

Cambridge AS & A Level · Economics 9708

Economics 9708 formulas and definitions: A2

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The price system and the microeconomy (A Level)

Utility

Marginal utility of the n th unit: $MU_n = TU_n - TU_{n-1}$

Total utility = sum of the marginal utilities of every unit consumed

Average utility = $TU \div$ quantity consumed

MU per dollar of a good = $MU \div$ its price

Equi-marginal principle: $\frac{MU_A}{P_A} = \frac{MU_B}{P_B}$, with all income spent

Equi-marginal principle rearranged: $\frac{MU_A}{MU_B} = \frac{P_A}{P_B}$, or $MU_A \times P_B = MU_B \times P_A$

Market demand at a price = sum of every consumer's quantity demanded at that price

Indifference curves and budget lines

Budget line: $P_X X + P_Y Y = M$, where M is income

Budget line intercepts: at most $\frac{M}{P_X}$ of X, or at most $\frac{M}{P_Y}$ of Y

Slope of the budget line, with X on the horizontal axis: $-\frac{P_X}{P_Y}$ (the opportunity cost of one unit of X in units of Y)

Marginal rate of substitution of X for Y = the gradient of the indifference curve (without the sign) = $\frac{MU_X}{MU_Y}$

Consumer equilibrium: the budget line is tangent to the highest reachable indifference curve, so

$MRS = \frac{P_X}{P_Y}$, equivalent to $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$

Price effect = substitution effect + income effect

Efficiency and market failure

Allocative efficiency (no externalities): $P = MC$, the value of the last unit to consumers equals the cost of making it

Allocative efficiency with externalities: $MSB = MSC$

Productive efficiency for a firm: output at the lowest point of AC, where $MC = AC$

Productive efficiency for an economy: production on the production possibility curve

Marginal social cost: $MSC = MPC + \text{marginal external cost}$

Marginal social benefit: $MSB = MPB + \text{marginal external benefit}$

Welfare loss of an externality

$= \frac{1}{2} \times (\text{market output} - \text{efficient output}) \times (\text{gap between MSC and MSB at the market output})$

Profit maximisation: $MR = MC$ (perfect competition long run: $P = MR = MC = \text{minimum AC}$)

Private costs and benefits, externalities and social costs and benefits

Social cost: $SC = PC + EC$

Social benefit: $SB = PB + EB$

Marginal social cost: $MSC = MPC + MEC$

Marginal social benefit: $MSB = MPB + MEB$

Marginal value from totals: marginal cost (or benefit) of a unit = change in the total when that unit is added

Free-market output: $MPB = MPC$ (demand meets supply)

Socially optimal (allocatively efficient) output: $MSB = MSC$

Marginal external cost at the free-market output: the vertical gap $MSC - MPC$ at Q_1

Deadweight welfare loss $= \frac{1}{2} \times |Q_1 - Q^*| \times (\text{gap between MSC and MSB at } Q_1)$

Net social benefit $= SB - SC$; cost-benefit rule: go ahead if $SB > SC$

Types of cost, revenue and profit, short-run and long-run production

Average product: $AP = \frac{TP}{L}$

Marginal product: $MP = \frac{\Delta TP}{\Delta L}$

Total cost: $TC = TFC + TVC$

Average fixed cost: $AFC = \frac{TFC}{Q}$

Average variable cost: $AVC = \frac{TVC}{Q}$

$$\text{Average total cost: } ATC = \frac{TC}{Q} = AFC + AVC$$

$$\text{Marginal cost: } MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q}$$

$$\text{Cost-product link with one variable factor at wage } W: MC = \frac{W}{MP}, AVC = \frac{W}{AP}$$

$$\text{Total revenue: } TR = P \times Q$$

$$\text{Average revenue: } AR = \frac{TR}{Q} = P$$

$$\text{Marginal revenue: } MR = \frac{\Delta TR}{\Delta Q}; \text{ for a price taker } MR = AR = P$$

$$\text{Supernormal (or subnormal) profit} = TR - TC = (AR - ATC) \times Q$$

$$\text{Normal profit: } TR = TC, \text{ that is } AR = ATC$$

$$\text{Profit-maximising output: } MC = MR$$

$$\text{Short-run shutdown rule: produce only if } P \geq AVC \text{ (} TR \geq TVC \text{); long run: stay only if } P \geq ATC$$

Different market structures

$$\text{Profit maximisation in every structure: } MC = MR \text{ (MC rising)}$$

$$\text{Perfect competition: } P = AR = MR; \text{ long run } P = MC = \text{minimum AC}$$

$$\text{Supernormal profit} = (AR - AC) \times Q; \text{ normal profit when } AR = AC$$

$$\text{Short-run shutdown price} = \text{lowest AVC}; \text{ long-run shutdown price} = \text{lowest AC}$$

$$\text{Perfectly competitive firm's supply curve: MC above the lowest AVC}$$

$$\text{Monopolistic competition, long run: } AR = AC \text{ (tangency) at the output where } MC = MR$$

$$\text{Allocative efficiency: } P = MC; \text{ productive efficiency: output at lowest AC}$$

$$\text{Natural monopoly: } MC < AC \text{ at every output; } P = MC \text{ gives a loss, } P = AC \text{ gives normal profit}$$

$$n\text{-firm concentration ratio} = \text{sum of the market shares of the } n \text{ largest firms}$$

Growth and survival of firms

$$\text{Profit maximisation: } MC = MR; \text{ revenue maximisation: } MR = 0; \text{ sales maximisation (normal profit): } AR = AC$$

$$\text{Supernormal profit} = (AR - AC) \times Q$$

$$\text{Merger cost saving} = (AC \text{ before} - AC \text{ after}) \times Q$$

$$\text{Percentage change} = \frac{\text{new} - \text{old}}{\text{old}} \times 100$$

$$\text{Extra profit from cheating on a cartel quota} = \text{area between the cartel price and MC, from the quota to the output where } MC = P$$

Differing objectives and policies of firms

Profit maximisation: $MC = MR$ (with MC rising through MR)

Revenue maximisation: $MR = 0$, where $PED = -1$

Sales maximisation (normal profit): $AR = AC$

Total revenue = $P \times Q$; profit = $TR - TC = (AR - AC) \times Q$

A straight-line demand $P = a - bQ$ has $MR = a - 2bQ$

$PED = \frac{\% \Delta Q}{\% \Delta P}$; elastic: TR moves the opposite way to price; inelastic: the same way

The change in TR between two outputs is the area under MR between them

Third-degree price discrimination: $MR_A = MR_B = MC$; the market with the less elastic demand pays the higher price

Government microeconomic intervention (A Level)

Government policies to achieve efficient resource allocation and correct market failure

Allocative efficiency: $MSB = MSC$; with no externalities, $P = MC$

Corrective (Pigouvian) tax per unit = marginal external cost at the optimum output

Corrective subsidy per unit = marginal external benefit at the optimum output

Tax revenue = tax per unit $\times$ quantity sold after the tax

Cost of a subsidy = subsidy per unit $\times$ quantity sold after the subsidy

Welfare loss removed = $\frac{1}{2} \times |Q_1 - Q^*| \times (\text{gap between social cost and social benefit at } Q_1)$

Percentage change in quantity = $PED \times$ percentage change in price

Monopoly profit maximum: $MR = MC$; welfare maximum: $P = AR = MC$; break-even: $P = AC$

Firm's cost of polluting with permits = permits needed $\times$ permit price; cut pollution while cutting a tonne costs less than a permit

Equity and redistribution of income and wealth

Gini coefficient = $\frac{A}{A + B}$, from 0 (perfect equality) to 1 (perfect inequality); a rise means more inequality

Effective marginal tax rate = marginal income tax rate + other deductions rate + benefit withdrawal rate

Extra net income kept = extra gross earnings $\times (1 - EMTR)$

Negative income tax, income Y below threshold T : payment = $t \times (T - Y)$; above T : tax = $t \times (Y - T)$

Disposable income = original (gross) income – direct taxes + cash benefits

Final income = disposable income – indirect taxes + benefits in kind (free education, health care)

Relative poverty line = chosen fraction (often 60% or 50%) $\times$ median income

Progressive tax: share of income paid rises with income; regressive: falls; proportional: constant

Labour market forces and government intervention

$MRP = MPP \times MR$; in a perfectly competitive product market $MRP = MPP \times P$

MPP of the n th worker = total product with n workers – total product with $n - 1$

Profit-maximising employment: $MRP = MCL$; in a perfect labour market $MCL = ACL = W$, so $MRP = W$

Marginal cost of labour = new total wage bill – old total wage bill

Monopsony: employ where $MCL = MRP$; pay the wage on the supply (= ACL) curve

Linear supply $W = a + bL$ gives $MCL = a + 2bL$

Transfer earnings = area under the supply curve up to employment; economic rent = total earnings – transfer earnings

One worker: transfer earnings = least pay that keeps them in the job; economic rent = pay – that minimum

Unemployment from a wage floor = quantity supplied – quantity demanded at that wage

Elasticity of demand for labour = $\frac{\% \text{ change in labour demanded}}{\% \text{ change in the wage}}$

The macroeconomy (A Level)

The circular flow of income

Aggregate demand: $AD = C + I + G + (X - M)$

Consumption function $C = a + bY$: a is autonomous consumption, b is the MPC

$APC = \frac{C}{Y}$, $APS = \frac{S}{Y}$, $APM = \frac{M}{Y}$, $ART = \frac{T}{Y}$

$MPC = \frac{\Delta C}{\Delta Y}$, $MPS = \frac{\Delta S}{\Delta Y}$, $MPM = \frac{\Delta M}{\Delta Y}$, $MRT = \frac{\Delta T}{\Delta Y}$

Income only consumed or saved: $APC + APS = 1$ and $MPC + MPS = 1$

Multiplier, closed economy without government: $k = \frac{1}{1 - MPC} = \frac{1}{MPS}$

Multiplier, closed economy with government: $k = \frac{1}{MPS + MRT}$

Multiplier, open economy with government: $k = \frac{1}{MPS + MRT + MPM}$

Change in national income: $\Delta Y = k \times \Delta J$ (or $\times$ the change in any autonomous spending)

Equilibrium national income: $Y = C + I + G + (X - M)$, or withdrawals = injections,
 $S + T + M = I + G + X$

Deflationary or inflationary gap = full employment income – AD at full employment income (positive: deflationary; negative: inflationary)

Change in injections needed to reach full employment = $\frac{\text{full employment income} - \text{equilibrium income}}{k}$

Accelerator: net investment = capital-output ratio $\times$ change in output

Economic growth and sustainability

Output gap = actual output – potential output (negative: spare capacity; positive: over-used capacity)

Output gap as a percentage = $\frac{\text{actual} - \text{potential}}{\text{potential}} \times 100$

Recession: real GDP falls for two or more consecutive quarters

Real growth $\approx$ nominal growth – inflation

Growth of real GDP per head $\approx$ real growth – population growth

Real GDP = nominal GDP $\times \frac{100}{\text{price index}}$

Automatic stabilisers: progressive taxes and means-tested benefits; in a downturn tax revenue falls, benefit spending rises and the budget deficit widens

Employment/unemployment

Labour force = employed + unemployed (the economically active)

Unemployment rate = $\frac{\text{unemployed}}{\text{labour force}} \times 100$

Employment rate = $\frac{\text{employed}}{\text{working-age population}} \times 100$

Participation rate = $\frac{\text{labour force}}{\text{working-age population}} \times 100$; inactivity rate = $100 - \text{participation rate}$

Change in percentage points = new rate – old rate; percentage change = $\frac{\text{new} - \text{old}}{\text{old}} \times 100$

Natural (equilibrium) unemployment = labour force – workers willing to accept a job, at the equilibrium real wage

Multiplier $k = \frac{1}{\text{marginal propensity to withdraw}}$; change in income = $k \times \text{change in injections}$

Money and banking

Quantity theory: $MV = PT$ (M money supply, V velocity of circulation, P price level, T volume of transactions)

With V and T constant, P changes in proportion to M

% change in $P \approx$ % change in M + % change in V – % change in T

Bank credit multiplier = $\frac{1}{\text{reserve ratio}}$; maximum change in deposits = new deposit $\times$ multiplier

Reserve ratio = $\frac{\text{cash and balances at the central bank}}{\text{deposits}}$

Capital ratio = $\frac{\text{bank capital (equity)}}{\text{risk-weighted assets}}$

Keynesian demand for money: $L = L_1(Y) + L_2(r)$; L_1 transactions and precautionary (income), L_2 speculative (interest rate)

Bond yield = $\frac{\text{fixed annual payment}}{\text{bond price}} \times 100$: bond prices and interest rates move in opposite directions

Government macroeconomic intervention (A Level)

Government macroeconomic policy objectives

The seven macroeconomic objectives: low stable inflation, a sustainable balance of payments, low unemployment, sustained growth, development, sustainability, a fairer distribution of income and wealth

Growth of real GDP per head = $\left(\frac{1+g}{1+n} - 1 \right) \times 100 \approx$ real GDP growth – population growth (%)

Current account balance as % of GDP = $\frac{\text{current account balance}}{\text{GDP}} \times 100$

With spare capacity, a rise in AD raises output and employment with little inflation; near full capacity it mostly raises prices

Expansionary policy: more growth and jobs, but risks inflation and a bigger current account deficit

Contractionary policy: lower inflation and a smaller current account deficit, but less growth and fewer jobs

Supply-side policy shifts LRAS right: growth, jobs and stable prices together, but slowly

Links between macroeconomic problems and their interrelatedness

Internal value of money = what money buys at home; inflation is a fall in it. % change = $\left(\frac{P_{\text{old}}}{P_{\text{new}}} - 1 \right) \times 100$

External value of money = the exchange rate (foreign currency per unit of home currency)

Faster inflation than abroad $\rightarrow$ exports less competitive $\rightarrow$ current account worse $\rightarrow$ currency depreciates (floating rate)

A fall in the exchange rate $\rightarrow$ dearer imports (cost-push) and more net exports (demand-pull) $\rightarrow$ higher inflation

Change in imports = marginal propensity to import $\times$ change in income

Direct effect of dearer imports on the price index $\approx$ share of imports in the basket $\times$ % rise in import prices

Traditional Phillips curve: inflation rate (vertical) against unemployment rate (horizontal), sloping down: a short-run trade-off

Expectations-augmented: inflation = expected inflation + a short-run effect that is positive when unemployment is below the natural rate

Long-run Phillips curve: vertical at the natural rate of unemployment (NAIRU); holding unemployment below it means accelerating inflation

Demand-led growth near capacity $\rightarrow$ inflation and a bigger current account deficit; supply-led growth $\rightarrow$ growth with lower inflation

Effectiveness of policy options to meet all macroeconomic objectives

Multiplier $k = \frac{1}{MPW} = \frac{1}{MPS + MPT + MPM}$; with no government or trade, $k = \frac{1}{1 - MPC}$

Change in national income = $k \times$ change in injections

Net injection after crowding out = extra government spending – private investment crowded out

Debt (or deficit) as % of GDP = $\frac{\text{debt (or deficit)}}{\text{GDP}} \times 100$

Tax revenue = tax rate $\times$ tax base; Laffer curve: revenue rises with the rate up to a peak, then falls

Percentage change = $\frac{\text{new} - \text{old}}{\text{old}} \times 100$

Marshall–Lerner condition: a devaluation improves the current account if PED for exports + PED for imports > 1 (ignoring signs)

Demand-side policy moves output and the price level in the same direction; supply-side policy raises output and lowers the price level

International economic issues (A Level)

Policies to correct disequilibrium in the balance of payments

Current account + capital account + financial account + net errors and omissions = 0

Change in imports = MPM $\times$ change in national income ($\Delta M = \text{MPM} \times \Delta Y$)

Fall in national income needed to cut imports by ΔM through expenditure-reducing policy = $\frac{\Delta M}{\text{MPM}}$

Import spending (current account debit) = price paid to foreign sellers $\times$ quantity imported; a tariff goes to the home government and is not part of it

Tariff revenue = tariff per unit $\times$ quantity imported after the tariff

Marshall–Lerner condition: a fall in the exchange rate improves the current account if PED for exports + PED for imports (ignoring signs) > 1

$$\% \text{ change in quantity demanded} = \text{PED} \times \% \text{ change in price}$$

Exchange rates

$$\text{Real exchange rate} = \text{nominal exchange rate} \times \frac{\text{home price index}}{\text{foreign price index}}; \text{ a rise means home goods are less price competitive}$$

$$\% \text{ change in a trade-weighted exchange rate} = \sum (\text{trade weight} \times \% \text{ change against each currency}), \text{ with the weights adding to 1}$$

$$\text{Reserves needed to hold a fixed rate} = \text{excess supply of the home currency at the fixed rate} \times \text{the fixed rate}$$

Marshall–Lerner condition: a fall in the exchange rate improves the current account if $\text{PED for exports} + \text{PED for imports (ignoring signs)} > 1$; a rise then worsens it

$$\text{Export revenue in home currency after a depreciation} = \text{old revenue} \times (1 + \text{PED}_X \times f), \text{ where } f \text{ is the fall in the foreign-currency price of exports as a decimal}$$

$$\text{Import spending in home currency after a depreciation} = \text{old spending} \times (1 + r)(1 - \text{PED}_M \times r), \text{ where } r \text{ is the rise in the home-currency price of imports as a decimal}$$

Economic development

$$\text{GNI} = \text{GDP} + \text{net primary income from abroad}$$

$$\text{NNI} = \text{GNI} - \text{depreciation (capital consumption)}$$

$$\text{GDP at factor cost} = \text{GDP at market prices} - \text{indirect taxes} + \text{subsidies}$$

$$\text{Income per head} = \frac{\text{national income}}{\text{population}}$$

$$\% \Delta \text{ real income per head} \approx \% \Delta \text{ money income} - \text{inflation rate} - \% \Delta \text{ population}$$

$$\text{Exact real income per head growth} = \frac{1 + g}{(1 + \pi)(1 + n)} - 1, \text{ with } g \text{ money income growth, } \pi \text{ inflation, } n \text{ population growth (as decimals)}$$

$$\text{PPP rate} = \frac{\text{cost of a basket in local currency}}{\text{cost of the same basket in US dollars}}$$

HDI: life expectancy at birth; mean and expected years of schooling; GNI per head at PPP; scale 0 to 1

$$\text{MEW} = \text{GNP} + \text{leisure} + \text{unpaid work} - \text{regrettable necessities} - \text{environmental damage}$$

$$\text{MPI} = H \times A \text{ (share of people poor} \times \text{average intensity of their deprivation); poor if weighted deprivations} \geq \frac{1}{3}$$

Kuznets curve: inequality (vertical) against income per head (horizontal), an inverted U

Characteristics of countries at different levels of development

$$\text{Crude birth rate} = \frac{\text{live births in a year}}{\text{population}} \times 1000$$

$$\text{Crude death rate} = \frac{\text{deaths in a year}}{\text{population}} \times 1000$$

$$\text{Infant mortality rate} = \frac{\text{deaths of babies under one year old}}{\text{live births in the year}} \times 1000$$

$$\text{Net migration rate} = \frac{\text{immigrants} - \text{emigrants}}{\text{population}} \times 1000$$

$$\text{Population growth (\%)} = \frac{\text{birth rate} - \text{death rate} + \text{net migration rate}}{10}, \text{ with all three rates per 1000}$$

$$\text{Dependency ratio} = \frac{\text{people aged 0–14} + \text{people aged 65 and over}}{\text{people aged 15–64}} \times 100$$

$$\text{Level of urbanisation (\%)} = \frac{\text{urban population}}{\text{total population}} \times 100$$

Optimum population: the population at which real output per head is at its maximum, given resources, capital and technology

Gini coefficient = $\frac{A}{A+B}$: A is the area between the line of perfect equality and the Lorenz curve, B the area below the Lorenz curve; 0 is perfect equality, 1 perfect inequality

Gini coefficient = $2A$ when both Lorenz axes run from 0 to 1 (the triangle under the diagonal has area $\frac{1}{2}$)

Area under a Lorenz curve from fifths: $B = \sum 0.2 \times \frac{L_{\text{left}} + L_{\text{right}}}{2}$, with L the cumulative income share as a decimal

Relationship between countries at different levels of development

Aid: a transfer from a government or official institution on better than market terms (grants, soft loans, goods, skills); NGO money, FDI and portfolio investment are not official aid

Tied aid: aid that must be spent on goods or services from a named source, usually the donor

Bilateral aid: from one government to another; multilateral aid: through an international body funded by many governments

MNC: a firm that owns or controls production in more than one country

FDI: investment by a firm to set up, buy or expand a business it controls in another country

Debt service = interest payments + repayments of principal

$$\text{Debt service ratio} = \frac{\text{debt service}}{\text{export earnings}} \times 100$$

Local-currency cost of a foreign debt payment = payment in foreign currency $\times$ exchange rate (local currency per unit of foreign currency)

A loan-financed project adds to income only if its rate of return $>$ the interest rate

FDI in the balance of payments: capital inflow is a financial account credit; repatriated profits are a primary income debit

Globalisation

Globalisation: growing integration and interdependence of national economies through freer cross-border flows of goods, services, capital, labour, technology and information

Free trade area: no tariffs or quotas between members; each member sets its own tariffs on non-members

Customs union: free trade between members plus a common external tariff on non-members

Monetary union: members share a single currency, one central bank and one monetary policy

Full economic union: single market and single currency plus harmonised fiscal and other economic policies

Trade creation: higher-cost domestic output replaced by lower-cost imports from a partner (welfare rises)

Trade diversion: imports switched from a lower-cost non-member to a higher-cost member (welfare falls)

Imports at a price = quantity demanded – domestic quantity supplied at that price

Tariff revenue = tariff per unit $\times$ imports from outside the bloc

Net welfare effect of joining a bloc = production triangle + consumption triangle – trade diversion rectangle

Trade diversion loss = (partner's price – world price) $\times$ quantity once imported from outside
