THE INCOME-EXPENDITURE MODEL: CONSUMPTION AND EQUILIBRIUM IN A SIMPLE ECONOMY

THEME 2

Index

2.1. THE KEYNESIAN CONSUMPTION FUNCTION IN A SIMPLE ECONOMY

Consumption is the demand for goods and services made by households and represents around 60% of GDP, making it the quantitatively most important component of the DA. There are several factors that affect household consumption.

Household consumption changes as their disposable income changes. In general, when household disposable income increases, families increase their consumption. In turn, if their disposable income decreases, they tend to reduce their consumption. Thus, a functional relationship is observed between consumption and disposable income, with the consumption function describing the relationship between the two variables.

The Keynesian consumption function in its simplest version can be formulated as follows:

$$C = \overline{C} + cYD \quad \text{being } \overline{C} > 0 \quad \text{and} \quad 0 < c < 1$$

Consumption depends on two components. The autonomous component or autonomous consumption ($\overline{C}$) represents the level of consumption that households make independently of their level of disposable income (YD). Thus, even if the level of disposable income of households is zero, they consume a certain level of goods to be able to subsist or lead a decent life, having to resort to savings, for example. This level of autonomous consumption (it does not depend on disposable income) can be higher or lower depending, among other factors, on the wealth of families and their expectations.

On the other hand, consumption depends on the level of household disposable income. The relationship between disposable income and the level of consumption is determined by the marginal propensity to consume (c), which shows the increase in household consumption caused by the increase of one monetary unit of disposable income. Thus, if disposable income increases by one monetary unit, household consumption will increase by c units.

The value of the marginal propensity to consume is between 0 and 1. This indicates that when disposable income increases by one unit, consumption will also increase, but by a positive amount that is less than that unit. In other words, the increase in consumption is positive, but less than proportional to the increase in disposable income.

If consumption increases less than disposable income, what happens to the part of disposable income that is not consumed? This part of disposable income is used by households to save. Thus, saving (S) is the part of disposable income that households do not consume. That is

$$S = YD - C$$

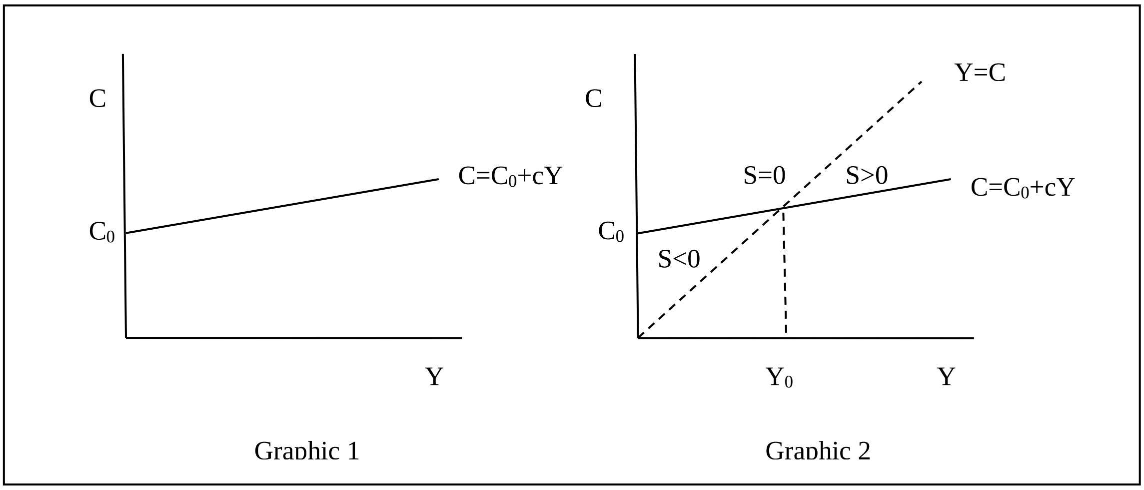
In a simple (two-sector) economy there is no public sector, so the disposable income of households (YD) is equivalent to the income of the economy (Y). That is, Y=YD. In this case, the consumption function can be expressed as follows:

$$C = \bar{C} + cY$$

Consumption then depends on the level of income in the economy. Likewise, saving in a simple economy is equivalent to the economy's income minus consumption, that is S = Y-C.

Figure 1 shows the consumption function in the case of a simple economy. The consumption level is represented on the ordinate axis of both graphs, while the income level of the economy is represented on the abscissa axis.

Figure 1. The consumption function in a simple economy



As shown in Graph 1 of Figure 1, if income Y equals zero, then the level of consumption C is equal to autonomous consumption C_0, but as the level of income begins to rise and becomes positive, so does the level of consumption. This positive relationship between income and consumption is shown by the positive slope of the consumption curve. Also, since this function is positive, but its slope is less than unity, consumption increases less than proportionally to income.

The slope of the consumption curve is the marginal propensity to consume. If it increases, the slope becomes steeper (but never steeper than 45°). Likewise, if the marginal propensity to consume decreases, the slope will be flatter (but never negative).

Graph 2 in Figure 1 shows the representation of the same consumption function, but also shows the bisector of the right angle formed by the coordinate axes. This bisector indicates the points at which income is equal to consumption. Thus, the cut-off point between the consumption curve and the bisector indicates the value of income for which consumption and income become equal. In Figure 2 it can be seen that the income level for which this occurs is Y_0. Thus, if the income level of the economy is Y_0, the level of consumption will be equal to that value. Therefore, if income and consumption are equal, S will be equal to zero.

It can also be seen in Graph 2 that, if the income level is lower than Y_0, consumption will be higher than the income level (consumption curve above the bisector), and therefore, savings will be negative. Whereas, if the income level is higher than Y_0, consumption will be lower than the income level (consumption curve below the bisector), and savings will be positive.

2.2. AGGREGATE DEMAND IN A SIMPLE ECONOMY

In a simple economy, aggregate demand is the sum of consumption and investment.

$$DA = C + I$$

In the previous section, we have obtained the value of consumption for a simple economy, which is as follows

$$C = \overline{C} + cY$$

What about investment? Let's simplify our model by assuming that investment is a constant value. Investment is a business decision that does not depend on the level of income in the economy. It is related to other factors such as the interest rate and the expectations of entrepreneurs. We will return to investment later. For the moment we assume that investment does not depend on the level of income. Its value is

$$I = \overline{I}$$

Therefore, aggregate demand is

$$DA = \bar{C} + cY + \bar{I}$$

If we reorder

$$DA = \bar{C} + \bar{I} + cY$$

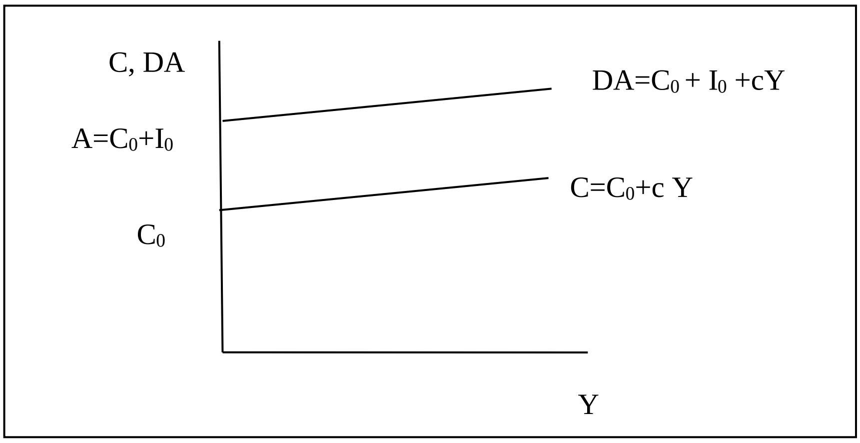
If we add the expenditure that does not depend on income, we obtain the autonomous expenditure, which we denote by $\bar{A}$. Thus given $\bar{A} = \bar{C} + \bar{I}$, then:

$$DA = \bar{A} + cY,$$

where $\bar{A}$ is the autonomous expense. That is, the part of the DA that does not depend on income.

Graphically (Figure 2), the DA can be represented from the consumption function, to which we add the autonomous component of the I. It can be observed that the DA has the same slope as the consumption function (parallel) but is located above it by an equal amount $I_0 = \bar{I}$

Figure 2: DA in a simple economy

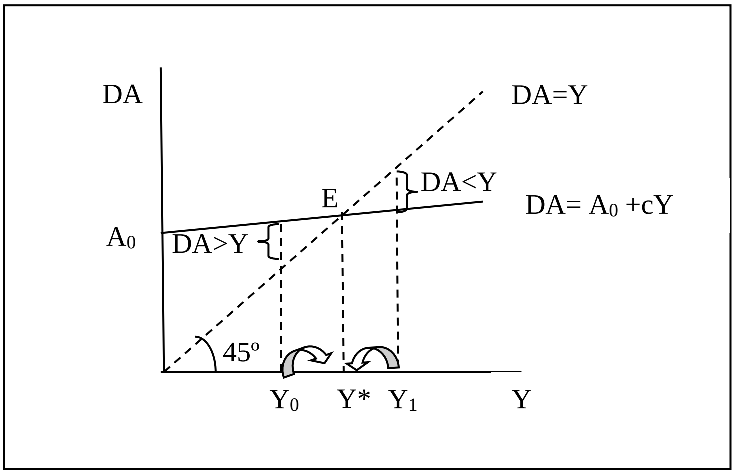


2.3. THE EQUILIBRIUM RENT IN A SIMPLE ECONOMY

Income Y is in equilibrium when it is equal to DA. In that case, unwanted stock investment is zero and firms neither increase nor decrease their level of production.

Graphically, as shown in Figure 3, the bisector of the angle formed by the axes of the DA and Y plane indicates the points at which it is satisfied that DA = Y, that is, they are equilibrium points. Figure 4 also shows that along the DA curve, only point E is an equilibrium point. That is, at that point planned expenditure equals production since the requirement DA = Y is satisfied. This point E is reached for income level Y*, where the income of our economy is Y*, the DA =Y and therefore the economy is in equilibrium.

Figure 3. Equilibrium income



At income levels below Y* (e.g., Y_0), aggregate demand exceeds the output of the companies. Companies' inventories begin to fall and the company increases its output. How long will companies continue to increase their output? Until the companies' inventories stop falling. That is, until Y=DA. Therefore, until the level of Y* is reached.

Conversely, when output levels are higher than Y*, companies accumulate unwanted inventories and therefore reduce output. Until when will companies continue to decrease their output? Until they stop accumulating unwanted stocks. That is, until Y = DA. Again, until it reaches the level of Y*.

Analytically, the equilibrium rent is obtained from the equality between Y and DA. Since in equilibrium DA = Y, and DA = $\bar{A} + cY$

Therefore Y= $\bar{A} + cY$

Thus, Y- cY = $\bar{A}$. So that Y(1- c) = $\bar{A}$

By clearing

$$Y^* = \frac{\bar{A}}{1-c}$$

The term 1/(1- c) is called multiplier and its value is always greater than 1 (since c is positive and less than unity). α is applied to designate its value. Thus, if α=1/(1- c), in a simple economy the equilibrium income is equal to:

$$Y^* = \alpha \bar{A}.$$

In this case, equilibrium income depends on autonomous expenditure (determined in the simple economy by the sum of $\bar{C}$ and $\bar{I}$) as well as c. As autonomous expenditure increases, equilibrium income rises. Likewise, the increase in the marginal propensity to consume causes an increase in the multiplier, causing equilibrium income to rise.

2.4. RELATIONSHIP BETWEEN CONSUMPTION, SAVINGS AND INVESTMENT IN A SIMPLE ECONOMY

Consumption, savings and investment are related in the economy. In the special case of a two-sector economy we can easily verify that in the equilibrium situation investment equals savings.

Analytically, the demonstration is simple. We have previously stated that in a two-sector economy, DA = C + I. We have also stated that in such a case, income equals disposable income, i.e., Y = YD. On the other hand, we also know that disposable income is used by households to consume or save. Therefore, YD = S+C. Thus, if Y = C+I, Y = YD and YD = C+S, then

$$C+I = Y = YD = C+S$$

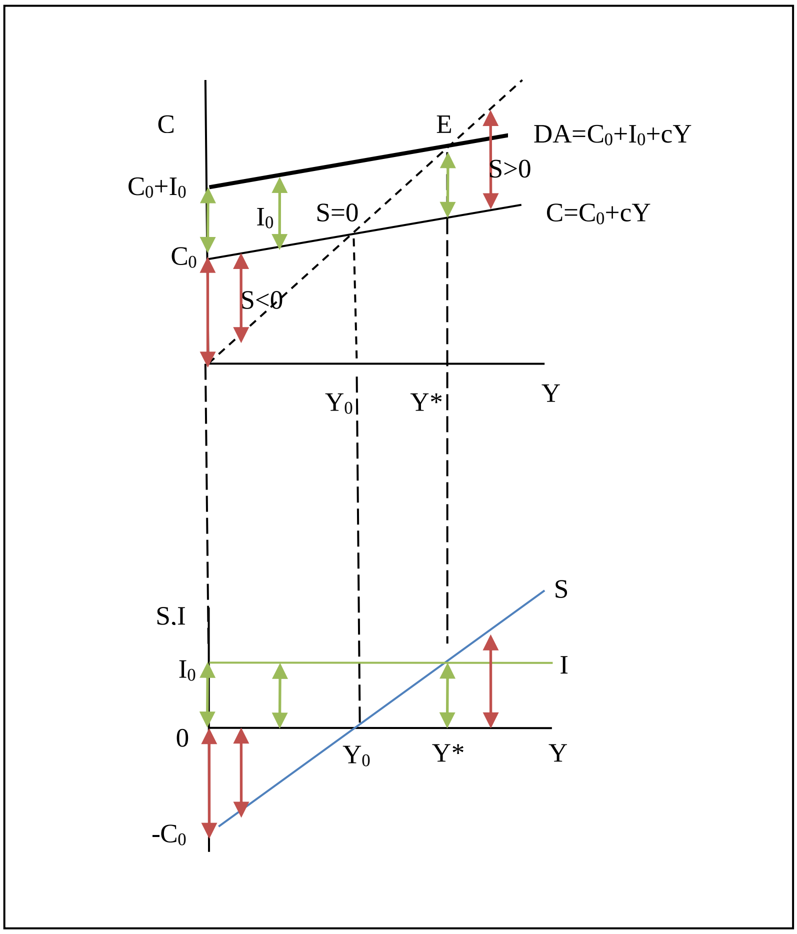
Therefore:

$$C+I = C+S$$

In such a way that necessarily, I = S

In a simple economy, it can therefore be easily demonstrated that saving equals investment. This relationship can also be shown graphically. Figure 4 shows two related graphs. The upper graph shows the income-expenditure model of a simple economy. Equilibrium of the economy occurs when DA = Y. The same graph also shows the consumption function of that economy. The lower graph shows the relationship between savings and investment with respect to income. Savings and investment are expressed on the vertical axis and income values on the horizontal axis.

Figure 4. Relationship between savings and investment in a simple economy



Let us start with the relationship between consumption and savings. We have already seen above that the difference between the bisector and the consumption function or curve shows or indicates the value of savings (any difference between the values is indicated in the graph above with a red segment). At the point of origin, when Y=0, the difference between the two curves is equal to the distance from the origin to C_0. Since consumption is above the bisector at that point, the saving is negative by an amount equal to C_0. This value is represented by a double red arrow on the vertical axis of the upper graph. The same value is also represented in the lower graph on the vertical axis. Since savings is negative, it is represented in the lower graph below the value 0. That is, it is a negative value equal to the autonomous consumption. We then have the first point of the savings function. However, to draw the savings curve, we need a second point. To do this, we ask ourselves what happens at Y_0? In the graph above, we can see that for Y_0, the consumption curve and the bisector intersect. Both are equal, so the saving is equal to zero. In the lower graph, then, for Y_0, we have no savings (its value is 0). We already have another point of the savings' curve, if we put both together, we can obtain the savings curve of the economy, which passes through the points $-C_0$ and Y_0. We show this curve in the graph below with a blue line. The difference between the abscissa axis (horizontal) and the blue line (savings curve) shows the values of savings in the economy for each income level.

What happens to the investment? We assume that the investment has a fixed and equal value I_0. In this case, DA is equal to

$$DA = C_0+I_0+cY.$$

We can graphically represent this curve. Since the sum of autonomous consumption C_0 and I_0 is equal to the autonomous expense $\bar{A}$, the difference between $\bar{A}$ and C_0 is the investment. We represent this value on the vertical axis of the upper graph with a green double arrow. Also, we know that the slope of the DA curve and the consumption function are the same, therefore, the consumption function and the DA are parallel lines. The DA will be above the consumption function by an amount equal to the investment. Therefore, for any value of Y, the difference between DA and C is I. We mark it on the graph with a green segment. The value of the investment is fixed and independent of the value of income. Therefore, in the lower graph, we draw it with a constant positive value of equal magnitude to the green segment.

What happens at the equilibrium point of the economy? The equilibrium point is the cut-off point between DA and Y, which occurs at E, for an income level equal to Y*. In the graph above, the investment is I_0 (green segment). It can be seen, that in E, the green segment is equal to the difference between consumption and the bisector. That is, those savings. This fact is also shown in the graph below. For Y*, the green segment is equal to the value of savings (which is determined by the savings function).

2.5. THE MULTIPLIER IN A SIMPLE ECONOMY

The multiplier indicates how much the equilibrium level of income or production (ΔY^*) increases when autonomous demand ($\Delta\bar{A}$) increases by one monetary unit.

The process may seem simple, since in equilibrium DA = Y. However, the increase in autonomous expenditure will produce a series of causal chain effects that will cause the final increase in equilibrium income to be greater than the initial increase in DA.

Thus, initially, a growth in autonomous expenditure $\bar{A}$ generates an increase in DA by the same amount (we must remember that DA = $\bar{A}$ + cY). The increase in that DA then generates an imbalance in the economy, so that DA>Y. Stocks will start to decrease in an undesirable way. Thus, companies will start producing more until equilibrium is restored and production equals the new DA. That is, there is an initial increase in Y equal to the initial increase in autonomous expenditure $\bar{A}$. However, this increase in income will not restore equilibrium, since the increase in income or production will cause households to start consuming more. It should be recalled that C = $\bar{C}$ + cY. Thus, when income Y (ΔY) increases, consumption will increase by cΔY. The increase in consumption will again increase DA, since consumption is one of the components of DA. This new increase in DA will generate a new disequilibrium in the economy, making DA>Y, and therefore will cause the subsequent increase in income. This new increase in income will again generate growth in consumption, which will cause an increase in DA and at the same time a new increase in income. In short, there will be chain effects that successively generate increases in income, consumption, demand, and income again. This process causes an income multiplier effect so that the final increase in income is greater than the initial increase in autonomous expenditure.

But can we quantify this multiplier effect? Through a step-by-step process, we can calculate the value of the multiplier. That is, the final increase in income. Table 1 shows the multiplier process starting with an increase in autonomous demand ($\Delta\bar{A}$). To make the explanation simpler, we will consider at the same time a numerical example. We assume that the initial increase in A is equal to €200 and the marginal propensity to consume (c) is equal to 0.8.

In the first stage, the increase in A produces an increase of the same magnitude in DA, producing an imbalance in the economy (DA>Y) and an increase in income similar to the increase in DA. Thus, the increase in income in that stage (shown in the third column) is equivalent to the increase in autonomous expenditure, i.e., equal to 200. At the end of the first stage, income will have increased in total by 200 monetary units (shown in the last column of the table).

Once income increases in the first stage, in the second stage there is an increase in consumption caused by the increase in income. This increase in consumption depends on the value of the marginal propensity to consume (since $C = C_o + cY$). If c=0.8 and the increase in income is 200, then the increase in consumption is equal to 160. This increase in consumption generates an increase in DA and income of the same value. How much increase in income have we accumulated in the second stage? The sum of the increase in income of the first stage (200) plus the new increase in income of the second stage (160). In total 360 monetary units.

Table 1. Multiplier effect

Stages	Initial increment at each stage	ΔDA	ΔY	ΔY Total (Cumulative increase in income)
1st	$\Delta\overline{A} = 200$	$\Delta\overline{A} = 200$	$\Delta\overline{A} = 200$	$\Delta\overline{A}$=200
2nd	$c.\Delta Y = c.\Delta\overline{A}$= $0,8.200 = 160$	$c\Delta\overline{A} = 160$	$c.\Delta\overline{A} = 160$	$\Delta\overline{A} + c\Delta\overline{A} =$ 200+160=360
3rd	$c.c.\Delta\overline{A} = c^2.\Delta\overline{A}$=128	$c^2\Delta\overline{A} = 128$	$c^2\Delta\overline{A} = 128$	$\Delta\overline{A} + c\Delta\overline{A} + c^2\Delta\overline{A}$= $(1 + c + c^2)\Delta\overline{A}$=200+160+128
.	……………	……..	…………	………
nª	$c^{n-1}.\Delta\overline{A}$	$c^{n-1}.\Delta\overline{A}$	$c^{n-1}.\Delta\overline{A}$	$(1 + c + c^2 + ... + c^{n-1})\Delta\overline{A}$
.	…………	………..	…….	$(1 + c + c^2 + ... + c^{n-1} + ...)\Delta\overline{A}$

However, the process does not end there. The increase in income in the second stage will cause consumption to increase again in a third stage. How much? A value equivalent to the increase in income in the second stage ($c.\Delta\overline{A} = 160$) multiplied by the marginal propensity to consume c. That is, in the third stage, the increase in consumption is equal to $c.c.\Delta\overline{A} = c^2.\Delta\overline{A}$=128. Once again, the DA and income will increase again by that amount and the process will continue in successive stages. What is the accumulated increase in income in the third stage? It is equal to the sum of income increases that have occurred in the three stages: $\Delta\overline{A} + c\Delta\overline{A} + c^2\Delta\overline{A}$ = 200 +160+128.

We can observe that the increases in income at each stage are smaller and smaller, since the increase in consumption at each stage is lower and lower than the value of the previous period. Thus, after many stages, the increase in consumption will tend to zero and the process will come to an end. Can we then calculate the total increase in income caused by the initial increase in autonomous expenditure? Yes. In the last column, we can see that after n stages the cumulative increase in income is equal to $(1+c+c^2+c^3+\ldots+c^{n-1}).\Delta\overline{A}$. But this stage n need not be the last. Thus, the general expression of the sum of the total accumulated income increase is $(1+c+c^2+c^3+\ldots+c^{n-1}+c^n+\ldots).\Delta\overline{A}$. The sum shown in parentheses is a geometric progression whose ratio is c. Thus, since c is a positive value and less than unity, the sum of this geometric progression is equal to 1/(1-c). In our example equal to 1/(1-0,8).

Thus, the total increase in income or production is the sum of the third column, the sum of a geometric progression whose ratio is c, less than unity and greater than zero. Therefore,

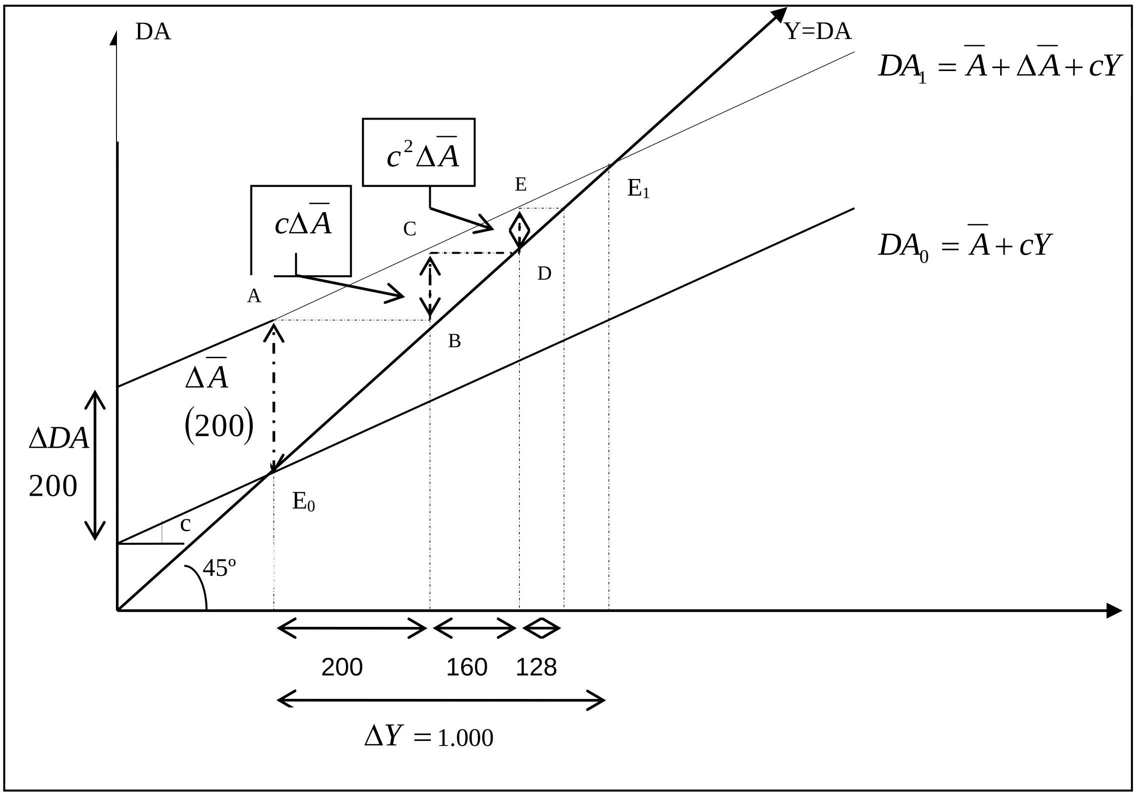
$$\Delta Y = \left(\frac{1}{1-c}\right)\times\Delta\overline{A}, \quad \text{being} \quad \alpha = \frac{1}{1-c} \quad \text{the multiplier.}$$

$$\Delta Y = \left(\frac{1}{1-0{,}8}\right)\times 200 = 1.000$$

Figure 5 shows the process graphically when autonomous expenditure increases by 200 monetary units and the marginal propensity to consume is 0.8.

Starting from an initial equilibrium E_0, the increase in autonomous expenditure ($\Delta\overline{A} = 200$) initially generates excess demand in the companies in the economy as measured by the vertical distance E_0A. Faced with this excess demand, entrepreneurs react by increasing production by the same amount ($\Delta Y = E_0A = AB = 200$). Of this increase in income, 160 units are dedicated to increasing consumer spending (segment $BC = c.\Delta\overline{A}$) and, therefore, of aggregate demand, to which the companies respond by again increasing production by the same amount ($\Delta Y = c\Delta\overline{A} = CD = 160$), which induces additional increases in consumption ($DE = c^2\Delta\overline{A} = 128$), and in income ($\Delta Y = c^2\Delta\overline{A} = 128$). The expansionary process continues, but it is becoming smaller and smaller, as in each round or phase the increase in demand and income is smaller and smaller ($\Delta\overline{A} > c\Delta\overline{A} > c^2\Delta\overline{A} > ...$).

Figure 5. The multiplier in a simple economy



The multiplier effect depends on the marginal propensity to consume. Given the analytical expression of the multiplier α=1/(1-c), the lower the marginal propensity to consume the lower the value of the multiplier. Thus, if the c = 0.6

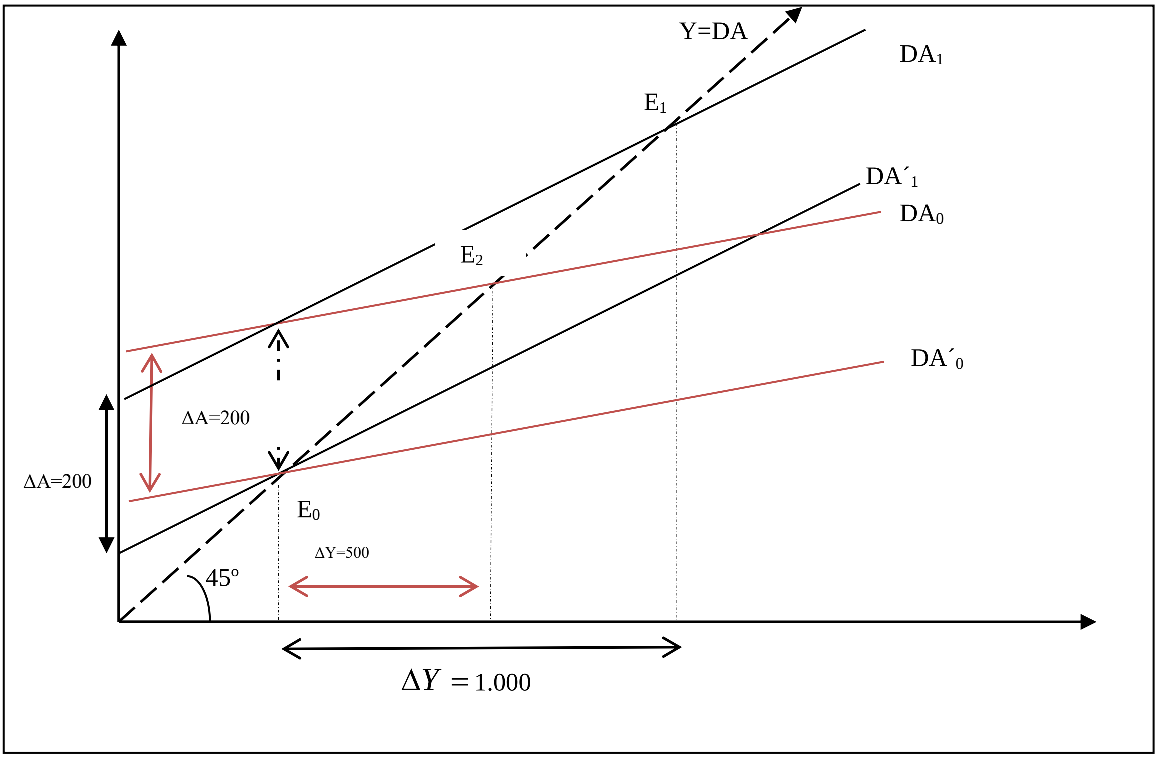
$$\Delta Y = \left(\frac{1}{1-c}\right) \times \Delta\overline{A} \Rightarrow \quad \Delta Y = \left(\frac{1}{1-0{,}6}\right) \times 200 = 500$$

Likewise, as the marginal propensity to consume increases, the greater the value of the multiplier and the greater the value of the increase in income caused by an increase in autonomous spending.

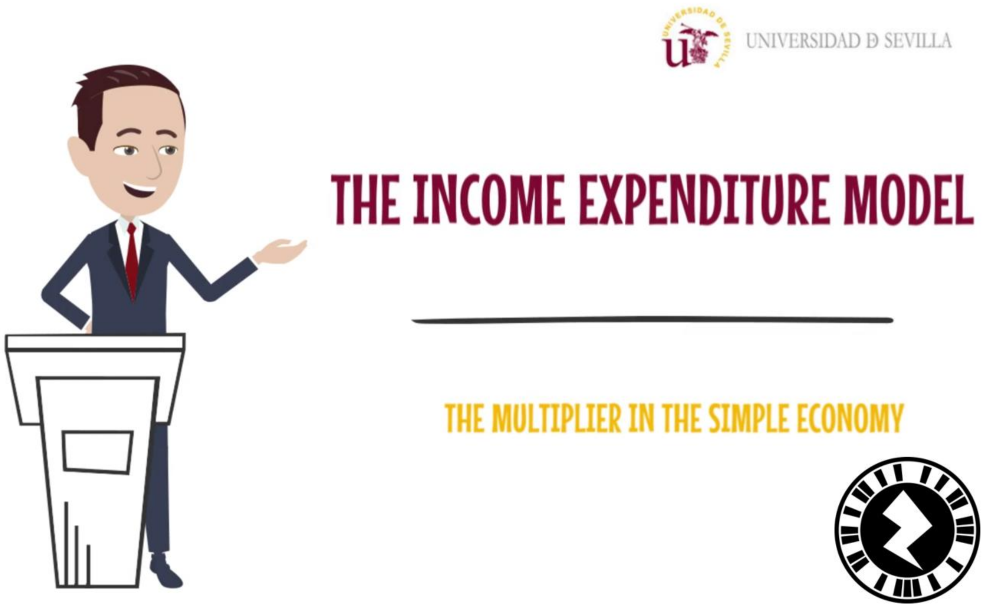
Graphically we can also show the effect of a change in c on the increase in income. We have seen in Figure 5 that an initial increase of 200 monetary units generates a final increase in income of 1,000 monetary units if c=0.8. The equilibrium point goes from E0 to E1. But what happens if c=0.6?

Graphically, the marginal propensity to consume c is the slope of the DA curve. Thus, if it decreases, we will now have (with c=0.6) a flatter DA curve. Assume that the initial equilibrium is the same as before, that is, E_0. The DA with smaller c (DA_0´) must then pass through E_0 and be flatter than the previous one. In Figure 6 we show it in red. If autonomous expenditure now increases by the same amount by 200 monetary units the red DA curve shifts upward parallel to DA_1´.

Figure 6. Effect of a change in the marginal propensity to consume on the multiplier.



The point of intersection with the bisector occurs at E2. The increase in income is now only 500 monetary units, i.e., lower than before. Thus, similar increases in autonomous expenditure produce different effects on income growth, depending on the value of the marginal propensity to consume. A smaller marginal propensity to consume produces lower multipliers.



2.6. Annex.

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