

AGGREGATE EXPENDITURE AND EQUILIBRIUM INCOME 2

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EE212

Introductory to macroeconomics

UP TO THIS POINT

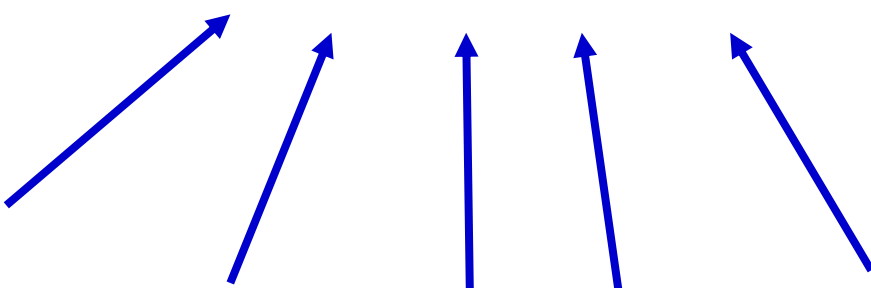
- We discussed about the behavior of **components of total spending**.
 - Theory of desired expenditure: $C, I, G, X, M (NX)$
- Various theories explain the behavior of components of total spending.
 - A common factor driving each type of spending is “**aggregate income**”.
- Given the total spending, this lecture focuses on the **aggregate income determination – i.e. equilibrium income determination!**

AGENDA

- **Aggregate expenditure function**
- Equilibrium income determination model
- Change in the equilibrium income and Multiplier
- Policy applications

AGGREGATE EXPENDITURE FUNCTION

- **Aggregate expenditure function:** behavioral equation that relates the aggregate expenditure to aggregate income.
- **Aggregate expenditure function =** Keynesian spending function combined

$$AE = C + I + G + X - M$$

$$C = \bar{C} - c_1(\bar{T} - \bar{R}) + c_1Y$$
$$I = \bar{I} + I_1Y$$
$$G = \bar{G}$$
$$X = \bar{X}$$
$$M = \bar{M} + m_1Y$$

AGGREGATE EXPENDITURE FUNCTION

$$AE = C + I + G + X - M = \overline{AE} + c_1Y + I_1Y - m_1Y$$

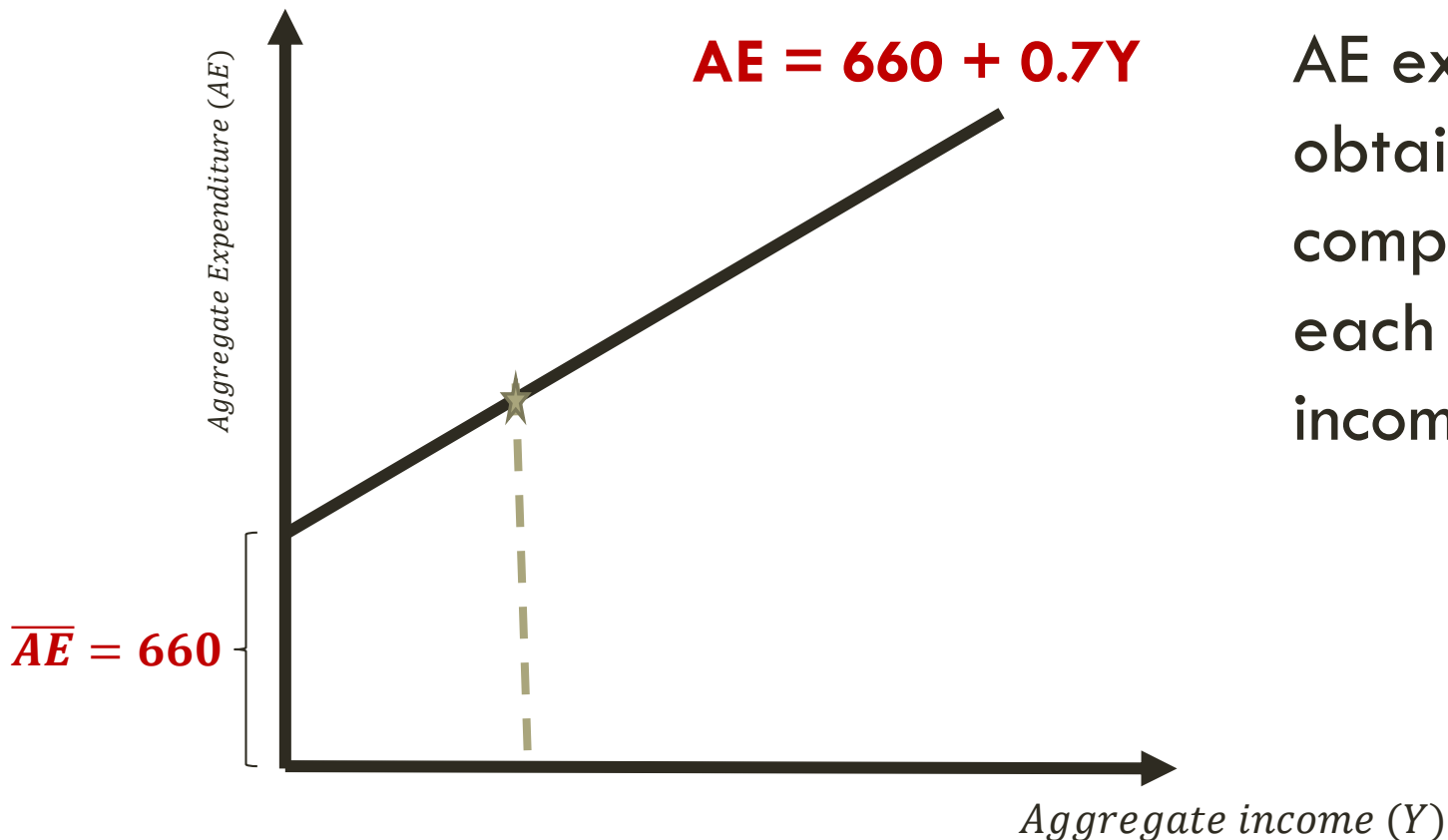
- $\overline{AE}$: (Net) autonomous aggregate expenditure
 - = Autonomous C, I, G – mpc*(Autonomous tax – Autonomous transfer) – Autonomous imports
 - Determined by non-income factors (given!)
- $c_1Y + I_1Y - m_1Y$: Income-induced desired aggregate expenditure

AGGREGATE EXPENDITURE FUNCTION: NUMERICAL EXAMPLE

➤ Suppose:

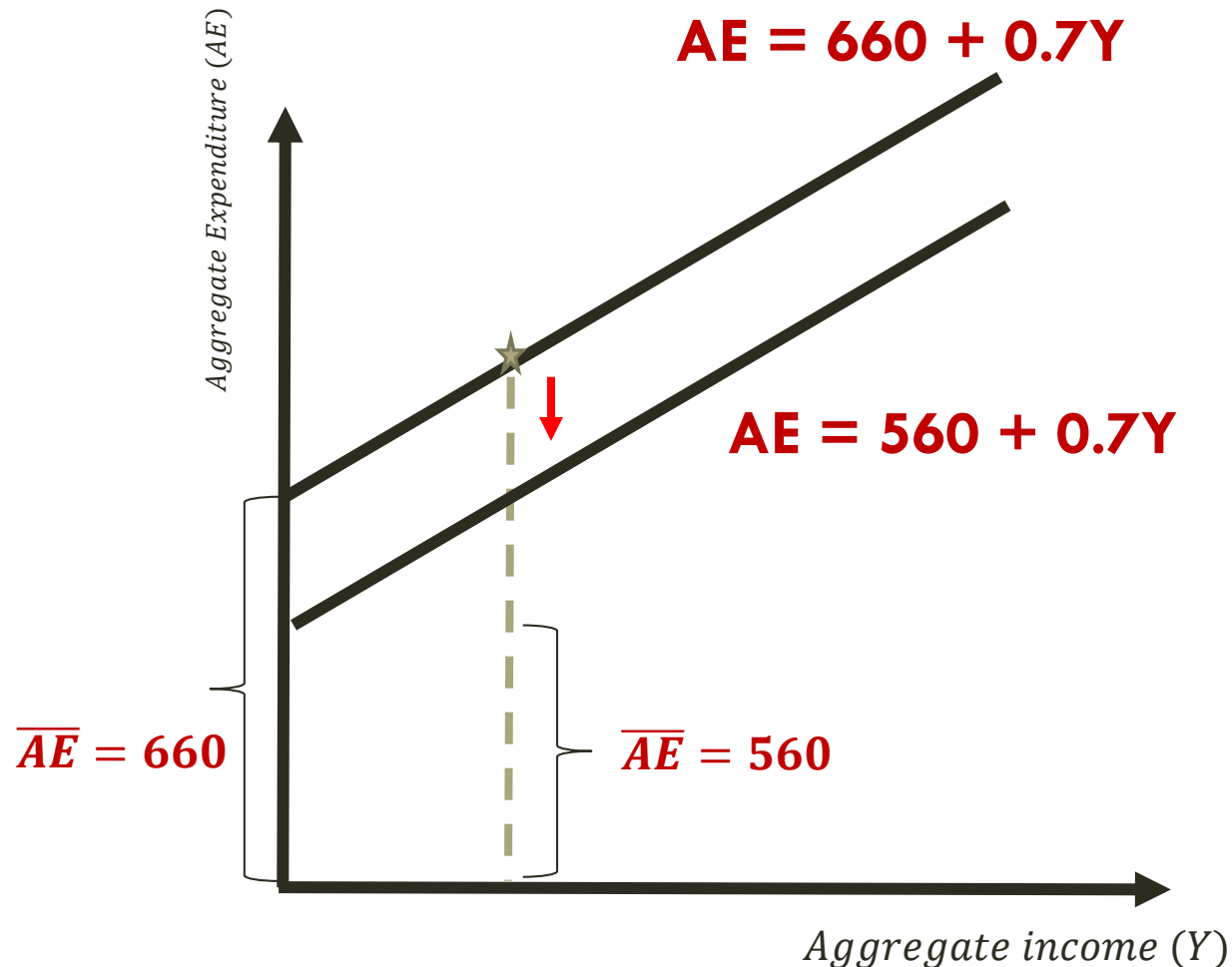
- $C = 185 + 0.75(Y - T + R)$; $T = 150, R = 50 \rightarrow T - R = 100$
- $I = 200 + 0.15Y$
- $G = 200$
- $X = 300$
- $M = 150 + 0.2Y$

AGGREGATE EXPENDITURE FUNCTION: AGGREGATE EXPENDITURE LINE



AE expenditure line can be obtained by **vertically summing up** components of total spending at each level of given aggregate income.

AGGREGATE EXPENDITURE FUNCTION: AGGREGATE EXPENDITURE LINE



$$C = 185 + 0.75(Y-100) \rightarrow$$

$$I = 200 + 0.15Y$$

$$G = 200$$

$$X = 300$$

$$M = 150 + 0.2Y$$

AE expenditure line can be changed if the (net) autonomous aggregate expenditure change or marginal propensity to spending (MPC, MPI, MPM)

Figure: A drop in autonomous consumption by 100 THB —e.g. $C = 85 + 0.75(Y-100)$

AGGREGATE EXPENDITURE FUNCTION: CHANGE IN THE AUTONOMOUS EXPENDITURE

- (Net) autonomous expenditure
= Autonomous consumption + Autonomous investment + Autonomous government spending + Autonomous exports – Autonomous imports – $MPC \cdot (\text{Autonomous tax} - \text{Autonomous transfer})$.
- Notice the direction and size of change.

ACTIVE LEARNING: EXPLAINING THE IMPACT OF FOLLOWING SITUATIONS / WHY?

- Tax cut by government
- Business sentiments improve
- Expectation of economic downturn in Thailand
- World GDP income decrease
- Thai baht appreciate
- Government lowers tax collection.
- Central bank increases the interest rate.

AGENDA

- Aggregate expenditure function
- **Equilibrium income determination model**
- Change in the equilibrium income and Multiplier
- Policy applications

EQUILIBRIUM INCOME DETERMINATION

- Income is components of total expenditure combined.
- But, aggregate expenditure depends on income!
- **Simultaneity problem:** Income and aggregate expenditure (as well as components of spending) *simultaneously* determine each other!
 - Technical jargon: *Endogenously determined*

EQUILIBRIUM INCOME DETERMINATION

- **Equilibrium income:** The level of income that makes *aggregate expenditure function equal to the income*

$$Y^* = AE(Y^*)$$

- **Idea:** Business units choose the level of output (income) that make sure all the output get exactly purchased – *i.e. no left-over output / no shortage of output.*

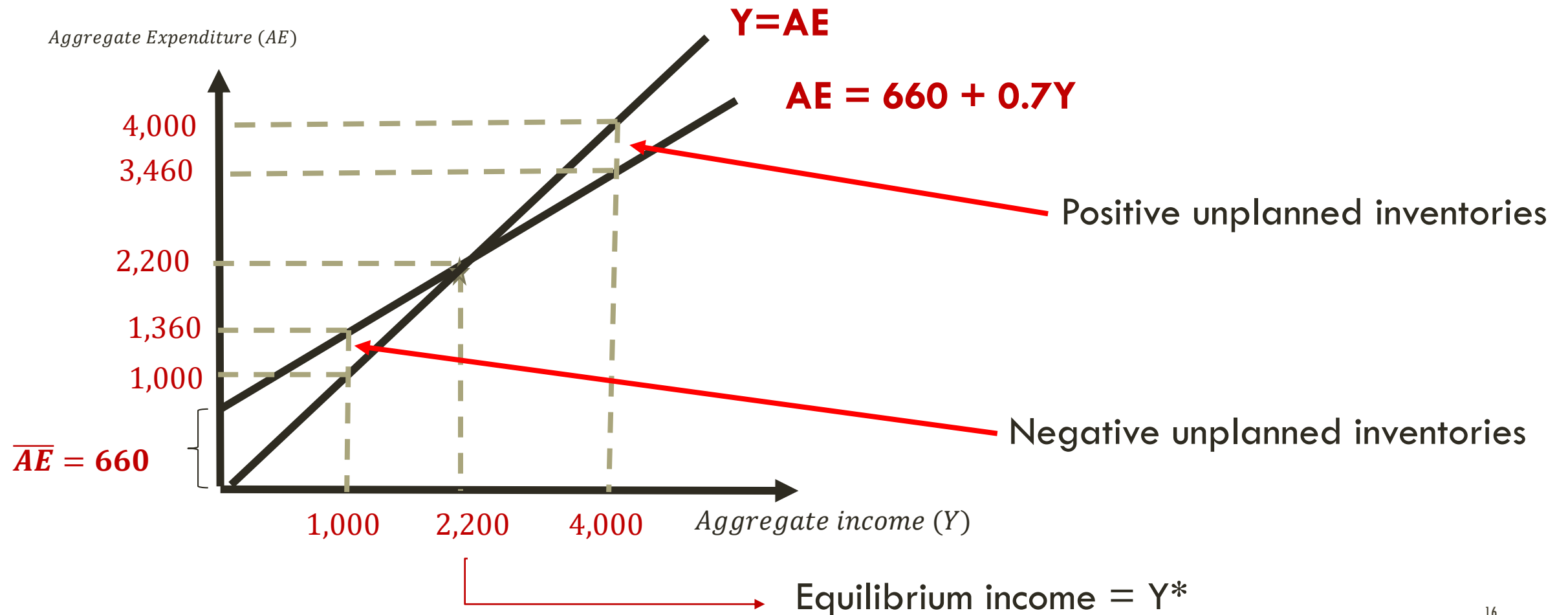
EQUILIBRIUM INCOME

- What do we mean by “all the output get exactly purchased?”
 - Having goods sold out does not mean that no output remains on the shelves.
- **Inventories:** product on the shelves or in the warehouse
 - **Planned inventories:** most firm plans the optimal inventory holdings.
 - **Unplanned inventories:** Unexpected drop in sale / Unexpected huge demand causes the amount of inventories higher / lower than planning

EQUILIBRIUM INCOME

- Firm will adjust the level of production (=Income) so as to make sure that unplanned inventories do not exist!
 - No pressure for adding or cutting the production
- Graphically illustrated, equilibrium income occurs where 45-degree line crosses with the (desired) aggregate expenditure line.
 - This is commonly known the Keynesian cross diagram

AGGREGATE EXPENDITURE FUNCTION: EQUILIBRIUM INCOME



AGENDA

- Aggregate expenditure function
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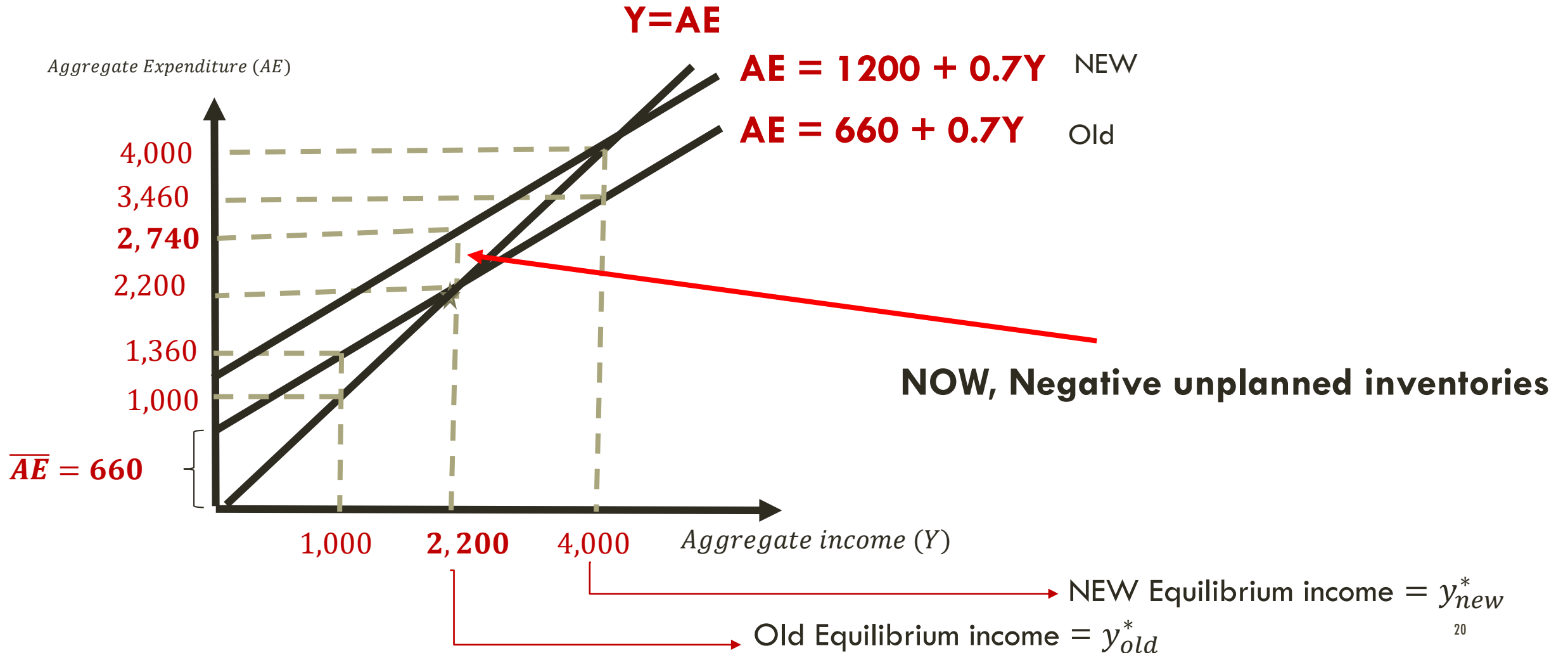
CHANGE IN EQUILIBRIUM INCOME

- Equilibrium income is determined by **NET autonomous expenditure**, which is ultimately determined by components of autonomous expenditure
 - Net autonomous aggregate expenditure
 - = **Autonomous consumption + Autonomous investment + Autonomous government spending + Autonomous exports – Autonomous imports – MPC*(Autonomous tax – Autonomous Transfer).**

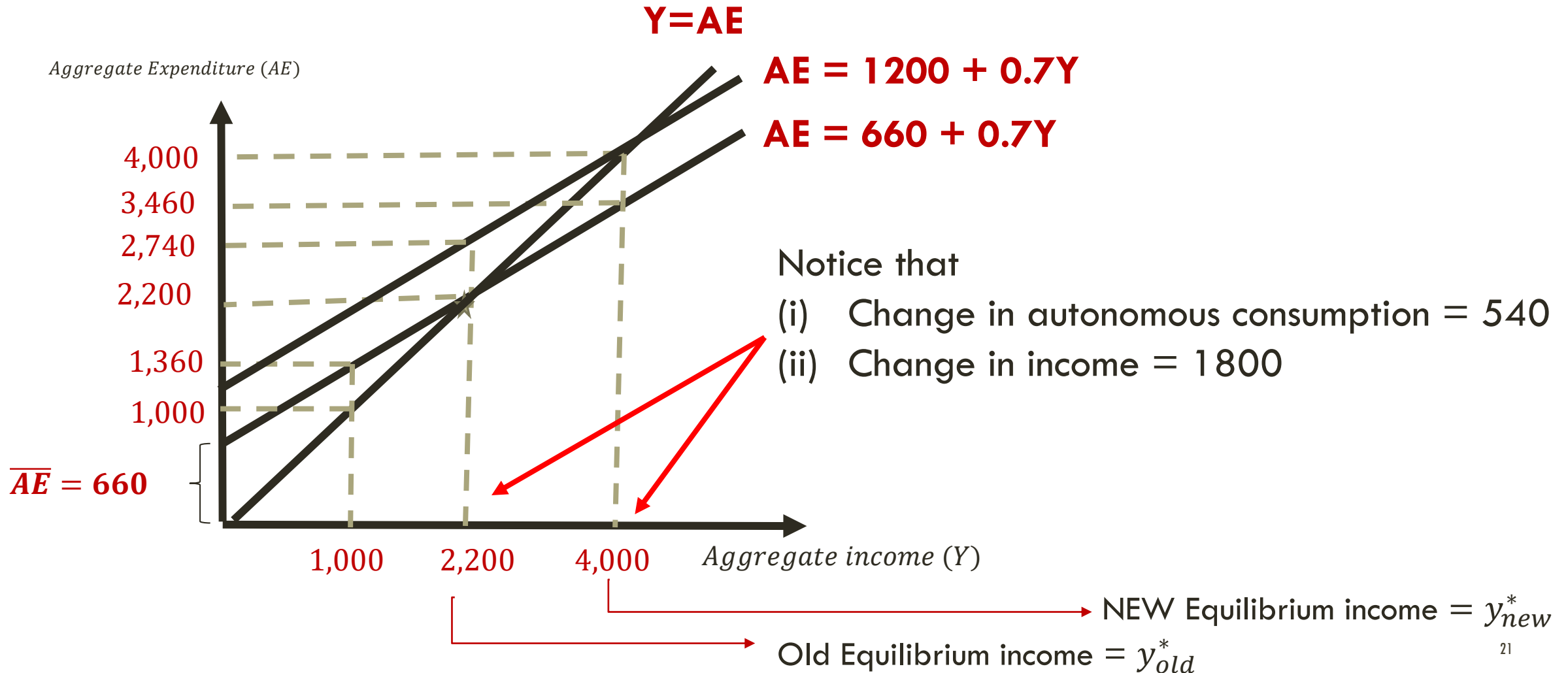
CHANGE IN EQUILIBRIUM INCOME

- If each of the autonomous expenditure changes, the level of equilibrium income will be changed as well
 - **Example:** Private sector may “*exogenously*” increase the autonomous consumption to **725** THB – i.e. an increase by 540 THB.
 - **Exogenous:** Having an external cause or origin.

CHANGE IN EQUILIBRIUM INCOME



CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER



CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

- First, a change in autonomous expenditure can create a change in national income.
- Second, the change in national income is **bigger** than the original change in autonomous consumption.

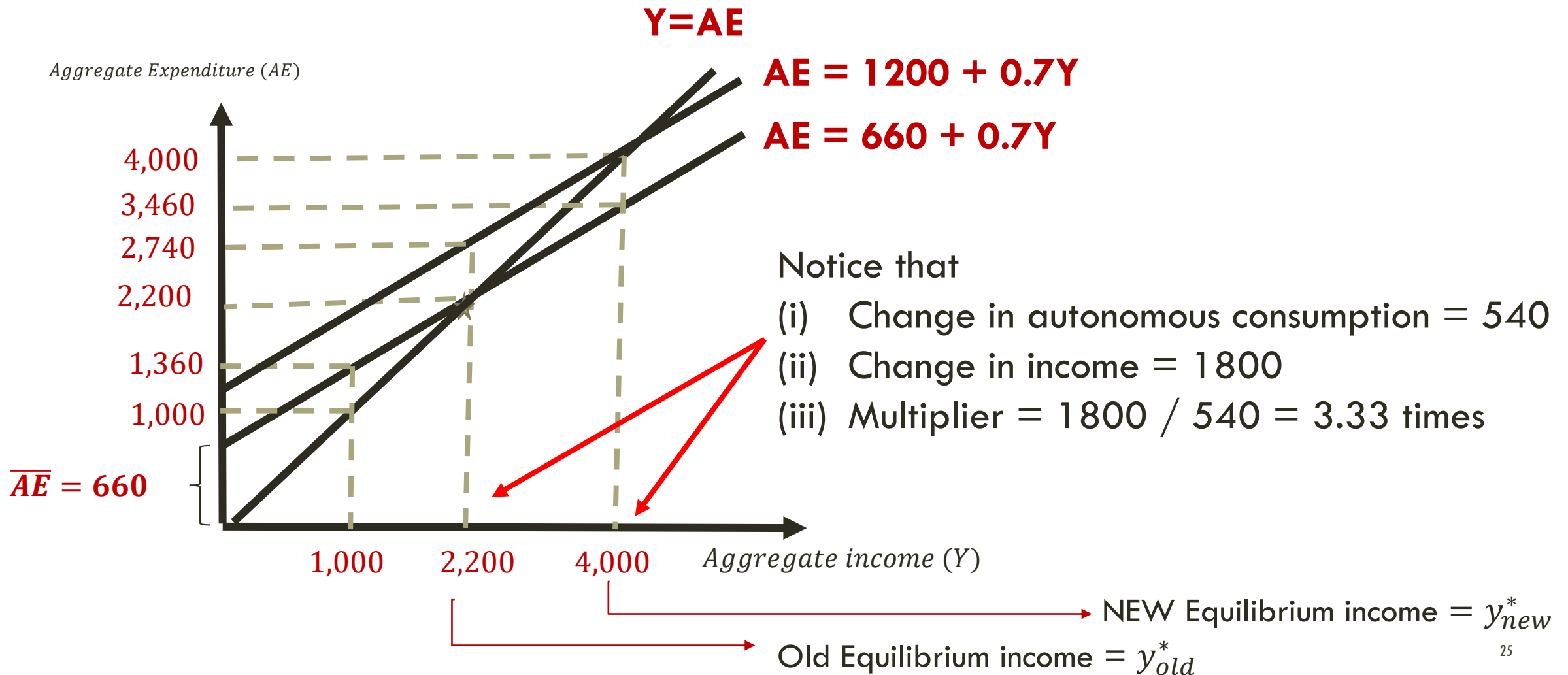
CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

- This is called the **multiplier effect** – i.e. the *amplified* change in equilibrium income due to the change in autonomous expenditure.
 - Multiplier: measuring the change in equilibrium income to the change in autonomous expenditure.
 - $\text{Multiplier} = \frac{\Delta y^*}{\Delta \bar{C}} = \frac{1800}{540} = 3.33$

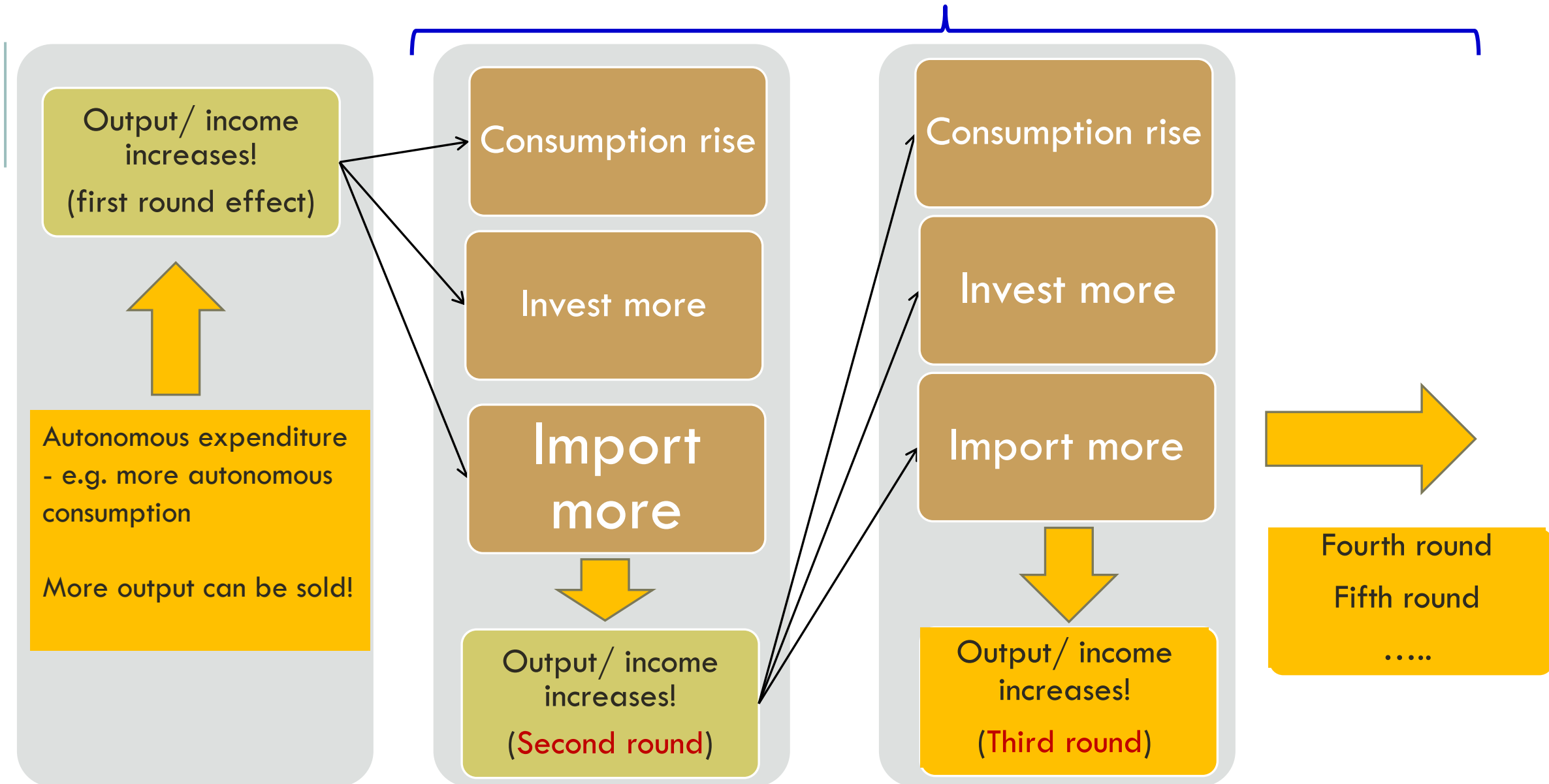
CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

- Rounds of interaction and impact!
 - **First-round effect:** The initial increase in autonomous consumption increases the aggregate output, and hence income by an equal amount.
 - **Indirect effects:** As income increases, private sectors will be spending more, causing **feedback effects** to the production. This **reinforces** the effect of the first round impact.

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER



Indirect effect (Spillover effect)



CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

➤ What is the multiplier effect?

Rounds of effect	C	I	G	X	M	Y
First-round	+540					+540
Second-round	+ 0.75(540)	+ (0.15) (540)			-0.2(540)	+ (0.7)(540)
Third-round	+ 0.75 ((0.7)(540))	+ (0.15) ((0.7)(540))			- 0.75 ((0.7)(540))	+ (0.7)(0.7)(540)
N-round effect						+ (0.7) ^{N-1} (540)

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

➤ Total effect = First-round effect + **Second-round effect +**

$$= 540 + \mathbf{0.7 (540) + (0.7)^2(540) + \dots}$$

$$= \{1 + 0.7 + (0.7)^2 + \dots\}(540)$$

$$= \frac{1}{1-0.7} (540)$$

$$= \left(\frac{10}{3}\right) (540)$$

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

➤ What is the multiplier effect?

Rounds of effect	C	I	G	X	M	AE = Y (Income)
First round effect	540					+ 540
Second round effect	MPC(540)	(MPI) (+540)			MPM(+540)	+ (MPC+MPI-MPM)(540)
Third round effect	MPC ((MPC+MPI-MPM))(+540))	(MPI) ((MPC+MPI-MPM))(+540))			MPM ((MPC+MPI-MPM))(+540))	+ (mpc + mpi – mpm)²(540)
N-round effect						+ (mpc + mpi – mpm)^{N-1}(540)

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

- Total effect = First-round effect + Second-round effect +
- $$= 540 + (mpc + mpi - mpm) (540) + (mpc + mpi - mpm)^2 (540) + \dots$$
- $$= \{1 + (mpc + mpi - mpm) + (mpc + mpi - mpm)^2 + \dots\} (540)$$
- $$= \frac{1}{1 - (mpc + mpi - mpm)} (540)$$
- Multiplier = $\frac{1}{1 - (mpc + mpi - mpm)}$

MULTIPLIER OF AUTONOMOUS CONSUMPTION

- Multiplier of autonomous consumption is equal to $\frac{1}{1-(mpc+mpi-mpm)}$
- Positive value (meaning?)
 - As the autonomous consumption rises (falls), equilibrium income rises (falls)
 - Greater than 1 if $mpc + mpi - mpm < 1$
 - The impact is bigger than 1.
 - For every 1 THB increase in the autonomous consumption, equilibrium income will change by $\frac{1}{1-(mpc+mpi-mpm)} > 1$.

MULTIPLIER OF OTHER AUTONOMOUS EXPENDITURES

- Other autonomous factors can also create similar effect
 - Recall that $\overline{AE} = \bar{C} + \bar{I} + \bar{G} + \bar{X} - \bar{M} - mpc * \bar{T} + mpc * \bar{R}$
 - This could be any autonomous factors.
- How about others?
 - All, except the autonomous tax and autonomous transfer, create a one-to-one change on net autonomous expenditure – i.e. equal shift of AE curve.
 - They all have the same multiplier!

MULTIPLIER OF OTHER AUTONOMOUS EXPENDITURES

Autonomous expenditure	Multiplier
$\bar{C}$	$\frac{1}{1 - (mpc + mpi - mpm)}$ Positive value, greater than one
$\bar{I}$	
$\bar{G}$	
$\bar{X}$	
$\bar{M}$	$-\frac{1}{1 - (mpc + mpi - mpm)}$ Negative value, greater than one

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

➤ What is the multiplier effect: autonomous import

Rounds of effect	C	I	G	X	M	AE = Y (Income)
First round effect					+ 1	- 1
Second round effect	MPC(-1)	(MPI) (-1)			MPM (-1)	(MPC+MPI-MPM)* (-1)
Third round effect	MPC * (MPC+MPI-MPM)*(-1)	(MPI)* (MPC+MPI-MPM)* (-1)			MPM* (MPC+MPI-MPM)*(-540)	$(mpc + mpi - mpm)^2(-1)$
N-round effect						$(mpc + mpi - mpm)^{N-1}(-1)$

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

- The multiplier of autonomous imports is **negative**.
 - As autonomous imports rise, aggregate expenditure will drop (money flows out to foreign countries.)
 - This reduces the level of output that firms choose in the product; the total income in the country then decreases.
 - The effect goes around in a number of round like when the increase in autonomous consumption affects the equilibrium income.
 - Negative value implies that “equilibrium income” falls when the “autonomous imports” rise.

MULTIPLIER OF OTHER AUTONOMOUS EXPENDITURES

- What about **autonomous tax and autonomous transfer**?
- Similar to other, but not that the first-round effect is smaller by a fraction of “MPC”
 - Transfer and tax does not create a direct exchange of goods & services.
 - Induced higher consumption, by a fraction of MPC.
 - Income changes by $(MPC \times \text{autonomous change in tax-or-transfer})$

MULTIPLIER OF OTHER AUTONOMOUS EXPENDITURES

Autonomous expenditure	Multiplier
$\bar{T}$	$- \frac{mpc}{1 - (mpc + mpi - mpm)}$ Negative value → An increase in autonomous tax will result in a decline in equilibrium income
$\bar{R}$	$\frac{mpc}{1 - (mpc + mpi - mpm)}$ Positive value → An increase in autonomous transfer will result in an increase in equilibrium income

CHANGE IN EQUILIBRIUM INCOME: MULTIPLIER

Effect of the increase in autonomous tax: note that the size of initial change in AE, and hence income, is by MPC a fraction of the increase in tax

Rounds of effect	C	I	G	X	M	AE = Y (Income)
First round effect	$MPC \times (-1)$					$MPC \times (-1)$
Second round effect	$MPC \times (MPC \times (-1))$	$(MPI) \times (MPC \times (-1))$			$MPM \times (MPC \times (-1))$	$(MPC + MPI - MPM) \times (MPC \times (-1))$
Third round effect	$MPC \times ((MPC + MPI - MPM)) \times (MPC \times (-1))$	$MPI \times ((MPC + MPI - MPM)) \times (MPC \times (-1))$			$MPI \times ((MPC + MPI - MPM)) \times (MPC \times (-1))$	$(mpc + mpi - mpm)^2 \times (MPC \times (-1))$
N-round effect						$(mpc + mpi - mpm)^{N-1} \times (MPC \times (-1))$

MULTIPLIER

- Multiplier is specific to model
- If the structure of macroeconomy differs, multiplier for the same autonomous factor will be changed too - i.e. Model-dependent multiplier

EXAMPLE 2

Consider an economy with the following behavioral equations;

Consumption $C = 120 + 0.7 * Y_d$

Investment $I = 60 + 0.17 * Y$

Government $G = 67$

Tax $T = 15 + 0.1 * Y$

Transfer $R = 5$

Exports $X = 20$

Imports $M = 10 + 0.05Y$

- Draw the aggregate expenditure line (AE-line).
- Calculate the equilibrium income and locate the equilibrium point in the Keynesian cross diagram.
- Calculate the multipliers of autonomous government, autonomous tax and autonomous export
- Derive the formula of multipliers under the given model

**A) DRAW THE AGGREGATE EXPENDITURE LINE
(AE-LINE)**

B) CALCULATE THE EQUILIBRIUM INCOME AND LOCATE THE EQUILIBRIUM POINT IN THE KEYNESIAN CROSS DIAGRAM

C) CALCULATE THE MULTIPLIERS OF AUTONOMOUS GOVERNMENT, AUTONOMOUS TAX AND AUTONOMOUS EXPORT

D) DERIVE THE FORMULA OF MULTIPLIERS UNDER THE GIVEN MODEL: EXPORTS

Rounds of effect	C	I	G	X	M	AE = Y (Income)
First round effect						
Second round effect						
Third round effect						
N-round effect						

D) DERIVE THE FORMULA OF MULTIPLIERS UNDER THE GIVEN MODEL: TAX

Rounds of effect	C	I	G	X	M	AE = Y (Income)
First round effect						
Second round effect						
Third round effect						
N-round effect						

D) DERIVE THE FORMULA OF MULTIPLIERS UNDER THE GIVEN MODEL

Autonomous expenditure	Multiplier
$\bar{C}$	$\frac{1}{1 - (mpc * (1 - mpt + mpr) + mpi - mpm)}$
$\bar{I}$	
$\bar{G}$	
$\bar{X}$	
$\bar{M}$	$-\frac{1}{1 - (mpc * (1 - mpt + mpr) + mpi - mpm)}$

D) DERIVE THE FORMULA OF MULTIPLIERS UNDER THE GIVEN MODEL

Autonomous expenditure	Multiplier
$\bar{T}$	$\frac{mpc}{1 - (mpc * (1 - mpt + mpr) + mpi - mpm)}$
$\bar{R}$	$\frac{mpc}{1 - (mpc * (1 - mpt + mpr) + mpi - mpm)}$

EXERCISE

- Show step-by-step the impact of an increase in autonomous transfer, and derive the multiplier of autonomous transfer
- Explain what happens to the equilibrium income if households and firms expect an improving economic outlook in the future. Link your analysis to the concept of multiplier
- What is the total (net) impact on equilibrium income if both autonomous government expenditure and autonomous tax rise in the same proportion.

$$C = 45 + 0.6Y_d$$

$$I = 20 + 0.19Y$$

$$G = 30$$

$$X = 13$$

$$M = 5 + 0.1Y$$

$$T = 12 + 0.1Y$$

$$R = 7 - 0.1Y$$

AGENDA

- Aggregate expenditure function
- Equilibrium income determination model
- Change in the equilibrium income and Multiplier
- **Policy applications**

ECONOMIC PROBLEMS

- One of the government objectives is to ensure high-level of output (GDP).
- Ideally, government wish to keep the GDP at the full-employment level.
- In the reality, **actual output can be higher or lower than the full-employment level.**
- This leads to **economic GAP problem.**

ECONOMIC PROBLEMS: GAP PROBLEM

- Define $GAP = y^* - y^f$
 - y^f = full-employment output
 - y^* = actual equilibrium output
- The economy is experiencing a **deflation GAP problem** if **$GAP < 0$** .
- The economy is experiencing an **inflation GAP problem** if **$GAP > 0$** .

ECONOMIC PROBLEMS: FIXING THE GAP PROBLEM

- Boom / Recession are both costly.
 - **Recession ($GAP < 0$):** Unemployment is high.
 - **Boom ($GAP > 0$):** Inflation is high; hurting people
- The GAP problem can be fixed if government assigns the right type of policy.
 - $GAP < 0 \rightarrow$ Expansionary policy: increase G , decrease T , increase R
 - $GAP > 0 \rightarrow$ Contractionary policy: lower G , increase T , lower R

ECONOMIC PROBLEMS: SIZE OF POLICY ACTION

- **Applications:** Multiplier effect
- Given we know the size of GAP, one can apply the multiplier concept to back out the required change of government spending, tax, and transfers.

$$\Delta y = multiplier_G * \Delta G \rightarrow \frac{GAP}{multiplier_G} = \Delta G$$

$$\Delta y = multiplier_T * \Delta T \rightarrow \frac{GAP}{multiplier_T} = \Delta T$$

$$\Delta y = multiplier_R * \Delta R \rightarrow \frac{GAP}{multiplier_R} = \Delta R$$

EXAMPLE

- What kind of economic problem are we experiencing if the full-employment level of GDP is 275.
- Propose some policies that can fix the economic problem.

$$C = 45 + 0.6Y_d$$

$$I = 20 + 0.19Y$$

$$G = 30$$

$$X = 13$$

$$M = 5 + 0.1Y$$

$$T = 12 + 0.1Y$$

$$R = 7 - 0.1Y$$



EXERCISE 1

- Consider two countries with the structure of macroeconomy given by the information in the table. Suppose each country is a closed-economy. Calculate the equilibrium income of each country. What is the multiplier of autonomous investment in both countries? Are they equal?

Country A $T = 0$	Country B $T = 0$
$C = 40 + 0.6Y_d$ $I = 35$ $G = 25$	$C = 40 + 0.6Y_d$ $I = 35 + 0.2Y$ $G = 25$

EXERCISE 2

Consider the macroeconomic model given by

$$C = 48 + 0.6Y_d$$

$$I = 30 + 0.14Y$$

$$G = 25$$

$$T = 10 + 0.1Y$$

$$R = 5 - 0.05Y$$

$$X = 30$$

$$M = 10 + 0.15Y$$

Answer the following questions

- Calculate the equilibrium income
- Calculate the level of government budget at the equilibrium income
- If the full-employment level of income is equal to 250, calculate the level of government purchase required so that economic problem can be fixed.