

# **From distribution to inequality: accumulation and growth in the neoclassical tradition**

(Mario Pomini)<sup>1</sup>

## **1. Introduction**

Study of the mechanisms via which capital is accumulated has been a central theme for economists belonging to all schools of thought: Classical, Marxist, Neoclassical and Keynesian. The reason for this centrality is not difficult to identify since one of the fundamental characteristics of capitalistic systems is their ability to expand production through a constant increase in production means. As this process of century-old expansion depends in the last analysis on the share of income saved and allocated to accumulation, a very close link is created between income distribution and economic growth.

The aim of this paper is to offer a retrospective reconstruction of the link between growth and distribution within the neoclassical approach, taking Solow's essay of 1956 as a starting point. In the marginalist approach<sup>2</sup> the problem of functional distribution of income is transformed into the more fundamental one of the determination of prices of factors on the basis of their contribution to the production process. By means of the assumptions of the Solovian model, this static approach has been mechanically extended also to the theory of growth with the result that, due to the levelling action of the principle of decreasing marginal

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<sup>1</sup> University of Padua, Department of Economics.

<sup>2</sup> For a reconstruction of the neoclassical theory of distribution, see Braff, (1988), pp.75-102.

productivity, income distribution between present and future does not diverge from the traditional paradigm, since it is completely determined by the initial set of resources and by the characteristics of the technology. The direction of growth does not depend on the way in which income is shared but only, and outside the stationary state, on the overall volume of the aggregate saving.

Affirmation of the new theory of growth in the second half of the eighties awakened interest also in study of the links between income distribution and economic development and challenged the results previously acquired. This led to the production of extensive literature within which two main currents can be recognised, although they are not the only ones<sup>3</sup>. The first took into consideration the links between distribution, redistribution and economic growth (Bertola 1993, Alesina and Rodrik 1994, Persson and Tabellini 1994), blending two different perspectives: that of endogenous growth and that of endogenous economic policy. The second current deals with the question from the more traditional angle of the externalities and market imperfections, considering their impact on production dynamics (Galor and Zeira 1993, Benabou 1996). The common result to these two currents, which remain within the neoclassical approach, is a radical change in perspective: the growth rate comes to depend on income distribution, i.e. the more equal the distribution of resources, the higher the growth rate.

The paper is organised as follows. The second paragraph outlines the main features of the neoclassical theory of growth and distribution, while the third examines a particular problem on which attention has been concentrated, that of the trend of the income shares. In the fourth, the analysis is extended to the implications at the level of personal distribution. The fifth paragraph describes some elements of the new theory of growth which are relevant for the theory of distribution. The sixth considers endogenous fiscal policy and the seventh focuses attention on the accumulation of human capital. The eighth contains some concluding remarks.

## **2. Accumulation and growth in the traditional neoclassical model**

As is known, the theory of distribution does not occupy a central position within the neoclassical theory, as other research programmes do. The problem of distribution is considered an aspect of the more general problem of price determination<sup>4</sup>, whereas an important position is occupied by the concept of productive factor (or original resource). Looking at distribution

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<sup>3</sup> At least another two currents can be identified: the current of political-social instability (Murphy and others, 1993; Behnabib and Rustichini 1996) and that of endogenous fertility (Galor and Zang 1997).

<sup>4</sup> Screpanti (1990), chap. 3.

dynamics, since the productive factors are goods like all the others, the price system will tend to ensure a monetary value that makes the demand for a good equal to its supply. The problem of income distribution among productive factors therefore becomes that of the determination of exchanges. According to the hypothesis that perfect competition conditions prevail in the market, in equilibrium each factor is remunerated in a measure equal to its productive contribution.

Given the salient features of the theory of neoclassical growth, which is substantially an extension of the analytical system of microeconomics to dynamic macroeconomics, the conclusions valid for the static case are extended by analogy and in a mechanical fashion also to the intertemporal case. To analyse the implications of this in distributive terms, it is expedient to start from the Solovian model, which today remains the reference point of the literature in question.

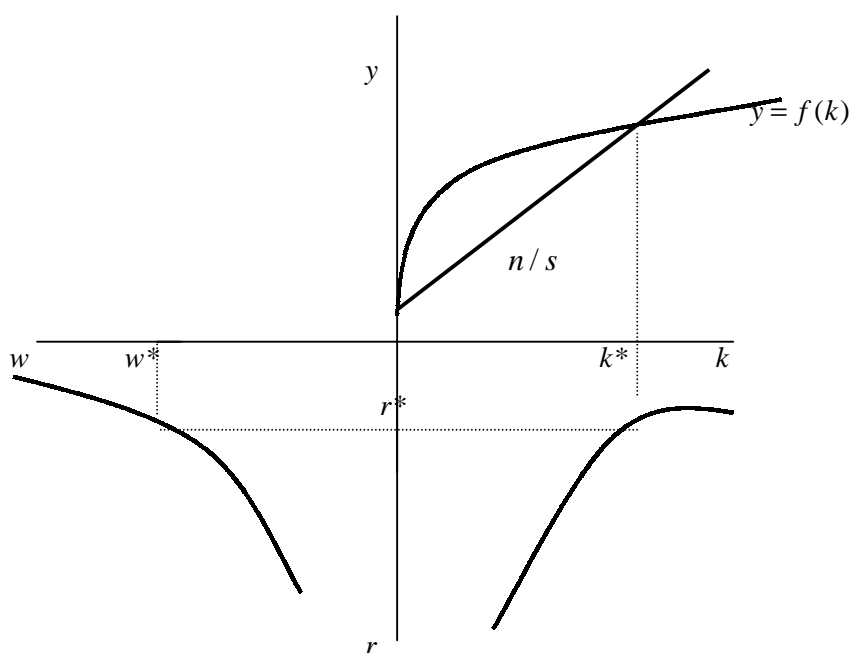
Solow takes a very specific case in which a single good is produced which can be created using exclusively work and capital. The proportions in which these two factors are used are variable and are described by a function of neoclassical production, characterised by decreasing marginal productivity for each factor and by constant returns to scale of the factors as a whole. The income is distributed between consumption and saving on the basis of the simple Keynesian rule. In Ramsey's vision an intertemporal utility function is introduced which the agent maximises with respect to consumption but the basic scenario does not change.

Solow demonstrates that in these conditions the economy reaches a stationary state in which all the quantities grow at the same exogenous rate. Starting from a position different from that of the stationary state, the economy will make adjustments which will restore it to the position of long-period equilibrium. Let's suppose, for example, that the saving is higher than the investment necessary to guarantee full employment. The capital/work ratio is too low and we find ourselves in a position, to use Harrod's terms, in which the guaranteed growth rate exceeds the natural rate. Given the existing technology there is an excess offer of capital that will push the profit down and, consequently, the salary up. The salary will grow to the point at which the capital/work ratio reaches a value where the capital is fully utilised, and the excess employment demand disappears. Reasoning in a typical neoclassical way, the price variations have cancelled the differences between supply and demand, restoring market equilibrium.

The essential elements of the distribution theory incorporated in the simple Solovian model are shown schematically in *figure 1*. The second quadrant shows the equilibrium condition of full employment  $f(k)/k = sn$ . Given the propensity towards saving  $s$  and the growth rate of the work force  $n$ , there is one single value of the capital  $k^*$  that satisfies the macroeconomic

equilibrium. The third quadrant describes the decreasing relation between marginal productivity of the capital, which in a single-sector context coincides with the profit rate and the stock of accumulated capital. Lastly, the fourth quadrant illustrates the relation, again decreasing, between salary and profit for each given technology, the functional expression of which is  $w = f(k(r) - rk(r))$ .

Figure 1: Neoclassical theory of growth and distribution



From the figure it can be seen that once the economy has reached its stationary state in the per capita capital  $k^*$  (second quadrant), the profit rate is univocally determined (third quadrant) and therefore also sharing of the income between the production factors. The crucial element of the model is represented by the existence of a univocal correspondence between the availability of the accumulated factor and its remuneration. Once the availability of the capital factor  $k$  and the corresponding technology  $f(k)$  are known, the income distribution is determined mechanically and residually, as in the static case. The only difference is that in a dynamic context the set of productive factors is no longer constant but depends on the choices made in terms of savings. An increase in the saving level determines an increase in the

stationary state per capita capital, with consequent drop in profit and an increase in the salary rate.

We can therefore conclude that income distribution is determined univocally by technology and by the initial set of factors. In its turn, availability of the factors is the result of the savings habits or the elements that determine the growth of the work force in the long period. With an exogenous growth rate, income distribution between salary and profit is therefore determined endogenously; in particular, due to the flexibility of the factor prices, income distribution is always compatible with full utilisation of the capital and full employment.

### **3. The constancy of the income shares**

In the previous paragraph we have seen how, if the productive factors are remunerated on the basis of their productive contribution, it is possible to obtain a coherent theory concerning the functional distribution of income from the neoclassical theory of growth. The value of a scientific theory depends not only on its coherence and internal elegance, however; it is determined firstly by its ability to explain the empirical facts. In the case of the theory of distribution, one of the empirical regularities that requires an explanation is represented by the constancy of the income shares. A series of empirical research studies, carried out from the thirties onwards, and repeatedly confirmed, established that the salary share tends to remain constant during the course of time despite the profound economic changes that occur in the meantime. It is interesting to analyse the neoclassical school theorists' organic explanation of this important stylised fact.

The income shares remain constant due to the flexibility of the production function and the adjustment mechanism of the related prices. The fundamental relation in this case is represented by the substitution elasticity which indicates to what extent the ratio between the factors increases in percentage terms for a given increase in the ratio between their prices. The basic idea is that companies will tend to replace the factor whose price has augmented and increase use of the other factor. The trend of the income shares depends on the action of the two effects, the one relating to the quantity and the one relating to the relative price. As a special case, the relative shares may remain constant: an increase in the salary on the one hand increases the share allocated to the remuneration of work, but on the other reduces it because the company will tend to reduce employment. The entity of this compensation depends on the form of the production function and therefore on the production technology.

In formal terms, the substitution elasticity between capital and work is the following:

$$\sigma = \frac{d \log(K/L)}{d \log(w/i)} \quad [1]$$

where the numerator term represents the percentage variation of the capital with respect to the work, while the denominator represents the percentage variation of the salary with respect to remuneration of the capital.

Taking account of the fact that aggregate production function is linear and homogeneous, it is possible to obtain a direct relation between the value of the substitution elasticity and the trend of the income shares. In this case [1] is solely a function of the per capita capital:

$$\sigma(k) = \frac{-f'(k)[f(k) - kf'(k)]}{kf(k)f''(k)} \quad [2]$$

The profit rate is, by definition, the following:

$$\pi = kf'(k) / f(k) \quad [3]$$

If we differentiate [3] with respect to the capital and we take account of [1], we obtain the following expression which indicates how the profit share varies as the value of the substitution elasticity varies:

$$\pi'(k) = \frac{kf''(k)}{f(k)} [1 - \sigma(k)] \quad [4]$$

Taking account of the fact that the aggregate production function is concave, the following is immediately obtained:

$$\pi' \geq 0 \quad \text{se} \quad \sigma \geq 1 \quad [5]$$

On the basis of [4] a variation in the relative prices of the factors will have no impact on the income shares only if the substitution elasticity is unitary. If  $\sigma < 1$ , the income share received by the workers drops as the accumulation increases; if  $\sigma > 1$  it increases to the advantage of the

profits. For example, if the elasticity value is equal to 2, a 10% increase in the real salary increases capital intensity by 20%, thus increasing the income share assigned to the capital.

The constancy of the income shares identified at empirical level in the different countries can explain the importance the Cobb-Douglas production function, the only functional form presenting a unitary substitution elasticity, has taken on at theoretical level. If the substitution elasticity between the factors is equal to the unit, whatever the trend of the factor prices, the income shares remain constant and are determined solely by the basic technological factors, the partial production elasticity.

#### 4. Personal distribution of income in the neoclassical model

One of the basic characteristics of the neoclassical model, the substantial irrelevance of the income distribution between salary and profit for the purposes of economic growth, is strengthened if we switch from analysis of functional distribution to analysis of personal distribution. This aspect was highlighted in an article by Stiglitz back in 1969, which deserves to be briefly analysed as it offers us a further tool for assessing the neoclassical approach.

Stiglitz analyses the neoclassical model when the agents are heterogeneous and therefore characterised by a different initial provision of wealth, which in this case coincides with the capital. The fundamental question he asks is whether initial income distribution will tend to evolve in an egalitarian direction or whether the initial differences will be maintained or reinforced in the course of the growth process, thus shifting the centre of gravity of the analysis from functional distribution to personal distribution.

With Stiglitz we assume that the income of each individual, or group of individuals, is given simply by the sum of the work income and the capital income:

$$Y_i = w + rK_i \quad [5]$$

where the term  $K_i$  represents the initial wealth of the individual agent,  $w$  the current salary and  $r$  the interest rate. The saving is a linear function of the income:

$$S_i = sY_i + b \quad [6]$$

where term  $b < 0$  represents the level of saving per capita when the income is nil, while the parameter  $s$  is the marginal propensity towards saving. The population is constant, therefore the number of individuals or the consistency of the groups does not change.

Under these assumptions, the accumulation of wealth for each individual or group is the following:

$$\dot{K}_i = S_i = b + s(w + rK_i) - \delta K \quad [7]$$

The dynamics of the aggregate capital are obtained by adding [7] among all the subjects between whom the stock of capital available to the economy is shared:

$$\dot{K} = \sum_i \dot{K}_i = b + sw + srK - \delta K \quad [8]$$

From [8] it follows that the accumulation of capital depends on the value of the aggregate saving but not on the mechanism of its formation, the personal distribution of income between workers and capitalists. This happens because the assumption of linearity of the saving function is such a strong aggregating element that it eliminates the differences in individual income. If  $b < 0$ , as is usually assumed in the Keynesian model, then two stationary states emerge: the one with less capital per capita will be unstable while the one with greater capital per capita will be stable.

The equation [7] helps us to understand how personal distribution of income evolves between the individual agents or groups making up the economy. Without any loss of generality, we consider the case of a group that has a stock of wealth above the average,  $K_1 > \bar{K}$ . Evolution of the distribution can be analysed in a very simplified manner: if the growth rate of  $K_1$  is below that of  $\bar{K}$ , the initial differences in income distribution will tend to be eliminated and distribution will tend to be more equal. If not, economic growth will be accompanied by an increase in inequality in income distribution.

The growth rate of  $K_1$  is by definition the following:

$$\frac{\dot{K}_1}{K_1} = \frac{b + sw}{K_1} + sr - \delta \quad [9]$$



and a similar expression applies to the growth rate of  $\bar{K}$ . The difference between the two growth rates is given by the following expression:

$$\frac{\dot{K}_1}{K_1} - \frac{\dot{\bar{K}}}{\bar{K}} = (b + sw)\left(\frac{1}{K_1} - \frac{1}{\bar{K}}\right) \quad [10]$$

If the term  $(b + sw)$  is positive, the economy tends to become more equal since the second term on the left-hand side of [10] is negative by hypothesis. The economic reason for the process of convergence is the following: a percentage increase in capital generates a lower percentage increase in savings, while the savings necessary to reintegrate the stock of capital is a linear function of  $K$ . The economy converges towards an equilibrium in which the personal distribution of income tends to level out as a result of the fact that those who have a lower provision of capital tend to grow at a higher rate than those who have a higher provision.

Stiglitz demonstrates that in a stationary state, the equation [11] can be written as:

$$\frac{\dot{K}_1}{K_1} - \frac{\dot{K}_2}{K_2} = (\delta - sr)k\left(\frac{1}{K_1} - \frac{1}{K_2}\right) \quad [11]$$

where in the case of stable equilibrium  $\delta - sr > 0$ .

Since the stationary state conditions are the same for both individuals and for the entire economy, the level of capital  $K^*$  reached in the long period will be identical for all individuals, independently of their starting level. In the stationary state there is no inequality in capital distribution and consequently also in income distribution. The levelling mechanism of the marginal productivity of the capital not only allows the economy to reach a stable stationary state, but also ensures that the differences in income tend to disappear.

## 5. Endogenous growth and role of the profit rate

One of the main results of endogenous growth modelling in the second half of the eighties was the awakening of interest in interactions between income distribution and the process of economic growth. A considerable amount of literature, both theoretical and empirical, was

produced in a short time, introducing significant innovations within a context that is still substantially marginalist-inspired and has not yet exhausted its theoretical impetus<sup>5</sup>.

The characteristic aspect of the theory of endogenous growth, at least in the first phase<sup>6</sup>, was the explicit abandonment of the hypothesis of decreasing returns of the accumulated factor, be it the physical capital or the human capital, via appropriate hypotheses on the form of the productive technology. There is a huge variety of models of this type where accumulation of the productive factor occurs under a regime of constant returns. In the simplest case, represented by the so-called model *AK*, the balance between investments and savings on the one hand and the steady state condition on the other univocally determines the relation between the profit rate and the growth rate which can be expressed as follows:

$$g = \frac{\dot{K}}{K} = sA - \delta \quad [12]$$

where  $s$  is the saving rate and  $\delta$  represents the capital amortisation share.

The equation [12], albeit simple, shows the main element of novelty contained in the recent modelling which is represented by the fact that a direct relation is determined between the remunerability of the accumulated factor  $A$  and the growth rate  $g$ , in this way returning to an approach well-rooted in the history of economic thought and which can be considered characteristic of the Classical School. Since profit is maintained constant as the accumulation proceeds, the growth rate of the economy will not show any tendency to decline. Secondly, the link between growth and propensity towards saving is re-established: in the long period an economy that allocates a greater share of resources to the process of accumulation can record higher growth. The model of Lucas (1988) in which the physical capital is replaced by the human capital presents the same basic structure and the rate of growth of the economy depends on the productivity of the sector that accumulates the human capital, said productivity being assumed constant.

The consequences of the relation [12] are very profound for the neoclassical theory of distribution. As the marginal productivity of the accumulated factor is constant, recourse is no longer possible to the principle of substitution to explain determination of the prices and consequently income distribution between the factors. The equilibrium prices lose their

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<sup>5</sup> Numerous surveys have attempted to reconstruct this current within endogenous growth, including: Benabou (1996), Cozzi (1999), Aghion and Howitt, (1999, chap. 8-9), Bertola (2002).

<sup>6</sup> On this point we have followed the approach of Kurz and Salvatori, (2003), chap. 1.

characteristic of being indexes of scarcity, thus one of the central assumptions of the neoclassical vision no longer holds. On the other hand in [12] the profit is solely determined by the technological relations via an over-favourable formulation of the production function. The typical neoclassical element remains linked to the fact that the distribution variable important for growth, the profit, is determined exogenously by technology. As observed by Kurz and Salvadori<sup>7</sup>, while in the traditional neoclassical theory growth was determined exogenously and income distribution was endogenous, in the new perspective the direction of the causality link changes: growth becomes an endogenous fact, while the mechanisms that oversee the functional distribution of income are exogenous and therefore to be determined.

Since with the new theory of growth we have returned, albeit in a much more complex and sophisticated analytical context, to a position well-rooted in the history of economic thought which postulated the centrality of the link between functional distribution and growth, it is not surprising that a first current explored how it is influenced by the policies, first and foremost the redistribution policies of governments, that can affect the profit rate. This current of *endogenous fiscal policy* has been developed by numerous authors (Bertola 1993, Alesina and Rodrik, 1994, Persson and Tabellini, 1994) who have analysed the growth implications of redistributive fiscal policies financed via taxation. In these models the level of public spending, and of the taxation necessary for its financing, is negatively correlated with economic growth, since when taxes are high there is less incentive to saving and accumulation. The general result is that a high inequality in income distribution is transformed into a brake on economic growth.

The second current we consider followed a different path, focusing attention on the particular characteristics presented by the process of accumulation of human capital. This approach was developed in a series of articles by Galor and Zeira, (1993), Benabou (1996) and Perotti (1996). In these models the accumulation of human capital, the driving force for growth, is obstructed by the fact that the poorest families are rationed on the credit market, as they are not able to obtain loans to finance their children's education solely on the basis of future earnings. If initial income distribution is very unequal, a large number of families will find themselves trapped in poverty with the consequence that spending on education will be too low. The human capital approach reaches the same conclusion, albeit via a different route, as the one highlighted in the endogenous fiscal policy approach: a high inequality in the distribution of resources reduces accumulation of the productive factor and consequently slows down long-period economic growth.

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<sup>7</sup> This point has been highlighted by Kurz and Salvadori (1998) p. 85.

A brief examination of these two currents, although not covering the entire panorama of the new literature, enables us to adequately highlight the main theoretical changes that have taken place within the neoclassical approach.

## 6. Endogenous fiscal policy

Endogenous fiscal policy gained momentum with the articles by Bertola (1993), Alesina and Rodrik (1994) and Persson and Tabellini (1994). The common aim of these models is to demonstrate that distribution is able to influence growth via the creation of redistributive type social pressures. A high inequality in income distribution increases the social pressure for redistributive policies which in their turn lead to higher taxation of capital, thus reducing economic growth.

The model of Persson and Tabellini (1994), which will now be examined, illustrates very clearly the central elements of this approach to the complex relations between distribution, redistribution and economic growth. It is a model with overlapping generations in which only the young offer work, the elderly hold the capital and there are no inheritances. As is typical in endogenous growth models, the hypothesis of decreasing returns to scale of the capital is removed thanks to the existence of a social externality effect linked to the accumulation of capital. The productive possibilities are described by a linear production function in the accumulated factor and individuals differ in their individual capacities. Lastly, a political decision mechanism is assumed in which only the young vote to determine the redistributive criterion for when they will be old.

The economic problem of the consumer-voter is that of maximising the usual Cobb-Douglas type biperiodical utility function:

$$U = \alpha \log c_{i,t} + (1 - \alpha) \log c_{i,t+1} \quad [13]$$

As regards the budgetary constraint, in the first period the consumer has an income that depends on his individual ability ( $e$ ) and the stock of capital inherited from the previous generation ( $\bar{k}$ ). This income is shared between the current consumption and the saving which will be used in the subsequent period:

$$y_{i,t} = (A + e)\bar{k} = c_{i,t} + k_{i,t+1} \quad [14]$$

In the second period the consumer has a consumption level ( $c_{t+1}$ ) commensurate with the return of the capital invested and with the public transfers he can receive, indicated by the redistributive parameter  $b$ . If  $b > 0$  we have a progressive type distribution and resources are transferred towards those who have less than the average; if  $b < 0$ , distribution has a regressive character. The budgetary constraint in the second period is the following:

$$c_{i,t+1} = r[(1-b)k_{i,t+1} + b\bar{k}_{t+1}] \quad [15]$$

The economic equilibrium is obtained by maximising the utility function under the constraints represented by the equations [14] and [15]. The results obtained are the following (where we have eliminated the index relating to the agent in order to simplify notation):

$$c_1 = \alpha[(A+e)\bar{k} + \frac{b}{1-b}\bar{k}_{t+1}] \quad [16]$$

$$c_{t+1} = (1-\alpha)r(1-b)[(A+e)\bar{k} + \frac{b}{1-b}\bar{k}_{t+1}] \quad [17]$$

which shows that more able individuals enjoy a higher level of income and consumption.

To determine the growth rate of the economy, which coincides in this model with the growth rate of the capital, we substitute [16] in the budgetary constraint [14], taking account of the fact that the variables are considered from an aggregate point of view (as mean values of the population). The resulting expression is the following:

$$G(e,b) = \frac{\bar{k}_{t+1}}{\bar{k}_t} - 1 = \frac{(1-\alpha)(A+e)(1-b)}{1-b(1-\alpha)} - 1 \quad [18]$$

From [18] it can be noted that the growth rate is a decreasing function of the values of the distributive parameter since  $G_b < 0$ . The message of the model is clear: the long-period effect of redistributive fiscal policies is to discourage economic growth. The economic reason for this is not difficult to identify: given the distorting nature of the fiscal burden which weighs on the accumulated factor, redistributive policies discourage accumulation by the young since part of

the benefits goes to everyone. This reduction of the aggregate accumulation results in fewer production possibilities for the subsequent generation.

In the second part of the model, Persson and Tabellini identify majority voting as the institutional mechanism by means of which the redistributive parameter is optimally determined. In making his choice, every consumer-voter takes account of the fact that he is taxed on the basis of his personal income whereas he receives a share of public spending on the basis of the stock of aggregate capital. Consequently, individuals with a low stock of capital will prefer very high tax rates, whereas individuals with a high stock of capital will prefer low rates. If we assume that the preferences are single-peaked and that they depend on the differences in individual capital with respect to the mean, by applying the theorem of the median voter an equilibrium can be determined in which the chosen tax rate is that of the median voter. If income distribution is asymmetrical, as shown by the empirical data, the median voter has a below-average income and a political majority favourable to taxation of capital will form which will be the higher the greater the inequality in income distribution.

In short, public spending and taxation, the tools via which redistribution policy is implemented, are negatively correlated with economic growth because they reduce investment remunerability and, in the last analysis, discourage accumulation by the young. The general conclusion of the model is that there is an inverse relation between growth and inequality in income distribution.<sup>8</sup>

We reach the same conclusions if we also consider functional distribution of income, as is highlighted in the models of Alesina and Rodrick (1994) and Bertola (1993). In the first, income distribution is introduced throughout taxation, aimed at sustaining public spending, on return on capital and income from work. The assumptions of the model are those typical of linear endogenous growth models for which growth rate depends on the chosen tax rate. As in the model of Persson and Tabellini the level of equilibrium taxation is determined by the median voter. The higher the inequality in income distribution, the greater the difference in income between the median and the average voter, and the higher the level of taxation.

Bertola's model has many of the characteristics of that of Alesina and Rodrick. Both models consider the inequality in functional distribution of income and emphasise the importance of the distinction between non accumulable factors, such as work, and accumulable factors such as physical capital. Since the production function is linear and the intertemporal utility function has constant elasticity, the income shares that go to the capital and to work are constant,

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<sup>8</sup> Persson and Tabellini (1994) and Perotti (1996) produced empirical estimates of this approach but they did not provide the confirmations hoped for.

likewise saving and growth rate are also constant. The model does not present any transition dynamics and the equilibrium growth rate depends on the chosen fiscal policy. As in the model of Alesina and Rodrick the fiscal policy measures chosen by individuals are constant in time and the theorem of the median voter guarantees the existence of an optimal level of taxation chosen by society.

The two models differ in the specific fiscal policies considered. Bertola's model is more flexible and allows consideration of the case in which subsidies to firms are financed by taxing work or capital. For example, since in Bertola's model the workers consume all their income, whereas the capitalists save a constant portion, a transfer of income from work to capital will increase the saving rate of the economy and also economic growth.

Summarising, therefore, in all these models a strong initial inequality in income distribution determines a political demand for a redistributive policy that discourages the accumulation of capital and reduces long-period economic growth.

## **7. Market imperfections and accumulation of human capital**

A second strand which analysed the links between growth and distribution followed a completely different route, focusing attention on the importance of human capital (Galor and Zeira 1993; Benabou 1996), an analytical metaphor referring to the abilities and skills acquired by each worker mainly with formal education. It has developed independently of the endogenous fiscal policy approach, permitting analysis of further aspects of the complex relationship existing between the distribution channels and economic growth. Although interest in human capital as a driving force for economic growth is not new in the field of endogenous growth theory, going back to the pioneering work of Shell and Uzawa in the sixties, the way in which it is considered in the models referred to above is completely new.

The characteristic aspect of these models is that the accumulation path of human capital can exert a decisive effect on economic growth when the capital market is not competitive. The fundamental hypothesis is that investment in education involves a fixed cost which low income families cannot sustain because the banking system does not grant them the necessary credit. This rationing of credit in turn determines a socially insufficient investment in human capital, depressing economic growth. Greater equality in initial distribution of income partly overcomes these liquidity constraints, permitting all individuals to take advantage of better opportunities, increasing accumulation and economic growth. The pioneering contribution of Galor and Zeira (1993), which we will now briefly examine, is particularly important in this current; they were

the first to demonstrate that market imperfections depress investment in a stable manner thus generating negative repercussions on long-period growth.

In the model in question there are two ways of producing the final good which can be used indifferently for consumption or for investment. One consists in using the capital ( $K$ ) and the qualified work ( $L_s$ ), while the other requires the use only of unqualified work ( $L_n$ ). Individuals' lives are divided into two periods: in the first the individual decides whether to work or to get himself an education, in the second he can be employed as a qualified worker or non-qualified worker according to his previous choice. He consumes only in the second period and a part of the income earned is left to his children. All individuals are identical from the point of view of natural ability, they differ due to the wealth inherited. The utility function is as follows:

$$U = a \log C + (1-a) \log B \quad [19]$$

where  $C$  is the consumption in the second period and  $B$  the inheritance left to the children.

In the model it is assumed, as a coherence condition, that the decision to get an education is always expedient for the single individual. With  $w_n$  indicating the salary earned by a non-qualified worker and  $w_s$  the salary of an educated individual, the following relation is valid:

$$w_s - h(1+r) > w_n + w_n(1+r) \quad [20]$$

where  $r$  represents the exogenous interest rate and the salaries are equal to the marginal product. According to [20] all workers would like to get an education if they could, covering education expenses equal to  $h$  with their own resources or by incurring debts.

Since education expenses are financed by inherited wealth or by incurring debts, the credit market has a strategic role. It is assumed that everyone can lend money at the current rate  $r$  but, taking account of the fact that some debtors may not honour their debt, the interest rate for borrowing is higher and equal to  $i$ . The difference between the two rates is strictly correlated to the resources that the financial system uses to perform this supervision activity and penalises the poorer families. Since the interest rate for financing the loan is greater than the one prevailing on the financial markets, the capital market is imperfect and some families will not obtain all the credit they need to sustain education expenses.

Let's now consider the optimal decisions of the individual agent. Given the characteristics of the production function, the optimal choice of the individual agent is to allocate a constant



share of his income to consumption in the second period, this choice depending on his preferences represented by the parameter  $a$  :

$$C = aY \quad [21]$$

$$B = (1 - a)Y \quad [22]$$

The dynamic structure of the model is expressed in [22]. In fact, since the inheritance is proportional to the income possessed by the individuals, and in particular depends on the amount of resources which they themselves have received, in general it will have the following recursive form:

$$B = (1 - a)F(B_{t-1}) \quad [23]$$

an equation which, using the inheritance route, fully summarises the evolution of the economic system.

We can distinguish three cases, according to the optimal choices made by the individual agent. Firstly there are individuals who do not receive sufficient inheritance to cover the cost of education and therefore for them it is not expedient to get an education; a second group is represented by those who, although not rationed on the credit market, must nevertheless incur debts to pay for their studies; lastly the third group is represented by well-off families who do not need credit to cope with education expenses. On the basis of the equation [22] the inheritance trend, and therefore the wealth trend, for each of the three groups is the following:

$$B = (1 - a)[(1 + r)(B_{t-1} + w_n) + w_n] \quad [24]$$

$$B = (1 - a)[w_s + (B_{t-1} - h)(1 + i)] \quad [25]$$

$$B = (1 - a)[w_s + (B_{t-1} - h)(1 + r)] \quad [26]$$

where  $h$  is the fixed cost of the investment in human capital.

Individuals choose to get an education on the basis of the utility level they can achieve. By equalising the income that the individual receives if he decides to get an education or not, we obtain the critical income level below which it is not expedient to invest in human capital:

$$(B_{t-1} + w_n)(1 + r) + w_n = w_s + [(B_{t-1} - hw_n)(1 + i)] \quad [27]$$

Individuals invest in human capital to the extent to which the following relation is valid:

$$B > \frac{w_n(2 - r) + h(1 + i) - w_s}{i - r} = f \quad [28]$$

The latter equation contains an important implication: an interest rate that is too high means that some families do not have sufficient initial resources to get an education and fall into the poverty trap.

We are now able to describe the dynamics of the model. The inheritance structure evolves over time according to the following law:

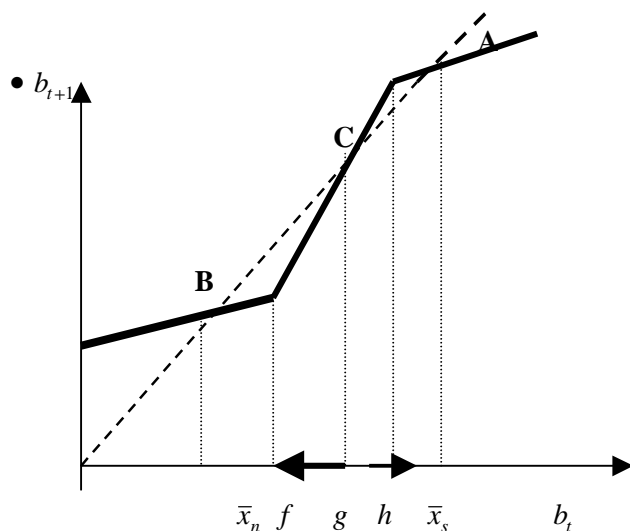
$$B_{t+1} \begin{cases} = (1 - a)[(1 + r)(B_t + w_n) + w_n] & \text{if } b < f \\ = (1 - a)[w_s + (B_t - h)(1 + i)] & \text{if } f < b < h \\ = (1 - a)[w_s + (B_t - h)(1 + r)] & \text{if } b > h \end{cases} \quad [28]$$

The graph of the equation [28] is shown in *figur 2*. The points A and B are locally stable and correspond to the stationary state for the non-educated individuals ( $\bar{x}_n$ ) and for the educated ones ( $\bar{x}_s$ ). The critical position for the economy is represented by point C. Individuals who inherit less than  $g$ , although they invest in human capital, are not able to guarantee for their children sufficient resources to continue the investment due to the high interest rate, since the point of attraction is represented by  $\bar{x}_n$ .

In short, in the long period the economy converges towards a dichotomous society: one extreme is represented by the educated individuals who have a higher income, and the other is represented by individuals who have a lower income as they have not been able to get an education. What is interesting is that the relative dimension of the two groups depends on the initial distribution of wealth. If we assume, with the Authors, that the growth rate of the economy is a weighted mean of the growth rates of the productivity of these two cohorts of workers, then the initial distribution of resources becomes a conditioning factor for economic growth. The greater the number of individuals that inherit more than  $g$ , therefore the more

substantial the middle class, the more robust economic growth will be<sup>9</sup>. The Authors therefore suggest that in situations of high inequality a public policy of redistribution of wealth can lead the economy towards a situation of greater economic growth, accompanied by greater equity. A policy aimed at taxing qualified workers to finance the education expenses of the young would reduce the social damage caused by the fact that there is an imperfection in the credit market, benefiting the poorest without penalising the wealthiest.

Figure no.. Dynamic evolution of inheritances



The conclusions reached by Galor and Zeira are extended and enriched by Benabou (1995, 1996) under the assumption that taxation assumes a non-linear form, in order to more fully comprehend the effects of inequality on economic growth. Benabou demonstrates that, for a given level of taxation, a greater inequality translates into less investment and therefore leads to lower economic growth. The economic intuition is the following: since the marginal return on capital is decreasing, an income distribution in favour of poor families relaxes their credit constraint, permitting greater social investment which increases the aggregate accumulation of capital. The picture becomes more complex if distribution becomes more equal via an increase

<sup>9</sup> The work of Perotti (1996) is the only attempt to offer an empirical estimate based on this approach. The results obtained are consistent with the hypotheses of the model.

in taxes since contrasting effects are present: on the one hand the distributive fiscal policy stimulates growth for the reason previously illustrated, on the other the increase in the fiscal load necessary to achieve redistribution reduces the incentive to invest, exactly as in the case of perfectly competitive markets. A more equal income distribution stimulates income growth if the level of distribution is given exogenously; if not, economic growth first grows with increase in the rate and then decreases, following the non-linear structure of taxation. A further step forward in the direction of examination of the links between imperfect markets and accumulation of human capital is represented by the contributions of Aghion and Bolton (1997) and Piketty (1997) where the rationing of credit is also rigorously subject to a dynamic model of general economic equilibrium.

To conclude, this second approach reaches the same economic policy implications as those that emerged in the current of endogenous fiscal policy: even if the connection element between growth and distribution is represented by market imperfection, a public redistributive policy creates new investment opportunities, stimulating economic growth.

## **8. Concluding remarks: from distribution to inequality**

The theory of income distribution, both functional and personal, has never been given great importance in the traditional neoclassical growth theory, occupying a marginal role in the theoretical debate. Within this approach, rather than a macroeconomic theory of income distribution, it would be more appropriate to talk about a mechanical extension of the analytical categories of microeconomics to dynamic macroeconomics, so that income distribution is an endogenous fact determined by the technological relations, defined as initial stock.

With the abandonment of the concept of scarcity as the regulating principle by the new growth theorists, and its analytical equivalent represented by the decreasing marginal productivity of the accumulated factor, growth has become endogenous but it is no longer possible to maintain the old theory of distribution linked to determination of the related prices. A completely new distribution theory has emerged aimed at the political and social mechanisms that can condition accumulation and growth, starting with inequality in resources and therefore in opportunities, in this way incorporating important analysis elements which up to now had lain outside the reflection of economists. The new model has achieved two important results. The first is that the analytical reference context has widened considerably, representing a big step forward in understanding of the operation of real economies. The second, perhaps even more important, is that the debate has been re-opened on the most appropriate economic policy

measures for stimulating and sustaining economic growth, a much richer and more complex process than traditional theory was prepared to admit, in which the public operator can perform a non-secondary role.

## **References**

Aghion, Philippe and Patrik Bolton, (1997), 'A theory of Trickle-Down Growth and Development', *Review of Economic Studies*, **64**, 151-172.

Aghion, Philippe, Eve Caroli and Cecilia Garcia Penalosa (1999) 'Inequality and Economic Growth: The Perspective of the New Growth Theories', *Journal of Economic Literature*, **37**, 1615-60.

Alesina, Alberto e Roberto Perotti (1996), 'Income distribution, political instability and investment', *European Economic Review*, **40**, 1203-28.

Alesina, Alberto e Dani Rodrik (1994), 'Distributive Politics and Economic Growth', *Quarterly Journal of Economics*, 109, 465-90.

Benabou, Roland (1996), 'Inequality and growth', *NBER Macroeconomics Annual*, 11-74.

Benhabib, Jess e Aldo Rustichini, (1996), 'Social conflicts and growth', *Journal of Economic Growth*, **1**, 125-42.

Bertola Giuseppe, (1993), 'Factor Shares and Saving in Endogenous Growth', *American Economic Review*, 83, 1184-98.

Cozzi, Guido (1998), 'Distribuzione e crescita. Una rassegna della letteratura recente', *Rivista Italiana degli Economisti*, n.1, 105-150.

Forbes (2000), 'A reassessment of the relationships between inequality and growth', *American Economic Review*, 90, 869-87.

Galor, O. e J. Zeira, (1993), 'Income distribution and Macroeconomics', *Review of Economic Studies*, 60, 35-52.

Galor, O. e H. Zang (1997), 'Fertility, Income Distribution, and Economic Growth: Theory and Cross-Country Evidence', *Japan and the World Economy*, **9**, 127-229.

Harris, Donald (1980), 'A postmortem on the neoclassical parable', in *Growth, Profits and Property*, a cura di Edward Nell, Cambridge: Cambridge University Press.

Kurz H. D. , Salvadori N. (1997), The "New" Growth Theory: Old Wine in New Goatskins, in F. Corricelli, M. Di Matteo and F.H. Hahn (eds.), *New Theories in Growth and Development* , London: Macmillan.

Kurz H. D. , Salvadori N. (1998) Theories of 'Endogeneous' Growth in Historical Perspective, ed. Murat R. Sertel, *Contemporary Economic Issues. Proceedings of the Eleventh*

*World Congress of the International Economic Association, Tunis. Volume 4 Economic Behaviour and Design*, London: Macmillan, and New York: St. Martin's Press, 1999.

Kurz H. D., Salvadori N. (1998) *Understanding Classical Economics. Studies in Long Period Theory*, London and New York: Routledge.

Morand, O. (1999), 'Endogenous Fertility, Income distribution and growth', *Journal of Economic Growth*, **4**, 331-49.

Murphy, Kevin a altri (1993), 'Why is Rent-Seeking so Costly for Growth?', *American Economic Review*, **83**, 409-413.

Perotti, Roberto (1993), 'Political Equilibrium Income Distribution, and Growth', *Review of Economic Studies*, **60**, 755-76.

Perotti, Roberto (1994), 'Income Distribution and Investment', *European Economic Review*, **38**, 827-35.

Persson, Torsten e Guido Tabellini, (1994), 'Is Inequality Harmful for Growth?', *American Economic Review*, **84**, 593-602.

Salvadori, Neri (2003), *The theory of economic growth: a 'classical' perspective*, Cheltenham, UK: Edward Elgar.

Screpanti, Ernesto (1990), *Teorie della distribuzione del reddito*, Etas Libri: Milano.

Stiglitz, Joseph (1969), 'Distribution of income and wealth among individuals', *Econometrica*, **37**, 382-97.