

Economics II

The IS-LM Model, Fiscal and Monetary Policy, Part I



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



The IS-LM Model

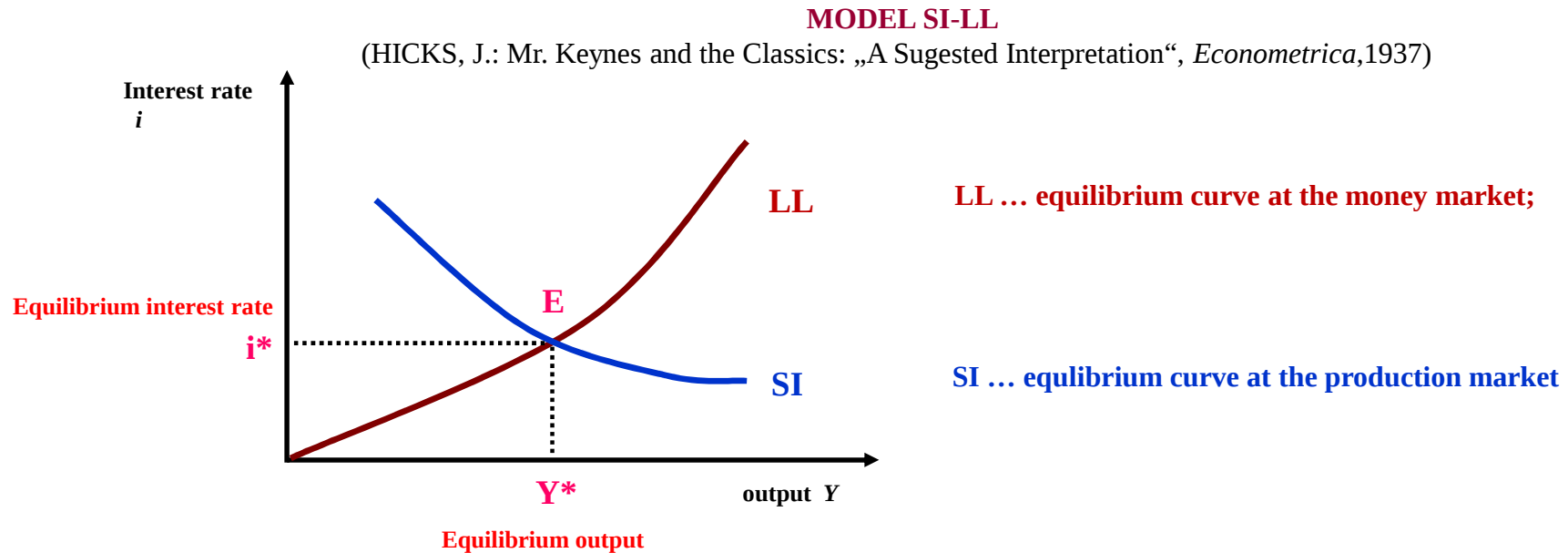
The aim of this lecture is to explain the interest rate as a determinant of aggregate demand, to develop the IS-LM model and clarify its structure and meaning.

Content:

- ❖ Introduction - a few remarks on the history of the IS-LM model
- ❖ The market of aggregate production, IS curve
- ❖ The market of assets (money market), LM curve
- ❖ The IS-LM model
- ❖ Conclusion – summary, list of tasks for students

Introduction - a few remarks on the history of the IS-LM model

Model IS-LM model was developed from the IS-LL, designed by J. R. Hicks. Consequently, this model gradually modified by A. H. Hansen in its present form IS-LM model.



The LM abbreviation indicates „liquidity = money supply“, and „liquidity“ means a demand for money. This is the LM curve describing the Keynesian money market and replaces the quantity theory of money. The acronym IS denotes „investment = savings“.

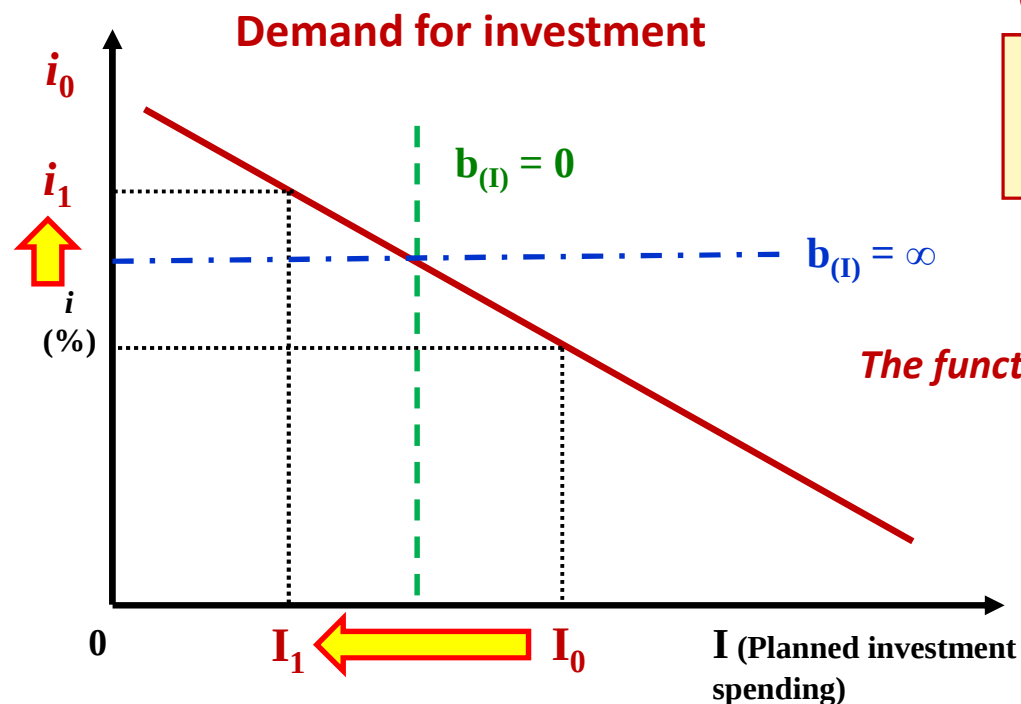
IS CURVE - derivation

Premise: Autonomous expenditures are dependent on the interest rate.

a) Interest rate and aggregate expenditures

$$Y = \bar{\alpha} \cdot \bar{A} \quad (= AD)$$

$$\bar{\alpha} = \frac{1}{1-c(1-t)}; \quad \bar{A} = \bar{C}a - c\bar{T}A + c\bar{T}R + \bar{I} + \bar{G}$$



The function of investment:

$$I = \bar{I} - b_{(I)}i, \quad b_{(I)}i \succ 0$$

The sensitivity of investment spending on interest rate:

$$b_{(I)} = \frac{\Delta I}{\Delta i}$$

Planned, respectively intended volume of investment is greater, the lower the interest rate is. And vice versa: the planned investment volume is lower, the higher the interest rate is.

IS CURVE

b) Demand for autonomous expenditures

$$\bar{A} = \bar{Ca} - c\bar{TA} + c\bar{TR} + \bar{I} + \bar{G}$$

$$Ca = \bar{Ca} - b_{(Ca)}i$$

$$b_{(Ca)} = \frac{\Delta Ca}{\Delta i}$$

(+)

$$b_{(I)} = \frac{\Delta I}{\Delta i}$$

(=)

$$b = b_{(Ca)} + b_{(I)}$$

Demand for planned autonomous expenditures:

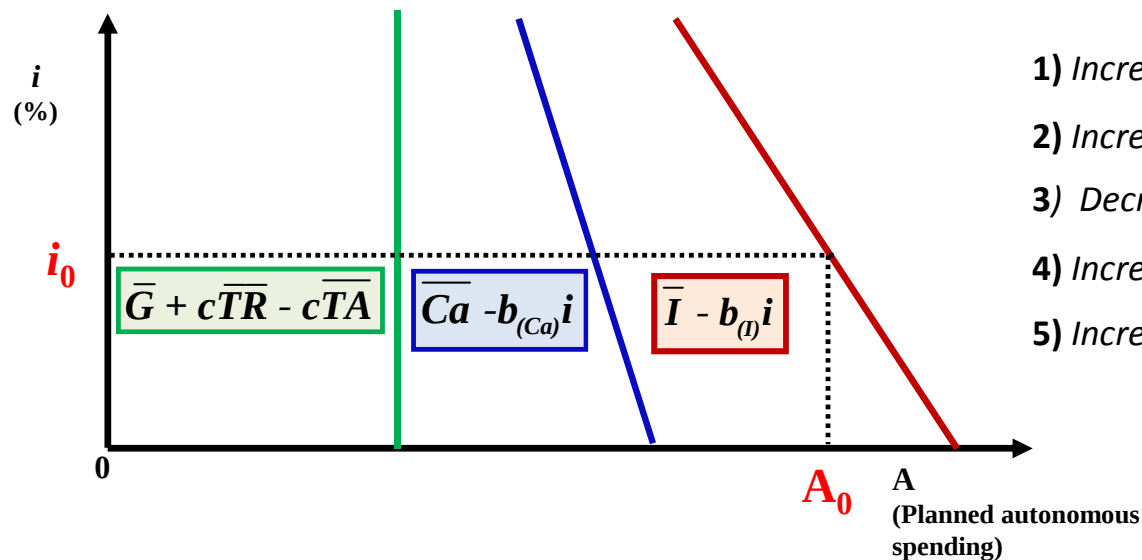
$$A = \bar{A} - bi$$

The sensitivity of planned autonomous expenditures to interest rate

$$b = \frac{\Delta A}{\Delta i}$$

Shifts of A curve to the right:

- 1) Increase in $\bar{G}$
- 2) Increase in $\bar{TR}$
- 3) Decrease in $\bar{TA}$
- 4) Increase in $\bar{I}$
- 5) Increase in $\bar{Ca}$



IS CURVE

IS curve - derivation

Basic identity:

$$AD = \bar{A} + c(1 - t)Y$$

$$\bar{A} = \bar{Ca} + c\bar{TA} + c\bar{TR} + \bar{I} + \bar{G}$$

$$Ca = \bar{Ca} - b_{(Ca)}i$$

$$I = \bar{I} - b_{(I)}i$$

Substitution:

$$AD = \bar{Ca} - b_{(Ca)}i + c(Y - \bar{TA} - tY + \bar{TR}) + \bar{I} - b_{(I)}i + \bar{G}$$

Assuming that:

$$\bar{A} = \bar{Ca} - c\bar{TA} + c\bar{TR} + \bar{I} + \bar{G}$$

a **AD = Y**

$$AD = Y = \bar{A} + c(1 - t)Y - bi$$

IS curve equation:

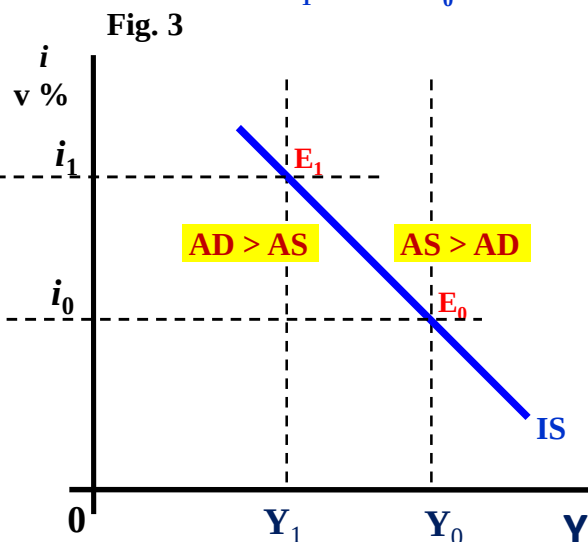
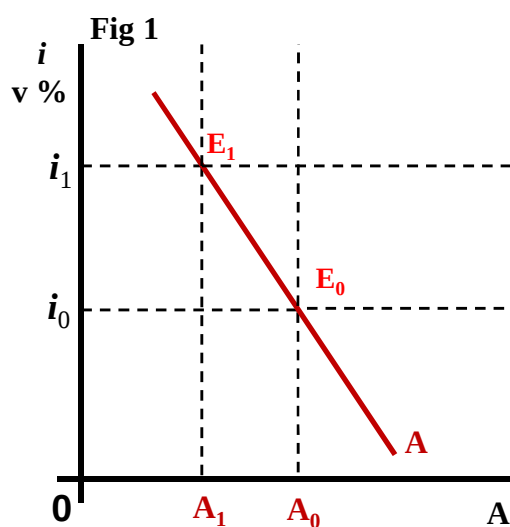
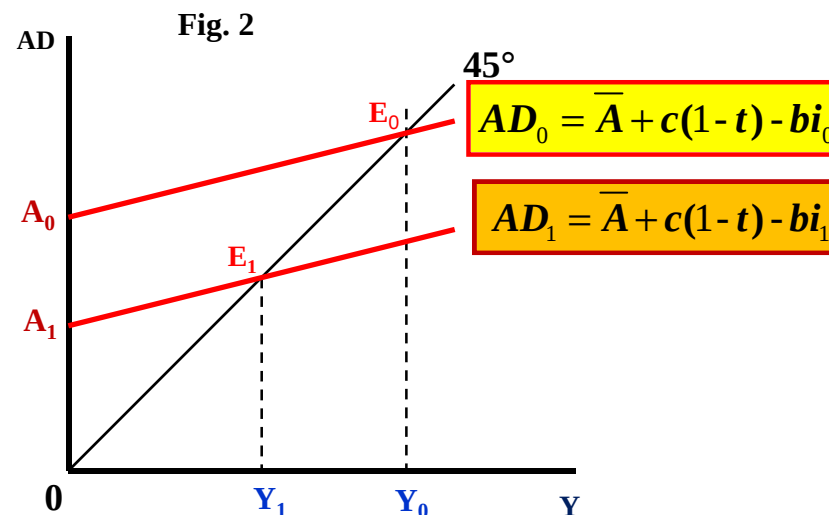
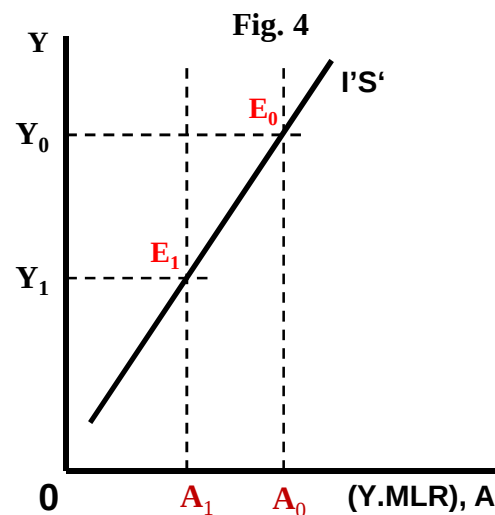
$$Y = \bar{a} \cdot (\bar{A} - bi)$$

If $i = 0$, then $bi = 0$

$$Y = \bar{a} \cdot \bar{A}$$

IS curve shows all combinations of interest rates (i) a level of income (Y), if the market of goods and services is in equilibrium, i.e. aggregate demand equals production (income): $AD = Y$.

IS curve – graphical derivation



IS CURVE

Position and points outside the IS curve

The slope IS: IS curve is the flatter (steeper), the greater (smaller) the expenditure multiplier and the higher (lower) the sensitivity of demand to autonomous expenditure rate.

The rate of sensitivity to interest rate (i)	Slope of IS
$b = 0$	vertical
$b \dots = \text{small}$	steep
$b \dots = \text{high}$	flatter
$b \dots = \text{infinity}$	horizontal

Points outside the IS curve:

- a) points leftward from the IS curve: aggregate demand is greater than aggregate supply ($IU < 0$) → production level is too low → involuntary drawdown of inventories
- b) points rightward from the IS curve: aggregate supply is greater than aggregate demand ($IU > 0$) → production level is high → unplanned inventory accumulation

Basic concepts and identity

Nominal wealth of the economy... WN/P

Demand for money ... L

Money supply ... M

Real money balances ... M/P

Demand (supply) for other financial assets $DOFA$ ($SOFA$)

$$1. \quad WN/P \equiv L + DOFA$$

$$2. \quad WN/P \equiv M/P + SOFA$$

$$3. \quad L + DOFA \equiv M/P + SOFA$$

$$4. \quad (L - M/P) + (DOFA - SOFA) \equiv 0$$

It is true that:

- if there is the equilibrium at the money market, there is also an equilibrium at the market of other financial assets
- if $L > M/P$, than $SOFA > DOFA$
- If $L < M/P$, than $SOFA < DOFA$

Conclusion: We are able to analyse the equilibrium at the market of financial assets through the money market equilibrium.

LM CURVE

a) Demand for money

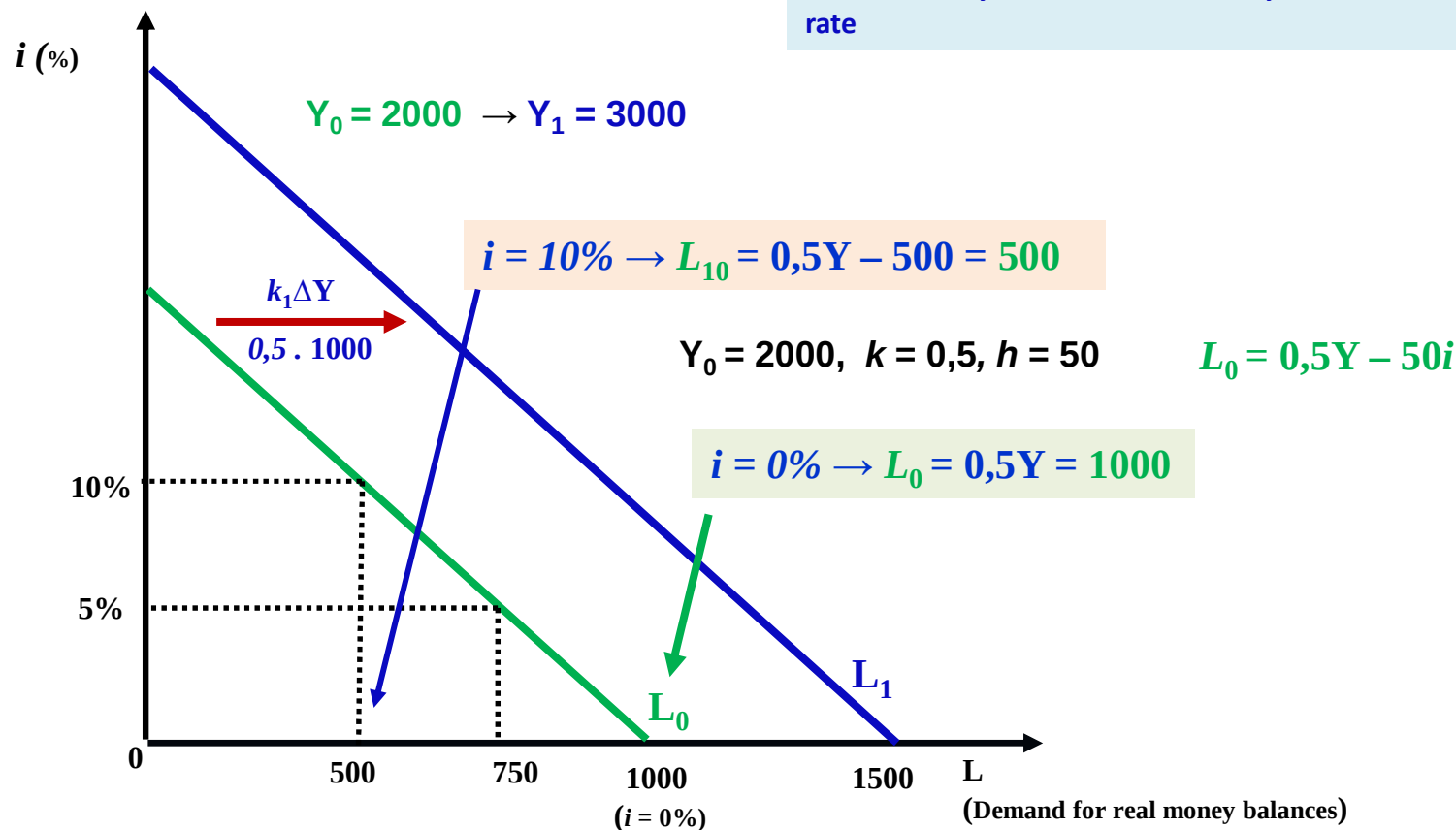
$$1. L = \frac{\bar{M}}{\bar{P}}; L = kY - hi$$

The sensitivity of demand for money (real money balances) to income

$$k = \frac{\Delta L}{\Delta Y}$$

The sensitivity of demand for money to interest rate

$$h = \frac{\Delta L}{\Delta i}$$



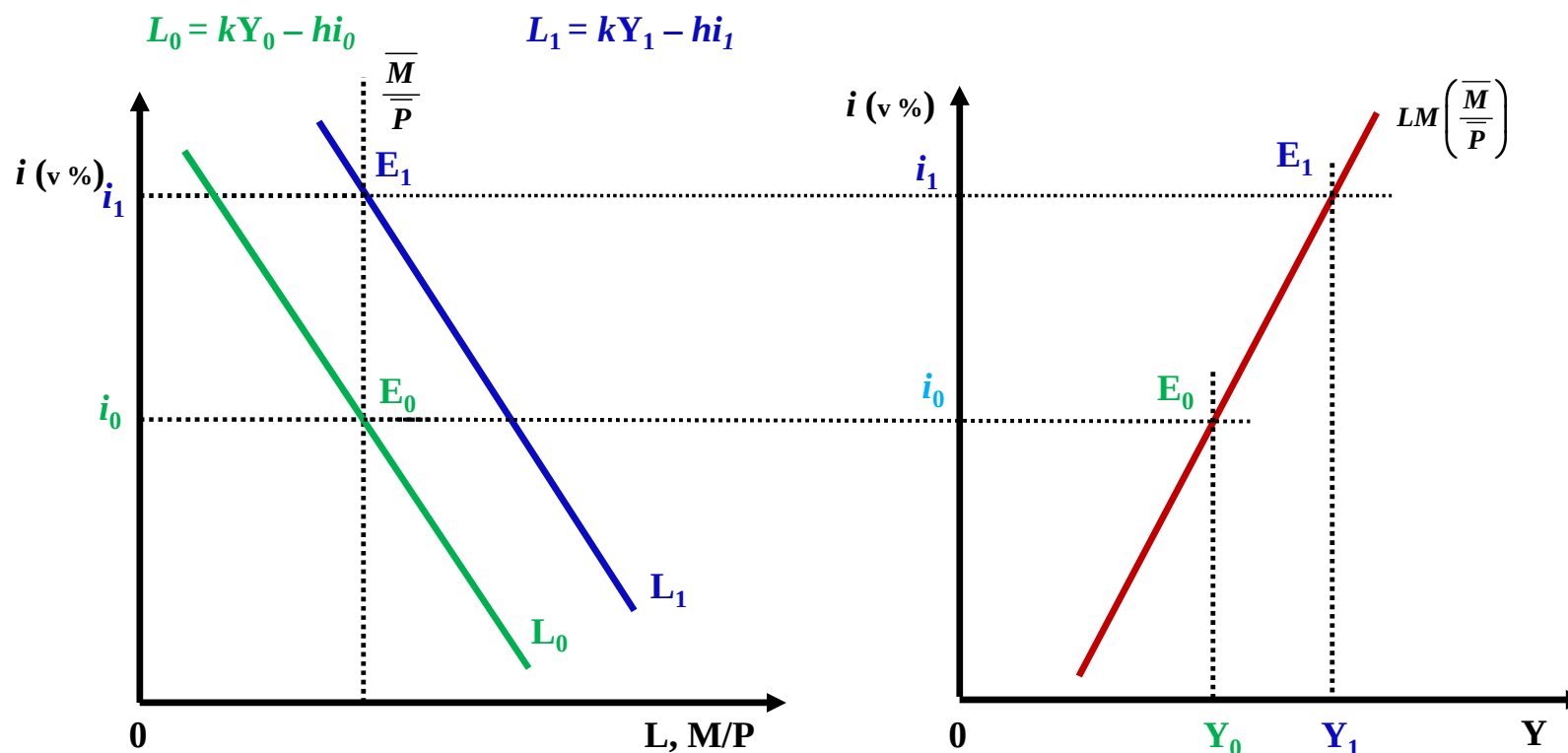
LM curve – graphical derivation

$$1. L = \frac{\bar{M}}{P}; \quad L = kY - hi$$

$$2. \frac{\bar{M}}{P} = kY - hi$$

LM curve equation:

$$i = \frac{1}{h} \cdot \left(kY - \frac{\bar{M}}{P} \right)$$



LM curve shows all combinations of interest rates (i) and income (Y), in which the money market and the market of other financial assets are in equilibrium (E).

Slope, position and point outside the LM curve

The slope of the curve LM: LM curve has a positive slope, which is conditioned by the fact that, given a fixed money supply must increase the level of income that increases the demand for real money balances associated with increases in interest rates. This reduces the quantity of demanded money, and keeps the money market in equilibrium.

Rates of h (k is given)	Slope of LM curve
$h = 0$	vertical
$h \dots = \text{small}$	steep
$h \dots = \text{high}$	flatter
$h \dots = \text{infinity}$	horizontal

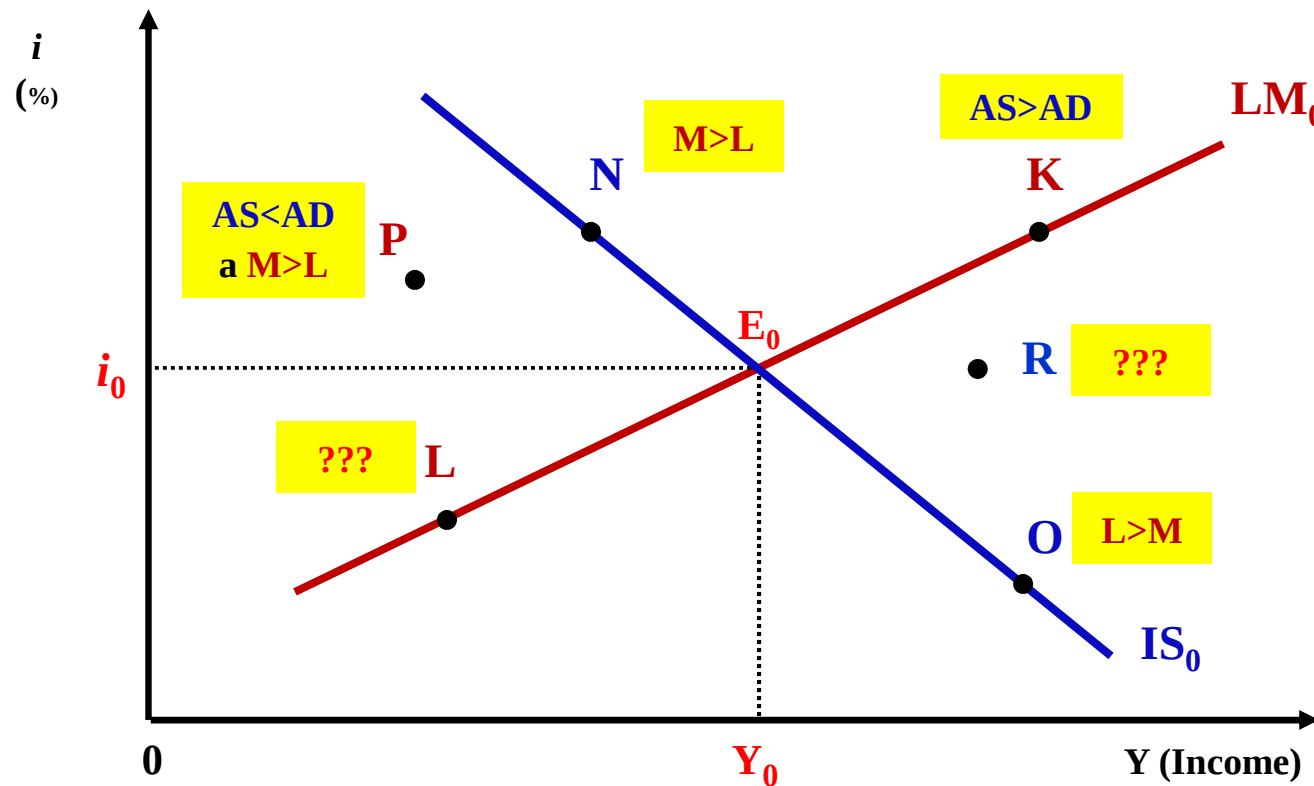
Points outside the LM curve:

- a) Points leftward from the LM curve: there is money supply excess and therefore DOFA surplus, as the income is low enough to create a demand for money.
- b) Points rightward from the LM curve: there is money demand excess and therefore SOFA surplus, as the income is too high and greater demand for money is generated.

CURRENT EQUILIBRIUM AT BOTH MARKETS: IS-LM MODEL

$$i_E = \frac{k}{h} \cdot \gamma \bar{A} - \frac{1}{h + \alpha b k} \cdot \frac{\bar{M}}{\bar{P}}$$

$$Y_E = \gamma \bar{A} + \gamma \frac{b}{h} \cdot \frac{\bar{M}}{\bar{P}}, \text{ kde } \gamma = \frac{\bar{a}}{1 + \frac{\alpha b k}{h}}$$



Equilibrium output and interest rate

The intersection of **IS** and **LM** curve.

$$\text{Rovnice křivky IS: } Y = \bar{\alpha} \left(\bar{A} - bi \right)$$

$$\text{Rovnice křivky LM: } i = \frac{1}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right)$$

Equilibrium output:

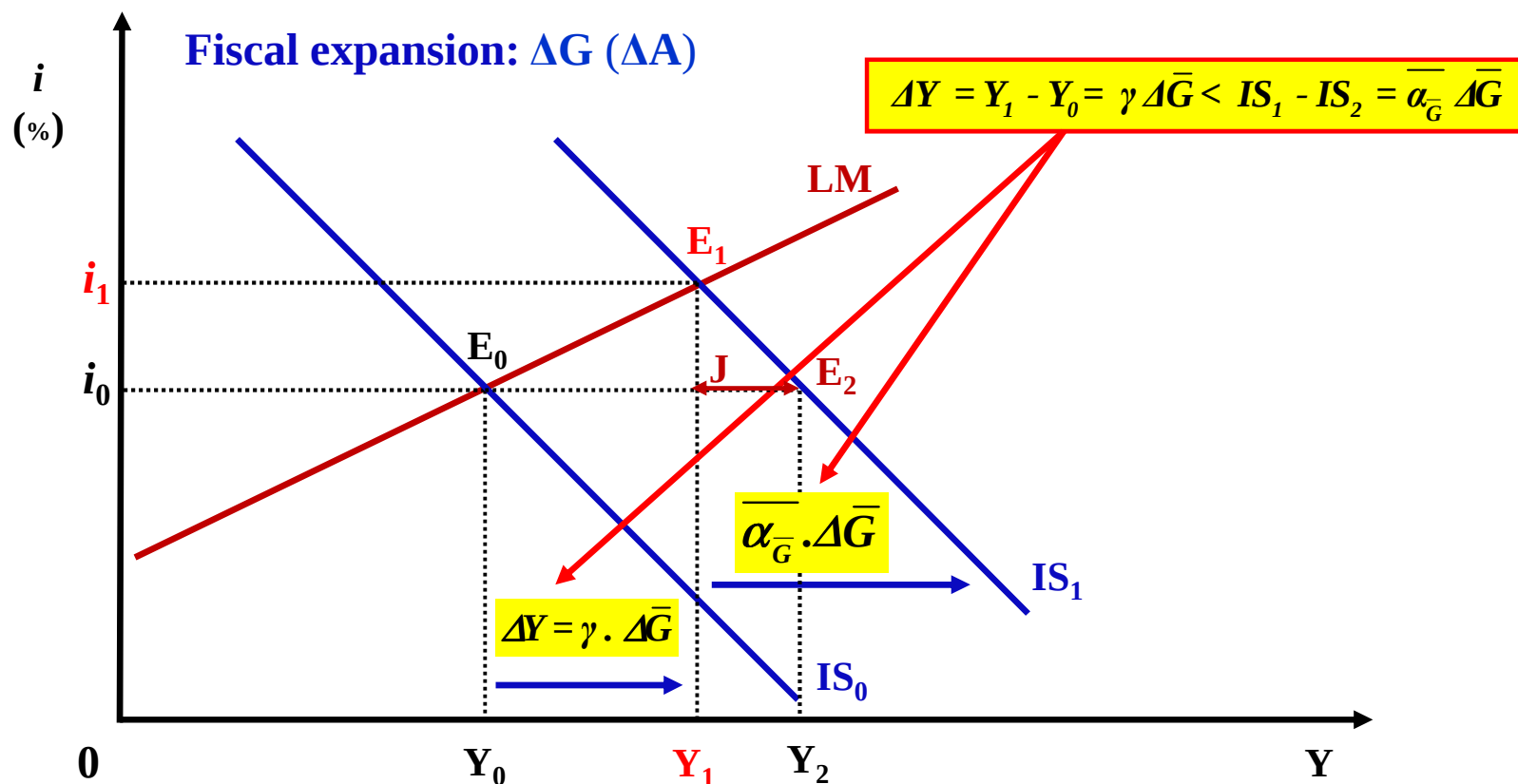
$$Y = \bar{\alpha} \left\{ \bar{A} - b \left[\frac{1}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right) \right] \right\} \quad \longrightarrow \quad \text{po úpravách a } \gamma = \frac{\bar{\alpha}}{1 + \frac{\alpha b k}{h}}$$

$$\text{Rovnovážný důchod: } Y = \gamma \cdot \bar{A} + \gamma \cdot \frac{b}{h} \cdot \frac{\bar{M}}{\bar{P}}$$

Equilibrium interest rate:

$$i = \left[\frac{1}{h} \cdot k \left(\gamma \bar{A} + \gamma \frac{b}{h} \frac{\bar{M}}{\bar{P}} \right) - \frac{\bar{M}}{\bar{P}} \right] \quad \longrightarrow \quad \text{Rovnovážná úroková sazba } i = \frac{k}{h} \cdot \gamma \bar{A} - \frac{1}{h + \alpha b k} \cdot \frac{\bar{M}}{\bar{P}}$$

Change in equilibrium output and equilibrium interest rate



Increase in interest rates causes a reduction in private autonomous expenditures (I & C) and there is a crowding out of private investment and consumer spending.

Distance between J and E_2 means the loss of Y due the crowding out effect.

Multiplier of fiscal and monetary policies

Multiplier of fiscal policy: γ

$$\Delta Y = \gamma \Delta \bar{A} + \gamma \cdot \frac{b}{h} \cdot \Delta \left(\frac{\bar{M}}{P} \right) = 0 \Rightarrow \Delta Y = \gamma \Delta \bar{A} \Rightarrow \frac{\Delta Y}{\Delta \bar{A}} = \gamma$$

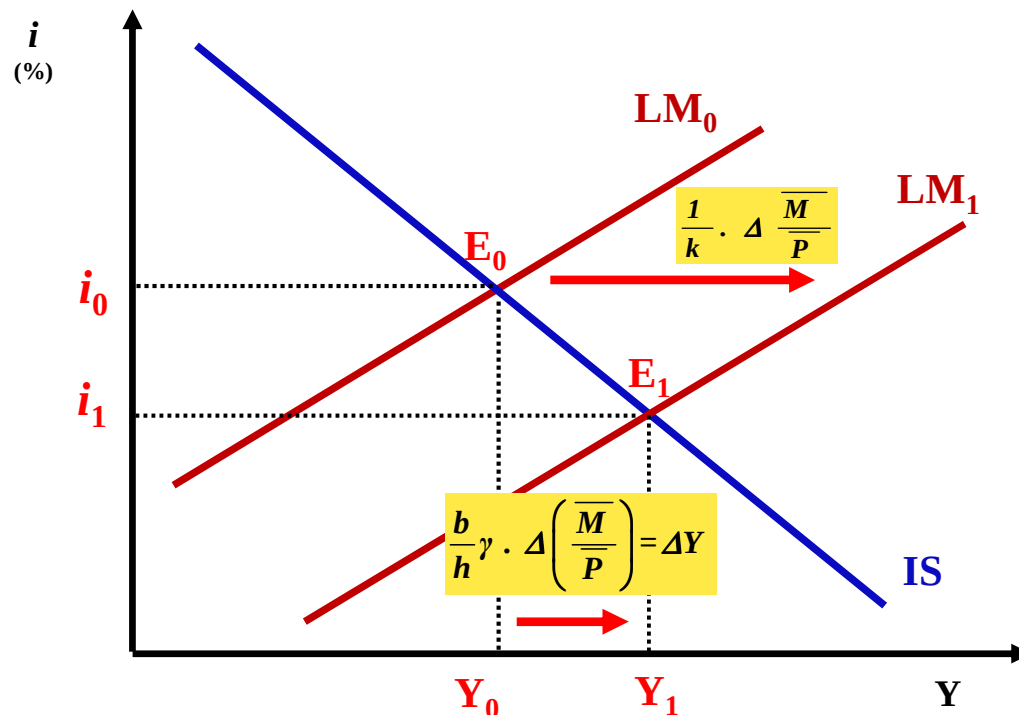
$$\gamma = \bar{\alpha} \frac{1}{1 + \frac{\alpha b k}{h}}$$

Multiplier of fiscal policy or government spending multiplier shows how much it will increase the equilibrium level of income due to increased government spending, if the supply of real money balances is constant.

Multiplier of monetary policy:

$$Y = \gamma \bar{A} + \gamma \cdot \frac{b}{h} \cdot \left(\frac{\bar{M}}{P} \right) \Rightarrow \Delta Y = \gamma \Delta \bar{A} + \gamma \cdot \frac{b}{h} \cdot \Delta \left(\frac{\bar{M}}{P} \right)$$

$$\frac{\Delta Y}{\Delta \left(\frac{\bar{M}}{P} \right)} = \gamma \cdot \frac{b}{h}$$



Multiplier of monetary policy expresses how an increase in real money balances raises the equilibrium level of income provided that fiscal policy is unchanged.

References and further reading:

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List of tasks for students

Exercise „The IS-LM model“

1. Explain the nature of the IS-LM model and its importance for macroeconomic analysis.
2. Characterize the market balance of goods and services, graphically derive the IS curve and by using its algebraic expression characterize the factors that affect the market balance of goods and services.
3. Characterize the market balance of assets (money), graphically derive the LM curve and by using its algebraic expression characterize the factors that affect the balance of the money market.
4. Explain the problem of possible changes in the equilibrium levels of income and interest rates.
5. Analyze the problem of adapting the economy as a movement towards its equilibrium.



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