

Harrod Domar Model of Growth

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Why study the Harrod Domar Model?

- Appreciate the role of savings and investment in the growth process
- Express the role of savings and investment in the growth process
- Identify the similarities and dissimilarities between the Harrod Model and the Domar Model
- Develop an integrated view of the Harrod Model and the Domar Model

Background for Study

- HDM integrated the classical and Keynesian analysis of economic growth.
- In the HDM, capital accumulation plays a crucial role in the process of economic growth.
- The classical economists considered only the capacity of the capital accumulation, and, believing that supply created its own demand, did not pay attention to the demand side.
- Keynesians, on the other hand, erred in the opposite direction. Concerned primarily with the short period, they considered only the adequacy of demand and neglected the problem of increase in capacity through investment in the long run.
- HDM considered **both** the sides of the investment process.

Essence

- An increase in capital expands the productive capacity of the economy. If it is not accompanied by an increase in income, any of the following things may happen: • The new capital may remain untitled. • The new capital may replace old capital depriving the latter of its labour and/or markets. • The new capital may be substituted for labour (and possibly other factors).
- Thus, increase in capital unaccompanied by an increase in income would result into unemployment of capital and /or labour. Excessive capital accumulation may result into overproduction and consequently into a fall in investment leading to depression.

Assumptions

- 1) An initial full-employment level of income exists.
- 2) There is no government interference in the functioning of the economy.
- 3) The exogenous factors do not influence the growth variables, i.e., it is a closed economy model.
- 4) There are no lags in adjustment, i.e., the economic variables like savings, investment, income, expenditure adjust themselves in the same period. Any change in saving brings about the corresponding change in investment in the same period.
- 5) The average propensity to save(S/Y) and marginal propensity to save($\Delta S/\Delta Y$) are equal to each other, i.e., the absolute change in saving is equal to the relative change in saving.
- 6) Propensity to save and "capital coefficient"(capital-output ratio) are constant. The law of constant returns operated because of the fixity of capital-out ratio.

Assumptions

7) Income, investment and savings are all defined in the net sense. It implies that these variables exclude depreciation.

8) Saving and investment are equal in ex-ante and ex-post sense, i.e., accounting and functional equality between saving and investment the equality can be expressed as:

$S_0 = I_0$ (accounting equality)

$S_e = I_e$ (functional equality)

S_0 and I_0 are observed saving and investment.

S_e and I_e are expected saving and investment.

All these assumptions are not necessary for the final solution of the problem; nevertheless, they serve the purpose of simplifying the analysis.

The Harrod model

The Harrod model is based on three growth rates.

1. The actual growth rate denoted by G . It is determined by the saving ratio and the capital-output ratio. It shows short-run cyclical variation in the rate of growth.
2. The warranted growth rate denoted by G_w . It is the full capacity growth rate of income in an economy.
3. The natural growth rate denoted by G_n . This is regarded as 'the welfare optimum'. It may also be called the potential or the full employment rate of growth.

The Harrod model

Actual Growth Rate (G)

$$GC = s$$

Substituting the values, we get

$$(\Delta Y/Y) \times (I/\Delta Y) = S/Y$$

$$\begin{aligned} \text{or} \quad & \frac{\Delta Y}{Y} \times \frac{I}{\Delta Y} = \frac{S}{Y} \\ & = \frac{I}{Y} = \frac{S}{Y} \end{aligned}$$

$$\text{or} \quad I = S$$

where G = actual rate of growth (or $\Delta Y/Y$)

C = the marginal capital output ratio [or $(I/\Delta Y)$]

s = saving income ratio [or (S/Y)]

Implication

The equality between saving and investment (export sense) is thus a necessary condition for achieving steady growth. It is also called the **dynamic equilibrium**.

The Harrod model

Warranted Growth Rate (G_w)

$$G_w C_r = s$$

where G_w = warranted growth rate

C_r = amount of capital required to maintain the warranted growth rate
 s = saving-income ratio

Implication

If the economy is to advance at the steady rate of G_w that will fully utilise its capacity, income must grow at the rate of s/C_r per year, i.e.,

$$G_w = s/C_r.$$

The Harrod model

Natural Growth Rate (G_n)

$$G_n = C_r \text{ or } \neq s$$

It is the maximum growth rate that an economy can achieve with its available natural resources.

The Harrod model

Interactions between G , G_w and G_n

Comparing G_w and G_n , it may be concluded that G_n may or may not be equal to G_w . In case G_n happen to be equal to G_w , the condition of steady growth would prevail. But such a possibility is remote one because a variety of factors (influencing G_n and G_w) come into play and make balance between these two growth-rates difficult. There exists a greater probability of inequality between G_n and G_w . It may take two terms:

- a) $G_w > G_n$
- b) $G_n > G_w$

The Harrod model

Interactions between G , G_w and G_n

a) $G_w > G_n$: If G_w exceeds G_n , G would lie below G_n for most of the time.

In this situation, there would be a tendency for cumulative recession. A downward trend would set in, resulting in unemployment and depression. However, downward trend cannot continue indefinitely. The reason is that lower limit to depression is set by the minimum consumption level. The consumption cannot fall below a minimum level. The minimum consumption requirements can be made possible by reducing the working capital. The entrepreneurs may not reduce fixed capital in the hope that future might entail bright prospects for investment. These two factors would gradually set the wheels of recovery in motion. The economy would experience upward trend.

The Harrod model

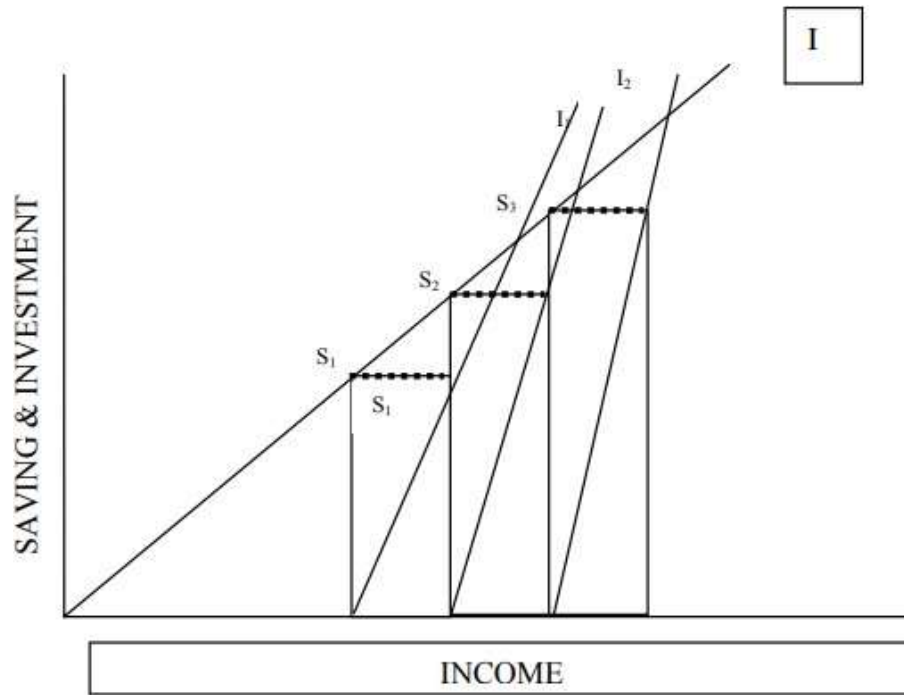
Interactions between G , G_w and G_n

b) $G_n > G_w$: In this situation, G would also exceed G_w for most of the time,

There would be a tendency for cumulative boom and full employment. Such a situation will create inflationary trend. To check this trend, savings should be encouraged, as these would ensure a high level of employment without inflationary pressures.

The Harrod model

Model



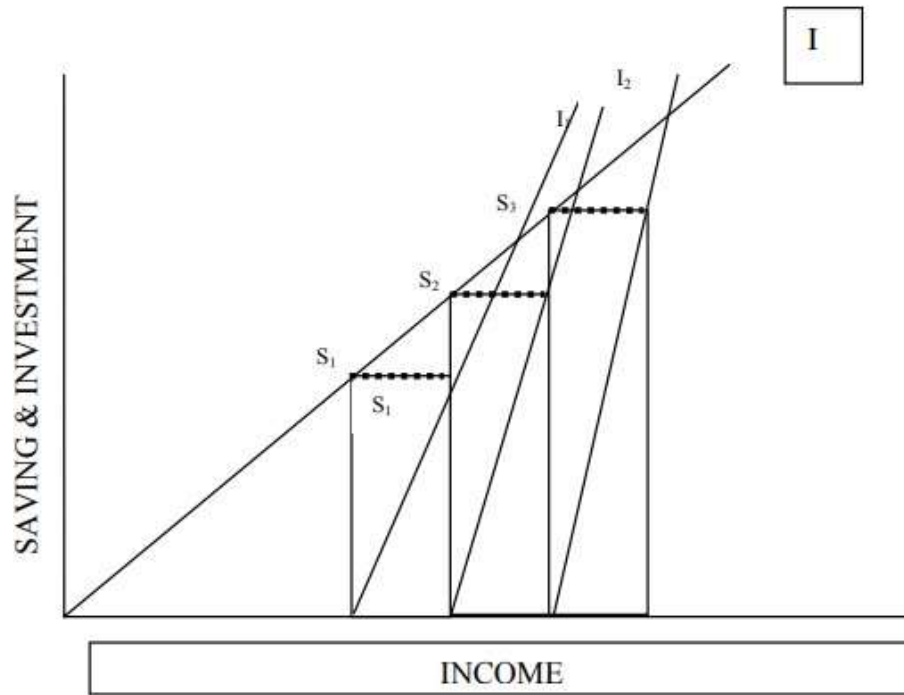
If, $G = G_w$

And $C = C_r$

The economy would be in equilibrium.

The Harrod model

Model



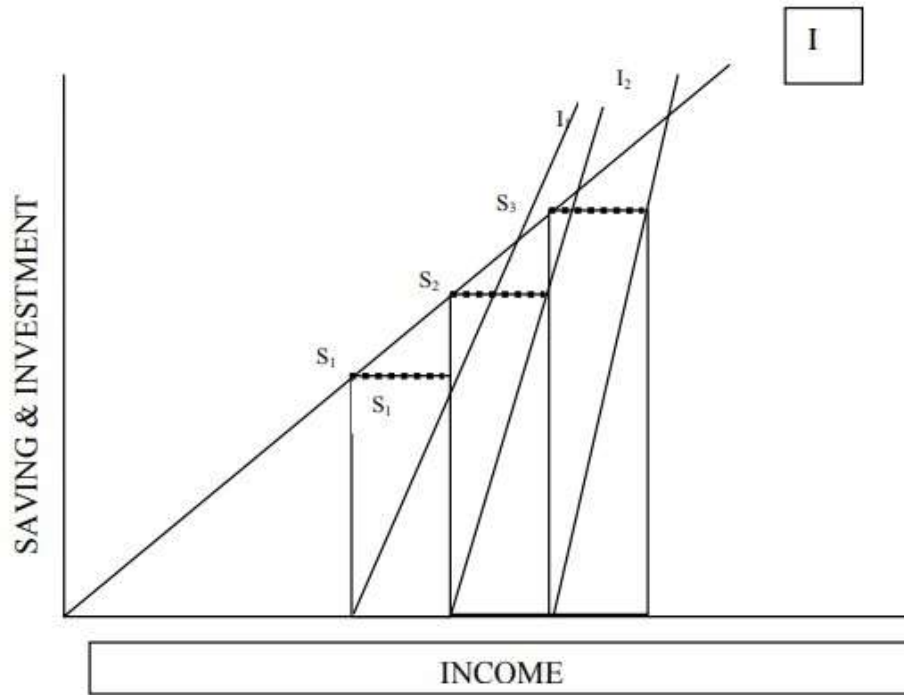
The economy would be in disequilibrium if

$$G > G_w$$

- Deficiency of capital
- Growth rate of income is higher than the growth rate of output
- Demand for output > Supply of output (because of lower level of output)
- Inflation

The Harrod model

Model



The economy would be in disequilibrium

$$G < G_w$$

- Excess of capital
- Growth rate of income is lower than the growth rate of output
- Demand for output < Supply of output
- Depression and unemployment

The Harrod model

Critique of the Harrod Model

The instability in Harrod's model is due to the rigidity of its basic assumptions, viz. fixed production function, a fixed saving ratio, and a fixed growth rate of labour force. Economists have attempted to relieve this rigidity by permitting capital and labour substitution in the production function, by making the saving ratio a function of the profit rate and the growth rate of labour force as a variable in the growth process.

The Domar model

Capacity Effect of Investment (Supply Side)

$$\Delta Y = \Delta Y \cdot \frac{\Delta Y}{\Delta K}$$
$$\therefore \Delta Y = I \cdot \sigma$$

- Increase in national income depends upon the increase in stock of capital and the productivity of capital.
- Absolute increase in national income can be obtained from an increase in stock of capital multiplied by the output produced per unit of capital.
- Change in capital = Investment made

The Domar model

Income Effect of Investment (Demand Side)

$$\Delta Y = \frac{1}{s} \cdot \Delta I$$

- Growth in capacity output will be realised if aggregate demand or income increases by a sufficient amount. (explained by Keynesian theory of multiplier)
- According to this theory, increase in income is given by an increase in investment and the size of the multiplier.
- The growth in income must be large enough to generate demand equal to capacity growth in output.

The Domar model

Domar's Growth Equation in terms of Rate of Growth (Derivation)

$$\begin{aligned}\frac{\Delta Y}{Y} &= \frac{\Delta K}{Y} \cdot \frac{\Delta Y}{\Delta K} \\ \therefore G_Y &= \frac{I}{Y} \cdot \frac{\Delta Y}{\Delta K} \\ \therefore G_Y &= \frac{I}{Y} \cdot \sigma \\ \therefore G_Y &= \frac{S}{Y} \cdot \sigma \\ \therefore G_Y &= s \cdot \sigma\end{aligned}$$

- Growth of capital is expressed as ratios of total income.
- $\Delta Y/Y$ = Growth of income
- ΔK = Increment in capital
- Assuming output – capital ratio remains constant, $\Delta Y/\Delta K$ will equal Y/K (average capital output ratio)
- I/Y = Investment as a ratio of national income
- σ = Output to capital ratio
- S/Y = Ratio of savings to national income

The Domar model

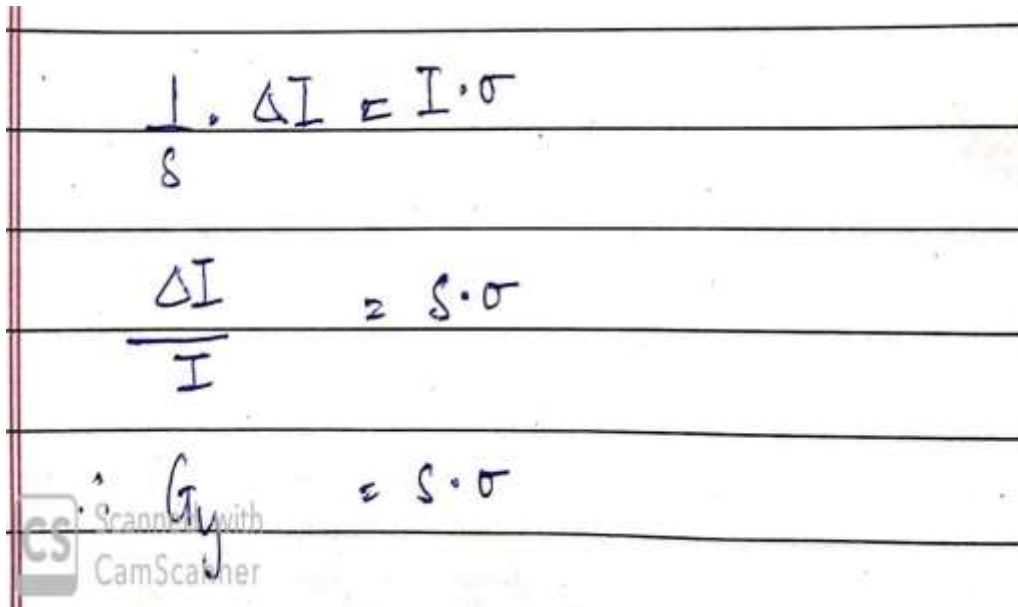
Domar's Growth Equation in terms of Rate of Growth (Explanation)

$$\begin{aligned}\frac{\Delta Y}{Y} &= \frac{\Delta K}{Y} \cdot \frac{\Delta Y}{\Delta K} \\ \therefore G_Y &= \frac{I}{Y} \cdot \frac{\Delta Y}{\Delta K} \\ \therefore G_Y &= \frac{I}{Y} \cdot \sigma \\ \therefore G_Y &= \frac{S}{Y} \cdot \sigma \\ \therefore G_Y &= s \cdot \sigma\end{aligned}$$

- Given the output to capital ratio, rate of growth of output depends upon the rate of investment.
- The greater the investment, the greater the rate of growth of output or income.
- To maintain full employment equilibrium, savings must remain equal to investment.
- The final step in the derivation represents the productive capacity effect of investment and saving and thus represents the supply side of the growth problem.

The Domar model

Condition for Equilibrium Growth



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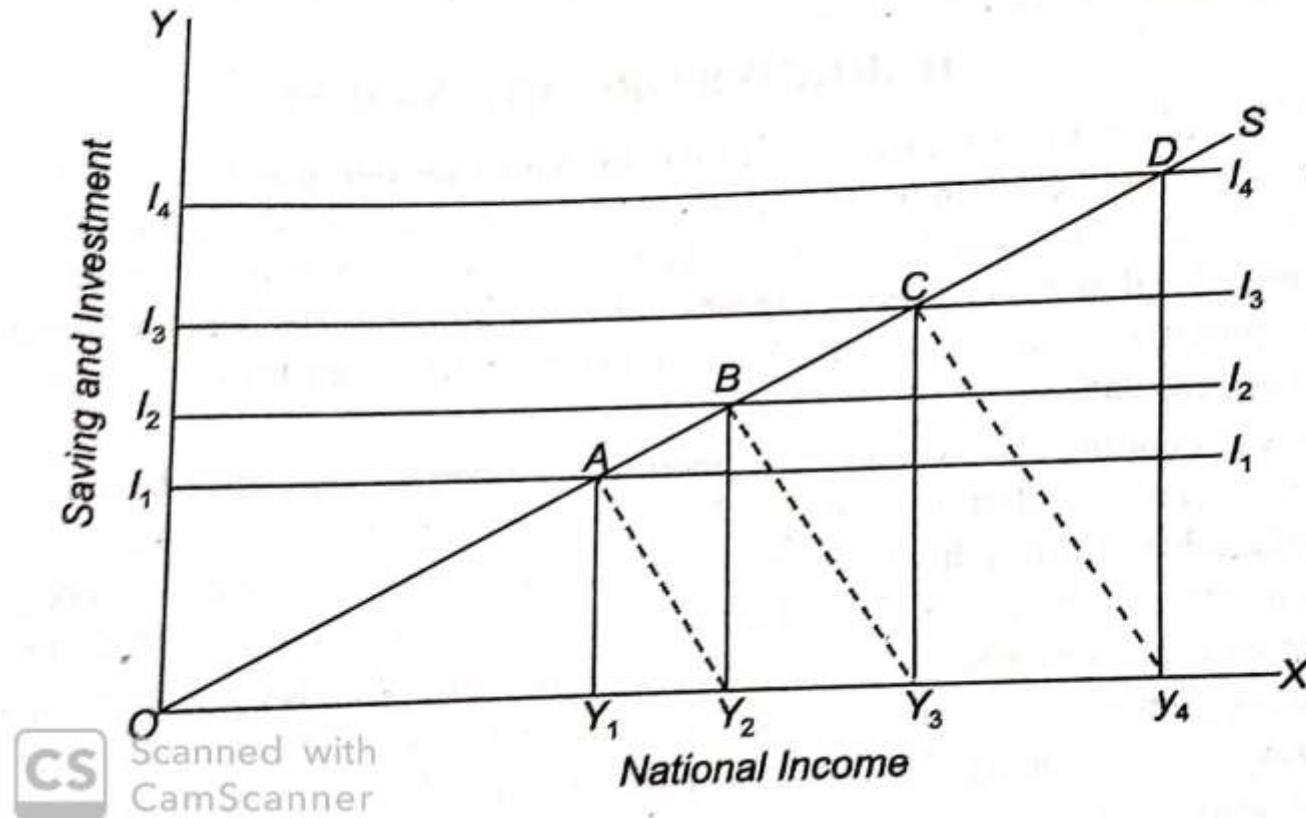
$$\frac{1}{s} \cdot \Delta I = I \cdot \sigma$$
$$\frac{\Delta I}{I} = s \cdot \sigma$$
$$G_y = s \cdot \sigma$$

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- To achieve and maintain equilibrium or balanced growth, aggregate demand must increase at the rate which is large enough to absorb the increase in capacity-output.
- Steady equilibrium growth rate will be achieved only if rate of growth of aggregate expenditure equals the rate of growth in capacity output.
- Thus, investment and real income must grow at a constant annual rate which is equal to the propensity to save multiplied by output –capital ratio.

The Domar model

Geometrical explanation to the Condition for Equilibrium Growth



The Harrod - Domar model

Comparison

Harrod's Model	Domar's Model
$\frac{\Delta I}{I} = \sigma \alpha$ $\frac{\Delta I}{\alpha} = \sigma I$	$G = \frac{S}{C}$
$\frac{\frac{\Delta I}{\Delta S}}{\frac{\Delta Y}{\Delta K}} = I \times \frac{\Delta Y}{\Delta K} = \frac{\Delta Y}{\Delta I}$ $\frac{\Delta I \times \Delta Y}{\Delta S} = I \times \frac{\Delta Y}{I}$ $\frac{\Delta I \times \Delta Y}{\Delta S} = \Delta Y$ $\text{or } \Delta I \cdot \Delta Y = \Delta S \cdot \Delta Y$ $\text{or } \Delta I = \Delta S$	$\frac{\Delta Y}{Y} = \frac{\frac{S}{Y}}{\frac{I}{\Delta Y}} \text{ or } \frac{S}{Y} \times \frac{\Delta Y}{I}$ $\frac{\Delta Y}{Y} \times \frac{I}{\Delta Y} = \frac{S}{Y}$ $\text{or } I = S$