FUNDING THEORIES FOR SOCIAL INSURANCE

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VOLUME LV, PAGE 303

DISCUSSION BY PAUL E. SINGER

In restating for our benefit Henry Aaron's theorem "The Social Insurance Paradox" and in extending the same type of analysis to conditions contrary to those assumed by Aaron, James Hickman has given us in "Funding Theories for Social Insurance" a deliberately simplified and limited analysis of alternative social insurance funding systems. He has been careful to draw no conclusions not justified by his analysis and he has attempted to attribute no more validity to his assumptions than they deserve. He has, in fact, warned us very effectively against the careless acceptance of conclusions based on his own or anyone else's assumptions.

The modest goals of his paper and the simple model he employs deserve credit for their modesty and simplicity. Simple as it is, his model of a social insurance system is entirely adequate for the demonstration he has undertaken; it is, in fact, an advance over Aaron's in having introduced a survival function which, while it does not affect the conclusions of the present paper, would have significance in any quantitative determination of tax rates. There should be no objection to his assumption that some of the parameters are constant, nor to his assumption that all workers enter the labor force at the same age and retire at the same age. Reasonable variations from these assumptions would not affect the conclusions he has reached, and to this extent the model is adequate for its intended purposes.

The first part of "Funding Theories for Social Insurance" is merely a modified restatement of Aaron's paper, designed to pave the way for the alternative analysis of the second part. Naturally, it reaches the same conclusion Aaron does, one which Hickman points out would be intuitively obvious to all of us. It is evident, almost without demonstration, that if, in Robert Myers' words, "the combination of the rate of growth of population and the rate of increase in earnings will continuously and forever exceed the rate of interest," then a pay-as-you-go social insurance system can be operated successfully on the principle of a chain letter.

Hickman goes on to explore the alternative assumption and to consider the implications of differing rates of time preference and of transformation of present into future goods. It is these considerations which lead to his Table 1, in which all the possible order relationships among three key rates are listed, together with their implications for the relative values of three different social insurance approaches: pay-as-you-go, completely funded, and none at all. The conclusions expressed in Table 1 are really only three rather than six; in each instance the choice of a social insurance approach is dictated by the rate which dominates the other two in size. Thus, for example, Inequality (1) supports a pay-as-you-go system, not because, as Hickman says, "the marginal time preference rate is less than the marginal rate of transformation between present and future goods," but simply because the rate of increase in aggregate real wages is greater than either of them; the same is true for Inequality (6). In Inequalities (2) and (3) the rate of transformation dominates and a funded system is preferred. In Inequalities (4) and (5) time preference rate dominates and social insurance is rejected.

Each of these pairs provides some occasion for thought. The assumption underlying Inequalities (1) and (6) has been rejected both by Hickman and by Myers in his review of Aaron's paper for the *Transactions of the Society of Actuaries.* If the only justification for a pay-as-you-go social insurance system were the hope of operating it forever as an infinitely proliferating chain letter, the pay-as-you-go approach would have to be abandoned. Even if total population were stable rather than increasing, the size of the labor force could be decreasing as the result of later ages of entry, earlier ages of retirement, or changing patterns of mortality. Even with a growth rate of zero for the labor force, it is unlikely that the rate of increase in real wages alone could support the system; with a negative growth rate, the situation would be impossible.

Inequalities (2) and (3) seem to represent a "good investment" approach; they are dominated by a high rate of transformation of present into future goods and they invite the investment of taxes in a fully funded social insurance system. At first blush, the problems of productively managing the assets of such a system provide some cause for concern. Even in its present immature state, this country's Social Security system would have to administer huge reserve funds; its now unfunded liabilities already are of the order of magnitude of the national debt and are increasing rapidly. In a wider perspective, however, this problem may not be so formidable as

it seems; the monies which would be in reserve under a fully funded system would have been drawn from an economy whose assets are already predominantly at work, and their deployment merely would be subject to different administrative controls than at present.

In honor of the anti-hero of one of Aesop's fables, Inequalities (4) and (5) might be said to represent the "grasshopper" approach. The assumptions underlying this evaluation of social insurance in terms of individual time preference rates deserve some close scrutiny, because the results obtained — consistent though they may be with "conventional actuarial wisdom" — may seem to many readers to be in conflict with their intuitive folk wisdom. If there is indeed a contradiction here, its source may be in the attribution to time preference of certain mathematical characteristics which it does not really possess.

In the first part of his paper Hickman, Like Aaron, assumes that the marginal rate of time preference is equal to the interest rate, and he finds it convenient to represent both by the familiar symbol δ for the force of interest. The mathematical properties of the force of interest are well-known. It combines cheerfully with other algebraic quantities, according to all the laws of exponents, in a perfectly regular fashion. Its negative is called the force of discount; the process of discounting is the algebraic inverse of the process of accumulation at interest. Everything works equally well in either direction along the time scale. If two sets of payments can be shown to be equivalent at any point in time, their equivalence is guaranteed at every other point, past or future — and inequalities are just as persistent. In the second part of the paper, Hickman considers the possibility that time preference may assume other values, and he permits it to retain the symbol δ, which is not needed for its usual purpose since interest rate is not being considered. He also attributes to it all the algebraic properties usually associated with δ when it represents the force of interest, and he takes advantage of these to construct Table 1. The mathematical attributes of δ, the marginal rate of time preference, apparently acquired by prior association with δ, the force of interest, enable him to make an evaluation *at retirement age* of both the taxes paid during working life and the benefits expected during retirement.

The utilization of the time preference rate in this fashion seems to be at odds with our usual understanding of its nature, whether we consider its origins in economic theory or our observations of the world about us. In the classical theory of interest its role is comparatively limited. It represents

an instantaneous individual attitude at a moment of decision: specifically, it quantifies the choice made between a present and a future good. It operates in one direction only — prospectively — and with a fairly limited time-horizon. Its value is influenced by the choices which are available. It is not by any means a constant for any individual; in fact, even at a single point in time it varies continuously along any one of the "indifference curves" which represent all the combinations of present and future goods that the individual would consider equally acceptable. Its only tendency toward any general value is found in its statistical contribution, through the processes of supply and demand, to the determination of the market interest rate. Human behavior suggests other ways in which time preference is very unlike the force of interest. Hickman's comment on "the economic behavior of many young people" suggests one: time preference appears to be a function of attained age. Even over fairly short time-spans, few humans consider their time preferences of the past binding on them in the present; we all reserve the right to change our minds, and we all hope to find a way to "eat our cake and still have it." The grasshopper's time preferences changed significantly from summer to winter! It also appears that time preference interacts in some way with an economic utility function: the preferences we display in the investment of surplus funds differ markedly from our attitudes toward the necessities of life.

If the marginal rate of time preference is to be employed in the actuarial evaluation of social insurance proposals, it would appear that serious thought must be given to the mathematical attributes of time preference. Some of the possibilities which suggest themselves for investigation are these:

1. Time preference rate may not be constant; it may be a function of age.
2. It may be unidirectional: while it may reflect the basis of decisions for the future, it probably is not valid for re-evaluation of the past.
3. It may vary with time-span in some complex fashion. If the amount A one year from now is worth Ae^{-d} now, it may not follow that A ten years from now is worth Ae^{-10d} now.
4. Time preference and economic utility may be inter-related.

In short, the marginal rate of time preference may require a mathematical model strikingly different from that which represents the force of interest.

The significance of these comments for Hickman's Table 1 is evident. If time preference can be manipulated mathematically just as the force of interest can be, then the Table presents the correct conclusions for each of its sets of assumptions. If not, then all the conclusions are suspect until a proper mathematical model for time preference can be developed. There are indications in both economic theory and folk wisdom that the conclusions are in fact not valid. A single counterexample might be found by investigating this question: Do some of the young persons who invest in insured pension plans display in their current discretionary activities time preference rates which are higher than the guaranteed interest rates of the plans?

One significant refinement of Hickman's model could be the introduction of an economic utility function, even if nothing else were changed. The assumption that every dollar has equal value may not be appropriate in this context. The dollars paid for social insurance taxes, if they are skimmed off the top of an adequate gross wage, may have a marginal value much less than that of the dollars received for essential retirement income; the difference could well affect the conclusions.

None of these comments detracts in any way from the fact that Mr. Hickman has presented a clear and cogent analysis of the problems he set out to treat, within the framework of his assumptions. He has at least answered all the questions he raised. This review obviously has not done as much; there is a tendency for reviewers to dwell on shortcomings which they have neither the inclination nor the skill to remedy. They must also, unfortunately, take note of technical flaws, and Mr. Hickman's paper is marred by a few. In the definitions the term "rate" is used ambiguously; not until the force of interest has been introduced and the first equation written does the reader learn what kind of rates h and g are. The ages a and r are defined as "average" but they are used as absolute uniform values; so is "average annual wage rate." Some of the notation, while not incorrect, tends to distract the reader. The time variable t serves in the first equation to identify all persons living at time t; then throughout the rest of the paper it identifies persons entering the labor force at time t. The function $W(t)$ and the constant $W(0)$ are defined in such a way that $W(0)$ is not, as one might expect, the value of $W(t)$ when $t=0$. This might have been avoided; neither $W(t)$ nor the corresponding function $R(t)$ is used in the subsequent development at all. Finally, the comment that g could serve either as a rate of increase in entrants to the work force or as a rate of increase

in the survival function, with the same effect on population, could not hold good for very long without implying probabilities of survival greater than unity.

DISCUSSION BY ROBERT J. MYERS

The paper "Funding Theories for Social Insurance" presented by Mr. Hickman contains an excellent mathematical proof of some theories of insurance financing. Although I have some minor points dealing with his notation and explanation of concepts,[1] his proofs are mathematically rigorous. The same can not be said of the paper by Henry Aaron that is cited by Mr. Hickman.

The proof deals with the readily evident idea that, if income to a pension system is assumed to increase perpetually at a rate faster than interest accumulates, then it is possible to operate that system perpetually at a pay-as-you-go premium rate that is lower than the corresponding entry-age-normal premium rate. This is similar to the old perpetual motion tricks, such as the Ponzi game, that we frequently encounter and that are generally dependent on the power of increasing input into the system. We all know of the many high-risk insurance firms which, due to their low premiums, were dependent on constantly increasing underwriting volume and with which mounting claims finally caught up.

Mr. Hickman is admirably cautious about avoiding the conveyance of the wrong idea that the mathematical concept involved is a panacea to social security financing. I would have preferred that he had delved more on the impracticability of the idea, but of course, each author must be allowed to maintain his own sense of proportions.

The proposition that is presented is highly theoretical and of little practical value. It is entirely based on the assumption that income to a retirement system will perpetually increase (due to both population and average-wage increases) at a rate that is higher than the interest rate. I believe that it is possible to observe in practice, for short periods of time, this

[1] For example, he defines $W(t)$ in terms of $W(0)$, but the latter is not the former, when valued at $t = 0$, as is customary in mathematical notation. Also, the values h and g are defined as annual rates, and δ is also defined as an annual rate (force of interest); as used in the derivations, all three conform to the actuarial concept of "force."