SAMENVATTING I

BASIS

WISKUNDIGE ANALYSE: MACRO-ECONOMISCHE PROBLEMEN

ACADEMIEJAAR ’22 - ’23

INHOUDSOPGAVE

SHORT TERM

GOODS MARKET

COMPOSITION OF GDP

= samenstelling BBP

- Consumption C

  Gevoelig aan **conjunctuur (of fluctuatie) = verandering groeipercentage van economie of productie op KORTE termijn**

  - Hoogconjunctuur: groei is bovengemiddeld = expansie
  - Laagconjunctuur: grooi is beneden gemiddeld → krimping van economie = recessie

- Investment I
- Government spending G
- Net export $X - IM$ trade surplus/balance/deficit *zie in IS-LM in open economie*
  - Export X
  - Import IM

DEMAND FOR GOODS

Demand = reflection GDP → $Z = C + I + G + X - IM$

Simplified MODEL:

$$Z = C + \bar{I} + G = c_0 + c_1(Y - T) + \bar{I} + G$$

In a **closed economy** $X = IM = 0$

- Consumption C
  - Disposable income = beschikbaar inkomen = inkomen – betaalde belastingen
    $$Y_D = Y - T$$
  - Gedragsvergelijking: $C = C(Y_D)$ *Y_D beïnvloedt C dus positief*
  - Veronderstel lineaire relatie
    $$C = c_0 + c_1(Y_D) = c_0 + c_1(Y - T)$$

- Investment I: exogeen bepaald ($\bar{I}$)
- Government spending G, taxes T: (exogeen) bepaald door overheid
  DOEL VAN MACRO OM INVLOED VAN DEZE IN TE SCHATTEN & BEPALEN

EQUILIBRIUM OUTPUT

= IS-relatie

DEMAND: $Z = c_0 + c_1(Y - T) + \bar{I} + G$

SUPPLY: $S = Y$

EQUILIBRIUM CONDITION: $Y = c_0 + c_1(Y - \bar{T}) + \bar{I} + \bar{G}$

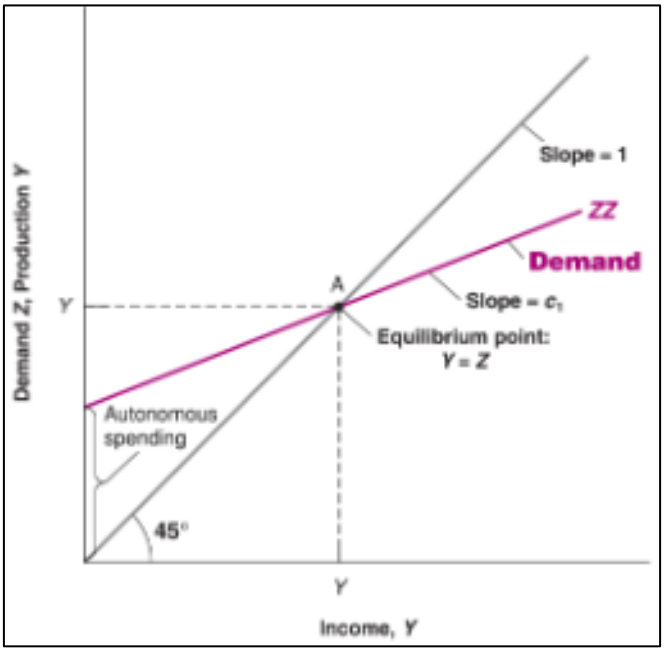
- Algebraic interpretation

$$Y = \frac{1}{(1 - c_1)}(c_0 + \bar{I} + G - c_1 T)$$

  - Autonomous spending $(c_0 + \bar{I} + G - c_1 T)$
    Overheid gebalanceerde uitgaven: $G = T$

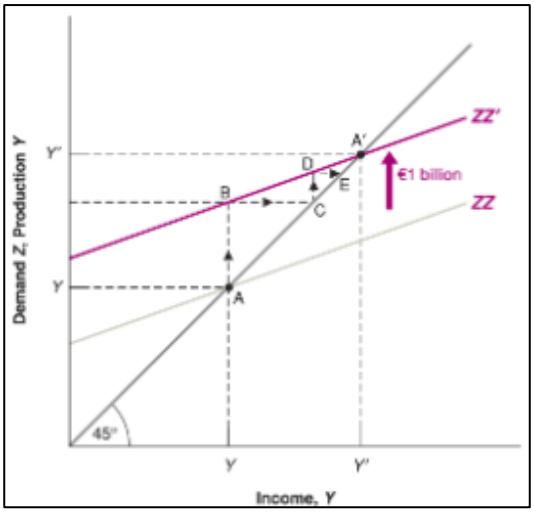
  - Multiplier $m = \frac{1}{1 - c_1}$
    $0 < c_1 < 1 \implies m > 1$ gevolg $(c_0 + \bar{I} + G - c_1 T) \uparrow \Rightarrow Y \uparrow\uparrow$

- Graphical interpretation
  BASISMODEL: $Y = Z$



MULTIPLICATIOR EFFECT:

1. $Y = Z$
2. Schok in autonomous spending $(c_0 + \bar{I} + G - c_1 T) \uparrow$
3. Productie neemt evenredig aan vraag toe $A \rightarrow B$
4. Inkomen neemt evenredig aan productie toe $B \rightarrow C$
5. $Y = Z$
6. Productie neemt evenredig aan vraag toe $C \rightarrow D$
7. Inkomen neemt evenredig aan productie toe $D \rightarrow E$
8. STABILISATIE in nieuw evenwicht A'
   Merk op: $(Y' - Y) > (ZZ' - ZZ)$



Total increase in production after $n + 1$ rounds

$$(ZZ' - ZZ) \cdot (1 + c_1 + c_1^2 + \cdots + c_1^n)$$

In zijn limiet $(n \rightarrow \infty)$ geeft dit $(ZZ' - ZZ) \cdot (\frac{1}{1 - c_1})$

- HOW LONG DOES IT TAKE FOR AN OUTPUT TO ADJUST?

ALTERNATIVE VIEW: INVESTMENT EQUALS SAVING

- Sparen = complement van uitgaven = private saving + public saving
  - Private saving $S = Y_D - C = Y - T - C$
  - Public saving $S = T - G$
    $G > T$ deficit
    $G < T$ surplus
  - Conclusion

$$S = \bar{I} + G - T$$
$$\bar{I} = S + T - G$$

- IS – relation
  Equilibrium in goods market if investment equals saving

- Multiplicator effect?

$$S = Y - T - C$$
$$S = -c_0 + (1 - c_1)(Y - T)$$
$$\Downarrow$$
$$\bar{I} = -c_0 + (1 - c_1)(Y - T) + T - G$$
$$Y = \frac{1}{(1 - c_1)}(c_0 + \bar{I} + G - c_1 T)$$

- **Paradox of saving**
  More savings → less consuming → more income NOT TRUE
  RESULT: decline in output and unchanged saving

FINANCIAL MARKET

DEMAND FOR MONEY

- **Money**: no interest, used for transactions
  - Currency = cash
  - Deposits = lopende rekeningen bij banken
- **Bond** = (overheids)obligatie: interest rate i, not used for transactions

Proportie money ←→ bonds afh transacties en interest rate

Demand = nominal inkomen negatief gecorreleerd met i

$$M^d = Y \cdot L(i)$$

DETERMINING THE INTEREST RATE

Interest rate $\boldsymbol{i} = \frac{P_{t+1} - P_t}{P_t}$ relatieve verandering prijspeil P

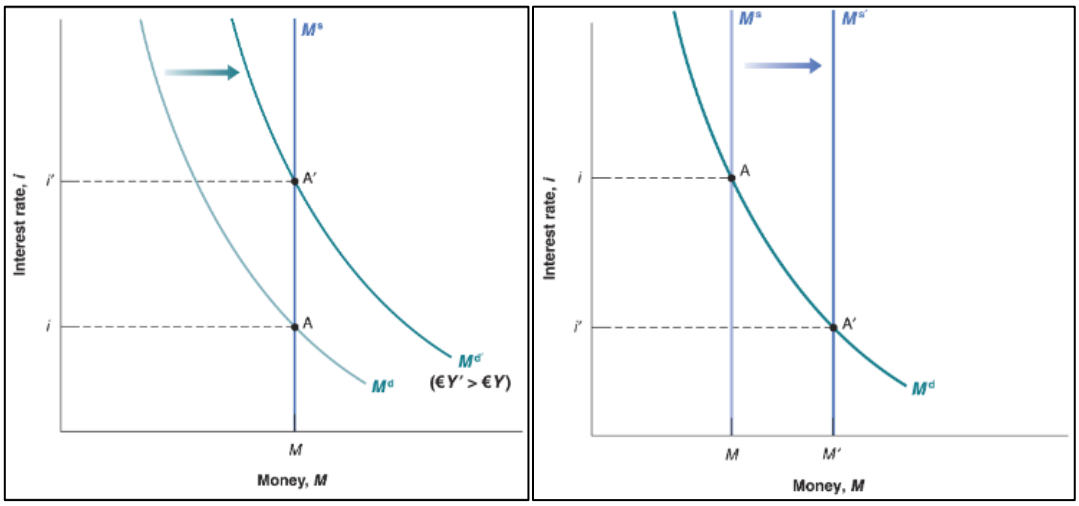
EQUILIBRIUM: MONEY SUPPLY = MONEY DEMAND

= LM-relatie

DEMAND: $Y \cdot L(i)$

SUPPLY: M^s

Schokken in interest:



Interpretatie schokken:

- Change in i increases/decreases demand → movement ALONG curve
- Change in nominal income Y shifts demand → movement OF curve

Change in money stock → open market operations

- CB buys bonds: increase in supply of money → Geld drukken! — expansionary o. m. operation
- CB sells bonds: decrease in supply of money — contractionary o. m. operation

Bonds Prices vs. Interest Rate

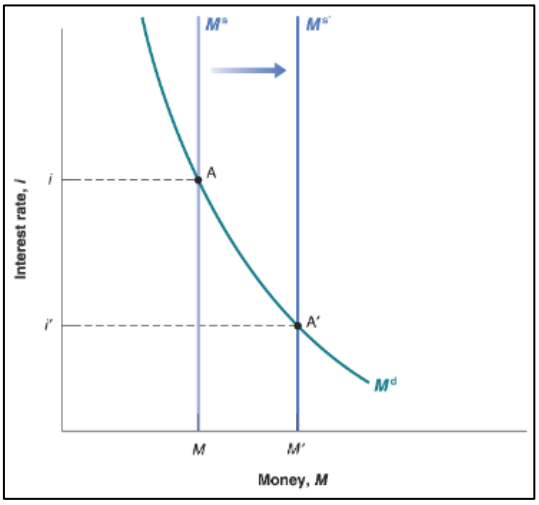
Treasury bill = garante terugbetaling of interest op overheidsobligatie

$$i = \frac{TB - P_B}{P_B}$$

$$P_B = \frac{TB}{1 - i}$$

CB heeft money supply in handen d.m.v kopen of verkopen van staatsobligaties, dit verandert echter het prijspeil van deze obligaties en end us de rente

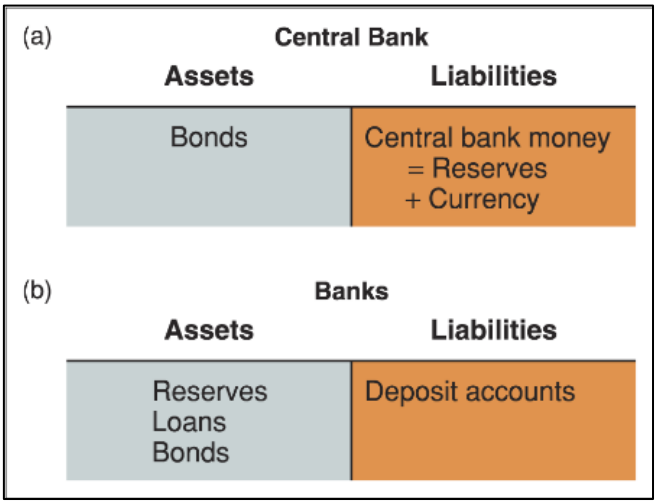
Schokken in money supply:



BANKS

Receive funds → buy bonds, make loans, keep reserves (10%)

Soms central bank money held as reserves by banks



Beslissing consument:

1. Bonds
2. Money
    a. Deposito
    b. Currency

EQUILIBRIUM CENTRAL BANK

SUPPLY = direct control CB H^s

DEMAND = demand currency + demand reserves by banks

- demand currency $CU = cM^d \Leftrightarrow D = (1-c)M^d$
- demand reserves $R = \theta(1-c)M^d = \theta D$
- demand for CB money

$$H^d = \big(c + \theta(1-c)\big) \cdot Y \cdot L(i)$$

TWO ALTERNATIVE WAYS OF LOOKING AT THE EQUILIBRIUM

ALTERNATIVE EQUILIBRIUM CONDITION

EQUILIBRIUM $H - CU = R$

Interest rate is federal funds rate

MONEY MULTIPLIER

EQUILIBRIUM $Y \cdot L(i) = \frac{1}{(c+\theta(1-c))}$

Money multiplier = $1/(c + \theta(1-c))$

IS-LM MODEL

GOODS MARKET AND IS-RELATION

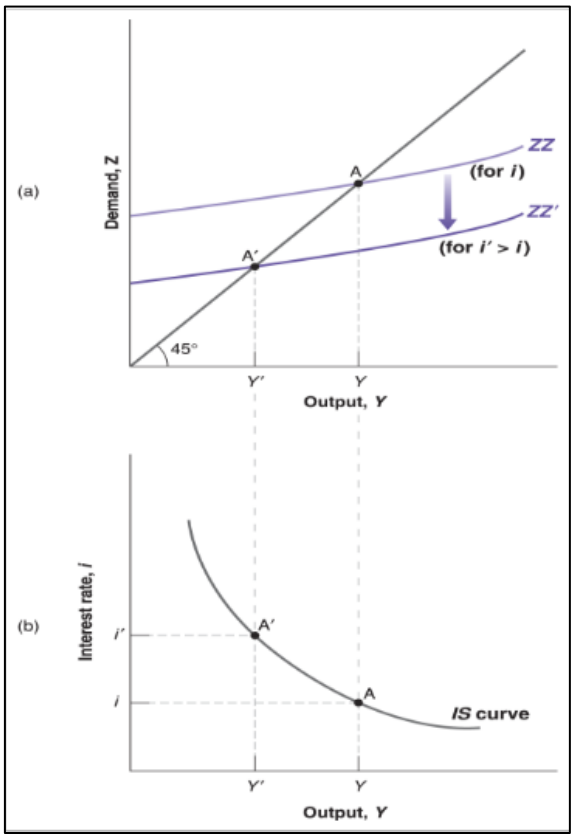
EQUILIBRIUM $Y = C(Y - \bar{T}) + \bar{I} - \bar{G}$

Investment is no longer exogenous, since it depends on the interest rate which fluctuates

$$I = I(Y, i = r)$$

We found a new demand curve: the ZZ-curve

The IS-curve is this ZZ-curve with respect to the interest rate i instead of the demand Z



This is an example of a movement along the IS-curve. When we change some of the fixed variables (taxes) we find a movement of the IS-curve.

FINANCIAL MARKET AND LM-RELATION

EQUILIBRIUM $M = Y \cdot L(i)$

Nominal vs. Real

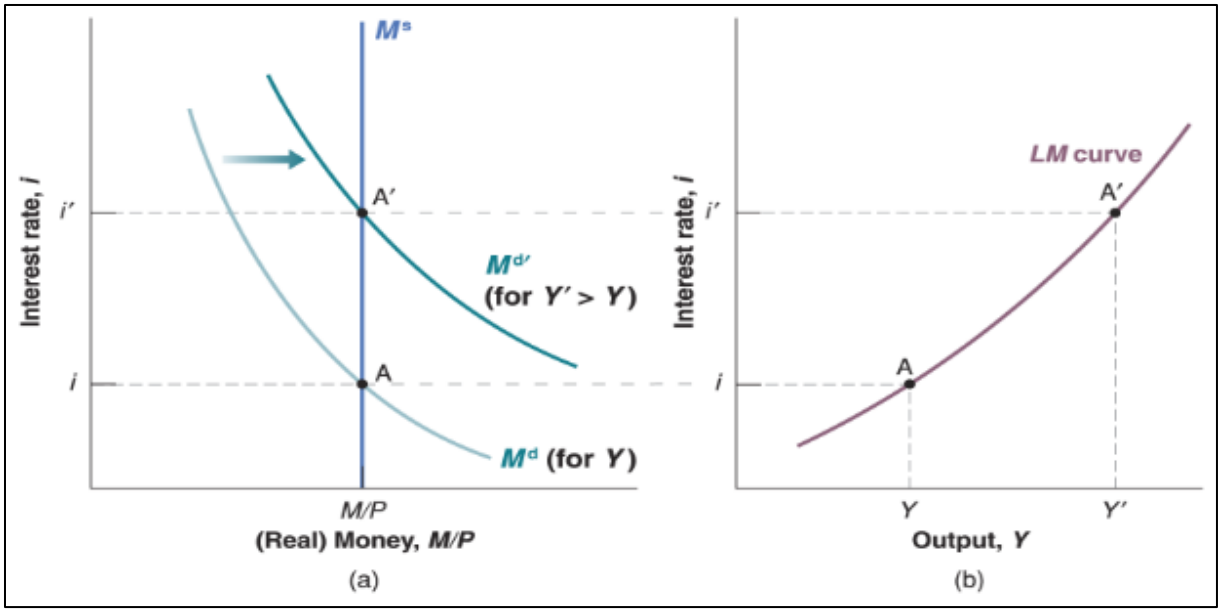
- Nominal income = the exact amount of money you get
- Real income = nominal income divided by the price level zegt iets over KOOPKRACHT

Note: until now we always used money stock and income in nominal terms, from now on we set the standard at real properties and denote nominal properties with €

Note: we can use this kind of definition because in the short term the price level is fixed

REAL EQUILIBRIUM $\frac{M}{P} = Y \cdot L(i)$ $€\ Y = Y/P$

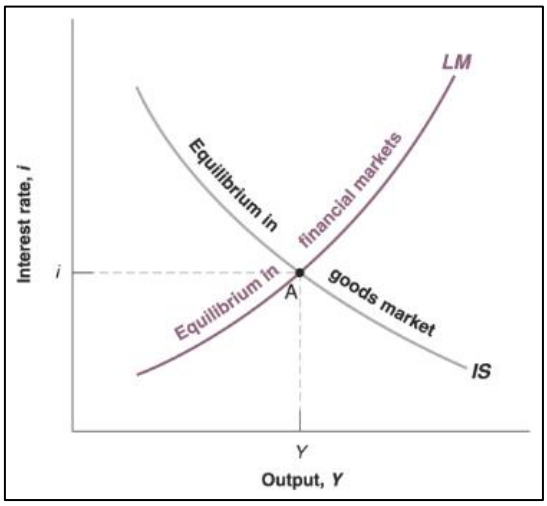
The LM-curve is this curve with respect to the interest rate i instead of the real money



This is an example of a movement along the ILM-curve. When we change some of the fixed variables (nominal money stock) we find a movement of the IS-curve.

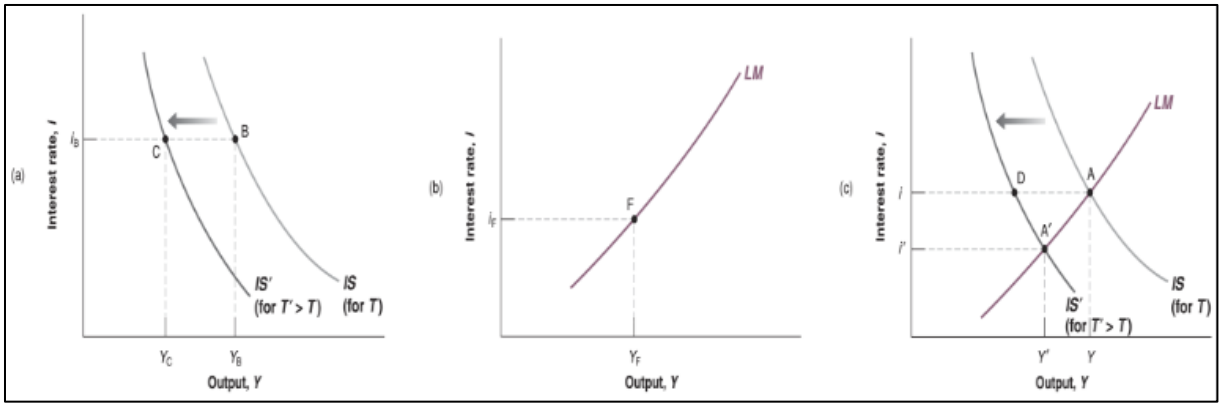
IS-LM-MODEL

Combinatie evenwicht in goederenmarkt en financiële markt



Bespreking van schokken

VOORBEELD: HEFFEN VAN MEER BELASTINGEN

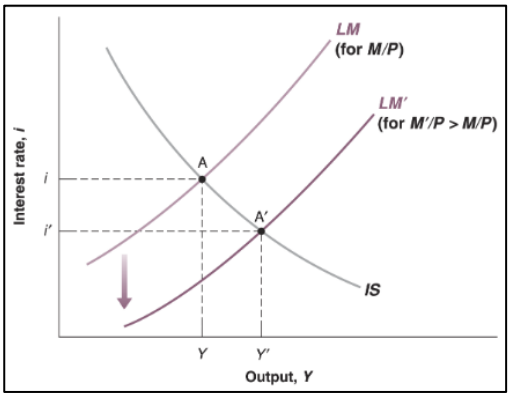


IS: minder vraag naar goederen, want er is minder inkomen → verschuiving curve

LM: geen effect

EQUILIBRIUM: i' op de LM-curve

VOORBEELD: MONETARY EXAPANSION



IS: geen effect

LM: de nominale geldhoeveelheid breidt uit → verschuiving curve

EQUILIBRIUM: i' op de IS-curve

POLICY MIX

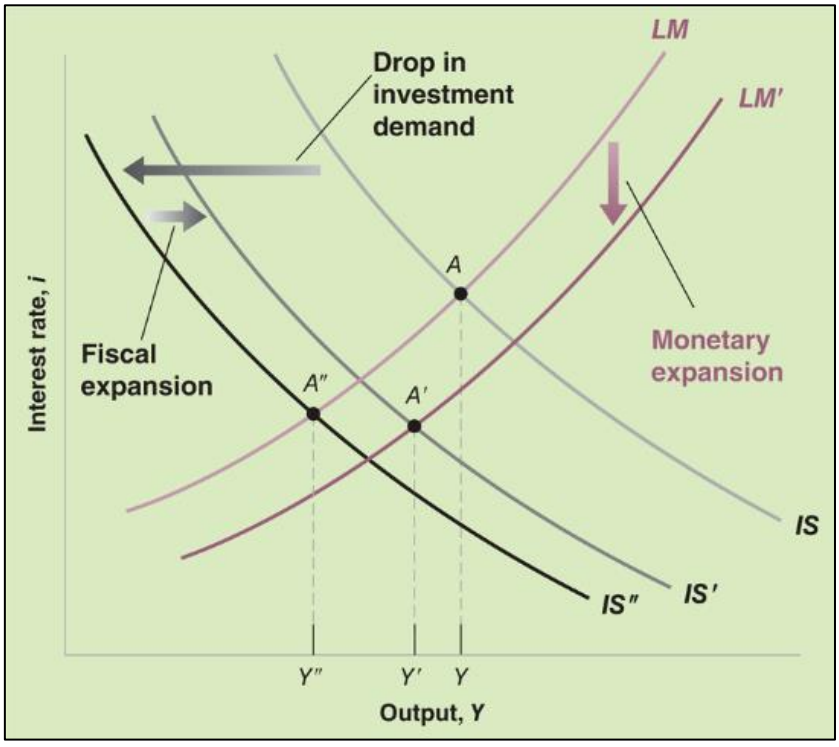
Macro-economisch beleid is er op gericht de schommelingen rond het potentiële inkomen te sturen en ze binnen een bepaalde marge te houden. Hiervoor moet het IS-LM-evenwicht gemonitord worden en zo nodig past de CB de rente aan.

OVERZICHT POLICY:

Table 5.1 The effects of fiscal and monetary policy

	Shift of *IS*	Shift of *LM*	Movement in output	Movement in interest rate
Increase in taxes	Left	None	Down	Down
Decrease in taxes	Right	None	Up	Up
Increase in spending	Right	None	Up	Up
Decrease in spending	Left	None	Down	Down
Increase in money	None	Down	Up	Down
Decrease in money	None	Up	Down	Up

OVERZICHT SCHOKKEN:



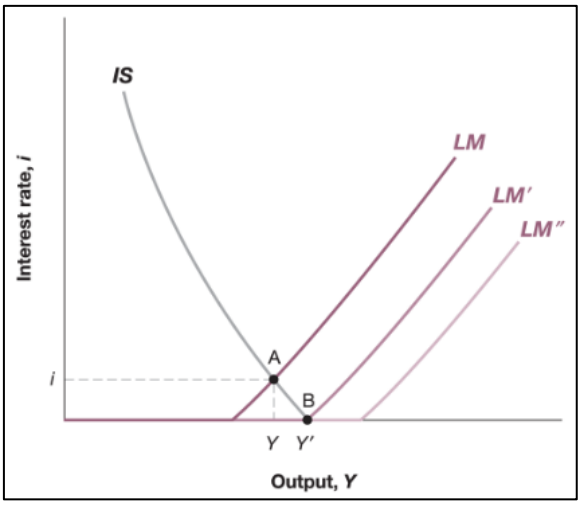
TWO REMARKS

LIQUIDITY TRAP

Interest rate = 0 → indifference between holding bonds or money → demand for money is horizontal → increases in money supply have no effect!

Low level of output → LM is flat

Monetary policy can't save the economy now and there is no way back



INTEREST RATE RULE

= monetaire beleidsregel

CB bepaalt de ideale rente en verandert de money supply om naar deze rente te striven, de rente is dus eigenlijk een functie die zegt hoe ver het inkomen afwijkt van het potentieel inkomen

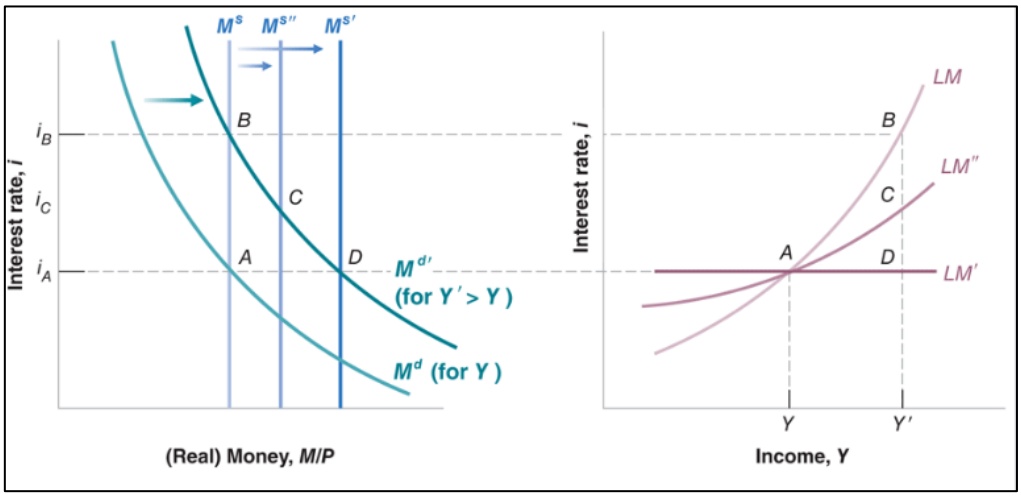


Figure: Increase in income => M^d shifts

If CB does not respond (M^S constant) => interest rate changes to i_B: implies LM

If CB wants to keep policy rate constant => increase money stock to $M^{S\prime}$ => LM'

If CB wants to mitigate (but not totally undo) the increase in the interest rate: $M^{S\prime\prime}$ => LM"

IS-LM-MODEL IN AN OPEN ECONOMY

OPENNESS IN GOODS MARKET

IMPORT AND EXPORT

Index of openness = proportion of aggregate output that are tradable goods (→ goods that compete with foreign goods in either domestic or foreign markets)
→ hangt sterk af van land tot land: eiland, vruchtbaar, dicht of ver van andere economiën etc.

Export ratio larger then GDP: intermediate goods = halffabricaten, worden dus opgewardeerd in binnen of buitenland en beïnvloeden zo het GDP

Domestic goods or foreign goods? Price domestic goods relative to foreign goods = REAL EXCHANGE RATE

EXCHANGE RATE

Nominal exchange rate E
= the price of domestic currency in terms of foreign currency (1 EUR = E USD)

Terms in a floating system:
Appreciation = increase nominal exchange rate
Depreciation = decrease in nominal exchange rate

Terms in fixed system:
Revaluations
Devaluations
(More info about (fixed) exchange rate in section open economy in medium run)

Nominal exchange rate → **Real exchange rate ε**
= EP/P^* = foreign price level/domestic price level

Terms in a floating system:
Real appreciation = increase real exchange rate
Real depreciation = decrease in real exchange rate

Multilateral exchange rates are exchange rates between several countries (instead of two)

OPENNESS IN FINANCIAL MARKET

Trade in foreign assets → buying or selling foreign currency = FOREIGN EXCHANGE

- Diversifying: both foreign and domestic assets
- Trade surplus and deficit countering: borrowing from the world

Balance of payments of a country

- Current account = IM, X, investment income, net transfers foreign aid
- Capital account = foreign assets

GNP

= Gross National Product ←→ Gross Domestic product

Closed economy: GNP = GDP

Open economy: GNP = GDP + NI NI = net income, relatively small

VOORBEELD: IERLAND

GDP > GNP → NI < 0
tax benefits: veel multinationals zetelen in Ierland, maar de inkomensvermeerdering gaat naar foreign holders

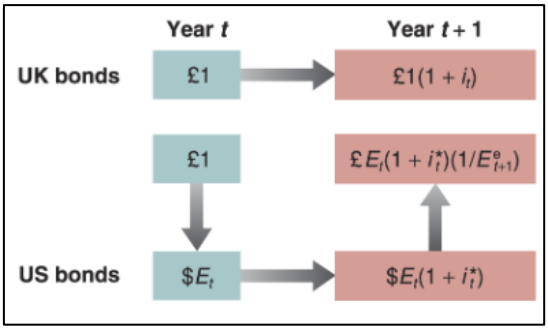
VOORBEELD: KUWAIT

GDP < GNP → NI > 0
olieopbrengsten: maken woekerwinsten en gebruiken die om foreign assets te kopen

CHOICE BETWEEN DOMESCTIC AND FOREIGN ASSETS

VOORBEELD: UK AND US BONDS

UK = domestic
US = foreign
E = nominal exchange rate



Both investments must have the same return → preventing arbitrage

Arbitrage relation:

$$(1+i) = (1+i^*)\left(\frac{E_t}{E^e_{t+1}}\right)$$

i^* = foreign interest rate
E^e_{t+1} = expected nominal exchange rate

INTEREST RATES AND EXCHANGE RATES

$$(1+i) = (1+i^*)\left(\frac{E_t}{E^e_{t+1}}\right) = \frac{1+i^*}{(1+\frac{E^e_{t+1}-E_t}{E_t})} \quad \Leftrightarrow \quad \boldsymbol{i \approx i^* - \frac{E^e_{t+1}-E_t}{E_t}}$$

Fixed exchange rate prevents arbitrage: $E^e_{t+1} = E_t \;\Rightarrow\; i = i^*$

IS IN OPEN ECONOMY

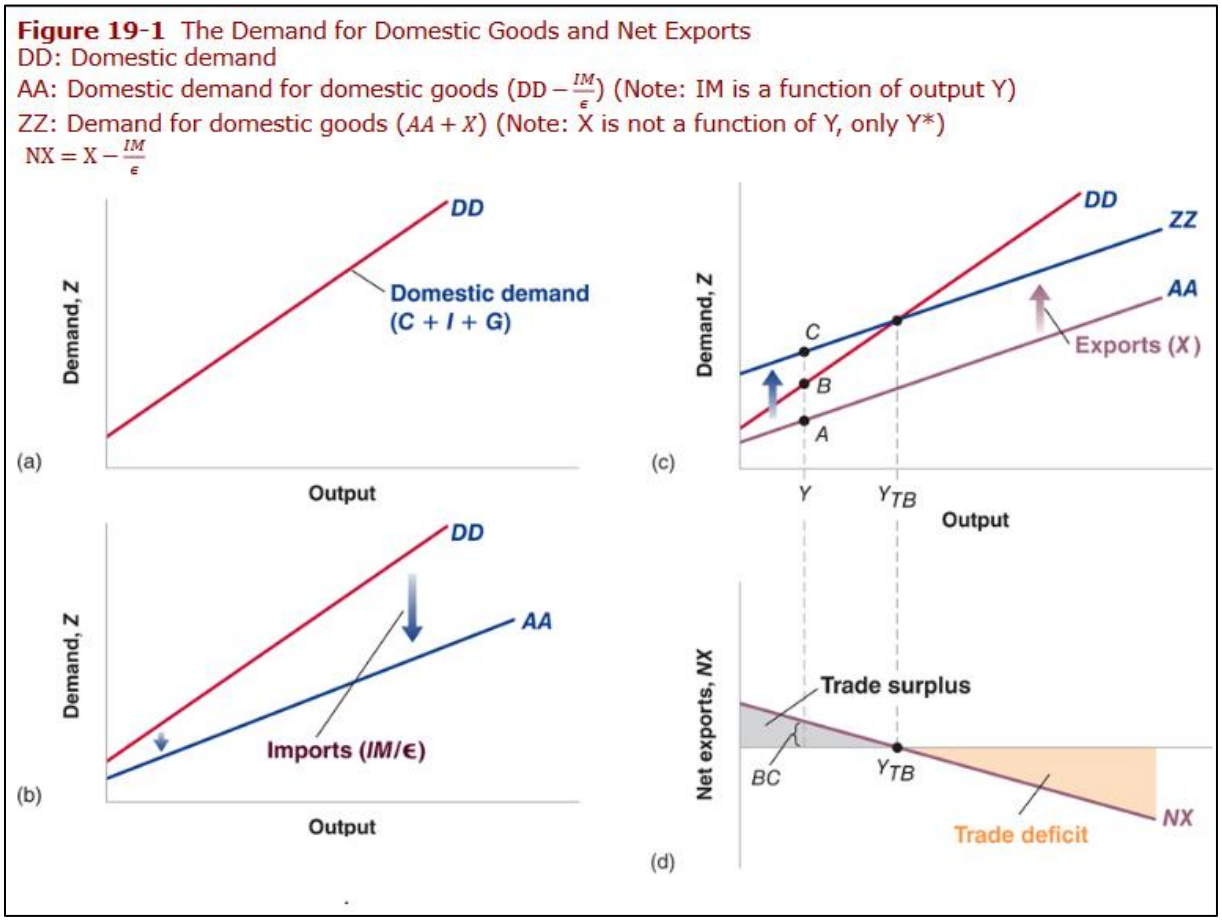
DEMAND for goods in a **closed economy** $DD \equiv C + I + G$
= domestic demand for domestic goods

DEMAND for goods in an **open economy** = domestic demand for domestic goods + domestic demand for foreign goods + foreign demand for domestic goods

$$ZZ \equiv C + I + G + \frac{IM}{\varepsilon} + X$$

Note: $1/\varepsilon$ is the price of foreign goods in terms of domestic goods P^*/EP

- domestic demand for domestic goods = $C(Y - T) + I(Y, r) + G$
  $r = i$ return is gelijk aan de interest als we de inflatie niet in beschouwing nemen
- domestic demand for foreign goods = $IM(Y, \varepsilon)$
- foreign demand for domestic goods = $X(Y^*, \varepsilon)$



Net export NX
Trade surplus: ZZ > DD
Trade deficit: ZZ < DD

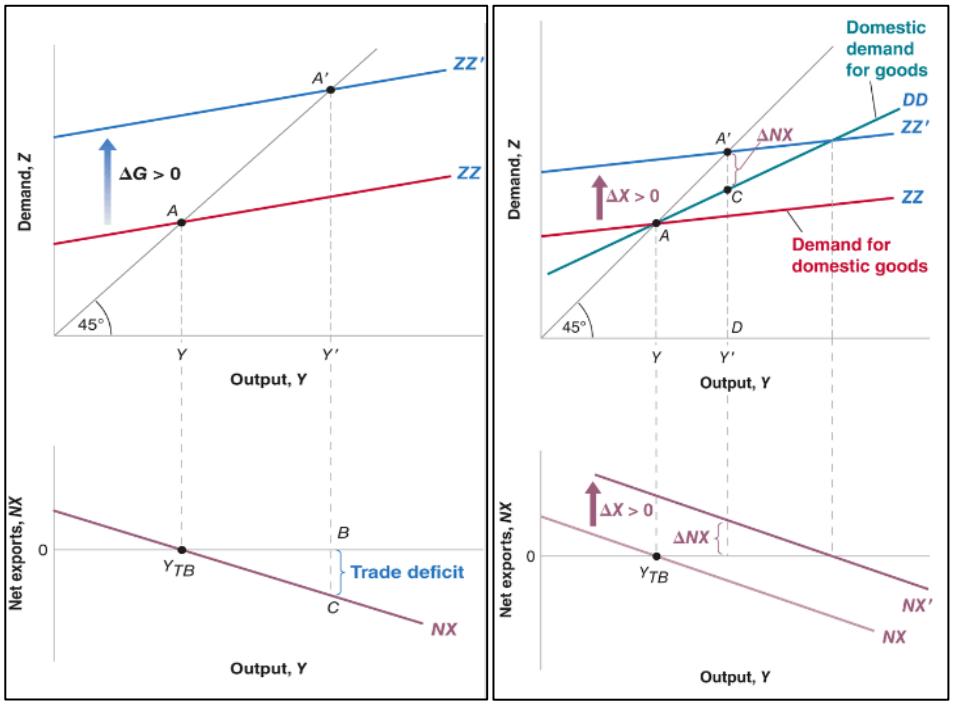
No need to have a trade balance in the equilibrium demand = supply!

Schokkenanalyse:

VOORBEELD 1: EXOGENE WIJZIGING G

- G↑, Z↑: shift of ZZ
  Herinner multiplier mechanisme: nog steeds aanwezig, maar minder uitgesproken

- No effect on IM, X: no effect on NX

1. 

2)

VOORBEELD 2: EXOGENE WIJZIGING Y*

- Y*↑, X↑: shift of ZZ
- Y*↑, X↑: shift of NX

FISCAL POLICY, TRADE BALANCE, DEPRECIATION

FISCAL MULTIPLIERS

Domestic fiscal multiplier $\frac{\partial Y}{\partial G} = \frac{1}{1-c_1+m/\varepsilon}$

Foreign fiscal multiplier $\frac{\partial Y}{\partial G^*} = \frac{m^*}{1-c_1+m/\varepsilon}$

DEPRECIATION $E \downarrow$

Since price levels constant in short run: $\varepsilon \downarrow$

- Trade balance: $NX = X(Y^*, \varepsilon) \uparrow + \frac{IM(Y,\varepsilon)\downarrow}{\varepsilon\downarrow}$
  Onduidelijk effect

- Domestic output: $ZZ \uparrow$, $Y \downarrow$
  Improvement trade balance

EXCHANGE RATE AND FISCAL POLICY

2 objectives: output and trade balance
2 instruments: fiscal and exchange rate policy

Initial Conditions	Trade Surplus	Trade Deficit
Low output	ϵ? G↑	ϵ↓ G?
High output	ϵ↑ G?	ϵ? G↓

TRADE BALANCE AND SAVINGS

Savings = disposable income- consumption
Current account CA = NX + NI + NT (≈ trade balance)

$$CA = S + (T - G) - I$$

CA surplus: S > I lend to world
CA deficit: S < I borrow from world

IS-LM-MODEL

IS-EQUILIBRIUM

$$Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \varepsilon)$$

Change in financial market:

- $r \uparrow \Rightarrow I \downarrow \Rightarrow demand \downarrow \Rightarrow Y \downarrow$
- $\varepsilon \uparrow \Rightarrow demand\ shift \Rightarrow NX \downarrow \Rightarrow Y \downarrow$

Dit zijn twee multiplicatoreffecten vanuit de financiële wereld → er zit potentieel in de geldmarkt om de goederenmarkt te beïnvloeden

Vereenvoudigde versie: $P_t = P_{t+1} = P^* \Rightarrow \varepsilon = E\ \pi$ en $= 0 \Rightarrow r = i$

$$Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E)$$

LM-EQUILIBRIUM

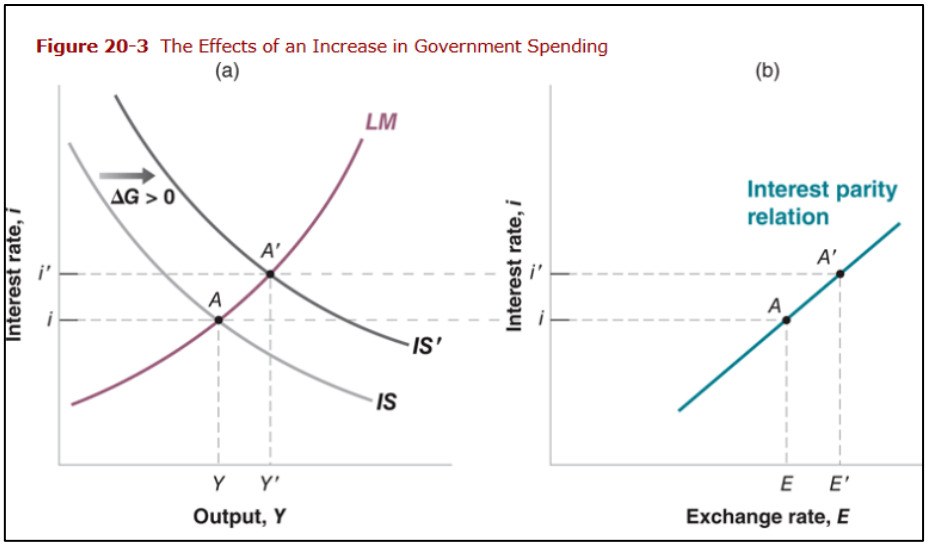
1. Money ←→ bonds: no change in open economy
$$\frac{M}{P} = Y \cdot L(i)$$
2. Domestic ←→ foreign bonds:
$$E = \frac{1 + i}{1 + i^*} E^e$$

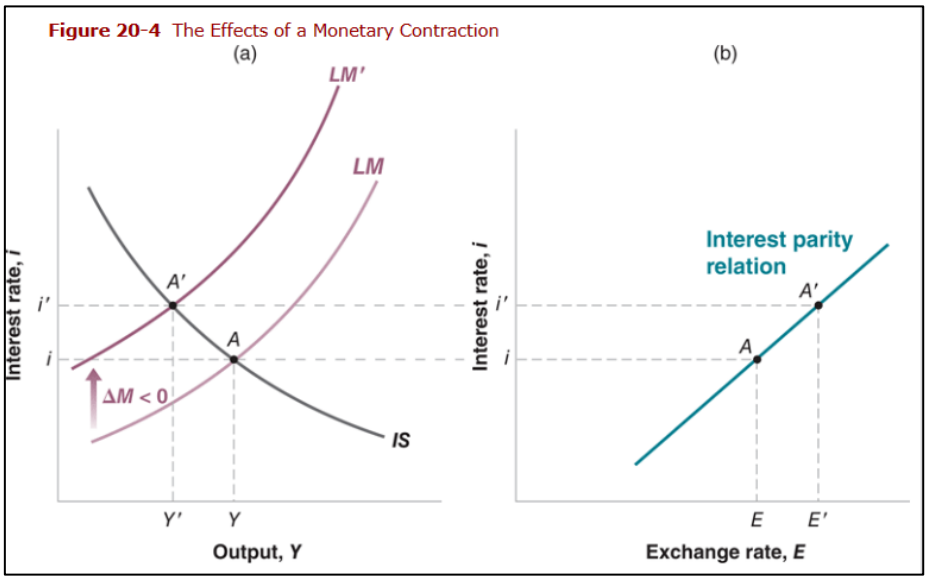
IS-LM-MODEL

$$\begin{cases} Y = C(T - Y) + I(Y, i) + G + NX\left(Y, Y^*, \frac{1 + i}{1 + i^*} E^e\right) \\ \frac{M}{P} = Y \cdot L(i) \end{cases}$$

Nieuwe effecten: given T, G, Y^*, i^*, E^e lead to SHIFT

Schokkenanalyse:



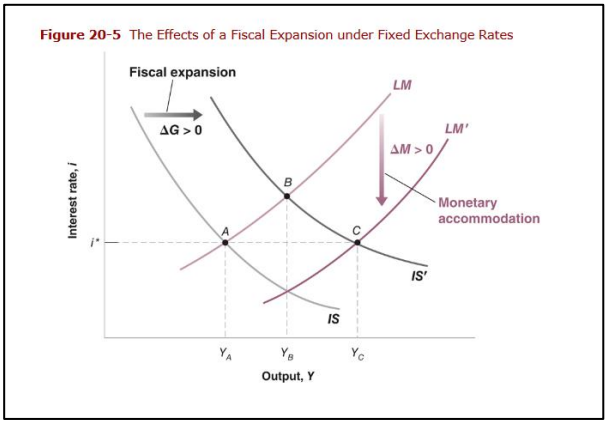


Fixed exchange rate:

De kans op een recessive vergroot door budgettaire contractie

Geldbeleid draait enkel rond rente

→Zie meer in midterm



MEDIUM TERM

LABOUR MARKET

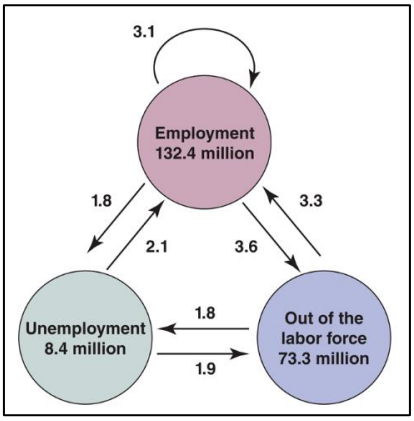
BASIC TERMINOLOGY

3 categories:

1. **O**ut of labour force (bv. studenten, langdurig zieken etc.
2. **U**nemployed
3. **E**mployed

Employment rate $E/(E+O+U)$
Participation rate $(E+U)/(E+U+O)$

Cyclical dynamic:



Reageert op business cycle: reactie is traag → uitslag ontslagen, onzekerheid over duur en ernst van recessie. Less demand, less need for imputs: 3 options

1. Hire fewer people
2. Reduce wage
3. Fire: U higher

Cyclus is sinds de jaren ’80 doorbroken met zeer hoge werkloosheidsgraad tot gevolg en dit is niet hersteld in Europa.

WAGE SETTING

→ typical European: strong unions, bargaining levels (firm, sector, country)

Reservation wage = highest wage at which you prefer not to work

BARGAINING

Employees have the power to bargain a wage > the reservation wage

- Employer needs to hire
  - Job-specific: firm-specific knowledge high → employee much power
  - Labour-market specific: U high → employee little power
- Employee needs a job
  - Job-specific: all knowledge firm-specific?
  - Labour-market specific: U ↑↓ → wage ↓↑

EFFICIENCY WAGES

Firms want to pay wage > reservation wage

- Reducing turnover
- High wage → productivity, efficiency
- U low → increase wage to avoid drain

VOORBEELD: EXPERIMENT HENRY FORD

MODEL OF THE LABOUR MARKET

SUPPLY: wage setting by employees

DEMAND: decide on prices → employer is price-setter product

EQUILIBRIUM: supply = demand

WAGE FORMATION

$$W = P^e \cdot F(u, z)$$

u = werkloosheidsgraad
z = catch-all variable → reservation wage, unemployment insurance, minimum wage etc.
W = nominal wage
W/P = real wage → koopkracht!
P^e = expected price level → wage-setting happens 2-3 years in advance

In medium run $\boldsymbol{P^e = P}$ (very important! Further discussed in AS-AD-model):

$$\frac{\boldsymbol{W}}{\boldsymbol{P}} = \boldsymbol{F}(\boldsymbol{u}, \boldsymbol{z})$$

PRICE SETTING

Production function $Y = f(inputs)$
Simplify: inputs = labour (N), constant technology rate, constant returns to scale: $Y = N$

Marginal cost of one unit Y is one employee N with cost W

- Perfect competition $P = W$
- Imperfect competition $P = (1 + m)W$

Result in medium run:

$$\frac{\boldsymbol{W}}{\boldsymbol{P}} = \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{m}}$$

NATURAL RATE OF UNEMPLOYMENT

= the u_n for whom the equilibrium is fulfilled without human influence

$$F(u_n, z) = \frac{1}{1+m}$$

Micro vs. macro effecten

- Unemployment benefits
  - Micro: insurance against unemployment, social measure
  - Macro: increase in equilibrium wage and so increase in uninployment

Natural rate of employment $N_n = L \cdot (1 - u_n)$ L = labour force

Natural output level Y_n

$$F\left(1 - \frac{Y_n}{L}, z\right) = \frac{1}{1+m}$$

AS-AD MODEL

AS AGGREGATE SUPPLY

Wage $W = P^e \cdot F(u, z)$ no more $P = P^e$, exept when $Y = Y_n$

Price $P = (1 + m)W$

AS:

$$P = P^e(1 + m)\, F(1 - Y/L, z)$$

Note: $u = 1 - Y/L$, we drukken evenwichten liever uit in termen van output i.p.v. u

Mechanismen:

- $P^e \uparrow \Rightarrow wage\ demand \uparrow \Rightarrow production\ cost \uparrow \Rightarrow P \uparrow$
- $Y \uparrow \Rightarrow N \uparrow \Rightarrow (L - N) \downarrow \Rightarrow u \downarrow \Rightarrow wage\ demand \uparrow \Rightarrow production\ cost \uparrow \Rightarrow P \uparrow$

High economic activities result in higher prices (AS has an upward slope):

$$Y > Y_n \;\Leftrightarrow\; u < u_n \;\Leftrightarrow\; F(u, z) > F(u_n, z) \;\Leftrightarrow\; P > P^e$$

Schokkenanalyse:

- Shift of curve: $P^e,\ m,\ z$
- Movement along curve: Y

AD AGGREGATE DEMAND

Follows from IS-LM-model:

IS $Y = C(Y - T) + I(Y, i) + G$

LM $\frac{M}{P} = Y \cdot L(i)$

AD:

$$Y = Y\left(\frac{M}{P}, G, T\right)$$

Schokkenanalyse:

- Shift of curve: M, G, T
- Movement along curve: P

AS-AD EQUILIBRIUM

SHORT TERM P^e GIVEN

- Every market is in equilibrium: goods market (AD), financial market (AD), labour market (AS)
- $P \neq P^e \Rightarrow Y \neq Y_n$

MEDIUM TERM P^e VARIABLE

- Equilibrium when $P = P^e \Rightarrow Y = Y_n$
- Opvolging van onderhandelingsrondes tot stabilisatie rond $P = P^e$

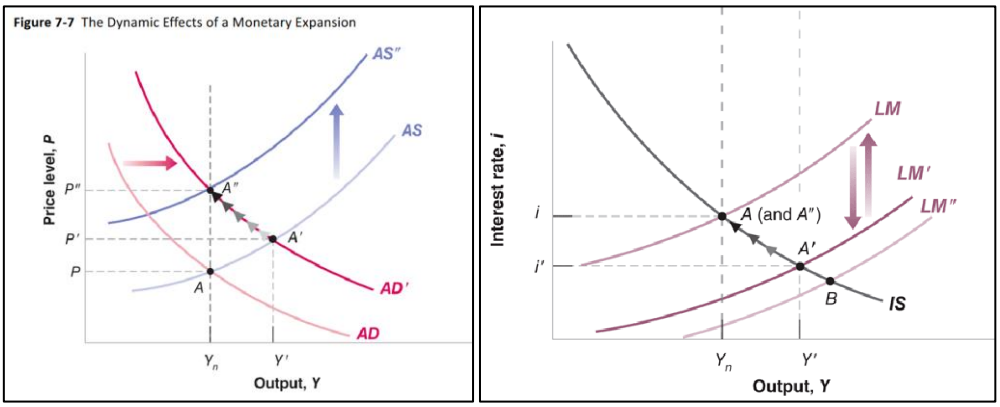
APPLICATIONS

MONETARY POLICY

AD shifts: function of M/P
AS does only shift after time together with P^e

MONETARY EXPANSION:

1. $M \uparrow \Rightarrow \frac{M}{P} \uparrow \Rightarrow$ downward shift on LM, movement along IS
2. Shift in AD
3. Prices increase (AS-AD)
4. Impact on IS-LM: M/P falls → undoes partly initial shift LM = short term equilibrium
5. AS shifts in medium run: P^e adjusts

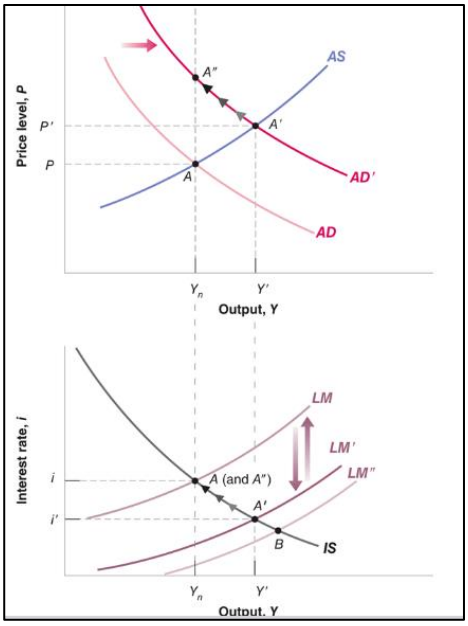


Summarized:
SHORT RUN: $Y \uparrow,\ i \downarrow,\ P \uparrow$
MEDIUM RUN: prices adjust to new price level, income and interest rate return to initial and natural level (shown in the LM-curve)

FISCAL POLICY

Reduction of government deficit $(G - T)$: fall of G
AD has at given price less consumption → recession
AS shows no direct effect

→ no lasting impact on Y
←→ lasting impact on i, P: change in composition of Y



OIL PRICES

Oil = important production factor in ALL sectors, so it hass an impact on the general AS-AD
Oil price increases markup m

Eventueel verder uitwerken

PHILIPS CURVE

PHILIPS CURVE

= particularly form of the AS-curve, shows correlation unemployment and inflation

HISTORICAL EVOLUTION

Pre 70's: negative correlation inflation rate and unemployment rate

70's: stagflation

Post 70's: negative correlation CHANGE in inflation rate and unemployment rate

DEFINITION

A rewritten form of the AS-curve:

$$\pi_t = \pi_t^e + (m + z) - \alpha u_t$$

Inflation $\pi_t = (P_t - P_{t-1})/P_{t-1}$

- Pre 70's: inflation around zero, very high fluctuations

  $$\pi_t = m + z - \alpha u_t$$

  Wage-prices spiral: $u \downarrow \Rightarrow W \uparrow \Rightarrow P_t \uparrow \Rightarrow \pi_t \uparrow \Rightarrow W \uparrow$

- 70's: stagflation = u and π both very high trough oil shocks in the m-variable
- Post 70's: inflation with little fluctuations and positive → $\pi_t^e \neq 0$, anders permanente onderschatting, meer algemeen $\pi_t^e = \theta \pi_{t-1}$ met pre 70's $\theta = 0$

  $$\pi_t = \pi_{t-1} + (m + z) - \alpha u_t$$

Model huidige economie:

$$\pi_t - \pi_{t-1} = (m + z) - \alpha u_t$$

Natural unemployment

- Medium run: $\pi_t = \pi_t^e$
  Note: in Philips curve nog wel steeds verwachte inflatie, maar in de medium run kunnen we de natuurijke werkloosheidsgraad pas waarnemen
- $u_n = (m + z)/\alpha$

Philipscurve herschreven:

$$\pi_t - \pi_{t-1} = -\alpha(u_t - u_n)$$

$$u_t < u_n \Rightarrow \pi_t > \pi_{t-1}$$

$u_t = u_n$ then inflation is constant → NIIRU, non-increasing inflation, rate of unemployment is +- 6% en is de enige lange-termijnindicatie van dit model

POLICY

De Philipscurve geeft het idee dat de politiek de werkloosheid kan sturen op lange termijn. Dit werkt slechts alleen als je de werknemers kan blijven verassen. Echter door naar het oorspronkelijke idee van de Philipscurve te handelen stortte het mechanisme in. Een permanente onderschatting van de inflatie geeft toch terug de natuurlijke unemploymentrate.

DISINFLATION

$$0 < \pi_t < \pi_{t-1}$$

≠ deflation

Disinflation necessary to get out stagflation: increasing unemployment → sacrifice ratio = $1/\alpha$ = the number of time periods of excess unemployment needed to achieve a decrease in inflation of 1%

Lucas critique: unrealistic that wage setters would not consider changes in policy when forming their expectation
→ er zijn geen natuurwetten in de economie: het gedrag van de mensen naar een model past het model zelf aan, verwachtingen zijn essentieel en beïnvloeden het economisch gebeuren

Clou Sargent & Lucas: bij $\pi_t < \pi_{t-1}$ hoort hoge werkloosheid, maar eens deze tactiek begint te werken passen onze verwachtingen voor het volgende jaar ook weer aan → disinflatie hoeft dus niet pijnlijk te zijn

Of wel? Fisher & Taylor: too rapid decrease in money growth will lead to higher unemployment
→ limits on disinflation so high unemployment would not be triggered

DEFLATION

$$\pi_t < 0$$

Very rare → for example the great depression in 30's
comes with very high unemployment

HIGH INFLATION

→ Inflation is also more variable

Wage indexation: zeer goed concept, ingebakken inflatieafhankelijkheid
→ werkt niet als inflatie zeer variabel is, een werknemer kan zo een periode lang veel te duur zijn tot nieuwe indexeringsronde

EUROPEAN UNEMPLOYMENT

Eventueel verder uitwerken

INFLATION, MONEY GROWTH AND REAL INTEREST RATE

OUTPUT, UNEMPLOYMENT AND INFLATION

OKUN'S LAW

= relation change in unemployment u to output growth g_y

$$u_t - u_{t-1} = -g_{yt}$$

> **Note**: this law describes a direct effect, change in unemployment is equal to the negative growth, ex.: 4% output growth, 4% decline in unemployment

This strict relationship is a result of strict assumptions:

- $Y = N =$ employment
- L is constant: $u = 1 - N/L$

In the real world this model has EXPERIMENTAL coefficients:

$$u_t - u_{t-1} = -\beta\left(g_{yt} - \overline{g_y}\right) = -0.4(g_{yt} - 3\%)$$

This is because the assumptions are mostly not fulfilled:

- $Y < N$: labour hoarding, keeping workers when it's not profitable because of lay-off costs, training, minimum staff etc.
- L not constant: not all new jobs at high employment rate are filled with unemployed

THE PHILIPS CURVE

= relation change in inflation π to unemployment u

$$\pi_t = \pi_t^e - \alpha(u_t - u_n)$$

> **Note**: u_n = **natural** unemployment rate

Say $\pi_t^e = \pi_{t-1}$ well approximated:

- $u_t < u_n \Rightarrow \pi_t > \pi_{t-1}$
- $u_t > u_n \Rightarrow \pi_t < \pi_{t-1}$

AD-CURVE

= relation output growth g_y to both nominal money growth g_m and inflation π

$Y = Y\left(\frac{M}{P}, G, T\right)$ simplified $Y_t = Y\left(\frac{M_t}{P_t}\right) = \gamma\frac{M_t}{P_t}$

Remember IS-LM mechanismes:

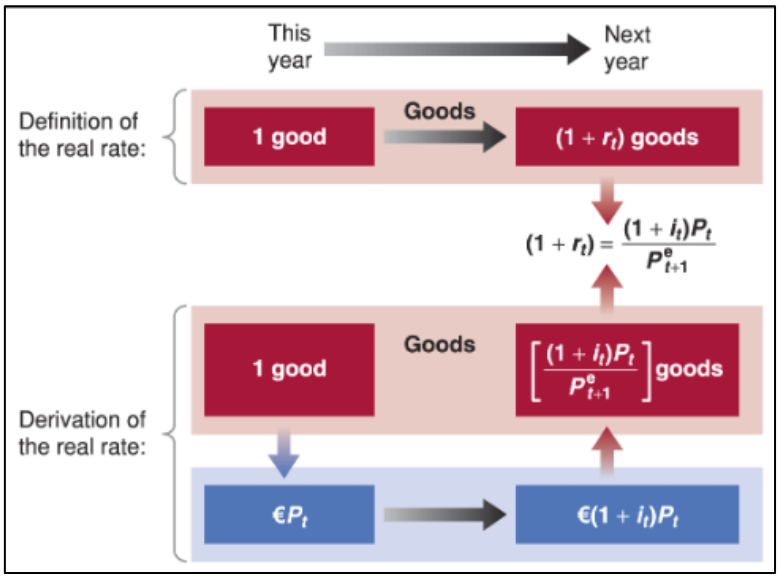
- $M \uparrow \Rightarrow i \downarrow$
- $i \downarrow \Rightarrow demand\ for\ goods \uparrow \Rightarrow Y \uparrow$

Hieruit volgt: $g_{yt} = g_{mt} - \pi_t$

NOMINAL VS. REAL INTEREST RATE

Remember: nominal (expressed in terms of dollar) ←→ real (expressed in terms of a basket of goods)

Interest rate, definition and derivation:



Simplified:

$ir_i \approx i_t - \pi^e_{t+1}$

So the real interest rate is equal to the nominal interest rate minus the expected rate of inflation.
Some implications:

- $\pi^e_t = 0 \Rightarrow i_t = r_t$
- $\pi^e_t > 0 \Rightarrow i_t > r_t$
- $\overline{i_t}: \pi^e_t \uparrow \Rightarrow r_t \downarrow$ nominal interest rate is constant

The IS-LM model:

IS $Y = C(Y - T) + I(Y, r) + G$

LM $\frac{M}{P} = Y \cdot L(i)$

Real interest rate $r = i - \pi$

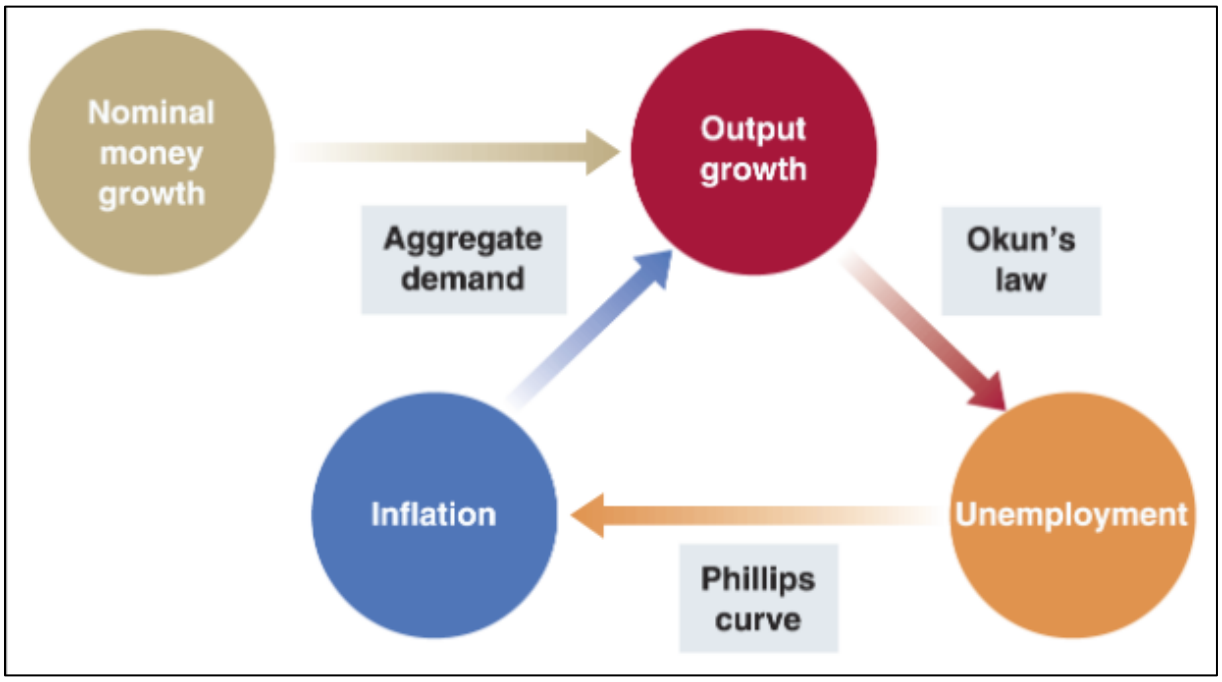
Implications:

- Interest rate affected by monetary policy is **nominal** interest rate
- interest rate that affects spending and output is **real** interest rate

→ effect of monetary policy on spending and output depends on **movements in nominal interest rate translated to real interest rate**

EFFECTS OF MONEY GROWTH

Schematic:



MEDIUM RUN

Assume constant money growth rate $\overline{g_m}$

- Okun's law: $u_t = u_{t-1}$
- AD: $\pi_t = \pi = \overline{g_m} - \overline{g_y}$
- Philips curve: $u_t = u_n$

SHORT RUN

Decrease nominal money growth

- AD: lower real money growth → decrease output growth
- Okun's law: lower output growth → increase in unemployment
- Philips curve: $u > u_n$ → decrease in inflation

Increase nominal growth: symmetrical effects

MONEY GROWTH, INFLATION, NOMINAL AND REAL INTEREST RATE

Summary:

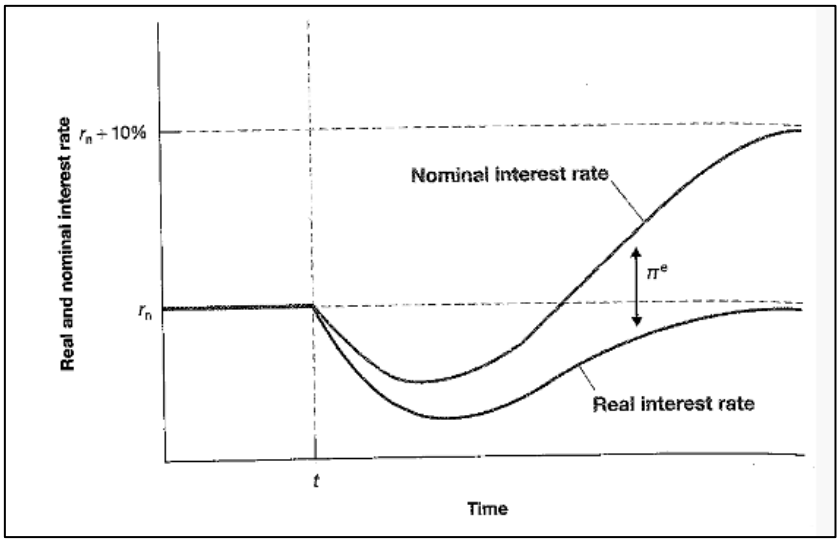
	SHORT RUN	MEDIUM RUN
HIGHER MONEY GROWTH	Lower nominal interest rate	Higher nominal interest rate
LOWER MONEY GROWTH	Lower real interest rate	No effect

Study effects on IS-LM model: increase in money growth

- Short run: $r = i - \pi^e_{t+1}$
- Medium run: $\pi = \pi^e$

  AD: $g_y = g_m - \pi \Rightarrow g_m = \pi$ (output does not grow)

  $r_n = i - g_m \Leftrightarrow i = r_n + g_m$



MEDIUM RUN IN AN OPEN ECONOMY

MEDIUM RUN

Real exchange rate

$$\varepsilon = \frac{EP}{P^*}$$

Change in ε through change in E or P

AD UNDER FIXED EXCHANGE RATE

$$Y = Y\left(\frac{\bar{E}P}{P^*}, G, T\right)$$

Closed economy: M/P instead of $\bar{E}P/P^*$

→ we have now an open economy so the factor $\bar{E}P/P^*$ appears

→ when using fixed exchange rate, CB gives up monetary policy as an instrument

Very different channel for same sign (-)

- Closed economy: price level affects output through effect on real money stock and so interest rate
- Open economy: price level affect output through effect on the real exchange rate

EQUILIBRIUM: SHORT & MEDIUM RUN

AS-curve:

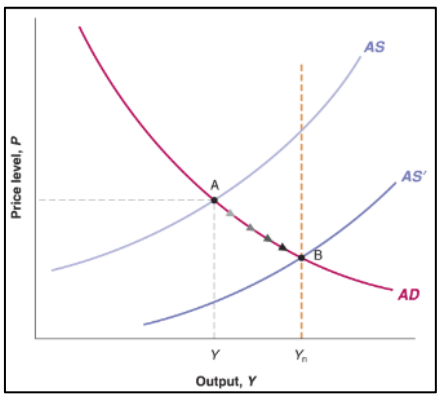
$$P = \boldsymbol{P^e}(1+\mu) \cdot F\left(1 - \frac{\boldsymbol{Y}}{L}, z\right)$$

Devaluation = decrease nominal exchange rate:

'right size' of devaluation can return output to natural level → too good to be true

effects on output take time

likely direct effect on price level → security of fixed exchange rate has no point anymore



A long-term equilibrium demand a shift of the AD-curve

EXCHANGE RATE CRISES UNDER FIXED EXCHANGE RATE

- Real exchange rate too high, domestic currency overvalued → devaluation
- Sometimes need for decrease in domestic interest rate → can NOT be achieved with fixed exchange rate

Fixed exchange rate $\Rightarrow \ i = i^*$
fenomeen = interestpariteit

Expectations of devaluation trigger crisis's
options for the government

- Convince that there are no devaluation intentions
- Increase interest rate (a little bit), if it does not compensate:
  - Investors sell domestic bonds
  - Exchange domestic for foreign assets

  Maintaining fixed exchange rate means using foreign reserves CB
- Validate expectations: devalue

1992 EMS-CRISIS

Context: DDR wordt opgedoekt, samengevoegd met BRD tot huidig Duitsland. De zwakke Oost-Duitse munt wordt gelijk geschakeld met de West-Duitse Mark, er wordt zo veel koopkracht aan de Duitsers geschonken. Er ontstaat demand driven boom en dreiging van inflatie. (tight monetary policy) De rest van Europa heft niets te maken met die boom en kampt met hoge werkloosheid. (loose monetary policy) Verschillende Europese munten zijn wel al aan de Mark gekoppeld, er ontstaat druk op de wisselkoersen.

- "no intention of devaluing" → no impact
- Interest rate increase → still capital outflow (vb. Zweden)
- Give in → nieuw wisselkoersensysteem

Self-fulfilling crisis: devaluation will occur because of the expectation

EXCHANGE RATE MOVEMENTS UNDER FLEXIBLE EXCHANGE RATE

Verandering in de exchange rate over $t + n$ Jaren:
jaar t en $t + 1$:

$$E_t = \frac{1 + i_t}{1 + i_t^*} E_{t+1}^e \qquad E_{t+1} = \frac{1 + i_{t+1}^e}{1 + i_{t+1}^{*e}} E_{t+2}^e$$

$$E_t = \frac{(1 + i_t)(1 + i_{t+1}^e)}{(1 + i_t^*)(1 + i_{t+1}^{*e})} E_{t+2}^e$$

Als we dit uitbreiden naar het jaar $t + n$:

$$E_t = \frac{(1 + i_t)(1 + i_{t+1}^e) \dots (1 + i_{t+n}^e)}{(1 + i_t^*)(1 + i_{t+1}^{*e}) \dots (1 + i_{t+n}^{*e})} E_{t+n+1}^e$$

The current exchange rate depends on the current and expected domestic and foreign exchange rate AND the expected exchange rate n years from now.

If domestic and foreign exchange rate are expected to be the same, the fraction will be 1 and $E(t) = E(t+n)$. There will be and impact on today's exchange rate directly from any expectation.

Because the exchange rate is flexible, so will be the interest rate i_t. Countries must accept a volatile interest rate.

CHOOSING BETWEEN EXCHANGE RATE REGIMES

In general flexible > fixed
exceptions:

- A group of countries is already tightly integrated: optimal currency area
  - Experience similar shocks
  - High factor mobility

  It allows countries to lower transaction costs
- A central bank can not be trusted with responsible monetary policy → dollarisation
  er wordt geloofwaardig geldbeleid geïnporteerd

Hard peg = technical mechanism by wich a country plans to maintain exchange rate parity (vb. dollarisation, use of currency board)

LONG RUN

FACTS OF GROWTH

MEASURING THE STANDARD OF LIVING

Standard of living ←→ growth: very connected!

- Straightforward: GDP of country expressed in currency of that country + exchange rate to dollars
  Exchange rates vary and low output per capita means lower prices of food and basic services

- Ouput per capita = GDP/population
- Purchasing power: purchasing power parity (PPP) → more fundamental and long term adequate of E
  = the exchange rate you need to buy the exact same goods in two countries for the exact same price → more important than the nominal income!

GROWTH IN RICH COUNTRIES

Algemene trend: arme landen met kleine outputlevels per capita groeien snel, rijke landen groeien trager (afnemende meeropbrengsten)

GROWTH ACROSS TIME AND SPACE

Before 1700s: very little or even no growth
After 1700s: exponential growth

Countries compared: no correlation between growth rate and output per capita
Western countries: high startlevel, convergence
Asian countries: low startlevel, convergence (follow path of Japan)
African countries: no convergence

THINKING ABOUT GROWTH

Determination of growth: AD-curve

$$Y = F(K, N)$$

K = capital
N = labour, number of workers

Returns to factors:

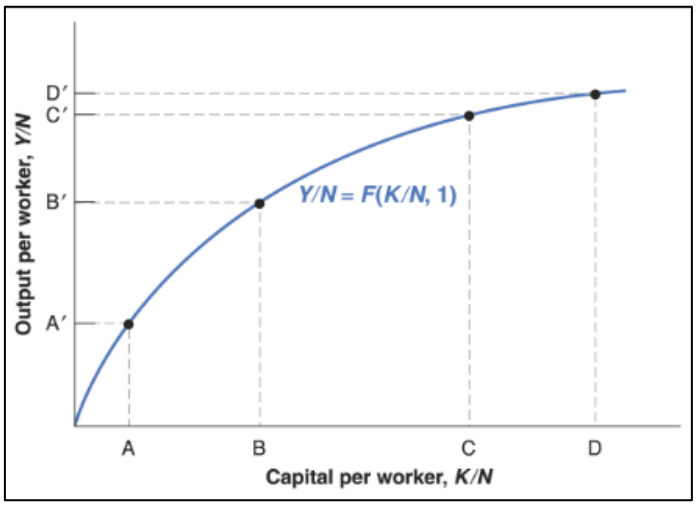
- Return to capital: smaller and smaller increases in output for increasing capital
- Return to labour: smaller and smaller increases in output for increasing level of labour

(Constant) returns to scale:

$$xY = F(xK, xN)$$

AD-rewritten:

$$\frac{Y}{N} = F\left(\frac{K}{N}, \frac{N}{N}\right) = F\left(\frac{K}{N}, 1\right)$$



Sources of growth:

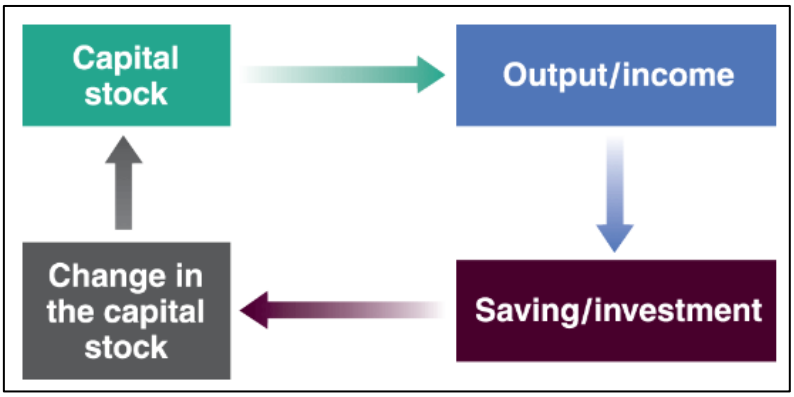
- Change along curve: change in K/N changes Y/N → not very efficient
- Shift of curve: change in technology rate → functions as a return to scale

CONCLUSION: economies growth rate is fully determined by rate of technology
→ only this way we can explain the exponential and permanent growth of the last centuries.

SAVING, CAPITAL ACUUMULATION AND OUTPUT

INTERACTIONS BETWEEN OUTPUT AND CAPITAL

Amount of capital → amount of output → amount of saving → amount of capital accumulated over time



CAPITAL TO OUTPUT

Assumptions: population, participation and unemployment rate are constant, no technological progress

$$\frac{Y}{N} = f\left(\frac{K}{N}\right)$$

Higher capital per worker leads to higher output per worker.

OUTPUT TO INVESTMENT TO CAPITAL ACCUMULATION

Assumptions: closed economy, no public saving $T - G = 0$, private saving prop to income

$$I = sY$$

Evolution of capital stock:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

δ = rate of depreciation

Together:

$$\frac{K_{t+1}}{N} = \frac{(1 - \delta)K_t}{N} + \frac{sY_t}{N}$$

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = \frac{sY_t}{N} - \frac{\delta K_t}{N}$$

Change in capital stock per worker is equal to saving per worker minus depreciation.

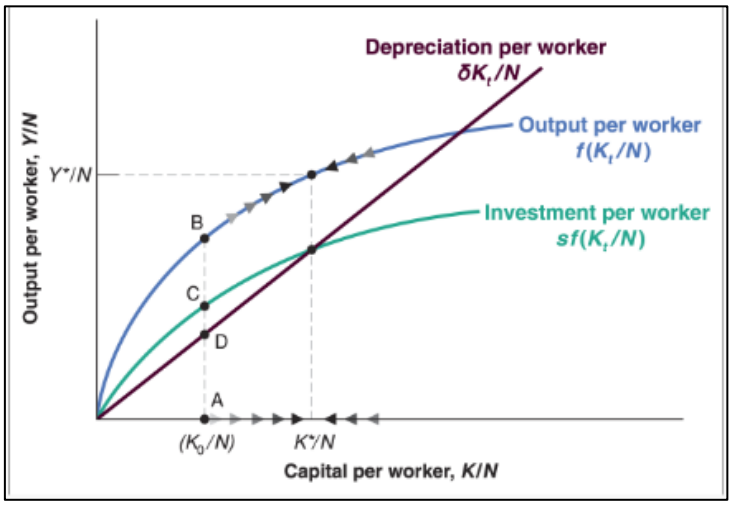
IMPLICATIONS OF ALTERNATIVE SAVING RATES

Overall dynamics:

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = sf\left(\frac{K_t}{N}\right) - \frac{\delta K_t}{N}$$

Change in capital year t to t+1 = investment year t – depreciation year t

The investment will slow down, but the depreciation is lineair!



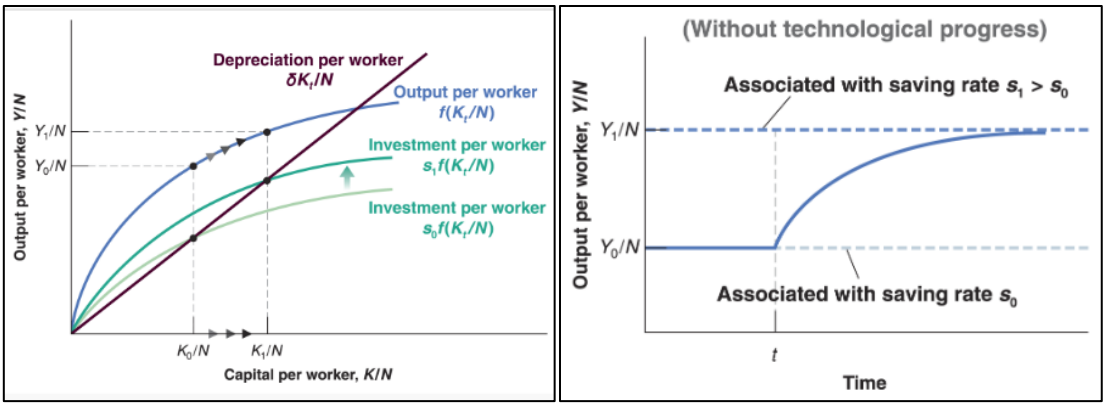
Where investment = depreciation we find and equilibrium: the **steady state**

Steady state in capital and output:

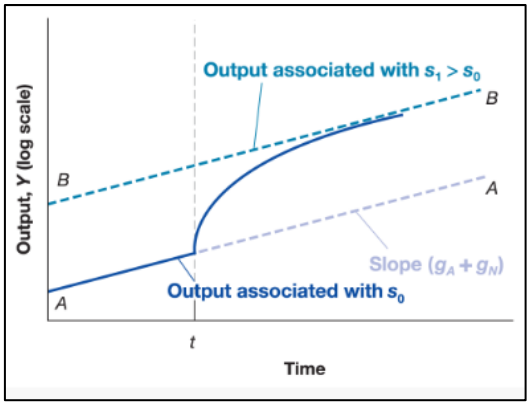
$$sf\left(\frac{K^*}{N}\right) = \frac{sY^*}{N} = \frac{\delta K^*}{N}$$

Saving rate

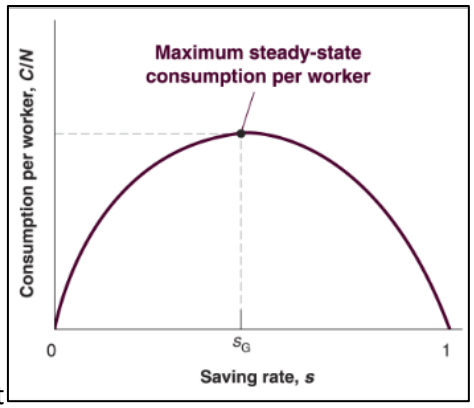
- No effect on long run growth rate
- Determines level of output per worker in long run
- Increasing savings will increase growth in the short run



Als we nu opnieuw technologie een plaats geven zien we een verandering in de asymptoten zel fen bevinden we ons na de spaarronde in een hoger groeipad.



Er zijn twee extreme waarden waarbij de consumptive volledig stilvalt. De ideale savings rate komt overeen met de steady-stade consumption per worker



rt

SENSE OF MAGNITUDES

Production function:

$$Y = \sqrt{K}\sqrt{N} \Rightarrow \frac{Y}{N} = \sqrt{\frac{K}{N}}$$

Effects on savings rate:

$$\frac{Y^*}{N} = \sqrt{\left(\frac{s}{\delta}\right)^2} = \frac{s}{\delta}$$

Consumption:

$$\frac{C}{N} = \frac{Y}{N} - \frac{\delta K}{N} = \frac{s}{\delta}(1 - s)$$

PHYSICAL VS. HUMAN CAPITAL

$$\frac{Y}{N} = f\left(\frac{K}{N}, \frac{H}{N}\right)$$

Clou: samenleving met skilled workers (hoge scholingsgraad etc.), zal hogere productiviteit hebben.

TECHNOLOGY AND GROWTH

TECHNOLOGICAL PROGRESS AND RATE OF GROWTH

Dimensions of technological progress:

- Larger quantities of output
- Better products
- New products
- Lager varieties

→ Overall increase in output for given capital and labour

TECHNOLOGICAL PROGRESS AND PRODUCTION FUNCTION

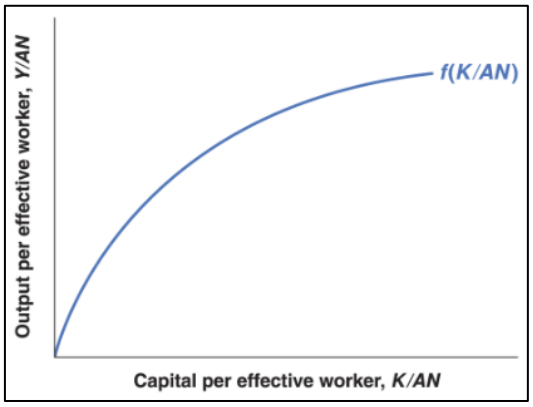
Productiefunctie:

$$Y = F(K, N, A) \rightarrow \ F(K, AN)$$

A = state of technology

AN = amount of effective labour, labour in 'efficiency units'

Again, constant returns of scale: $\frac{Y}{AN} = F\left(\frac{K}{AN}, 1\right) = f\left(\frac{K}{AN}\right)$

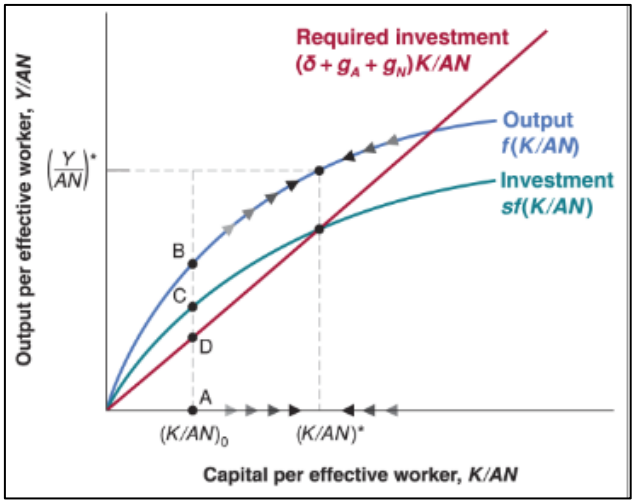


Interaction Output and Capital

Savings constant with income:

$$I = S = sY \Leftrightarrow \frac{I}{AN} = s\frac{Y}{AN} = sf\left(\frac{K}{AN}\right)$$

Investment in steady state is $(\delta + g_A + g_N)\frac{K}{AN}$ with depreciation and growth rates

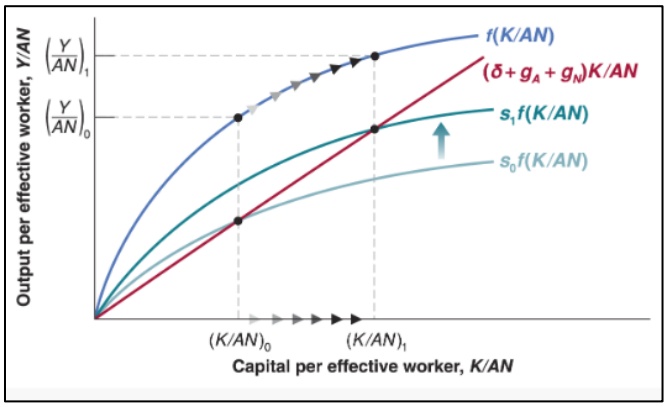


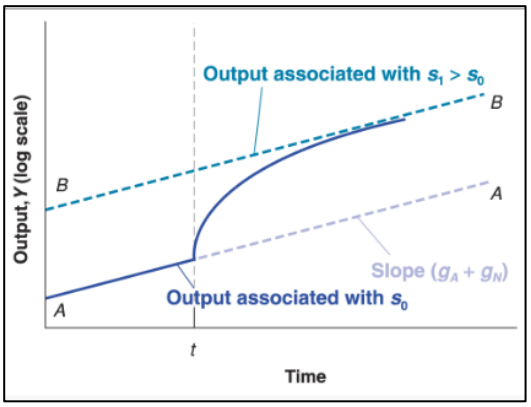
Dit model lijkt nauwelijks veranderd, maar is toch in staat permanente groei te verklaren. In de steady state is $\left(\frac{K}{AN}\right)^*$ constant. Stel dat $A \uparrow, N \uparrow$ met hun gegeven groeivoet, dan zal automatisch $K \uparrow$ zonder dat we on suit de steady state begeven.

De steady state wordt nu **state of balanced growth** genoemd omdat output, kapitaal en effectieve arbeid allemaal met dezelfde groeivoet $(g_A + g_N)$ groeien.

Effects of Saving

Sparen blijft effect geven:





DETERMINANTS OF TECHNOLOGICAL PROGRESS

- Fertility of research process
  - Interaction basic and applied research
  - Place: developed countries
  - Time
- Appropriability of production process
  - Payoff at being first?
  - Legal protection, patents

FACTS OF GROWTH – REVISITED

Capital Accumulation vs. Technological Progress in Rich Countries since 1985

- Higher rate of technology progress: $g_A \uparrow \Rightarrow \ g_Y \uparrow = g_A + g_N$
- Adjustment of K/AN to higher level

Both growth and convergence of output per worker has come from technological progress

CAPITAL ACCUMULATION VS. TECHNOLOGICAL PROGRESS IN CHINA

Technology frontier = Western countries: constant need to develop new ideas
Technological catch-up = China: imitate rather than innovate tech

CLIMATE: EXTENDED SOLOW MODEL

Solow Model: capital → income → investment → capital

Climate concerns: production → emissions → temperature increase → damages

DAMAGES BY EXTERNAL TEMPERATURE RISE

$$Y = DAK^{\alpha}L^{1-\alpha}$$

L = population/labour force
D = damages

$$D = \frac{1}{1 + \theta_1 T^{\theta_2}} \leq 1$$

T = temperature

- $D = 1$: ordinary Solow Model
- $D < 1$: production suffers from damages

Growth rates:

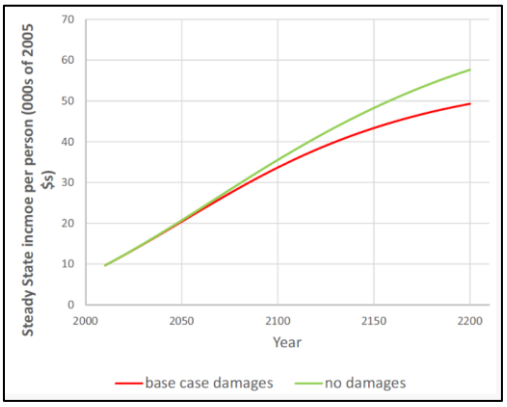
$$g_L = g_{L,0}\frac{1}{(1+\delta_L)^t}$$
$$g_A = g_{A,0}\frac{1}{(1+\delta_A)^t}$$

delta reduces population of technology growth

Stead state:

$$K^* = \left(\frac{sDA}{\delta_K + g_L}\right)^{\frac{1}{(1-\alpha)}}$$

Kapital per worker increases when tech grows, increases when population growth diminishes, **reduces** as damages increas



Weinig schade in 2050 geeft zonder enige andere verandering een ander groeipad dat steeds verder en verder afwijkt. Nu nog schade verder opvoeren heft in de toekomst exponentiële gevolgen, ookal zijn ze nu nauwelijks voelbaar.

Production Influences Temperature

Link = carbon emissions

$$E = \sigma Y$$

σ = emissions intensity

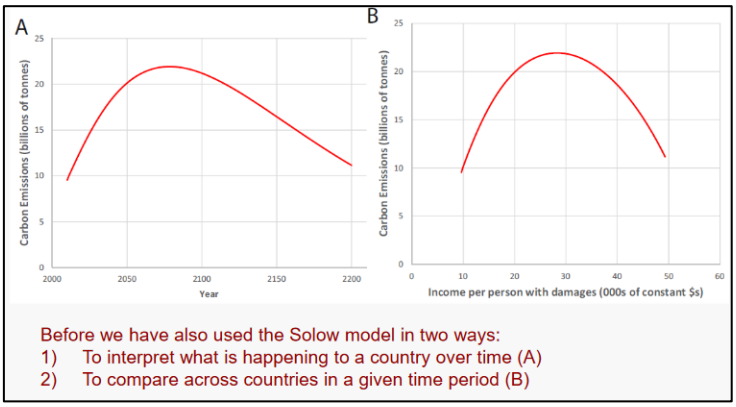
Emission fall:

- Tech improvements
- Sectoral reallocation
- Shift dirty → clean energy

$$g_\sigma = g_{\sigma,0} \frac{1}{(1+\delta_\sigma)^t}$$

Growth rate emission: $g_E = g_\sigma + g_Y$

Visual through **Kuznets curve**



Since $E \Rightarrow T$, we have the last link that closes the model