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Voting for Equity: Estimating Society's Preferences Toward Inequality

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ABSTRACT

Economics often finds it difficult to make comparisons across economic policies based upon equity considerations. This paper uses a social welfare function incorporating both efficiency and equity to estimate society's collective preferences for equity. The function is based upon a demographically modified demand system that delivers an interpersonally comparable measure of money metric individual welfare. A social planner stands prepared to select a price policy so as to maximize social welfare. To do so it must know to what degree equity should matter in its welfare function, and the innovation here is the development of a voting scheme for compiling individuals' equity preferences into a social decision. It is found that while preferences across households are heterogenous, the optimal level of equity is quite low.

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VOTING FOR EQUITY: ESTIMATING SOCIETY'S PREFERENCES TOWARD INEQUALITY

1. Introduction.

Economists have long found it difficult to incorporate equity concerns—judgments about how wealth should be distributed among people—into economic analysis. Since Pareto, emphasis has been placed upon efficiency. The criterion of Pareto efficiency has no concern for equity whatever. While two alternative economic outcomes can be compared using Pareto's criterion without saying anything about who gets what, equity-based comparisons require this. The "new welfare economics" developed in the middle part of the century (Robbins 1932), a tradition exemplified in Samuelson (1947) shunned cardinal utility and the comparison of welfare across people. By insisting that unobservables be ruled out as a basis for theory, this tradition rejects the notion, with which Marshall was comfortable, that one may state which of two agents is better off.

Little remained of the disciplinary resistance to interpersonal comparisons of well-being when Arrow (1963) achieved his famous impossibility result. Employing an axiom that rules out the use of information concerning intensity of preference (independence of irrelevant alternatives), Arrow established that any rule for compiling individual preferences into a social preference ordering must be dictatorial. Economists others were at that time already prepared to accept the notion that only ordinal preferences should be used for making social judgments, and they did just this in embracing Arrow. Arrow's result has since then been shown to hold even if a certain degree of cardinality is allowed (d'Aspremont and Gevers 1977).

Nevertheless, interest in equity and equity-based comparisons has not vanished (see, for example, Elster and Roemer 1991). Roberts (1980), in detailing the ordinal and cardinal aspects of social choice, devised a (single-profile) social welfare function that incorporates both equity and efficiency. According to this function, social welfare is enhanced when average individual welfare increases, but it is reduced when dispersion in individual welfare increases. What's more, the function captures in elegant fashion—through the use of a single "equity" parameter describing the curvature of social welfare in individual welfare space—society's preferences toward inequality. Recently, Jorgenson

(1990) and Jorgenson and Slesnick (1983, 1987) have employed this function in measuring the effects of various economic policies upon average welfare and upon the level of equity-based social welfare. In these studies a value for the equity parameter is selected arbitrarily. In particular, Jorgenson and Slesnick (1983, 1987) assume that equity matters as much as it possibly can in their model, and their analyses proceed from there to a series of normative recommendations concerning policy measures.[1]

The purpose of the present paper is to extend that approach by *estimating* society's collective preferences regarding equity. Using a time series data set, from which a Barten-Gorman demographically modified demand system has been estimated, we develop a policy regime under which a benevolent social planner selects a price policy so as to maximize a Jorgenson and Slesnick (1987) type social welfare function. This optimization takes the equity parameter as given. We then devise a scheme that allows households—observations in our data set—to calculate their own preferred value for this parameter, ρ. We then define a voting scheme that selects the unique majority-rule winner among the feasible values for ρ, and this winner we call society's optimal or preferred degree of aversion to inequality. We find that though households appearing in the later years in our data set wish for equity to matter a great deal, early households do not wish this, and their numbers are great enough to ensure that the planner's choice will place little emphasis on equity.

The demand system upon which our welfare calculations rely is of interest itself for the technique by which demographic information is incorporated. The social welfare scheme requires full comparability of welfare across households, and so it is necessary to devise an interpersonally comparable money metric welfare measure. This is accomplished using adult equivalence scales and the modifying technique of Lewbel (1985) for constructing household expenditure functions and scaled income. The methods that are presented in the following section, and the econometric results that our voting for equity scheme employs, are adapted from two papers by Ferreira and Perali (1992a, 1992b).

2. Interpersonally comparable individual welfare.[2]

[1] Buccola and Sukume (1993) employ two of the social welfare functional expressions due to Roberts (1980) in assessing the effect of equity considerations on agricultural policy in Zimbabwe. For several values of their equity parameter, Buccola and Sukume (1993) determine the range in which optimal producer prices fall. Their study does not consider the views of households toward the equity parameter itself.

[2] This section draws on Ferreira and Perali (1992a, 1992b).

Suppose that a household obeys a direct utility function of the form $U^*(q_k)$, where q_k denotes the n-vector of goods consumed by household k ($k = 1, \ldots K$), available at prices p. Corresponding to U is a cost (or expenditure) function of the form $C^*(U, p)$, which yields the cost to the household of achieving utility level U at prices p.[3] Lewbel (1985) presents a technique for modifying the cost function C^* to incorporate demographic information. Let d_k denote a vector of demographic variables (household size, schooling, and so on) specific to household k. Lewbel's modifying technique calls for construction of a new cost function of the form $C(u, p, d_k) = f(C^*(u, p, d_k), p, d_k)$. Lewbel presents conditions that must be satisfied by f in order for C to be a legitimate cost function.[4] Note that by construction C will take the value of household income y_k.

The modifying function approach is a generalization of a variety of specific approaches to the problem of incorporating demographic information into a demand system. These include the translating and scaling approaches, the Gorman (1976) approach that combines translating and scaling, and also reverse Gorman as developed in Pollak and Wales (1981, 1992). The demographic specification used in this study is the reverse Gorman approach, which, following Ferreira and Perali (1992a,b), we call Barten-Gorman.

Our aim in this paper is to use a measure of household welfare accompanying this Barten-Gorman demographically modified cost function to compare the level of social welfare for various economic policies. For this purpose we shall need a household equivalence scale $m_0(p, d_k)$, depending on prices and on demographic characteristics, that describes the number of equivalent adults in the household. This scale can be used to form a money measure of welfare that is comparable across households. A household's scaled income is given by $y_k/m_0(p, d_k)$. If a two-adult household with income of \$60,000 has $m_0 = 1.5$, for example, then each of its members achieves the same level of utility as a single adult with income of \$40,000. Similarly, if a household with two adults and two children with income of \$60,000 has $m_0 = 3.0$, then each of its members achieves the same level of utility as a single adult with income of \$20,000.[5]

[3] At the risk of some confusion, we suppress the index on the functions U^* and C^* and on their unstarred counterparts below. In rendering these functions interpersonally comparable we essentially make them the same for all households (so that only demographic make-up distinguishes households). Once this scaling has been achieved the k index becomes misleading.

[4] That is, C must be homogenous of degree one in prices, nonnegative, nondecreasing in prices, increasing in u, increasing in at least one price, and concave. See Lewbel (1985), Theorems 1–3.

[5] This example closely resembles the one presented by Blackorby and Donaldson (1991, p. 174). They write, "If

The scale m_0 can be written in this manner—without utility as an argument—only if it is independent of the base level of income (IB) (Lewbel 1989; Blackorby and Donaldson 1992). The IB property of equivalence scales permits interhousehold comparisons to be made in a theoretically consistent manner, and it generalizes the more restrictive property of homotheticity of preferences. (For a discussion of the related exactness property of an equivalence scale, see Blackorby and Donaldson 1991.)

Suppose that demand is specified as the almost ideal demand system of Deaton and Muellbauer (1980). The Barten-Gorman demographically modified AIDS cost function, as specified in Ferreira and Perali (1992a), expressed in logarithms, is

$$\ln C(u,p,d_k) = \ln A(p,d_k) + B(p,d_k)\ln u + \ln P^T. \tag{1}$$

This cost function is in the Gorman polar form (see Blackorby, Boyce and Russell 1978), from which the AIDS is derived using the Barten-Gorman demographic transformation. In (1), the $\ln A$, B, and $\ln P^T$ terms are expressions depending upon the parameters in a Barten-Gorman demographically modified demand system.

$$\ln A(p,d_k) = \alpha_0 + \sum_i \alpha_i \ln p_i^* + \frac{1}{2}\sum_i\sum_j \gamma_{ij}\ln p_i^* \ln p_j^*, \tag{2a}$$

$$B(p,d_k) = \beta_0 \Pi_i (p_i^*)^{\beta_i}, \tag{2b}$$

$$\ln P^T(p,d_k) = \sum_i t_i(d_k)\ln p_i^*, \tag{2c}$$

where $i = 1, \ldots n$ indexes the goods. In equations (2), $p_i^* = p_i m_i(d_k)$ is the price of good i scaled by the Barten (1964) commodity-specific scheme. The scaling demographic function is specified as $m_i(d_k) = \sum_r \delta_{ir} \ln d_k^r$, and the translating demographic function is specified as $t_i(d_k) = \sum_r \tau_{ir} \ln d_k^r$. The parameters α_i, β_i, and γ_{ij}, and also the τ_{ir} and δ_{ir}, are to be estimated using the following share demand system, derived from equation (1) and equations (2)

$$w_{ik} = \alpha_{ik} + t_i(d_k) + \sum_j \gamma_{ij}\ln p_j^* + \beta_i \ln\left(\frac{y_k^* P^T}{A(p^*)}\right),$$

we say that the number of adult equivalents in the household is 1.5, then we mean that the household is equivalent, for utility purposes, to two *single reference* adults with incomes of \$20,000 each (\$30,000 divided by 1.5)" (emphasis in original). The subtle but important distinction between our sentence and theirs is that Blackorby and Donaldson use the family, while we use an individual family member, as the reference unit. The distinction carries through to our empirical investigation where, as in Jorgenson (1990), an "equivalent household member" is the unit of comparison.

where $\ln y_k^* = \ln y_k - \sum_i t_i(d_k) \ln p^*$.

In order for the scale m_0 to be IB, it is necessary that the $B(p, d_k)$ term be independent of d_k. Let us suppose that it is. Then following Lewbel (1989), write the modified cost function

$$C(u, p, d_k) = m_0(p, d_k) G(p, u) \tag{3}$$

for some function G.[6] The separability of d_k from u in the two terms on the right side of (3) makes the IB property convenient. In the demographically modified AIDS framework we may write

$$\ln G_k(p, u) = \ln A(p) + B(p) \ln u,$$

which, combined with (3), yields the following money metric of utility (Lewbel 1989; Blackorby and Donaldson 1988)

$$\ln\left(\frac{C}{m_0}\right) = \ln A(p) + B(p) \ln u. \tag{4}$$

Equation (4) highlights an important feature of the interpersonally comparable nature of this setup. Note that everything specific to a household's preferences appears in the left side; the right is an affine transformation of utility levels u. Thus, it accords with Roberts' (1980) definition of cardinal full comparability (CFC) of utilities.[7] Once again employing the notation of the Barten-Gorman demographically modified AIDS framework, the equivalence scale m_0 may be written in log form as

$$\begin{aligned}\ln m_0(p, d_k) &= \ln A(p, d_k) + \ln P^T(p, d_k) \\ &= \alpha_0 + \sum_i \ln p_i^* + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i^* \ln p_j^* + \sum_i t_i(d_k) \ln p_i^*.\end{aligned}$$

Upon rearranging equation (4), the indirect utility function for household k may be written

$$\ln V_k(y_k, p, d_k) = \frac{\ln\big(C/m_0(p, d_k)\big) - \ln A(p)}{B(p)}, \tag{5}$$

where by definition $y_k = C(V_k(y_k, p, d_k), p, d_k)$. The curvature properties of $\ln V_k$ in (5) are important in what follows. Ferreira and Perali (1992b), who develop the econometric results upon which our empirical results draw, find that, numerically, the money metric welfare functions $\ln V_k$ are concave in prices.

[6] Lewbel (1989) shows that the ability to write the cost function in this way is necessary and sufficient for a "cost of characteristics" index, $I_k = C(u, p, d_k)/C(U, p, d^0)$ to be IB, where d^0 is the demographic make-up of a reference household. If and only if the index is IB, an IB household scale exists.

[7] Lewbel (1989, p. 383) also provides a nice discussion of the various degrees of comparability with cardinal and with ordinal preferences. The CFC property is built into equation (4.4) in Jorgenson (1990), upon whose social welfare function we rely in the next section.

3. Social welfare.

Suppose that the welfare of society is determined according to the following social welfare function taken from Jorgenson and Slesnick (1983, 1987) and Jorgenson (1990). Let U denote the K-dimensional vector of household utility levels, and let x denote the state of the world. The social welfare function takes the form

$$W(U, x \mid \rho) = \ln \bar{V} - \gamma(x)\left(\frac{\sum_k m_0(p, d_k) \cdot \mid \ln V_k - \ln \bar{V} \mid^{-\rho}}{\sum_k m_0(p, d_k)}\right)^{-1/\rho}, \tag{6}$$

where

$$\ln \bar{V} = \frac{\sum_k m_0(p, d_k) \ln V_k}{\sum_k m_0(p, d_k)},$$

and

$$\gamma(x) = \left[\frac{\sum_{k \neq j} m_0(p, d_k)}{\sum_k m_0(p, d_k)}\left(1 + \left(\frac{\sum_{k \neq j} m_0(p, d_k)}{m_0(p, d_j)}\right)^{-(\rho+1)}\right)\right]^{1/\rho},$$

where $m_0(p, d_j) = \min_k m_0(p, d_k)$ is the scale for a reference household. In a time series application, like the one to follow, it is natural to let this reference household correspond to the household in period 1.

The first term in (6) is the average of money metric welfare across households. The second term is a measure of dispersion (or inequality) in money metric welfare. For a given level of average welfare, social welfare declines as the inequality in welfare increases. The $\gamma(x)$ term in (6) is constructed so as to permit the highest possible value that satisfies that Pareto principle. It is conceivable, for general definitions of $\gamma(x)$, that social welfare might fall as a result of an increase in one households welfare level. As W is defined in (6), this cannot happen. With the definition for $\gamma(x)$ used here, the second term in (6) is as large as it can be while still ensuring that W never decreases as $\ln V_k$ increases for some household k.

The parameter ρ captures society's "degree of aversion to inequality" (Jorgenson 1990, p. 1025), which is the same thing as the degree of curvature of the welfare function in $\ln V$ space. It takes values on the interval $(-\infty, -1]$. If $\rho = -\infty$, then the second term in (6) disappears and the social welfare function becomes utilitarian. If ρ takes its maximum value of -1 then society places the greatest possible value upon equity. We turn now to a model of a social planner that chooses economic policy so as to maximize W given ρ, and the accompanying scheme for estimating the value for ρ that actually reflects society's attitudes toward equity.

4. Voting for equity.

In this section we develop a scheme for recovering society's preferences toward inequality from demand behavior and demographic characteristics. The informational assumptions placed upon the problem are crucial. It is assumed that the social planner has complete information concerning all households' Barten-Gorman demographically modified cost functions. Each household knows only its own cost function, and it is also privy to the information it needs in order to make its selection in the voting scheme. Let Ω_k denote the information held by household k.[8]

The voting for equity scheme is recursive in nature, comprising two parts. For any given ρ, the social planner's aim is to set prices so as to maximize social welfare $W(U, x \mid \rho)$. The first part, then, consists in the planner devising a table each row of which corresponds to a value for ρ. The distance between ρ's may be as small as desired. The remaining entries in a row of the table consist of a price vector with the property that for the corresponding ρ, this price vector yields a maximum to $W(U, x \mid \rho)$.

In the second part of the scheme, the planner sends each household a copy of the table, and each household calculates its own level of welfare $\ln V_k$ at every price vector in the table. The household then returns a ballot on which it has recorded the value of ρ for which the corresponding price yields a maximum to $\ln V_k$. Let this report be denoted ρ_k^*. The planner then combines the K-vector of ρ_k^*'s into a social choice ρ^*. In this last step the planner announces the median value of the ρ_k^*'s as society's choice of aversion to inequality.

This scheme may be thought of as a constitutional convention for carrying out social policy. The social planner, who knows everything about agents' cost functions, is nothing more than a computer for calculating, for any conceivable value of ρ, the price vector that maximizes $W(U, x \mid \rho)$ in (6). It only needs to be given the appropriate ρ parameter, to be able to choose its policy. The parameter itself is voted upon by society, with each household casting a single ballot on which it has noted its preferred value for ρ. We suppose that the winning ρ must be able to defeat all alternatives in a pairwise majority vote.

[8]In this paper the information held by households is limited, though the planner is assumed to know everything. The incentive aspects of the scheme—whether households are able to or wish to behave strategically—inhere in this informational assumption, which we shall seek to broaden in future work.

The social planner's problem.

The social planner has the authority to set prices however it chooses, so long as $p_i > 0$ for each good i. Demands are homogenous of degree zero in prices; it is assumed the prices are normalized by setting $p_n = 1$. Then the set of prices that are available—the social planner's choice set—is $\mathcal{P} = R_{++}^{n-1}$. The planner's decision problem is to maximize $W(U, x \mid \rho)$ on $\mathcal{P}$. Let $p^*(\rho)$ denote the solution to the planner's problem.

$$p^*(\rho) = \operatorname{argmax}_{p \in \mathcal{P}} W(U, x \mid \rho). \tag{7}$$

We assume that the planner's table is finite in length. That is, there is some finite T such that $\mid \rho^* \mid < T$. The planner's search, then, will take place on the interval $[-T, -1]$. Problem (7) is well defined only if W is strictly concave in p and achieves a unique maximum on $\mathcal{P}$. Numerical evidence suggests that W has this property. Figure 1, containing the level curves of $W(U, x \mid \rho = -1)$, depicts this numerical evidence. Let us suppose that the planner's problem does indeed have a unique solution for each ρ.

The households' problem.

Upon inserting $p^*(\rho)$ into its own money metric welfare function $\ln V_k$, household k can calculate its welfare as a function of ρ. The household's problem is to calculate the value of ρ at which its welfare level is maximized. It informational resource Ω_k limits the household to responding to the planner's query with its preferred level for ρ. Let $\rho_k^*(U, x \mid \rho\Omega_k)$ denote the solution to household k's problem.

$$\rho_k^*(U, x \mid \rho\Omega_k) = \operatorname{argmax}_{\rho_k \in [-T, -1]} \ln V_k\big(y_k/m_0, p^*(\rho), d_k\big). \tag{8}$$

Note that ρ_k^* is a composite mapping that depends upon ρ indirectly through $p^*(\rho)$.

Because $\ln V_k$ is a continuous function defined on a closed set, it must achieve a maximum on $[-T, -1]$. If ρ_k^* achieves a maximum over an interval—if there are multiple values of ρ that yield the same level of welfare—then we assume that the household selects the least of these values.[9]

[9] In the application presented in the following section, there are many households for whom there are multiple solutions to problem (8). Under our assumption that such a household chooses as its optimal ρ_k the minimum of these values, its problem may be written $\rho_k^*(U, x \mid \rho) = \min\{\operatorname{argmax}_{\rho_k \in (-\infty, -1]} \ln V_k\}$.

The voting for equity scheme.

Our scheme for deducing society's collective opinion concerning the level of equity that should be incorporated in policy making—the choice of ρ—involves compiling the individual ρ_k^* into a single value ρ^*. For this purpose we assume that majority rule is employed, with households now playing the role of voters.

Consider the K-vector $(\rho_1^*, \ldots, \rho_K^*)$ of optimal ρ's. We assume that in any pair-wise vote households select the value for ρ that is nearest ρ_k^* according to the Euclidean distance metric. Given this assumption, Black's (1948) median voter theorem guarantees that the median of the ρ_k^*'s will be a majority rule winner. Denote this median by ρ^*.

Define a *voting for equity scheme* $\mathcal{S}$ by (i) a set of individual money metric welfare functions $(\ln V_1, \ldots, \ln V_K)$ and (ii) the social welfare function W. We now provide a definition for an equilibrium for $\mathcal{S}$. This definition requires simply that households choose optimally, that the majority rule winner is selected as society's optimal ρ, and that given this value the social planner selects a price vector according to (7).[10]

DEFINITION. *Given a voting for equity scheme $\mathcal{S}$, an* **equilibrium** *is a pair (ρ^*, p^*) at which (i) households choose ρ_k^* according to (8) and ρ^* is the median of the ρ_k^*, and (ii) p^* solves (7) given ρ^*.*

5. A time series application.[11]

In this section we present the results of applying the our voting for equity scheme to a time series data set. The data are yearly U.S. aggregates spanning the period 1953 through 1988. An observation can be thought of as a representative household for the corresponding year. The $n = 3$ consumption variables include food at home, food away from home, and a composite of all other goods. Two demographic variables are included for each year: percent of the U.S. population aged 15 years and under; and the percent of the U.S. population enrolled in schools. These come from the Current Population Reports of the U.S. Bureau of the Census. Income y_k is personal consumption

[10] Given our informational assumption—that households do not know other households' $\ln V_k$—there is no scope here for strategic behavior. However, in future work the informational assumption we adopt here will be relaxed, permitting an exploration of the incentives facing households in the voting scheme and of the effects of strategic opportunities.

[11] This section draws upon, and uses the econometric results from, Ferreira and Perali (1992b).

expenditure, taken from the National Income and Product Accounts of the U.S., published by the Department of Commerce. Prices are indices taken from the regular urban national Statistical Accounts with base years 1983–84. Table 1 contains summary statistics for the data.

A time series application requires treating a yearly observation (of which there are 36) as a "household." Henceforth this term is used to denote such an observation. There are reasons, perhaps, why a cross-section data set would be preferable for our purposes. Chief among them is the difficulty of interpreting a vote that occurs across 36 years, and the accompanying requirement that households have complete information about each other. To be sure, it cannot be said that consumers in 1953 knew what preferences (or prices and income) would be in later years. The data are known now, however, and the exercise can be conducted today. Another difficulty is the requirement that the social planner's price policy be applied to each household. This means that the same price vector faces households in each period. We acknowledge this difficulty, but do not feel that it takes away from the value of our results.

Though there are drawbacks to a time series application, it seems there are significant advantages as well. We are able to interpret our results as society's preferences regarding *intergenerational* equity. The outcome of the voting for equity scheme yields an extension to the over time welfare comparisons of Jorgenson (1990). That is, in addition to information about whose welfare is greatest and least, we can estimate the intergenerational society's preferences for equity. We have little intuition to guide us in assessing beforehand which households will want equity to play an important role in policy-making. It is true that in our data set scaled income is lowest in the early periods. However, because the effect of price policies upon individual households is complex, it is unclear whether the price policy that maximizes social welfare will deliver more or less *welfare* to the households with low income.

The estimation of the Barten-Gorman demographically modified AIDS using these data is reported in Ferreira and Perali (1992a). There, a number of alternative demographic schemes are compared statistically, and diagnostic procedures are performed. We take those results as the starting point for our analysis. In order to calculate $m_0(p, d_k)$ a decision must be made regarding the benchmark period or reference household. We have chosen period 1 as our reference household, and have calculated the vector of m_0 using actual prices.[12]

The calculations of $p^*(\rho)$ and the ρ_k^* were carried out in the GAUSS programming language. From the perspective of a household, the program to calculate the solution to (6) is simply a subroutine. It lays out the mapping between ρ and optimal policies. We take values of ρ in the interval from -1 to -16, in increments of 0.04. The solution to (6) is calculated numerically for the 375 values of ρ in this grid. The program generates a 375×3 matrix, with row s containing a 3-vector (ρ^s, p_1^s, p_2^s).

Figure 1 contains a plot of the level curves of the planner's objective function W as it depends upon p_1 and p_2. This diagram shows clearly the planner's optimal choice of $p^*(-1) = (2.095, 1.233)$. In Table 2 we present the relationship between the prices and ρ, and also the values of $\ln \bar{V}$ and W. The difference between these columns is the value of the equity term in (6). When ρ reaches -11.8 the optimal policy ceases its movement. This is because at this level the equity term in (6) becomes negligible, and the planner's objective becomes the maximization of average welfare $\ln \bar{V}$.

A household, being interested only in its own welfare, does not care about social welfare but only about the relationship between ρ and its own $\ln V_k$. Using this fact, we solve each household's problem by calculating $\ln V_k$ for each ρ^s, using the corresponding price pair (p_1^s, p_2^s). The ρ^s corresponding to the maximum $\ln V_k$ is selected the household's choice. It has been denoted ρ_k^*, and equals the value that this household will write on its ballot in the voting for equity scheme.[13]

In Figure 2 we present the relationship, for selected households, between ρ and $\ln V_k$, via the planner's choice $p^*(\rho)$. There, it is seen that the early households (those from years early in our data set) do not want equity to matter very much. (Recall that $\rho = -1$ reflects the greatest possible considerations of equity.) Their welfare is maximized if ρ is in the neighborhood of 10.88, which ensures that equity is of little importance to the planner. Households late in our data set, on the other hand, want equity to matter a great deal. They achieve their greatest level of welfare when $\rho = -1.48$.

[12]Because m_o depends upon p, it is not unique. This delicate issue is important, for the optimal policy p^* depends upon the scale which, without fixing the prices in m_0, in turn depends on p^*. The choice of period 1 actual prices as the base price vector is in some sense arbitrary, but some choice like it is necessary in order to break this jointness between prices and the scale.

[13]For the final calculation of the median of ρ_k^*, we discard the household from 1953, which played the role of our reference household. The choice of ρ^* would be the same if we left this household in the voting scheme.

Table 3 catalogs the values for scaled income, ρ_k^*, and the difference between their money metric welfare value at its optimal value (corresponding to ρ_k^*) and at its final value as given by the median, which is

$$\rho^* = -10.84.$$

This is the equity value that society ultimately chooses, and that the planner uses in selecting its ultimate price policy of $p^* = (1.778, 1.118)$. This result is the central finding of our study. The intergenerational "society" that we have examined does not wish collectively for equity to matter very much to policy making. More specifically, the households from early years—1953 through 1972—do not want equity to matter, while households from the later periods do want equity to matter. The twenty early households agree almost complete agreement concerning the optimal value for ρ. Our interpretation of this result is that policies to maximize social welfare in which equity plays an important role enhance social welfare by promoting the interests of contemporary households at the expense of their parents. What's more, and given our voting for equity scheme this is unfortunate for the later households, there are relatively few households who want equity to matter a great deal. Under majority rule the early households constitute an unstoppable force in the political process determining ρ^*.

This outcome may appear to run against intuition at first glance. In a given time period we might expect (for a cross-sectional study using the technique we have developed) the older cohort to seek the greatest amount of equity. This intuition is not helpful in interpreting our results, however. One must bear in mind that each of our observations, being a per capita national average, includes both old and young individual citizens. What we have learned is that once welfare is made interpersonally comparable, and once demographic information has been incorporated into a demand system, people alive in the relatively distant past are harmed at the expense of their children when intergenerational equity figures prominently in social policy. Stated another way, one could say that we have discovered that current households, though their scaled incomes are much greater than their forebears', gain by these equity considerations.

6. Conclusions.

In this paper we have developed a scheme for assessing society's preferences regarding the age-old equity versus efficiency trade-off. The method uses a social welfare function due to Roberts

(1980) and employed recently by Jorgenson (1990) and by Jorgenson and Slesnick (1983, 1987). There, the function has been used to compare the efficiency and equity effects of various economic policies, and to measure changes in welfare over time. We have used the same welfare function to ask the next question, namely, *how much* does society wish for equity to matter? Our scheme is devised to harness households' selfish impulses, calculating their selfish interest in the degree of equity to be incorporated in setting policy, and then it polls society to arrive at an optimal collective level of equity.

The results indicate that there is a fair bit of heterogeneity among household in different time periods concerning their preferences toward equity. Households appearing early in our data set do not wish for equity to matter very much, as their own welfare declines as the level of equity in the social welfare function increases. Recent households, on the other hand, wish for equity to matter a great deal. Unfortunately for them, their numbers are too small to achieve this aim.

The voting for equity scheme itself has desirable properties that have been treated lightly here. Evidently the scheme is incentive compatible in the sense that households cannot gain anything by misrepresenting their preferences in the vote. A formal analytical development of this result shall occupy us in future research, in which the voting scheme is itself formulated as a noncooperative game among households, the Nash equilibrium of which is also a dominant strategy equilibrium.

Other extensions of our work would also appear to be of interest. An application using a cross-section data set would permit a more natural interpretation of the voting scheme itself, and would provide insights concerning the interaction of contemporary agents and their equity preferences. Comparing results of this sort of study for different countries or for a variety of alternative economic policies would permit still another view of collective equity preferences.

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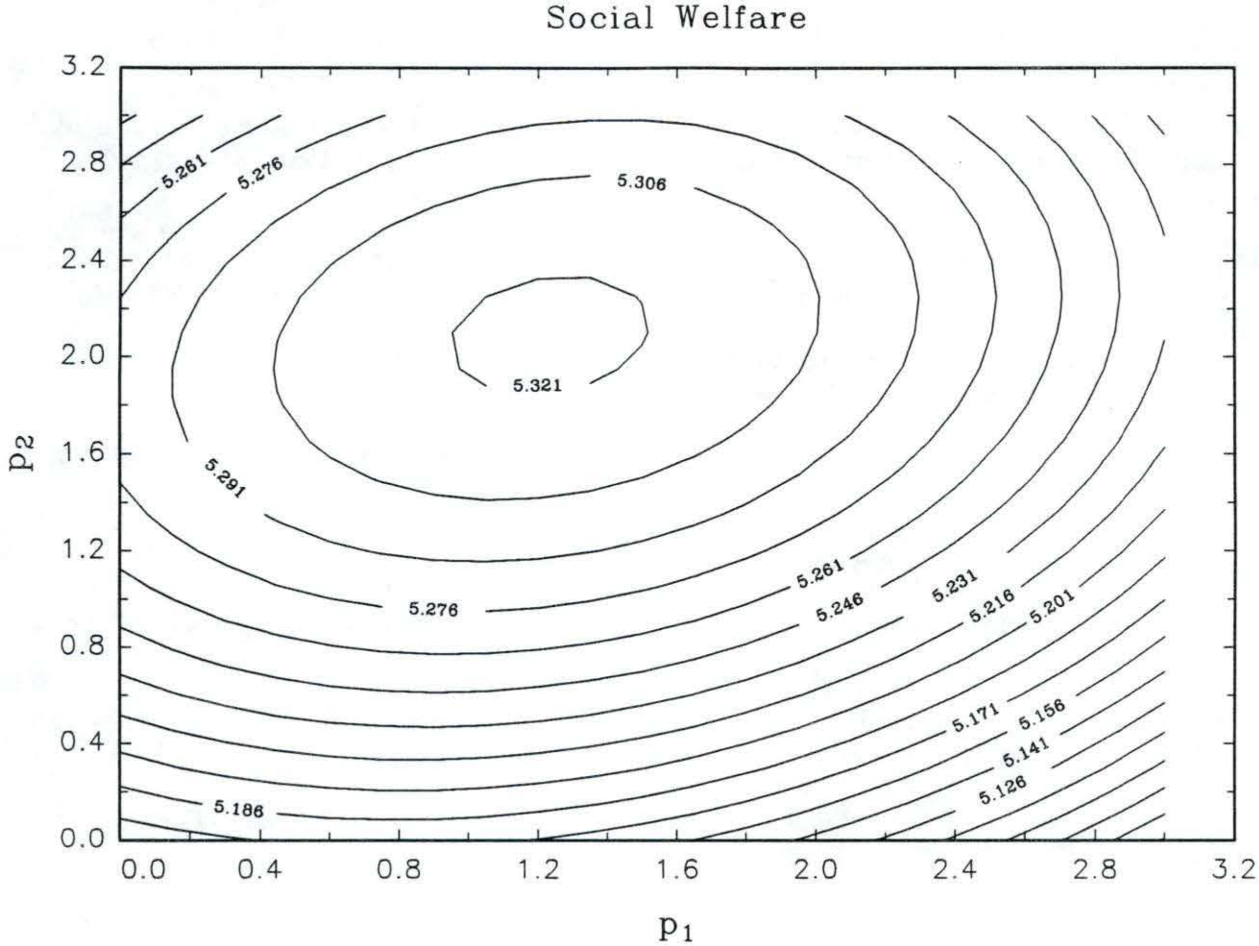

Figure 1. Level curves in (p_1, p_2) of $W(U, x \mid \rho = -1)$.

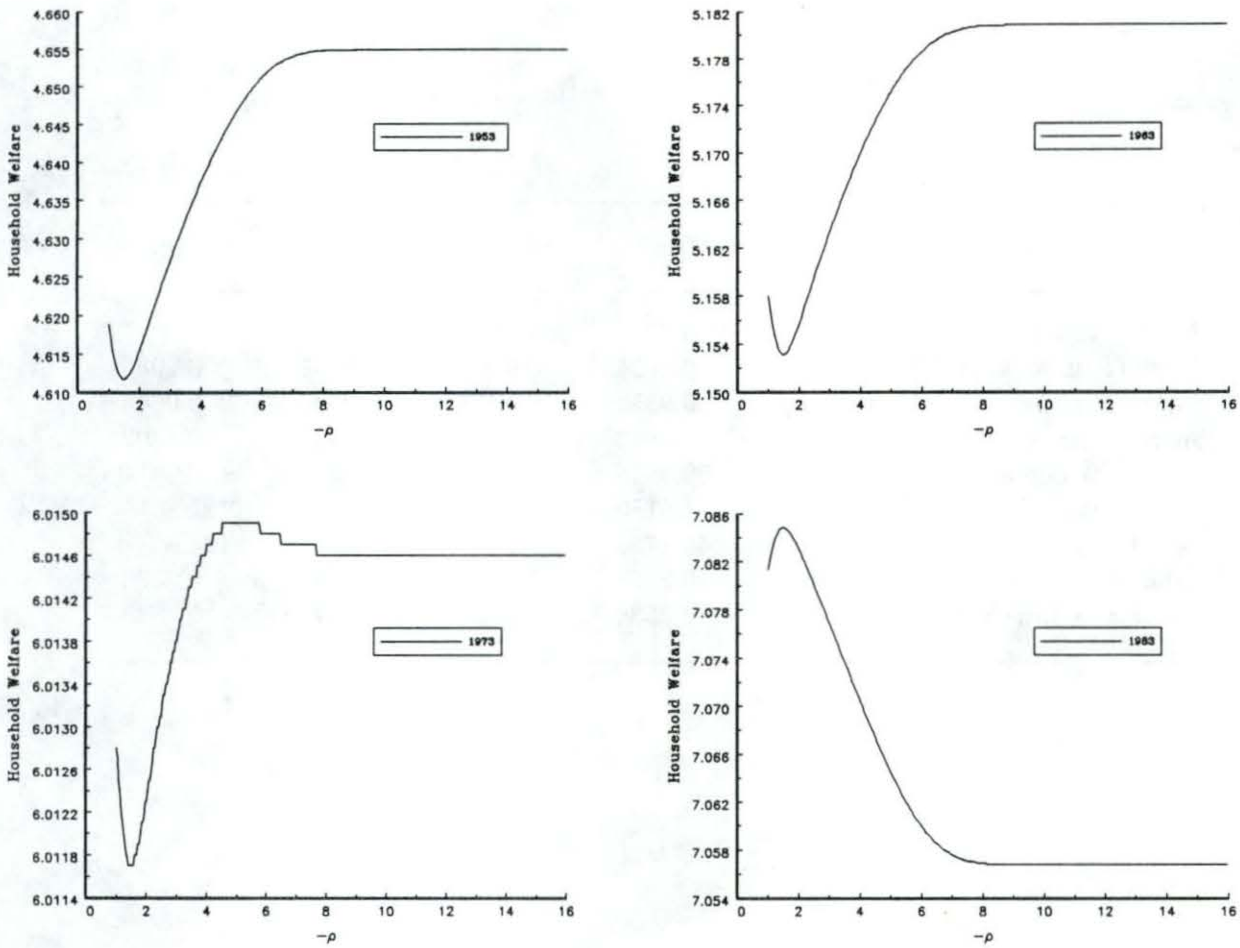

Figure 2. Relationship between ρ and $\ln V_k$ for selected households.

Table 1. Descriptive statistics ($K = 36$).

Variable	Mean	Std Dev	Minimum	Maximum
Expenditure ($ billion)	1070.61	904.22	232.6	3235.1
Share (food at home, %)	0.1604	0.0264	0.1151	0.2056
Share (food away from home, %)	0.0554	0.0019	0.0529	0.0606
Share (other goods, %)	0.7843	0.0274	0.7347	0.8302
p (food at home)	50.2916	1.6450	29.50	116.60
p (food away from home)	44.6150	1.8094	21.50	121.80
p (other goods)	45.1786	1.7558	23.32	124.69
Population 1–15 years old (%)	0.2827	1.1421	0.2285	0.3306
Population in school (%)	0.2584	1.0905	0.2047	0.2943

Table 2. Optimal price policy and social welfare levels, depending upon ρ.

ρ	$p_1^*(\rho)$	$p_2^*(\rho)$	$\ln \bar{V}$	$W(U, x \mid \rho)$
-1.00	2.095	1.233	5.9134	5.3233
-2.00	2.122	1.243	5.9127	5.7976
-3.00	2.030	1.230	5.9148	5.8774
-4.00	1.943	1.178	5.9162	5.9025
-5.00	1.868	1.151	5.9170	5.9124
-6.00	1.815	1.131	5.9172	5.9160
-7.00	1.787	1.121	5.9172	5.9171
-8.00	1.779	1.118	5.9173	5.9172
-9.00	1.778	1.118	5.9173	5.9172
-10.00	1.778	1.118	5.9173	5.9173
-11.00	1.778	1.118	5.9173	5.9173
-12.00	1.778	1.118	5.9173	5.9173
-13.00	1.778	1.118	5.9173	5.9173
-14.00	1.778	1.118	5.9173	5.9173
-15.00	1.778	1.118	5.9173	5.9173
-16.00	1.778	1.118	5.9173	5.9173

Table 3. Optimal choice ρ_k^*, scaled income, $\ln V_k(\rho_k^*)$, and $\ln V_k(\rho^*)$ for each household.

Year	y_k/m_0	ρ_k^*	$\ln V_k(\rho_k^*)$	$\ln V_k(\rho^*)$	Year	y_k/m_0	ρ_k^*	$\ln V_k(\rho_k^*)$	$\ln V_k(\rho^*)$
1953	301.2702	-10.84	4.6551	4.6511	**1971**	895.7800	-10.88	5.8118	5.8118
1954	310.5958	-10.84	4.6874	4.6874	**1972**	981.2651	-10.88	5.9086	5.9086
1955	334.0394	-10.84	4.7647	4.7647	**1973**	1084.3653	-5.08	6.0149	6.0146
1956	350.4888	-10.84	4.8157	4.8157	**1974**	1187.0769	-3.76	6.1120	6.1107
1957	369.5287	-10.84	4.8718	4.8718	**1975**	1311.8075	-2.52	6.2201	6.2168
1958	381.5743	-10.84	4.9059	4.9059	**1976**	1462.7016	-1.48	6.3389	6.3323
1959	409.6808	-10.84	4.9813	4.9813	**1977**	1628.3613	-1.48	6.4562	6.4462
1960	428.3321	-10.84	5.0286	5.0286	**1978**	1817.8532	-1.48	6.5765	6.5631
1961	441.8025	-10.84	5.0615	5.0615	**1979**	2029.3641	-1.48	6.6968	6.6799
1962	468.7432	-10.84	5.1243	5.1243	**1980**	2244.1129	-1.48	6.8068	6.7867
1963	494.3887	-10.88	5.1809	5.1809	**1981**	2480.4922	-1.48	6.9162	6.8930
1964	530.1370	-10.88	5.2550	5.2550	**1982**	2656.1251	-1.48	6.9910	6.9657
1965	570.8072	-10.88	5.3334	5.3334	**1983**	2894.1881	-1.48	7.0849	7.0568
1966	618.2126	-10.88	5.4181	5.4181	**1984**	3148.0529	-1.48	7.1768	7.1460
1967	652.2771	-10.88	5.4751	5.4751	**1985**	3405.1558	-1.48	7.2626	7.2294
1968	715.6138	-10.88	5.5734	5.5734	**1986**	3623.2723	-1.48	7.3305	7.2953
1969	774.4171	-10.88	5.6573	5.6573	**1987**	3899.6740	-1.48	7.4108	7.3733
1970	828.9463	-10.88	5.7295	5.7295	**1988**	4190.1938	-1.48	7.4894	7.4496