Chapter 3: The goods market

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Learning objectives: Chapter 3

After you worked through this chapter, you should know

a) the composition of GDP,
b) which variables influence the different components of the demand for goods,
c) which variables are exogenous and endogenous,
d) how to determine the equilibrium income with graphical and formal tools,
e) how shocks can be analyzed in a verbal, graphical and formal way,
f) which relationship consists between investment and savings in equilibrium,
g) why the paradox of savings exists.

Composition of GDP: Aggregate Demand

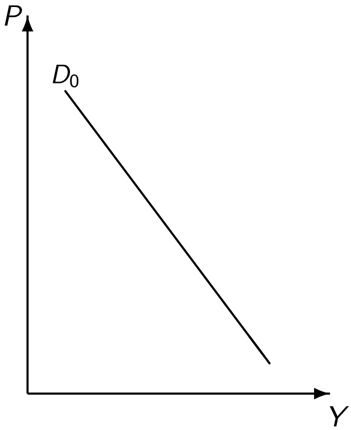
$$Z \equiv C + I + G + X - IM$$

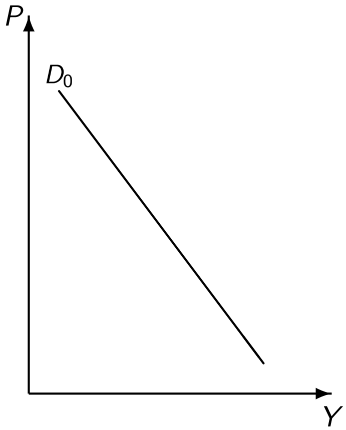
Assumptions

- Only 1 good.
- Supply completely price elastic, demand determines supply.
- Closed economy.

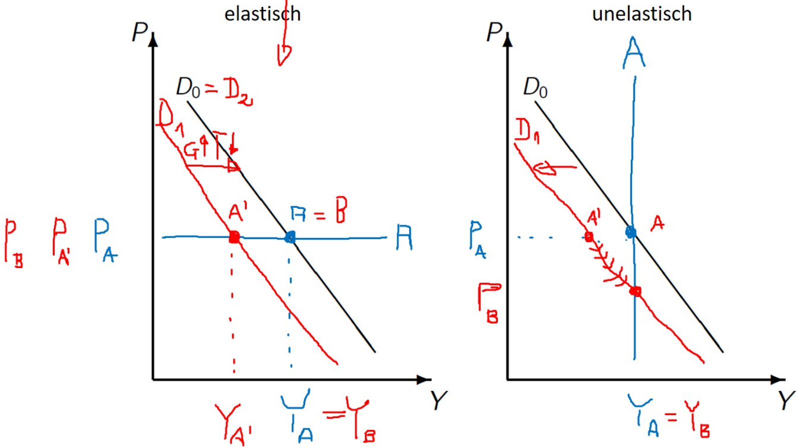
$$Z \equiv C + I + G$$

Effects of a negative demand shock depends on the slope of the supply curve





Auswirkungen eines neg. Nachfrageschocks in Abhängigkeit des Verlaufs der Angebotsfunktion



Consumption (C)

$$C = C(Y_D) \tag{1}$$

$$C = c_0 + c_1 \cdot Y_D \tag{2}$$

- With the autonomous component of consumption $c_0 > 0$ and the marginal propensity to consume $1 > c_1 > 0$
- Disposable income: $Y_D \equiv Y - T$

$$C = c_0 + c_1(Y - T) \tag{3}$$

Investment (I)

$$I = \bar{I}$$

- Investment level is exogenous.

Government spending (G)

$$G = \bar{G}$$

- Government spending is exogenous.

Structure of the economy

$$Z \equiv C + I + G$$

Demand for goods

$$Z = c_0 + c_1(Y - \bar{T}) + \bar{I} + \bar{G} \quad (4)$$

Equilibrium condition

$$Y = Z \quad (5)$$

Graphical analysis

Parameter	Marginal propensity to consume	$c_1 = 0.75$
Exogenous variables	Autonomous consumption	$c_0 = 100$
	Taxes	$T = 200$
	Investments	$I = 150$
	Government spending	$G = 300$
Endogenous variables	Supply (=GDP, Income)	Y
	Demand	Z

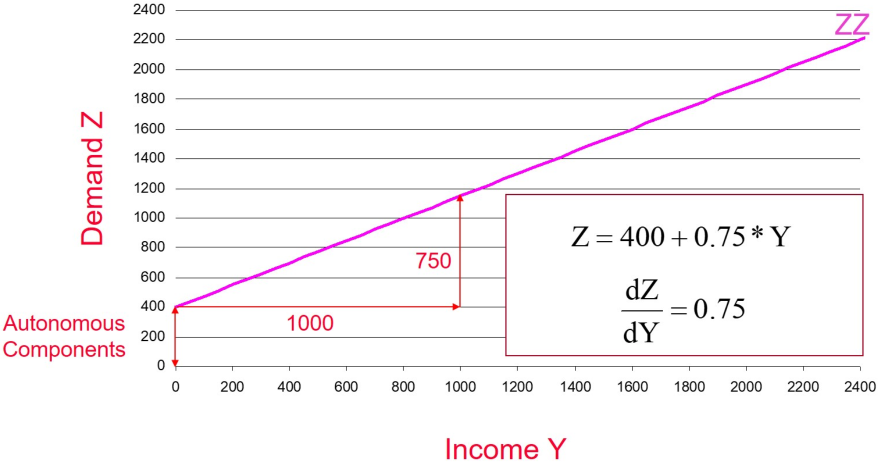
$$Z = c_0 + c_1(Y - \bar{T}) + \bar{I} + \bar{G} \tag{6}$$

$$Z = \underbrace{c_0 - c_1\bar{T} + \bar{I} + \bar{G}}_{\text{autonomous component}} + c_1 \cdot Y \tag{7}$$

$$Z = \underbrace{100 - 0.75 \cdot 200 + 150 + 300}_{\text{autonomous component}} + 0.75 \cdot Y \tag{8}$$

$$Z = 400 + 0.75 \cdot Y$$

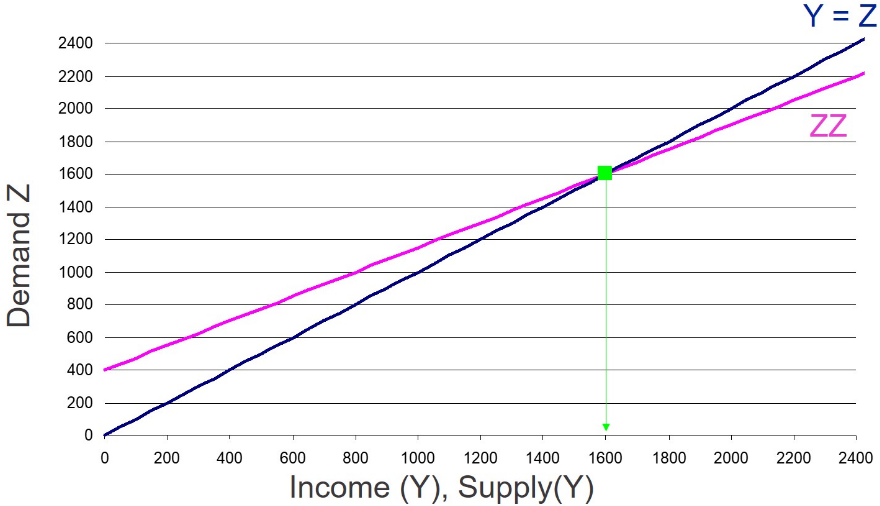
Aggregate Demand



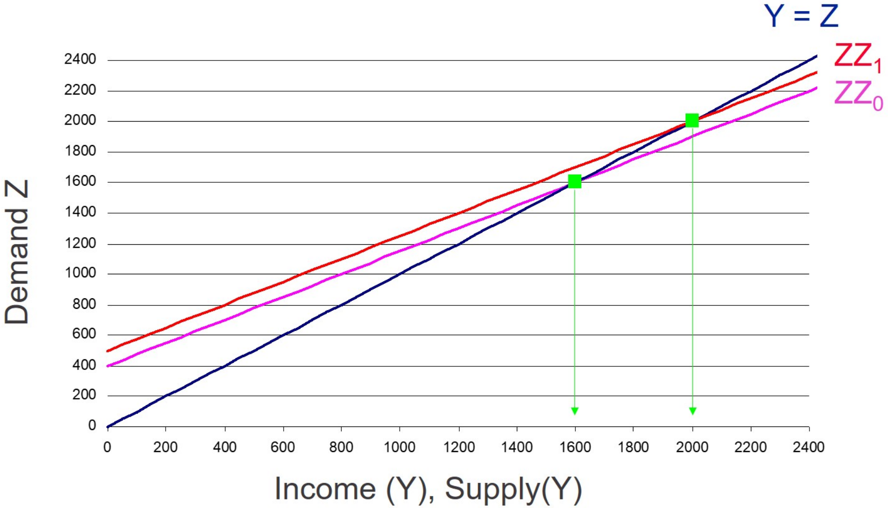
$$Z = 400 + 0.75 * Y$$

$$\frac{dZ}{dY} = 0.75$$

Equilibrium: Demand for goods = supply of goods



Increase in demand $(G = 400) \rightarrow dG = 100$



Formal analysis: Equilibrium level of income

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

$$Y = Z$$

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

$$Y - c_1 Y = c_0 - c_1 \bar{T} + \bar{I} + \bar{G}$$

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

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

Equilibrium level of income: Numerical example

$$Y = \frac{1}{1-c_1}\left[c_0 - c_1\,\bar{T} + \bar{I} + \bar{G}\right]$$

$$\begin{aligned} c_1 &= 0.75 \\ c_0 &= 100 \\ T &= 200 \\ I &= 150 \\ G &= 300 \end{aligned}$$

$$Y_0 = \frac{1}{1-0.75}\left[100 - 0.75 \cdot 200 + 150 + 300\right] = 4 \cdot 400 = 1600$$

$$\downarrow$$

$$Y_1 = \frac{1}{1-0.75}\left[100 - 0.75 \cdot 200 + 150 + 400\right] = 4 \cdot 500 = 2000$$

Formal analysis: The income multiplier of a fiscal expansion via government spending

$$Y = \frac{1}{1-c_1} \cdot [c_0 - c_1 \bar{T} + \bar{I} + \bar{G}] \quad (9)$$

$$Y = \frac{1}{1-c_1} c_0 - \frac{c_1}{1-c_1} \bar{T} + \frac{1}{1-c_1} \bar{I} + \frac{1}{1-c_1} \bar{G} \quad (10)$$

- Assumption: Parameters are always constant $\Rightarrow$ c_1 does not change!
- Taking the differential, we get:

$$dY = \frac{1}{1-c_1} dc_0 - \frac{c_1}{1-c_1} d\bar{T} + \frac{1}{1-c_1} d\bar{I} + \frac{1}{1-c_1} d\bar{G} \quad (11)$$

Formal analysis: The income multiplier of a fiscal expansion via government spending

$$dY = \frac{1}{1-c_1}dc_0 - \frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{I} + \frac{1}{1-c_1}d\bar{G} \tag{12}$$

- Only G changes ($dG > 0$), all other variables are constant so that changes are equal to zero.
- $dc_0 = 0$, $dT = 0$, and $dI = 0$.

$$dY = \frac{1}{1-c_1}d\bar{G} \tag{13}$$

$$\frac{dY}{d\bar{G}} = \frac{1}{1-c_1} > 0 \qquad \frac{dY}{d\bar{G}} = \frac{1}{1-0.75} = 4 \tag{14}$$

Question 4: Haavelmo-Theorem

- Basic scenario: Government budget is balanced.
- Government is increasing government spending (G) and raises taxes (T) simultaneously to finance the additional expenses ($\mathrm{dG} = \mathrm{dT}$).
- Tax increases reduces the disposable income of the private households and hence private consumption.
- **Simultaneously** government increases demand for domestic goods, because of higher government spending

What are the effects of an increase in government spending which is tax financed?

Haavelmo-Theorem

a) By how much does Y change, if G increases by one unit?
- Compute the government spending multiplier!

b) By how much does Y change, if T increases by one unit?
- Compute the tax multiplier!

c) By how much does Y change, if G increases by one unit and T increases by one unit simultaneously?
- Compute the balanced budget multiplier!

Haavelmo-Theorem: Part a)

$$Y = \frac{1}{1-c_1}[c_0 - c_1\bar{T} + \bar{I} + \bar{G}] \tag{15}$$

$$Y = \frac{1}{1-c_1}c_0 - \frac{c_1}{1-c_1}\bar{T} + \frac{1}{1-c_1}\bar{I} + \frac{1}{1-c_1}\bar{G} \tag{16}$$

Taking the differential, we get:

$$dY = \frac{1}{1-c_1}dc_0 - \frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{I} + \frac{1}{1-c_1}d\bar{G} \tag{17}$$

Haavelmo-Theorem: Part a)

$$dY = \frac{1}{1-c_1}dc_0 - \frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{I} + \frac{1}{1-c_1}d\bar{G}$$

Only G changes, all other changes are equal to zero:

$$dY = \frac{1}{1-c_1}d\bar{G}$$

$$\frac{dY}{d\bar{G}} = \frac{1}{1-c_1} \qquad \frac{dY}{d\bar{G}} = \frac{1}{1-0.75} = 4$$

Haavelmo-Theorem: Part b)

$$dY = \frac{1}{1-c_1}dc_0 - \frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{I} + \frac{1}{1-c_1}d\bar{G}$$

Only T changes, all other changes are equal to zero:

$$dY = -\frac{c_1}{1-c_1}d\bar{T}$$

$$\frac{dY}{d\bar{T}} = -\frac{c_1}{1-c_1} < 0 \qquad \frac{dY}{d\bar{T}} = -\frac{0.75}{1-0.75} = -3$$

Haavelmo-Theorem: Part c)

$$dY = \frac{1}{1-c_1}dc_0 - \frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{I} + \frac{1}{1-c_1}d\bar{G}$$

T and G change, all other changes are equal to zero:

$$dY = -\frac{c_1}{1-c_1}d\bar{T} + \frac{1}{1-c_1}d\bar{G}$$

Under consideration of $d\bar{T} = d\bar{G}$, it follows:

$$dY = -\frac{c_1}{1-c_1}d\bar{G} + \frac{1}{1-c_1}d\bar{G} \qquad dY = \frac{1-c_1}{1-c_1}d\bar{G}$$

$$\left.\frac{dY}{d\bar{G}}\right|_{d\bar{T}=d\bar{G}} = 1 > 0$$

Haavelmo-Theorem: Numerical example

Basic scenario	After the shock
$c_1 = 0.75$	$c_1 = 0.75$
$c_0 = 100$	$c_0 = 100$
$T = 300$	$\mathbf{T} = \mathbf{400}$
$I = 225$	$I = 225$
$G = 300$	$\mathbf{G} = \mathbf{400}$

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

$$\begin{aligned} Y_0 &= 4[100 - 0.75 \cdot 300 + 225 + 300] = 4 \cdot [400] = 1600 \\ Y_1 &= 4[100 - 0.75 \cdot 400 + 225 + 400] = 4 \cdot [425] = 1700 \end{aligned}$$

Chapter 3: The goods market

Investment Equals Saving

Private savings (S): Difference between disposable income and consumption

$$S \equiv Y_D - C \qquad\qquad S = Y - T - C$$

Equilibrium on the goods market

$$Y = C + I + G \qquad \rightarrow \qquad Y - T = C + I + G - T$$

$$\underbrace{Y - T - C}_{S} = I + G - T \qquad \rightarrow \qquad S - G + T = I$$

$$(3.10) \quad I = S + (T - G)$$

Investment Equals Saving

$$(3.10) \quad I = S + (T - G)$$

- $T - G$: Government‘s savings
- $T > G$: Budget surplus
- $T < G$: Budget deficit

A numerical example

$$S = Y - T - C \quad \rightarrow \quad S = Y - T - c_0 - c_1(Y - T)$$

$$S = 1600 - 200 - 100 - 0.75 \cdot (1600 - 200) = 250$$

$$\begin{aligned} I &= S + (T - G) \\ 150 &= 250 + (200 - 300) \end{aligned}$$

Government budget deficit is financed by private saving!

A graphical analysis

$$S = Y - T - c_0 - c_1(Y - T) \tag{18}$$

If one gets rid of the bracket, it follows:

$$S = c_1 T - T - c_0 + (1 - c_1)Y \tag{19}$$

$$I = S + (T - G) \tag{20}$$

$$I = c_1 T - T - c_0 + (1 - c_1)Y + T - G \tag{21}$$

$$I = -c_0 + c_1 T - G + (1 - c_1)Y \tag{22}$$

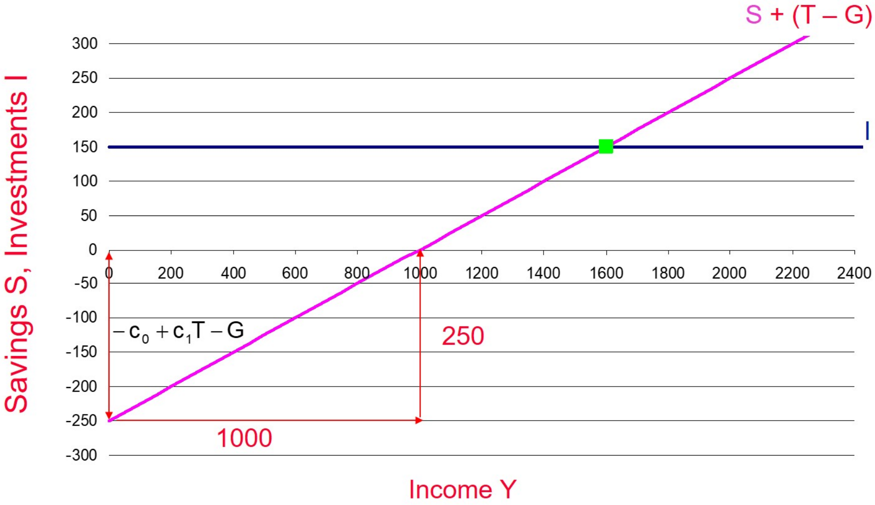
A graphical analysis

$$I = -c_0 + c_1 T - G + (1 - c_1) Y$$

$$c_1 = 0.75$$
$$c_0 = 100$$
$$T = 200$$
$$I = 150$$
$$G = 300$$

$$\begin{aligned} 150 &= -100 + 0.75 \cdot 200 - 300 + (1 - 0.75) Y \\ 150 &= -250 + 0.25 \cdot Y \end{aligned}$$

Investment = Saving: A graphical analysis



Shock: Government spending increases ($G = 400$)

Paradox of Savings

- All private households want to save more at a given income level
- Consumers reduce their autonomous component of consumption ($c_0 = 0$), so that – at a given level of income – consumption decreases and savings increase.
- But what happens to the income and savings level?

$$S = c_1 T - T - c_0 + (1 - c_1)Y \tag{23}$$

- c_0 lower, so that S increases

Overall effect ambiguous?

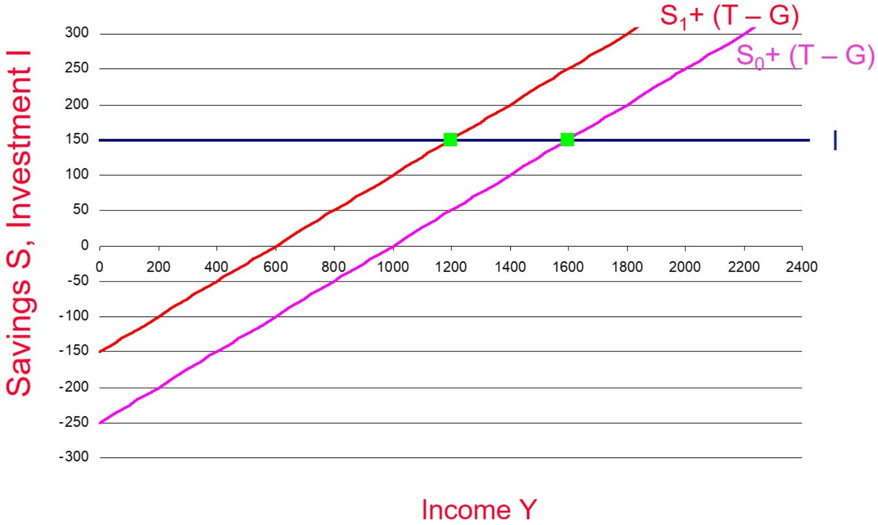
- Y lower, so that S decreases

Paradox of Savings

$$(3.10) \quad I = S + (T - G)$$

Savings volume cannot change!

Paradox of Savings ($c_0 = 0$)



Paradox of Savings

$$S = c_1 T - T - c_0 + (1 - c_1) Y$$

$$c_1 = 0.75$$
$$c_0 = 100$$
$$T = 200$$
$$I = 150$$
$$G = 300$$

$$\begin{aligned} S &= 0.75 \cdot 200 - 200 - 100 + (1 - 0.75) \cdot 1600 \\ &= -150 + 400 = 250 \\ S &= 0.75 \cdot 200 - 200 - 0 + (1 - 0.75) \cdot 1200 \\ &= -50 + 300 = 250 \end{aligned}$$