

Solow model of growth



Robert Merton Solow is an American economist particularly known for his work on the theory of economic growth that culminated in the exogenous growth model named after him.

Solow model of growth

Prof. R.M.Solow builds his model of economic growth as an alternative to the Harrod-Domar model of growth without its crucial assumption of fixed proportion in production. He brings a continuous production function linking output to input of Labor and capital which are substitutable

Assumptions

- One composite commodity is produced
- Output is net output after depreciation of capital
- Labor and capital are substitutable
- Prices and wages are flexible
- There is full employment of labor
- There is constant returns to scale
- There is neutral technical progress
- The saving ratio is constant
- The two factors of production land and capital are paid according to their marginal physical productivities

Basic idea

- In Solow model there would be tendency for K/L (capital labor ratio) to adjust itself through time in the direction of equilibrium ratio. If the initial ratio of capital to labor is more capital and output would grow more slowly than labor force and vice versa. Solow's analysis is convergent to equilibrium path to start with any capital labor ratio.

Explanation

- Solow takes output as a whole the only commodity in the economy.
- Annual rate of production is $Y(t)$ part of it is consumed and rest is saved and invested.
- That which is saved is a constant s , and rate of saving is $s Y(t)$
- $K(t)$ is the stock of capital and net investment or rate of increase of this stock of capital is K

Equations

- Basic equation is $K=sY$... (1) equation
- Since output is produced with capital and labor, technological possibilities are represented by the production function $Y=F(K,L)$ that shows constant returns to scale.. (2) equation

Inserting equation 2 in 1 we get

$$K=sF(K,L) \quad (3) \text{equation}$$

- In equation 3 i.e. $K=sF(K,L)$ L represents total employment since population is growing exogenously, the labor force increases at a constant relative rate n thus fourth equation is

$$L(t) = L_{oe}^{nt}$$

Solow regards n as Harrod natural rate of growth in the absence of technological change and $L(t)$ as the available supply of labor at the rate t

Final equation

- By inserting equation 4 in 3 we get

$$K = sF(K, L_{oe}^{nt})$$

He regards this basic equation of as determining the time path of capital accumulation K that must be followed if all available labor is to be fully employed.

Growth pattern I

- Equation $r = sF(r,1) - nr$
- here r is the K/L ratio of capital to labor
- N is relative change of labor force L/L
- The function $r = sF(r,1)$ represents output per worker as a function of capital per worker. It is total product curve as varying amounts of capital are employed with one unit of labor
- In fig 1 ray through origin is the function nr the other curve is function $sF(r,1)$ which shows diminishing mu of capital. At the point of intersection of the two curves $nr = sF(r,1)$ and $r=0$
- Here K/L is a constant and capital stock must expand at same rate of labor force

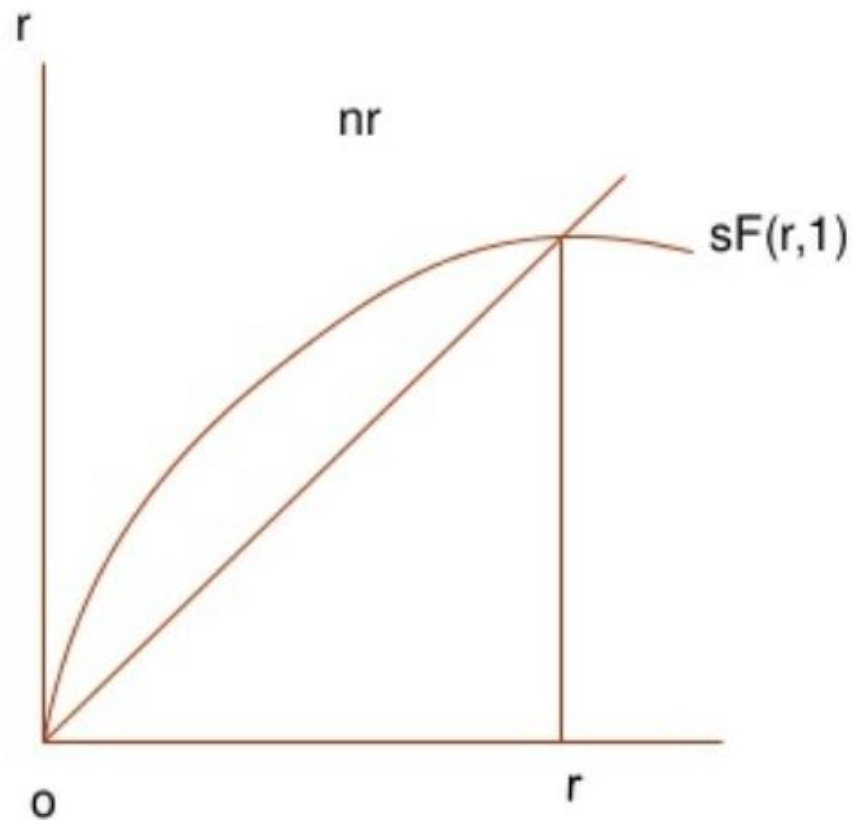
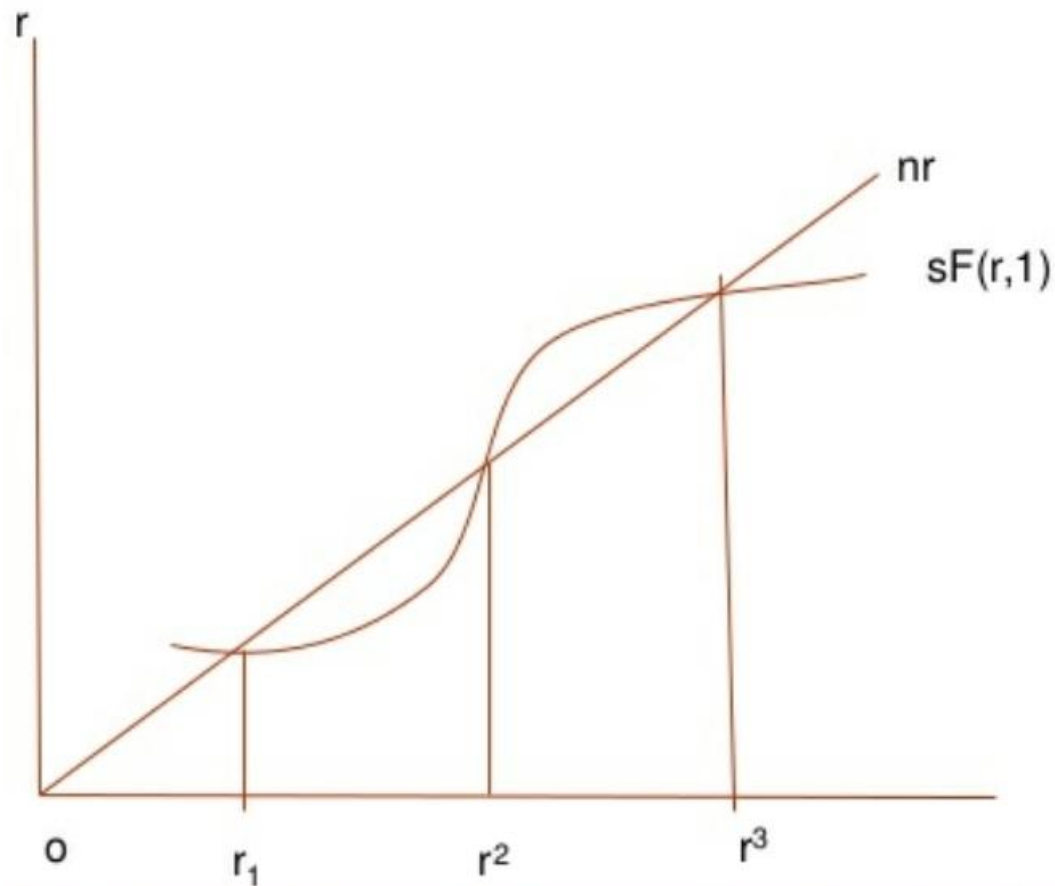


Fig 1

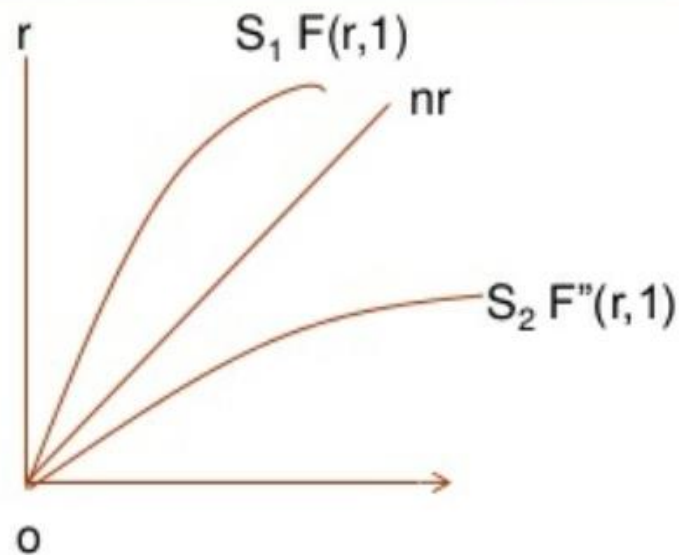
Growth pattern II



In Fig 2 the productivity curve $sF(r,1)$ intersects the curve nr at three points r_1 , r_2 , r_3 . Here r_1 and r_3 are stable equilibrium positions because the total productivity curve is above nr but at r_2 it is below nr and it is unstable

Growth pattern III

In Fig 3 the ray nr depicts equilibrium path where warranted and natural growth rates are equal the curve $sF'(r, 1)$ which is above nr represents a highly productive system in which capital and income increase more rapidly than the labor supply than this system, which is of perpetual full employment, income and saving increase so much that the capital labor ratio increase limitlessly on the other hand curve $S_2 F''(r, 1)$ depicts highly unproductive system in which the full employment path leads to ever diminishing per capital income



summary

- Professor Solow conclusion of his model is “ when production takes place under the usual neo-classical conditions of variable proportions and constant returns to scale, no simple opposition between natural and warranted growth rates is possible. There may not be any knife edge. The system can adjust to any given rate of growth of the labor force, and eventually approach a state of steady proportional expansion i.e.

$$\Delta K/K = \Delta L/L = \Delta Y/Y$$

Critical appraisal

- The Solow model is a major improvement over the Harod-Domar model as in H-D model there is a knife edge and if any of the used parameters change a bit consequences would be chronic inflation or unemployment. While assumption of substitutability between labor and capital gives the growth process an adjustability and problem of Knife edge doesn't arise.