UNIT-I
OUTPUT & EMPLOYMENT IN AN OPEN ECONOMY

SESSION- V

Four-Sector Model with Exports, No Imports.

Equilibrium income in an open economy with no imports:

$$Y = a + b\,(Y-T) + I + G + X$$

Solving for Y,

$$Y = (a - -bT + I + G + X)\ /\ (1-b) \qquad \ldots\ldots 1)$$

Next: The Export Multiplier

Working out the Export Multiplier

We have, in equilibrium, $Y = (a - -bT + I + G + X) / (1-b)$ ……2)

Now suppose exports increase by ΔX.

The new National income equilibrium:

$$Y + \Delta Y = 1/ (1-b) \{(a - -bT + I + G + X + \Delta X)\}$$ ……3)

- Subtracting Eq. 3) from Eq. 4), we get:

$$\Delta Y = \Delta X \{1/ (1-b)\}$$ …. ….4)

So that, $\Delta Y / \Delta X = 1/ (1-b)$, giving us

the export multiplier, the rate at which income increases in response to an increase in exports.

Where, b = mpc

Import Function: Representation

- In our previous session, we have already discussed the determinants of imports.

- We now look at how the import function is expressed in our basic 4-sector model.

- The two major variables in the short run import function are:

  The level of income,

  Autonomous imports, that is those imports that are independent of income level

- We can therefore express the import function as:

$$M = M^* + m.Y \quad \ldots \quad 5)$$

M^* → constant, autonomous import

$m.Y$ → marginal propensity to import

(What does "m" tell us?) → Class Discussion)

Imports and Aggregate Demand: Four-Sector Model

What happens to aggregate demand when we introduce imports, along with already considered volume of exports?

- AD gets reduced by the amount of payments for foreign goods.
- Hence we account for imports in the aggregate demand equation by prefixing a negative sign before imports (M).

We can therefore express the aggregate demand equation in an open economy as follows:

$$Y = C + I + G + X - M \quad \ldots \quad \ldots \quad 6)$$

- The above also means that **if exports exceed imports**, that is, **X > M**, the aggregate demand would **increase**. It would **decrease if M >X**.

Equilibrium NY in Four Sector: Graphical Depiction

- How is equilibrium national income determined in our simple model of an open economy?

- We first look at the graphical depiction, following up with

- Mathematical derivation, of equilibrium income.

- Next, we derive the foreign trade multiplier in the presence of both exports and imports.

- Finally, once equilibrium income has been determined, we find out the corresponding level of employment.

INCOME DETERMINATION IN A 4-SECTOR MODEL

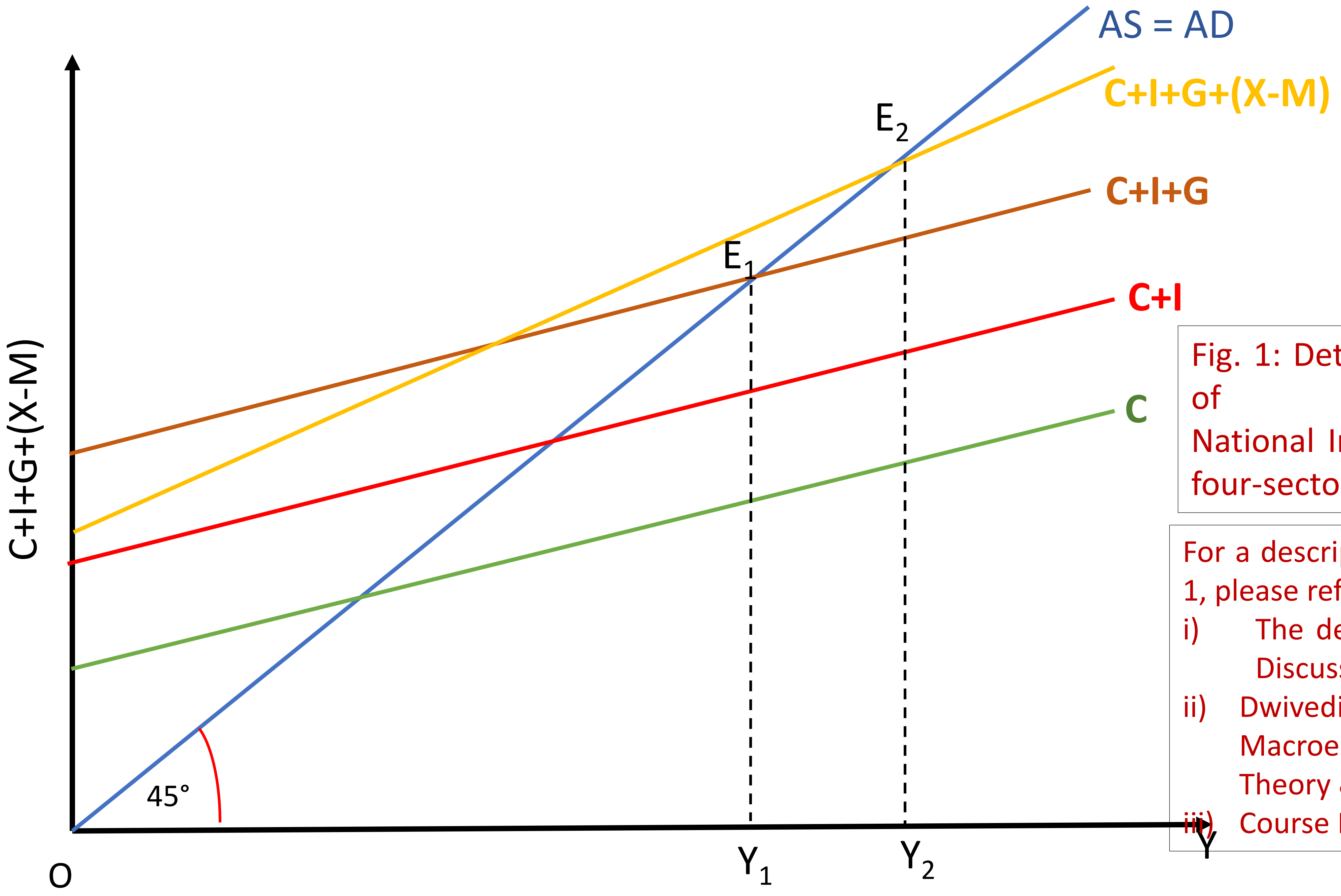

Fig. 1: Determination of Equilibrium National Income in a four-sector economy

For a description of Fig. 1, please refer to:

i) The detailed Class Discussion,
ii) Dwivedi, Macroeconomic Theory & Policy, or
iii) Course Material

Introducing Exports & Imports in the Basic Model: Important Points to Note:

- Introducing foreign trade will cause an increase in equilibrium income when $X > M$, as in the case of our example (Fig. 1).

- Introducing foreign trade will cause a decrease in equilibrium income when $M > X$

- In terms of Balance of Trade: What would be the implications of

  $X > M \rightarrow$?

  $M > X \rightarrow$?

Equilibrium National Income in the presence of both Exports and Imports.

- Always, in deriving the equilibrium solutions, start from the basic equilibrium equality between the level of national income and aggregate expenditure.

- The entire four-sector model of income determination can be written as follows.

$$Y == C + I + G + (X - M) \qquad (7)$$

where

.

$$C = a + b(Y - T) \qquad \dots \qquad \dots. \qquad 8)$$

$$M = M + mY \qquad 9)$$

I, G and X are autonomous (exogenous) with respect to Y, and T is a given lumpsum tax.

Substituting Eq. (2) and Eq. (3) in Eq. (1).

We have, at equilibrium,

$$Y = a + b(Y - T) + I + G + (X - M^* - mY) \qquad 10)$$

So that, the final form of the equilibrium equation becomes :

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$$Y = \{\{a - bT + I + G + X - M^*)\} \quad \{1/(l - b + m)\} \qquad (11)$$

In Eq. (11), the term $l/ (1 - b + m)$ is the ***foreign trade multiplier*** when consumption and imports are both linear functions of income.

The Foreign Trade Multiplier:

Given the equilibrium Eq. (5), suppose exports increase by ΔX, all other variables remaining constant.

The equilibrium level of national income can then be written as ·

$$Y + \Delta Y = \{1/ (1-b+m)\} \{(a --bT+ I + G + X + \Delta X-M)\} \quad \ldots \quad \ldots 12)$$

Rewrite Eq. 6) as,

$$Y + \Delta Y = \{1/ (1-b+m)\} \{(a --bT+ I + G + X-M) \} + \{1/ (1-b+m)\}.\{\Delta X\} \ldots 13)$$

Subtracting Eq. 6) from Eq. 7),

$$\Delta Y = \{1/ (1-b+m)\}. \Delta X \quad . \quad \ldots .14)$$

Deriving The Foreign Trade Multiplier

We have,

$$\Delta Y = \{1/\ (1\text{-}b+m)\}.\ \Delta X \qquad 14)$$

On rearranging, we get

$$\Delta Y/\ \Delta X = \qquad 1/(1\text{-}b+m),$$

Or,

$$\Delta Y/\ \Delta X \qquad = \qquad 1/(1-(b-m)) \quad \ldots \qquad \ldots\ldots \quad 15)$$

Which gives us the foreign trade multiplier.

IMP:

1) Higher b, (marginal propensity to consume), higher the multiplier

2) Higher m, (marginal propensity to import), lower the multiplier

Note that, if b = m, the foreign trade multiplier will be unity.

Equilibrium Income in Open Economy: Alternative Formulation

From the equilibrium condition in the open economy:

$$Y = C + I + G + (X\text{-}M)$$

We derived the equilibrium expression for national income as:

$$Y = \{1/(l\text{-}b+m)\}\ \{a\text{- } bT + I + G + X – M^*) \qquad (11)$$

What are the basic functions/ variables involved here?

$$C = a + b\ (Y\text{-}T),$$

$$I = I^*,\ G = G^*, X = X^*$$

$$M = M + m.Y$$

We also saw the foreign trade multiplier, that is, change in equilibrium national income in response to change in exports, as given by:

$$\Delta Y/ \Delta X \qquad = \qquad 1/(1\text{-}(b\text{-}m)), \qquad 12)$$

So that, the multiplier

i) is higher when b, or mpc, is larger, and

ii) Lower, the larger the marginal propensity to import.

Leakages from the Income-Expenditure Flow

(What are the leakages and injections in the system that we have been studying?)

Equilibrium can also be characterized as equality between net leakages and net injections.

Leakages:

- Saving
- Imports: Explicitly considered.

  APM, MPM
- APM: Average Propensity to Import:

- Representing equilibrium in terms of equality between net leakages and net injections.

- **Saving:** Function of Disposable Income
- Disposable income is distributed among saving and consumption:

$$Y\text{-}T = C + S$$

$$S = (Y\text{-}T) - C$$

$$= (Y\text{-}T) - (a + b\,(Y\text{-}T))$$

$$S = (Y\text{-}T) - (a + b(Y\text{-}T))$$

or,

$S = (1\text{-}b)Y - (a - T\,(1\text{-}b)) \rightarrow$ the Saving Function.

Imports: Function of national income, as seen earlier.

Alternative Representation of Equilibrium:

Equilibrium defined in terms of equality between net leakages and net injections.

Having noted the items of leakage and injection in the open economy, we can write the national income equilibrium condition as:

$$S + T + M = I + G + X$$

Where,

S, M	→	Functions of Income,
T, I, G, X	→	All are assumed given / exogenously determined.

Equilibrium in the Open Economy

The equilibrium expression for national income, as derived before:

$$Y = \{1/(l- b + m)\} \{a- bT + I + G + X - M^*\} \qquad 11)$$

Also, as we have seen, the foreign trade multiplier is given by:

$$\Delta Y/ \Delta X = 1/(1-(b-m))$$

$$= 1/1-b+m \qquad 12)$$

(Higher b or mpc, higher the multiplier, and higher mpm, lower is the value of the multiplier).

Now, let us look at expressions 11) and 12) above, and the saving function

$$S = (1-b)Y - (a- T (1-b)) \qquad 13)$$

The expression in the denominator is (1-b+m), or (1-mpc+mpm).

However, 1-b is nothing but the mps, so that our multiplier now becomes

$\Delta Y/ \Delta X = 1/ (mps + mpm)$ → A result that we will use later.

(Class Discussion: What happens to the multiplier when mps is higher?)

Employment Determination in a 4-sector Model

- We have seen how output/ income is determined in our four-sector model.

- We have also seen how changes in autonomous expenditure, sp. exports, affect the equilibrium income level.

Our next question is: Determination of the employment level in this economy.

- Once the income/ output level is known, we can determine the level of employment, by using

The Aggregate Production Function:

Which expresses the functional relationship between total output in the economy and the factors of production engaged in producing the output. Symbolically,

$Y = f$ (K,L, land, entrepreneurship, technology, …), where K (capital), L (labour), together with land, technology etc. constitute the resources/ factors that go into the production of output.

Now, as is the practice, if we use "Capital" in the inclusive sense to denote all resources other than labour, then the production function becomes:

$$Y = f(K,L)$$

Note that,

Land is a fixed factor. Also, in the short-run, technology can be taken as given. Assuming further that the level of capital is fixed at K* in the short run, we have

The Short-run Production Function:

$Y = f(K^*, L)$, where labour is the only variable factor of production.

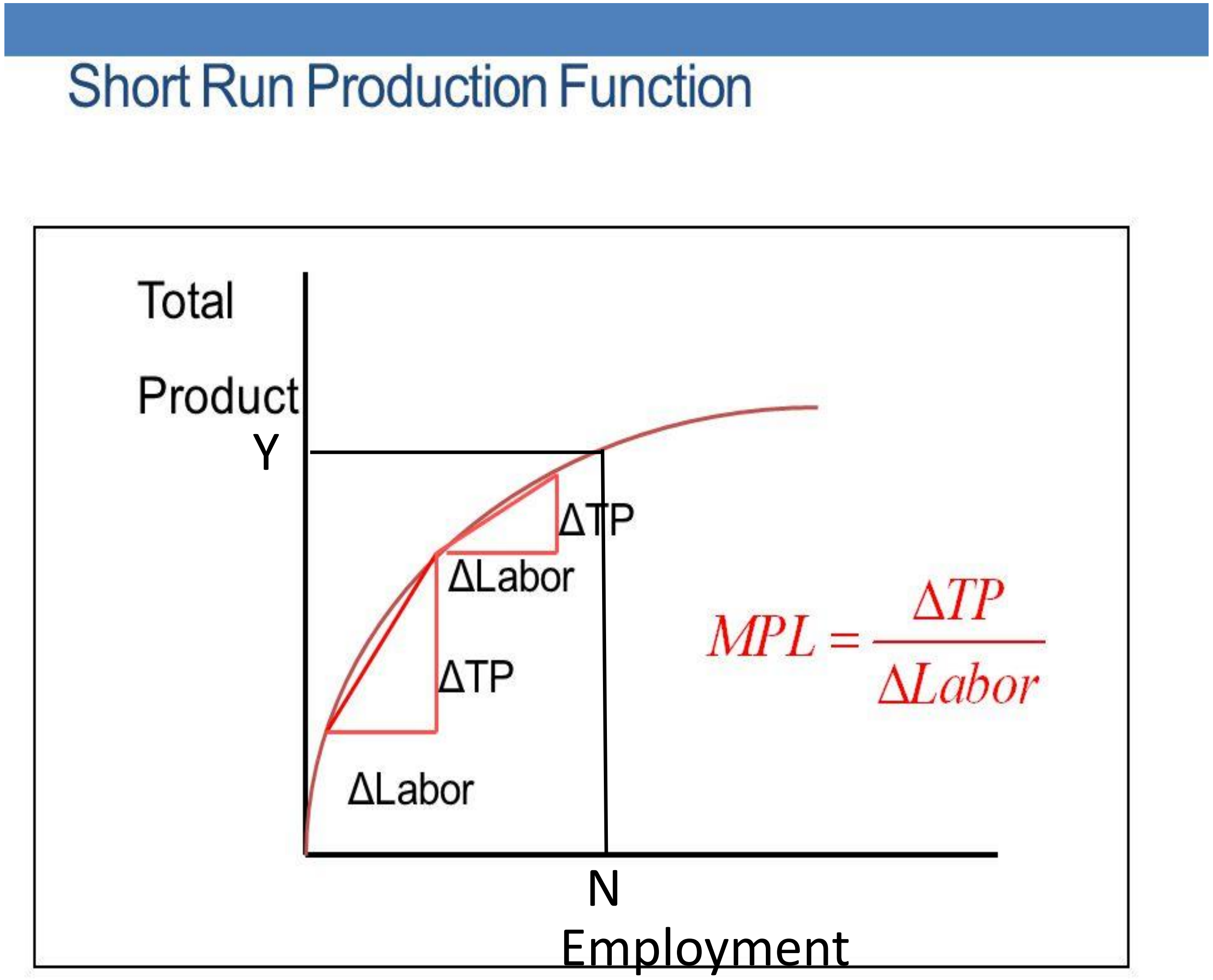
The short run production function has the added characteristics that,

$f'(L) > 0$, that is, output Y is an increasing function of L,

But, $f''(L) < 0$, that is, output increases at a decreasing rate.

In other words, MPL, the marginal product of labour, diminishes as more and more labour is employed, in the short run.

The Short-run Production Function



The short-run production function TP, showing output (Y) as a function of (given the fixed capital stock) labour, the only variable factor in the short-run.

The slope of the production function keeps falling as additional units of labour are employed in the short-run.
MPL = ΔY/ ΔN, falls as more and more labour is employed in the short run.

Fig. 2: EMPLOYMENT DETERMINATION IN A 4-SECTOR MODEL

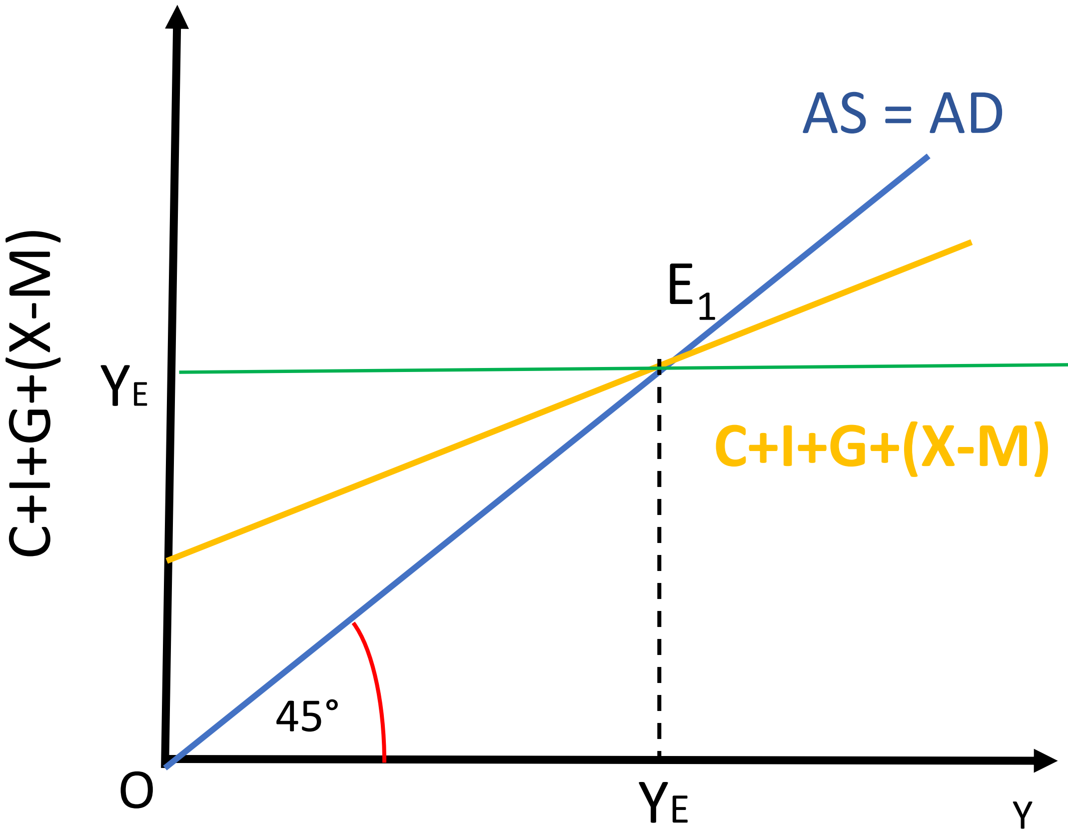


Fig 2 (a)

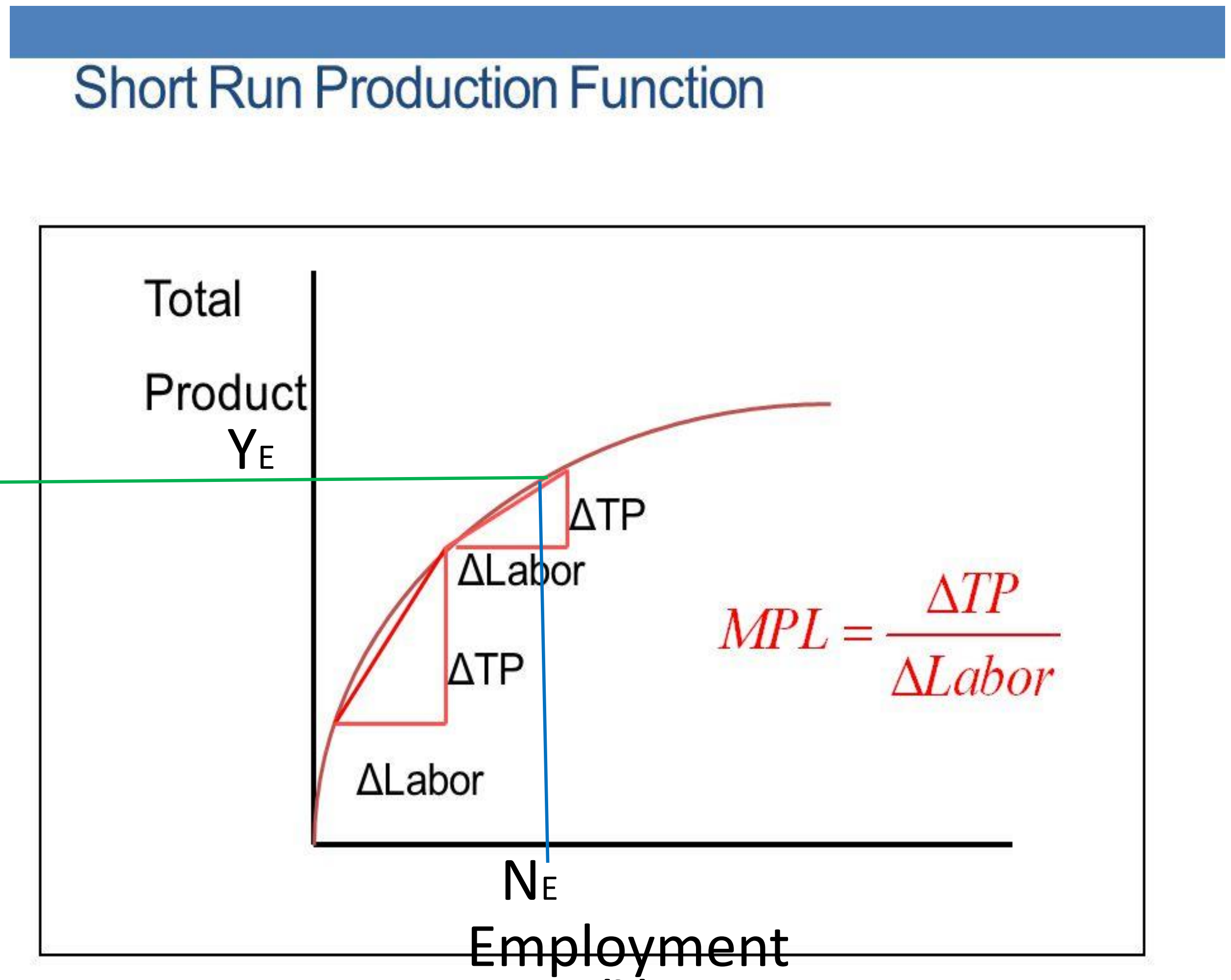


Fig 2 (b)

In Fig. 2(a), the equilibrium level of national income is determined, as before, at Y_E, where AS=AD→ Y = C+I+G+ (X-M).
Using the Income/ Output equality, we then plot Y_E onto the production function in Fig, 2(b), which gives us the unique employment level for every level of output.
Given Y_E , the corresponding employment level from the total product curve in Fig 2(b), is N_E.

Income Determination in an Open Economy: Alternative Formulation– Deriving the Trade Balance

We have discussed the open economy equilibrium in terms of equality between net leakages and net injections:

Recall that our equilibrium condition, in this alternative formulation, was given by:

$$Y = C+S+T+M= C+I+G+ X,$$

Or, taking away the common term C from both sides,

$$S+T+M = I+G+X \qquad \ldots \qquad \ldots \qquad \ldots \qquad 1)$$

That is, at equilibrium level of national income, the sum of saving, taxes and imports in the economy should equal the sum of autonomous injections, that is, investment, government spending and exports.

Alternative equilibrium condition in terms of net leakages and net injections.

We now make the Simplifying Assumption that in this economy, there is no government spending, or, taxes. That is, $G = T = 0$.

So that, 1) above becomes:

$$S(Y)+ M(Y) = I + X \quad \ldots \qquad \ldots \qquad \ldots.. \qquad 2)$$

Graphical Depiction

Following Figure 3 depicts:

a) Determination of equilibrium national income using the S+M = I+X condition,

b) The effect of an increase in exports (can be worked with increase in imports, too)---

And

c) Calculating the trade balance at equilibrium income.

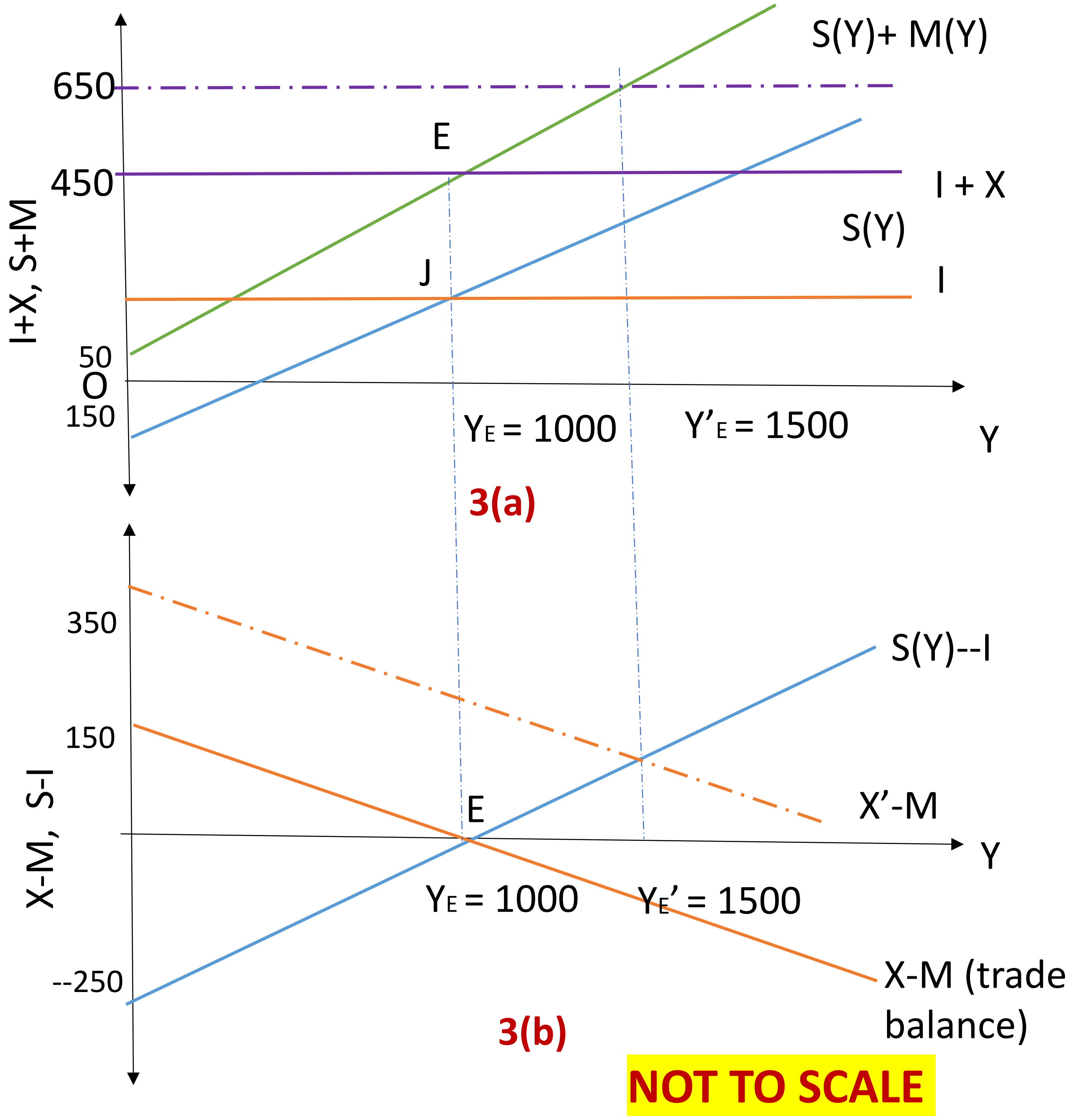


Fig 3: National Income Determination in a Small Open Economy

The top panel 3 (a) measures saving plus imports, as well as investment plus exports on the vertical axis, and NY along the horizontal axis..

The equilibrium level of national income, Y_E=1000 is given by point E where the I+X function crosses the S(Y) + M(Y) function.

At Y_E=1000, S=I=150, so X = M = 300.

The bottom panel 3 (b) measures (X-M) and (S-I) on the vertical axis, and national income Y on the horizontal axis.

(Why does X-M fall, and S(Y)-I rise?)

Note that: At E, X-M = S-I = 0.

An autonomous increase in X of 200 (broken lines in top and bottom panels) raises YE to 1500, and X'-M is now 125 = S-I.

What is the advantage of using figure 3(b)? The trade balance can be read directly from the figure. Any disturbance→ Automatic income adjustment mechanism.

- (X-M falls because we are subtracting a rising M(Y) from a constant X as Y rises.

- S(Y)-I function rises because we subtract a constant (I) from the rising saving function).

Equilibrium Income

- The equilibrium level of national income is

$$Y = 1000,$$

Determined where the (I + X) function crosses the S(Y) + M (Y) function (point E in the top panel 3 (a)).

That is, at a point where:

$$\text{INJECTIONS} = \text{LEAKAGES}$$

$$I + X = S+M$$

$$150 + 300 = 150+300$$

$$450 = 450$$

Note that at the equilibrium national income level, the trade balance is also in equilibrium (X=M=300).

This equilibrium is stable (mismatch between leakages and injections would lead the system to Y_E).

Open Economy: Foreign Income Adjustment Process

- So far, we have studied

  i) Equilibrium GNP (Y) in an open economy, and

  ii) The effect of a change in exports on Y

- In all this, we assumed that:
- Autonomous changes in imports and/or exports do not have any ***repercussions,***
- For the rest of the world, or for the trading partners of our domestic economy.

Foreign Income Adjustment Process

- Repercussions ??

Consequences/ Impact

- This assumption, (of NO repercussions), is valid only when our domestic economy is of very small size.

- For a large country, such autonomous changes (in X and/or M), will affect the incomes; exports and imports of its trading partners.

- Such changes will be more or less equivalent to the changes in home country.

- In our next discussion, we will consider how, in an interrelated world, changes in the external balance in one country lead to ripple effects in its trading partner(s).