Macroeconomic Equilibrium in the Short-Run (Chapter 11)
Part I

Equilibrium

Equilibrium by John Buck 1993, Arts for Health Milton Keynes collection

Outline

- Aggregate demand and the goods market
  - determinants of demand
  - q-theory of investmens
- IS Curve
- Monetary policy, TR-curve
- Macroeconomic equilibrium, IS-TR model

Introduction

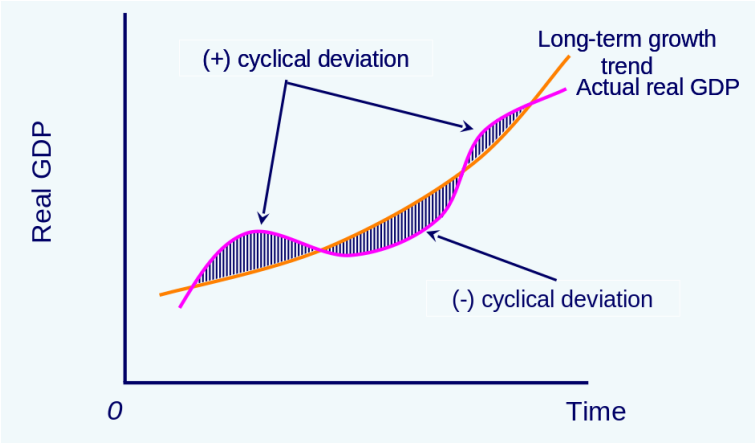
What is short-run in macroeconomics?

- prices rigidities: prices move slowly or not at all (our working assumption, aka Keynesian assumption)
- nominal and real sides of the economy interact
- in practice: 1-2 years
- necessary assumption to explain how money can affect real economy

Short-run approach aims to explain variations around the long run growth path

- one of the primary concerns of macroeconomics
- reactions to policy changes or *shocks*

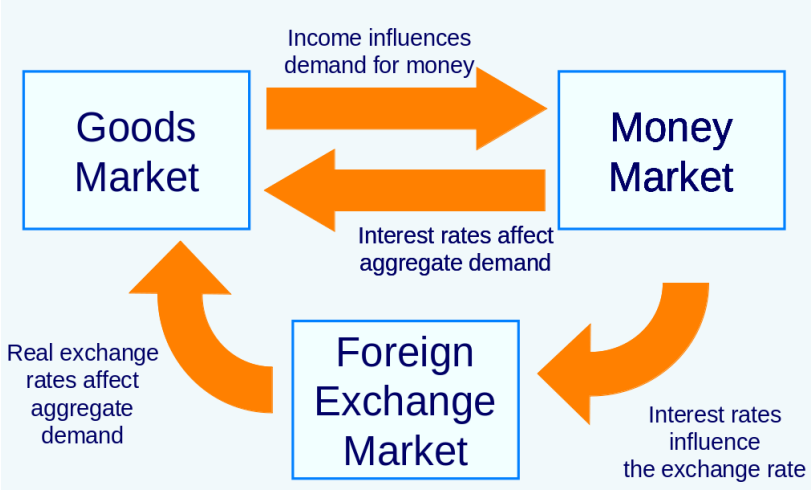
Introduction



Assumptions about Short-Run

1. Prices are constant
   - price rigidities
2. Demand determines supply
   - firms supply the amount that is demanded
   - if excess production, firms accumulate inventories, and if excess demand inventories are run down
   - in practice assumption works better in downturns than in booms
3. International trade but no international capital flows
   - this assumption is relaxed later

Macroeconomic Equilibrium: Open Economy



Aggregate Demand and the Goods Market

GDP decomposition:

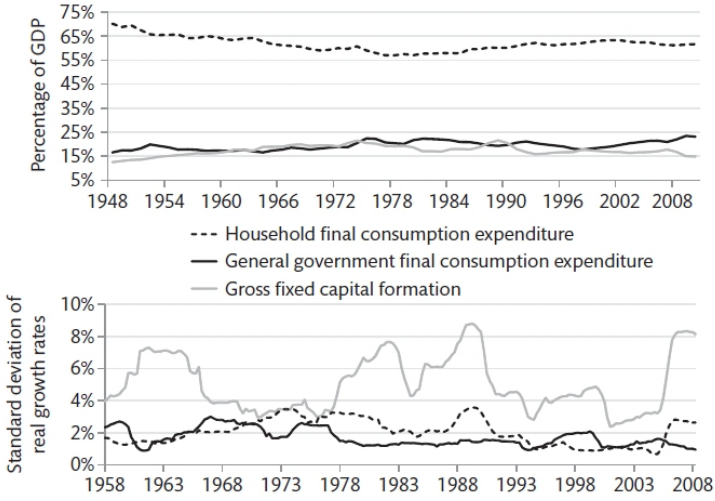
$$Y = C + I + G + (X - Z) \tag{1}$$

- all variables in real terms, consumption C, investment spending by firms I, exports X and imports Z
- RHS: aggregate demand
- LHS: aggregate supply

(1) is a market equilibrium condition

- demand determines supply: demand responds to exogenous shocks and supply adapts to demand

Components of GDP in the UK



Note: Volatility over rolling 21 quarter periods

Price Rigidity

Empirically observed *fact*

- nominal prices are resistant to change
- price stickyness in one sector can spillover to *flexible* sectors

Possible explanations

- menu cost: changing prices is costly
- long-term contracts
- search frictions

Implication: price- and wage setters become forward looking

- expectations affect decisions

Price Rigidity in CPI

Country	Frequency	Mean Price Spell
US	27%	3.7
UK	19%	5.3
Eurozone	15%	6.6
Germany	10%	10
Italy	9%	11.1
France	19%	5.3

Frequency: how many of the firms change prices in one month

Price spell: how many months prices remain the same

Comparison to Long Run

Prices adjust

- if there is over capacity, prices would decrease and vice versa

In the long run, money and prices behave independently of output

- money neutrality or classical dichotomy or neoclassical assumption
- monetary shocks would lead to changes in the nominal prices

Determinants of Demand

Consumption function $C(\underset{+}{\Omega}, \underset{+}{Y} - \bar{T})$

- wealth Ω, private sector tax payments $\bar{T}$

Investment function $I(\underset{+}{q}, \underset{-}{r})$

- Tobin's q= market value of installed capital/replacement cost
- real interest rate r
- can be decomposed into planned investments and inventories

Determinants of Demand

Import function $Z(\underset{+}{A}, \underset{+}{\sigma})$

- absorption $A = C + I + G$ (total domestic spending)
- real exchange rate σ (measures the competitiveness of the economy)

Export function $X(\underset{+}{A^*}, \underset{-}{\sigma})$

- foreign absorption A^*

Net export function $NX(\underset{-}{A}, \underset{+}{A^*}, \underset{-}{\sigma})$

- $X - Z$
- short-cut: $NX(Y, Y^*, \sigma)$ (eliminate absorption)

Nominal and Real Exchange rates

Appreciation (depreciation) of currency

- increase (depreciation) of its value in terms of other currency, exchange rate rises (decreases)

Nominal exchange rate S

- exchange rates are quoted in nominal terms in FX markets
- nominal rates do not tell anything how much one can buy with money

Real exchange rates $\sigma = SP/P^*$

- price index in euro (domestic) area P, US (foreign) price index P^*
- real exchange rates compare price indices, e.g. BigMac index
- example: euro basket worth 100 EUR, dollar basket worth 200 USD, dollar value of european basket is 150 (nominal exhange rate $S = 1.5$), real exchange rate $SP/P^* = 1.5 \times 100/200 = 0.75$

Nominal and Real Exchange rates

Practical concern

- what is a relevant foreign currency?
- no uniform measure
- usual approach: compute "average exchange rate", e.g. weighted geometric average

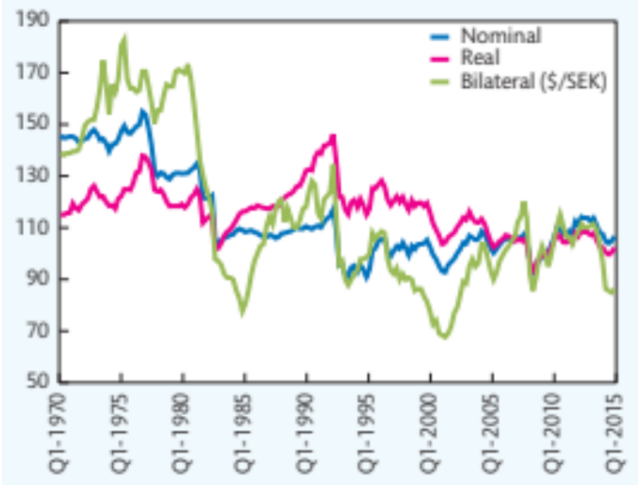
External terms of trade

- ratio of domestically produced exports prices to foreign-produced import prices

Internal terms of trade

- ratio of nontraded to traded goods prices

Swedish Krona 1970–2015



Purchasing Power Parity

Currencies depreciate at the rate of inflation $\Delta S/S = \pi^* - \pi$

- long-run property (note: money neutrality)
- note: π^* taken as exogeneous (foreign inflation)

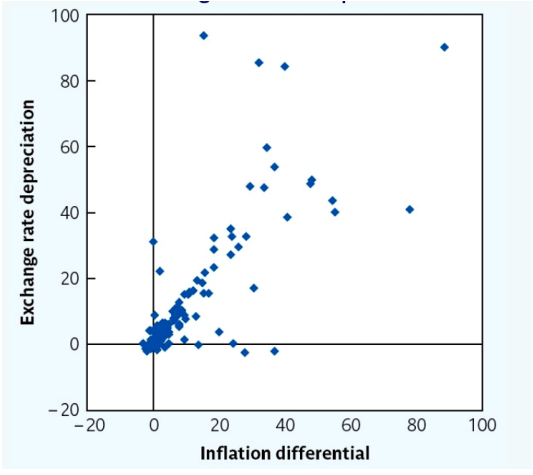
(relative) Purchasing Power Parity $\Delta\sigma/\sigma = 0$

- driving force: arbitrage in goods markets
- in the long run the real exchange rate is constant
- note: $\Delta\sigma/\sigma \approx \Delta S/S + \Delta P/P - \Delta P^*/P^*$

Intuition: assume more expansionary domestic monetary policy than foreign

- if nominal exchange rate is unchanged, the real exchange rate appreciates due to domestic inflation
- domestic goods become more expensive relative to foreign goods
- domestic producers lose *competitiveness*
- nominal exchange rate will depreciate; when it depreciates by $\pi^* - \pi$ the loss in competitiveness is erased

Inflation and Exchange Rate Depreciation 1975–2006



q-Theory of Investment

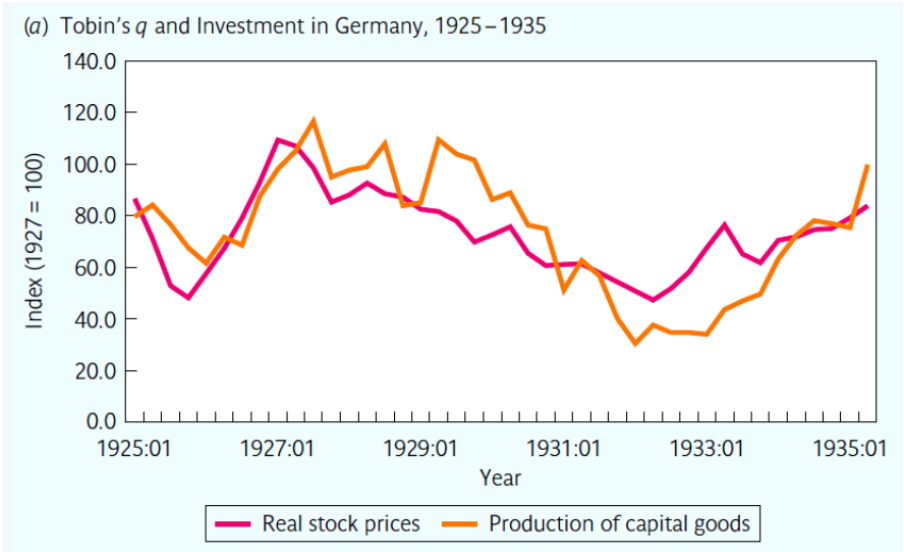
Tobin's q (market value of installed capital/replacement cost)

- market value often equals the value as priced by the stock market
- replacement cost = cost of all installed capital when it is bought from markets
- q reflects expectations on future profits
- higher q ($q > 1$), more attractive to invest, low q ($q < 1$) incentive to disinvest
- $q = 1$ in the long-run
- q-theory links stock markets and the state of the economy

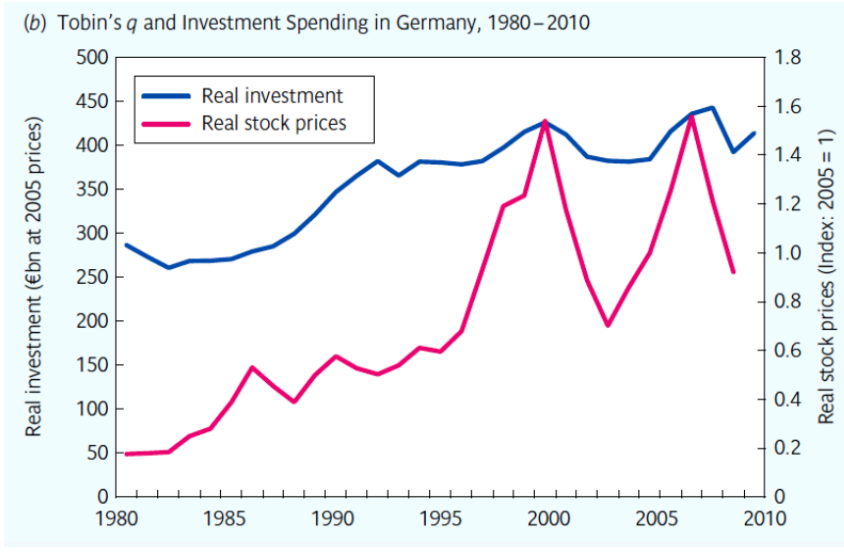
Higher interest rate $\rightarrow$ higher requirement for returns on investments $\rightarrow$ less investments in new capital

- interest rate is used when discounting the future earnings
- note: stock prices predicts investments

Investments in Germany 1925–1935



Investments in Germany 1980–2010



Microfoundations of Tobin's q

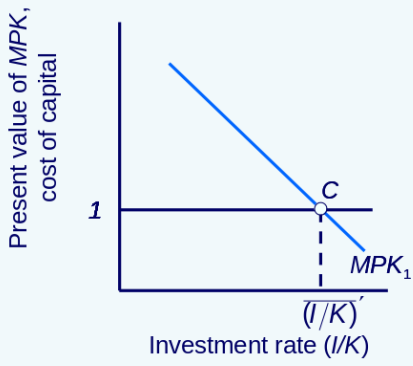
Installation costs

- cost of increasing capacity can be significant
- explanation why $q > 1$ temporarily
- in the absence of installation costs marginal cost of equipment is 1: marginal product of capital=marginal cost of capital, $MPK/(1+r) = 1$ (note: 2 period model)
- with installation costs $MPK/(1+r) = 1+\phi$, where ϕ is the marginal cost of installing capital
- a firm reaches the optimal capital level in small steps and in the process ϕ converges to zero

Approximation: MPK equals the average return on capital

- in this case $q = [MPK/(1+r)]/1$
- return on unit invested $MPK/(1+r)$
- cost of investment 1
- if $MPK/(1+r) = 1+\phi$, then $q > 1$

Tobin's $q = 1$, No Adjustment Costs

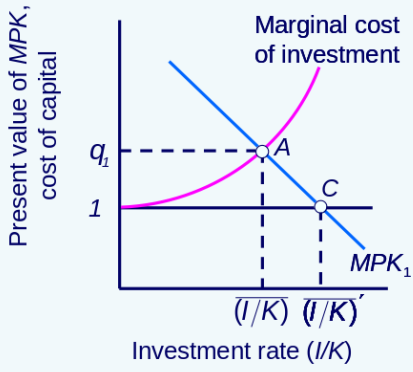


If there were no costs of adjustment, the present value of the marginal cost of capital would be independent of the investment rate.

If there were no depreciation, the investment rate, I/K, = $\Delta K/K$, the rate of change of the capital stock.

MPK=Marginal return of new investment

Tobin's q with Adjustment Costs

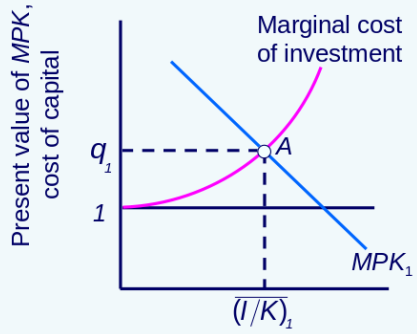


However the faster we try to install new capital, the more it adds to the cost of that capital. "Haste makes waste." Hence the upward slope of the marginal cost of investment with respect to the investment rate.

MPK=Marginal return of new investment

Tobin's q

With the investment rate corresponding to the rate at point *A*, in the following period there will be more capital and a lower *MPK*.



MPK=Marginal return of new investment

Goods Market Equilibrium

Desired demand

$$DD = C(\underset{+}{\Omega}, \underset{+}{Y - \bar{T}}) + I(\underset{+}{q}, \underset{-}{r}) + G + NX(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{\sigma})$$

- note: inventories are 0

Exogenous variables E : r, σ, $\bar{T}$, Ω, q, Y^*

Equilibrium condition:

$$Y = DD(Y, E)$$

- note: in RHS Y is income, in LHS it is production
- desired demand equals supply
- solution is the equilibrium GDP

Keynesian Cross

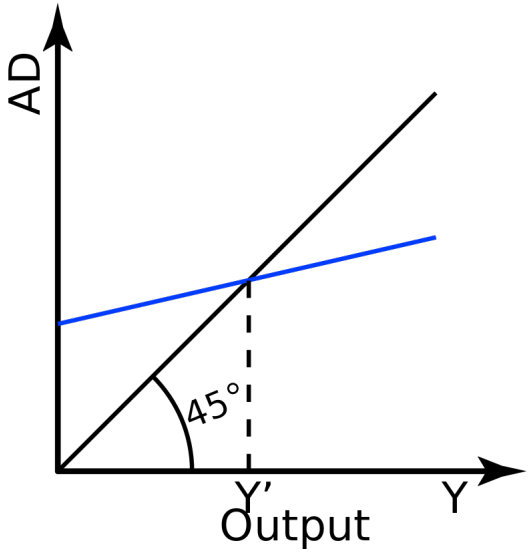
Desired demand as a function of income

- demand of consumers and firms
- line with slope $<$ 45 degrees
- in the short run all demand is satisfied: supply curve is a 45 degrees line

Equilibrium level of income and expenditure is where DD intersects 45 degree line

- the picture is kown as the Keynesian cross

Keynesian Cross



The Role of Inventories

National accounting identity $Y = C + I + G + NX$

Are markets always in equilibrium?

No!

- in national accounting I contains inventories
- inventories may change unplannedly, and in practice they are highly volatile

In equilibrium inventories are 0

On the Equilibrium

How does DD behave?

- if Y increases, C increases and NX decreases (but in absolute terms less than C)
- note: imports are relatively small compared to C
- C increases less than Y; part of income is saved and part goes to imports

There is a unique equilibrium

On the Equilibrium

Equilibrium $\hat{Y}$; $DD(\hat{Y}) = \hat{Y}$

What if $Y' > \hat{Y}$?

- $Y' - \hat{Y} > DD(Y') - DD(\hat{Y})$, but then $DD(Y') < Y'$, i.e., excess supply and there are inventories
- to reduce inventories firms reduce output, Y decreases until equilibrium level is met

What if $Y' < \hat{Y}$?

- now $DD(Y') > Y'$, i.e., excess demand and there are backlogs
- to satisfy demand firms increase output, Y increases until equilibrium level is met

Example

$C = a + c \cdot (Y - \bar{T})$, $NX = -czY$, $c, z \in [0, 1]$

- c is the marginal propensity to consume
- a is sometimes called as the autonomous consumption
- z is the marginal propensity to import

Equilibrium: $Y = a + c \cdot (Y - \bar{T}) + I + G - czY$

- note: I and G exogenous in this example
- $(1 - c + cz)\, Y = a - c\bar{T} + I + G$ which yields $Y = (a - c\bar{T} + I + G)/(1 - c + cz)$

Permanent Income Hypothesis

Consumption depends mostly on expected average income in the future ("permanent income")

- people prefer to smooth their consumption because of diminishing marginal utility

PIH consumption function $C_t = [r/(1+r)]\psi$

- ψ is is the expected discounted value of future income (assuming infinitely lived consumer this would be the same in each period)
- obtained when subjective discount rate= real interest rate
- example: $r = 4\%$, change in consumption when income changes permanently is $c = 0.04/1.04 = 3.8\%$ (marginal propensity to consume)

Empirics

- PIH has some merit, but current income also seems to matter more than this theory would suggest

The Keynesian Multiplier

What happens when G is increased?

- temporarily demand exceeds output, the production adjusts, which causes the demand to increase further (and so on)
- in the end demand has increased more than G
- when the question is on fiscal stumulus, the tax revenues increase as well, and the stimulus it at least partially self financed

Fiscal multiplier

- expresses how much increases in fiscal spending impact economic output
- $\Delta Y / \Delta G$

Obtaining the Keynesian Multiplier

Marginal propensity to consume c

- fraction of income consumed

Marginal propensity to import z

- fraction of consumption spent on imports

First round G increases by ΔG

- income increases by ΔG, consumption increases by $c\Delta G$ of which z goes to imports

Second round: Y increases by $c(1-z)\Delta G$

n'th round: Y increases by $[c(1-z)]^{n-1}\Delta G$

- in total (geometric sum): $\Delta Y = [1/(1-c(1-z))]\Delta G$, where $1/(1-c(1-z))$ is the fiscal multiplier

Fiscal Multiplier Empirically

Hard to measure accurately

Some assessments

- roughly 0.5 in normal growth: crowding out of private spending
- about 0 in booms
- around 1–3 in recessions
- note: different public investments may have different multipliers, different consumer groups have diffent marginal propensities to consume

Keynesian fiscal policy

- stimulate economy when recession
- contractionary fiscal policy in booms
- effectively smoothing business cycles

Crowding Out (or In)

Crowding out effect

- rising public sector spending drives down private sector spending

Reasons

- when the government increases borrowing the real interest rates increase
- it becomes less attractive for firms to invest and consumers to consume
- Ricardian equivalence: consumers expect increasing taxes in the future and save more

Crowding in

- rising public sector spending increases private sector spending
- after GFC, government spending reduced interest rates
- possible in recessions when the private sector has unused savings and government spending creates investment opportunities