UNIT 12: ACCELERATION PRINCIPLE

UNIT STRUCTURE

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12.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define the concept of the accelerator
- discuss the principle of accelerator
- illustrate the operation of the accelerator
- state the assumptions of the acceleration principle and discuss its criticisms.

12.2 INTRODUCTION

This unit deliberates on the concept of accelarator. The concept of accelerator occupies an important place in the study of Macroeconomic theory. In an economy, investment spending and the changes in consumption spending are interrelated.

More specifically, the demand for capital goods depends upon demand for consumer goods because former helps to produce the later. However, the rate of change in demand for capital goods is always faster than the initial change in demand for consumption goods under all normal conditions. In this unit, we shall discuss the linkage between consumption

expenditure and investment, which is known as the acceleration principle.

12.3 THE CONCEPT OF ACCELERATION PRINCIPLE

We have already mentioned that in an economy, investment spending and the changes in consumption spending are interrelated. More specifically, the demand for capital goods depends upon demand for consumer goods because former helps to produce the later. However, the rate of change in demand for capital goods is always faster than the initial change in demand for consumption goods under all normal conditions.



LET US KNOW

- Capital is (a) the stock of equipments or structures used in production and (b) the funds to finance the accumulation of equipment and structure.
- The earliest study on the accelerator theory or principle was undertaken by J.M. Clark in “Business Accelerator and the Law of Demand”, published in the Journal of Political Economy, March 1971, pp. 217-35.
- Cost of capital: the amount forgone by holding a unit of capital for one period, including interest, depreciation and the gain or loss from the change in the price of capital
- Investment spending: expenditure incurred on the purchases or goods by individuals and firms that add to their stock of capital.

In general, acceleration principle establishes the link between consumption spending and investment spending. It is defined as the process by which an increase (or decrease) in the consumption spending leads to a manifold increase (or decrease) in investment on capital goods. Symbolically, $v = \frac{\Delta I}{\Delta c}$ or $\Delta c \times v = \Delta I$, where "v" is the accelerator coefficient, "ΔI" is net change in investment and Δc is the net change in consumption expenditure. Numerically, if the increase in consumption expenditure of Rs. 10 lakhs leads to an increase in investment of Rs 30 lakh, the accelerator coefficient is 3.

In specific interpretation, accelerator is defined as the ratio which states that investment spending is proportional to the change in output and is not affected by the cost of capital. Here, the coefficient of accelerator is defined as $v = \frac{I_t}{\Delta Y}$ or the capital- output ratio, where I_t is net investment in time period "t", "Y" stands for national output and $\Delta Y = Y_t - Y_{t-1}$. Here, the guiding rule as Shapiro (2000) notes is the following:

> "an increase in productive capacity requires an expansion of the capital stock, which in turns calls for a higher rate of investment spending than would otherwise be needed. Accordingly, the rate of investment spending is made to depend on the changes in the level of national output." (Page. 398)

12.4 THE PRINCIPLE OF ACCELERATION

The fundamental relationship, as explained in section 12.1, between the changes in the level output and the volume of investment spending is known as the acceleration principle. The capital-output ratio "v" is known as the accelerator. To be precise, the theory of investment based on this relationship is known as the accelerator theory.

Let's explain this principle in terms of equations in the following manner:

If K stands for capital stock, Y stands for national output and *v* the capital-output ratio, then,

$K = vY$ ..... (1)

[Equation (1) states that if v is given as 2, then income (y) of Rs. 400/- is desired for the investment (or capital) of Rs. 200/-]

Since, the principle works under the assumption of constant or unchanging capital-output ratio, the capital stock, K in equation (1) will change over successive time periods only with changes in output, Y. If 't' stands for time period, taking time period into account, equation (1) can be expressed as,

$K_{t-1} = vY_{t-1}$ ..... (2)

Here, *t-1* is the preceding time period and *t* is the current or present

time period. If output rises from period *t-1* to *t* then the desired capital stock becomes,

$$K_t = vY_t \quad \text{..... (3)}$$

It is clear from equation (2) and (3), the increase in desired capital stock is $K_t - K_{t-1}$. In other words, to increase the capital stock from K_{t-1} to K_t, the net investment spending required is equal to the change in capital stock, i.e.

$$I_t = K_t - K_{t-1} \quad \text{..... (4)}$$

Here, I_t is net investment for period *t*. By definition net investment is obtained while we deduct depreciation of capital from gross investment. By substituting equation (3) in (4), we find:

$$I_t = vY_t - vY_{t-1}$$

$$\text{or, } I_t = v(Y_t - Y_{t-1}) \quad \text{..... (5)}$$

Equation (5) finally tells us that net investment depends upon the change in output from *t-1* to *t* multiplied by the capital-output ratio, *v*. If $Y_t > Y_{t-1}$, equation indicates that $I_t > 0$ and vice versa. Thus, for any given value of *v* and for any change in *Y* from *t-1* to *t*, the amount of net investment required (either positive or negative) depends upon change in level of output. If the economy is producing with no excess capacity and if capital-output ration is constant, any expansion of output requires an expansion of the capital stock. Further, if the value of accelerator is greater than one, the needed increase in capital stock must exceed the increase in output so that increase in investment spending is greater than the increase in output which causes it.

12.5 OPERATION OF THE ACCELERATOR

Having discussed the basics of acceleration principle, let us explain how acceleration principle works in practice. In order to know the working of the acceleration principle in an economy, we have to look at the changes in output and gross investments over a period of time. An arbitrary example relating to this is presented in Table 12.1 which is adapted here from the textbook *Macroeconomic Analysis* by E. Shaprio (2000).

Table 12.1:The Working of the Acceleration Principle

(here "v" is assumed to be 2)

Time period (in years)	Output (in units)	Desired Capital (in Rs Cr)	Actual Capital (in Rs Cr)	Repacement Investment (in Rs Cr)	Net Investment (in Rs Cr)	Gross Investment (in Rs Cr)
t	200	400	400	20	0	20
t + 1	210	420	420	20	20	40
t + 2	220	440	440	20	20	40
t + 3	250	500	500	20	60	80
t + 4	270	540	540	20	40	60
t + 5	260	520	520	20	-20	0
t + 6	256	512	512	20	-8	12
t + 7	250	500	500	20	-12	8
t + 8	230	460	480	20	- 40	20
t + 9	200	400	460	20	- 60	40
t + 10	190	380	440	20	- 20	0
t + 11	210	420	420	20	- 40	60
t + 12	220	440	440	20	20	40

In table 12.1, column-1 shows series of time periods, column-2 gives the assumed and given level of income or output in each time period. Capital-output ratio,, is assumed to be constant at 2. This capital-output ratio is used to calculate the desired capital stock which is presented in column-3. Desired capital stock is obtained by multiplying output/income level with the constant capital-output ratio. Since actual capital stock might be different from the desired capital stock, in column-5, actual capital stock is presented. Based on average life time of the capital, in each time period the replacement investment is assumed to be five percent of the initial capital stock i.e. the capital stock in time period one. Thus, the replacement investment is found to be Rs. 20 cr. per time period and remains fixed in each time period. In column-6, net investment is presented which is equal to times the change in output between that period and the preceding period. Finally, gross investment of column-7 is obtained by adding replacement and net investment.

From the table, we can simply explain the acceleration principle in the following manner:

When the demand for output increases by 10 units (from 200 units to 210 units) in period t+1, given $v = 2$, new investment requirement is: $I_t = v(Y_t - Y_{t-1})$, *i.e., 2(210-200) = 2 x 10 = Rs. 20 cr.*

Total expenditures for capital goods (which combine both replacement and net investment), have increased to 40 in period t+1 from 20 in the previous period t. Thus, with an accelerator of 2, the increase of 10 (equivalent to 5 percent) in expenditures for output produce an increase of 20 (equivalent to 100 percent) in expenditures for capital goods. This 100 percent increase in expenditure for capital goods due to 5 percent increase in output is mainly due to accelerator.

Let us consider another hypothetical example, presented in table 12.2, to illustrate the working of the acceleration principle.

Table 12.2:The Working of the Acceleration Principle

(here "v" is assumed to be 5)

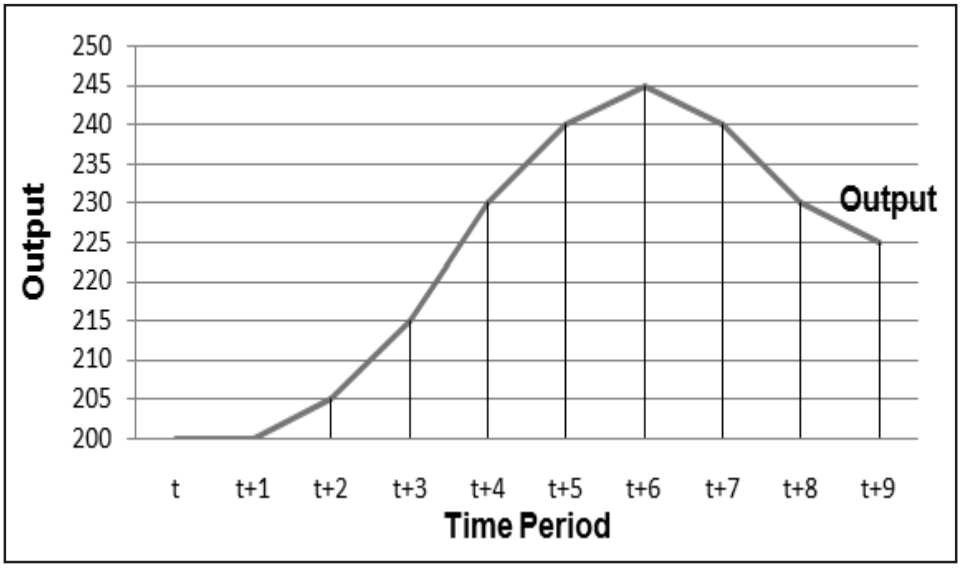
Time period (in years)	Output (in no. of units)	Desired Capital (In Rs Cr.)	Actual Capital (In Rs Cr.)	Repacement Investment (In Rs Cr.)	Net Investment (In Rs Cr.)	Gross Investment (In Rs Cr.)
t	200	1000	1000	50	0	50
t + 1	200	1000	1000	50	0	50
t + 2	205	1025	1025	50	25	75
t + 3	215	1075	1075	50	50	100
t + 4	230	1150	1150	50	75	125
t + 5	240	1200	1200	50	50	100
t + 6	245	1225	1225	50	25	75
t + 7	240	1200	1200	50	-25	25
t + 8	230	1150	1150	50	-50	0
t + 9	225	1125	1125	50	-25	25

Table 12.2 depicts changes in total output, capital stock, net investment and gross investment over ten years time period. The value of accelerator v (is assumed to be 5)**.** Given $K_t = vY_t$, i.e. the required or desired capital stock in each period is 5 times the corresponding output of

that period as shown in column-3. The replacement investment is assumed to be 5 percent of initial capital in first year which is shown as 50 in each time period. Net investment in column-5 equals *v* times the change in output between one period and the preceding time period i.e. $I_t = v(Y_t - Y_{t-1})$. It is clear that net investment depends upon the change in total output gives the value of accelerator. So long as the demand for output rises, net investment is positive. Net investment turns out to be negative when change in output between two time periods is negative. In our table total output increases at an increasing rate up to time period *t+4* year and so does the net investment. Then it increases at diminishing rate from *t+5* year onwards and net investment has declined. From *t+6* year output has declined and net investment becomes negative.

The acceleration principle based on Table 12.2 has been illustrated diagrammatically in the following figures 12.1 and 12.2.

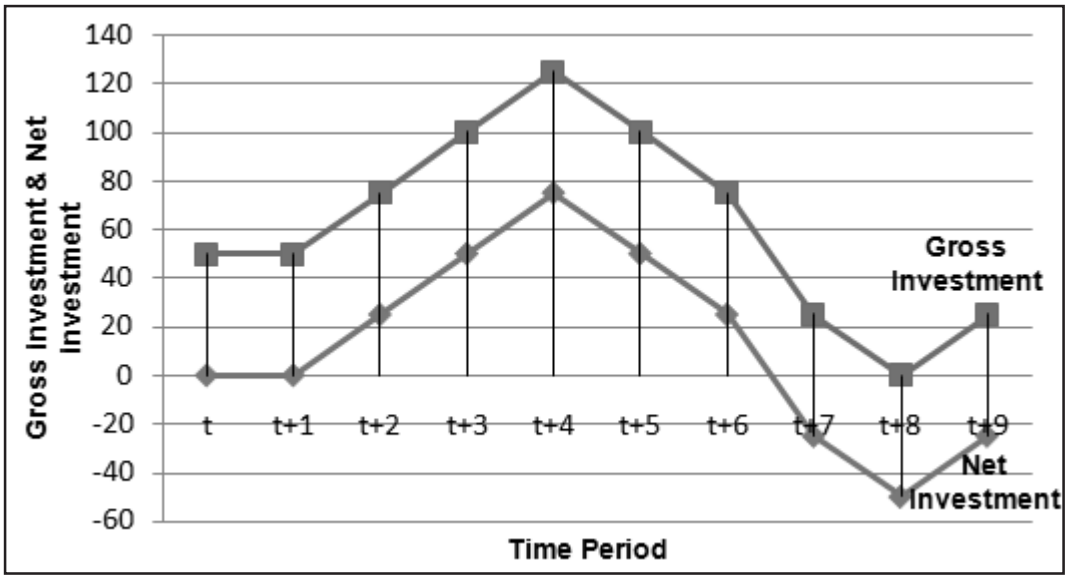
Figure 12.1: Acceration Principle: Output Curve



In Figure 12.1, total output curve is shown. It is clear from the figure that total output curve (Y) increases at an increasing rate up to time period t+4, then at a decreasing rate up to time period t+6, after this it starts declining.

Let us now view the net investment and gross investment cuves. These have been shown in Figure 12.2.

Figure 12.2: Acceleration Principle: Gross Investment & Net Investment Curves



The net investment curve in Figure 12.2 shows that the rising output leads to increase in net investment (due to accelerator) up to t+4 periods because output is increasing at an increasing rate. But when output increases at decreasing rate between t+4 and t+6 periods, net investment declines. When output has declined since t+7, net investment has become negative. It is also clear from figure 12.2 that gross investment curve has shown same behaviour as the net investment curve.



CHECK YOUR PROGRESS

Q 1: Why is the accelerator used? Answer in about 30 words.

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Q 2: Define accelerator principle. Answer in about 40 words.

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Q 3: Fill in the blanks: $I_t = v(Y_t$ - .....)

12.6 ASSUMPTIONS AND CRITICISMS OF THE ACCELERATION PRINCIPLE

The acceleration principle rests upon a few assumptions.

- The capital-output ratio is assumed to be remaining constant.
- The firms operate without excess capacity, i.e. firms can not expand output with decreasing average cost of production.
- The firms will increase its capacity to meet every increase in real spending. That is resources (especially supply of credit and capital) demanded by the firms are assumed to be elastic.
- There is no gap between desired/required capital and actual/real capital stock within a single time period.
- Increase in output immediately leads to a rise in net investment.

The acceleration principle has been criticised for its rigid assumptions. The following are its main limitations:

- **Capital-output ratio is not constant**: The acceleration principle is based on a constant capital-output ratio. But capital output does not remain constant for many reasons. For example, (a) rapid technological advancements in all economies (more so in the developing countries) improve marginal efficiency of capital which in turn lead to increase in output of any commodity per unit capital, (b) speculative behaviour of investors or traders with regard to prices, wages, interest affects future demand for a commodity which affects current output. High optimism in business causes capital-output ratio to go up and vice versa.
- **Resources are not elastic:** The underlying assumption that the resources should be elastic i.e. they are unemployed in the capital goods industries and can be used to expand the industries, is objected by economists. This resource elasticity is feasible when there is unemployment in the economy. But once the economy reaches the full employment level, the capital goods industries fail to expand due to the absolute as well as relative scarcity of resources. This limits the working of the acceleration principle. Therefore, when an economy undergoes recession this principle doesn't work.

- **There is possibility of idle/excess capacity in plants**: The acceleration theory assumes that there is no idle/unused capacity in plants. But it is obvious that many firms mostly in their infancy enjoy idle capacity. Under such circumstances, an increase in the demand for consumer goods will not lead to the increased demand for new capital goods. In such a situation, the acceleration principle becomes inoperative.
- **There is difference between required and real capital stock:** The acceleration theory assumes no difference between required and real capital stock. Even if it exists it ends in one period. But if industries are already producing capital goods at full capacity, it is not possible to end the difference in one period.



12.7 LET US SUM UP

- In general, the ratio of the change in consumption expenditure to the change in net investment is known as the accelerator coefficient. Symbolically, . Where *I* stands for invest and C for consumption expenditure.
- In specific interpretation, accelerator is defined as the ratio which states that investment spending is proportional to the change in output and is not affected by the cost of capital.
- The Cost of capital is the amount forgone by holding a unit of capital for one period, including interest, depreciation and the gain or loss from the change in the price of capital.
- The earliest study on the accelerator theory or principle is the one done by J.M. Clark, “Business Accelerator and the Law of Demand”, published in the Journal of Political Economy, March 1971.
- The fundamental relationship between the changes in the level output and the volume of investment spending is known as the acceleration principle. The capital-output ratio is known as the accelerator.
- Net investment is the gross investment less depreciation cost of capital.

- Acceleration principle is based upon assumptions like, constant capital-output ratio, no excess capacity, presence of resource elasticity and the absence of difference between required capital stock and real capital stock.
- The principle is objected mainly for its underlying unrealistic or rigid assumptions.



12.8 FURTHER READING

1) Chopra, P.N.(2008). *Micro Economics*. Ludhiana: Kalyani Publishers..
2) Jhingan, M. L. (2014). *Advanced Economic Theory. New Delhi:* Vrinda Publication Pvt. Limited
3) Shapiro, E. (2013), *Macroeconomic Analysis.* New Delhi: Galgotia Publications

12.9 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No. 1: In general, acceleration principle establishes the link between consumption spending and investment spending.

Ans to Q No. 2: In specific interpretation, accelerator is defined as the ratio which states that investment spending is proportional to the change in output and is not affected by the cost of capital. Here, the coefficient of accelerator is defined as $v = \frac{I_t}{\Delta Y}$ or the capital-output ratio, where I_t is net investment in time period "t", "Y" stands for national output and $\Delta Y = Y_t - Y_{t-1}$.

Ans to Q No. 3 : $I_t = v(Y_t - Y_{t-1})$.



12.10 MODEL QUESTIONS

A) Very Short Questions:

Q 1: What is capital?

Q 2: What is investment?

Q 3: What is Gross investment?

Q 4: What is net investment?

Q 5: What do you mean by capital output ratio?

Q 6: What is acceleration principle?

Q 7: State Hick's accelerator coefficient.

Q 8: Does capital-output ratio of any economy remain constant?

Q 9: What do you understand by excess capacity of a firm?

Q 10: How is required capital obtained using acceleration principle?

Q 11: What do you understand by cost of capital?

B) Short Questions (Answer each question in about 150 words)

Q 1: Give a suitable definition of acceleration principle?

Q 2: Derive the equation of acceleration principle?

Q 3: Define investment. State the distinction between gross investment and net investment.

Q 4: Define capital-output ratio. Explain under what conditions an economy's capital-output ratio doesn't remain constant.

Q 5: Explain what happens when accelerator coefficient is found to be greater than one.

C) Long Questions (Answer each question in about 300-500 words)

Q 1: Define accelerator. Critically discuss the principle of acceleration.

Q 2: Explain with the help of a numerical example the operation of acceleration principle. Discuss the main limitations of acceleration principle.

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