2(X_2, Y_2) \) (The preferences of consumer 2)

- The solution to this problem yields a Pareto optimum. In a more realistic example of millions of consumers, millions of products, and several factors of production, the maths gets more complicated.
Social Welfare maximization (II)

• The First Fundamental Theorem of Welfare Economics states that the competitive equilibrium, where supply equals demand, maximizes social efficiency.

• Any quantity other than $Q^*$ reduces social efficiency.

• Consider restricting the price of the good to $P' < P^*$. 
Demand curve for movies

Supply curve of movies

Social surplus area

Demand curve for movies

Social surplus area

Demand curve for movies
The social surplus from $Q'$ is this area, consisting of a larger consumer and smaller producer surplus. With such a price restriction, the quantity falls to $Q'$, and there is excess demand.
Social surplus area

The social surplus from Q’ is this area, consisting of a larger consumer and smaller producer surplus.
Social surplus area

This triangle represents lost surplus to society, known as “deadweight loss.”
Social surplus area

This triangle represents lost surplus to society, known as “deadweight loss.”
Social Welfare maximization (III)

• Societies usually care not only about how much surplus there is, but also about how it is distributed among the population.

• **Social welfare** is determined by both criteria. Society often faces an equity-efficiency tradeoff.

• The *Second Fundamental Theorem of Welfare Economics* states that society can attain any efficient outcome by a suitable redistribution of resources and free trade opening the “socialist calculation” debate.
Social Welfare maximization (IV)

- Social welfare maximization vs. minimization of cost

- In planning it is often assumed that the minimization of cost to meet the demand is the same that to maximize the social welfare

- However….it is not exactly the same, it a simplification in order to get faster, simpler and more robust algorithms

- The idea behind this simplification is that as demand is quite inelastic (almost totally inelastic in short-term and relatively inelastic in long-term) the difference that can be got by considering simultaneously demand-supply in relation to consider only supply are negligible.
Thanks for your attention