A BRIEF REMINDER ON STEADY-STATE

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Abstract
This study is only a short reminder which emphasizes some important characteristics of steady-state. According to the study, since constant returns to scale conditions imply full capacity or full employment and it is compatible with steady-state, then, steady-state conditions indicate full capacity or full employment. Besides, since Harrod-neutral technological progress is compatible with steady-state conditions, then, Harrod-neutral technological progress guarantees full employment. The study proposes that; these characteristics of steady-state should not be neglected during economic analysis, in order to be consistent with the concepts of economics.

Keywords Steady-state; constant returns to scale; full employment.
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Introduction

Steady-state and stability are two important concepts for economic analysis. Once steady-state conditions of a model are defined, it becomes possible to determine an attractor. If the economy goes towards the attractor, then there is stability. Once stability is established it becomes possible to implement and control economic policy. The present study emphasizes some important characteristics of steady-state from the point of view of **economics**. In other words, this brief note attempts to remind some characteristics of steady-state. It is claimed that neglecting these characteristics makes an **economic** analysis inconsistent.

Next section explains some logical consequences on steady-state. Final section is the conclusion.

Logical consequences on steady-state

Assume that factors of production (capital and labor) are doubled. If output is also doubled then, by definition, there will be constant returns to scale.

In order to explain the linkage between constant returns to scale and full employment, let us write total cost (TC) and average cost (AC) equations as follows:

$$TC = wL + rK \tag{1}$$

$$\frac{TC}{Q} = AC = w\frac{L}{Q} + r\frac{K}{Q} \tag{2}$$

where w, L, r, K and Q are wage, labor, rate of return, capital and output, respectively. Then, (3) and (4) are written:

$$\Delta AC = \Delta\left(w\frac{L}{Q}\right) + \Delta\left(r\frac{K}{Q}\right) \tag{3}$$

$$\Delta AC = w\Delta\frac{L}{Q} + r\Delta\frac{K}{Q} + \frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r \tag{4}$$

(4) can be rearranged as follows:

$$\Delta AC = w\frac{L}{Q}\frac{\Delta\frac{L}{Q}}{\frac{L}{Q}} + r\frac{K}{Q}\frac{\Delta\frac{K}{Q}}{\frac{K}{Q}} + \frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r \tag{5}$$

Thus (5) will be:

$$\Delta AC = w\frac{L}{Q}\left(\frac{\Delta L}{L} - \frac{\Delta Q}{Q}\right) + r\frac{K}{Q}\left(\frac{\Delta K}{K} - \frac{\Delta Q}{Q}\right) + \frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r \tag{6}$$

Since $Q = f(K, L)$, if there are constant returns to scale, then by definition:

$$\frac{\Delta K}{K} = \frac{\Delta L}{L} = \frac{\Delta Q}{Q} \tag{7}$$

Therefore (6) becomes:

$$\Delta AC = \frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r \tag{8}$$

If average cost reaches its minimum in the long-run, since it should be $\Delta AC = 0$, then $\frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r = 0$. Indeed, when $\frac{L}{Q}\Delta w + \frac{K}{Q}\Delta r = 0$ (6) becomes:

$$\Delta AC = 0 \tag{9}$$

(9) means that if long-run average cost reaches its minimum, so, by definition, full capacity or full employment is achieved. Note that if there were increasing to returns to scale, (6) would be negative, so the scale will be below the full capacity or full employment level.

Result 1: When constant returns to scale is assumed, it theoretically guarantees full capacity or full employment in the long-run.

If there are steady-state conditions, then by definition:

$$\frac{\Delta K}{K} = \frac{\Delta L}{L} = \frac{\Delta Q}{Q} \tag{10}$$

Note that, again by definition, when there are constant returns to scale (10) occurs in the long-run.

Result 2: Constant returns to scale is compatible with steady-state conditions in the long-run.

Note that, Hicks (1989, p. 14-15) also points out relationship between constant returns to scale and steady-state.

Immediately Result 3 can be written based on Result 1 and Result 2:

Result 3: Steady-state guarantees full capacity or full employment conditions in the long-run.

According to Uzawa (1961) Result 4 is obvious:

Result 4: Harrod-neutral technological progress is compatible with steady-state conditions.

Finally, using Result 3 and Result 4, following will be written:

Result 5: Harrod-neutral technological progress guarantees full employment conditions in the long-run.

Conclusion

This brief note points out five important elements of steady-state: i) Constant returns to scale conditions imply full capacity or full employment conditions in the long-run, ii) Constant returns to scale assumption is compatible with steady-state in the long-run, iii) Steady-state conditions indicate full capacity or full employment conditions in the long-run, iv) Harrod-neutral technological progress is compatible with steady-state conditions, v) Harrod-neutral technological progress guarantees full employment conditions in the long-run.

This study emphasizes that, one should not ignore these characteristics of the steady-state while making an **economic** analysis, in order to be consistent with the concepts of **economics**.

References

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