Chapter 2

Inheritance and the Redistribution of Wealth

A. B. ATKINSON

2.1 INTRODUCTION

In his writing James Meade has been very much concerned with the relationship between economic analysis and economic policy. He has always emphasised the development of economic models not for their own sake but for the light that they cast on the solution of economic problems; at the same time he has remained deeply convinced of the value of economic analysis as an aid to the formation of policy. The choice of topic for this chapter has been greatly influenced by the important contributions that he has made. The taxation of inheritance - and, more generally, the redistribution of income and wealth - is a subject on which he has written extensively and persuasively. His *Economic Analysis and Policy* (1936) contains a substantial discussion of the distribution of income among persons and of the effects of taxation. In *Planning and the Price Mechanism* (1948), and more recently in *The Intelligent Radical's Guide to Economic Policy* (1975), he has elaborated the case for reform, and this reaches its culmination in the Meade Report on *The Structure and Reform of Direct Taxation* (1978). Alongside this discussion of policy he has pioneered the development of models of wealth distribution, notably in *Efficiency, Equality and the Ownership of Property* (1964), which contains a rich account of the factors influencing the distribution. This essay has stimulated much of the subsequent research in this area, and Meade himself has taken the subject further in his Keynes Lecture of 1973 (*The Inheritance of Inequalities*) and in *The Just Economy* (1976).

The aims of this chapter are to survey the literature on inheritance, to bring out its relationship to the distribution of wealth, and to assemble some of the building blocks necessary for an analysis of redistributive policies. Section 2.2 is concerned with the bequest motive for saving. It describes several different formulations and discusses some of the implications for the taxation of inheritance. (Throughout, the term

'inheritance' is used to refer to all transmission of material wealth, whether through bequest or gift.) Section 2.3 takes up the division of estates. It first examines the treatment of sons and daughters and the role played by marriage. It then considers situations where wealth is unequally divided between sons (or daughters). Stress is placed on the inter-relationship between different aspects of the inheritance process, and it is shown that the conclusions drawn concerning the impact of taxation may critically depend on the pattern of inheritance. The analysis to this point is in partial equilibrium terms and focuses on unearned incomes. In section 2.4 the model is set in a general equilibrium context, and the inter-relation with earned incomes is discussed. The main conclusions, and some of the directions for further research, are summarised in section 2.5.

Meade once described his work as that not 'of a tool-maker nor a tool-user, but of a tool-setter'. This chapter is written in a similar spirit. It is not the intention to develop basic theoretical ideas, nor to examine in detail particular policy proposals; rather, it attempts to provide an analytical framework within which policy can be discussed. It is concerned with the relation between the formulation of economic models and the nature of the policy conclusions drawn. This is illustrated by reference to inheritance taxation, and numerical examples are given in sections 2.3 and 2.4, but it is not the purpose here to argue for particular reforms of the tax system or to assess the relative contribution of fiscal and other measures to redistribute wealth.

2.2 THE BEQUEST MOTIVE AND THE TAXATION OF INHERITANCE

2.2.1 *A Simple Bequest Model*

As a starting point for the discussion of different treatments of the bequest motive we may take the straightforward extension of the Fisherian lifetime-consumption model to allow for utility derived from wealth transfers. In its simplest form, where the person expects confidently to live for a fixed lifetime, the lifetime utility function may be written (Yaari, 1964 and 1965)

$$\int_0^1 U(c_v)\, dv + \phi(B) \tag{1}$$

where the unit of time is taken as the lifetime and there is assumed to be no discounting of utility. (This can readily be introduced, however.) Consumption c_v, at time v, and bequests B at death, are related by the intertemporal budget constraint. In a perfect capital market, where the individual can borrow or lend freely at a rate of interest r, and where r is assumed constant over time, this constraint is of the form

$$\int_0^1 c_v e^{-rv}\,dv + Be^{-r} = \int_0^1 w_v e^{-rv}\,dv + I \equiv Z \qquad (2)$$

where w_v denotes the wage income received at time v and I the present value of inheritances received. The present value of wages plus I, denoted by Z, is referred to as 'lifetime wealth'. (It is assumed that wealth transfers are only made at death, via B, but other transfers can be incorporated.) In this and the next section we shall take a partial equilibrium approach, assuming that the wage and rate of interest are exogenously determined (and constant); the general equilibrium aspects are taken up in section 2.4.

The essence of the model is that the individual chooses his consumption stream and bequests to maximise lifetime utility, subject to the lifetime budget constraint (2). From this formulation one can derive the bequest behaviour as a function of r and Z and examine the implications of wealth transfer taxes (as in Atkinson, 1971). These clearly depend on the form of the utility functions $U(c)$ and $\phi(B)$. One special, and not necessarily realistic, case is that where the elasticities of the marginal utility of consumption, and of bequests, are constant and equal. Bequests are then proportional to lifetime wealth; that is,

$$B = s_1(r)Z = s_1(r)\left(I + \int_0^1 w_v e^{-rv}\,dv\right) \qquad (3)$$

Where the wage is constant ($w_v = w$), this may be rewritten as

$$B = s_1(r)I + s_2(r)w \qquad (4)$$

This brings us close to the savings model applied by Meade to the distribution of wealth in *Efficiency, Equality and the Ownership of Property* (1964). The main difference is that the process is here given an explicit intergenerational setting, and we can consider the evolution of wealth-holding across generations.

The savings model provides a relationship between the present value of wealth inherited by one generation, say t, at the beginning of its life, denoted by I_t, and the amount bequeathed at death to the next generation $(t + 1)$, denoted by B_t. The second link in the process is that between B_t and I_{t+1}. At this point we need to introduce assumptions about the

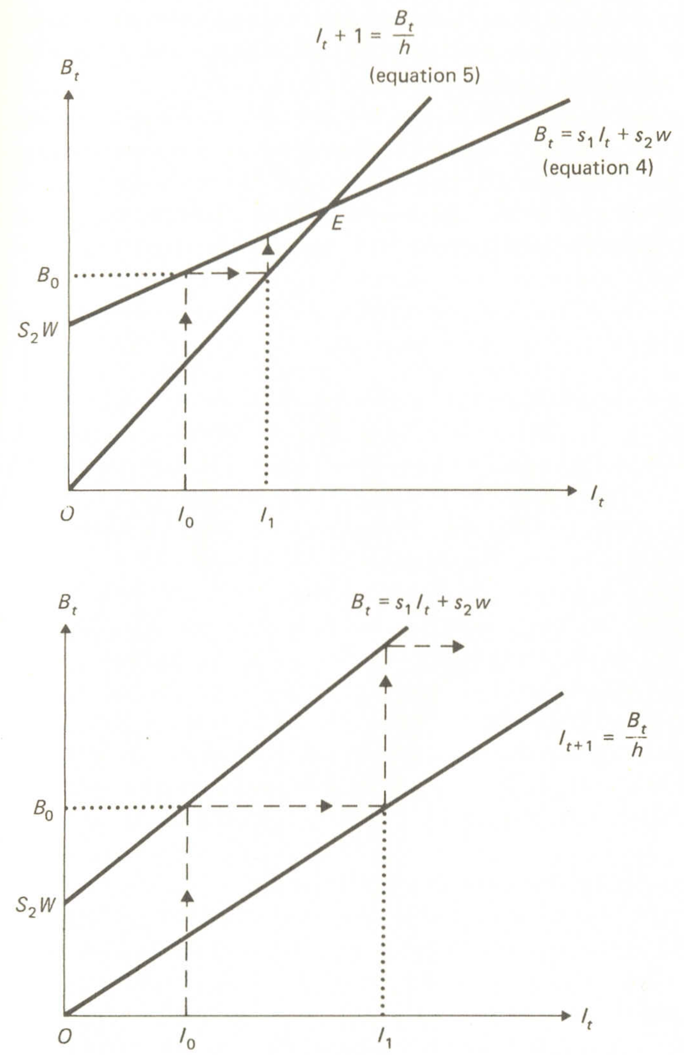

Figure 2.1 *Alternative time paths for bequests and inheritances*

division of estates. For the present it is assumed that each family has h children and that the wealth is divided equally among them, so that the *per capita* inheritance is

$$I_{t+1} = \frac{B_t}{h} \qquad (5)$$

The h children are assumed to be of the same sex and to reproduce themselves unaided. (The division between sons and daughters and the role of marriage are discussed in the next section.)

Combining the savings relationsip (4) and the division-of-bequests equation (5), we can trace out the dynamics of wealth-holding across generations. The case where the savings relationship is of the form shown in equation (4) is depicted in Figure 2.1. In Figure 2.1a there is stable equilibrium at point E, and the equilibrium level of wealth is given by

$$I^* = \frac{s_2 w}{h - s_1} \tag{6}$$

Thus, starting, for example, from inherited wealth I_0, the level of bequests is determined by B_0 (see dotted lines). Divided among h heirs, this provides in turn I_1 each in the next generation. As the dynamic path is traced out, E is approached. In Figure 2.1b the bequest levels tend to diverge. (The more general case where bequests are not necessarily proportional to lifetime wealth is discussed in Atkinson, 1971.)

The condition for Figure 2.1a to apply, rather than Figure 2.1b, is that $s_1(r) < h$. This condition illustrates a key feature, namely, that the distribution of wealth depends on the balance between those forces leading to the accumulation of capital (s_1) and those leading to the division of capital (h). Where the latter are more powerful, individual wealth tends across generations to an equilibrium level; where the 'internal' growth of capital is larger ($s_1 > h$), individual wealth increases without limit. (The relation with the aggregate equilibrium is discussed below.)

2.2.2 *Alternative Treatments of the Bequest Motive*

This treatment of bequests may be criticised from two different directions. First, it can be argued that the formulation in terms of the function $\varphi(B)$ is *ad hoc* and that the bequest motive should be derived from more basic assumptions about preferences. Thus, $\varphi(B)$ may adequately capture the utility obtained by a person concerned solely with the size of his estate (e.g. with the thought of the prospective entry in the newspaper wills column), but it does not allow for the case where bequests are merely the instrument for achieving other objectives (e.g. increasing the welfare of the children). Meade himself (1966) has formulated the problem in terms of concern for the consumption level of the children, with parents making a transfer sufficient to allow the children's consumption to attain a specified ratio of their own. Since the children's own plans will be influenced by concern for their children, this involves an indirect concern for the grand-

children, and so on to succeeding generations. More recently, Barro (1974) has used a closely related model of overlapping generations, where the attainable utility of generation ($t + 1$) enters the lifetime utility function of generation t, and such interdependencies have been discussed more generally by Becker (1974) and others.

The main feature introduced by this refinement of the bequest motive is that the utility derived from wealth transfers depends on the circumstances of succeeding generations. One argument commonly used in discussions of the moral justification of inherited wealth is that parents seek to make provision for children whose earning capacity is expected to be low (e.g. the disabled). Conversely, parents may feel less need to make bequests where the general level of earnings is increasing secularly. This aspect has been brought out by Shorrocks (1979), who has assumed that individuals maximise the sum of lifetime utilities over the next M generations and shown that (with an isoelastic utility function and a single heir)

$$B = [1 - \omega(r, M)]Z - \omega(r, M)e^{-r}X(r, M) \tag{7}$$

where X denotes the discounted value of the expected earnings of the next M generations. The marginal propensity to consume lifetime wealth, ω, depends on the rate of return, on the time horizon (which is a measure of the degree of altruism), on taxation (not explicitly included) and on the parameters of the utility function. On the other hand, bequests are reduced by a proportion ωe^{-r} of expected future income. As Shorrocks has noted, it is quite possible for transfers to be negative, with high-earning children supporting their parents in old age.

The second direction of criticism is that bequests are not in fact determined by individual utility-maximising calculus but reflect instead a combination of class expectations and chance. We may, for example, go back to the class savings model of Kaldor (1955-6) and Pasinetti (1962). If there are fixed propensities to save out of wage and capital income, and the model is interpreted in intergenerational terms, we obtain a bequest relationship such as that in equation (4), with a different interpretation to s_1 and s_2.

We can, however, go further and argue that for those primarily dependent on wage income the bequest motive is unimportant (Atkinson, 1974; Marglin, 1975). To the extent that workers do leave bequests it is the result of chance; for example, in an imperfect annuity market people may leave substantial estates 'by mistake' if they die young. On the other hand, those who have inherited significant wealth are likely to have inherited at the same time 'tastes' that lead them to pass on wealth. The notion that one's inheritance should be passed on, suitably augmented, is endogenously implanted. Finally, there is a third group, namely, those who have acquired substantial wealth through 'entrepreneurship' (broadly interpreted to include, for example, those benefiting from capital gains without active business participation). The members of this group do pass on wealth, but the origin of their fortunes is not to be found in wage income. This source of new capital accumulation may indeed be seen more as the product of random chance.

In elaborating the model to take account of these different views a course has to be steered between realism and tractability. Thus, the extension of the model to include explicit intergenerational altruism along the lines of Shorrocks means that we have to consider the expected future income for M generations to come. In order to illustrate the different approaches we bring them together in a formulation that is simpler but includes elements of both intergenerational altruism and the alternative class model just outlined; thus,

$$B_t = s_1(r)I_t + s_2(r)w_t - s_3(r)w_{t+1} + s_4(r)u_B \tag{8}$$

where u_B is a stochastic variable. The model of equation (4) is the case where $s_3 = s_4 = 0$. The intergenerational altruism model is that where there is the term in s_3 (> 0) looking forward to the earnings prospects of the next generation (and $s_4 = 0$). It is simpler than equation (7) in that it depends on the earned income of only the next generation; that is, $M = 1$. The class model is the special case where $s_2 = s_3 = 0$, and bequests are determined by the amount inherited and the random term, the latter including both chance bequests by wage-earners and bequests made out of entrepreneurial income.

The formulation in (8) allows one to assess the impact of different views of the bequest process and how they influence the conclusions drawn regarding the effect of inheritance on the distribution of wealth. Suppose, for example, that we have the class model ($s_2 = s_3 = 0$), which is used considerably in what follows. From (8), the mean and variance of bequests are respectively given by

$$\bar{B}_t = s_1\bar{I}_t + s_4\mu_B \tag{9a}$$

$$\sigma_B^2(t) = s_1^2\sigma_I^2(t) + s_4^2\Sigma_B^2 \tag{9b}$$

where $\bar{X}_t$ and $\sigma_X^2(t)$ are respectively the mean and variance of variable X at time t, and μ_B and Σ_B^2 are respectively the mean and variance of the stochastic term (which is assumed to be independent of I_t). If we now combine this with the assumption of equal division of the estate (using equation 5), equation (9b) yields

$$\sigma_I^2(t+1) = \left(\frac{1}{h}\right)^2[s_1^2\sigma_I^2(t) + s_4^2\Sigma_B^2] \tag{10}$$

Assuming that the variance of the stochastic term is constant over time, we can solve for the behaviour of the variance of bequests. As before, this depends on whether $s_1 \gtrless h$. If $s_1 > h$, the variance grows without limit; if $s_1 < h$, the variance of inherited wealth tends to an equilibrium level at

$$\sigma_I^2 = \frac{(s_4/h)^2\Sigma_B^2}{1-(s_1/h)^2} \tag{11}$$

In other words, where the internal rate of accumulation (s_1) is less than the growth of the population (h), the variance converges to a finite level, which is given by the variance of 'new' wealth $(s_4/h)^2\Sigma_B^2$, magnified by the effects of saving out of inheritance $[1-(s_1/h)^2]^{-1}$. Where $s_1 < h$, the mean level of inherited wealth also converges to an equilibrium value, obtained by combining equation (9a) with the equal division relationship (equation 5):

$$\bar{I} = \frac{s_4\mu_B}{h-s_1} \tag{12}$$

It follows that the equilibrium coefficient of variation, which may be taken as an indicator of *relative* inequality, is given by

$$V_I^2 \equiv \frac{\sigma_I^2}{\bar{I}^2} = \frac{\Sigma_B^2}{\mu_B^2}\left(\frac{h-s_1}{h+s_1}\right) \tag{13}$$

2.2.3 *Taxation and Bequests*

This framework may be used to examine the effects of fiscal measures to redistribute wealth. Suppose, for example, that on account of taxation the propensity to save out of 'stochastic' income (s_4) is reduced; this could come about as a result of more effective legislation on capital gains tax, for instance. If we interpret B_t as relating to bequests net of taxation and consider the class model ($s_2 = s_3 = 0$), where the stability condition $s_1 < h$ is assumed to be satisfied, then the effect of the reduction in s_4 is to bring about a fall in the equilibrium variance of inherited wealth (see equation 11). At the same time there is also a fall in the mean level of inherited wealth, and the coefficient of variation (equation 13) is unchanged. Relative inequality of inherited wealth is not therefore directly affected by the reduction in s_4 in this model.

Inheritance taxation, however, may influence the different propensities (s_i) in rather different ways. The consequences of changes in s_2 and s_3 depend on the inter-relation between capital and earned income, discussed in section 2.4. The effects on s_1 can be seen to be particularly crucial. First, a reduction in s_1, where s_1 was previously below h, would have the apparently paradoxical effect of *increasing* the coefficient of variation. As can be seen from equation (13), V_I^2 is a *decreasing* function of s_1. For example, if the inheritance tax reduced s_1 from $\frac{1}{2}h$ to zero, the coefficient of variation would rise by a factor of 3. The reason for this is that inherited wealth, being divided at each death, tends to moderate the inequality generated by 'new' wealth.

The possibility that inheritance taxation may have the reverse effect of that intended (i.e. magnifying rather than reducing inequality) has been given prominence by some writers (e.g. Stiglitz, 1978). The conclusions do, however, depend on the assumption made concerning the division of estates, and this is investigated further in section 2.3.3. In the present context we may note that, if s_1 is originally above h, the effect of inheritance taxation may be to reduce s_1 below h and hence change the qualitative behaviour of the distribution. In terms of Figure 2.1, we may be switched from a situation like that in Figure 2.1b, where inherited wealth grows without limit, to one like that in Figure 2.1a, where there is a stable equilibrium. In this case it *does* have the intended effect.

To this point we have simply assumed that taxation affects the net propensities to make bequests. In the case of the class savings model it is hard to go further, since the propensities are simply parameters of the model. In contrast, the utility-maximising framework allows the response to different types of taxation to be deduced. Suppose, for example, that there is a proportional tax, at rate τ, on bequests. If the Fisherian model is defined in terms of net bequests, so that $\varphi(B)$ is replaced by $\varphi[B(1-\tau)]$, it can be shown that, although the net bequest is always reduced, the impact on the gross bequest depends on the parameters of the utility function (Atkinson, 1971).

The influence of taxation also depends on the nature of the tax system, and in *Efficiency, Equality and the Ownership of Property* Meade (1964) has discussed the merits of different types of wealth transfer taxation. He has attached particular weight to the effect on the division of estates, and we shall turn now to a closer examination of this aspect.

2.3 DIVISION OF ESTATES AND MARRIAGE

2.3.1 *Sons and Daughters*

In the analysis so far we have not considered the role played by marriage in the inheritance process. There have been no wealthy heiresses pursued by penniless adventurers or, more probably, by wealthy heirs. How far does marriage permit the consolidation of large holdings? This in turn raises the question of the division of estates between sons and daughters. Obviously, if sons (respectively, daughters) inherit everything, the pattern of marriage is not relevant.

In order to see some of the implications we begin with the case considered by Blinder (1973), where each family has only two children: one boy and one girl. The population is therefore constant in size. Blinder has assumed that the total estate left by husband and wife, denoted by B_t, is divided so that the son receives a fraction λ ($0 \leqslant \lambda \leqslant 1$). The children are all assumed to marry. The total inherited wealth of a couple in the next generation is given by

$$I_{t+1} = \lambda B_t^{\mathrm{h}} + (1-\lambda)B_t^{\mathrm{w}} \tag{14}$$

where B^{h} and B^{w} denote the estates left by the husband's and wife's parents respectively. The variance of inherited wealth is therefore

$$\sigma_I^2(t+1) = [\lambda^2 + (1-\lambda)^2]\sigma_B^2(t) + 2\lambda(1-\lambda)[\mathrm{cov}(B_t^{\mathrm{h}}, B_t^{\mathrm{w}})] \tag{15}$$

where $\mathrm{cov}(X, Y)$ denotes the covariance. Defining ρ to be the correlation between the inheritances of husbands and wives, we have

$$\sigma_I^2(t+1) = [\lambda^2 + (1-\lambda)^2 + 2\lambda(1-\lambda)\rho]\sigma_B^2(t) \tag{16}$$

$$= [1 - 2\lambda(1-\lambda)(1-\rho)]\sigma_B^2(t) \tag{17}$$

Blinder has in effect assumed that there is no net accumulation over a generation, so that $\sigma_B^2(t) = \sigma_I^2(t)$, and this equation then governs the development of the inherited wealth distribution over time.

From equation (17) we can see some of the factors influencing the distribution of wealth. No equalisation takes place where $\lambda = 1$ (i.e. all wealth goes to sons) or $\lambda = 0$ (i.e. all wealth goes to daughters). If estates are divided ($0 < \lambda < 1$), the variance will decline (since the square bracket in (17) is less than 1) where $\rho < 1$. Put another way, assortative marriage ($\rho > 0$) tends to offset the effects of the division of estates, and where $\rho = 1$ this offset is complete, the variance remaining unchanged across generations. This last case is that of 'class' marriage and is equivalent, in this respect, to everyone's marrying his/her own sister/brother.

The influence of wealth transfer taxation via the division of estates may be seen from equation (17). If the structure of taxation is such as to induce a less unequal division between sons and daughters, and if $\rho < 1$, the decline of the variance of inherited wealth is faster. (The term $\lambda(1-\lambda)$ reaches a maximum where estates are equally divided.) The division may also be affected by other instruments of government policy, including legislation, as with the law of *legitim*, where division of the estate is statutorily prescribed. Moreover, it is conceivable that the degree of assortative marriage may itself be influenced by policy. Meade (1976) has noted, for example, the possible link with education reform:

> . . . a system of higher education which was less structured according to social class would tend to bring boys and girls together according to their intellectual ability . . . Only the able children of gentlefolk would get to the university where, for the first time, they would meet the selected able children of the working class. (p. 167).

(This would also have implications for the correlation of earned incomes.)

2.3.2 *Unequal Division*

The treatment by Blinder illustrates clearly the interaction between the pattern of marriage and the division of estates between sons and daughters, but his analysis is limited in that he has considered only a static population. Since each family has only one son or daughter, it is not possible to explore the consequence of unequal division of property between children of the same sex. There is, for instance, no difference in his model between primogeniture and equal division among sons. (An early analysis of the consequences of unequal division is that in Champernowne's fellowship dissertation of 1936, published in Champernowne, 1973.)

Suppose first that we consider the case of equal division among sons ($\lambda = 1$), where the pattern of marriage is irrelevant. With a stationary population and no net saving ($B_t = I_t$) the variance and the mean of lifetime wealth are unchanged across generations. If we now modify this by allowing each family to have h (>1) sons, the variance of total (family) inherited wealth is

$$\sigma_I^2(t+1) = \left(\frac{1}{h}\right)^2 \sigma_B^2(t) = \left(\frac{1}{h}\right)^2 \sigma_I^2(t) \tag{18a}$$

and

$$\bar{I}_{t+1} = \frac{\bar{I}_t}{h} \tag{18b}$$

It follows that the coefficient of variation is unchanged across generations, since both mean and standard deviation are reduced by a factor $1/h$. In this sense population growth makes no difference.

Suppose now that we consider primogeniture, where this is interpreted to mean that all property is left to the eldest son. Where $h = 1$, the outcome is the same; that is, the coefficient of variation is constant across generations. However, where $h > 1$, there are penniless younger children. The variance of inherited wealth is then given by

$$\sigma_I^2(t+1) = \left[\sum_i (I^i_{t+1} - \bar{I}_{t+1})^2 + (h-1)P_t\bar{I}^2_{t+1}\right]\frac{1}{P_{t+1}} \tag{19}$$

where P_t is the number of males in the generation and I^i_{t+1} is the inherited wealth of the eldest sons. The first term in this expression is the sum over those in generation $(t+1)$ who have inherited (P_t is all); the second is the contribution to the variance of the younger sons. (Again, we are concerned with family wealth, so that husbands and wives are treated as a single unit.) The right hand side of (19) can be rearranged thus:

$$\sigma_I^2(t+1) = \left\{\sum_i [(I^i_{t+1} - \bar{I}_t) + \bar{I}_t - \bar{I}_{t+1}]^2\right\}\frac{1}{P_{t+1}} + \left(\frac{h-1}{h}\right)\bar{I}^2_{t+1} \tag{20}$$

Since I^i_{t+1} is distributed in the same way as I^i_t and

$$\bar{I}_{t+1} = \frac{\bar{I}_t}{h} \qquad P_{t+1} = hP_t \tag{21}$$

we can derive

$$\sigma_I^2(t+1) = \frac{1}{h}\sigma_I^2(t) + (h-1)\bar{I}^2_{t+1} \tag{22}$$

The behaviour of the coefficient of variation is given by

$$V_I^2(t+1) = \frac{\sigma_I^2(t+1)}{\bar{I}_{t+1}^2} = hV_I^2(t) + (h-1) \tag{23}$$

If $h > 1$, the coefficient of variation grows without limit. Without the damping influence of new accumulation of wealth, primogeniture leads to ever-increasing relative inequality (Atkinson, 1972; Meade, 1973).

Primogeniture may also be interpreted as meaning that the property is left to the eldest child, whether boy or girl. In order to see the implications let us suppose that in θ cases a son inherits and in $(1-\theta)$ a daughter. If the distribution of wealth is identical in both cases, then by an argument analogous to that in the previous paragraph we can write the variances of wealth inherited by sons (I^s) and daughters (I^d) respectively as

$$\sigma_s^2(t+1) = \theta\left(\frac{1}{h}\sigma_I^2(t) + (h-\theta)\bar{I}_{t+1}^2\right) \tag{24a}$$

$$\sigma_d^2(t+1) = (1-\theta)\left(\frac{1}{h}\sigma_I^2(t) + (h-1+\theta)\bar{I}_{t+1}\right) \tag{24b}$$

Let us denote by ρ the correlation between the inherited wealth of sons and daughters. (We ignore the complications caused by the fact that brothers and sisters cannot marry.) The variance of $(I^s + I^d)$ is then

$$\sigma_I^2(t+1) = \sigma_s^2(t+1) + \sigma_d^2(t+1) + 2\rho\sqrt{[\sigma_s^2(t+1)\sigma_d^2(t+1)]} \tag{25}$$

In the special case where $\theta = \frac{1}{2}$, the variances of I^s and I^d are equal, and the coefficient of variation may be written

$$V_I^2(t+1) = h(1+\rho)V_I^2(t) + (h-\tfrac{1}{2})(1+\rho) \tag{26}$$

If $\rho > 0$, then, even where $h = 1$, the coefficient of variation is increasing over time; the speed of divergence depends on the pattern of marriage and can be rapid where ρ is close to 1. Where $h = 2{\cdot}0$ and $\rho = 1$, the sequence of values for V_I^2 in successive generations is 1·0, 2·6, 5·6, which may be compared with 1·0, 1·7, 2·6 in the case where primogeniture means inheritance by the eldest son (from equation 23). (It may be noted that the permissible range of values taken by ρ depends on the structure of wealth-holding, it being bounded below by the case where no heirs marry heiresses, which gives the previous results.)

These results, summarised in Table 2.1, bring out once more the interdependence of different mechanisms. The impact of changes in one social institution, such as the division of bequests, depends on other features of the process, such as the marriage pattern and the family size. We can clearly go further in the direction of incorporating further inter-relations. We have, for example, assumed that family size is uniform, whereas differential fertility may be a significant factor. We have not allowed for the facts that the sex of children is stochastic and that some people do not marry. However, rather than pursue these aspects here we shall turn to examine the relationship between the division of estates and the accumulation of wealth, as discussed in section 2.2.

Table 2.1 *Interaction of pattern of bequests, marriage and population growth*

Pattern of bequests	*With class marriage ($\rho = 1$) and constant population ($h = 1$)*	*Implications of marriage and population growth*
Property left to all sons (or all daughters)	Constant coefficient of variation	Population growth and marriage make no difference
Property left to eldest son (or eldest daughter)	Constant coefficient of variation	Marriage makes no difference. With population growth ($h > 1$) the coefficient of variation increases over time
Property left to eldest child (whether son or daughter)	Coefficient of variation increasing over time	Speed of divergence increases with population growth and is lower where some degree of randomness in marriage exists ($0 \leqslant \rho < 1$)

2.3.3 *Accumulation and the Pattern of Bequests*

In the Blinder model, and its generalisation in the preceding section, there is assumed to be no net accumulation. The relationship between the rate of accumulation and the pattern of bequests is, however, a further example of the interdependence between different mechanisms. In order to see this let us replace the assumption that $B_t^i = I_t^i$ by the class savings relationship

$$B_t^i = s_1 I_t^i + s_4 u_B^i \tag{27}$$

Suppose that estates are divided into λB_t^i, shared equally by h sons, and $(1-\lambda)B_{t+1}^i$, shared equally by h daughters. Where all children marry, the wealth inherited by a couple in the next generation is

$$I_{t+1}^i = [\lambda B_t^h + (1-\lambda)B_t^w]\frac{1}{h} \tag{28}$$

This is of the same form as equation (14) except for the factor h. Combining (27) and (28), the mean inherited wealth is governed by

$$\bar{I}_{t+1} = \frac{\bar{B}_t}{h} = \frac{s_1}{h}\bar{I}_t + \frac{s_4}{h}\mu_B \tag{29}$$

where μ_B is the mean of u_B. As before, the condition for stability is that $s_1 < h$. If that is satisfied, mean inherited wealth tends to an equilibrium value at

$$\bar{I} = \frac{s_4 \mu_B}{h - s_1} \tag{30}$$

The variance of inherited wealth is governed as before by (parallel to equation 17)

$$\sigma_I^2(t+1) = [1 - 2\lambda(1-\lambda)(1-\rho)]\sigma_B^2(t)\frac{1}{h^2} \equiv \alpha\sigma_B^2(t)\frac{1}{h^2} \tag{31}$$

Using (27), we get

$$\sigma_I^2(t+1) = \alpha\left[\left(\frac{s_1}{h}\right)^2\sigma_I^2(t) + \left(\frac{s_4}{h}\right)^2\Sigma_B^2\right] \tag{32}$$

where u_B is assumed to be independent of I. If the stability condition $s_1 < h$ is satisfied, the variance converges to

$$\sigma_I^2 = \frac{s_4^2\Sigma_B^2}{(h^2/\alpha) - s_1^2} \tag{33}$$

and the equilibrium coefficient of variation is

$$V_I^2 = \frac{\Sigma_B^2}{\mu_B^2}\left(\frac{(h-s_1)^2}{(h^2/\alpha) - s_1^2}\right) \tag{34}$$

In this model, where the stability condition holds, the equilibrium level of concentration of inherited wealth depends on the inequality in the stochastic term (the term in square brackets in equation 34 is the coefficient of variation of u_B) modified by the effects of inheritance. As before, the impact of random marriage ($\rho < 1$) is to reduce α where $\lambda(1-\lambda) > 0$. A lesser degree of assortative marriage works to reduce concentration. Where $\alpha = 1$, the level of concentration is the same as that found in section 2.2 (see equation 13). As there, the coefficient of variation is a declining function of s_1, and an inheritance tax that reduces s_1 will have the effect of increasing relative inequality. This finding, which holds true for all α ($0 < \alpha \leqslant 1$), depends on the stability condition's being satisfied (the internal rate of accumulation being less than the rate of population growth) and on the distribution's being sufficiently close to the equilibrium for the steady state properties to be relevant. (On this, see Shorrocks, 1975.)

The conclusions reached concerning the impact of inheritance taxation may, however, be highly sensitive to the assumptions about the pattern of bequest. To demonstrate this, let us take the extreme case of primogeniture, where all wealth is left to the eldest son. The behaviour of $\bar{I}_t$ is unaffected, but

$$\sigma_I^2(t+1) = \frac{1}{h}\sigma_B^2(t) + (h-1)\bar{I}_{t+1}^2 \tag{35}$$

(Compare equation 22.) Using (27), we get

$$\sigma_I^2(t+1) = \frac{s_1^2}{h}\sigma_I^2(t) + \frac{s_4^2}{h}\Sigma_B^2 + (h-1)\bar{I}_{t+1}^2 \tag{36}$$

Where $s_1 > 1$, the condition $s_1 < h$ is no longer sufficient to ensure convergence of the second moment. For this we require $s_1^2 < h$. If this holds, then in steady state

$$\sigma_I^2 = \left[\frac{s_4^2}{h}\Sigma_B^2 + \left(\frac{(h-1)s_4^2}{(h-s_1)^2}\right)\mu_B^2\right]\frac{1}{1-(s_1^2/h)} \tag{37}$$

Using (30), the coefficient of variation is given by

$$V_I^2 = \frac{h(h-1)}{h-s_1^2} + \frac{\Sigma_B^2}{\mu_B^2}\left(\frac{(h-s_1)^2}{h-s_1^2}\right) \tag{38}$$

Comparing this with equation (34), we can see that, if h were equal to unity, the coefficient of variation would be the same as in equation (34) with $\alpha = 1$. The consequences of primogeniture are that h^2 is replaced by h in the denominator of the second term and that the first term is now positive. We may contrast the result with that obtained where there is no net accumulation. In that situation the mean inherited wealth falls with the rising population, and the *relative* position of the wealthy improves, so that the coefficient of variation increases over time (see equation 23). Here there is new accumulation, which, where $s_1^2 < h$, dampens the effect of primogeniture.

With primogeniture the effect of an inheritance tax may be quite different. In equation (38) the first term is unambiguously increasing in s_1, and the second term is increasing where $s_1 > 1$. An inheritance tax that reduces s_1 will definitely reduce the coefficient of variation where $s_1 > 1$. Policy will work in the expected direction. Moreover, it is quite possible that the variance does not converge to an equilibrium value. Suppose that $s_1 < h < s_1^2$, so that the mean inheritance converges but the variance does not. Taking $\bar{I}_t = \bar{I}_{t+1} = \bar{I}$, the coefficient of variation is governed by

$$V_I^2(t+1) = \frac{s_1^2}{h} V_I^2(t) + \frac{\Sigma_B^2}{\mu_B^2}\left(\frac{(h-s_1)^2}{h}\right) + (h-1) \tag{39}$$

The variance grows without limit, and a rise in s_1 speeds the rate of increase where

$$V_I^2 > \left(\frac{h}{s_1} - 1\right)\frac{\Sigma_B^2}{\mu_B^2} \tag{40}$$

In other words, beyond a certain point an inheritance tax that reduces s_1 will slow down the rate of increase in inequality.

2.3.4 *A Numerical Example*

A simple numerical example may help to pull together the threads of this discussion. As we have seen, there are several different factors at work, and it is their interaction that influences the development of inherited wealth across generations.

The first consideration is how wealth is divided between sons and daughters (λ) and how this wealth is then recombined through marriage (ρ). These two parameters together determine α. For purposes of illustration we take three values. The first assumes equal division between sons and daughters ($\lambda = \frac{1}{2}$) and random marriage ($\rho = 0$), so that $\alpha = \frac{1}{2}$; in this case the pattern is that most favourable to the division of estates, and there is no offsetting assortative marriage. The second case assumes that sons receive the lion's share ($\lambda = \frac{3}{4}$) and that there is a correlation ($\rho = \frac{2}{3}$; this means that $\alpha = \frac{7}{8}$ and that the equalising forces are considerably less strong. The third case is the extreme one where $\alpha = 1{\cdot}0$.

The second consideration is how wealth is divided among sons (or daughters). We consider two cases: equal division and primogeniture (to the eldest son). In this context the family size h is relevant, since with $h = 1$ there is no difference between equal division among sons and primogeniture (eldest son). We assume that $h = 2{\cdot}0$, which with a generation of thirty years implies a population growth rate of 2·3 per cent per annum.

The third set of factors are those governing accumulation. Here we have assumed the class savings model ($s_2 = s_3 = 0$). In this context the key role is played by the internal rate of accumulation (s_1). We assume in the example that the stability condition $s_1 < h$ is satisfied, but we take a range of values $1 \leqslant s_1 < h$.

The numerical example is given in Table 2.2, which shows the equilibrium value of the coefficient of variation of inherited wealth (squared). The value of Σ_B^2/μ_B^2 is taken as 4·0. If the distribution were lognormal, this would imply that the top percentile of u_B was some twenty times the median. The first three lines in the table are calculated from equation (34), the fourth line from equation (38). The differing values of s_1 indicate what may be achieved by inheritance taxation. The results bring out quite clearly how the conclusions drawn for policy depend on the assumptions of the model. Where there is equal division, an inheritance tax that reduces s_1 from, say, 1·4 to 1·2 leads to an increase in the steady state coefficient of variation. Where there is unequal division (the extreme being that of primogeniture, as shown in the table), the tax leads to a substantial reduction in the coefficient of variation. Put another way, policy measures that influence the *pattern* of bequests may lead to a qualitative change in behaviour.

Table 2.2 *Numerical example: rate of accumulation, pattern of bequests and equilibrium value of coefficient of variation of inherited wealth (squared)*

Pattern of bequests	*Rate of accumulation* (s_1) 1·0	1·2	1·4	1·6	1·8
Equal division (among sons and daughters respectively):					
$\alpha = \frac{1}{2}$	0·57	0·39	0·24	0·12	0·03
$\alpha = \frac{7}{8}$	1·12	0·82	0·55	0·32	0·12
$\alpha = 1$	1·33	1·00	0·71	0·44	0·21
Primogeniture (eldest son)	6·00	8·14	86·00	Does not converge to finite value	

Note: $h = 2{\cdot}0$, $\Sigma_B^2/\mu_B^2 = 4{\cdot}0$.

2.4 BEQUESTS IN A BROADER FRAMEWORK

The discussion so far has concentrated on individual bequest behaviour without considering the wider context and the possible interactions with the economic system. In this section we shall consider in turn a general equilibrium formulation and the inter-relation between earned and unearned incomes. Both of these may significantly affect the conclusions drawn. In the previous sections we have noted that the condition for the convergence of mean wealth is related to the general equilibrium of the economy as a whole. In section 2.4.1 we shall discuss the connection between this stability condition ($s_1 < h$) and the behaviour of aggregate economy. We have also discussed policy measures on the assumption that they do not affect earned incomes; it is possible, however, that parents make transfers in the form of increased earning power. A tax on the transmission of material capital may lead to increased transfers via human capital. This aspect is discussed in section 2.4.2.

2.4.1 *General Equilibrium of the Economy*

Much of the analysis of bequest behaviour has, like the preceding sections, been explicitly partial equilibrium in nature, taking the rate of interest and the wage rate as fixed exogenously (and typically constant). The accumulation of capital for bequest purposes may influence the rate of return, however, and this general equilibrium effect needs to be taken into account. On the other hand, the construction of a full-scale general-equilibrium

model involves a great deal of complexity. For this reason a number of writers (e.g. Stiglitz, 1969; Conlisk, 1977) have adopted a more limited approach. This is based on the assumption that the microrelationships are linear in the variables that differ across individuals, so that the aggregate behaviour is determined independently of the distribution. Thus, shifts in bequests may affect r and w, but only through their effect on mean capital. This approach is restrictive and does not allow for any feedback from the distribution to factor returns; on the other hand, it allows the model to be solved recursively. One first calculates w and r, as determined by the aggregate variables, and then uses these values when solving for the distribution. This means that one can introduce at least one aspect of the general equilibrium effects into the distributional model, and as such it represents a definite step forward.

To illustrate the approach we take the savings model of equation (8) with $s_3 = 0$ (i.e. without the forward-looking element). We assume that in generation t output per person (Y_t) is a function of mean inherited capital per person ($\bar{I}_t$); that is,

$$Y_t = f(\bar{I}_t) \tag{41}$$

where $f' > 0$, $f'' < 0$, $f(0) = 0$, $f'(0) = \infty$ and $f'(\infty) = 0$. Given that the population grows by a factor h in each generation, the behaviour of $\bar{I}_t$ is governed by

$$\bar{I}_{t+1} = \frac{\bar{B}_t}{h} = (s_1 \bar{I}_t + s_2 \bar{w}_t + s_4 \mu_B)\frac{1}{h} \tag{42}$$

Suppose first that

$$s_1 = 1 + s_2 r$$

where s_2 is constant and r is the rate of return per generation ($\bar{w}_t$ being interpreted similarly), and that $s_4 = s_2$. Equation (42) can then be rewritten

$$\begin{aligned}\bar{I}_{t+1} - \bar{I}_t &= \frac{s_2}{h}(r\bar{I}_t + \bar{w}_t + \mu_B) - \left(\frac{h-1}{h}\right)\bar{I}_t \\ &= \frac{s_2}{h} f(\bar{I}_t) - \left(\frac{h-1}{h}\right)\bar{I}_t\end{aligned} \tag{43}$$

(The payments to capital, labour and 'entrepreneurship', via u_B, are assumed to add up to total output.)

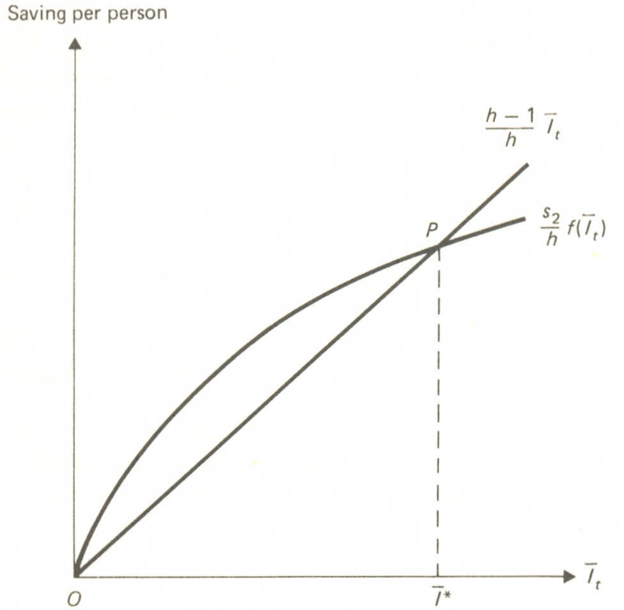

Figure 2.2 *Aggregate equilibrium*

Assuming that $h > 1$, we may depict the aggregate equilibrium in this case as in Figure 2.2. Given the assumptions about the production function, there is a unique steady state at point P, and it is globally stable. If $\bar{I}_t$ is strictly less than $\bar{I}^*$, then $\bar{I}_{t+1} > \bar{I}_t$; conversely, if $\bar{I}_t$ is strictly greater than $\bar{I}^*$, then $\bar{I}_{t+1} < \bar{I}_t$. Point P is the standard Solow equilibrium of neoclassical growth theory, since with proportional savings we have $s_2 f = (h-1)\bar{I}_t$, where $(h-1)$ is the growth in the population. It has, however, implications for the distribution of wealth. From the definition of s_1, in steady state

$$\begin{aligned} s_1\bar{I} &= (1+s_2 r)\bar{I} \\ &= \bar{I} + s_2[f(\bar{I}) - \bar{w} - \mu_B] \\ &= h\bar{I} - s_2(\bar{w} + \mu_B) \end{aligned} \tag{44}$$

where the last step uses the steady state condition $s_2 f = (h-1)\bar{I}$. It follows that in steady state $s_1 < h$. The stability condition assumed earlier is an implication of the aggregate steady state. (This result has been given in a continuous time model by Stiglitz, 1969, although it should be noted that here we have not assumed perfect competition.)

This aggregate analysis shows how the determination of $(\bar{w} + \mu_B)$ and r may be made endogenous to the model and how the aggregate properties may have implications for the distribution. At the same time the assumptions are strong and need to be relaxed. For example, we need to explore the consequences of non-proportional savings, as with the class savings model, and we need to allow for the dependence of s_1, s_2 and s_4 on the rate of return. The introduction of these considerations can change the conclusions drawn regarding the stability condition.

Special reference should be made to the relationship between current aggregate variables and the lifetime wealth that has been the focus of the distributional model. In the treatment so far we have equated $\bar{I}_t$ with the capital available for production, but this ignores the contribution of life cycle savings. If we consider a continuous lifetime process embedded within the discrete generational model, as we have indeed done in section 2.2, the 'average' capital relevant to the aggregate analysis is not the same as average inherited wealth. (This aspect has been discussed by Conlisk, 1977.) It means in particular that there is not necessarily a direct link between the conditions for the convergence of aggregate capital and the behaviour of inherited wealth.

2.4.2 *Inheritance and Earnings*

The discussion so far has concentrated on the transmission of material wealth, but parents may also provide advantages to their children through enhanced earnings potential. This includes the provision of private schooling, the financing of higher education, the role of 'contacts' and of the parental social network in securing entry to jobs, nepotism and selective recruiting. The role of the parents in financing education, for example, and its relation to financial transfers have been examined in a life cycle context by Ishikawa (1975). Such mechanisms may be important in the persistence of economic status from generation to generation, and inheritance taxation is itself likely to provide an incentive for transmission to take the form of human rather than non-human capital.

Some of the different factors at work are brought out here in a simple recursive model of the determination of earnings (as used, for example, by Bowles and Nelson, 1974). This is depicted in Figure 2.3 and set out algebraically below. Person i in generation t starts life with a genetic endowment of ability (G_t^i) and family background, represented by the bequest level (B_{t-1}^i). The joint influence of these factors is reflected first in measured ability (A_t^i). (In the case of IQ the contribution of the two factors is, of course, highly controversial.) This affects, together with family background, access to education (E_t^i); and education, measured

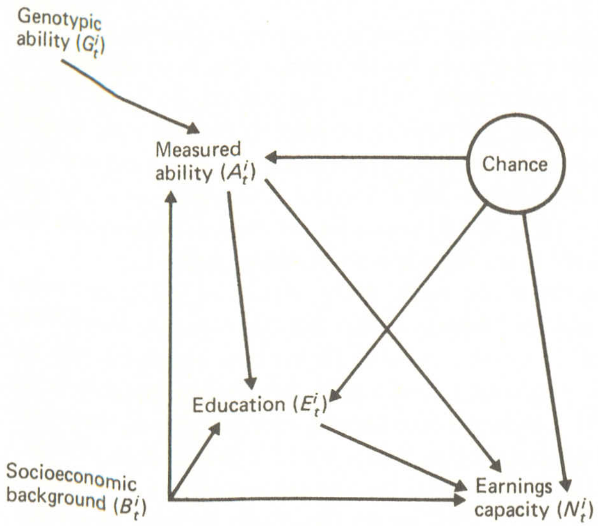

Figure 2.3 *Influences on earnings*

ability and family background in turn are assumed to determine earnings capacity (N_t^i). In addition, at each stage there is an additive stochastic component (i.e. 'chance'). This may be set out algebraically as follows:

$$G_t^i = gG_{t-1}^i + u_G^i \tag{45a}$$

$$A_t^i = a_1 G_t^i + a_2(B_{t-1}^i - \bar{B}_{t-1}) + u_A^i \tag{45b}$$

$$E_t^i = a_3 A_t^i + a_4(B_{t-1}^i - \bar{B}_{t-1}) + u_E^i \tag{45c}$$

$$N_t^i = a_5 A_t^i + a_6(B_{t-1}^i - \bar{B}_{t-1}) + a_7 E_t^i + \tilde{u}_N^i \tag{45d}$$

(The impact of family background is defined as advantage relative to the mean.) From the last three equations we can obtain the reduced form

$$\begin{aligned} N_t^i &= (a_5 + a_3 a_7)a_1 G_t^i + [a_6 + a_4 a_7 + a_2(a_5 + a_3 a_7)] \\ &\quad \times (B_{t-1}^i - \bar{B}_{t-1}) + \tilde{u}_N^i + a_7 u_E^i + (a_5 + a_3 a_7) u_A^i \\ &\equiv cG_t^i + b(B_{t-1}^i - \bar{B}_{t-1}) + u_N^i \end{aligned} \tag{46}$$

so that earnings are governed by equations (45a) and (46), where the coefficients c and b reflect both direct and indirect effects, the latter being those via measured ability and education.

In order to illustrate the inter-relation between earned incomes and inherited wealth, let us assume that all property is held by men (alternatively, all held by women) and that men (alternatively, women) are the only earners. Moreover, let us take the class accumulation relationship

$$B_t^i = s_1 I_t^i + s_4 u_B^i \tag{27}$$

If, in addition, estates are equally divided, then

$$I_t^i = \frac{B_{t-1}^i}{h} \tag{47}$$

We can therefore summarise the model in terms of the stochastic difference equations thus:

$$G_t^i = gG_{t-1}^i + u_G^i \tag{45a}$$

$$B_t^i = \frac{s_1}{h} B_{t-1}^i + s_4 u_B^i \tag{48}$$

$$N_t^i = cG_t^i + b(B_{t-1}^i - \bar{B}_{t-1}) + u_N^i \tag{46}$$

From these equations we can derive the time path of lifetime income, which we take here to be defined as

$$Y_t^i = wN_t^i + rI_t^i + u_B^i \tag{49}$$

Finally, we need to specify the assumptions concerning the random vector (u_G^i, u_N^i, u_B^i). This is assumed to be distributed independently of the state variables and to have mean and diagonal variance-covariance matrix that are constant over time and across individuals. The vector is assumed to be independent over individuals i and across generations. It is also assumed that the population is sufficiently large that we can replace sample moments by the corresponding population moments, in this way moving from a stochastic to a distributional model (Atkinson and Harrison, 1978, ch. 8).

For simplicity we assume that the factor prices (w and r) are constant (i.e. that the economy is in aggregate equilibrium). We then characterise the behaviour of the distribution in terms of the first and second moments, where the former satisfy the following equations:

$$\bar{G}_t = g\bar{G}_{t-1} + \mu_G \tag{50a}$$

$$\bar{B}_t = \frac{s_1}{h} \bar{B}_{t-1} + s_4 \mu_B \tag{50b}$$

$$\bar{N}_t = c\bar{G}_t + \mu_N \tag{50c}$$

where μ_X denotes the mean of u_X^i. It is assumed that $0 \leqslant g < 1$, which ensures the convergence of $\overline{G}_t$ and hence $\overline{N}_t$. The stability condition $s_1 < h$ ensures the convergence of $\overline{B}_t$. The variances (σ_X^2) and covariances (σ_{XY}) are governed by

$$\sigma_G^2(t) = g^2\sigma_G^2(t-1) + \Sigma_G^2 \tag{51a}$$

$$\sigma_B^2(t) = \left(\frac{s_1}{h}\right)^2 \sigma_B^2(t-1) + s_4^2\Sigma_B^2 \tag{51b}$$

$$\sigma_N^2(t) = c^2\sigma_G^2(t) + b^2\sigma_B^2(t-1) + \Sigma_N^2 + 2bcg\sigma_{BG}(t-1) \tag{51c}$$

$$\sigma_{BG}(t) = \frac{gs_1}{h}\sigma_{BG}(t-1) \tag{51d}$$

$$\sigma_{GN}(t) = c\sigma_G^2(t) + bg\sigma_{BG}(t-1) \tag{51e}$$

$$\sigma_{BN}(t) = c\sigma_{BG}(t) + \frac{bs_1}{h}\sigma_B^2(t-1) \tag{51f}$$

Note that in obtaining some of these results we have substituted for G_t^i in equation 46 and that equation 51b is obtained from equation 32 with $\alpha = 1{\cdot}0$.) The earlier assumptions ensure convergence to the following steady-state values:

$$\sigma_G^2 = \frac{\Sigma_G^2}{1-g^2} \tag{52a}$$

$$\sigma_B^2 = \frac{s_4^2\Sigma_B^2}{1-(s_1/h)^2} \tag{52b}$$

$$\sigma_{BG} = 0 \tag{52c}$$

$$\sigma_{GN} = c\sigma_G^2 \tag{52d}$$

$$\sigma_{BN} = \frac{bs_1}{h}\sigma_B^2 \tag{52e}$$

$$\sigma_N^2 = c^2\sigma_G^2 + \Sigma_N^2 + b^2\sigma_B^2 \tag{52f}$$

and we may deduce that the steady state variance of lifetime income is

$$\sigma_Y^2 = w^2\sigma_N^2 + \left(\frac{r}{h}\right)^2\left(1 + \frac{2bs_1w}{r}\right)\sigma_B^2 + \Sigma_B^2 \tag{53}$$

$$= w^2(c^2\sigma_G^2 + \Sigma_N^2) +$$

$$\Sigma_B^2\left(1 + \frac{(s_4/h)^2}{1-(s_1/h)^2}(b^2h^2w^2 + 2bws_1r + r^2)\right) \tag{54}$$

This model provides a framework within which one can analyse the implications of changes in policy parameters. Consider first the impact of a capital gains tax that reduces saving out of 'entrepreneurial' income (i.e. s_4 is reduced). From equation (54) we may see how this reduces the variance of lifetime income. The effect depends on the return to capital and the interaction with earned income via the parameter b, which captures the effect of family background on earnings. It is also magnified by the factor $1-(s_1/h)^2$, which represents the effects of inheritance. (Note that we are considering here the variance, not the coefficient of variation.) Similarly, we can see the impact of an inheritance tax that works to reduce s_1. Again, this interacts with the family background effect.

Moreover, we can see how the effect may be reversed if parents switch their transfers from material to human capital, so that s_1 falls but b rises. To take an extreme case, suppose (1) that before the introduction of the tax there is no family background effect ($b = 0$), and (2) that the effect of the tax is to eliminate accumulation out of inherited wealth ($s_1 = 0$) but for parents to make transfers of human capital ($b > 0$). From equation (54) we can see that the condition for the variance of lifetime wealth to decline is

$$\frac{r^2}{1-(s_1/h)^2} > r^2 + b^2h^2w^2 \tag{55}$$

This may be rearranged as

$$\frac{s_1^2/h^2}{1-(s_1/h)^2} > \frac{b^2w^2}{(r/h)^2} \equiv \gamma^2 \tag{56}$$

The right hand side has the following interpretation. The increment in lifetime wealth per £1 of B_{t-1} via earnings is bw; the increment via inheritance is r/h. The value of γ is therefore greater (less) than unity as the earnings (inheritance) effect is larger. If, for example, they are equally matched, the variance of lifetime income is decreased where the saving out of inherited wealth is greater than $\sqrt{\tfrac{1}{2}}h$.

2.4.3 *A Numerical Example*

As in the preceding section, a numerical example may be helpful. For this purpose we take over the earlier assumptions that $h = 2{\cdot}0$ and $\Sigma_B^2/\mu_B^2 = 4{\cdot}0$. Moreover, it is assumed that the aggregate production and distribution relations are such that the shares of wages, capital and entrepreneurial income are constant and equal to 0·7, 0·2 and 0·1 respectively.

Dividing equation (53) by $\bar{Y}^2$, the coefficient of variation of lifetime income in steady state is given by

$$V_Y^2 = \left(\frac{w\bar{N}}{\bar{Y}}\right)^2 V_N^2 + \left(\frac{r\bar{I}}{\bar{Y}}\right)^2 \left(1 + \frac{2s_1}{h}\gamma\right) V_B^2 + \left(\frac{\mu_B}{\bar{Y}}\right)^2 \frac{\Sigma_B^2}{\mu_B^2} \qquad (57)$$

where (using the definition of γ)

$$V_N^2 = \frac{c^2\sigma_G^2 + \Sigma_N^2}{\bar{N}^2} + \gamma^2 \left(\frac{r\bar{I}}{w\bar{N}}\right)^2 V_B^2 \qquad (58)$$

The term $(c^2\sigma_G^2 + \Sigma_N^2)/\bar{N}^2$ is the value taken by the coefficient of variation (squared) if there is no family background effect. Let us assume that this is 0·15, which means, with a lognormal distribution of earnings, that the Gini coefficient is around 0·2. Using (50b), we get

$$V_B^2 = \frac{\Sigma_B^2}{\mu_B^2}\left(\frac{h - s_1}{h + s_1}\right) \qquad (59)$$

Table 2.3 *Coefficient of variation (squared) of lifetime income (V_Y^2), the rate of accumulation, and the inter-relation with earned incomes*

	Rate of accumulation (s_1)				
	1·0	1·2	1·4	1·6	1·8
$\gamma = 0{\cdot}5$					
V_B^2	1·33	1·00	0·71	0·44	0·21
V_N^2	0·18	0·17	0·16	0·16	0·15
V_Y^2	0·21	0·19	0·17	0·15	0·13
$\gamma = 0{\cdot}8$					
V_B^2	1·33	1·00	0·71	0·44	0·21
V_N^2	0·22	0·20	0·19	0·17	0·16
V_Y^2	0·24	0·22	0·19	0·16	0·14
$\gamma = 1{\cdot}0$					
V_B^2	1·33	1·00	0·71	0·44	0·21
V_N^2	0·26	0·23	0·21	0·19	0·17
V_Y^2	0·27	0·24	0·21	0·18	0·15

Note: $h = 2{\cdot}0$, $\Sigma_B^2/\mu_B^2 = 4{\cdot}0$.

This corresponds to equation (34), with $\alpha = 1$, and we can read off the values of V_B from the line $\alpha = 1$ in Table 2.2.

Table 2.3 shows the results obtained from different values of s_1 and γ. These may be taken as representing the possible influence of inheritance taxation, namely reducing s_1 and increasing b (which enters γ). Suppose, for example, that $s_1 = 1{\cdot}6$, so that $V_B^2 = 0{\cdot}44$. If $\gamma = 0{\cdot}8$, this means that $V_N^2 = 0{\cdot}17$ (using the value of $r\bar{I}/w\bar{N} = 0{\cdot}2/0{\cdot}7$). Substituting in turn into V_Y^2, we obtain a value of

$$(0{\cdot}7)^2(0{\cdot}17) + (0{\cdot}2)^2[1 + (1{\cdot}6)(0{\cdot}8)](0{\cdot}44) + (0{\cdot}1)^2(4{\cdot}0) = 0{\cdot}16$$

This calculation and those given in the table provide some indication of the sensitivity to the parameters, although it must be borne in mind that they relate to one special set of assumptions about the accumulation relationship (class savings), about the division of estates (equal division among sons) and about the sources of earnings (only men work).

2.5 CONCLUDING COMMENTS

One of the principal points of this chapter has been to bring out the inter-relation between different factors influencing the distribution of wealth. The influence of marriage patterns depends on how estates are divided; the impact of the division of estates depends on the process of accumulation; the conditions of aggregate equilibrium have implications for the behaviour of the distribution; the inheritance of wealth may facilitate the enhancement of earnings potential; the accumulation of capital may in turn depend on earnings and expected earnings in the next generation. In view of this it is clear that one should be cautious in drawing conclusions about the impact of policy instruments without a complete model of the distribution.

Some of the building blocks for such a complete model have been examined in this chapter. In section 2.2 a formulation of the bequest relationship (equation 8) that allows for several different interpretations of the motives for passing on wealth to the next generation has been given. Section 2.3 has discussed different patterns of inheritance, allowing for variation in the division of estates and for the role of marriage. The model can be put in a general equilibrium context along the lines described in section 2.4, with the distinction being drawn between lifetime and current wealth. The determinants of earnings can be introduced via the recursive structure of section 2.4.2.

At the same time a great deal remains to be done. First, each of these building blocks can at best be described as a stylisation, and individual elements of the model are in need of considerable development. For example, there is the nexus of family decisions concerning fertility and the allocation of resources to children (whether child care, education or inheritance). The work of Becker and others on child 'quality' and intergenerational transmission (see, for example, Becker and Lewis, 1973; Becker and Tomes, 1976) rests on strong assumptions about family behaviour but raises important questions about the advantage derived from family background and interfamily allocation. To take another example, we have not modelled explicitly the risk-taking behaviour that lies behind the accumulation of wealth (see, for example, Stiglitz, 1978; Pestieau and Possen, 1979).

Secondly, the assembly of the blocks is not necessarily an easy operation. What we are doing may be seen as formalising relationships typically presented in words (or in ingenious diagrams such as that on page 8 of Meade's *The Inheritance of Inequalities*, 1973). This formalisation has the merit that one can characterise the equilibrium of the process and examine the dynamic development of the distribution. The balance between equalising and disequalising factors can be assessed and comparative static properties derived. However, these advantages can typically only be realised at the cost of considerable simplification. Analytical tractability can often involve sacrificing some of the richness of the analysis. Simulation methods (as in Pryor, 1973) appear to be an attractive alternative, but interpretation of the results may nonetheless require considerable understanding of the analytical structure.

Finally, the empirical implementation of the model poses serious problems. Certain relationships have been extensively examined, such as the links between earnings, education and ability (see, for example, Griliches, 1977), but even here there remains controversy (e.g. about the effect of parental wealth, i.e. the coefficient b). In other areas, such as that of bequest behaviour, the evidence is much more fragmentary. (For the United Kingdom, see Harbury and Hitchens, 1979. For the United States, see Brittain, 1978; Menchik, 1977.) While it may be possible to make plausible guesses about the likely ranges of coefficients, the micro-econometrics of the distribution of income and wealth is an underdeveloped field.

REFERENCES: CHAPTER 2

Atkinson, A. B. (1971), 'Capital taxes, the redistribution of wealth and individual savings', *Review of Economic Studies*, vol. 38, pp. 209-28.
Atkinson, A. B. (1972), *Unequal Shares* (London: Allen Lane).

Atkinson, A. B. (1974), 'A model of the distribution of wealth', MIT Discussion Paper.
Atkinson, A. B. and Harrison, A. J. (1978), *Distribution of Personal Wealth in Britain* (Cambridge: CUP).
Barro, R. J. (1974), 'Are government bonds net wealth?', *Journal of Political Economy*, vol. 82, pp. 1095-118.
Becker, G. S. (1974), 'A theory of social interactions', *Journal of Political Economy*, vol. 82, pp. 1063-94.
Becker, G. S. and Lewis, H. G. (1973), 'On the interaction between quantity and quality of children', *Journal of Political Economy*, vol. 82, pp. S279-S288.
Becker, G. and Tomes, N. (1976), 'Child endowments and the quantity and quality of children', *Journal of Political Economy*, vol. 84, pp. S143-S162.
Blinder, A. S. (1973), 'A model of inherited wealth', *Quarterly Journal of Economics*, vol. 87, pp. 608-26.
Bowles, S. and Nelson, V. (1974), 'The "inheritance of IQ" and the intergenerational reproduction of economic inequality', *Review of Economics and Statistics*, vol. 56, pp. 39-51.
Brittain, J. A. (1978), *Inheritance and the Inequality of Material Wealth* (Washington, DC: Brookings Institution).
Champernowne, D. G. (1973), *The Distribution of Income between Persons* (Cambridge: CUP).
Conlisk, J. (1977), 'An exploratory model of the size distribution of income', *Economic Inquiry*, vol. 15, pp. 345-66.
Griliches, Z. (1977), 'Estimating the returns to schooling: some econometric problems', *Econometrica*, vol. 45, pp. 1-22.
Harbury, C. D. and Hitchens, D. M. W. N. (1979), *Inheritance and Inequality in Britain* (London: Allen & Unwin).
Institute for Fiscal Studies (1978), *The Structure and Reform of Direct Taxation*, report of a committee chaired by Professor J. E. Meade (London: Allen & Unwin).
Ishikawa, T. (1975), 'Family structures and family values in the theory of income distribution', *Journal of Political Economy*, vol. 83, pp. 987-1008.
Kaldor, N. (1955-6), 'Alternative theories of distribution', *Review of Economic Studies*, vol. 23, pp. 83-100.
Marglin, S. A. (1975), 'What do bosses do? - part II', *Review of Radical Political Economics*, vol. 7, pp. 20-37.
Meade, J. E. (1936), *Economic Analysis and Policy* (London: OUP).
Meade, J. E. (1948), *Planning and the Price Mechanism* (London: Allen & Unwin).
Meade, J. E. (1964), *Efficiency, Equality and the Ownership of Property* (London: Allen & Unwin).
Meade, J. E. (1966), 'Life-cycle savings, inheritance and economic growth', *Review of Economic Studies*, vol. 33, pp. 61-78.
Meade, J. E. (1973), *The Inheritance of Inequalities* (London: OUP).
Meade, J. E. (1975), *The Intelligent Radical's Guide to Economic Policy* (London: Allen & Unwin).
Meade, J. E. (1976), *The Just Economy* (London: Allen & Unwin).
Meade, J. E. (1978), see Institute for Fiscal Studies (1978).
Menchik, P. L. (1977), 'Primogeniture, equal sharing and the US distribution of wealth', Institute for Research on Poverty Discussion Paper, no. 390.
Pasinetti, L. (1962), 'Rate of profit and income distribution in relation to the rate of economic growth', *Review of Economic Studies*, vol. 29, pp. 267-79.
Pestieau, P. and Possen, U. M. (1979), 'A model of wealth distribution', *Econometrica*, vol. 47, pp. 761-72.
Pryor, F. L. (1973), 'Simulation of the impact of social and economic institutions on the size distribution of income and wealth', *American Economic Review*, vol. 63, pp. 50-72.

Shorrocks, A. F. (1975), 'On stochastic models of size distributions', *Review of Economic Studies*, vol. 42, pp. 631–41.

Shorrocks, A. F. (1979), 'On the structure of intergenerational transfers between families', *Economica*, vol. 20, pp. 415–425.

Stiglitz, J. E. (1969), 'Distribution of income and wealth among individuals', *Econometrica*, vol. 37, pp. 382–97.

Stiglitz, J. E. (1978), 'Equality, taxation and inheritance', in W. Krelle and A. F. Shorrocks (eds), *Personal Income Distribution* (Amsterdam: North-Holland).

Yaari, M. E. (1964), 'On the consumer's lifetime allocation process', *International Economic Review*, vol. 5, pp. 304–17.

Yaari, M. E. (1965), 'Uncertain lifetime, life insurance and the theory of the consumer', *Review of Economic Studies*, vol. 32, pp. 137–50.

Chapter 3

Housing and the Tax System*

G. A. HUGHES

3.1 INTRODUCTION

This chapter deals with the issues raised when we consider the application of various taxes to the housing market. In particular, we shall focus on the dual role of housing as a major component of household expenditure and as an asset that generates an income either in kind or in money terms for its owner. In analytical terms, the characteristic that perhaps distinguishes housing most from other consumption or capital goods is its long life span and low rate of growth, which mean that at any point in time the housing market is dominated by the existing stock rather than by the flow of new building. As a consequence our discussion of the effect of different taxes on the housing market will concentrate on their impact on the capital values of existing houses, since the associated changes in new building, land use and other variables can usually be directly inferred from this. Our focus on house values also provides an introduction to their use in the evaluation of a wide variety of public policies in the fields of taxation, local government, environmental control, and so on. Each individual house is distinguished by its location and thus by all the neighbourhood characteristics, which may be regarded as complementary to the house itself. As a result the behaviour of the housing market reflects not only the balance between the demand for, and supply of, different types of housing but also preferences concerning transport facilities, the physical environment, local services and other aspects of a neighbourhood.

We shall pay relatively little attention to such locational characteristics of the housing market in this chapter because of limitations on space. This may be justified by distinguishing between the land market and the market for houses (i.e. residential structures). In the short run the two are inextricable, but in the medium the longer term public policies that have an impact varying from one locality to another (e.g. site value taxes,

*I am grateful to David Newbury for his comments on the original draft of this chapter.