SOME NEGLECTED DETERMINANTS OF WELFARE FUNCTIONS *

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The welfare concept is central to economics and to some topical problems, requiring interdisciplinary research. Psychology, biology and pedagogics may be important contributors. Economists have overemphasized economic, and among these consumption, aspects. A learning process to reduce unhealthy consumption remains topical. On the production side the diversity of labor types has been neglected. Here a central problem is job choice by maximizing welfare. Variables needed are capabilities required by jobs and personality traits. We ignore the number of independent characteristics. Path analysis with inherited and learnable traits may be extended by data on grandparents and on non-cognitive capabilities. A more precise production function of education is badly lacking. Two methods of measuring welfare functions and the shape of the latter are discussed.

Introduction

Economics as a science cannot do without some elements originating in psychology, since the satisfaction of human needs is one of its central issues. This was emphasized by the introduction of the subjective base of value almost simultaneously by Jevons, Menger and Walras more than a century ago (*cf.* Samuelson 1947: 90ff.). Even more explicitly and almost a century ago this relationship was brought out by Edgeworth (1881) whose treatise on (mathematical) economics carries the title Mathematical Psychics.

The century that separates us from Edgeworth's standard work has been characterized by two, almost opposite, tendencies in scientific development. On the one hand we have experienced a widespread specialization. Most, if not all, sciences have been split up into parts

(such as astrophysics, economics of public finance, *etc.*) which were each developed in more depth. On the other hand, and as a conse-quence of the first tendency, the need for interdisciplinary research has increasingly been felt. With some time lag more interdisciplinary work —common already to all practical work—has been organized by scientific institutions as well. In the present article we will extensively profit from one interdisciplinary analysis of welfare (Baerends *et al.* 1978).

The concept of welfare is one of the key concepts used by economic science; in De Groot's opinion (Baerends *et al.* 1978: 53) the problem to enhance welfare—and hence what welfare stands for—is the funda-mental problem of our times. A welfare function indicates how anyone's welfare depends on its determinants. Mathematically this statement implies that what we are after, in economics and other disciplines, is to know a list of variables entering into the welfare function and the shape of the mathematical function expressing some welfare indicator in terms of the values of these variables.

The psychology applied by the economist—we may call it economic psychology, as this journal's name does—for quite some time was rather primitive. It is natural that the picture an outsider has of whatever science lags behind the actual state of that science: it takes some time for the picture to reach the outsider. As we shall see later, this also applies to the picture of economics held by outsiders. Also the methods used by—at least some—psychologists were unknown to—most—economists. As an econometrician I did not know that econo-metric model building (started in 1936) has so much in common with what psychologists call path analysis (started some twenty years earlier).

The primitive character of economic psychology, as understood for a long time, made it desirable to start multidisciplinary research on the welfare concept. The initiative of the Foundation for Interdisciplinary Research of the Behavioral Sciences (Stichting voor Interdisciplinair Gedragswetenschappelijk Onderzoek) to organize a seminar on March 24, 1977 at Apeldoorn, The Netherlands, deserves to be applauded: its report, already quoted (Baerends *et al.* 1978) proved to be a source of inspiration to this author. The interdisciplinary character of that sym-posium reflects itself in the list of disciplines represented: mathematical philosophy, ethology, ecology, social psychology, technology of energy production, cardiology, philosophy, psychological theory of behavior, social psychiatry, psychobiology, methodology, psychology, humanist

psychology, cultural anthropology, family sociology, biology, international law, polemology. forensist psychiatry, child psychiatry, child medical science, comparative and physiological psychology, pharmacology, sociology, business psychology. This list is taken from the presentation of the attending personalities, with apologies to the reader for the random order of disciplines Clearly and correctly psychologists of different specializations participated; apparently no economist attended. To this author it was strik'ng that in particular the ecologists' contributions appeared to be helpful in formulating this article's subject matter. Part of the explanation may be that their subject implies the behavior of animals of different levels of evolution and hence presumably induces them to use models of different levels of sophistication. In addition, the models presented by Professor Baerends have a double similarity to economic problems models: they show similarities with the economics of individual behavior but also similarities with the economics of social systems, for instance organizational hierarchies.

The welfare concept

In modern economics (*cf.* Samuelson 1947) the concept of welfare, whether applied to individuals, households, or a nation's economy, is much broader than, say, a century or even half a century, ago. It is sometimes used as synonymous to "happiness", even if the oldest terminology "utility" is maintained. This implies that at least it is defined more broadly than well-being, which has a materialist connotation. It is an illustration of the lag between economists' and outsiders' use of a concept, that at the symposium mentioned, this more restricted definition of well-being was assumed to be the economist's present concept. The broadest interpretation, that of "happiness", contains elements such as friendship, religion or love, which are sometimes excluded since they cannot be a subject of socio-economic policies. Even then, economic science tends to overemphasize the economic determinants of welfare.

This may be illustrated with the aid of figures collected in the spring of 1973 by Levy and Guttman (1975) among 1,940 inhabitants, 20 years of age and over, of the four largest cities of Israel. With the aid of the four determinants showing the highest single correlation coefficient with the respondents' "happiness". 59 percent of the variance in happi-

ness could be "explained". None of these determinants were economic in character; they were indicated as good family life, good health. satisfied with leisure and satisfied with life in town. Using as determinants the three with an economic character (sufficient income, satisfied with education, and good labor relations at work) the percentage of variance we could explain was only 18. Other applications of the same material confirmed that socioeconomic determinants, even if broadly interpreted, can only affect happiness in a limited way.

Levy and Guttman's findings have some relevance to the explanation of today's cultural crisis, by which we mean the state of mind of those who increasingly feel alienated from social life and show this by increasing use of violence, by vandalism, up to addiction to drugs. The contribution to the variance in welfare of a good family life and of satisfaction with the way leisure is used is no less than 25 and 16 percent respectively. If we add the satisfaction derived from the life in town (8 percent) close to one-half of total variance is connected—for the positive as well as the negative values of these determinants, it should be understood—with these determinants; a convincing piece of evidence that certainly not only good economic policies are what we need.

Some similar conclusions can be drawn from a second enquiry, conducted in the summer of 1973, and reported on in the same article.

Apart from being too closely connected with economic determinants, the welfare or utility concept as studied and applied by economists is also often too static: the fact of life is overlooked that a positive change over time of the determinants may make people relatively happy even if the absolute level of these determinants is low in comparison to the situation elsewhere. Even the prospect that their children will be better off than they are themselves may lift people's welfare. This dynamic aspect is, of course, the base for development policies and is, to that extent. accepted by development economists. But it should be recognized that often sociologists have shown a better understanding for the forces at work here than the economic profession as a whole. The issue is connected with the well-known thesis that a revolutionary situation is more likely to emerge by a reduction of relatively high welfare levels than by a very low absolute level of welfare.

Consumption orientation of welfare functions

Restricting ourselves—more or less in accordance with the present economists' attitude—to static, economically oriented welfare functions, another shortcoming of that attitude will now be discussed. Welfare or utility functions have been studied more with the purpose of understanding economic man's consumption behavior than production behavior. Productive behavior covers not only the supply of (immediately) productive labor and—as far as an object of personal possession—land and capital. It also implies the participation in the preparation of (later) productive contributions. Most text books of economics hardly use the welfare function as a source of productive behavior, whereas considerable attention is given to the welfare function as a source of consumer behavior. Demand functions for individual consumer goods and groups of such goods receive treatment, as shown by Henry Schulz (1938), P.A. Samuelson (1947) or E. Schneider (1948). The same rather one-sided application of the welfare function to problems of the demand for consumer goods is reflected in econometric research, as is exemplified by R. Stone's (1967 and many other publications) impressive contribution to such research. Correspondingly, also the availability of statistical information on consumer behavior is abundant. Typical for this abundance are household expenditure statistics which already have a long history (*cf.* for The Netherlands, W.H. van der Goot 1930); in the United States an even larger volume of information on consumer behavior, extended to include consumer expectations, is currently being made available.

Even though the subject of consumer attitudes—including such concepts as planned and anticipated consumption alongside actual consumption and the related use of the concepts of *ex-ante* alongside *ex-post* values of it—has been explored with great care, present circumstances require advancement in new directions. With the spectacular development of consumption on the one hand and the new scarcities (clean environment, energy) on the other hand, the divergence between the satisfaction of "natural" or "reasonable" needs as distinct from actual behavior has become a key problem, also because a large number of human beings is being exposed to extreme shortages of essential consumer goods. Increasingly, the consumption of unhealthy goods (from old enemies such as alcoholic beverages and tobacco products to new ones known as soft and hard drugs) and the unhealthy quantities

consumed of goods considered healthy (meat, sugar) requires further research. Advertizing (absorbing, in the USA, levels of 3 percent of GNP) and the Jones are among the villains of the piece, but what is more fundamentally needed is what learning processes can be discovered and which of these can be stimulated by feed-back in the individual and in society to reduce the divergency between healthy and grossly unhealthy behavior. It is here that the interdisciplinary research mentioned in the introductory paragraphs of this essay may find one of its applications. A simple and self-evident example is the input that medical experts can make; but various types of psychologists will have to add their contributions, if only because any learning process will rightly attract their interest. Since we are coming back to this subject in a broader context, we may refer to the next few sections for some elaboration.

Production orientation of welfare functions: the supply of capabilities

We are now entering one of the underdeveloped uses of welfare functions: how do human beings behave as potential participants in the production process? In economic science it is customary to think of the production process as the combined use of land, equipment or capital goods, and labor, called the three production factors. The combination may be said to be undertaken by the "organizers of production", often called entrepreneurs. The supply of land and of capital goods may or may not originate from private individuals, depending on the social order. These two factors are not necessarily connected with the individuals: they can be owned by them but are not part of them. This is why we will concentrate on the supply of labor, which anyway contains a number of psychological aspects. It is correct, we think, to say that this side of the welfare function has long been neglected by economic science. A simple illustration is the fact that for a long time, in economic production theory, labor was treated as one homogeneous factor (cf. Schneider 1948: 430ff.). In the last few decades a relatively small group of economists has joined those who had chosen job classification as a practical activity. Job classification is used to streamline the wage and salary structure as well as to facilitate the matching of demand and supply of services on the highly diversified labor market. In fact, it is better to speak of the many compartments of the latter, or of the complex of labor markets.

Each individual joining the labor market is characterized by a number of degrees to which a list of relevant capabilities is in her or his possession. In a direct sense this may be a BA or MA degree in chemistry. but the concept of degree is meant also to include an estimated level, often expressed in figures on a scale, of such capabilities as physical strength, finger dexterity or general or social intelligence. By the latter term the capability to deal with people is meant, important for jobs in which contact with other people is numerous or intense. General intelligence may be measured by an IQ test. Most scales are the result of negotiations between representatives of labor and management, assisted by experts on job classification.

Each person, during her or his lifetime, goes through a process of learning which, from a certain moment on, is combined with working and, as a rule, holding a succession of jobs, whose classification indicates the degree required to perform properly in that job. A simplified picture of the process of production, closer to what it was in the past than what it is at present, is that each person involved first goes through a process of schooling and then fills a job for the rest of her or his life until retirement. The main choice at stake is, in that picture, the choice of the job, implying an effort to obtain the degrees required of the relevant capabilities plus the effort to perform in that job. These efforts give rise to positive or negative satisfaction, and are combined with the satisfaction derived from the consumption the income attached to the job permits. Examples of the development of this branch of economic science in the last few decades include work by Bowles and Nelson (1974), Corocan et al. (1976), De Wolff and van Slijpe (1972), Garfinkel and Haveman (1975), Hartog (1978), Taubman (1975) and Wise (1975)—this list is not aiming at completeness—who all introduced variables indicative of some types of capabilities.

A thorough treatment of the choice of a job would have to include the use of a welfare function in which job satisfaction or dissatisfaction is reflected. In this approach the choice is based on an attempt to maximize welfare subject to a number of restrictions. This aspect of the approach is rearely dealt with explicitly, as is customary for consumption-oriented behavior. From both the economist's and the psychologist's point of view, the ideal would be to express welfare as a function of income, representing the consumption possibilities, personality traits, reflecting the person's tastes and job characteristics, expressing the impact of these characteristics on job satisfaction or dissatisfaction. A

concrete theoretical example has been elaborated by this author some decades ago (Tinbergen 1956) but attempts to check it econometrically were only undertaken after 1970. The essence of the 1956 setup was the assumption that welfare or utility depends on the effort required by one's job and on what was called the "tension" between the required and the actually available degree or intensity of the various capabilities, and that both a positive and a negative deviation between the two would reduce welfare. So far, the somewhat crude attempts to check this assumption have not been successful (Tinbergen 1975; Bouma et al. 1976).

A central question regarding the use of personality traits and job characteristics is the number of them that can be considered mutually independent. An interesting attempt made by Hartog (1978) concerning the number of mutually independent job characteristics, using factor analysis, seemed to suggest that that number might be rather modest— of the order of three only. This conclusion was considered provisional only and the issue deserves further research.

Another central question, to be elaborated on below, concerns the variability of personality traits: which of these are unchangeable and which can be changed by some learning process. We will indicate the (practically) predetermined traits as parameters: these are entities constant for a given individual, but different among individuals. In contradistinction, other arguments entering into the welfare function are variables. This is true in particular for the job, although within limits.

The number of arguments entering into the welfare function constitutes, on the basis of the proceding remarks, an as yet undecided issue. As an approximation we may simplify matters by some convenient mathematical combination—for instance, a linear expression in some variables considered relevant. An important example is the use of only one argument to be called income corrected for a number of inconveniences so as to keep utility equal. Thus, income may be corrected for the size of the household, or for heavy physical work. It may also be corrected upward for interesting or challenging work, such as scientific research or managerial work. Figures given by Burck (1976), showing that chief executives' incomes in real terms did not change between 1952 and 1976, whereas the average income in the USA rose by 3 percent, may be interpreted to disclose that this group was overpaid in 1952 and probably enjoys a positive psychical income (cf. J Tinbergen 1980).

The learning process and the role of genetical factors

As stated, the strict separation of learning and working had increasingly been replaced by processes where, from around the age of fifteen, working and learning are combined or alternate. Moreover, formal learning is preceded by informal learning from birth 'or the entire life time, human beings are involved in learning processes and it is here that interdisciplinary research is particularly important. The work done by psychologists and geneticists, in cooperation with education experts (Jencks (1972); Fägerlind (1975); Dronkers (1979); to mention a few only) may be taken as a starting point. The main problem dealt with is the estimation of the influences exerted by some genetic and some environmental determinants on occupation and income. The material used, originates from enquiries sometimes made for their own sake and sometimes made for other purposes but useful for the problem at stake. Examples are tests taken from a school population all of the same age (as, for instance, in Malmö, Sweden), or tests taken from conscripts (*cf.* Husén 1974 and later). The method used is known as path analysis, in which each "endogenous" variable is supposed to be determined directly by causal connections with a number of "endogenous" and "exogenous" variables. Here endogenous means unknown, and exogenous given, in the context of the problem set considered. As already observed, there is much similarity between models as used, for instance, in econometrics, and path analysis. The latter always works with "normalized" variables (*i.e.* variables with mean equal to zero and standard deviation equal to unity), which is not customary in econometric models, although perfectly possible and sometimes helpful. In econometric models the time lags between variables are specified which is not always done in path analysis.

The main problem dealt with by psychologists, geneticists and education experts does not necessarily contain the same variables in all its versions; often the availability of data limits their number. The variables standing for inherited determinants refer to the parents and may include their education, occupation or income; these data may refer to the father or to the mother, or to both. They are taken as data. Among the endogenous variables early cognitive ability, if known from enquiries, or cognitive ability at a later date (*e.g.* 20 years of age), or both, may appear. Schooling (or "educational level attained"), occupation (sometimes for both initial and later jobs), and income (or earnings

only) are, in most cases, included.

Clearly much remains to be desired. Thus it would be desirable to include more information concerning inherited determinants. To begin with, data on grandparents are desirable since some genetical endowments of the parents would be a highly useful variable. Alongside cognitive abilities, non-cognitive abilities of all concerned should also be included (*cf.* Behrman *et al.* 1980). Further, the educational process is represented rather poorly if only the number of years of schooling is considered (*cf.* De Wolff and van Slijpe 1972). The last mentioned authors give different weights to years of different phases of education. In a few cases more data on the quality of education have been studied (*cf.* Morgenstern 1973).

In a general way, and using economic terminology, we must confess that the "production function of (formal) education" is a badly neglected subject, especially if we compare its treatment with that of production functions for material production. And even in the latter, realm engineers have often been much more sophisticated than economists (*cf.* Boon 1964 and after). Of the sometimes decisive inputs into the formal education process (quality of teachers, type of school, curriculum, *etc.*), the impact on the output (split up into types of school leavers) is a question for speculation rather than empirical research. An example of the lack of accurate information is the debate on the desirability or undesirability of the comprehensive school (German: Gesamtschule; Dutch: middenschool). Clearly the definition of the data needed already constitutes a problem and, subsequently, the collection of (sufficiently representative) data. For socioeconomic policy more insight into the "degree of learnability" of some personality traits, such as leadership, is extremely important. If more people with managerial capabilities could be supplied through, say, business schools, their relative incomes may be put under pressure. If the relevant capabilities cannot be learned—that is, are "genetically predetermined"—these relative incomes cannot be easily reduced (*cf.* Tinbergen 1979). Intuitive opinions vary as much here as about the genetical differences (or nonexistence of differences) between races (*cf.* Husén 1974). So do preferences with regard to the comprehensive school, even if the production function were exactly known.

One very general question may be raised here where interdisciplinary research might be very fruitful. Biologists tell us that the simple contrast "nature or nurture" (genetically predetermined or learnable) is

suggesting too simplest an approach. There are more types of behavior between the extremes. How can educational psychologists and economists profit from this biological sophistication (*cf.* Baerends *et al.* 1978)? One of the aspects of the problems just discussed can also be formulated in a seemingly simple way: are there, and if so, limits to learnability (*cf.* De Groot, in Baerends *et al.* 1978: 55)? Among the limits suggested by some is a time limit or a generation limit: for certain degrees of capabilities a minimum time of ten years or of two generations may exist.

Measurement of welfare

If welfare is a central issue of economic science or even (De Groot, in Baerends *et al.* 1978: 53) of our times, the question of its measurability remains vital. Natural scientists are anxious to keep open the possibility of measurement (Groen, p. 48 and De Groot, p. 61 in Baerends *et al.* 1978) and groups of philosophers hold that measurement is impossible "in principle". Economic science has oscillated between these two attitudes. At present the majority of the economics profession is still following Pareto's rejection of the measurability of welfare. An active minority has made, in recent times, attempts at measurement, however. As customary, two approaches have been followed. Van Praag (1968, 1978 and in a number of publications between these dates) sent out questionnaires to some 2500 members of Consumers' Unions in Belgium and The Netherlands and plans to collect this type of information in other countries. Apart from information about age, occupation, schooling and family size he asks the interviewees to indicate the incomes with which they would feel "very well off", "well off", *etc.* down to "very badly off". The verbally indicated scale shows eight levels, and hence nine intervals. It appears that, if numbered by a rising arithmetical scale, the welfare function of income shows practically the same form for all respondents, the cumulated log-normal curve, characterized by two parameters. Van Praag *c.s.* use these functions as welfare functions: one of the parameters appears to be a rather precisely determined function of family size and other objectively determinable parameters (*cf.* Bouma *et al.* 1976). The advantage of this method apparently consists of the possibility in a political debate, the respondent may be quoted to have "declared voluntarily that some

income different from what they now have would be satisfactory or would constitute a rise by 10 percent of their previous welfare level". A well-known disadvantage of the method—extensively dealt with by the authors in a number of studies, including Van Praag (1978)—is that people do not always react to a change in their situation the way they have told the interviewer. They have not forecast correctly their own behavior or evaluation of their new situation: in our case a new income. Their welfare evaluation is subject to what is called a "preference drift".

The other approach to measure welfare is not based on what people think they will do, but what they are actually doing; hence on observation of their behavior. This method has been followed by this author and set out elsewhere (Tinbergen 1975: ch. 4). Work done so far is in its infancy still, and of restricted value for lack of the relevant data. One drawback of this method is that it needs at least one additional assumption—a compensation for avoiding the disadvantage of the first method. For further details of the attempts made along the lines sketched, the reader may be referred to Tinbergen (1980).

A last point to be mentioned is the question which mathematical form should be preferred in the approach followed by Van Praag, and generally if only one composite argument is chosen (for instance, income corrected for a number of inconveniences). This author is strongly in favor of choosing the logarithm of (corrected) income, one reason being that this function shows a decline in marginal utility with an increase in income. The function preferred by Van Praag c.s. shows an increasing marginal utility for very low incomes, which diverges from what most economists (and psychologists?) would require. Interestingly enough, Van Praag's results give an equally good fit to both functions.

References

Baerends, G.P. et al., 1978. Over welzijn [On welfare]. Deventer: Van Loghum Slaterus.

Behrman, J.R. et al., 1980. Socioeconomic success. Amsterdam: North-Holland.

Boon, G.K., 1964. Economic choice of human and physical factors in production. Amsterdam: North-Holland.

Bouma, N. et al, 1976. Testing and applying a theory of utility. European Economic Review 8, 181-191.

Bowes, S. and V.I. Nelson, 1974. The "inheritance of IQ" and the intergenerational reproduction of economic inequality. Review of Economics and Statistics 56, 39-51.

Burck, C.G., 1976. A group profile of the Fortune 500 Chief Executives. Fortune, May, 173 ff.

Corocan, A., C. Jencks and M. Olneck, 1976. The effects of family background on earnings. American Economic Review 66 (Proceedings), 430–435.

De Wolff, P. and A.R.D. van Slijpe, 1972. The relation between income, intelligence, education and social background. Institute of Actuarial Science and Econometrics, University of Amsterdam.

Dronkers, J. and U. de Jong, 1979. Jencks and Fägerlind in a Dutch way, Social Science Information 18(4/5). London: Sage, pp. 761–781.

Edgeworth, F.Y., 1881. Mathematical psychics. London.

Fägerlind, I., 1975. Formal education and adults earnings. Stockholm: Almqvist and Wiksell.

Garfinkel, J. and R.H. Haveman, 1975. Economic inequality and the utilization of earnings capacity. Madison, WI: Academic Press.

Hartog, J., 1978. Personal income distribution: a multicapability theory. The Hague: Drukkerij J.H. Pasmans.

Husén, T., 1974. Talent, equality and meritocracy. The Hague: Martinus Nijhoff.

Jencks, C. et al., 1972. Inequality. New York: Basic Books.

Levy, S. and L. Gutman, 1975. On the multivariate structure of wellbeing. Social Indicators Research 2, 361–388.

Morgenstern, R.D., 1973. Direct and indirect effects on earnings of schooling and socio-economic background. The Review of Economics and Statistics 55, 225–233.

Samuelson, P.A., 1947. Foundations of economic analysis. Cambridge, MA: Harvard University Press.

Schneider, E., 1948. Einführung in die Wirtschaftstheorie, II. Teil. Tübingen: J.C.B. Mohr (13th ed. 1972: Paul Siebeck).

Schultz, H., 1938. The theory and measurement of demand. Chicago, Il: The University of Chicago Press.

Stone, R., 1967. Spending and saving in relation to income and wealth. Cambridge: University of Cambridge Department of Applied Economics. Reprint Series no. 265.

Taubman, P., 1975. Sources of inequality in earnings. Amsterdam: North-Holland.

Tinbergen, J., 1956. On the theory of income distribution. Weltwirtschaftliches Archiv 77, 155–175. Reprinted in: Selected Papers. Amsterdam: North-Holland. pp. 243–263 (1959).

Tinbergen, J., 1975. Income distribution. Amsterdam: North-Holland.

Tinbergen, J., 1979. 'Hoogte en beïnvloedbaarheid van inkomens van "managers"'. In: W.M. van den Goorbergh et al. (eds), Over macht en wet in het economisch gebeuren. Leiden: H.E. Stenfert Kroese B.V. pp. 7–25.

Tinbergen, J., 1980. Two approaches to quantify the concept of equitable income distribution. Kyklos 33, 3–15.

Van der Goot, W.H., 1930. De besteding van het inkomen. The Hague: Martinus Nijhoff.

Van Praag, B.S.M., 1968. Individual welfare functions and consumer behaviour. Amsterdam: North-Holland.

Van Praag, B.S.M., 1978. 'The perception of income inequality'. In: W. Krelle and A.F. Shorrocks (eds.), Personal income distribution. Amsterdam: North-Holland. pp. 113–136.

Wise, D.A., 1975. Academic achievement and job performance. American Economic Review 65, 350–366.