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ECONOMIC POLICY AND NONRATIONAL BEHAVIOUR

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Abstract

The question of how much choice a benevolent government should provide for its people is examined. In the model used, people choose according to the Luce direct utility model from whatever set of options is made available to them. Under reasonable assumptions, but for a special case, it is shown that when the degree of nonrationality is sufficiently great, it is optimal to allow no choice, even though the government is unable to discriminate among individuals. Even when rationality is very high, it is desirable to increase the probability of choosing options that would suit the average person, for example by the way options are presented. The general case of the model is discussed, and a condition for no choice to be optimal obtained.

Mistakes and Utilities

It is almost certain that people do not always choose what is best for themselves. If an all-knowing, well-meaning government could costlessly choose for them, the outcome might be better. Some people hold that there is intrinsic value in individual choice. In many areas this is at least disputable. Be that as it may, I want to consider a different, more compelling argument against transferring choice from individuals to government: that individuals know more about themselves than it is possible for governments to know. This paper considers the strength of that argument.

The argument is strengthened by the consideration that it is often not in an individual's private interest to reveal his full characteristics to a government. Good government compromises among the interests of different individuals: a selfish individual would prefer that it transferred resources to him. Taking that for granted, it is nevertheless desirable that the government allow individuals to make choices, provided that they make no mistakes. If they always choose from whatever alternatives are available to them the ones that severally maximize their utilities, then it is generally desirable that there are, roughly, as many alternatives available as there are different types of individual. Each individual will then choose the alternative that is best for him. Each person's choice might be different from every other person's. For example, in the provision of social insurance for disability, unemployment, and length of life, there should be a range of alternative insurance contracts, amongst which

high) wages are very limited. In any case the theory of optimal policy does not imply that private markets should be allowed (cf. Diamond and Mirrlees 1979, where it is shown that it may be optimal to prohibit private saving for retirement). Optimality implies that there be choice, not that the choice provided by the market-place is best, or even that it is superior to the provision of a single alternative by the State. It may not be useful to speculate about the causes of limited choice in public policy. It is interesting to enquire whether relaxing the assumption of rational choice by individuals may remove the presumption that a range of choice is desirable,

There are many ways of setting up a model of nonrational behaviour: it is not easy to do so in a disciplined way, but one may be able to assess the broad implications of different kinds of nonrationality by considering a variety of models. Broadly speaking, one might expect people to make errors of perception, i.e. to maximize utility, but on the basis of incorrect beliefs about some relevant variables; to make errors of action, i.e. to do something that deviates randomly from what is best for them; and to make errors of choice, i.e. to choose in some randomized way that reflects utility maximization imperfectly. In the present paper I analyze a model of random choice. In other papers I intend to deal with random action and random perception.

One model of random choice that promises to be relatively easy to use is the model proposed by Luce(1959), sometimes called the strict utility model. A special form is the well-known logit model. The model postulates that the probability an individual will choose an option x^j from a finite set of alternatives

The model also has considerable merits. It is nicely independent of the way in which commodities happen to have been measured; it incorporates a tendency to utility maximization; it allows a convenient measure of the degree of nonrationality; and it introduces the possibility that anyone might choose anything that is made available. The model might be expected to be applicable especially when people have to try to understand a number of different, rather complicated, options, and have to make once-for-all choices, as with some of the major tax and social insurance possibilities. It may also be relevant to the choice of residence, career, or spouse. Even the apparent flaw, that the relative probability of choosing any particular option can be increased by making available a number of effective copies, allows a valuable interpretation: it is possible by various means to increase or reduce the relative probability of choosing particular options by a variety of means not readily modelled, but well known to salesmen, stage magicians, and educators. The model allows the possibility of increasing the relative weight of an option, with the appropriate constraint that the increase be the same for all individuals.

We shall be dealing with a population of individuals who differ among themselves, precisely to capture the idea that individual choice has some value arising from the individual's special knowledge of his own needs and tastes. $u(x, n)$ is the utility of a person of type n when he gets x . The mathematical expectation of u will be taken to be a satisfactory measure of the individual's welfare, and the sum of expected values will be taken to measure social welfare.

rationality, and considerable dispersion of needs, with a wide range of choice: in some sense, the set B should be large, when nonrationality q is, on average, large and

$$v = \text{Var}(v) = \int v^2 f(n) dn \quad (4)$$

is large. Small q and v should, correspondingly, imply that B is small. A small range of choice should be provided so as to counteract the high propensity to make mistakes, and there is little loss from doing so, since similar people have similar needs.

Intuition seems not to suggest in what sense one should expect B to be small when q and v are small. "Small" might mean that B is a set in which no two of the options provided differ by very much; or it might mean that B should not have many members. More generally, it is an interesting question whether, when q is positive B should be a continuum or a set of isolated points, though possibly a very numerous one. Perhaps the most important issue is whether B reduces to a single point for values of the parameters that are, in some sense, plausible, i.e. correspond to what is likely to be true of particular applications.

In this paper I first study an example — the simplest I could think of — in detail. The example has x a real number, and a quadratic utility function. It is shown that, when the distribution of people, as described by the distribution of the values of x they would ideally have, has moderate kurtosis, then for all small enough v and q it is optimal for B to consist of a single point. On the other hand, when v and q are

be interpreted as a generalized function, or equivalently a nonnegative measure, but it makes some manipulations more natural if we pretend that B is described by such a continuous distribution. Then social welfare is

$$W = \int \frac{\int u(x, n) P(u(x, n)) g(x) dx}{\int P(u(x, n)) g(x) dx} f(n) dn \quad (5)$$

The policy problem is now expressed as the choice of a nonnegative function g to maximize W , given by (5). It is easy to write down the first-order conditions, but I have not found them particularly helpful. The method used to solve the example is different. Because of the special properties of the exponential function, it is possible to express W fairly directly in terms of a new function that represents g . This new function is chosen to maximize W and we can then determine whether the optimizing function represents a distribution, i.e. a measure on x . If not, we can try again, maximizing subject to some of the constraints that the new function must satisfy if it is to represent a distribution.

In the example,

$$u(x, n) = - (x - n)^2 \quad (6)$$

$$P(u) = e^{qu} \quad (7)$$

The distribution of individual characteristics is taken to be fairly general, but in order to state the results, I introduce the following definition:

Theorem 2

If n is normally distributed, and $qv \leq \frac{1}{4}$, no choice is optimal, whereas if

$$qv \geq \frac{1}{4} \quad (10)$$

welfare is maximized when all options are made available, with x given weight

$$g(x) = \exp \left[- \frac{x^2}{4v - \frac{1}{q}} \right] \quad (11)$$

Something like Theorem 2 is true for normally concentrated distributions, but it will be easier to set this out when the theorem has been proved.

The theorems show, first, that it is optimal to have no choice even when the degree of nonrationality is not particularly large: the sense in which it is optimal to restrict choice to a "small" set of options because of imperfect rationality is in this model very strong. Secondly, there is a sharp transition in the normal case (and, as we shall see, a smoother but still quite rapid transition in other cases) to providing all the options that might be good for someone: perfect rationality is not required for that to be the optimum. Thirdly, it is desirable to weight options, with a bias towards those that would most commonly be best; and that is true even in the limit as rationality becomes perfect. When rationality is perfect, the weighting does not matter: when it is almost perfect, it is best to provide the options with a weighting substantially different from the

$$\varphi(m) = \int_{-\infty}^{\infty} e^{mx} h(x) dx \quad (15)$$

which is the denominator of the integral in (13). For the function h to make sense as a weighting function, φ must exist for all real m . φ is a kind of Laplace transform; and is also known as the moment generating function for h . Differentiating under the integral sign, we have

$$\varphi'(m) = \int_{-\infty}^{\infty} x e^{mx} h(x) dx, \quad \varphi''(m) = \int_{-\infty}^{\infty} x^2 e^{mx} h(x) dx$$

Therefore we can write

$$W = -v + \int \frac{2n\varphi'(2qn) - \varphi''(2qn)}{\varphi(2qn)} f dn \quad (16)$$

and if we further define

$$\theta(n) = \varphi'(2qn)/\varphi(2qn) \quad (17)$$

we obtain

$$W = -v + \int (2n\theta - \frac{1}{2q}\theta' - \theta^2) f dn \quad (18)$$

Define $G(n) = \int_n^{\infty} mf(m) dm$, so that, integrating by parts,

$$W = -v - 2 \int \left[G(n) - \frac{1}{4q} f(n) \right] \theta' dn - \int \theta^2 f dn \quad (19)$$

$$\varphi(m) = f\left(\frac{m}{2q}\right)^{\frac{1}{2}} e^{m^2/q} \quad (22)$$

apart from an irrelevant multiplicative constant. In the case of a normal distribution, this function corresponds to the function g given in the statement of the theorem. Since the optimization was carried out without any constraint on θ , or equivalently on φ , and it now turns out that this φ corresponds to a proper distribution, we have found the optimal policy.

When the distribution is not normal, it seems to be harder to tell whether the function in (22) corresponds to a measure on the real line. In the case of a uniform distribution, it does not, and it is necessary to consider appropriate constraints in the maximization. When the distribution is sufficiently similar to a normal distribution, appeal to continuity assures us that φ does correspond to a distribution; but only in the case of normal distributions do we get a complete solution in this way, with a sharp dividing line between the region where no choice is optimal, and the region where full (but weighted) choice is optimal.

If the distribution of n is not normally concentrated, theorem 1 may not hold. It is then possible to do better than the singleton policy by means of a set $\{-X, 0, X\}$, where the outliers are given a small weight, and X is made large.

the sets, parametrized by vector y and scalar r ,

$$A(y,r) = \{y + rz^1, y + rz^2, \dots, y + rz^m\}. \quad (26)$$

A necessary condition for $\{0\}$ to be an optimum among all sets B is that $y = 0$ and $r = 0$ be an optimum when only sets $A(y,r)$ are available. Write $W(y,r)$ and $C(y,r)$ for (23) and (24) evaluated at the choice set $A(y,r)$. Then there exists a scalar λ' such that

$$W_y(0,0) = \lambda' C_y(0,0) \quad (27)$$

and

$$W_r(0,0) = \lambda' C_r(0,0) \quad (28)$$

In calculating the derivatives of W and C with respect to y , we may first set $r = 0$. The set $A(y,0)$ is in effect a singleton, so that $W = Eu(y,n)$ and $C = Ec(y,n)$. The derivatives in (27) are therefore $Eu_x(0,0)$ and $Ec_x(0,0)$, the derivatives that appear in (25). Therefore $\lambda' = \lambda$. From the definition of W , we have

$$W_r(0,0) = \frac{\partial}{\partial r} \left[\frac{\sum_i \{u(rz^i, n) - u(0, n)\} P(u(rz^i, n))}{\sum_i P(u(rz^i, n))} \right] = E u_x(0, n) \cdot \bar{z} \quad (29)$$

where $\bar{z}$ is $\sum z^i/m$. Similarly $C_r(0,0) = Ec_x \bar{z}$. Therefore (28) is automatically satisfied when (27) is: the optimal singleton choice set is a locally stationary choice set.

It is clear that (33) places an upper bound on q . Indeed that upper bound is defined by the smallest positive real root of the equation obtained by setting the determinant of the matrix equal to zero, since the determinant must vanish at the point beyond which the matrix ceases to be negative semi-definite. We can gain more insight into the magnitude of this bound by considering a distribution with small variance v .

Since, by the first order condition, $E[u_x - \lambda c_x] = 0$, we have the approximation

$$E[(u_x - \lambda c_x)u_x] = v(\bar{u}_{xx} - \lambda \bar{c}_{xx})\bar{u}_{xx}$$

where the bar denotes evaluation at the mean of n . Condition (33) is therefore, approximately, that

$$E[u_{xx} - \lambda c_{xx}] + 2qv(\bar{u}_{xx} - \lambda \bar{c}_{xx})\bar{u}_{xx} \text{ is negative semi-definite.}$$

How large can qv be without violating negative semi-definiteness? There is a theorem in linear algebra that tells us. The matrix is negative semi-definite if and only if

$$-2qv(\bar{u}_{xx} - \lambda \bar{c}_{xx}) \cdot (E[u_{xx} - \lambda c_{xx}])^{-1} \cdot \bar{u}_{xx} \leq 1 \quad (34)$$

To first order, the expectation of the matrix $u_{xx} - \lambda c_{xx}$ is equal to its value at the mean of n . We may therefore rewrite (34) as

$$-2qv(\bar{u}_{xx} - \lambda \bar{c}_{xx}) \cdot (\bar{u}_{xx} - \lambda \bar{c}_{xx})^{-1} \cdot \bar{u}_{xx} \leq 1 \quad (35)$$

The three symbolic factors in this formula measure the degree of nonrationality, the variability of tastes in the population, and the sensitivity of individual utilities to differences in outcome.

A particular example may help to give some sense of the numerical magnitudes involved. In the example, policies are two-dimensional (e.g. consumption and work). Let utility be

$$u(x, y, n) = u_1(x - n) + u_2(y) \quad (38)$$

and let costs be

$$c(x, y, n) = x - y \quad (39)$$

It is easily seen that $\hat{x} = \xi + n$, where $u'_1(\xi) = 1$, and $\hat{y}$ is a constant satisfying $u'_2 = -1$. Therefore

$$\hat{u}_{nn} = -u''_1(\xi)$$

and we can write condition (38) in the form

$$\frac{P u'_1 \bar{x}}{P} \cdot \frac{\text{Var}(\hat{x})}{\bar{x}^2} \cdot \left[\frac{\bar{x} u''_1}{u'_1} \right] \leq \frac{1}{2} \quad (40)$$

The first factor here is the elasticity of relative choice-probability with respect to income x ; the second is the coefficient of variation of

important to find ways of identifying those areas of consumer choice that are most subject to behaviour that fails to maximize utility. Consideration of long periods and various risks, which is required in the design of social insurance, seems likely to be particularly badly done. If so, the argument of the paper provides a rather precise case for paternalism in this area.

More generally, the ideas here bear on the role and fashioning of constitutions, conceived as constraints on the choices available to future governments. The argument was developed in terms of a world in which public benevolence is more rationally pursued than private interest. There is, by the way, no reason to suppose that the conclusions would apply less strongly were the government itself less rational. But if the government is itself not fully rational — a notion that may, oddly enough, appeal to many who are disinclined to entertain the idea of private nonrationality — something like the model of this paper could well be applied to the larger issue of the optimal design of the State.

It should perhaps be emphasized that the suggestions of this paper could not be universally applied. There are other reasons, not here considered, for freedom of choice, which apply strongly, or could be held to apply strongly, to areas of policy or potential policy not earlier alluded to. I suggest that these other arguments for freedom and liberality are not such as to override the considerations analysed here in all areas of public policy.

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