

A CASE FOR HAPPINESS, CARDINALISM, AND INTERPERSONAL COMPARABILITY

Yew-Kwang Ng

Modern economists are strongly biased in favour of preference (in contrast to happiness), ordinalism, and against interpersonal comparison. I wish to argue for the opposite. The proposed change in perspective has important conceptual and policy significance, as also evidenced in the papers by Frank and Oswald in this issue that I strongly endorse.

I. ECONOMISTS' PREFERENCE FOR PREFERENCE AND ORDINALISM

Neoclassical economists used more subjective terms like satisfaction, marginal utility, and even happiness, pleasure, and pain. After the indifference-curve or ordinalism revolution in the 1930s, modern economists are very adverse to the more subjective concepts and very hostile to cardinal utility and interpersonal comparisons of utility. They prefer to use the more objective concepts like preference and choice. In a very important sense, these changes represent an important methodological advance, making economic analysis based on more objective grounds. However, the change or correction has been carried to an excess, making economics unable to tackle many important problems, divorced from fundamental concepts, and even misleading. In my view, while we should prefer using just the more objective concepts when they are sufficient, we should not shy from the more subjective concepts and even their interpersonal comparison when they are needed.

Similar changes happened in psychology. Classical psychologists spoke of mind, consciousness, and used introspection in their analysis. Then came the Watson–Skinner behaviourist revolution which prohibits the analysis of anything subjective: only actual behaviours are the proper subject matter of psychology. This achieved a huge advance in making psychology more scientific but also some felt it had ‘gone out of its mind...and lost all consciousness’ (Chomsky, 1959, p. 229). The reaction against the excesses of behaviourism resulted in the cognitive revolution which has been many decades old and has made much headway. It is time economists make a reassessment of their position, if not staging a subjectivist counter-revolution.

II. WHY IS HAPPINESS MORE IMPORTANT?

Happiness is more important than the more objective concepts of choice, preference and income (especially if narrowly interpreted and eschewing cardinal utility and interpersonal comparison, as is the usual practice in modern economics) for at least two reasons. First, happiness is the ultimate objective of most, if not all people. (See Veenhoven (1984) and Ng (1996*a*),

pp. 13–4 for empirical evidence.) We want money (or anything else) only as a means to increase our happiness. If having more money does not substantially increase our happiness, then money is not very important, but happiness is.

Secondly, for economically advanced countries (the number of which is increasing) there is evidence suggesting that, for the whole society and in the long run (in real purchasing power terms) money does not buy happiness, or at least not much (Easterlin, 1974; Veenhoven, 1984; Argyle and Martin, 1991, p. 80; Oswald, 1997). The reasons are not difficult to see. Once the basic necessities and comforts of life are adequate, further consumption can actually make us worse off due to problems like excessive fat and cholesterol and stress. Our ways to increase happiness further then take on the largely competitive forms like attempting to keep up with or surpass the Joneses. From a social viewpoint, such competition is a pure waste (Frank, 1997). On top of this, production and consumption to sustain the competition continue to impose substantial environmental costs, making economic growth quite possibly happiness-decreasing (Ng and Wang, 1993). To avoid this sad outcome, a case can be made for *increasing* public expenditures (contrary to the currently popular view against public expenditures among economists) to safeguard the environment and to engage in research and development that will increase welfare (Ng, 1995*a*). This is especially so since relative-income effects makes the traditional estimate of optimal public expenditure sub-optimal (Ng, 1987). As the schoolmates of one's child all receive expensive birthday gifts, one feels the need to give as expensive gifts. Thus, the perceived importance of private expenditures is inflated relative to that for public spending.

There is a particular line of research that will lead to quantum leaps in our happiness which is yet largely disregarded. This is the stimulation of the pleasure centres in our brain. This was discovered nearly half a century ago by Olds and Milner (1954). Electrical, chemical, and magnetic stimulation of certain parts of our brain induces intense pleasure and obliterates emotional and physical pain without diminishing marginal utility, as the stimulation bypasses the peripheral nervous system. The genetic device to prevent excessive (from the viewpoint of survival) activities programmed our peripheral nervous system to ensure diminishing marginal utility. Since no animal was clever enough to stimulate its own brain directly without passing through the peripheral nervous system, evolution found it unnecessary to impose diminishing marginal utility on the pleasure centres themselves. Since we have time and resources in excess of simply ensuring survival, we may engage in welfare (i.e. happiness) maximisation. (This differs from the evolutionary process which maximises survival and propagation; see Ng (1995*b*) which raises and attempts to provide a partial answer to three basic questions in welfare biology.) The possibility of intense pleasure without diminishing marginal utility opens up a tremendous avenue for increasing our welfare by a quantum leap. (The only potentially more welfare-improving method is genetic engineering in the far future when it could be used safely to enhance our capacity for happiness.) Why is there no substantial research to ensure its feasibility for widespread application? (See Ng (1996*b*) for a case in favour of

the widespread use of brain stimulation after sufficient research and certain safeguards.)

Some economists may argue that my point about the importance of happiness is valid only against the narrow concepts of income but not against the wider concepts of choice and preference. It is true that 'preference' could and should take account of such relevant factors as pollution and relative income. However, there are still a number of reasons making economists miss the important factors. First, individual choices are directly effective in affecting variables under her direct control. She can choose to work harder and consume more private goods but cannot on her own choose to have less pollution with less consumption for every person. Economists observe that people still engage in the rat race for earning more money despite affluence and incorrectly infer the importance of higher income to be greater than it really is. Secondly, people do not have perfect foresight and are typically myopic. For example, most people believe that a big windfall will spectacularly increase their happiness (witness the amount of money spent in buying lotteries) and that being crippled in an accident is worse than being killed. However, there is evidence that lottery winners are no happier than non-winner controls, and quadriplegics are only slightly less happy than healthy people (Brickman *et al.* 1978). After an initial period of adjustment, maimed victims can still enjoy life and are glad that they were not killed. Also, people typically underestimate the negative/positive effects of current enjoyment/suffering on future ability for enjoyment. (See Headley and Wearing, 1991.)

It is true that some economists have emphasised the importance of relative-income effects, environmental protection, public goods, etc. However, the majority has not taken into account the implications of these factors in their analysis. For example, after an otherwise competent cost-benefit analysis, Portney (1990) concludes that 'Congress and the President are about to shake hands on a landmark piece of environmental law [The Clean Air Act] for which costs may exceed benefits by a considerable margin. Why is this so?' (p. 179). The analysis of costs and benefits was based on ignoring the existence of relative-income effects, the full consideration of which may change the cost-benefit ratio rather dramatically (Ng and Wang, 1993). Moreover, by eschewing cardinal utility and interpersonal comparison, economists ensured that they cannot solve the paradox of social choice. (See Mueller 1989, ch. 19.)

III. CARDINAL UTILITY

Most modern economists use utility as only an indicator of choice or (ordinal) preference in the sense that the utility of a situation is larger than that of another if and only if the first situation is preferred to the second. In this sense, utility is only ordinal. Any positive monotonic transformation of a preference-representing utility function is also a suitable function. Moreover, for the positive theory of demand, this is sufficient. Different cardinal-utility numberings of the same set of indifference curves will give the same demand functions. Occam's razor requires shaving off the unnecessary assumption of cardinal utility. I have no argument against all these positions. However, many

economists go from here to deny the use of cardinal utility even where it is essential or at least helpful, such as in social choice, optimal population, choices involving risk, and choices affecting the probability of survival. (On the usefulness of cardinal utility for the last item, see Ng (1992*a*) which shows that the dollar value of life may *increase* spectacularly with age.) This is like insisting that I have to shave off my moustache on the ground that it is unnecessary for eating, while I want to keep it to increase my sex appeal.


Selected almost at random, the following is representative of the modern textbook hostility against utility measurability and comparability. ‘There is no way that you or I can measure the amount of utility that a consumer might be able to obtain from a particular good...there can be no accurate scientific assessment of the utility that someone might receive by consuming a frozen dinner or a movie relative to the utility that another person might receive from that same good... Today no one really believes that we can actually measure utils’ (Miller, 1994, pp. 418, 419). There is at least one counter-example to this confident assertion – the present writer.

Another textbook example (a non-textbook example is Kolm, 1993) on the hostility against cardinal utility is Varian: ‘But how do we tell if a person likes one bundle twice as much as another? How could you even tell if *you* like one bundle twice as much as another? One could propose various definitions for this kind of assignment: I like one bundle twice as much as another if I am willing to run twice as far to get it, or to wait twice as long, or to gamble for it at twice the odds... Although each of them is a possible interpretation of what it means to want one thing twice as much as another, none of them appears to be an especially compelling interpretation’ (Varian, 1993, pp. 57–8).

There is in fact an interpretation of cardinal utility that is especially compelling. This is whatever the individual concerned values ultimately. If we abstract away effects on other individuals and sentient, what I ultimately value is my net happiness (i.e. enjoyment minus suffering, including the sensuous as well as the spiritual). On the ground of evolutionary biology, daily experience, and interviews, I have reasons to believe that I am not an exception here but rather quite representative. Since, for myself, it is ultimately net happiness that I want, it has an especially compelling interpretation (for cardinal utility).


I want money but not for its own sake, only to obtain, ultimately, happiness. Thus, I have diminishing marginal happiness of money. For big variations, my willingness to pay twice as much does not indicate twice as much happiness or utility. (The two are the same if we abstract away ignorance, concern for others, and irrational preference. This is so with my definition of irrational preference as preferring something that decreases one’s own happiness or welfare, neither due to ignorance nor to a concern for the welfare of others.) Utility here is taken as representing preference which can be cardinal. (See Ng (1979), Section 1.3 for details.) However, as I want happiness for its own sake, if bundle *A* (or anything else) gives me twice as much happiness as bundle *B*, it is perfectly sensible, natural, and informative to say that I prefer (recalling the abstraction of ignorance, etc.) bundle *A* twice as much as bundle *B*.

Even if we re-introduce factors other than personal happiness in the preference function, I have no difficulty (except for imperfect information to be discussed presently) in comparing the intensities of my preference for different pairs of alternatives. Thus, if I take account of the income or welfare levels of others, there is no problem in allowing for that. For the simple case where both my and the (only) other person's welfare are functions of the log of own income, my preference or utility function could be the log of my income plus alpha times the log of the other person's income, where alpha is a positive number slightly larger than zero. I could also allow for alpha itself to be a function of the income or welfare level of others. (The rationality of doing that may however be queried.) It is true that I often have difficulties knowing the intensity of my preference for an alternative over another. This is due to the lack of information (or lack of perfect memory for past events) as to what my own and other people's welfare values will be under different alternatives. Given this lack of information, I even have difficulties knowing whether I prefer *A* to *B* or *vice versa*. Thus, not only the intensities of preference or cardinal utility are made unclear but the ordinal preference or ranking itself is also made unclear. If you put two close enough quantities of water into two containers of different shape, I may have difficulties judging which container has more water. But that does not mean that the volume of water is not a cardinally measurable quantity!

 I have also no difficulties saying that my welfare level is positive, zero, or negative. When I am neither enjoying nor suffering, my welfare is zero. Thus, the value of my welfare is a fully cardinal quantity unique up to a proportionate transformation. I am also sure that I am not bestowed by God or evolution to have this special ability of perceiving the full cardinality (both intensity and the origin) of both my welfare and preference levels. In fact, from my daily experience, observation, and conversation, I know that all people (including ordinalist economists) have this ability, except that economists heavily brain-washed by ordinalism deny it despite actually possessing it. This denial is quite incredible. If your preference is really purely ordinal, you can only say that you prefer your present situation (*A*) to that plus an ant bite (*B*) and also prefer the latter to being bodily thrown into a pool of sulphuric acid (*C*). You cannot say that your preference of *A* over *B* is less than your preference of *B* over *C*. Can you really believe that!

IV. THE MEASUREMENT AND INTERPERSONAL COMPARISON OF UTILITY AND HAPPINESS

The majority of economists are not that heavily brain-washed. They believe that cardinal utility is not meaningless. In fact, in his path-breaking model of optimal income taxation, Mirrlees (1971), a Nobel laureate (and his followers), use not only interpersonally comparable cardinal utility, but also a utilitarian social welfare function. However, most economists still doubt the possibility of the measurement of cardinal utility and believe in the meaninglessness or normative nature of interpersonal comparison of utility.

 While some economists accept the use of the Neumann–Morgenstern

expected utility hypothesis as a valid way of measuring individual cardinal utilities (but cardinal only in a limited sense, as any linear transformation of a utility function is still allowed), others (e.g. Arrow 1951/63, p. 10; Baumol 1977, p. 431) query its relevance to the subjective utility of the Neoclassical economists and its relevance to social welfare considerations. Using a set of axioms no stronger than that used in the expected utility hypothesis plus the recognition that individuals are not infinitely sensitive (more on this below), I show that the utility function derived by the Neumann–Morgenstern method is in fact a Neoclassical subjective utility function (Ng, 1984*a*). Hahn (1982, p. 195) and Samuelson (1947, p. 228n) declare their failure to see why social choice (e.g. with respect to income distribution) should depend on individual risk aversion (with respect to income), as will be the case if the N–M utility indices are used. This dependence is straightforward once my (1984*a*) result is recognised. The degree of risk aversion reveals the degree at which subjective marginal utility of income diminishes. Since social welfare is a function of individual subjective utilities, how rapidly marginal utilities diminish has obviously important effects on social choices that affect individual income levels.

The belief in the non-comparability of utility has a long tradition from the time of Wicksteed and Robbins when they declared that every mind is totally inscrutable to any other mind and that interpersonal comparisons of utility are pure value judgements without any objective basis (see Robbins, 1932). However, the judgement that individual *I* will be made better off than individual *J* will be made worse off by the choice of alternative *A* over *B* does not imply that *A* ought to be chosen socially. This is true only with the additional normative judgement that social choice should be guided by the maximisation of aggregate welfare. If the normative judgement is for the minimisation of aggregate welfare (or the maximisation of the minimum utility level), the implication is reversed (or may be reversed depending on relative utility levels). Thus, interpersonal comparisons of utility are at most subjective judgements of fact, not value judgements. (See Ng (1972) for details and for the point that economists are more qualified in making those subjective judgements of fact closely related to their field of study.)

I have also argued (Ng, 1992*b*) that the belief in the impossibility of interpersonal comparisons of utility is based on the existence of a soul in each person's mind. (However, the existence of souls is not sufficient to ensure non-comparability.) The compelling evidence for the Darwinian theory of evolution, the split-brain experiments and other developments in neurology and psychiatry strongly suggest a materialist (biological/neural) basis of mind, making interpersonal comparison of utility possible at least in principle, if not yet accurately in practice. In fact, I have developed and actually applied a method of happiness measurement that is fully cardinal and interpersonally comparable (Ng, 1996*a*). This is based on the fact (established by everyday observation and psychological studies) that no one is infinitely sensitive. Thus, Edgeworth (1881, pp. 7ff., 60ff.) regarded it as axiomatic ('a first principle incapable of proof') that the just-perceivable increments of pleasure, of all

pleasures for all persons, are equatable. I derived this as a proposition based on some compelling axioms but noted the need to consider different lengths of time (Ng (1975, 1981) where a number of objections are also responded to). It is true that the method of utility and happiness measurement has yet to be improved to make its results more reliable. If economists are not that hostile to cardinalism and interpersonal comparison, perhaps faster advance will be made. (On cardinalism, welfare measurement and comparison, see also Allais and Hagen (1994), Harsanyi (1997), Simon (1974), van Herwaarden *et al.* (1977), van Praag (1968).)


Recently, Roberts (1997) asked whether it is possible to aggregate the different interpersonal comparisons of utilities made by different individuals into a social or aggregate (misleadingly termed 'objective' by Roberts) interpersonal comparison. He concluded: 'Because opinions themselves are not comparable across the individuals making them, the class of possible aggregation mechanisms is severely restricted. With...rich information structure of full comparability, the only opinion aggregator is dictatorial' (p. 95). However, he remarks that a way out may be the use of 'some "objective" comparisons which have an independent existence' (p. 94). The interpersonal comparison outlined in the preceding paragraph provides indeed one that has an independent objective existence and hence a way of solving the Roberts impossibility.


V. THE ACCEPTABILITY OF MONETARY MEASURES OF WELFARE CHANGES USED BY ECONOMISTS


Despite my emphasis on the more subjective concept of happiness over income, I am more tolerant and less sceptical (especially on certain technical or methodological grounds) of the use of monetary measures of consumer surplus or welfare changes such as the willingness to pay and to accept (or compensating variation and equivalent variation in income), subject to some qualifications mentioned below. In fact, I go further than most economists in advocating the principle of treating a dollar as a dollar and using this to largely solve the paradox of interpersonal cardinal utility. As explained below, this will make it less necessary to make interpersonal comparisons of utility.

The impossibility results of Arrow (1951/63), Sen (1970), Kemp and Ng (1976) and Parks (1976) show the impossibility of reasonable social decisions without interpersonal comparison of cardinal utility, whether we operate with alternative profiles of individual preferences like Arrow, or go along with Little (1952) and Samuelson (1967) in holding individual preferences fixed. Despite my argument above on the meaningfulness and feasibility of cardinal utility measurement and interpersonal comparison, I freely admit that the practical difficulties associated with cardinal utility measurement and comparison are an order of magnitude higher than those for ordinal preferences (these also exist and are significant, though ignored by most economists). Thus, a paradox is created: we need interpersonal cardinal utilities but have difficulties measuring them. This paradox of interpersonal cardinal utility may be largely (but not

completely) solved by using some monetary measure of net benefits (e.g. willingness to pay) to reflect the *intensity* of individual preferences, and then using the unweighted sum of individual net benefits in making social choices (i.e. treating a dollar as a dollar to whomsoever it goes).

 The use of the monetary measure for cardinal utility is subject to some qualifications. First, where individual ignorance, myopia, or irrationality are strong, especially if also related to insufficient concern for the welfare of children, strong divergence from individual preferences may be needed. The prohibition of heroin, the fluoridation of water, etc. are justified on this ground. Secondly, where there are important external effects, including environmental effects and relative-income effects, appropriate adjustments should be allowed for, as discussed above.

 Thirdly, there is the well-known inaccuracy of consumer surplus measurement due to the possibly changing marginal utility of money as prices change. Moreover, where some individuals gain and some lose from a change, there is the paradox of Boadway (1974). A positive aggregate willingness to pay (i.e. the compensating variations in income over all individuals sum to a positive figure) does not ensure that the gainers can overcompensate the losers, even given the feasibility of costless lump-sum transfers. This is due to a change in relative prices as compensation takes place, possibly making aggregate willingness to pay not perfectly accurate as it is when based on unchanged prices. (For the explanation why this inaccuracy always goes in the same direction, see Hird (1997).) I have argued (Ng, 1979, pp. 96–100) that both these inaccuracies are trivial for most changes. Where changes in relative prices are not huge, as is true for most specific projects or measures, the Boadway inaccuracy involved is negligible. While aggregate willingness to pay does not correspond perfectly with a potential Pareto improvement, it corresponds closely for most cases. For cases involving big changes in the marginal utility of money, I have advocated the use of marginal dollar equivalent (the number of times the utility change is the multiple of the marginal utility of a dollar) in place of either CV or EV to avoid the inaccuracy of the latter (Ng, 1979, Appendix 4A).¹

 Even with the above qualifications, how can we justify the use of *unweighted* sum of aggregate benefits since a marginal dollar may be worth much more to the poor than to the rich in utility terms? The answer is that this issue of income inequality is better tackled through the general tax/transfer system. However, this system has disincentive effects. Thus, most economists (including myself before I tried to prove that a dollar is *not* a dollar to counter the view of my colleague Ross Parish) mistakenly believe that it is better to shift some of the redistributive burden to specific items such as taxing/subsidising items consumed disproportionately by the rich/poor. Though some *marginal* efficiency costs of distorting choice are created, they are thought to be smaller than the reduction in disincentive effects due to relying less on the progressive

¹ From Hause (1975) to Becht (1995) an increasing group of economists believe in the superiority over the compensation measures and the perfect validity of the equivalent variation as a measure of individual welfare; I show the imperfection of either measure in Ng (1979, Sec. 4.6).

tax/transfer system. This belief is incorrect. The reason is that, assuming rational individuals, the disincentive effects are in accordance to the total system of tax/transfer, taxes/subsidies, plus all other redistributive and preferential measures, instead of having a separate and independent increasing marginal disincentive effects schedule for each of the separate measures. A rational person, in their work/leisure choice, does not just ask how much post-tax income they can earn, but also has a rough idea of the utility they can get from consuming goods and services purchased from the income. They are trading off the utility of leisure with the utility from work (which consists of the utility from consuming the higher income and the positive or negative utility of work itself). Moreover, the utility of consuming the higher income is affected by whatever specific redistributive or preferential measures are in place. Thus, the preferential treatment against the rich in government expenditure and other areas will *add on* to the progressive tax/transfer system to determine the total disincentive effects. Hence, even if only a marginal amount of specific equality-oriented measures are used, the disincentive effects involved are not just marginal. Thus, for the same degree of equality in real income (utility) achieved, the same degree of distinctive effects is incurred whether we use only the tax/transfer system or use a combination of it and some specific purely equality-oriented system. But the latter alternative has the additional efficiency costs of distorting choice, and is thus inferior. (See Ng (1979, ch. 9), (1984*b*) and (1996*c*) for more detailed arguments.)

Using the principle of unweighted aggregate net benefits in making decisions achieves a tremendous simplification in the formulation of economic policy in general and in cost-benefit analysis in particular. This frees us from having to make interpersonal comparisons of utility except in choosing the optimal tradeoff between efficiency and equality in the general tax/transfer system and except where the relevant monetary measures are not available or are untrustworthy due to important ignorance and/or irrationality (such as in the case of hard drugs).

Chinese University of Hong Kong and Monash University

REFERENCES

- Allais, Maurice and Hagen, Ole (1994). *Cardinalism*. Dordrecht: Kluwer.
- Argyle, Michael and Martin, Maryanne (1991). 'The psychological causes of happiness.' In *Subjective Well-Being* (ed. M. Argyle and N. Schwarz). Oxford: Pergamon.
- Arrow, Kenneth J. (1951/1963). *Social Choice and Individual Values*. New York: Wiley.
- Baumol, William J. (1977). *Economic Theory and Operations Analysis*, 4th ed. London: Prentice-Hall.
- Becht, Marco (1995). 'The theory and estimation of individual and social welfare measures', *Journal of Economic Surveys*, vol. 9, pp. 53–87.
- Boadway, Robin W. (1974). 'The welfare foundations of cost-benefit analysis.' *ECONOMIC JOURNAL*, vol. 84, pp. 926–39.
- Brickman, P., Coates, D. and Janoff-Bulman, R. (1978). 'Lottery winners and accident victims: is happiness relative?' *Journal of Personality and Social Psychology*, vol. 36, pp. 917–27.
- Chomsky, N. (1949). Review of *Verbal Behaviour* by B. F. Skinner. *Language*, vol. 35, pp. 26–58.
- Easterlin, Richard A. (1974). 'Does economic growth improve the human lot? Some empirical evidence'. In *Nations and Households in Economic Growth* (ed. P. David and M. W. Reder). New York: Academic Press.
- Edgeworth, F. Y. (1881). *Mathematical Psychics*. London: Kegan Paul.
- Frank, Robert H. (1997). 'The frame of reference as a public good.' *ECONOMIC JOURNAL*, vol. 107, p. 1832–47.

- Hahn, F. (1982). 'On some difficulties of the utilitarian economist.' In *Utilitarianism and Beyond* (ed. A. Sen and B. William). Cambridge: Cambridge University Press.
- Harsanyi, John C. (1997). 'Utilities, preferences, and substantive goods.' *Social Choice and Welfare*, vol. 14, pp. 129-45.
- Hause, John C. (1975). 'The theory of welfare cost measurement.' *Journal of Political Economy*, vol. 83, pp. 1145-82.
- Headley, Bruce and Wearing, Alexander (1991). 'Subjective well-being: a stocks and flows framework.' In *Subjective Well-Being* (ed. M. Argyle and N. Schwarz). Oxford: Pergamon.
- Hird, Tom (1997). 'Individual welfare measurements and price indices: the importance of constancy in the marginal utility of money.' Ph.D. thesis, Monash University.
- Kemp, Murray C. and Ng, Yew-Kwang (1976). 'On the existence of social welfare functions, social orderings and social decision functions.' *Economica*, vol. 43, pp. 59-66.
- Kolm, S.-C. (1993). 'The impossibility of utilitarianism.' In *The Good and the Economical* (ed. P. Koslowski and Y. Shionoya) Berlin: Springer-Verlag.
- Little, Ian M. D. (1952). 'Social choice and individual values.' *Journal of Political Economy*, vol. 60, pp. 422-32.
- Miller, Roger L. (1994). *Economics Today*. London: HarperCollins.
- Mirrlees, James (1971). 'An exploration in the theory of optimal income taxation.' *Review of Economic Studies*, vol. 38, pp. 175-208.
- Mueller, Dennis C. (1989). *Public Choice II*. Cambridge: Cambridge University Press.
- Ng, Yew-Kwang (1972). 'Value judgments and economists role in policy recommendation.' *ECONOMIC JOURNAL*, vol. 82, pp. 1014-8.
- Ng, Yew-Kwang (1975). 'Bentham or Bergson? Finite sensibility, utility functions, and social welfare functions.' *Review of Economic Studies*, vol. 42, pp. 545-70.
- Ng, Yew-Kwang (1979). *Welfare Economics*. London: Macmillan.
- Ng, Yew-Kwang (1981). 'Bentham or Nash? On the acceptable form of social welfare functions.' *Economic Record*, vol. 57, pp. 238-50.
- Ng, Yew-Kwang (1984a). 'Expected subjective utility: is the Neumann-Morgenstern utility the same as the neoclassical's?' *Social Choice and Welfare*, vol. 1, pp. 177-86.
- Ng, Yew-Kwang (1984b). 'Quasi-Pareto social improvements.' *American Economic Review*, vol. 94, pp. 1033-50.
- Ng, Yew-Kwang (1987). 'Relative-income effects and the appropriate level of public expenditure.' *Oxford Economic Papers*, vol. 39, pp. 293-300.
- Ng, Yew-Kwang (1992a). 'The older the more valuable: divergence between utility and dollar values of life as one ages.' *Zeitschrift für Nationalökonomie*, vol. 55, pp. 1-16.
- Ng, Yew-Kwang (1992b). 'Utilitarianism and interpersonal comparison.' *Social Choice and Welfare*, vol. 9, pp. 1-15.
- Ng, Yew-Kwang (1995a). 'Relative income and diamond effects: a case for burden free taxes and higher public expenditures.' *Economic Papers* (Economic Society of Australia), vol. 4, pp. 29-33.
- Ng, Yew-Kwang (1995b). 'Towards welfare biology: evolutionary economics of animal consciousness and suffering.' *Biology and Philosophy*, vol. 10, pp. 255-85.
- Ng, Yew-Kwang (1996a). 'Happiness surveys: some comparability issues and an exploratory survey based on just perceivable increments.' *Social Indicators Research*, vol. 38, pp. 1-27.
- Ng, Yew-Kwang (1996b). 'Electrical brain stimulation.' Typescript.
- Ng, Yew-Kwang (1996c). 'The paradox of interpersonal cardinal utility: a proposed solution.' Paper presented to the International Conference on Social Choice and Welfare, Maastricht, June.
- Ng, Yew-Kwang and Wang, Jianguo (1993). 'Relative income, aspiration, environmental quality, individual and political myopia.' *Mathematical Social Sciences*, vol. 26, pp. 3-23.
- Olds, J. and Milner, P. (1954). 'Positive reinforcement produced by electrical stimulation of septal area and other regions of the rat brain.' *Journal of Comparative Physiological Psychology*, vol. 47, pp. 419-27.
- Oswald, Andrew J. (1997). 'Happiness and economic performance.' *ECONOMIC JOURNAL*, vol. 107, pp. 1815-31.
- Parks, Robert P. (1976). 'An impossibility theorem for fixed preferences: a dictatorial Bergson-Samuelson welfare function.' *Review of Economic Studies*, vol. 43, pp. 447-50.
- Portney, P. R. (1990). 'Policy watch: economics and the Clean Air Act.' *Journal of Economic Perspectives*, vol. 4, pp. 173-81.
- Roberts, Kevin (1997). 'Objective interpersonal comparisons of utility.' *Social Choice and Welfare*, vol. 14, pp. 79-96.
- Robbins, Lionel (1932). *An Essay on the Nature and Significance of Economic Science*. London: Macmillan.
- Samuelson, Paul A. (1947). *Foundations of Economic Analysis*. Cambridge, MA: Harvard University Press.
- Samuelson, Paul A. (1967). 'Arrow's mathematical politics.' In *Human Values and Economic Policy: A Symposium* (ed. S. Hook). New York: New York University Press.
- Sen, Amartya K. (1970). *Collective Choice and Social Welfare*. Amsterdam: North-Holland.

- Simon, Julian L. (1974). 'Interpersonal welfare comparisons can be made and used for redistribution decisions.' *Kyklos*, vol. 27, pp. 63-98.
- Van Herwaarden, Floor, Kapteyn, Arie and Van Praag, Bernard (1977). 'Twelve thousand individual welfare functions.' *European Economic Review*, vol. 9, pp. 283-300.
- Van Praag, Bernard M. S. (1968). *Individual Welfare Functions and Consumer Behavior*. Amsterdam: North-Holland.
- Varian, Hal. R. (1993). *Intermediate Microeconomics*. New York: Norton.
- Veenhoven, R. (1984). *Conditions of Happiness*. Dordrecht: Reidel.