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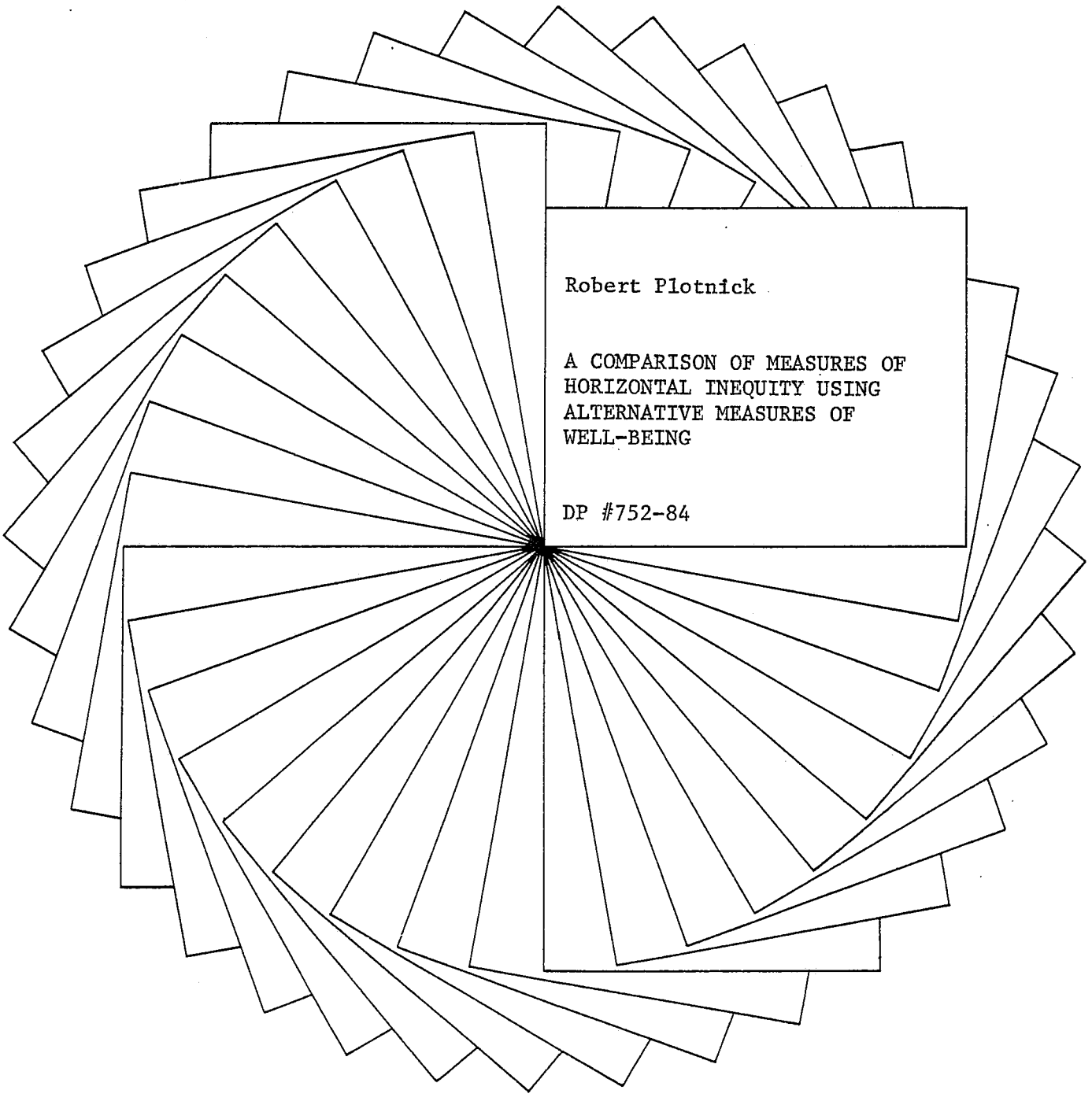

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A COMPARISON OF MEASURES OF HORIZONTAL INEQUITY USING ALTERNATIVE MEASURES OF WELL-BEING

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A Comparison of Measures of Horizontal Inequity Using Alternative Measures of Well-Being

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Abstract

The principle of horizontal equity states that "equals should be treated equally:" redistributive policies should levy identical taxes or provide identical transfers to all units with the same level of well-being. More generally, it means that a redistribution should not alter the rank order of units in the distribution of well-being.

To empirically apply the principle, this study systematically explores the behavior of five measures of horizontal inequity. I use micro data to examine the indices' sensitivity to eleven redistributions and three alternative adjustments for family size and composition. Some of the redistributions are defined over a wide set of policies such as all cash transfers. Others involve only a few programs (e.g. cash public assistance and food stamps).

The five measures possess characteristics consistent with an interpretation of horizontal equity which emphasizes that rank reversals reduce overall social welfare. Because all measures implicitly contain normative judgements on the relative importance of rank reversals at different positions in the distribution of well-being, the findings cannot provide support for preferring one measure over the others.

It would simplify the choice among indices if they all produce similar ordinal rankings of the extent of horizontal inequity created by various redistributions. Empirically, however, this does not occur. The choice of index may affect perceptions of the relative amount of horizontal inequity of different redistributions. Analysts, therefore, must be sensitive to the normative issues.

Two other main findings emerge:

The particular adjustment for family size and composition does affect the absolute values of the indices. Sensitivity to such adjustments varies among the indices.

The choice of adjustment tends to have little effect on how each index scales the relative degree of horizontal inequity of various redistributions.

1. Introduction

The principle of horizontal equity is usually stated as "equal treatment of equals." Policies that redistribute should levy identical taxes or provide identical transfers to all units with the same level of well-being. In recent years several researchers have argued that if this classic definition is to be analytically useful and intuitively reasonable, it must be amended to include the more general condition that a redistribution of well-being must not alter the rank order of units (Atkinson 1980; Feldstein 1976; King 1983; Plotnick 1982).[1]

As attention to the concept of horizontal equity has grown, methods for appropriately measuring the extent of horizontal inequity have also received increased scrutiny (Atkinson 1980; Berliant and Strauss 1983; Cowell 1980, 1982; King 1983; Plotnick 1981, 1982; Rosen 1978). Empirical work on this issue, however, has been meager and unsystematic.[2] Papers with empirical sections have simply illustrated a particular measure (or measures) using a convenient data set. Analysts have not compared different measures applied to the same data and measure of economic welfare. Nor have they examined differences resulting from using the same measure of horizontal inequity and same data, but alternative definitions of economic well-being.

This study seeks to fill these gaps in the literature. Such an exercise is needed to give analysts a better "feel" for the meaning of different values of an inequity index and for how various indices differ in their sensitivity to changes in the definition of well-being.[3]

Aside from whatever intrinsic scholarly interest it may hold, advancing our understanding of the measurement of horizontal inequity may

contribute to better informed policy analyses and decisions. It is evident that the horizontal inequity generated by public policies which explicitly or implicitly redistribute economic welfare concerns decision makers. Analyses of proposed tax and welfare reforms and changes in entitlement programs prepared by the Congressional Budget Office or the U.S. Treasury Department routinely include simple "gainers and losers" tables. Such information provides a crude assessment of the extent of reordering. Examples of situations in which a non-working welfare mother's cash and in-kind transfer income exceeds the take-home pay of a working poor family have featured prominently in welfare reform debates since 1969. So, too, have examples of differences in public assistance provided to equally needy families caused by state-by-state variation in eligibility rules and benefit schedules. Waiting lists for subsidized public housing or other benefits with limited availability have been viewed as unfair since some equally deserving persons are denied access. Special provisions in the tax code are frequently defended or attacked by claiming they reduce or induce unequal treatment of equals.

There are sound reasons for this concern. Unequal treatment of equals and rank reversals are likely sources of social tension in a society which tends to view incomes (and, hence, ranking in the distribution) generated by market processes as deserved. Knowledge that some persons with lower market incomes than oneself attain greater disposable incomes by receiving some public benefit or avoiding their "fair share" of taxes may well breed resentment.

Because public policies may create horizontal inequity in accomplishing their primary objectives, decision makers should be aware of the extent of this negative effect. They may also be interested in

possible tradeoffs between it and the likely efficiency and conventional distributional impacts (i.e. effects on poverty or inequality independent of any reordering) of policy options. But to do so, they require useful indicators of the magnitude of horizontal inequity. This study, then, takes a necessary step towards our being able to sensibly evaluate the implications for horizontal inequity of specific policy proposals.

The balance of this paper has four parts. Part 2 more carefully examines the concept of horizontal inequity and develops the implications for properly measuring it. The third section describes the measures of horizontal inequity and well-being used and the data set. Part 4 contains the empirical findings. The final section is a summary and conclusion. A word of warning: the conclusion will not identify the best index on the basis of the empirical results. Such a judgement, as argued in part 3, is normative to an important degree and cannot be reached solely from the evidence provided here.

2. The Concept of Horizontal Inequity

While the classic notion of horizontal equity as "equal treatment of equals" expresses an important principle of policy design, it is conceptually incomplete. King (1983, p. 101) observes:

> "In practice, of course, no two individuals are ever identical, and the principle of equal treatment of equals has little empirical significance unless it can be usefully extended to include 'and unequals treated accordingly'. To do this we are led naturally to a comparison of the ordering of utility levels before and after a tax change."

Following this logic, a horizontally equitable redistribution is one that preserves the initial rank order of the units. This conception encompasses the classic definition but is more general.

The requirement of rank preservation has raised objections from some quarters (Berliant and Strauss, 1982). I believe it is essential for two reasons. First, though one is always free to require the term "horizontal inequity" to concern only unequal treatment of equals, the concept will then have little practical application, as King noted. Arbitrarily grouping "similar" units together and examining whether their treatments were equal appears to be an artificial way to salvage empirical applicability. Broadening the definition to cover rank reversals makes empirical analysis more feasible.[4]

The second is more fundamental and is rooted in the view that, ceteris paribus, horizontal inequity diminishes social welfare. Consider an economy characterized by competitive markets and equal opportunity.[5] As many have observed, the distribution of marginal revenue products and rents generated in such an economy is not necessarily just. Consequently, transforming the distribution of market income into one that better conforms to the society's preferred distribution will raise social welfare. The degree to which differences in initial well-being should be narrowed is debatable, but once this is resolved, what social purpose would be promoted by reversing ranks during the transformation? None -- if the economic game is regarded as a fair process. (And such an economy, I believe, would likely be a U.S. consensus choice for a fair system.) Unless the socially optimal distribution is one of full equality, those earning more initial well-being should surely have greater final well-being than those earning

less. What logic could justify otherwise? Thus, any reversals incidental to the redistributive process would seem to lower social welfare.[6]

A reranking causes a unit's actual level of final well-being to diverge from its rank-preserving final level. It is this divergence, rather than the rank reversal per se, that is the real source of the problem and that lowers social welfare. A useful measure of horizontal inequity, therefore, must be a function of such differences in economic well-being.[7]

In the dense portions of the income distribution, a modest cardinal difference in well-being would translate into a large difference between the actual ordinal rank and the rank-preserving one. The same difference in well-being for a unit in the upper tail would lead to a much smaller difference in ranks. A measure that examines differences in well-being, therefore, is probably superior to one based on rank differences.

If this perspective on horizontal inequity is accepted, the implications for the narrower "equal treatment of equals" approach are serious. Suppose that distinct groups of equals could somehow be identified. And assume that all members within any specific group received identical treatment. Then according to the equal treatment view, no horizontal inequity exists. Yet the final levels of well-being of two groups could well be in reverse order of their initial levels. The unfairness of such a situation would never be recognized by focusing on equal treatment.[8]

The view that rank reversals reduce social welfare rests, ultimately, on an intuitive appeal to notions of fairness and deservingness in the distribution and redistribution of economic resources. This judgement cannot be derived from either the principle of welfare maximization or that

of Pareto optimality (Atkinson 1980; Stiglitz 1982). It appears to be an independent principle of tax and transfer policy. (Hence, complete criteria for evaluating alternative redistributive policies must allow for tradeoffs among their horizontal inequities, vertical inequities, inefficiencies, administrative costs and other attributes.)

As should now be clear, I interpret the principle of horizontal equity as one concerned with fairness in the process of redistribution. It offers no guidance on whether the initial or final distribution is optimal or just, nor on whether the redistributive instruments made the distribution more or less just. Instead, given the initial and final distributions, it poses a criterion to judge the fairness of the means used to alter the distribution. Conceivably, one could argue that a particular final distribution was not just, but agree that it was obtained by a horizontally equitable process.

The emphasis on process brings out an important implicit assumption in the interpretation of horizontal inequity -- the initial ranking is accepted as fair. Yet in real economies, unlike the ideal one posited above, there are many reasons to reject this assumption. For example, the influence of racial discrimination, monopoly rents or bribes on setting the initial ranking would lead one to question its fairness. Nonetheless, on pragmatic grounds, this assumption may not be too bad. If, despite the contrary arguments that can be offered, most persons tacitly accept the initial ranking as reasonably fair when making judgements on redistributive equity, a useful measure of horizontal inequity (useful in the sense that it measures a phenomenon of public concern, even if the concern is partly based on "faulty" perception of what constitutes the fair ranking) must also accept this ranking.

If no normative value attaches to the initial ranking, a reranking need not, of course, be inequitable. In the empirical section of the paper, I necessarily assume that the initial ranking deserves to be preserved.[9]

Horizontal Versus Vertical Equity

The rank condition may appear to be a principle of vertical equity. Carefully distinguishing between the concepts of vertical and horizontal equity shows that this interpretation does not follow, however. Vertical equity is perhaps best interpreted, in Nozick's (1974) terms, as an "end state principle." One compares an observed distribution of economic well-being to an optimal one. (How the optimum is derived is immaterial for this discussion.) If they differ, vertical inequity exists -- the relative incomes of some or all of the units are too large or too small. A redistribution reduces the extent of vertical inequity if it moves the actual distribution "closer" to the optimum.[10]

This notion of vertical equity does not include a rank order condition. Measures of inequality which satisfy the widely accepted anonymity principle are independent of which unit occupies each position in the distribution.

There has been conflict and confusion over terminology among researchers who analyze changes in the income distribution. This semantic problem leads to disagreement about how to properly measure various effects of redistributive activity. One can ask if a redistributive policy 1) alters the level of inequality, 2) reranks units, and 3) requires those with greater ability to pay to, in fact, pay more taxes or receive lower benefits. I view these as questions of vertical equity, horizontal equity

and progressivity. Others may choose different terms to label these three issues or use these three terms to refer to different issues. It would be useful to reach consensus on terminology.

3. Empirical Procedures

Five Measures of Horizontal Inequity

Economists have proposed a large variety of indices for measuring horizontal inequity. Many are unsatisfactory, however, because they mistakenly fold norms of vertical equity into the index formula or do not adequately deal with reranking (Plotnick 1982, pp. 386-90).

This study provides empirical results only for the five "good" measures that I have found in the literature. "Good" measures satisfy three properties (Plotnick 1982, p. 384). First, their values are independent of the mean of the final distribution of well-being. Second, they satisfy a simple anonymity condition. Last, if one redistribution differs from a second solely by having some units' actual final levels of welfare closer to what their rank-preserving (i.e. their horizontally equitable) final levels are, the index must show less horizontal inequity for the first redistribution. This third property is crucial, for it forces measures to embody the loss-of-social-welfare interpretation of horizontal inequity offered in part 2.

Denote unit i's actual observed level of welfare in the final distribution by oy_i. Unit i's final level of welfare <u>if its rank in the initial and final distribution were identical</u> is denoted fy_i. That is, fy_i is the level of well-being that would have been attained in a rank-preserving, completely horizontally equitable redistribution. The observed rank in the final distribution and the rank in the initial

distribution are, respectively, or_i and fr_i. Assume N units with mean final welfare of Y. The first of the five measures is:

$$(1) \qquad A\text{-}P = \frac{\sum_i fr_i(fy_i - oy_i)}{N^2 YG}$$

where G = Gini coefficient of final well-being.

This index has a familiar geometric interpretation (Atkinson 1980; Plotnick 1981). Construct a concentration curve by ordering units according to their initial rank and plotting cumulative shares of final well-being. The curve will always lie above and to the left of the conventional Lorenz curve for final well-being. The area between these two curves, divided by the maximum possible area between them (which has the same value as G), equals A-P.

The second measure is:

$$(2) \qquad K_{h,t} = 1 - \left[\frac{\sum_i [oy_i \exp(-h|oy_i - fy_i|/Y)]^t}{\sum (oy_i)^t}\right]^{1/t}, \qquad t \neq 0$$

$$= 1 - \exp\left(\frac{-h}{N}\sum_i |oy_i - fy_i|/Y\right), \qquad t = 0$$

In this index h is a non-negative number chosen by the analyst and indicates the degree of aversion to horizontal inequity (King 1983). King notes that the social value of the level of economic well-being, oy_i, of a unit which is reranked equals the social value of a level of well-being $oy_i e^{-hs}$, where $s = |oy_i - fy_i|/Y$. If h = 1.0 (5.0), s = 0.05 is equivalent in terms of social evaluation to a reduction in well-being of about 5 (22) percent. Parameter t = 1 - e, where e is the coefficient of inequality

aversion (Atkinson 1970). Since e may be any non-negative number, t may have any value less than or equal to one. I obtained results for 20 combinations of h and t: h = 0.5, 1, 2 or 5; t = -1, -0.5, 0, 0.5 or 1.

Indices 3a and 3b are special cases of a family of one-parameter measures (Cowell 1980) with the parameter equal to zero or -1:[11]

$$(3a) \qquad C_0 = \frac{\sum_i oy_i \ln(oy_i/fy_i)}{NY}$$

$$(3b) \qquad C_{-1} = \frac{-\sum_i fy_i \ln(oy_i/fy_i)}{NY}$$

Of the infinite set of possible indices, only these two yield useful decompositions of total horizontal inequity into within and between subgroup components.

Measure 4 is defined as:

$$(4) \qquad P_h = \left[\frac{\sum_i |oy_i - fy_i|^h}{\max}\right]^{1/h}, \qquad h \geq 1$$

where max = the maximum value possible for the expression in the numerator and $h \geq 1$. P_h is a slight modification of the index suggested by Plotnick (1982, p. 385). As in King's index, P_h is an increasing function of h. The calculations set h = 1, 1.5, 2, 2.5, 3 and 4.

Last:

$$(5) \qquad S = \frac{3 \sum_i (or_i - fr_i)^2}{N^3 - N}$$

This measure is half of one minus the Spearman rank correlation coefficient. (The subtraction is a needed formality if S is to satisfy the third property listed earlier.)

A-P, $K_{h,t}$, P_h and S range between zero and one. C_0 and C_{-1} have a lower bound of zero, but indeterminate upper bound.

These measures vary along two general dimensions. First, different functional forms are used to cardinalize the "amount of horizontal inequity" produced by a gap between oy_i and fy_i. For example, $K_{h,t}$ exponentiates the product of h and the absolute value of the difference between oy_i and fy_i, while C_0 and C_{-1} use the logarithm of the income ratio. For all measures except $K_{h,t}$ with a non-zero t, if $oy_i = fy_i$ (which implies $or_i = fr_i$) the functions give the value zero for unit i, as one would expect.[12] Second, different weights are assigned to each unit in the income distribution when summing the "amount of horizontal equity." For example, A-P uses the rank of the unit in the initial distribution. P_h assigns equal weights. Thus, like inequality indices, measures of horizontal inequity necessarily contain implicit judgements or require explicit ones, and are not objective.[13]

Measures of Well-Being

To compute indices of horizontal inequity, one must define the initial and final measures of economic well-being. The precise characteristics of the distribution of initial well-being (such as its level of inequality) are not important. Rather, its importance is to establish the fair ranking

of units that a horizontally equitable redistribution would preserve.[14] The vector of actual final levels of well-being, in which element j is the level of final well-being of the unit with rank j in the initial distribution, is then compared to what the rank-preserving vector of levels of final well-being would have been, and the differences summarized by an index.

The concept of horizontal inequity itself offers no guidance on how equals are to be identified and the appropriate ranking established. Instead, the choice of initial and final concepts of well-being necessarily varies with the interests of the analyst. For example, if the horizontal inequity of the cash transfer system were at issue, initial well-being might be pretax, pretransfer income. Final well-being would then be pretax, post-cash-transfer income. (Or one might use a posttax variant.) If the inequity of only cash public assistance were under scrutiny, initial and final well-being might be pretax, post-social-insurance income (since social insurance income helps define eligibility) and pretax, post-all-cash-transfer income. And if one wanted to know whether food stamps reduce horizontal inequities created by interstate variation in cash public assistance, one would compare the index resulting from the preceding definition of initial and final well-being to one based upon the same initial income, but final well-being equal to income after taxes, all cash transfers and food stamps.[15] Adjustments for needs, cost-of-living differences, leisure, net assets, etc. may also be incorporated if the analyst regards them as important "admissible distinctions" (Stiglitz 1982, pp. 25-28) for determining the initial ranking that serves as the benchmark.

This exploratory exercise examines a variety of redistributions. Table 1 lists the measures of initial and final income which define each redistribution. In some, the horizontal inequity of a wide set of tax and transfer instruments is assessed. CASHT considers all cash transfers. ALLT examines cash transfers plus the major in-kind programs -- food stamps, Medicare and Medicaid. Since the appropriate method for assigning benefits from medical care transfers is uncertain (Smeeding and Moon, 1980), CASHT+FS includes only cash and food stamp benefits. The next 3 redistributions cover the same sets of transfers but also include federal income and payroll taxes. With others, the difference between the concepts of well-being involves three or fewer transfer programs or taxes. WELF looks at cash public assistance; WELF+FS adds food stamps, and WELF+FS+MCAID examines Medicaid as well. Redistribution 10 assesses these three income-tested transfers and the federal income tax, all of which have explicit redistributive purposes. Finally, TAX isolates just the federal income and payroll taxes for analysis. I also computed all index values for each redistribution using welfare ratios based on the federal poverty lines and income per family member to check the indices' sensitivity to alternative adjustments for family size and composition ("needs adjustments").

Redistributions 1-6 and 10 have substantial impacts on income inequality. The Gini coefficient is reduced by between 15 and 26 percent. The other four redistributions exert much smaller equalizing effects since they are less comprehensive. The Gini coefficient falls by 3 to 6 percent. (Appendix table A-1 contains initial and final Gini coefficients for all rows in table 1.)

Table 1

Concepts of Initial and Final Income Used in the Analysis

	Initial Income Concept	Final Income Concept	Assesses Horizontal Inequity of:
Comprehensive Redistributions:			
1. CASHT	pretax, pretransfer[a]	pretax, post cash transfers	all cash transfers[b]
2. ALLT	" "	pretax, post all transfers	all cash transfers, food stamps, Medicare, Medicaid
3. CASHT+FS	" "	pretax, post cash transfers and food stamps	all cash transfers, food stamps
4. CASHT+TAX	" "	posttax, post cash transfers	as in row 1, plus federal income and payroll tax
5. ALLT+TAX	pretax, pretransfer	posttax, post all transfers	as in row 2, plus federal income and payroll tax
6. CASHT+FS+TAX	" "	posttax, post cash transfers and food stamps	as in row 3, plus federal income and payroll tax

Table 1 (continued)

	Initial Income Concept	Final Income Concept	Assesses Horizontal Inequity of:
Redistribution by Income-Tested Programs:			
7. WELF	pretax, post cash social insurance	pretax, post cash transfers	public assistance
8. WELF+FS	" "	pretax, post cash transfers and food stamps	public assistance, food stamps
9. WELF+FS+MCAID	pretax, post cash social insurance	pretax, post all transfers	public assistance, food stamps, Medicaid
Redistribution by Explicitly Redistributive Instruments:			
10. INCTX+INCTEST	post payroll tax, social insurance and Medicare	post all taxes and transfers	income tax, public assistance, food stamps, Medicaid
Redistribution by Taxes:			
11. TAX	pretax, pretransfer	posttax, pretransfer	federal income and payroll tax

a. Includes labor, property and miscellaneous market income and private transfers.
b. OASDI, unemployment insurance, workers' compensation, veterans compensation and pensions, government pensions and all forms of cash public assistance.

Data

The data set is a modified March 1975 Current Population Survey. Income information is for 1974 and has been adjusted for underreporting of all types of money income. Estimated federal income and payroll taxes and imputed benefits from food stamps, Medicare and Medicaid have been added to the data. Both medical transfers are imputed on an insurance value basis. In-kind benefits are counted at taxpayer cost, not cash-equivalent values.[16] Expressions (1) - (5) are suitably modified to account for the data's population weights. To reduce computational burdens, one quarter of the observations (N = 11495) were used in the calculations.

4. Empirical Results

Table 2 presents a representative set of ten index values for the 11 redistributions listed in table 1 using income as the indicator of well-being.[17] All indices clearly are sensitive to the choice of initial and final income since, as a glance down the columns shows, their values vary by factors of 5 or more. Columns 3 and 4 show that increasing the degree of aversion to horizontal inequity (holding t constant) can significantly raise that index's value. Columns 6 and 7 suggest somewhat less sensitivity of P_h to the size of h. Differences across a row cannot be meaningfully compared (just as one would not cardinally compare the Gini coefficient, coefficient of variation and Atkinson's index for the same distribution).

More interesting is a comparison of how the indices order the extent of horizontal inequity of the various redistributions. Table 3 shows the ordinal ranking according to six of the indices presented in table 2. For the same six indices, table 4 normalizes the figures in table 2 by setting

Table 2

Values of Selected Indices of Horizontal Inequity[a]

Redistribution	Index of Horizontal Inequity									
	A-P	$K_{1,.5}$	$K_{1,0}$	$K_{5,0}$	$K_{2,-.5}$	P_1	P_4	C_{-1}	C_0	S
1. CASHT	.0194	.110	.112	.448	.215	.106	.181	.0336	.0426	.0238
2. ALLT	.0245	.119	.122	.481	.244	.122	.182	.0329	.0386	.0310
3. CASHT+FS	.0195	.109	.111	.455	.220	.106	.181	.0293	.0354	.0239
4. CASHT+TAX	.0333	.146	.144	.542	.264	.150	.293	.0442	.0557	.0354
5. ALLT+TAX	.0423	.157	.156	.573	.297	.173	.298	.0435	.0511	.0471
6. CASHT+FS+TAX	.0337	.145	.143	.538	.272	.151	.295	.0390	.0468	.0361
7. WELF	.0018	.013	.019	.093	.065	.017	.054	.0078	.0164	.0026
8. WELF+FS	.0022	.014	.022	.104	.081	.020	.056	.0075	.0129	.0032
9. WELF+FS+MCAID	.0045	.025	.034	.159	.096	.032	.075	.0097	.0158	.0067
10. INCTX+INCTEST	.0095	.073	.072	.310	.142	.075	.197	.0140	.0210	.0110
11. TAX	.0009	.044	.030	.141	.005	.024	.084	.0012	.0006	.0004

[a]Computed using income as the measure of well-being.

Table 3

Ordinal Rankings of Redistributions in Terms of Horizontal Inequity[a]

Redistribution	Index of Horizontal Inequity					
	A-P	$K_{1,.5}$	$K_{2,-.5}$	P_1	C_0	S
1. CASHT	7	7	6	6.5	8	6
2. ALLT	8	8	8	8	7	8
3. CASHT+FS	6	6	7	6.5	6	7
4. CASHT+TAX	9	10	9	9	11	9
5. ALLT+TAX	11	11	11	11	10	11
6. CASHT+FS+TAX	10	9	10	10	9	10
7. WELF	2	1	2	1	4	2
8. WELF+FS	3	2	3	2	2	3
9. WELF+FS+MCAID	4	3	4	4	3	4
10. INCTX+INCTEST	5	5	5	5	5	5
11. TAX	1	4	1	3	1	1

[a]Based on Table 2.

Table 4

Normalized Index Values as the Redistribution Varies

Redistribution	Index of Horizontal Inequity					
	A-P	$K_{1,.5}$	$K_{2,-.5}$	P_1	C_0	S
1. CASHT	100	100	100	100	100	100
2. ALLT	126	109	113	115	91	130
3. CASHT+FS	101	99	102	100	83	101
4. CASHT+TAX	172	133	122	142	131	149
5. ALLT+TAX	218	143	138	164	120	198
6. CASHT+FS+TAX	173	132	126	142	110	152
7. WELF	9	12	30	16	39	11
8. WELF+FS	11	13	38	19	30	13
9. WELF+FS+MCAID	23	23	45	30	37	28
10. INCTX+INCTEST	49	67	66	71	49	46
11. TAX	5	40	3	23	1	2

the top value in each column at 100. (For completeness, parallel computations for the other four are in appendix tables A-2 and A-3.) The columns, then, display the relative changes in the cardinal values of each index as the redistribution varies. Every index (except P_4, as seen in tables A-2 and A-3) separates the redistributions into three strata. Redistributions 7-11 create the least horizontal inequity. The top three fall in a middle range. Rows 4-6 show the most inequity.

The rankings and normalized values are surprisingly similar among the A-P, $K_{h,t}$, P_h and S measures. Each shows its largest value for ALLT+TAX. In table 4, each records very small differences between rows 4 and 6, though $K_{1,.5}$ ordinally ranks 4 higher than 6 and the others give the reverse order. These five indices all rank ALLT eighth and place INCTX+INCTEST fifth. All five exhibit trivial normalized differences between CASHT and CASHT+FS. Only for rows 7, 8, 9 and 11 do the rankings and relative values differ noticeably. Though all five measures rank WELF, WELF+FS and WELF+FS+MCAID in ascending order, they disagree on where the horizontal inequity of TAX stands in relation to the inequity of these three redistributions.

The ranking of C_0 differs substantially from those of the other measures (though it is nearly identical to that of C_{-1} shown in table A-2). For example, C_0 indicates that CASHT+TAX (not ALLT+TAX) is most inequitable, that CASHT+FS is sharply less inequitable than CASHT (instead of being almost equal), that WELF+FS is less inequitable than WELF (instead of being more inequitable) and that ALLT clearly ranks seventh instead of eighth. Thus, the choice of index may well affect one's perceptions of the relative amount of horizontal inequity created by different redistributions.

To examine the effect of needs adjustments, tables like table 2 were prepared using welfare ratios and income per family member in the computations. (See appendix tables A-4 and A-5.) For each of redistributions 1-6, 10 and 11, the index values were usually smallest when income was used and largest with the per capita adjustment. (This was true in 85 percent of the comparisons.) For redistributions 7-9, though, results based on welfare ratios were lowest in 23 of the 30 cells. Since a major component of these three redistributions is cash welfare, which, like the poverty lines, increases with family size but at a decreasing rate, this difference is understandable. Thus, for a given set of tax and transfer programs, the particular measure of well-being defined by the needs adjustment does affect the absolute values of the indices.

The sensitivity to needs adjustment varies across the measures. In redistributions 1-6, for example, values of A-P based on income and welfare ratios were about 54 and 82 percent, respectively, of the corresponding values based on income per member. For $K_{5,0}$ the same calculations were about 82 and 91 percent.

At the same time, the choice of needs adjustment tends to have little effect on how each index scales the relative degree of horizontal inequity of various redistributions. Compare table 3 to table 5, which contains the ordinal rankings of each index when welfare ratios were used in the calculations. The rankings in both tables are identical for columns 2, 5 and 6, and similar in the other three columns. With income per family member as the indicator of economic well-being, rankings again were very similar to those in tables 3 and 5. When rankings differed, the source was often small differences in cardinal index values. Tables of relative

Table 5

Ordinal Rankings of Redistributions in Terms of Horizontal Inequity[a]

Redistribution	Index of Horizontal Inequity					
	A-P	$K_{1,.5}$	$K_{2,-.5}$	P_1	C_0	S
1. CASHT	6.5	7	7	7	8	6
2. ALLT	8	8	8	8	7	8
3. CASHT+FS	6.5	6	6	6	6	7
4. CASHT+TAX	9	10	10	10	11	9
5. ALLT+TAX	11	11	11	11	10	11
6. CASHT+FS+TAX	10	9	9	9	9	10
7. WELF	2	1	2	1	4	2
8. WELF+FS	3	2	3	2	2	3
9. WELF+FS+MCAID	4	3	4	4	3	4
10. INCTX+INCTEST	5	5	5	5	5	5
11. TAX	1	4	1	3	1	1

[a]Based on Table A-4, which uses income/poverty line as the indicator of well-being.

values for indices calculated with welfare ratios and income per member (not shown) generally resembled table 4, as well.

While the figures in tables 2-5 provide evidence on how different measures behave, they do not inform us whether they signal a "lot" or a "little" horizontal inequity. The indices with an upper bound of 1.0 are generally well below this value.

The following calculations may help decide if redistributions generate high, moderate or low levels of horizontal inequity. Compute conventional inequality indices for the initial and final distributions. For each redistribution divide its horizontal inequity index by the decline in inequality it produced as measured by initial inequality minus final inequality, divided by initial inequality. The quotients are indicative of the amount of horizontal inequity generated per "unit reduction in vertical inequity."

In addition, some redistributions might show relatively little horizontal inequity but have a minor effect on inequality (e.g. cash welfare), while another might create more horizontal inequity but reduce inequality substantially (e.g. all cash transfers). The quotients are simple attempts to adjust for these differences and might be a useful alternative way to compare redistributions.[18]

Four of the horizontal inequity indices have natural analogs among the inequality measures. For A-P, I used the Gini coefficient. For $K_{h,t}$, Atkinson's index with e = 1-t is the obvious choice. The coefficient of variation pairs with P_h. Theil's two entropy measures, which are special cases of a one-parameter family with the parameter set to zero or -1 (Cowell 1980), correspond to C_0 and C_{-1}. The fifth index, S, has no clear mate among inequality measures and is omitted from this analysis.

Table 6 contains the quotients for five of the indices. Results for the other four are in appendix table A-6. They give widely varying readings. $K_{5,0}$ and P_1 suggest that most of the 11 redistributions create major horizontal inequities relative to the net vertical equalization. A-P and Cowell's index, in contrast, suggest relatively small horizontal inequities, while $K_{1,0}$ falls in the moderate range. If these figures can be reasonably compared across a row (unlike those in table 2), the choice of index will strongly influence one's perception of the degree of horizontal inequity of a given redistribution.

Table 7 presents the ordinal ranking, by column, of the figures in table 6. Every index assigns a small rank to INCTX+INCTEST (row 10), which had a low rank in table 3, as well, where no adjustment for changes in inequality had been made. But this is the extent of any uniformity in the ordering, and of any congruence with the rankings in tables 3 or A-3. Only three indices rank WELF, WELF+FS and WELF+FS+MCAID low in table 7. Three rank TAX low, but two place it eleventh! Yet these four redistributions had consistently low ordinal values in table 3.[19] There is little agreement on the ranks of redistributions 1-6. So, in line with an earlier conclusion, the choice of measure will affect the relative amount of horizontal inequity observed among redistributions.

Finally, turn from this analysis of the anatomy of measures to the policy-oriented question: do food stamps reduce the horizontal inequities created by the categorical nature of most cash welfare programs and state differences in their benefit levels? Since food stamp benefits are greater for families with lower incomes, unequal treatment of equally poor families by the cash welfare programs would tend to be reduced. But welfare recipients tend to be channeled to the food stamp program and are probably

Table 6

Redistributions' Horizontal Inequity Relative to Percentage Decline in Inequality[a]

Redistribution	Index of Horizontal Inequity				
	A-P	$K_{1,0}$	$K_{5,0}$	P_1	C_0
1. CASHT	.131	.205	.821	.815	.137
2. ALLT	.133	.196	.769	.763	.104
3. CASHT+FS	.125	.190	.762	.779	.109
4. CASHT+TAX	.151	.239	.899	.600	.127
5. ALLT+TAX	.163	.230	.840	.612	.102
6. CASHT+FS+TAX	.146	.223	.838	.585	.103
7. WELF	.059	.068	.327	.766	.214
8. WELF+FS	.055	.063	.301	.672	.134
9. WELF+FS+MCAID	.077	.091	.425	.713	.119
10. INCTX+INCTEST	.062	.152	.660	.379	.066
11. TAX	.016	.657	3.10	.217	.005

[a]Computed from results in Table 2 divided by (initial inequality - final inequality)/initial inequality.

Table 7

Ordinal Rankings of Redistributions Based on Table 6

Redistribution	Index of Horizontal Inequity				
	A-P	$K_{1,0}$	$K_{5,0}$	P_1	C_0
1. CASHT	7	7	7	11	10
2. ALLT	8	6	6	8	5
3. CASHT+FS	6	5	5	10	6
4. CASHT+TAX	10	10	10	4	8
5. ALLT+TAX	11	9	9	5	3
6. CASHT+FS+TAX	9	8	8	3	4
7. WELF	3	2	2	9	11
8. WELF+FS	2	1	1	6	9
9. WELF+FS+MCAID	5	3	3	7	7
10. INCTX+INCTEST	4	4	4	2	2
11. TAX	1	11	11	1	1

better informed of it than families who are ineligible for AFDC or SSI. If participation rates in the program are higher for welfare recipients, food stamps will tend to promote unequal treatment. The net effect is unclear *a priori*.

From table 2 one concludes that the second effect probably dominates. Comparing rows 7 and 8 shows every index except C_0 and C_{-1} has a larger value when the inequity of cash welfare and food stamps is assessed relative to the inequity of just cash welfare.[20] At the same time, food stamps reduce inequality. Thus, whether food stamps, on balance, are equitable overall depends on one's willingness to trade off more horizontal inequity for less inequality. Table 6 suggests that the trade-off is favorable, for all the numbers in row 7 exceed those in row 8. Different methods of evaluating this trade-off might reverse this finding. (Indices computed using welfare ratios and income per person yield the same results.)

5. Summary and Conclusion

This study explored in a systematic fashion the behavior of five measures of horizontal inequity. The five were selected from many proposed in the literature because they possessed characteristics consistent with an interpretation of horizontal equity that emphasizes the social welfare costs due to reversals of rank in the distribution of economic well-being. These measures can be used to assess any actual redistributive program(s) or to see if a proposed reform or new program would change the extent of horizontal inequity. I used micro data for 1974 to examine their sensitivity to different types of redistributions and needs adjustments. Three main findings emerged:

The choice of index may well affect one's perceptions of the relative amount of horizontal inequity of different redistributions.

The particular adjustment for family size and composition does affect the absolute values of the indices. Sensitivity to such adjustments varies among the indices.

The choice of adjustment for family size and composition tends to have little effect on how each index scales the relative degree of horizontal inequity of various redistributions.

To improve the usefulness of the measures for policy applications, several steps might be taken. Better data sets such as the Survey on Income and Program Participation (SIPP), with information on more transfer programs and assets, and actual rather than imputed values for taxes and in-kind transfers, should be used. Such data would permit examination of the horizontal inequity of more varied combinations of transfers (and taxes) and the possible horizontal inequities created by asset tests. The calculations would be more accurate than those based on imputed benefits (as in this paper) since variation within the imputed variables tends to be suppressed. Further development of methods for judging the magnitude of horizontal inequity in relation to redistributions' impacts on inequality or poverty is needed[21]. Behavioral responses to redistributive policies, and to possible changes in them, should be incorporated via simulation techniques developed in recent years. Exploration of horizontal inequity within demographic groups (e.g. the aged or families with female householders) remains on the research agenda. Last, detailed analysis of

how the interaction between program rules and persons' economic and demographic circumstances creates horizontal inequity is needed for policy analysis and reform to reduce such inequity.

These exploratory findings provide no support for preferring one measure over the others because, as noted in part 3, all measures embody normative judgements. It would have simplified matters if all indices had produced similar ordinal rankings. Since this did not occur, analysts must be sensitive to the normative issues.

Table A-1

Gini Coefficients of Initial and Final Economic Well-Being for 11 Redistributions

Redistribution	Measure of Well-Being: Income		Welfare ratio		Income per family member	
	Initial	Final	Initial	Final	Initial	Final
1. CASHT	.474	.403	.465	.386	.494	.412
2. ALLT	.474	.386	.465	.367	.494	.393
3. CASHT+FS	.474	.400	.465	.382	.494	.408
4. CASHT+TAX	.474	.367	.465	.351	.494	.380
5. ALLT+TAX	.474	.350	.465	.331	.494	.361
6. CASHT+FS+TAX	.474	.365	.465	.346	.494	.375
7. WELF	.416	.403	.400	.386	.426	.412
8. WELF+FS	.416	.400	.400	.382	.426	.408
9. WELF+FS+MCAID	.411	.386	.394	.367	.420	.393
10. INCTX+INCTEST	.414	.350	.397	.331	.423	.361
11. TAX	.474	.446	.465	.434	.494	.466

Table A-2

Ordinal Rankings of Redistributions in Terms of Horizontal Inequity[a]

Redistribution	Index of Horizontal Inequity			
	$K_{1,0}$	$K_{5,0}$	P_4	C_{-1}
1. CASHT	7	7	5.5	8
2. ALLT	8	8	7	7
3. CASHT+FS	6	6	5.5	6
4. CASHT+TAX	10	10	9	11
5. ALLT+TAX	11	11	11	10
6. CASHT+FS+TAX	9	9	10	9
7. WELF	1	1	1	3
8. WELF+FS	2	2	2	2
9. WELF+FS+MCAID	4	4	3	4
10. INCTX+INCTEST	5	5	8	5
11. TAX	3	3	4	1

[a]Based on Table 2.

Table A-3

Normalized Index Values as the Redistribution Varies[a]

Redistribution	Index of Horizontal Inequity			
	$K_{1,0}$	$K_{5,0}$	P_4	C_{-1}
1. CASHT	100	100	100	100
2. ALLT	110	107	101	98
3. CASHT+FS	99	99	100	87
4. CASHT+TAX	129	121	162	132
5. ALLT+TAX	140	128	165	130
6. CASHT+FS+TAX	128	120	163	116
7. WELF	17	21	30	23
8. WELF+FS	19	23	31	22
9. WELF+FS+MCAID	30	35	42	29
10. INCTX+INCTEST	64	69	109	42
11. TAX	27	31	46	4

[a]The figures are computed from unrounded values of the indices and, thus, may differ slightly from those calculated using the rounded values in Table 2.

Table A-4

Values of Selected Indices of Horizontal Inequity,

Welfare Ratio as the Measure of Well-Being

Redistribution	Index of Horizontal Inequity									
	A-P	$K_{1,.5}$	$K_{1,0}$	$K_{5,0}$	$K_{2,-.5}$	P_1	P_4	C_{-1}	C_0	S
1. CASHT	.0290	.131	.132	.508	.264	.134	.177	.0404	.0506	.0352
2. ALLT	.0374	.143	.145	.543	.289	.157	.179	.0399	.0477	.0479
3. CASHT+FS	.0290	.130	.130	.502	.262	.133	.177	.0349	.0421	.0356
4. CASHT+TAX	.0503	.172	.169	.604	.322	.191	.298	.0532	.0670	.0542
5. ALLT+TAX	.0652	.186	.184	.638	.351	.223	.302	.0528	.0638	.0749
6. CASHT+FS+TAX	.0506	.170	.166	.597	.323	.191	.303	.0457	.0564	.0547
7. WELF	.0015	.011	.018	.086	.070	.017	.040	.0078	.0149	.0020
8. WELF+FS	.0017	.012	.019	.091	.077	.018	.040	.0071	.0110	.0024
9. WELF+FS+MCAID	.0047	.024	.033	.157	.098	.034	.058	.0092	.0133	.0071
10. INCTX+INCTEST	.0107	.082	.079	.336	.157	.090	.175	.0138	.0184	.0132
11. TAX	.0007	.049	.032	.151	.010	.027	.073	.0011	.0008	.0004

Table A-5

Values of Selected Indices of Horizontal Inequity,

Income per Family Member as the Measure of Well-Being

Redistribution	Index of Horizontal Inequity									
	A-P	$K_{1,.5}$	$K_{1,0}$	$K_{5,0}$	$K_{2,-.5}$	P_1	P_4	C_{-1}	C_0	S
1. CASHT	.0354	.151	.150	.556	.273	.146	.148	.0492	.0688	.0478
2. ALLT	.0478	.168	.168	.601	.308	.174	.150	.0503	.0666	.0695
3. CASHT+FS	.0357	.150	.148	.552	.281	.145	.148	.0430	.0569	.0489
4. CASHT+TAX	.0590	.196	.191	.653	.330	.205	.267	.0646	.0915	.0713
5. ALLT+TAX	.0795	.217	.212	.696	.371	.243	.272	.0666	.0898	.1026
6. CASHT+FS+TAX	.0597	.195	.189	.649	.341	.205	.267	.0573	.0770	.0735
7. WELF	.0019	.012	.019	.093	.073	.017	.039	.0086	.0200	.0033
8. WELF+FS	.0023	.014	.021	.101	.084	.019	.040	.0078	.0144	.0041
9. WELF+FS+MCAID	.0069	.030	.039	.179	.101	.037	.057	.0104	.0171	.0124
10. INCTX+INCTEST	.0138	.086	.083	.353	.152	.089	.122	.0156	.0243	.0211
11. TAX	.00002	.054	.037	.172	.006	.030	.083	.0010	.0018	.0007

Table A-6

Redistributions' Horizontal Inequity Relative to Percentage Decline in Inequality[a]

Redistribution	Index of Horizontal Inequity			
	$K_{1,.5}$	$K_{2,-.5}$	P_4	C_{-1}
1. CASHT	.255	.413	1.39	.050
2. ALLT	.240	.335	1.14	.044
3. CASHT+FS	.242	.336	1.34	.041
4. CASHT+TAX	.276	.503	1.17	.061
5. ALLT+TAX	.264	.410	1.05	.055
6. CASHT+FS+TAX	.264	.414	1.15	.052
7. WELF	.098	.073	2.40	.024
8. WELF+FS	.090	.058	1.92	.019
9. WELF+FS+MCAID	.126	.092	1.67	.023
10. INCTX+INCTEST	.204	.243	.99	.027
11. TAX	.466	3.66	.76	.018

[a]Computed from results in Table 2 divided by (initial inequality - final inequality)/initial inequality.

Notes

1. While Berliant and Strauss (1982) have taken issue with this amendment, it is adopted in this study. See part 2 for further discussion.

2. Here is a quick but nearly complete review of the empirical literature: Plotnick and Skidmore (1975, pp. 156, 234-36) offered tabular evidence for cash transfers but no summary measure. Atkinson (1980) used aggregate data on the U.S. income tax and one measure. Berliant and Strauss (1983) also examined this tax using a measure they developed. Rosen (1978) analyzed the U.S. income and payroll tax with two measures. King (1983) applied the index he derived to a simulated reform of housing subsidies in England and Wales. Plotnick (1981) adopted the same index as Atkinson, but used micro data and two measures of well-being to examine several redistributions involving taxes and cash and in-kind transfers. Still different indices are implemented in the specialized studies by Chernick and Reschovsky (1982) and Menchik and David (1982). See Plotnick (1982) for citations to earlier studies and criticisms of many of the horizontal inequity indices used in them.

3. In contrast, analysts appear to have a better intuitive sense of, for example, what a Gini coefficient of .3 means relative to one of .6. There has, in addition, been substantial work on the sensitivity of measures of inequality to changes in the reporting unit or measure of well-being (Beach et al. 1981; Benus and Morgan 1975; Danziger and Taussig 1979; Taussig 1973).

4. If one wants to label rank order requirements something other than "horizontal inequity," so be it. Semantics aside, my interest in this study is in understanding and quantifying the extent of such reversals.

5. I.e. no discrimination in any market or social institution based on ascriptive characteristics such as race or sex. See Rae et al. (1981) for extended discussion of the concept of equal opportunity.

6. I am using "social welfare" in a broader sense than usual. Typically, overall social welfare is a function only of individual utility levels. Here, though, I am suggesting that reordering has an effect on social welfare independent of the utility levels at each rank. The social welfare function, then, incorporates non-utility information and rejects "welfarism" (Sen 1979).

7. Useful measures will not be concerned with comparisons between initial and actual final levels of well-being, nor between initial and final rank-preserving levels. These comparisons may also be of interest, but they are not appropriate for assessing horizontal inequity.

8. See the remarks in footnote 4, also.

9. If the fairness of the initial ranking is questionable, the analyst may, in principle, specify what the fair initial ranking should be. This can be compared to the actual final ranking to assess horizontal inequity.

10. The term "vertical equity" as used here is not equivalent to "progressivity." Kakwani (1982) establishes the conceptual distinction between progressivity and changes in inequality (i.e. changes in vertical inequity) due to taxes and transfers.

11. While Cowell developed measures of distributional change, they are readily adapted as measures of horizontal inequity, which are less general. To do so, interpret his distributions of "old" x_i and "new" y_i as the

distributions of fy_i and oy_i, respectively. See Cowell (1980, p. 151). Since the means of fy and oy are identical, expressions 5 and 7 in his paper simplify to what I have presented.

12. If t is non-zero and $oy_i = fy_i$, $\exp\{-h(oy_i - fy_i)\}$ attains its largest value and, thus, lowers the index as much as possible. If $oy_i = fy_i$ for all i, $K_{h,t} = 0$.

13. Note that S uses rank differences instead of differences in well-being. For this reason it is probably the least satisfactory index. (See also Plotnick 1982, pp. 383, 388.)

14. For example, the two redistributions A and B below are equally inequitable because the pattern of reranking is identical:

	Initial Well-being		Final Well-being	
	A	B	A	B
Unit x	12	9	6	6
Unit y	5	7	9	9
Unit z	3	4	5	5

The differences between initial and final levels of well-being at each position in the distribution vary in A and B. However, attention to this distinction between A and B reflects <u>vertical</u> equity judgements on the appropriate pattern for altering relative levels of welfare via redistribution.

15. Similarly, to see if a program reform has effects on horizontal inequity, one would compare the horizontal inequity of the current situation to that with the reformed program in place using the pre-current-program distribution as the initial measure of well-being in both cases. Note that whatever the initial measure selected by the analyst, he or she is implicitly assuming the initial ranking to be fair.

16. I thank Tim Smeeding for sharing the data. Procedures for correcting and augmenting the CPS data are in Smeeding (1975). Using Smeeding's cash-equivalent values gave very similar results.

17. For $K_{h,t}$ and P_h, results for other choices of h and t were similar to one of the 4 columns shown here and in later tables.

18. A more rigorously derived method for balancing vertical and horizontal equity effects of a redistribution would be welcome.

19. Normalized values derived from table 6 reveal similar disagreement with table 4.

20. This result may also be partly caused by the food stamp asset test. Suppose some low income families are declared ineligible for food stamps because their assets are too large. Then it will appear in these data, which have no asset information, that food stamps create rank reversals and that living units with roughly equal levels of well-being are receiving very different benefits from the program. The lack of asset data prevents analysis of the role of asset tests in producing horizontal inequity. Similarly, asset tests for cash public assistance and Medicaid may also be responsible for part of the measured horizontal inequity in the tables.

If the data were suitable, one might wish to incorporate assets into one's measure of well-being before determining initial and final rankings and measuring horizontal inequity. Even with such an adjustment, asset tests would lead to horizontal inequity. For example, consider two units with equal cash incomes that would qualify them both for $1000 in food stamp assistance. Assume that one has assets $100 above the limit for benefit eligibility, while the other has assets $100 below. Although the

latter's economic well-being before the in-kind transfer is less, it is not much less and a $1000 benefit would reverse ranks.

21. On the other hand, instead of seeking an explicit formula, analysts perhaps should simply compute the level of horizontal inequity and changes in inequality and poverty, and let policy makers draw their own conclusions about the right balance.

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