ECONOMICS

DEMAND AND SUPPLY ANALYSIS: INTRODUCTION

The demand function captures the effect of all these factors on demand for a good.

$$\text{Demand function: } QD_x = f(P_x, I, P_y, \ldots) \quad \ldots \text{(Equation 1)}$$

Equation 1 is read as "the quantity demanded of Good X (QD_X) depends on the price of Good X (P_X), consumers' incomes (I) and the price of Good Y (P_Y), etc."

The supply function can be expressed as:

$$\text{Supply function: } QS_x = f(P_x, W, \ldots) \quad \ldots \text{(Equation 5)}$$

The own-price elasticity of demand is calculated as:

$$ED_{Px} = \frac{\%\Delta QD_x}{\%\Delta P_x} \quad \ldots \text{(Equation 16)}$$

If we express the percentage change in X as the change in X divided by the value of X, Equation 16 can be expanded to the following form:

$$ED_{Px} = \frac{\%\Delta QD_x}{\%\Delta P_x} = \frac{\Delta QD_x / QD_x}{\Delta P_x / P_x} = \left(\frac{\Delta QD_x}{\Delta P_x}\right)\left(\frac{P_x}{QD_x}\right) \quad \ldots \text{(Equation 17)}$$

Slope of demand function.

Coefficient on own-price in market demand function

Arc elasticity is calculated as:

$$E_P = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}} = \frac{\%\,\Delta\, Q_d}{\%\,\Delta\, P} = \frac{\dfrac{(Q_0 - Q_1)}{(Q_0 + Q_1)/2} \times 100}{\dfrac{(P_0 - P_1)}{(P_0 + P_1)/2} \times 100}$$

Income Elasticity of Demand

Income elasticity of demand measures the responsiveness of demand for a particular good to a change in income, holding all other things constant.

Same as coefficient on I in market demand function (Equation 11)

$$ED_I = \frac{\%\Delta QD_x}{\%\Delta I} = \frac{\Delta QD_x / QD_x}{\Delta I / I} = \left(\frac{\Delta QD_x}{\Delta I}\right)\left(\frac{I}{QD_x}\right) \quad \ldots \text{(Equation 18)}$$

$$E_I = \frac{\text{\% change in quantity demanded}}{\text{\% change in income}}$$

Cross-Price Elasticity of Demand

Cross elasticity of demand measures the responsiveness of demand for a particular good to a change in price of *another* good, holding all other things constant.

Same as coefficient on P_Y in market demand function (Equation 11)

$$ED_{Py} = \frac{\%\Delta QD_x}{\%\Delta P_y} = \frac{\Delta QD_x / QD_x}{\Delta P_y / P_y} = \left(\frac{\Delta QD_x}{\Delta P_y}\right)\left(\frac{P_y}{QD_x}\right) \quad \ldots \text{(Equation 19)}$$

$$E_C = \frac{\text{\% change in quantity demanded}}{\text{\% change in price of substitute or complement}}$$

Demand And Supply Analysis: Consumer Demand

he Utility Function

In general a utility function can be represented as:

$$U = f(Q_{x_1}, Q_{x_2},..., Q_{x_n})$$

Demand and Supply Analysis: The Firm

Accounting Profit

Accounting profit (loss) = Total revenue – Total accounting costs.

Economic Profit

Economic profit (also known as abnormal profit or supernormal profit) is calculated as:

Economic profit = Total revenue – Total economic costs

Economic profit = Total revenue – (Explicit costs + Implicit costs)

Economic profit = Accounting profit – Total implicit opportunity costs

Normal Profit

Normal profit = Accounting profit - Economic profit

Total, Average and Marginal Revenue

Table 2: Summary of Revenue Terms [2]

Revenue	Calculation
Total revenue (TR)	Price times quantity (P × Q), or the sum of individual units sold times their respective prices; Σ(Pi × Qi)
Average revenue (AR)	Total revenue divided by quantity; (TR / Q)
Marginal revenue (MR)	Change in total revenue divided by change in quantity; (ΔTR / ΔQ)

Total, Average, Marginal, Fixed and Variable Costs

Table 5: Summary of Cost Terms [3]

Costs	Calculation
Total fixed cost (TFC)	Sum of all fixed expenses; here defined to include all opportunity costs
Total variable cost (TVC)	Sum of all variable expenses, or per unit variable cost times quantity; (per unit VC × Q)
Total costs (TC)	Total fixed cost plus total variable cost; (TFC + TVC)
Average fixed cost (AFC)	Total fixed cost divided by quantity; (TFC / Q)
Average variable cost (AVC)	Total variable cost divided by quantity; (TVC / Q)
Average total cost (ATC)	Total cost divided by quantity; (TC / Q) or (AFC + AVC)
Marginal cost (MC)	Change in total cost divided by change in quantity; (ΔTC / ΔQ)

Marginal revenue product (MRP) of labor is calculated as:

MRP of labor = Change in total revenue / Change in quantity of labor

For a firm in perfect competition, MRP of labor equals the MP of the last unit of labor times the price of the output unit.

MRP = Marginal product * Product price

A profit-maximizing firm will hire more labor until:

$$MRP_{Labor} = Price_{Labor}$$

Profits are maximized when:

$$\frac{MRP_1}{\text{Price of input 1}} = \ldots = \frac{MRP_n}{\text{Price of input n}}$$

[2] Exhibit 3, pg 106, Volume 2, CFA Program Curriculum 2012

The Firm And Market Structures

The relationship between MR and price elasticity can be expressed as:

$$MR = P[1 - (1/E_P)]$$

In a monopoly, MC = MR so:

$$P[1 - (1/E_P)] = MC$$

N-firm concentration ratio: Simply computes the aggregate market share of the N largest firms in the industry. The ratio will equal 0 for perfect competition and 100 for a monopoly.

Herfindahl-Hirschman Index (HHI): Adds up the squares of the market shares of each of the largest N companies in the market. The HHI equals 1 for a monopoly. If there are M firms in the industry with equal market shares, the HHI will equal 1/M.

Aggregate Output, Price, And Economic Growth

Nominal GDP refers to the value of goods and services included in GDP measured at **current prices**.

$$\text{Nominal GDP} = \text{Quantity produced in Year t} \times \text{Prices in Year t}$$

Real GDP refers to the value of goods and services included in GDP measured at **base-year prices**.

$$\text{Real GDP} = \text{Quantity produced in Year t} \times \text{Base-year prices}$$

GDP Deflator

$$\text{GDP deflator} = \frac{\text{Value of current year output at current year prices}}{\text{Value of current year output at base year prices}} \times 100$$

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$$

The Components of GDP

Based on the expenditure approach, GDP may be calculated as:

$$GDP = C + I + G + (X - M)$$

C = Consumer spending on final goods and services
I = Gross private domestic investment, which includes business investment in capital goods (e.g. plant and equipment) and changes in inventory (inventory investment)
G = Government spending on final goods and services
X = Exports
M = Imports

Expenditure Approach

Under the expenditure approach, GDP at market prices may be calculated as:

This equation is just a breakdown of the expression for GDP we stated in the previous LOS, i.e. GDP = C + I + G + (X – M).

GDP = Consumer spending on goods and services
+ Business gross fixed investment
+ Change in inventories
+ Government spending on goods and services
+ Government gross fixed investment
+ Exports – Imports
+ Statistical discrepancy

Income Approach

Under the income approach, GDP at market prices may be calculated as:

GDP = National income + Capital consumption allowance
+ Statistical discrepancy … (Equation 1)

National income equals the sum of incomes received by all factors of production used to generate final output. It includes:

- Employee compensation
- Corporate and government enterprise profits before taxes, which includes:
  - Dividends paid to households
  - Corporate profits retained by businesses
  - Corporate taxes paid to the government
- Interest income
- Rent and unincorporated business net income (proprietor's income): Amounts earned by unincorporated proprietors and farm operators, who run their own businesses.
- Indirect business taxes less subsidies: This amount reflects taxes and subsidies that are included in the final price of a good or service, and therefore represents the portion of national income that is directly paid to the government.

The **capital consumption allowance (CCA)** accounts for the wear and tear or depreciation that occurs in capital stock during the production process. It represents the amount that must be reinvested by the company in the business to maintain current productivity levels. You should think of profits + CCA as the amount earned by capital.

Personal income = National income
– Indirect business taxes
– Corporate income taxes
– Undistributed corporate profits
+ Transfer payments … (Equation 2)

Personal disposable income = Personal income – Personal taxes … (Equation 3)

Personal disposable income = Household consumption + Household saving

… (Equation 4)

Household saving = Personal disposable income
– Consumption expenditures
– Interest paid by consumers to businesses
– Personal transfer payments to foreigners … (Equation 5)

Business sector saving = Undistributed corporate profits
+ Capital consumption allowance … (Equation 6)

GDP = Household consumption + Total private sector saving + Net taxes

The equality of expenditure and income

S = I + (G – T) + (X – M) … (Equation 7)

The IS Curve (Relationship between Income and the Real Interest Rate)

Disposable income = GDP – Business saving – Net taxes

S – I = (G – T) + (X – M) … (Equation 7)

The LM Curve

Quantity theory of money: MV = PY

The quantity theory equation can also be written as:

M/P and $M_D/P = kY$

where :

k = I/V
M = Nominal money supply
M_D = Nominal money demand
M_D/P is referred to as real money demand and M/P is real money supply.

Equilibrium in the money market requires that money supply and money demand be equal.

Money market equilibrium: $M/P = RM_D$

Solow (neoclassical) growth model

Y = AF(L,K)

Where:

Y = Aggregate output
L = Quantity of labor
K = Quantity of capital
A = Technological knowledge or total factor productivity (TFP)

Growth accounting equation

Growth in potential GDP = Growth in technology + W_L(Growth in labor)
+ W_K(Growth in capital)

Growth in per capital potential GDP = Growth in technology
+ W_K(Growth in capital-labor ratio)

Measures of Sustainable Growth

Labor productivity = Real GDP/ Aggregate hours

Potential GDP = Aggregate hours × Labor productivity

This equation can be expressed in terms of growth rates as:

Potential GDP growth rate = Long-term growth rate of labor force + Long-term labor productivity growth rate

Understanding Business Cycles

Unit labor cost (ULC) is calculated as:

ULC = W/O

Where:

O = Output per hour per worker
W = Total labor compensation per hour per worker

Monetary And Fiscal Policy

Required reserve ratio = Required reserves / Total deposits

Money multiplier = 1/ (Reserve requirement)

The Fischer effect states that the nominal interest rate (R_N) reflects the real interest rate (R_R) and the expected rate of inflation (Π^e).

$R_N = R_R + \Pi^e$

The Fiscal Multiplier

Ignoring taxes, the multiplier can also be calculated as:

- 1/(1-MPC) = 1/(1-0.9) = 10

Assuming taxes, the multiplier can also be calculated as:

$$\frac{1}{[1 - MPC(1-t)]}$$

International Trade And Capital Flows

Balance of Payment Components

A country's balance of payments is composed of three main accounts.

- The current account balance largely reflects trade in goods and services.
- The capital account balance mainly consists of capital transfers and net sales of non-produced, non-financial assets.
- The financial account measures net capital flows based on sales and purchases of domestic and foreign financial assets.

Currency Exchange Rates

The real exchange rate may be calculated as:

$$\text{Real exchange rate}_{DC/FC} = S_{DC/FC} \times (P_{FC} / P_{DC})$$

where:
$S_{DC/FC}$ = Nominal spot exchange rate
P_{FC} = Foreign price level quoted in terms of the foreign currency
P_{DC} = Domestic price level quoted in terms of the domestic currency

The forward rate may be calculated as:

$$F_{DC/FC} = \frac{1}{S_{FC/DC}} \times \frac{(1 + r_{DC})}{(1 + r_{FC})} \quad \text{or} \quad F_{DC/FC} = S_{DC/FC} \times \frac{(1 + r_{DC})}{(1 + r_{FC})}$$

This version of the formula is perhaps easiest to remember because it contains the DC term in numerator for all three components: $F_{DC/FC}$, $S_{DC/FC}$ and $(1 + r_{DC})$

Forward rates are sometimes interpreted as expected future spot rates.

$$F_t = S_{t+1}$$

$$\frac{(S_{t+1})}{S} - 1 = \Delta\%S(DC/FC)_{t+1} = \frac{(r_{DC} - r_{FC})}{(1 + r_{FC})}$$

Exchange Rates and the Trade Balance

The Elasticities Approach

Marshall-Lerner condition: $\omega_X \varepsilon_X + \omega_M(\varepsilon_M - 1) > 0$

Where:
ω_X = Share of exports in total trade
ω_M = Share of imports in total trade
ε_X = Price elasticity of demand for exports
ε_M = Price elasticity of demand for imports