ECO 209Y
MACROECONOMIC THEORY AND POLICY

LECTURE 3: AGGREGATE EXPENDITURE AND EQUILIBRIUM INCOME

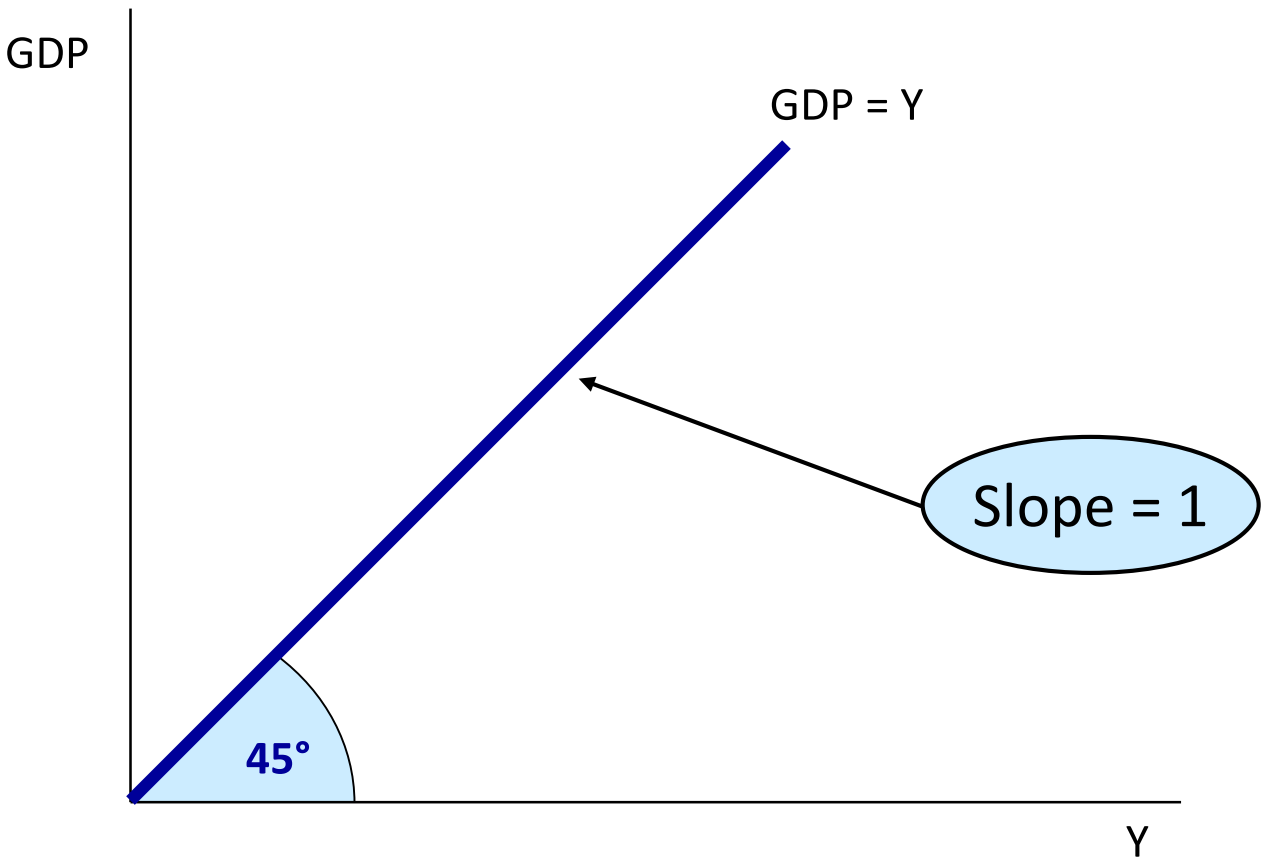
ASSUMPTIONS

- We will assume that:
  - There is no ***depreciation***
  - There are no ***indirect taxes***
  - Net payment to foreign factors of production is nil

- Therefore, ***GDP***, ***Net Domestic Income*** , and ***Gross National Product*** are all equal

- In other words, the values of ***output*** and ***income*** are assumed to be equal and we will use the notation **Y** to refer to both

Graphical Representation of GDP = National Income (Y)



ASSUMPTIONS (CONT'D)

We will also assume that the ***price level*** (**P**) is fixed

- Therefore, this model applies to a situation where the economy is in a ***deep recession*** characterized by ***excess capacity*** and ***high unemployment***

- That is, we will consider the so-called short-run ***Keynesian model***

AGGREGATE EXPENDITURE

- ***Aggregate Expenditure*** (**AE**) is the total ***desired*** or ***planned*** expenditure on goods and services in the economy, that is:

$$\boxed{AE = C + I + G + NX}$$

- Using the expenditure approach, we have seen that **GDP** was equal to:

$$\boxed{Y = C + I + G + NX}$$

- **GDP** is equal to the ***actual*** expenditure on domestically produced goods and services
  - Therefore, ***actual*** expenditure on domestically produced goods and services is equal to ***income*** (**Y**) by assumption
  - Note that ***actual*** investment expenditure includes involuntary changes in inventory

AGGREGATE EXPENDITURE (CONT'D)

- The ***Aggregate Expenditure*** function indicates the desired level of expenditure at each level of income (**Y**)
  - The ***Aggregate Expenditure*** function is an ***increasing function*** of **Y**
- Therefore, there must be a level of income at which ***desired*** aggregate expenditure (**AE**) is equal to ***actual*** aggregate expenditure (**GDP** = **Y**)
- This level of income at which **Y = AE** is the ***equilibrium*** level of output or income (**Y***)
  - At **Y*** the ***goods market*** is in ***equilibrium***
  - The economy has produced (**Y**) exactly what economic agents were planning to purchase (**AE**)

Aggregate Expenditure (cont'd)

- If **Y** $\neq$ **AE**, then the economy is not in equilibrium
  - If **Y > AE** → excess supply in the goods market
  - If **Y < AE** → excess demand in the goods market

- Since **P** is assumed fixed, then the implicit assumption is that **aggregate expenditure** determines the amount of goods produced in the economy

- That is, **Y** must change in order to match **AE** and restore equilibrium in the economy
  - **Y** must increase to eliminate an excess demand
  - **Y** must decrease to eliminate an excess supply

A Simple Model

- Consider a simple model of an economy without government sector (**G = 0**) and without external sector (**X = Q = 0**)

- Therefore, **AE = C + I**

- How is equilibrium income (**Y***) determined in this economy?

The Planned (or Desired) Consumption Function

- The ***planned consumption function*** is a description of the total planned personal consumption expenditure by all households in the economy

- Planned consumption expenditure depends on variables such as:
  - Disposable income
  - Wealth
  - Interest rates
  - Expectations about the future

THE PLANNED CONSUMPTION FUNCTION

- ***Assumption:*** With the exception of ***disposable income***, all the variables that determine ***planned consumption*** will be assumed ***constant***

- ***Assumption:*** Therefore, ***planned consumption*** will be assumed to be a function of ***disposable income*** (**YD**):

$$\boxed{C = \bar{C} + c\,YD}$$

- This equation indicates that ***planned consumption*** is equal to some constant (**$\bar{C}$**) plus another constant (**c**) times disposable income (**YD**)

THE CONSUMPTION FUNCTION (CONT'D)

- The constant $\bar{C}$ describes the elements of consumption which are ***independent*** of disposable income
  - The constant $\bar{C}$ is called ***autonomous consumption*** and captures the impact on **C** of all the constant variables

- The constant **c** describes the ***rate of change*** of consumption as disposable income changes, that is, it indicates the increase in consumption per unit increase in disposable income:

$$\boxed{c = \frac{\Delta C}{\Delta YD}}$$

  - The constant **c** is called the ***marginal propensity to consume*** out of disposable income (MPC_{YD})

Marginal Propensity to Consume

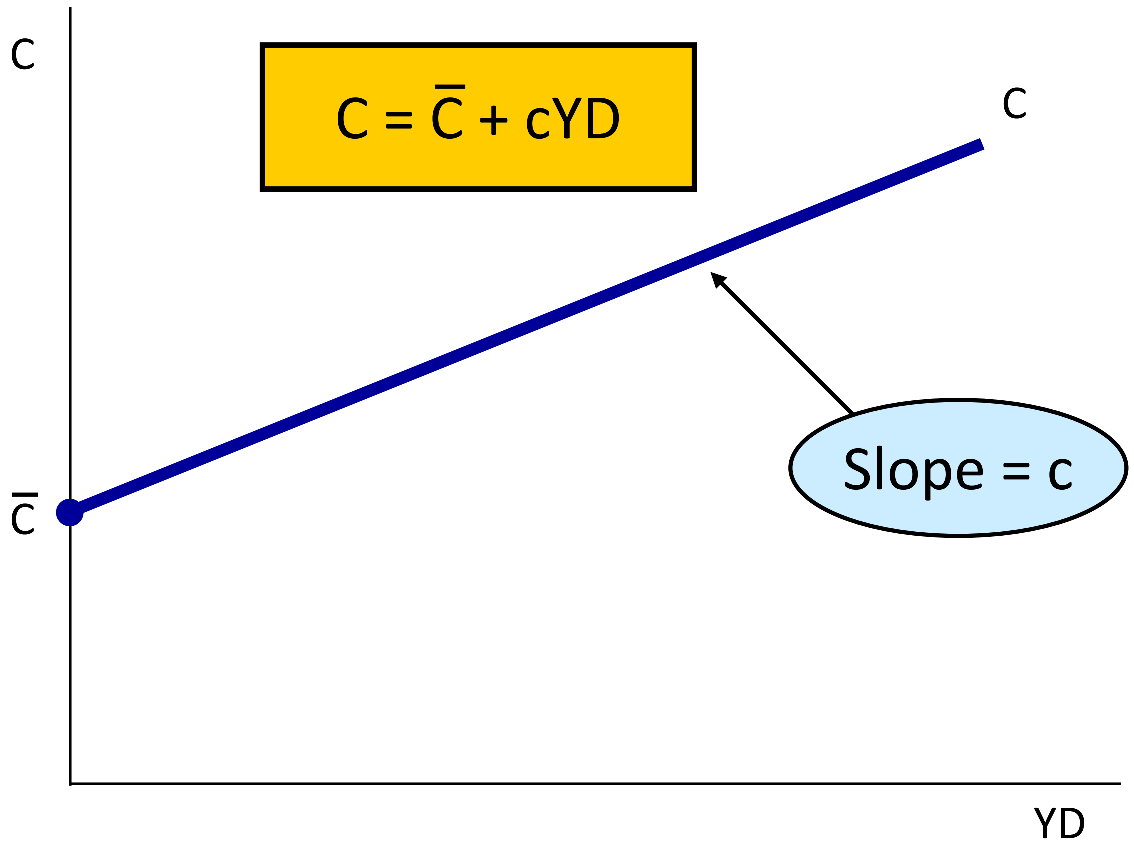
- Since we are assuming that there is no government sector, taxes (**TA**) and transfer payments (**TR**) are nil
  - Therefore, **YD = Y**
  - This means that consumption is assumed to depend on ***income*** (**Y**) alone:

$$\boxed{C = \bar{C} + cY}$$

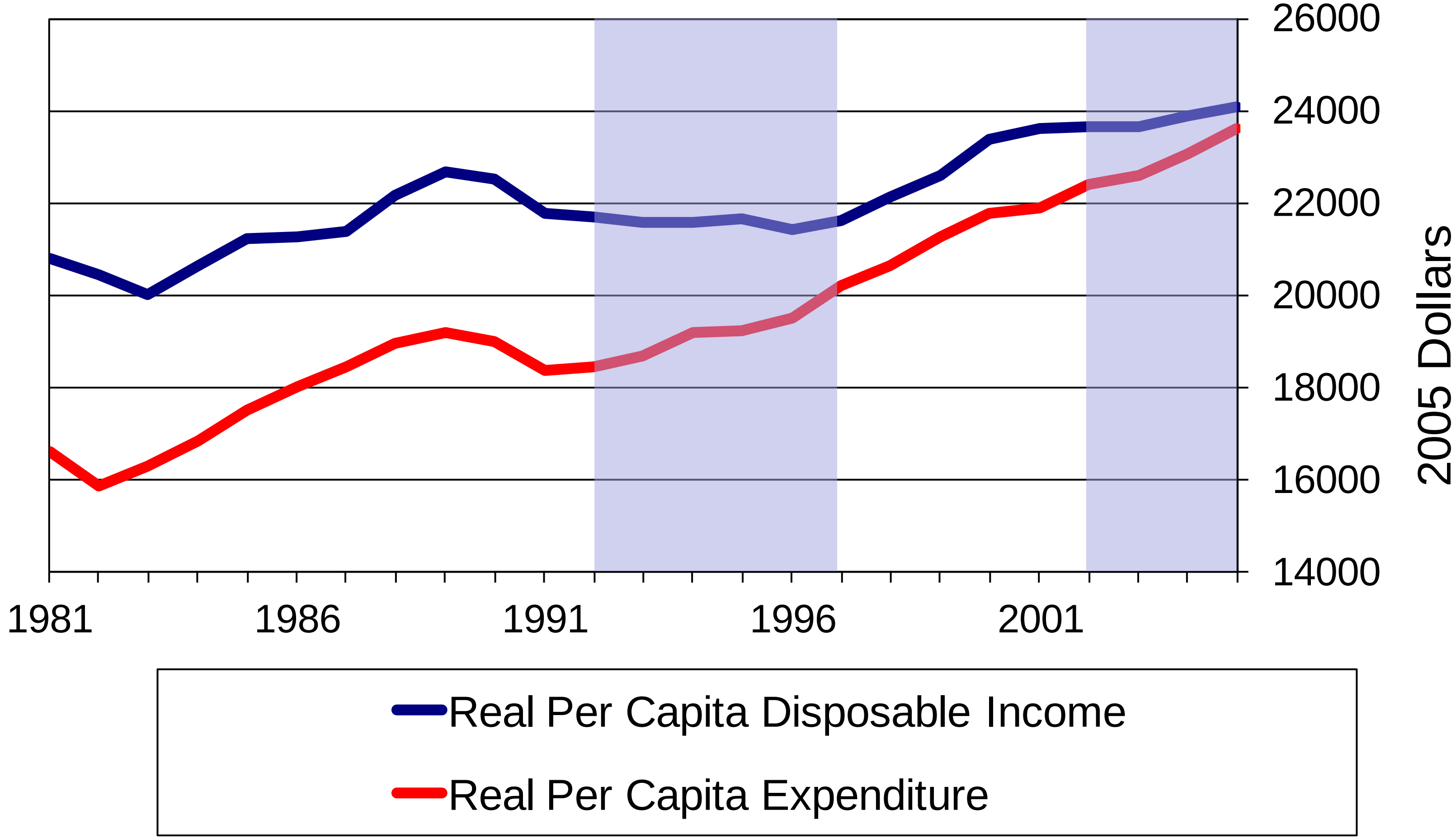
- Note that since **Y = YD**, then $\mathbf{MPC_Y = MPC_{YD}}$

- However, as we will soon see, when **YD** differs from **Y**, $\mathbf{MPC_Y}$ also differs from $\mathbf{MPC_{YD}}$

The Consumption Curve



Canada: Per Capita Consumption and Disposable Income (1981-2005)



MARGINAL PROPENSITY TO SAVE

- The **MPC_{YD}** is positive but less than 1, thus implying that a $1 increase in ***disposable income*** does ***not*** increase ***consumption*** by $1

- A fraction **c** is spent on consumption and the rest is saved (i.e., a fraction **s = 1 – c** is saved)

- The constant **s** is the ***marginal propensity to save*** out of disposable income (**MPS_{YD}**)

- Therefore, **c + s = 1**

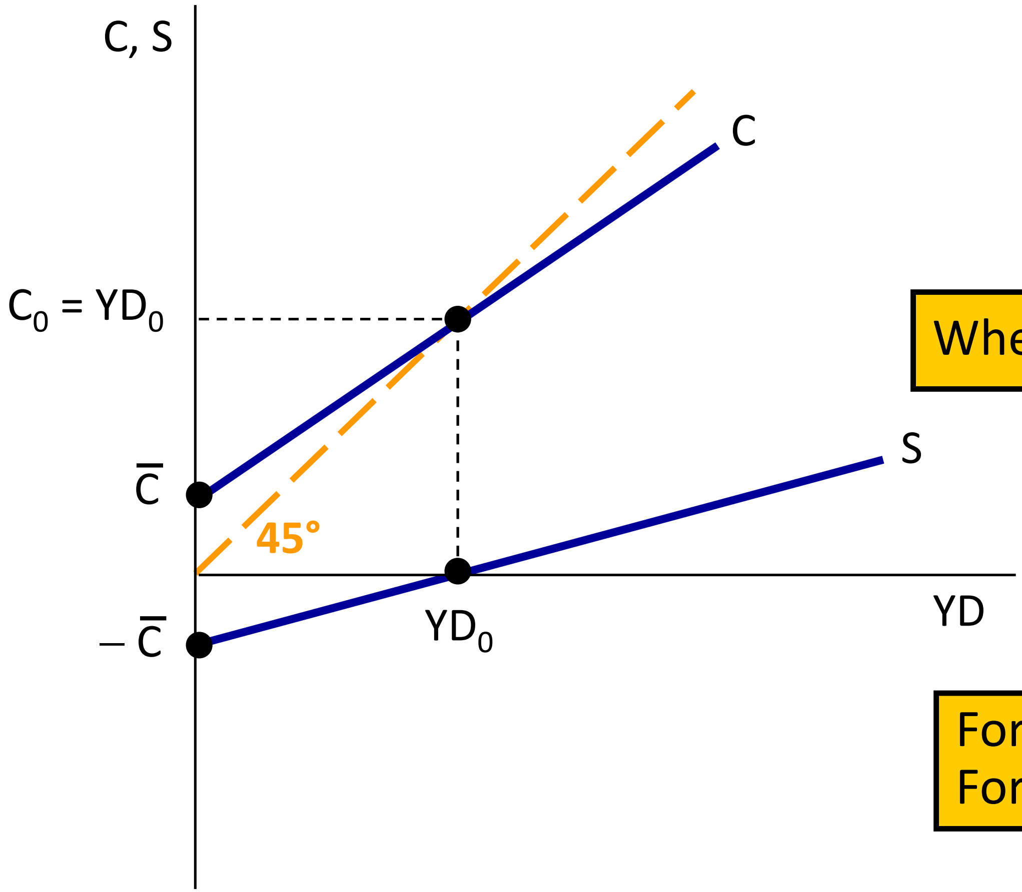
The Planned Savings Function

- Since **YD = C + S**, the ***savings function*** is given by:

$$\begin{aligned} S &= YD - C \\ &= YD - (\bar{C} + cYD) \\ &= -\bar{C} + (1 - c)YD \\ &= -\bar{C} + sYD \end{aligned}$$

- Note that the $\mathbf{MPS_{YD}}$ is also positive and less than 1 since $\mathbf{s = 1 - c}$
- The ***savings function*** is sort of the mirror image of the consumption function

CONSUMPTION AND SAVINGS FUNCTIONS



$C = \overline{C} + c\,YD$
$S = -\overline{C} + (1 - c)\,YD$

When YD = 0, then $C = \overline{C}$ and $S = -\overline{C}$

At the level of YD at which the C curve intersects the 45° line, C = YD and thus S = 0.

For $YD < YD_0$, $C > YD$ and thus $S < 0$.
For $YD > YD_0$, $C < YD$ and thus $S > 0$.

The Planned Investment Function

- The ***investment function*** is a description of the total (desired or planned) investment expenditure by all private economic agents in the economy

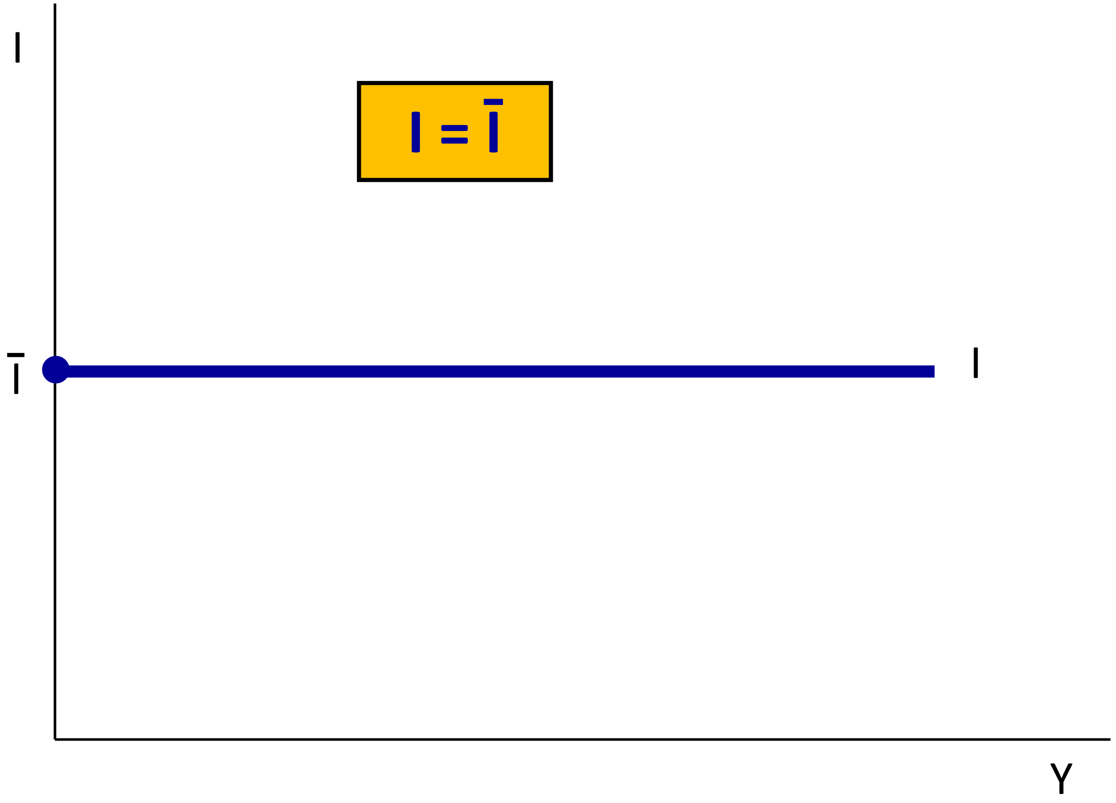
- In general, planned investment expenditure depends on:
  - The ***real*** rate of interest
  - The level of economic activity (**Y**)
  - Businesses' ***expectations*** about the behaviour of these variables during the lifetime of the investment

- I would argue that ***expectation*** about **Y** (and therefore about ***future demand***) is the most relevant variable determining investment

The Planned Investment Function

- ***Assumption:*** For simplicity, we will ***assume*** that the rate of interest and expectations about the future are constant
- ***Assumption:*** For simplicity, we will further ***assume*** that planned investment is independent of the level of income (**Y**)
- ***Assumption:*** Therefore, ***planned investment*** will not change as the level of income (**Y**) changes
  - **I** is equal to autonomous investment: $\mathbf{I} = \bar{\mathbf{I}}$

The Investment Curve



The Aggregate Expenditure Function

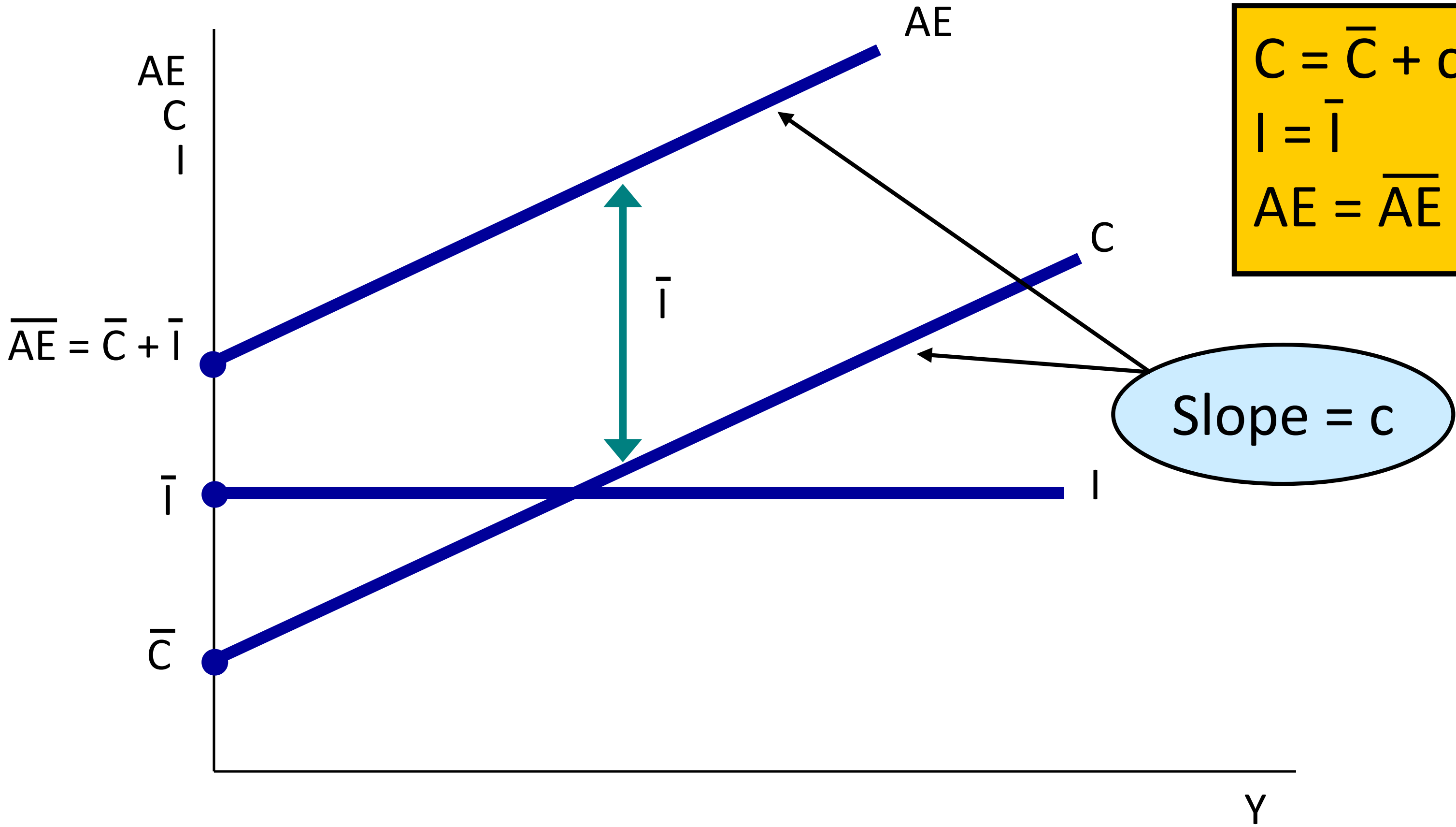
- In this very simple model, the ***aggregate expenditure*** function is:

$$\begin{aligned} \mathbf{AE} &= \mathbf{C + I} \\ &= (\overline{\mathbf{C}} + \mathbf{cY}) + \overline{\mathbf{I}} \\ &= (\overline{\mathbf{C}} + \overline{\mathbf{I}}) + \mathbf{cY} \\ &= \overline{\mathbf{AE}} + \mathbf{cY} \end{aligned}$$

  where $\overline{\mathbf{AE}} = \overline{\mathbf{C}} + \overline{\mathbf{I}}$ is ***autonomous*** aggregate expenditure and **cY** is ***induced*** aggregate expenditure

- $\overline{\mathbf{AE}}$ is the vertical intercept of the **AE** function, and **c** is the slope of the **AE** function (or the ***marginal propensity to spend***)

AGGREGATE EXPENDITURE FUNCTION



$C = \overline{C} + cY$

$I = \overline{I}$

$AE = \overline{AE} + cY$

Equilibrium Income and Output

- We have seen that in ***equilibrium***, ***output*** (**GDP**) or ***income*** (**Y**) is equal to ***aggregate expenditure*** (**AE**):

$$\begin{aligned} Y &= AE \\ &= \overline{AE} + cY \end{aligned}$$

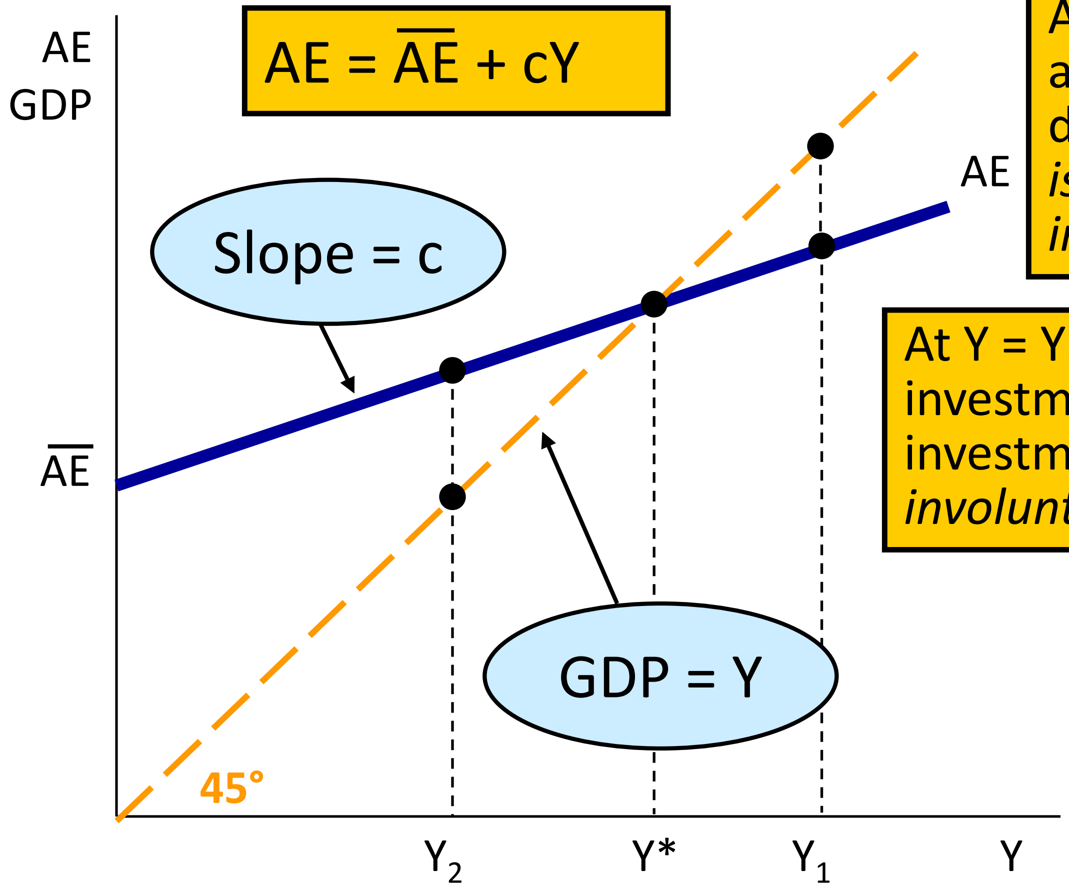
- Therefore, $Y - cY = \overline{AE}$

$$(1 - c)Y = \overline{AE}$$

and ***equilibrium income*** is:

$$\boxed{Y^* = \frac{1}{1 - c}\,\overline{AE}}$$

Aggregate Expenditure Function



At Y = Y*, Y = AE and thus actual investment is equal to desired investment → *There is no involuntary change in inventories*.

At Y = Y_1, Y > AE and thus actual investment is greater than desired investment → *There is an involuntary increase in inventories*.

At Y = Y_2, Y < AE and thus actual investment is smaller than desired investment → *There is an involuntary decrease in inventories*.

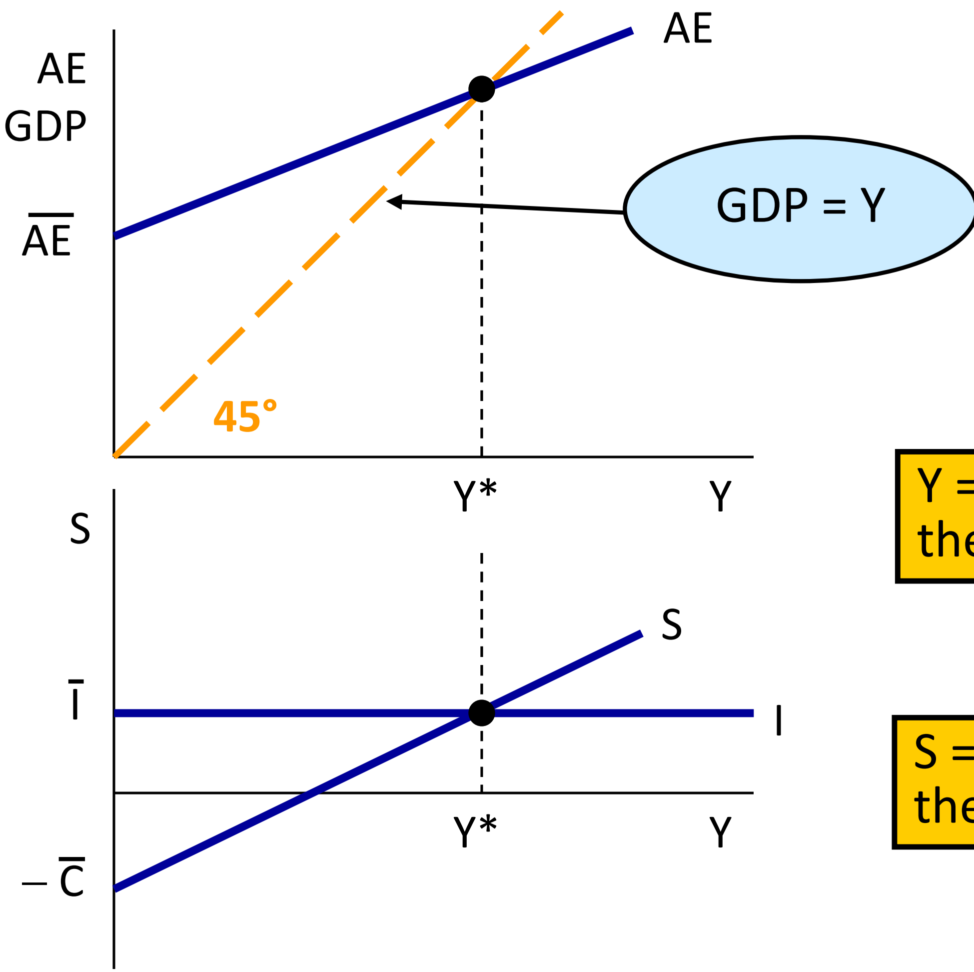
Consumption and Saving

- The implicit ***assumption*** is that ***actual*** consumption is always equal to ***desired*** consumption as a result of ***involuntary*** changes in inventory
  - If **AE > Y**, there is an ***involuntary*** decrease in inventory to satisfy the level of desired consumption
  - If **AE < Y**, there is an ***involuntary*** increase in inventory because desired consumption is not enough (i.e., saving is too large)
- Therefore, since ***actual*** consumption and ***desired*** consumption are always equal, then ***actual*** saving and ***desired*** saving are always equal as well

SAVINGS AND INVESTMENT

- By definition, ***savings*** is equal to ***actual investment***
  - Output (**GDP**) is equal to income (**Y**) by assumption
  - Income not spend on consumption is saved
  - Output not used for consumption is used for investment
- **Y = C + S** and **Y = C + *actual* I** → **S = *actual* I**
- In equilibrium, when **Y = AE**, there is no ***involuntary*** change in inventory
  - Therefore, ***desired*** and ***actual*** investment are equal
- Therefore, in a closed economy with no government sector,
  - If **Y = AE**, then **S = desired I**
  - If **Y < AE**, then **S < desired I**
  - If **Y > AE**, then **S > desired I**

Two Ways of Expressing Equilibrium Income in the Economy



$S = -\bar{C} + (1 - c)Y$

$I = \bar{I}$

$AE = \overline{AE} + cY$

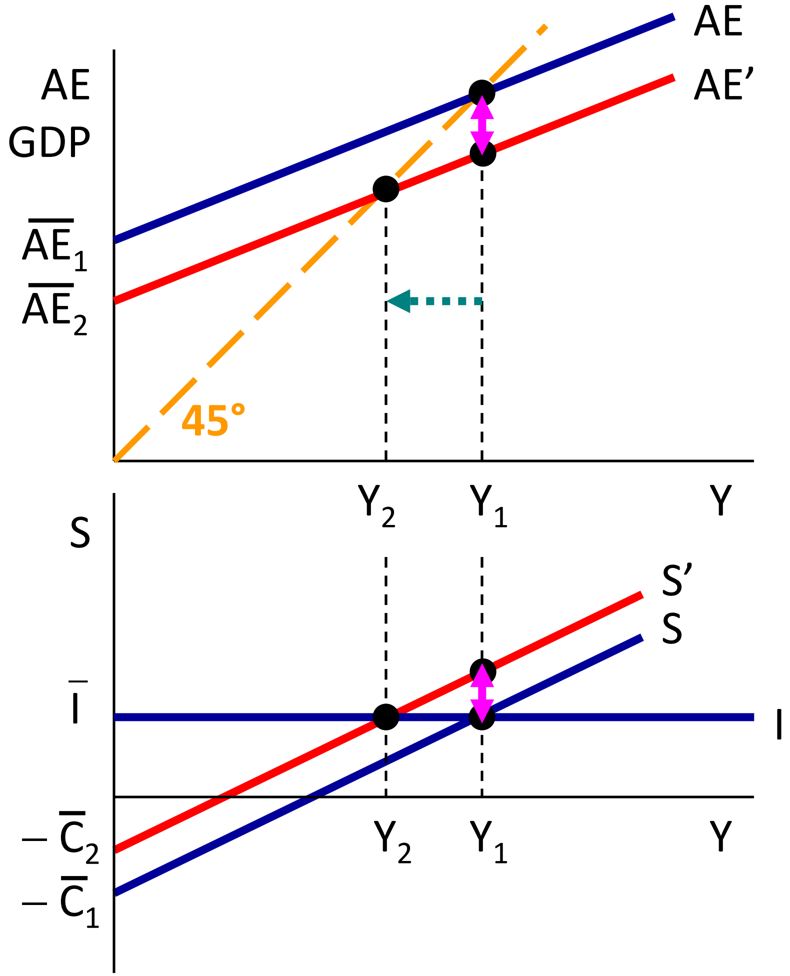
Y = AE at Y = Y*, and thus Y* is the equilibrium level of income.

S = I at Y = Y*, and thus Y* is the equilibrium level of income.

SAVINGS AND INVESTMENT

- By definition, ***savings*** is always equal to ***actual investment***
- **Question:** If high rates of ***investment*** are desirable, are high rates of ***savings*** also desirable?
  - If ***productive*** investment were determined by savings, then high rates of savings would be desirable
- But ***high desired savings*** is the result of ***low desired consumption expenditure***
  - Therefore, ***actual investment*** is large because firms are experiencing ***involuntary*** increases in inventory
- Therefore, ***higher desired savings*** does not translate into ***higher productive capacity*** of the economy
  - But ***higher desired investment*** does translate into ***higher* Y** and thus into ***higher desired savings***

Savings and Investment (cont'd)



$S = -\bar{C} + (1 - c)Y$
$I = \bar{I}$
$AE = \overline{AE} + cY$

Initially the economy is in equilibrium at Y_1.

As desired savings increases to S' and aggregate expenditure decreases to AE', Y > AE and Y falls.

THE MULTIPLIER

$$Y^* = \frac{1}{1-c}\overline{AE}$$

- How does a change in ***autonomous expenditure*** (**$\overline{AE}$**) affect ***equilibrium income*** (**Y***)?
- The equation for equilibrium income shows that a **$\Delta\overline{AE}$** will affect **Y*** in the following way:

$$\Delta Y^* = \frac{1}{1-c}\Delta\overline{AE}$$

- The expression

$$\alpha_{AE} = \frac{\Delta Y^*}{\Delta\overline{AE}} = \frac{1}{1-c} = \frac{1}{1-\text{slope of AE curve}}$$

is called the ***autonomous expenditure multiplier*** or just the ***multiplier***

The Multiplier (cont'd)

- A change in autonomous expenditure (**$\Delta\overline{AE}$**) causes equilibrium income (**Y^***) to change by the initial change in **$\overline{AE}$** times the multiplier (**α_{AE}**)
- This change in **Y^***, **$\alpha_{AE}\,\Delta\overline{AE}$**, is the ***final result*** and does not show the ***process*** leading to it
- Let's have a look at the process leading to this final outcome
- Suppose that autonomous expenditure increases by **$\Delta\overline{AE}$**

Process of Adjustment

Round	ΔAE this round	ΔY this round	Accumulated ΔY
1	$\Delta\overline{AE}$	$\Delta\overline{AE}$	$\Delta\overline{AE}$
2	$c\,\Delta\overline{AE}$	$c\,\Delta\overline{AE}$	$(1+c)\,\Delta\overline{AE}$
3	$c^2\,\Delta\overline{AE}$	$c^2\,\Delta\overline{AE}$	$(1+c+c^2)\,\Delta\overline{AE}$
4	$c^3\,\Delta\overline{AE}$	$c^3\,\Delta\overline{AE}$	$(1+c+c^2+c^3)\,\Delta\overline{AE}$
…	…	…	…
n	$c^{n-1}\,\Delta\overline{AE}$	$c^{n-1}\,\Delta\overline{AE}$	$[1/(1-c)]\,\Delta\overline{AE}$

Process of Adjustment (cont'd)

- After **n** rounds, the series $\mathbf{1 + c + c^2 + c^3 + \ldots}$ converges to $\boldsymbol{\alpha_{AE} = 1/(1 - c)}$
- Let's call $\mathbf{a = 1 + c + c^2 + c^3 + \ldots}$
- Multiply **a** by **c** → $\mathbf{ca = c + c^2 + c^3 + \ldots}$
- Now subtract **ca** from **a**:

  $\mathbf{a - ca = (1 + c + c^2 + c^3 + \ldots) - (c + c^2 + c^3 + \ldots) = 1}$
- Therefore, $\mathbf{a\,(1 - c) = 1}$ → $\boxed{\mathbf{a = 1/(1 - c)}}$

Introduction of the Government Sector

- Disposable income (**YD**) changes:
  - Households pay ***taxes***
  - Households receive ***transfer payments***

- Equation for **AE** changes:
  - **AE = C + I + G**

- We will assume that ***government expenditure*** on goods and services is ***independent*** of the level of income, that is, **G** is ***fixed*** → $G = \overline{G}$

Disposable Income and the Consumption Function

- We have seen that consumption is a function of **disposable income** (**YD**):

$$C = \bar{C} + cYD$$

where $\bar{C}$ is autonomous consumption and **c** is the ***marginal propensity to consume*** out of ***disposable income*** (**MPC_{YD}**)

- Disposable income (**YD**) is equal to:

$$YD = Y + TR - TA$$

where **TR** are ***government transfer payments*** and **TA** are ***direct taxes***

Disposable Income and the Consumption Function (cont'd)

- Let's assume that taxes are a function of income and that transfer payments are independent of income:
  - $TA = \overline{T} + tY$
  - $TR = \overline{TR}$

- Therefore, disposable income is equal to:

$$\begin{aligned} YD &= Y + TR - TA \\ &= Y + \overline{TR} - (\overline{T} + tY) \\ &= \overline{TR} - \overline{T} + (1 - t)Y \end{aligned}$$

The Consumption Function as a Function of Income

- As a function of *income*, the consumption function is:

$$\boxed{YD = \overline{TR} - \overline{T} + (1 - t)Y}$$

$$\begin{aligned} C &= \overline{C} + cYD \\ &= \overline{C} + c\,[\,\overline{TR} - \overline{T} + (1 - t)Y\,] \\ &= (\overline{C} + c\overline{TR} - c\overline{T}) + c(1 - t)Y \end{aligned}$$

- That is, $(\overline{C} + c\overline{TR} - c\overline{T})$ is the vertical intercept and $c(1 - t)$ is the slope

- Note that $c(1 - t)$ is the ***marginal propensity to consume*** out of ***income*** (MPC_Y)

- Also note that $MPC_Y < MPC_{YD}$ if $t > 0$

THE AGGREGATE EXPENDITURE FUNCTION

- The ***aggregate expenditure*** function is:

$$\begin{aligned} \mathbf{AE} &= \mathbf{C + I + G} \\ &= [\,\overline{C} + c\overline{TR} - c\overline{T} + c(1-t)Y\,] + \overline{I} + \overline{G} \\ &= \overline{AE} + c(1-t)Y \end{aligned}$$

  where $\overline{AE} = \overline{C} + c\overline{TR} - c\overline{T} + \overline{I} + \overline{G}$

- The vertical intercept is $\overline{AE}$ and the slope is **c(1 – t)**

- Recall that the slope of the **AE** curve is the ***marginal propensity to spend***

EQUILIBRIUM OUTPUT AND INCOME

- Equilibrium income is determined where **Y = AE**:

$$Y = \overline{AE} + c(1 - t)Y$$

$$[\, 1 - c(1 - t) \,]\, Y = \overline{AE}$$

- Therefore,

$$\boxed{Y^* = \frac{1}{1 - c(1 - t)} \overline{AE}}$$

The Multiplier

- The ***autonomous expenditure multiplier*** becomes:

$$\alpha_{AE} = \frac{1}{1 - c(1 - t)}$$

- Note that as before, the multiplier is equal to 1 over 1 minus the slope of the **AE** curve

- Also note that, as **t** increases, α_{AE} becomes smaller (the **AE** curve becomes flatter)

  What's the economic explanation?

The Introduction of the Foreign Sector

- We will assume that the equations for ***exports*** (**X**) and ***imports*** (**Q**) are as follows:

  $$X = \bar{X}$$

  $$Q = \bar{Q} + mY$$

  where **m** is the ***marginal propensity to import***

- Therefore, the equation for ***net exports*** (**NX**) is:

  $$\begin{aligned} NX &= X - Q \\ &= \bar{X} - \bar{Q} - mY \end{aligned}$$

The Equation for the AE Curve

$NX = \overline{X} - \overline{Q} - mY$

- In a closed economy, the equation for AE was:

$$\mathbf{AE = C + I + G}$$
$$\mathbf{= \overline{AE} + c(1 - t)Y}$$

where $\mathbf{\overline{AE} = \overline{C} - c\overline{T} + c\overline{TR} + \overline{I} + \overline{G}}$

- In an open economy, the equation for **AE** is:

$$\mathbf{AE = C + I + G + NX}$$
$$\mathbf{= \overline{AE} + [c(1 - t) - m]Y}$$

where $\mathbf{\overline{AE} = \overline{C} - c\overline{T} + c\overline{TR} + \overline{I} + \overline{G} + \overline{X} - \overline{Q}}$

EQUILIBRIUM INCOME

- In equilibrium, **$Y = AE$**, that is,

$$Y = \overline{AE} + [c(1-t) - m]Y$$

$$\{1 - [c(1-t) - m]\}\, Y = \overline{AE}$$

$$[1 - c(1-t) + m]\, Y = \overline{AE}$$

- Therefore, equilibrium income is:

$$\boxed{Y^* = \frac{1}{1 - c(1-t) + m}\,\overline{AE}}$$

where $\overline{AE} = \overline{C} - c\overline{T} + c\overline{TR} + \overline{I} + \overline{G} + \overline{X} - \overline{Q}$

THE MULTIPLIER

- The multiplier is:

$$\alpha_{AE} = \frac{1}{1 - c(1 - t) + m}$$

$$= \frac{1}{1 - \text{slope of the AE curve}}$$

- Where the ***slope*** of the **AE** curve (i.e., the ***marginal propensity to spend***) is the fraction of each additional dollar of income which is spent on ***domestically produced goods***