Key Equations

	"_ _" denotes subscript (eg. P_{t+1}/P_t)
Production and Prices	
Production Function	production depends on the inputs of capital, labour and technology factor $Y = F(K, E N)$ **Y** = production **K** = capital **N** = labour **E** = technology factor
Cobb-Douglas Production Function	$Y = K^{\alpha} (E N)^{1-\alpha}$
Marginal Product of Labour	take derivatice of $Y = K^{\alpha} (E N)^{1-\alpha}$ with respect to N $MPL = (1 - \alpha) E^{1-\alpha} (K/N)^{\alpha}$
Monopoloistc Competition Price	$P = (1+ \mu) MC$ **μ** = mark-up
Marginal Cost	$MC = W/MPL$
Marginal Cost in term of Cobb-D-ouglas	$MPL = K^{\alpha} (1 - \alpha) E^{1-\alpha} N^{\alpha} = (1 - \alpha) Y/N$ and thus $WN/PY = 1-\alpha/1+\mu$
Real Interest Rate, Investment, and Consumption	
Inflation	rate of growth of price level $\pi_t = \Delta P_t/P_{t-1}$ One plus real interest rate is the price of goods today divided by the discounted price of goods next year $1 + r_{t+1} = P-t/(P_{t+1}/(1+i_t)) = 1+i_t/(P_{t+1}/P_t) = 1+i_t/1+\pi_{t+1}$ or $r_{t+1} \approx i_t - \pi_{t+1}$
Firm Investment	to increase capital stock and replace depreciated capital $I_t = K^d_{t+1} - K_t + \delta K_t$ K^d_{t+1} = desired capital stock next year **δ** = depricitation
Profit Maximising Investment Level	the real marginal revenue product minus depreciation is equal to the real interest rate $MPK/I+\mu - \delta = r$

Key Equations (cont)

Investment Function	investment depends on real interest rate, expected future income and the existing capital stock at the beginning of the period $I = I(r, Y^e, K)$ **r** = real interest rate **Y^e** = expected future income **K** = existing capital stock at beginning of period
Utility-maximising Consumption/Savings Decision	ratio of marginal utility of consuming today divided by discounted marginal utility next year is equal to one plus the real interest rate $u'(C_t)/u'(C_{t+1})/(1+\rho) = 1 + r_{t+1}$ **ρ** = subjective discount rate
Real Disposable Income	production minus tax payments plus the real interest rate on net claims on government and foreign households and firms $Y^d = Y - T + r(D + F)$
Consumption Function	consumption depends on income today, future expected income, the real interest rate and level of assests $C = C(Y^d, Y^e - T^e, r, A)$
Long-run Growth	
Constant returns to scale	production per effective worker depends on the capital stock per effective worker $Y/EN = F(K/EN', 1) = f(k)$ where $k = K/EN'$
Steady State Growth Path	capital stock per effective worker is determined by $f'(k^*)/1+\mu - \delta = r$
Constant Capital per Effective Worker on Steady State Growth Path	capital stock and production grow at same rate as the effective number of workers $K = k^*EN$, $Y = f(k^*)EN$ $\Delta K/K = \Delta Y/Y = g+n$
Long Run Level of Real Interest Rate (closed econ)	is equal to the subjective discount rate plus the technological growth rate $r \approx \rho + g$
The Labour Market and Phillips Curve	
Unemployment Rate	fraction of labour force not employed $u = U/L = L-N/L$

Key Equations (cont)

Wage-setting Equation	if unemployment is above natural level, firms want to raise wages less than the average wage increase, and conversely $\Delta W^d_t/W_{t-1} = \Delta W_t/W_{t-1} - b(u_t - u^n_t)$
Unemployment on Natural Level	in the long run desired wages must be equal to actual wage increases, so unemployment must be on a natural level $N^n = (1 - u^n)L$
Phillips Curve	assuming that a share 1- λ of wages is set in advance $\Delta W/W = \Delta W^e/W - b_c (u - u^n)$; $b_c = \lambda b/1-\lambda$
Rate of Wage Increase (short run)	depends on the expected wage increase and unemployment short-run analysis disregard capital, so inflation is the rate of wage increase minus productivity growth $\pi = \Delta W/W - \Delta E/E$
Phillips Curve (inflaation)	relates inflation to expected inflation, the output gap and a cost-push shock {{nl}} $\pi = \pi^e + \beta Y_c + z$ π^e = expected inflation Y_c = output gap - has a circumflex z = cost-push shock

Government Debt

Change in Real Government Debt	equal to the primary deficit plus the real interest rate

General (intro)

Macroeconomics	- production - employment - price increase - interest rates Macroeconomic models
Three Markets	- labour - goods - credit (money)
Three Decision-makers	- typical firm - typical household - policymakers
Monetary Policy	**central banks** - set the interest rate
Fiscal Policy	**government** - decides taxes and government expenditure

General (intro) (cont)

Basic Model Factors	**typical firm** - price-setting - wage-setting - investment **typical consumer** - consumption
Open Economy	trades with the rest of the world
Keynes Theory	nominal wages are 'rigid'/'sticky'
Classical Theory (real business cycle theory)	wages and prices are adjustable to equate supply and demand marets
Neoclassical Synthesis	even if wages and prices are sticky in the short run, we expect them to respond to changes in economic conditions over the long run
National Accounts	- flows of production, incomes, savings and investments in a period of time (year/quater)
Balance of Payements Statistics	- flow of payments connected to exports, imports, international transfers, capital flows
Value of Production (output)	sales of all firms and value of production in public sector added **output not a good measure as large share of output is used as input in other firms**
Intermediate Goods	goods that are used as inputs in other firms
Value Added	subtract value of intermediate inputs from value of output

The Open Economy Long Run (Ch13)

Real Exchange Rate	price level in an open economy relative to the price level abroad, where price levels are converted to the same currency determinant of aggregate demand in the open country
Real Exchange Rate	price level of domestic goods relative to foreign goods $\varepsilon = eP/P^*$ **P** = price of good production at home in domestic currency **P*** = price of good produced abroad in foreign currency ***e*** = nominal exchange rate - price of domestic currency in terms of foreign currency ε = real exchange rate - price of domestically produced goods in terms of goods produced abroad

The Open Economy Long Run (Ch13) (cont)	
Current Account	difference between savings and real investments in the country deficit = borrowing from abroad government/private sector/both borrowing to finance consumption and real investments in excess of income
(open) Interest Parity Condition	links interest rate differentials between countries to expected changes in exchange rate
Interest Parity Condition	for foreign lenders, the expected returns on loans in the currency of the small open economy must be the same as the expected return or loans in the foreign currency $i + \Delta e^e/e = i^*$ **left** = interest rate in small open economy plus expected appreciation of currency **right** = return on loans in foreign currency
Long-run Analysis	- analyse the effects of changes in exogenous variables - assume that prices and wages have time to adjust, employment and production at natural levels - assume international financial markets are completely integrated, free flow of financial capital and interest parity condition holds
Real Interest Rate	determines real cost of borrowing and required return on investment - open economy it is tied to real in the world financial market - independent of savings and investment in the small open economy - adjusts in long run to bring equality between aggregate demand and natural level of production
Nominal Exchange Rate	$e=\varepsilon P^*/P$
Constant Real Exchange Rate	relative change in the nominal exchange rate is equal to foreign inflation minus domestic inflation $\Delta e/e = \pi^*-\pi$ $r=r^*$

The Open Economy Long Run (Ch13) (cont)

Long Run Trends in Nominal Exchange rates	shown by $\Delta e/e = \pi^* - \pi$ - inflation differentials between countries high inflation = depreciating nominal exchange rate high inflation for number of years = constant nominal exchange rate - exporters will find hard so must depreciate at some point
Long Run Equilibrium	expected change in exchange rate is equal to the actual change $i - \pi = i^* - \pi^*$ **left**= real interest rate in the small open economy **right** = world real interest rate can also be written $i - i^* = \pi - \pi^*$
Nominal Interest Rate	a country with high inflation and depreciating currency must have a higher nominal interest rate to compensate international investors so that the real return is the same on loans in different currencies
Natural Level of Production	$Y^n = F (K, E (1 - u^n) L)$
IS Equation	determines aggregate demand and production in the small open economy $Y = C (Y^d, Y^e - T^e, r^*, A) + I (r^*, Y^e, K) + G + NX (\varepsilon, Y^*, Y)$ **C**= private consumption (units of domestic goods) **NX** = net exports (units of domestic goods) **Y^d** = disposable income **Y^e** = expected future income **r*** = real interest rate **A** = assests **G** = government spending **K** = capital **I** = investment **ε** = real exchange rate **Y*** = **T^e** = where $Y^d = Y^n - T + r^* (D + F)$
Natural Real Exchange Rate (open)	real exchange rate that is consistent with production at natural level ε^n