

Economic Growth and Population: Perspectives of the "New Home Economics"

MARC NERLOVE
Northwestern University

There is no more important prerequisite to clear thinking in regard to economics itself than is recognition of its limited place among human interests at large.

FRANK H. KNIGHT (1933)

investment in health, nutrition, and intellectual and skill development, as well as the more traditional subjects of consumption and savings behavior. This resurgence has been called "the new home economics." In this essay I discuss both the elements of the new home economics and the contribution which recent developments can make to our understanding of the relation between economic growth and demographic change. In particular, I argue that, despite its obvious limitations, economics and the calculus of rational choice may possibly go a long way towards explaining the so-called demographic transition in the economically developed and developing countries of the world. This is not to say that what is here offered constitutes a complete theory of the twin phenomena of declining mortality and birth rates in Western societies and Japan, but rather it is a sequence of conjectures and speculations which point the way to such a theory. The key issues of why parents wish to transfer so much to future generations in modern societies and of what sets off the cumulative process here described are left unexplained in economic terms.

Introduction

Economics, as a discipline, deals largely with the problem of rational choice. A deeply ingrained paradigm of economic choice behavior must inevitably shape the contribution which economics can make to the study of population and to our understanding of the family or any other social institution. There has, recently, been a resurgence of interest in the household and family, and considerable exploration of the extent to which rational choice among alternatives can explain household behavior with respect to fertility decisions, labor force participation, and

Some History of Economic Thought

Economics is originally a Greek term, and for the Greeks the study of economics was largely the study of household management and of choices made within the family. (Aristotle, *Politics* 1, 3-13; 2, 1-8). At no time in the history of economics has the consumer

been omitted, but the complex of decisions which take place within the family and are related to consumption, procreation, labor supply, education and asset formation of various kinds, and thus centrally to the problem of poverty itself, have been much neglected until recently. In England, where modern economics largely developed, the transition from an agricultural to a commercial (trading) society and then to an industrial society, and from a family system in which husband and wife shared a common management problem to one in which there was a greater differentiation between household and market activity transformed economics: The subject in the original Greek sense became the preoccupation of women and popular writers; "Political Economy" emerged as the grand preoccupation of men with how to manage the affairs of the state, allocate its natural resources of men, land, labor, and capital, and make its wealth grow.

In the eighteenth century there was much concern with international trade and its relation to economic growth, and in the nineteenth with monetary problems and the organization of financial institutions as well as with the nature of the capitalist system itself. The English utilitarians did, of course, derive much of the philosophical structure from consideration of the individual and the family, and Malthus, Ricardo, and Mill built a major theory of economic growth and development on a rather specific model of family formation and procreation.

In essays published in 1798 and 1830, Malthus (reprinted 1970) and the other classical economists, particularly Ricardo (1817 reprinted 1948), combined a very simple model of family decision-making with an equally simple model of the operation of the economy. The Malthusian model of family decision-making was, on the whole, that there wasn't much: procreation without bound except possibly by "... a foresight of the difficulties attending the rearing of a family ... and the actual distresses of some of the lower classes, by which they are disabled from giving the proper food and attention to their children" (Malthus, 1970, p. 89). In their simple model of the economy, a high level of capital accumulation induced by a high level of profits representing the difference between output and the rent of land (natural resources) and wages, permitted a continual increase in output and population, albeit at the cost of resort to land of increasing poorer quality. It did not, as the result of the model of family decision-making adopted, however, lead to a rising standard of living for the population as a whole. Thus, the classical economists achieved a very simple model of economic growth and development (Baumol, 1970, pp. 13-21). Modern growth theorists in the tradition of Solow (1956) and Swan (1956),

have developed theories of economic growth based on far more elaborate theories of the economy, but, with few exceptions, theories of population growth which incorporate an analysis of family decision-making have gone little beyond the Malthusian model of the latter (Pitchford, 1973, pp. 1-10).

Indeed, the triumph of the theory of marginal utility, with its emphasis on individual maximization towards the end of the nineteenth century (Stigler, 1965), led economists to concentrate more on the study of the firm and the decisions made within the firm. Responsibility for much of this shift must be given to Alfred Marshall (1920, especially Books IV and V), who more than any other individual laid the foundations, in his development of partial equilibrium analysis, of the theory of the firm and the way in which decisions at the level of the firm interact to produce aggregate industry results. A central role was also given to the firm by Schumpeter (1934) in his famous theory of economic development.

Since the great depression of the 1930's especially, economics and economists have been largely preoccupied with the problem of economic fluctuations. Such concerns have led naturally to an emphasis on production and investment decisions, which, in highly developed market economies, take place within the firm although they are influenced by phenomena outside it. Until recently, the nature of decisions taking place within the household and lying within the purview of economics has been rather narrowly construed. In the 1950's there was a resurgence of interest in economic development and long-term economic growth. At first, major emphasis was placed on the low income, so-called less developed countries and on the historical development of modern economies.

Recent research has brought out, however, that much investment which occurs in the economy, crucial to the understanding of long-term growth, takes place in human beings rather than physical capital, and that fertility itself is shaped in important ways by economic considerations? It is, perhaps, this rediscovery of the concept of "human capital" which, more than anything else, is responsible for a renewed interest in the economics of the household. Fertility, investments in human capital through nutrition, health care and schooling, migration, labor force participation, and, in some sense, marriage itself, are all closely related to decisions which take place within the household and the family considered as an economic unit. Thus, in recent years, economists have once again begun to devote more attention to the household as an economic decision-making unit, but, so far as I am aware, economists have not yet integrated, in any systematic fashion, work on the household with the research of the 50's and 60's on economic growth and development.

redoing in modern form what Malthus and Ricardo did at the beginning of the nineteenth century for the economics of their day.

Elements of the "New Home Economics":

Summary and Critique²

As it presently stands, the theory of household production and choice is largely a static one, developed in its modern form by Becker (1965) and others.³ Much of present-day theory, however, originated in most of its essentials in the earlier work of Margaret Reid (1934). Her work, in turn, was largely inspired by Wesley Mitchell's fascinating essay (1912) on "The Backward Act of Spending Money." It is not possible to describe the theoretical framework of the new home economics and its shortcomings at any length in this essay; I can only summarize those elements essential to the discussion in the section which follows, and point to a number of important unresolved issues.

In its simplest and most unadorned form, economics is the theory of choice among competing ends in order to maximize satisfactions (or utility), subject to the constraints imposed by limitations in the availability of the resources required to achieve those ends. Various elaborations and accretions are necessary to accommodate this central theoretical core to the dynamics of choices made sequentially over time and in the presence of uncertainty regarding both future constraints and future preferences. To study household decision-making, particularly as it relates to fertility, it is thus necessary to formulate the function to be maximized and the constraints subject to which maximization takes place. The manner in which this is done determines the form of the conclusions which may be reached on the basis of further assumptions concerning the underlying quantitative structure of the maximal and the constraints.

The four main elements of the theoretical structure of the new home economics are: (1) a utility function with arguments which are not physical commodities but home-produced bundles of satisfactions; (2) a household production technology; (3) an external labor market environment providing the means for transforming household resources into market commodities; and (4) a set of household resource constraints which consist of inherited material wealth and time available to individual family members for household production and market activities. The time available may be of varying quality, and it is at this point that inherited human capital and investments in human capital made both by one generation on behalf of future generations and on its own behalf, enters the picture.⁴ To anticipate the argument of the next section, it is that the "new home economics" may be integrated into a theory of economic growth and devel-

opment through an understanding of the way in which investment in human capital increases the value of human time. In this way, such investment changes over time the resource constraints and the relative costs and prices which households face in their decisions on the number and quality of children they attempt to produce. The question as to whether this constitutes a true economic explanation of the so-called demographic transition is basically an empirical one and is left open.

The first element in the new home economics is the utility function to be maximized. Its form and its arguments (i.e., what variables determine its level) are obviously crucial in determining the choices which result from its maximization. But *whose* utility function is it that is maximized in connection with these choices we are discussing, marriage, children, consumption of commodities, work and leisure, and investment in all forms of capital?

Consider, for the moment, a household which is already formed. The utility function of the new home economics has several key characteristics: First, it involves non-market goods or physical commodities as we usually think of them in economics, but *abstract* goods, or perhaps we should say "satisfactions," which must themselves be produced within the household (Becker, 1965; Lancaster, 1966; Muth, 1966).⁵ The importance of this characteristic of the utility function is that it leads directly to the key questions of household technology and the composition of different types of market goods and services and physical commodities in terms of attributes contributing to satisfactions.

A second key characteristic of the utility function of the new home economics is that it is just that, *one* utility function of a single decision maker (not always the husband and father!), thus obviating the necessity for assuming a "family utility function" with all the concomitant problems of social utility functions in general. It is, perhaps, not entirely accurate to identify this position too closely with the new home economics; it should perhaps be called the "Samuelsonian finesse" (Samuelson, 1956).⁶ The assumption of a single utility function raises both complex conceptual and complex ethical issues. Conceptually, there are problems in defining a single household utility function for households yet unformed; but this seems essential for a theory with which we might hope to explain fertility.⁷ The ethical issue is even more central as Koopmans (1967) has pointed out.⁸ The utility function of the new home economics has most important implications for the intergenerational transfers of material wealth and human capital which Knight (1921, pp. 374-375) has so eloquently described as central to the continuity of the social order. Moreover, I argue in the next section that it is the very magnitude of the desire

to transmit wealth, both human and physical, to successive generations which is the driving force behind the demographic changes which occur during economic development.

There is also, in the magnitude of accumulation in developed economies, a distinct paradox, as pointed out by Robert Solow (personal communication): Advanced societies make extraordinary provision for the future suggesting an extremely small intergenerational rate of time preference. At three percent roughly, one weights one's grandchildren's utilities at approximately a quarter of one's own; and we seem to save far too much for that; yet private rates of interest, even after allowing for inflationary effects, exceed even this very low rate of time preference. (See also Solow, 1970, p. 99.) Current ecological concerns, even discounted for a certain amount of hysteria, suggest a concern for future generations far in excess of that of intragenerational rates of time preference as exhibited in interest rates for virtually riskless loans adjusted for inflation. Thus, what appears to be the driving force behind the demographic change which accompanies development, remains inexplicable in economic terms.

The second element in the new home economics is the technology of household production described by a production function or functions and a list of the resources utilized in the processes involved. Typically, following Becker (1965), the inputs are time, perhaps distinguishable by household member (e.g., husband and wife) and market-purchasable commodities. These inputs are used to produce the goods *within* the household which, in turn, lead to satisfaction. In its simplest form in the economic theory of fertility, two time inputs, the husband's and wife's, and one general market-purchasable commodity are assumed to produce three household goods: child numbers, child quality, and a general commodity called "other satisfactions" (Willis, 1973; De Tray, 1973).⁹ In general, complementarity is ruled out by the restrictive nature of the assumptions typically employed in the new home economics; while this limitation has not been serious to date, it is worth pointing out that it may become more so in future research involving several dimensions of child quality, for example, health and physical development and intellectual achievement. In a dynamic context, such potential complementarities are of even greater significance since, for example, there is some evidence that early under-investment in nutritional capital may substantially affect the productivity of later investments in intellectual human capital. (Berg, 1973, pp. 9-12)

The third element in the new home economics is a set of assumptions about the way in which household resources, principally time, can be transformed into market-purchasable commodities to be used in the

household production process. Strictly speaking, I suppose one could consider this set of assumptions as part of the general technology of household production and subsumed under the second element of the theory. It is, however, better to treat the matter separately since most what is involved concerns the terms upon which household members can enter the labor market, the wages they can earn, and, somewhat secondarily, the prices at which market commodities can be purchased. It is here that the lack of dynamic character of the new home economics cuts most deeply into its potential implications for the central problems of fertility and female labor force participation. The timing and spacing of children, the opportunities for part-time work and accumulation of lifetime labor market experience, and choices as to the amount of educational investment to be made early in the life cycle, all depend heavily on the terms under which women can participate in the labor market and thus share in the transformation of the household's time resources into market commodities. The human capital literature (Ben-Porath, 1967; Mincer, 1970 and 1972) is, of course, replete with dynamic analyses of investment in human capital over time and the life-cycle effects of these investments on earnings. But little of this work has been integrated into the more general framework of the "new home economics," particularly as this theory bears on decisions concerning the numbers of children and their timing and spacing within a marriage and the relation of these decisions to the accumulation of other forms of assets. The work of Heckman (1971), Ghez and Becker (1972), and unpublished work of Frank Stafford does, however, represent a notable beginning of the extension of this part of theory into more dynamically relevant realms. Yet we need to understand far more than we presently do about why the labor market functions so differently for men than for women, the role of institutional constraints, discrimination, and the relation of these to women's choices of occupation and timing of labor force participation.¹⁰

The fourth and final element in the new home economics is the resource constraints facing the household in its production and optimization decisions. Traditionally, these constraints are divided into time (husband's and wife's, although often the husband is assumed to devote full time to the market) and "other" non wage income. While it is universally recognized that some elements of household production and consumption, sleep and food, for example, are in fact inputs into the production of time resources, little attention has thus far been paid to the quality of the time resources themselves and the other family resources—both genetic and material—passed from one generation to the next.¹¹ The resource constraints facing the

household once formed, are thus a product of the desire of each generation to bequeath human and material capital to the succeeding generation. Not only are the resource constraints not independent of the process of household formation, but, in many societies children are used productively before leaving the household into which they are born, so that the resource constraints are not independent of fertility decisions either. The budget constraint of the household conceals beneath the serene and mathematically differentiable exterior the central problem of the continuity of society itself (see Knight, 1921, pp. 374-75).

Many special additional assumptions must be added to the framework to arrive at empirically refutable propositions. Moreover, the nature of the required additional specifications is intimately related to the peculiarities of the particular bodies of data to which the new home economics has been applied. These data range all the way from aggregate time series data covering long periods of time, to cross-sectional census data for both large and small geographic regions at a point in time and over time, to household and family data based on individual interviews with and without collection of retrospective information.

Perhaps the most important results of empirical research for the development which follows in the next section are that young children are highly intensive of the mother's time in comparison with other activities within the home and older children are less intensive, and that for institutional or biological reasons the comparative advantage of the male partner in the acquisition of market-purchasable commodities significantly exceeds that of the female partner. A number of interesting implications of a theory based on these facts are tolerably well supported by additional empirical evidence so far analyzed, and lend some credence to the theory of economic growth and population change developed here. Setting aside the inadequacy of the observed market wage to measure a nonworking woman's cost of time, the immediate implication of the theory is that a rise in the cost of a mother's time for the family will cause a substitution away from time-intensive goods such as children and towards those requiring more inputs of market-purchasable commodities. Indeed, if we further assume momentariness that males are completely specialized in market activities, changes in their wages represent pure income effects for the family, and we do then observe for families with working mothers positive association of family size with income and negative association with female wage rates. To the extent that education serves as a proxy for the relative costs of time which may measure some of these costs less imperfectly, or at least in a fashion different from market wages, similar differences are observed between the effects of male

and female educational attainments (Mincer 1963; Nerlove and Schultz 1970; Willis 1973; DeFray 1973; Ben-Porath, 1973).¹²

Married women as a group also tend to withdraw from the labor force when they have children, which is an application of the new home economics on the assumption that children are more female-time intensive than other commodities produced within the home; but the rates at which women with different educational attainments withdraw is not the same. During the child-rearing years, more highly educated women reallocate more hours to household production than do women with lesser education. Ben-Porath's (1973) finding of a U-shaped relation between education and labor-force participation for Israeli women with young children is strongly suggestive of differences in the effects of education at different levels on the relative efficiencies of home and market production as well as of the interactions between female education and child quality.

At this point one must be very careful to distinguish *net* time intensitivity from *gross* time intensitivity. It is clear that many activities such as watching television or attending a symphony concert are highly time-intensive; yet the time spent in the activity itself may be a source of considerable pleasure (a point well brought out by R. Pollak and M. Wachter in an unpublished paper). Thus, some activities which involve a large gross expenditure of time may not, in fact, be high time-cost activities because of the consumption component involved.

Very little is now known about the relation between a mother's input of time and child quality, as measured by later educational and economic attainment. It seems clear that such investments are also highly time intensive; however, one may argue along the lines suggested above that the *net* time intensitivity of investments in quality in early childhood are less than that of investments in numbers of children because of the consumption component inherent in such investments. This aspect is also closely related to investments, both social and within the household, which reduce child mortality. Indeed, there is reason to believe that such investments will occur *first* in order of time as time becomes more costly, but before it reaches the very high cost levels prevalent in modern industrial societies.

Clearly, a high probability of child mortality affects the costs of achieving a given family size, i.e., the number of children surviving to a given age. If it is assumed that on the whole parents achieve a greater (discounted) sum of satisfactions the longer a child survives, and if declines in mortality result in greater relative increases in the conditional probabilities of survival from earlier ages to successively older ages, the

clines in mortality should tend, according to the new home economics, to generate a greater demand for children; but this need not lead to an increase in births, however, since such declines in mortality lower the cost of child quality relative to the cost of numbers of children. Of course, the net effect must depend on the technology of the production of child numbers and child quality as well as on the relative importance of these in the utility function. These factors may vary substantially from time to time, culture to culture, and place to place. The elucidation of such effects, however, must surely constitute one of the central challenges to the empirical application of the new home economics. To explore such effects fully, however, requires that the household decision-making process be integrated into a model of economic growth and development.

The Value of Time, Economic Growth, and Household Responses¹⁹

What will be the cumulative effects of family investments in child quality over time? How will the increasing capacity of human beings interact with increases in the stock of physical capital and stock of knowledge of the economy as a whole despite increasing scarcity of nonrenewable natural resources? I argue here that continuing investment in human beings must eventually increase the value of a unit of human time. (An exception is investment which increases the productive length of life or decreases the number of working days lost to illness.) The increasing value of human time, in turn, alters the relative costs of family activities and the resource constraints faced by families in successive generations. In a series of speculations and conjectures, which do not constitute a formal model, I suggest here that these changes will progressively lead to improvements in health and nutrition which reduce infant and child mortality, to fewer children, and to increasing investments in child quality. Eventually, the increasing value of human time may be expected to lead to a substitution away from both numbers and quality of children and use of time in less intensive ways, or ways which yield a greater personal consumption component. The projection which emerges is thus quite opposite to the gloomy forecasts of Malthus and his followers. For societies in which a high bequest motive exists, and in which the terms on which investment in human capital remain relatively favorable over time, we should expect to find eventually, population growing only very slowly or not at all. It is even possible that population may decline absolutely for a time, although highly unlikely that a declining population would persist for any substantial period. This is not to say that the cumulative process here described characterizes all societies. The model is much colored

by the experience of Europe, North America and Japan over the past 150 or 200 years. Where bequest motives are weak or nonexistent, and where people live on a margin of subsistence so slender as not to permit much investment in the health and nutrition of children, the process may never begin. Exogenous improvements in health, leading to declines in infant and child mortality, will then simply have the effect of causing population to grow more rapidly.

In his classic paper on "Diminishing Returns from Investment," Knight (1914) pointed out that: "if new investment can be freely directed to all uses, i.e., embodied in all types of productive agents indifferently, it will not be subject to diminishing returns" (p. 37). Moreover, he stressed, as did Marshall before him, the concept of capital in human beings. Although investment "freely directed" might not be subject to diminishing returns, certainly, under static circumstances, continued investment in any one particular direction ought eventually to result in a declining rate of return. Yet, as T. W. Schultz (1973) has emphasized, the rate of return appears to have diminished little, if at all, in response to a high level of and even accelerated pace of investment in human capital, and, indeed, it may have actually risen (Schultz, 1971, p. 173).

We do not, of course, have a really accurate measure of the extent of investment in human capital as compared with investment in nonhuman capital and in the stock of knowledge through investment in research and development. Yet there are a number of clues which suggest that the capital stock invested in human beings, even on a per capita basis, has been a steadily growing portion of the total capital stock. Schultz (1961, p. 73) suggests a rise of the value of the stock of educational human capital embodied in the stock of labor of persons age 14 and older, from 18% in 1900 of the total stock of educational and physical capital to 30% in 1957. These estimates do not include on-the-job training or investments in better health and nutrition. In terms of gross capital formation, Kuznets (1966, p. 243) calculates, on the basis of Schultz's earlier work, a rise in the share of investments in formal education alone from "about 9% in 1930 to over 38% in the 1950s." Moreover, for Western countries as a whole, Kuznets (1971) calculates the share of labor has risen from 55 to 75 percent of national income over the same period. These facts, meager as they may be, suggest two significant questions which are germane to the issue with which this paper began, namely, how can the new home economics be integrated into a general theory of economic growth and development in a manner which has some hope at least, of bearing on the grand question of the demographic transition?

First, what accounts for the apparent failure of the

rate of return to such investments in human capital, even counting education investments, to fall despite a high and accelerating rate of investment in this form of capital relative to other forms? We might argue that there has been a persistent disequilibrium among these rates of return, at least in the first half of the twentieth century. It is not necessary for the theory proposed here that such a disequilibrium exist, and, indeed, more recent evidence suggests that that rate of return to investment in educational human capital may have fallen in the past ten years. Nonetheless, as long as investment in human capital which increases the stock per capita occurs, we may ask a second question. What effect will the increasing stock of human capital per capita have on the allocation of resources within the household, and what repercussions will it have on the rate of growth of population and labor force?¹¹

Razin (1969, 1972) shows how, under certain circumstances, the ratio of human to total capital per capita will increase along the optimal growth path of an economy experiencing technical progress. As indicated earlier, T. W. Schultz has emphasized this aspect of the persistent failure of rates of return to investments in human capital to decline. The demand for skills and knowledge embodied in human capital does not decline because of additional investments in the stock of useful knowledge and technique (technological change) which require the continual adaptation and adjustment of the human agent to utilize efficiently this augmented stock and seek out the new sources of investment opportunities which maintain the growth process. But even in the absence of a persistent disequilibrium created by the demand for human capital, it is possible that the rates of return to such investments would fail to fall over time, or fall only slowly, in relation to the rates of return to other forms of investment because of endogenously changing relative costs of investment, that is, changes on the supply side.

One of the most important consequences of the growing "quality" of human beings, as reflected in the increased stock of human capital per capita, as pointed out by T. W. Schultz (1973), is the increasing value of human time per unit of such time. Many of the consequences of the increasing value of time over time are amusingly explored by Lindler (1970) in his penetrating study of *The Harrison Leisure Class*. Yet Lindler and Schultz fail to note the important link which may exist between the increasing value of human time, due presumably to investment in human capital as well as to investment in other forms of capital and in technological change, and the terms on which investment in human capital takes place. If one assumes, as I think plausible, that children (with respect both to quality and quantity) are net time-intensive as compared with other goods produced within the home, it follows that

unless the increasing investment of human capital increases the marginal productivity of a unit of time in the care and rearing of children within the home in an off-setting fashion, increases in the value of time will lead to a shift away from children to less net time-intensive activities. To be sure, such a substitution effect may be offset by a strong income effect, but there are still further grounds to suppose that both substitution and income effects will tend to lead to an increase in child quality rather than child numbers.¹²

Increases in child quality may take the form of better nutrition and health care or the intellectual form of education, acquisition of skills and of attitudes conducive to acquisition of education and skills. To the extent that better nutrition and health increase the life span of a child, particularly the span of years over which he can be economically active, such an increase in quality will raise the return to investments in human capital which a child may later wish to make in himself. To the extent that better health and nutrition result in a reduction in child mortality, they increase the satisfactions accruing to parents from other forms of investment which also raise child quality, for the returns to these investments may then be expected to be enjoyed over a longer period of time on average. Increases in longevity, particularly those which increase the years over which an individual can be economically productive, increase the amount of human time available without necessarily increasing fertility, although, of course, they do increase population. Such an increase in time available would tend by itself to lower the value of time per unit, but, as we know, most of the effects of better health care and nutrition occur in childhood and enhance the quality of a unit of time in later years more than increasing the number of children. On net balance, therefore, I would conjecture that better health and nutrition lower the costs of further investments in human capital relative to those in other forms of capital and increase the returns therefrom. Thus such investments should tend to occur first as economic development proceeds.

The second main form which an increase in child quality may take is through investment in him in the form of education, skills, or attitudes conducive to later acquisition of further education or skills. Much investment in human capital of this type tends to be time-intensive in the preschool years, although the productivity of a unit of a mother's time, as remarked, may be especially enhanced by a greater stock of human capital embodied in her, so it is not necessarily true that over time, as the result of the increasing value of human time, substitution will tend to occur away from this form of investment. Nonetheless, it is in this area that we might expect some induced "technological innovations" which could economize on a

mother's scarce time. Nursery schools, day-care centers, and the proliferation of "educational" toys are perhaps examples. On the whole then, I think we may conclude that increases in quality of children relative to their numbers, take the form of investments in human capital which ultimately have the effect of raising the value of *their* time per unit in their economically active years.

Irrespective of the motivation, however, the increasing value of human time must have an effect on the form in which each generation bequeaths a growing stock of capital to the next. As long as rates of return on investments in human capital remain above, or fall more slowly than, the rates of return to investments in other forms of capital, parents will be induced to bequeath a greater part in the form of human capital. Thus, the tendency towards increasing quality of children will be intensified by the bequest motive, despite the opposite tendency, resulting from the increasing cost of time, to invest in bequests which are less time-intensive. But as rates of return tend to equality over time, parents should tend to bequeath less in the form of human capital and more in the form of financial and physical capital. Nonetheless, as long as investment in human capital occurs, the value of a unit of human time will continue to rise with increases in the stock of capital per capita, reinforcing the tendency to fewer children of higher quality. Substitution will occur in favor of fewer children of ever higher quality and perhaps eventually against both quality and quantity of children in favor of commodities and knowledge. The "facts" cited at the beginning of this section, suggesting an increasing portion of total capital formation in this century in the United States has occurred in the form of human capital, however, indicate that we may be far from the point at which such substitution begins to take place against children, quality and quantity combined.

The outlines of a new theory of the relation between household and economy begin to emerge, albeit dimly, from the foregoing conjectures and speculations. In this model, the value of human time and changes in that value over time are pivotal, and the limitations imposed by natural resources may be mitigated, if not eliminated, by technological progress and increases in the stock of knowledge and of capital, both human and nonhuman. The main link between household and economy is the value of human time; the increased value of human time results in fewer children per household, each child embodying greater investments in human capital which, in turn, results in lower mortality and greater productivity in their economically active years. Greater productivity in turn further raises both the value of a unit of time and income in the subsequent generation and enables members of the

generation to make efficient use of new knowledge and new physical capital. Eventually, rates of return to investments in physical capital, new knowledge, and human capital may become equal, but as long as investment occurs which increases the amount of human capital per individual, the value of a unit of human time must continue to increase. It is not possible to say whether the diminishing ability of a human being to absorb such investment would eventually stabilize the number of children per household and at what level, given the satisfaction parents obtain from numbers of children as well as their quality, and from the act of investing in that quality. Nonetheless, this theory does predict over time, in rough qualitative fashion, declining rates of population growth (perhaps eventually zero rates or even negative rates for a time) and declining rates of infant mortality. These are the main features of the so-called demographic transition.

FOOTNOTES

1. The concept of "human capital" in economics is not new. Adam Smith (1776 reprinted 1937, Book I, Chapter 10, pp. 101-102) explicitly recognizes the importance of investments in skills, training and education for the explanation of relative wages. Marshall (1920, Book IV, Chapter I, pp. 188-189) clearly considers man and his abilities, as created by investment in them, as central to production of material goods, knowledge, and organization. The importance of investment in human capital for understanding economic growth was early recognized by Finberg (1942), Knight (1944), and Spengler (1950), but credit for widespread appreciation must be given to F. W. Schultz who summarized his own earlier work and the research of others which he had stimulated in his 1960 Presidential Address to the American Economic Association (Schultz, 1961). In his 1971 book, *Investment in Human Capital*, Schultz collects and amplifies many of his papers on this subject. Becker (1946) works out many of the theoretical and empirical implications of the concept of human capital for investment in education and on-the-job training, but does not explicitly consider the implications of the concept for the way in which the economy may evolve over time.

2. For a more extensive, more critical, and somewhat more technical discussion, the reader is referred to Nerlove (1974, section 2).

3. In this context, "static" may be taken to mean "timeless," in the sense that all decisions are viewed as taking place at a point in time with full knowledge of all future consequences. Such an analysis is clearly unrealistic, but it is a usual first step in economic analysis of most any problem. What matters is not the lack of realism of the assumptions, but how far they can get us in understanding the problems at hand.

4. Moreover, in many societies the time of the children of the family is also productive, so that decisions as to their numbers may shift the resource constraint to the family. Thus, one may encounter here an interdependence between what economists call preferences and what they call opportunities. Such interdependencies are extremely hard to cope with from a theoretical point of view.

5. This, indeed, is the point made forcefully by Muth (1968) and recently emphasized by Becker and Michael (1973). Some years ago, Leontief (1947) pointed out that the theory of consumer behavior as then developed, although of great generality, lacked content to the extent that it gave no clue on the types of relations to be expected among different categories of goods. *Strotz* (1957, 1959) and *Gorman* (1969) attempted to give more empirical content to the theory of consumer demand by giving it more "structure." An important aspect of the household production model, including time and market-purchasable goods, as introduced by *Becker* (1965), *Lancaster* (1966), and *Muth* (1968) is precisely, as *Muth* points out, that it does yield a utility function of the type *Strotz* suggested (*Muth*, 1968, p. 709). While it is true, in a sense, that many conclusions of the "new home economics" could be derived directly from the *Strotzian* formulation and other specializing assumptions, the home-production aspect of the household production model lends an intuitive insight and empirical content which is lacking in the more abstract formulation. It suggests a more direct look at the technology of processes within the household and particularly how they use time and non-purchased inputs in addition to market-purchasable commodities. Indeed, the supposed differences in the time-intensivity of the production of household goods give much of the content to recent applications of the "new home economics" to the problems of fertility and human capital formation.

6. He writes:

"Where the family is concerned the phenomenon of altruism inevitably raises its head: if we can speak at all of the indifference curves of any one member, we must admit that his tastes and marginal rates of contribution are contaminated by the goods that other members consume. These . . . external consumption effects are the essence of family life. . . . Such problems of home economics are, abstractly conceived, exactly of the same logical character as the general problem of government and social welfare." (p. 9)

" . . . if within the family there can be assumed to take place an optimal reallocation of income so as to keep each member's dollar expenditure of equal ethical worth, then there can be derived for the whole family a set of well-behaved indifference contours relating the totals of what it consumes: the family can be said to act as if it maximizes such a group preference function." (p. 21)

The problem with the *Samuelsonian* fiasco, however, is that it assumes a fixed family membership and a great deal of what the utility function of the new home economics is designed to explain is how that family composition gets determined. This requires much more than *Samuelson* allows for in his formulation. When, for example, are children members of the family, and thus co-determiners of the utility function, and when are they just arguments in the utility function determined for the family not including them? The full internalization argued by *F. W. Schultz* (1972) seems a necessary addition to the argument. Yet for this to be true, what might be called the "John Donne Effect" must be extremely powerful. Casual observation suggests that each individual's concern for other diminishes with distance in both time and space. Yet it may be true under certain restrictive assumptions, as pointed out to me by *Assaf Razin*, that what might be called pair-wise intergenerational internalization, by which I mean full internalization of the utilities of the next succeeding generation by the immediately pre-

ceding generation, would lead to essentially the same type of problem as that encountered in the discussions of optimal growth with an infinite horizon. Further discussion of this complex matter would, however, take us beyond the scope of this paper.

7. There is a profound problem in, on the one hand, internalizing all the family members' satisfactions in one utility function and, at the same time, using this same utility function to determine the number and "quality" of the family members themselves. Essentially the problem results from the condensation of a sequential, dynamic set of decisions into a theory of choice based on the maximization of a single static, timeless utility function. In its most extreme form, the issue of the conceptual adequacy of the approach arises in connection with the application of the new home economics to household formation itself, what in an earlier, less abstract and nonconformist era might have been described as "marriage." Yet marriage, in some sense, remains very much associated with procreation and the act of marriage, or at least of household formation, is the normal first step in the central process of choice with which the new home economics deals. Where then is the utility function? Can the entire process really be broken into two distinct and separable parts, what the econometrician would call a recursive system? If a fundamental purpose of marriage itself is the procreation of one's legitimate children, given a society's definition of both marriage and legitimacy, clearly the process cannot be regarded as recursive. (See *Becker*, 1973) Again, the static character of the analysis, while not necessarily limiting its usefulness in an empirical sense, introduces a conceptual difficulty of a high order.

8. "What is at issue is clearly an intertemporal distribution problem: that of balancing the consumption levels of successive generations, and of successive stages in the life-cycle of a given cohort of contemporaries. The most pertinent decisions—individual, corporate, or governmental—are those that determine investment in physical capital, in human capital, and in research and development. Investments in physical capital, if well made, augment future consumption through an increase in future capital-labor ratios. Investment in human capital raises the quality of labor and, one hopes, of life. Successful research and development augment future capital and labor inputs through the development of better techniques of production." (*Koopmans*, 1967, p. 96)

9. See *Nerlove* (1973) for an extended critique of simplistic household technology usually assumed in the new home economics and the restrictive effects of these assumptions on the nature and form of the conclusions which may be drawn.

10. See *Kreps* (1971) for a careful, detailed, and complete account of our current state of knowledge in this crucial area.

11. For an excellent survey of recent work on the transmission of material wealth see *Brittain* (1973). Despite the availability of a substantial amount of statistical evidence, there has been surprisingly little research on this important topic. Needless to say, data on transmission of non-material wealth by investments in human capital through better nutrition and health, education, and the creation of attitudes and skills, is almost non-existent. Some evidence, however, is presented in *Arcleen Leibowitz's* study of *Terman's* 1921 sample of California school children (1974), which bears importantly on the manner in which much human capital is passed from one generation to another, especially to a

child of pre-school age. The sample is very unrepresentative, but it is instructive, for the investments of mother's time in her child and the quality of those investments as measured by her education, are found to affect appreciably later measures of the child's ability and future earning capacity.

12. The interpretation of many of these results is somewhat complicated by the effects of marriage on the association of the educational attainments of spouses.

13. This section parallels section 3 of Nerlove (1974).

14. I do not deal here with the problem of the fixity of supply of exhaustible natural resources, but assume that technical progress is fully offsetting.

15. See Becker and Lewis (1978).

REFERENCES

- Baumol, William J. *Economic Dynamics: An Introduction*. 3rd ed. (New York: Macmillan Company, 1976).
- Becker, G. S. *Human Capital, A Theoretical and Empirical Analysis with Special Reference to Education*. (New York: National Bureau of Economic Research, 1964).
- . "A Theory of the Allocation of Time," *Economic Journal*, 75: 493-517 (September, 1965).
- . "A Theory of Marriage: Part I," *Journal of Political Economy*, 81: 813-846 (July/August, 1973).
- Becker, G. S., and H. G. Lewis. "On the Interaction between the Quantity and Quality of Children," *Journal of Political Economy*, 81 (Part II): S279-S288 (March/April, 1973).
- Ben-Porath, Y. "Economic Analysis of Fertility in Israel: Point and Counterpoint," *Journal of Political Economy*, 81 (Part II): S202-S233 (March/April, 1973).
- Berg, Alan. *The Nutrition Factor: Its Role in National Development*. (Washington: The Brookings Institution, 1973.)
- Brittain, J. A. "Research on the Transmission of Material Wealth," *American Economic Review*, 63: 335-345 (May, 1973).
- Cain, Glen G. *Married Women in the Labor Force: An Economic Analysis*. (Chicago: University of Chicago Press, 1966).
- DeFray, Dennis N. "Child Quality and the Demand for Children," *Journal of Political Economy*, 81 (Part II): S79-S95 (March/April, 1973).
- Ghez, G. R., and G. S. Becker. *The Allocation of Time and Goods Over the Life Cycle*. Report No. 7217, Center for Mathematical Studies in Business and Economics, University of Chicago (April, 1972).
- Gorman, W. M. "Separability and Aggregation," *Econometrica*, 27: 460-81 (1959).
- Gronau, R. "The Effect of Children on the Housewife's Value of Time," *Journal of Political Economy*, 81 (Part II): S168-S199 (March/April, 1973).
- Hall, R. E. "Commuter," *Journal of Political Economy*, 81 (Part II): S200-01 (March/April, 1973).
- Heckman, J. J. *Three Essays on the Supply of Labor and the Demand for Goods*. Ph.D. dissertation, Princeton University (May, 1971).
- Hicks, J. R. *Value and Capital*. (Oxford: Clarendon Press, 1939).
- Knight, Frank H. *Risk, Uncertainty and Profit*. (Boston: Houghton-Mifflin, 1921).
- . *The Economic Organization*. (New York: Harper and Row, 1965). Originally published by the College of the University of Chicago, 1933.
- Knight, Frank H. "Diminishing Returns from Investment," *Journal of Political Economy*, 52: 26-47 (1944).
- Koopmans, Tjalling C. "Intertemporal Distribution and Optimal Aggregate Economic Growth," in W. Fellner, et al., *Ten Economic Studies in the Tradition of Irving Fisher*. (New York: John Wiley, 1967) pp. 95-126.
- Kreps, Juanita. *Sex in the Market Place: American Women at Work*. (Baltimore: The Johns Hopkins Press, 1971).
- Kuznets, Simon. *Modern Economic Growth: Rate, Structure, and Spread*. (New Haven: Yale University Press, 1966).
- . *Economic Growth of Nations*. (Cambridge: Harvard University Press, 1971).
- Lancaster, Kelvin J. "A New Approach to Consumer Theory," *Journal of Political Economy*, 74: 132-57. (April, 1966).
- Leibowitz, Arleen S. "Women's Allocation of Time to Market and Nonmarket Activities: Differences by Education." Ph.D. dissertation, Columbia University (1972).
- . "Home Investments in Children," *Journal of Political Economy*, 82 (March/April, 1974).
- Leontief, W. W. "Introduction to a Theory of the Internal Structure of Functional Relationships," *Econometrica*, 15: 361-373 (1947).
- Linder, Stefan B. *The Harried Leisure Class*. (New York: Columbia University Press, 1970).
- Malthus, T. R. *An Essay on the Principle of Population and a Summary View of the Principle of Population*. Edited with an introduction by Anthony Flew. (Baltimore: Penguin Books, Inc., 1970). First published in 1798 and 1830.
- Michael, R. T. and G. S. Becker. "On the New Theory of Consumer Behavior." Unpublished mimeo. (December, 1972).
- Mincer, J. "Market Prices, Opportunity Costs, and Income Effects," *Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld*. Edited by Carl Christ, et al., (Stanford: Stanford University Press, 1963).
- . "The Distribution of Labor Incomes: A Survey with Special Reference to the Human Capital Approach," *Journal of Economic Literature*, 8: 1-26. (March, 1970).
- . "Schooling, Experience, and Earnings." Mimeographed. (New York: National Bureau of Economic Research, 1972).
- Mitchell, Wesley C. "The Backward Art of Spending Money," *American Economic Review*, 2: 269-81 (1912).
- Muth, Richard F. "Household Production and Consumer Demand Functions," *Econometrica*, 34: 699-708 (July, 1966).
- Nerlove, Marc. "Lags in Economic Behavior," *Econometrica*, 40: 221-252 (March, 1972).
- . "Tuition and the Costs of Higher Education: Prolegomena to a Conceptual Framework," *Journal of Political Economy*, 80 (Part II): S178-218 (May/June Supplement, 1972).
- . "Household and Economy: Toward a New Theory of Population and Economic Growth," *Journal of Political Economy*, 82 (March/April, 1974).
- Nerlove, Marc and T. P. Schultz. *Love and Life between the Centuries: A Model of Family Decision Making in Puerto Rico, 1950-1960*. RAND Corporation, RM-6322-AID (September, 1970).
- O'Hara, Donald J. *Changes in Mortality Levels and Family Decisions Regarding Children*. RAND Corporation, R-914-RF (February, 1972).