INTERMEDIATE MACROECONOMICS

IS-LM MODEL OF BUSINESS CYCLES

11. IS & LM CURVES

Pascal Michaillat
pascalmichaillat.org/c4/

IS SUBMODEL

- consumer behavior: consumption = function of disposable income
- extended firm behavior: investment = function of interest rate and income
  - so far: investment was assumed to be constant
- accounting identity: income = expenditure
- IS curve: relates income Y to interest rate i when the IS submodel is in equilibrium

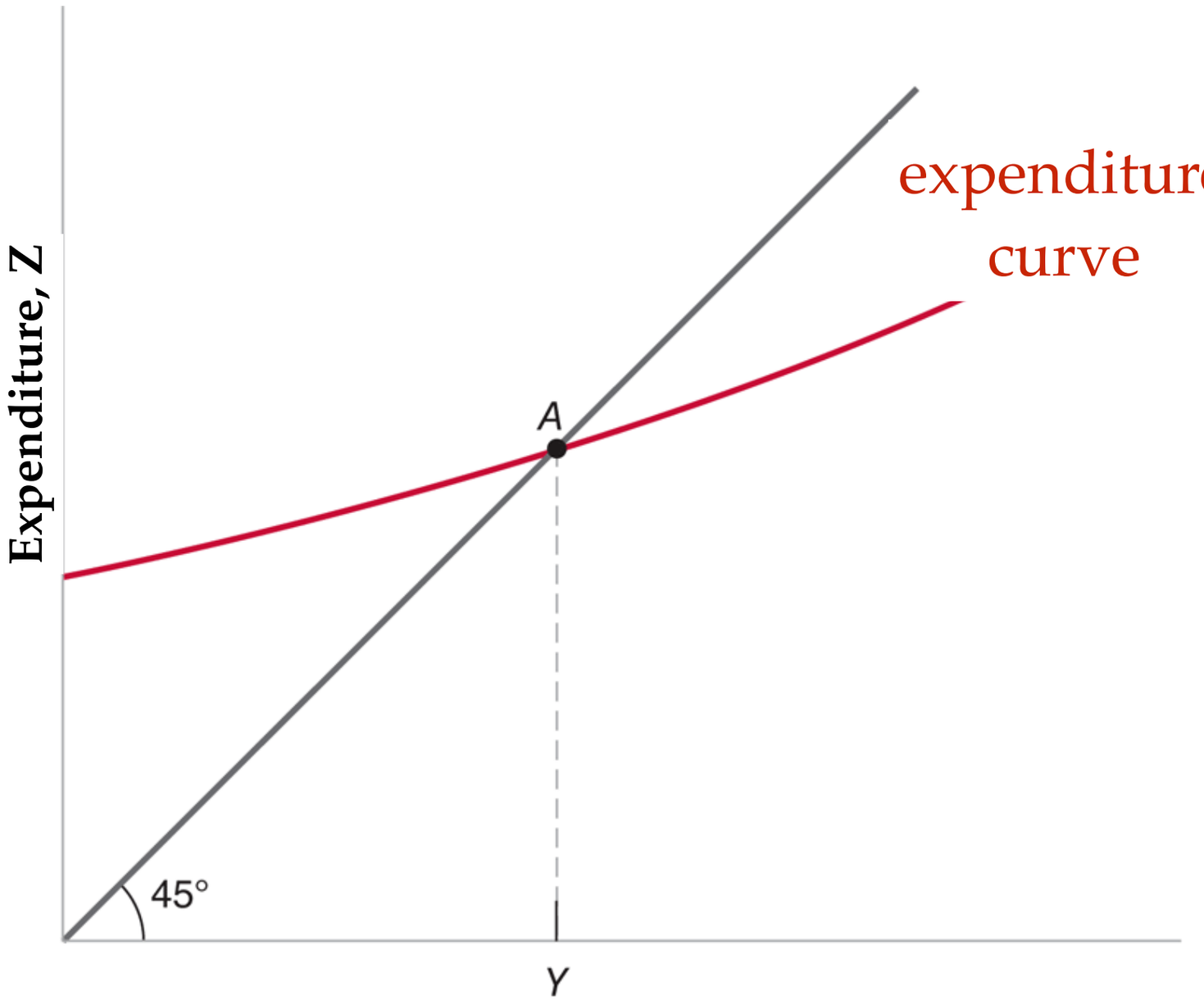
INVESTMENT

- firms invest based on income Y and interest rate i: $I = I(Y , i)$
- function I(Y,i) is increasing in Y: more income means and more production by the firm
  - this justifies investment in new productive capital
- function I(Y,i) is decreasing in i: higher interest rate means that it is more expensive to borrow money
  - this makes it less appealing to invest
- shape of investment function: $I(Y , i) = z_0(i) + z_1 \times Y$
  - $z_0(i)$ is a decreasing function of i
  - $z_1 < 1$ is the marginal propensity to invest out of income (MPI)

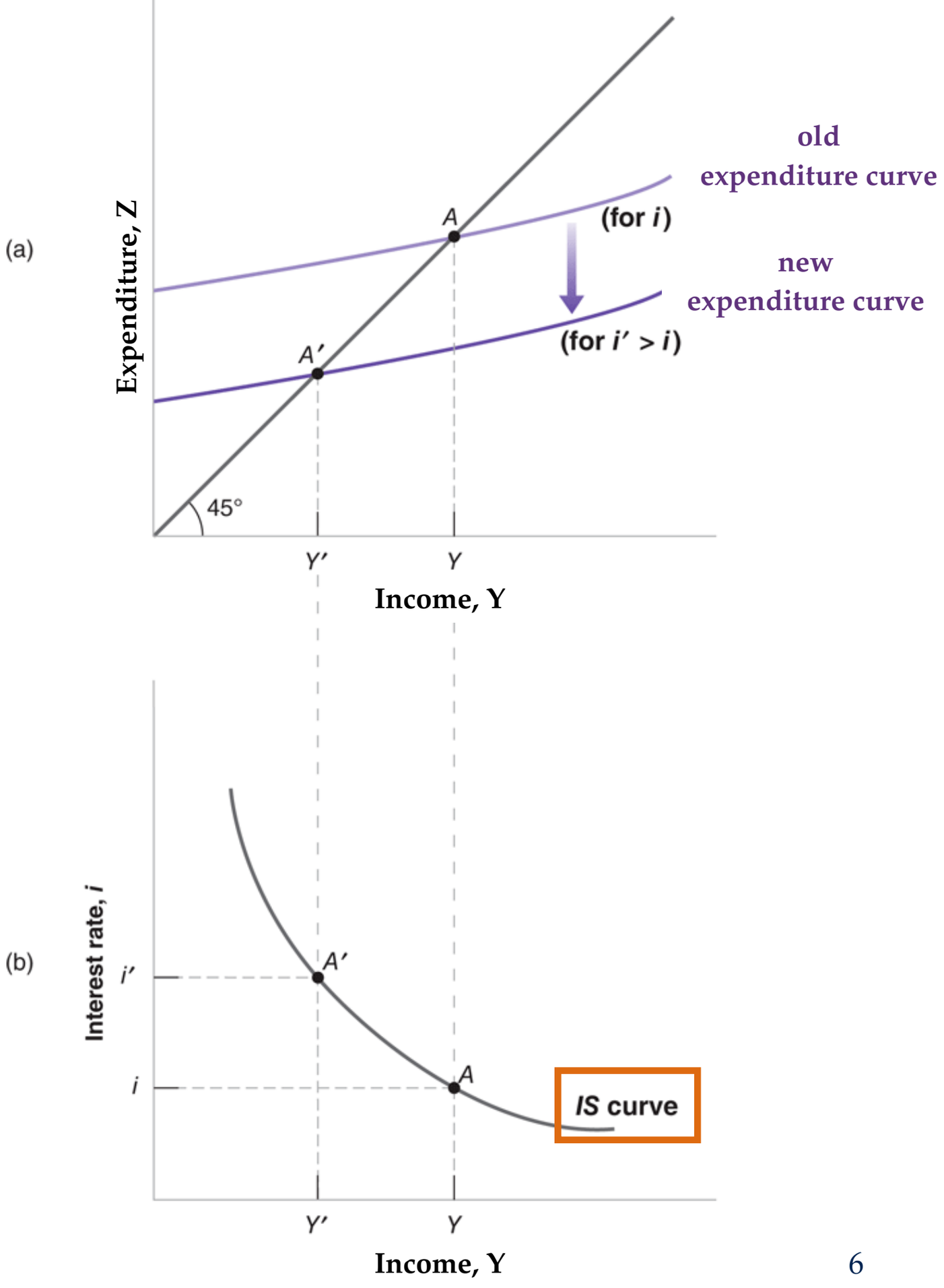
EQUILIBRIUM IN IS SUBMODEL

- expenditure function with investment:
  - $Z(Y,i) = C(Y - T) + I(Y\ ,\ i) + G$
  - $Z(Y,i) = c_0 + c_1 \times (Y - T) + z_0(i) + z_1 \times Y + G$
  - $Z(Y,i) = [c_0 + z_0(i) + G - c_1 \times T\ ] + [c_1 + z_1\ ] \times Y$
- income = expenditure: $Z = Y$
- combining both equilibrium conditions yields $Y = Z(Y,i)$, which gives
  - $Y^* = [c_0 + z_0(i) + G - c_1 \times T\ ] / [1 - c_1 - z_1\ ]$
  - autonomous expenditure: $c_0 + z_0(i) + G - c_1 \times T$
  - spending multiplier: $1/[1 - c_1 - z_1] > 1$ (need $c_1 + z_1 < 1$)
- in IS equilibrium, income Y^* depends on interest rate i

IS CURVE: GRAPHICAL CONSTRUCTION



- the expenditure curve is upward sloping
  - more income Y yields more consumption C and more investment I
- the expenditure curve is flatter than 45° line
- accounting identity: expenditure Z = income Y



- higher interest rate i decreases expenditure at any level of income
  - because it decreases investment I(Y,i)
- this leads to lower income Y
- the IS submodel implies that higher interest rate i leads to lower income Y
- IS curve is downward sloping in a (Y,i) plane

IS CURVE: NUMERICAL CONSTRUCTION

- consumers: $C(Y - T) = 30 + 0.5 \times (Y - T)$
  - marginal propensity to consume = 0.5
- firms: $I(Y,i) = 17 - 100 \times i$
- government: $G = 18$ and $T = 10$
  - government deficit: $G - T = 8$

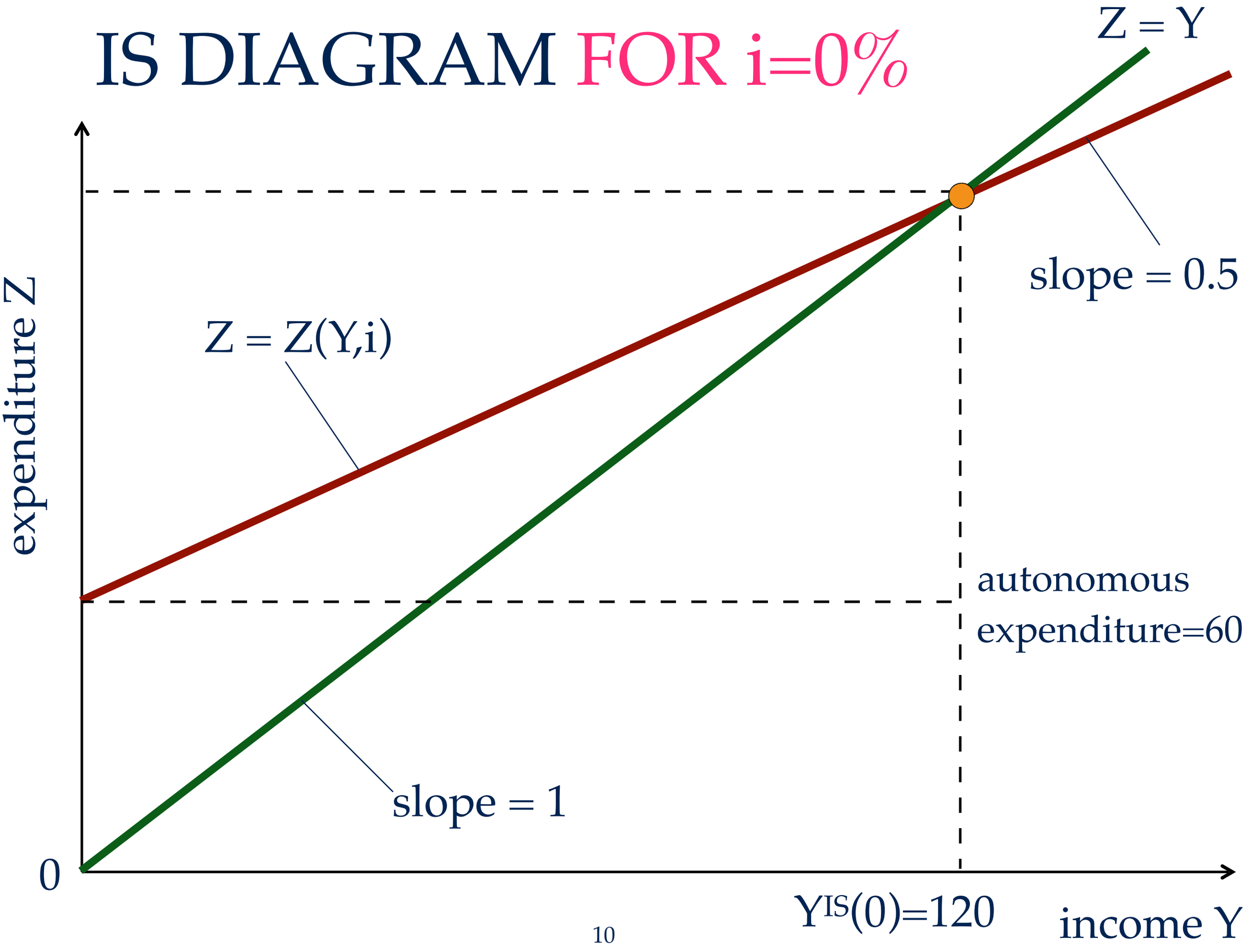
EXPENDITURE FUNCTION

- $Z(Y,i) = C(Y - T) + I(Y,i) + G$
- using our assumptions:
  - $Z(Y,i)=[30+0.5 \times (Y - 10)]+[17 - 100 \times i] + 18$
- reshuffling the terms to isolate Y:
  - $Z(Y,i) = [60 - 100 \times i] + 0.5 \times Y$
- autonomous expenditure: $60 - 100 \times i$
- spending multiplier: $1/0.5 = 2$

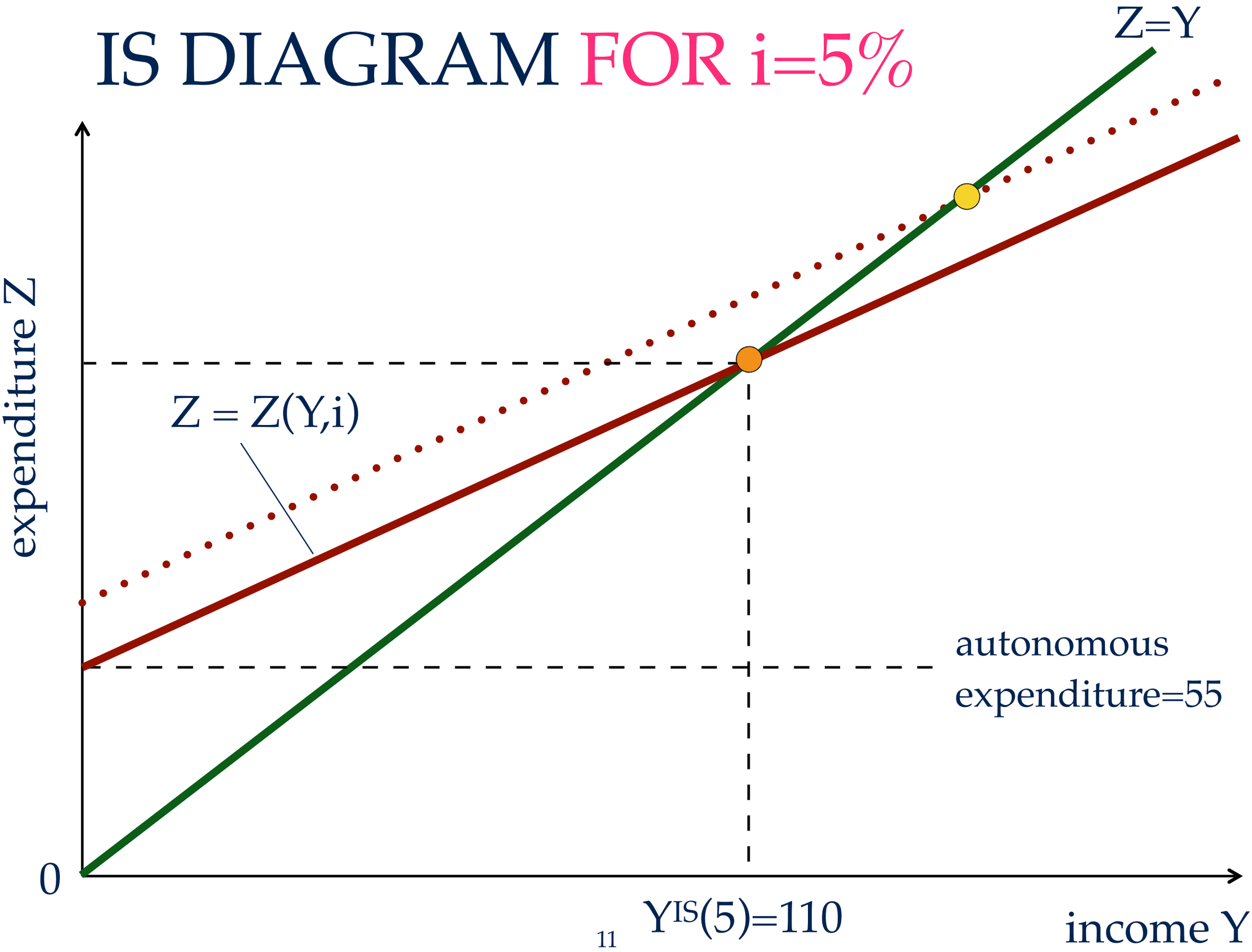
IS CURVE

- equilibrium condition 1 (accounting identity): $Y = Z$
- equilibrium condition 2 (expenditure function): $Z = Z(Y,i)$
- combining both conditions gives $Y = Z(Y,i)$, or
  - $Y = [60 - 100 \times i] + 0.5 \times Y$
  - $0.5 \times Y = [60 - 100 \times i]$
  - $Y = 2 \times [60 - 100 \times i] = 120 - 200 \times i = Y^{IS}(i)$
- the curve tracing $Y^{IS}(i)$ in a (Y,i) plane is the IS curve
  - IS curve is downward sloping because lower interest rate implies more investment and thus higher autonomous expenditure and, in equilibrium, more income

IS DIAGRAM FOR i=0%

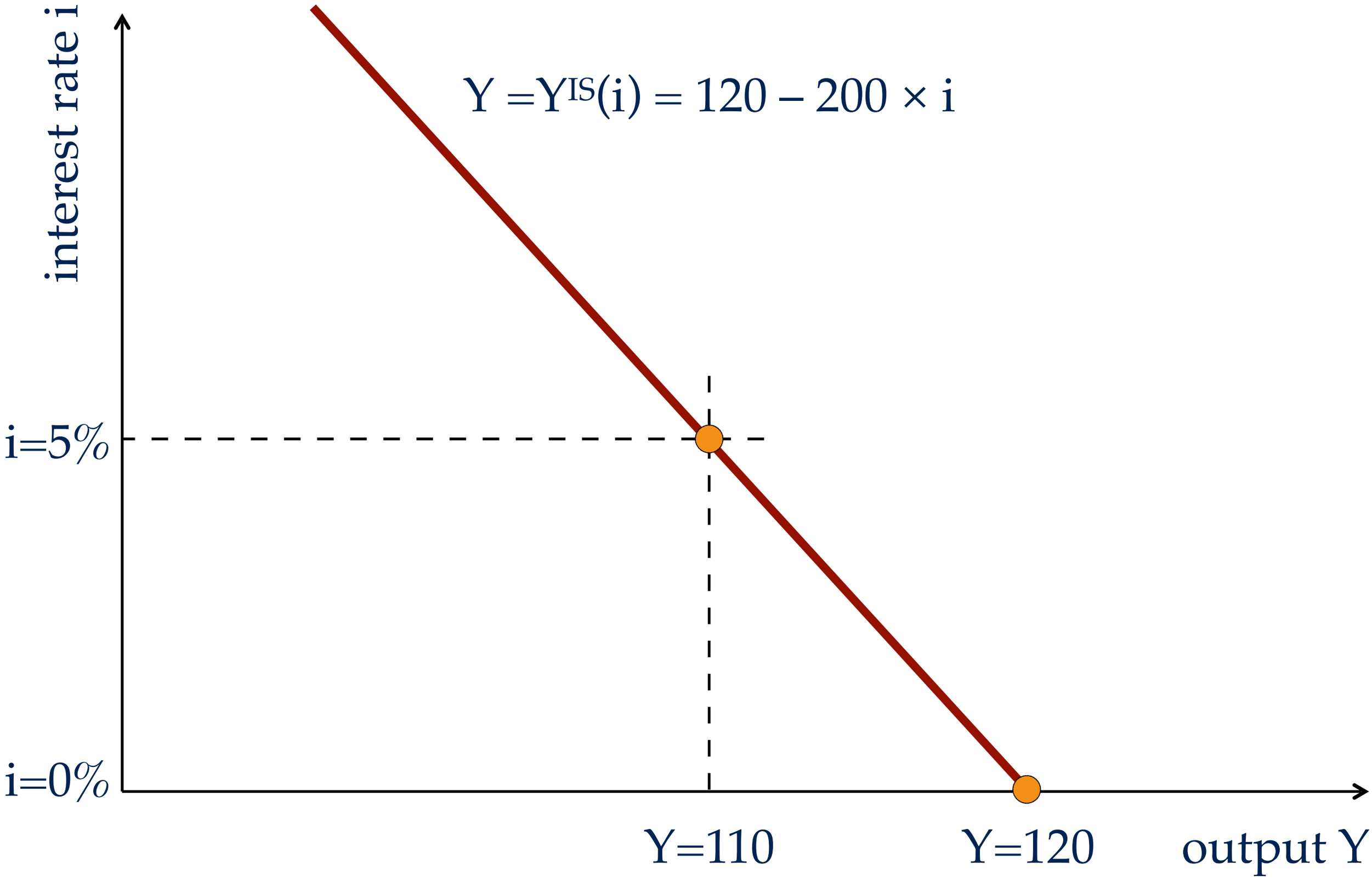


IS DIAGRAM FOR i=5%



IS CURVE

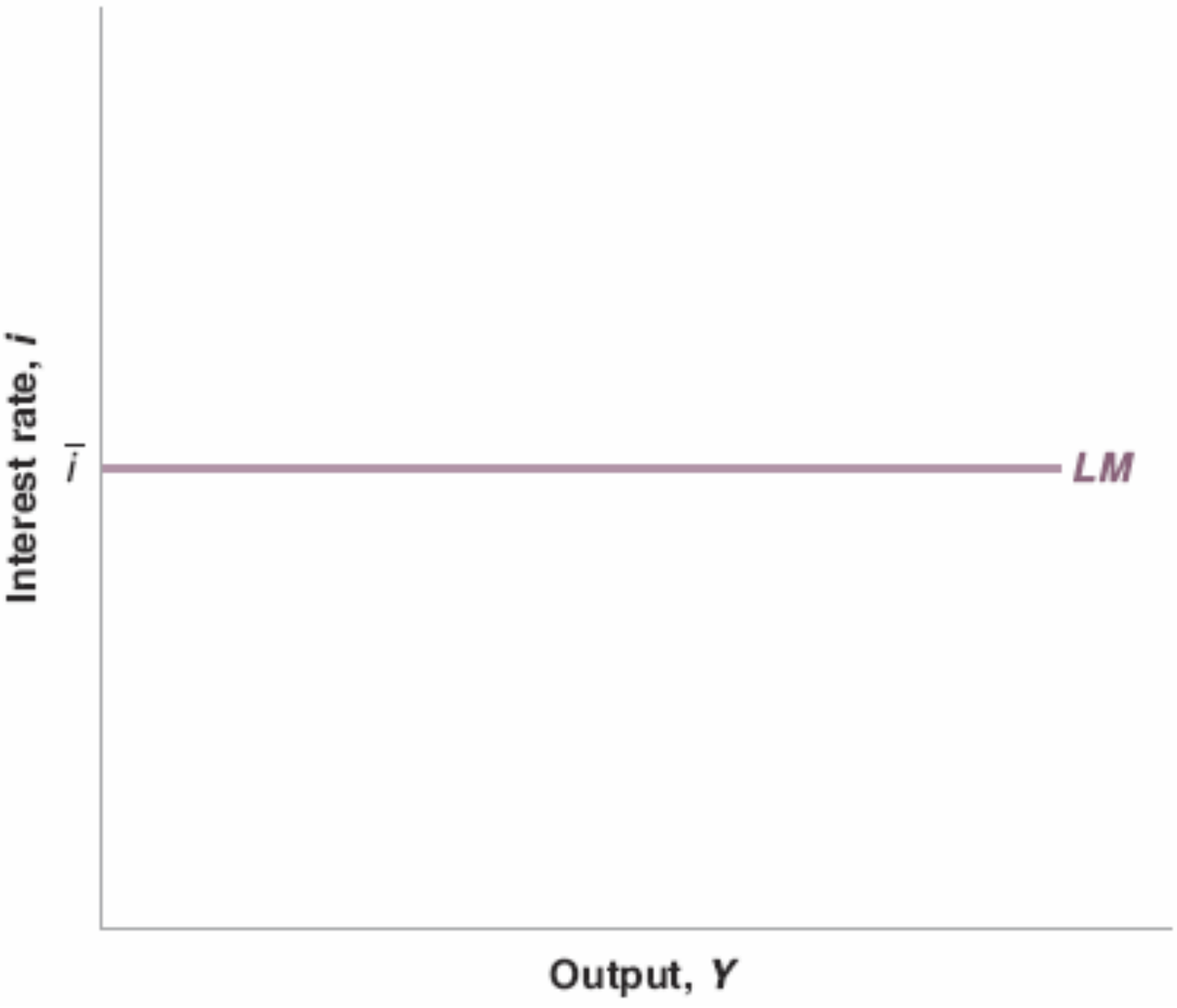
$$Y = Y^{IS}(i) = 120 - 200 \times i$$



LM SUBMODEL

- abstract from financial intermediaries
- demand for money: function of income + interest rate
- supply of money: determined by central bank
- in LM equilibrium: the interest rate adjusts so demand for money = supply of money
- LM curve indicates that central bank sets an interest rate i
  - in the background: central bank adjusts money supply through OMO to maintain the interest rate at i

LM CURVE



- for any level of output, the central bank maintains the interest rate at i
- i must be positive: monetary policy is subject to ZLB

IS-LM EQUILIBRIUM DIAGRAM