INCOME INSTABILITY AS A DIMENSION OF WELFARE[a]

Jacob Benus and James Morgan
Institute for Social Research, University of Michigan

Economists have long argued that classifying individuals according to income level in any given year may result in an erroneous representation of economic well-being.[1] That is, since some low-income individuals are temporarily below their "permanent" income level and some high-income individuals are temporarily above theirs, single year income data may misclassify those with income fluctuations. To guard against this, many have favored the use of income averaged over several periods as a measure of "permanent" income level. With a longer accounting period, income level is less likely to reflect temporary vagaries, thereby reducing the likelihood of misclassification.

Income level, even when it is taken over a long accounting period, however, presents only a partial picture of economic well-being. That is, two persons may experience vastly different income patterns yet have the same income level. To capture such differences in income patterns, additional parameters such as trend and instability are necessary. These parameters not only help describe the behavior of income over a period of time, but also serve as additional dimensions of economic welfare, distinct from income level. Clearly, an individual with constant income is in a different welfare position from another individual whose income fluctuates unexpectedly - even if their average incomes are the same. With a stable income, for example, an individual may make long-run plans and commitments with confidence that his income level will continue at a steady rate. On the other hand, an individual who experiences substantial fluctuation in his income is likely to refrain from committing himself to any long-run obligations.

Since it is easier to adjust to unexpected income increases than to unexpected decreases, direction of income change (i.e., trend) is another important dimension of welfare. That is, an individual who experiences sporadic income increases is certainly better-off than another individual who experiences sporadic decreases, even if their level and instability are identical. Since instability measures treat income increases and decreases identically, one cannot distinguish between two such cases using level and instability alone. To fully describe an individual's welfare position, therefore, one must combine three dimensions: level, trend and instability.

In this paper we analyze these three dimensions of economic welfare and examine whether a trade-off exists between level, trend and instability. In addition, we isolate those subgroups in the population who face substantial income instability and examine the relationship of these parameters within each of the subgroups.

The data used in this analysis are from the OEO Panel Study of Income Dynamics.[2] The Panel is currently composed of approximately five thousand households, many of which have been interviewed annually since 1968. However, since we focus on head's labor income we restrict our analysis to those households with the same family head throughout the period, 1968-1971. Furthermore, since some family heads voluntarily entered or left the labor force during the analysis period, we eliminate those who were in the labor force less than 1500 hours (i.e., hours worked plus hours missed due to unemployment and/or illness) during any year. The resulting sample following these restrictions is composed of 2326 individuals.

Measures of Level, Trend, and Instability

The availability of four years of income data leaves several options for measuring level, trend, and instability. The most obvious measure of income level is a simple four-year average of the annual incomes. Since we are measuring income level over a four-year period rather than "permanent" income as of year four, the simple average seems superior to a weighted average of past incomes.

An appropriate measure for income trend is less obvious. One measure, however, which is recommended by its straightforward interpretation is the least-squares slope of the regression of income on "time." If we set the origin at the mid-point of the period (i.e., T = -1.5, -.5, .5, 1.5) the equation for the slope of the time trend is:

$$b = \frac{\sum_{t=1}^{4} Y_t T_t}{\sum_{t=1}^{4} T_t^2} = \frac{1.5Y_4 + .5Y_3 - .5Y_2 - 1.5Y_1}{5} \qquad (1)$$

where Y_t = head's labor income in year t (henceforth we omit the index of summation when it is t=1, ..., 4).

Still less obvious is an appropriate measure for income instability. One possibility is the proportion of the variance in income around the mean unexplained by the time trend:

$$u_1 = \frac{\Sigma(Y-\hat{Y})^2}{\Sigma(Y-\bar{Y})^2} = 1 - \frac{\Sigma(\hat{Y}-\bar{Y})^2}{\Sigma(Y-\bar{Y})^2} = 1 - \frac{\frac{(\Sigma YT)^2}{\Sigma T^2}}{\Sigma Y^2 - \frac{(\Sigma Y)^2}{N}} \qquad (2)$$

A problem with using u_1 as the instability measure arises when the slope of the trend line equals zero. That is, since $\frac{(\Sigma YT)^2}{\Sigma T^2}$ in equation (2) may also be written as $b^2\Sigma T^2$, u_1=1 whenever b=0. The problem arises since the slope may equal zero under very different circumstances. For example, an individual with constant income over the analysis period would have a zero trend slope. At the same time another individual whose income varied substantially over the period may also end up with a zero slope. In both cases,

equation (2) yields the same instability measure (i.e., u_1=1). Actually this happens very infrequently in practice.

To avoid the problem of assigning the same instability level to all individuals with zero time trends, one may use the following instability measure:

$$u_2 = \frac{\Sigma(Y-\hat{Y})^2}{\Sigma Y^2} = \frac{\Sigma Y^2 + \Sigma(\hat{Y}-\bar{Y})^2}{\Sigma Y^2} =$$

$$1 - \frac{\frac{(\Sigma Y)^2}{N} + \frac{(\Sigma YT)^2}{\Sigma T^2}}{\Sigma Y^2} . \qquad (3)$$

This measure represents the proportion of the total sum of squares around zero unexplained by the regression. Using this measure, an individual with a constant four-year income would have u_2=0, whereas an individual whose income fluctuated but with b=0 would have $0 < u_2 < 1$.

While u_2 may solve the problem created by zero slopes, it is not necessarily a superior measure. The chief difficulty with u_2 as an instability measure is that it is highly correlated (negatively) with the income level. On the other hand, u_1 is unaffected by the income level since it involves only deviations from the mean. These points may become clearer with an example. Suppose two families with initial incomes of $5,000 and $10,000, respectively, have a $1,000 increase between years 1 and 2 and $500 increases thereafter. Using u_2, the instability level of the $5,000 family exceeds the instability level of the $10,000 family by over three fold; whereas, using u_1, the instability levels are the same for the two families. That is, since four-year income of one family is nearly twice the income of the second family, squaring income in the denominator of u_2 results in a substantially lower instability level for the higher income family. Since the denominator of u_1 involves only deviations from the mean, both families exhibit the same instability.

Another possibility for an instability measure is the coefficient of variation:

$$u_3 = \frac{\sigma}{\bar{Y}} = \sqrt{\frac{\Sigma(Y-\bar{Y})^2}{T-1}} \Big/ \bar{Y} . \qquad (4)$$

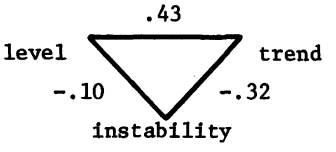
It may be thought of as a measure of relative income variation since it involves a ratio of the standard deviation of income to its mean. Thus, if the standard deviation were one-quarter the level of income, u_3 would equal .25. This measure, like the previous one, is strongly negatively correlated with income level. In computing the coefficient of variation (or any of the other measures of level, trend, and instability for any group, we first calculate the parameter for each individual in the group and then average over the entire group.

One deficiency with each of these instability measures is that they do not differentiate between increases and decreases in income. Since only unexpected decreases are likely to cause difficulties we present in addition to the instability measures, measures which consider only income decreases. Several such measures suggest themselves. If one assumes, for example, that individuals expect income to continue at the previous year's level, then an appropriate measure for unexpected decreases is the relative decline from the previous year's income. On the other hand, it may be argued that a more appropriate measure is the relative decline from previous-peak income since individuals adjust slowly to income decreases. The list of potential measures may be extended ad infinitum if we consider various possible weights for declines with different time lags. To avoid this difficulty we present only the first two measures, i.e., the sum of annual declines from previous-year income and the sum of annual declines from previous-peak income

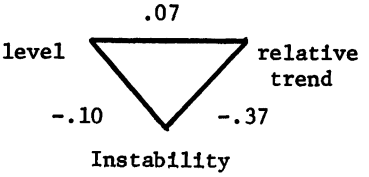
Empirical Results

Since one objective of this paper is to examine the trade-off between level and instability for various subgroups, one important criterion in choosing an instability measure is that it be realtively uncorrelated with income level. Otherwise, the trade-off that we observe may be dominated by the subgroup income level, thereby hiding any behavioral differences that may exist. While each of the proposed instability measures is inversely correlated with income level (see Table 1), the measure least correlated with income level is u_1, the unexplained variation around the trend. In fact, the fraction of the total sum of squares explained by income (i.e., ETA^2) is .020 for u_1 as compared with .084 and .107 for u_2 and u_3, respectively. As a result, we choose u_1 as our instability measure.

The average instability level for our sample of 2326 households is .42, the four-year average of head's labor income and the annual income trend are $9,250 and $734, respectively. The relationship among these parameters may be summarized by the following correlation coefficients for each pair of parameters:



As expected, the correlation between level and instability is negative and relatively weak. The correlation between level and trend, on the other hand, is positive and quite strong. However,since absolute income trend is automatically correlated with income level (since large annual increases in income lead to high income), we replace absolute trend by relative trend (i.e., absolute trend divided by level):



The effect of this substitution is to reduce the correlation between trend and level to .07 from .43. Thus, both the correlation between level and relative trend as well as the correlation be-

Table 1

Measures of Income Instability by Income Level
(same head and in the labor force at least 1500 hours each year, N = 2326)

Head's 4-year Average Labor Income	%	$u_1 = \frac{\Sigma(Y-\hat{Y})^2}{\Sigma(Y-\bar{Y})^2}$	$u_2 = \frac{\Sigma(Y-\hat{Y})^2}{\Sigma Y^2}$	$u_3 = \frac{\sigma}{\bar{Y}}$
Under $2000	1.2	.50	.08	.48
$2000 - 3999	7.9	.52	.04	.28
$4000 - 5999	16.4	.45	.02	.23
$6000 - 7999	21.9	.43	.02	.20
$8000 - 9999	18.4	.39	.01	.17
$10,000 - 11,999	13.2	.37	.01	.16
$12,000 - 14,999	11.6	.40	.01	.16
$15,000 - 19,999	5.7	.34	.01	.19
Over $20,000	3.6	.34	.02	.23
TOTAL OR AVERAGE	100.0	.41	.02	.20
ETA^2		.020	.084	.107

tween level and instability are relatively weak. The relationships, however, are in opposite directions; high (low) income level is associated with high (low) relative trend and low (high) instability level. The third pair of parameters, relative trend and instability, exhibits a relatively strong, negative correlation. Thus the higher the relative trend, the lower the instability level.

In order to examine whether the same relationships among the parameters persist for subgroups with various levels of instability, we employ an AID analysis to isolate groups with different instability levels. The results, presented in Figure 1, indicate that the most important determinant of income stability is occupation. The self-employed and the farmers have the highest level of instability; the white collar occupation, the lowest. For the remainder of the population other important determinants of income instability are size of largest city, race, and education. In highly urbanized areas those with less than a high school education have substantial instability. In less urbanized areas it is the blacks who face substantial instability.[3]

In Table 2 we present for each of the six final subgroups of the AID tree the estimates of the parameters discussed above. The results suggest an inverse relationship between income level and instability across groups; for example, the white collar group (#2) has the highest income level and the lowest instability level. The relationship, however, is not monotonic. The self-employed and farmer group (#5) has the highest instability level, yet its income level is higher than several other subgroups. Thus, we may conclude that low-income subgroups do not necessarily suffer greater instability, but the tendency is in that direction.

The relationship between level and absolute trend, on the other hand, is positive. Those who experience large annual income increases tend to have high income levels. Again this relationship is not monotonic with group 5 (self-employed and farmers), for example, receiving the lowest income increases of any group, but with one of the highest income levels. Substituting relative trend for absolute trend nearly eliminates the positive relationship between trend and level found above. For example, groups 2 and 8 (with the highest and lowest income levels, respectively) have the two highest relative trends.

The relation between trend and instability completes the matrix of inter-relationships. We observe a strong inverse relationship between absolute trend and instability; however, between relative trend and instability the relationship is weak. The latter result is surprising inasmuch as the micro correlation between relative trend and instability is stronger than the correlation between absolute trend and instability. This finding suggests that while some subgroups exhibit both a high relative trend and high instability, the micro correlations within these groups is negative (i.e., high relative trend is associated with low instability). For example, group 8 has a high average relative trend as well as a high average instability level, yet within the group the correlation between relative trend and instability is negative.

Further examination of the correlations within the AID subgroups reveals substantial differences across groups. For example, for group 5 (i.e., self-employed and farmers) the correlation between relative trend and instability is only -.11; for the remaining subgroups the correlation is at least three times as large. We may, therefore, conclude that for most of the sample high relative trend is associated with income stability. For the farmer and self-employed group, however, this association is rather weak.

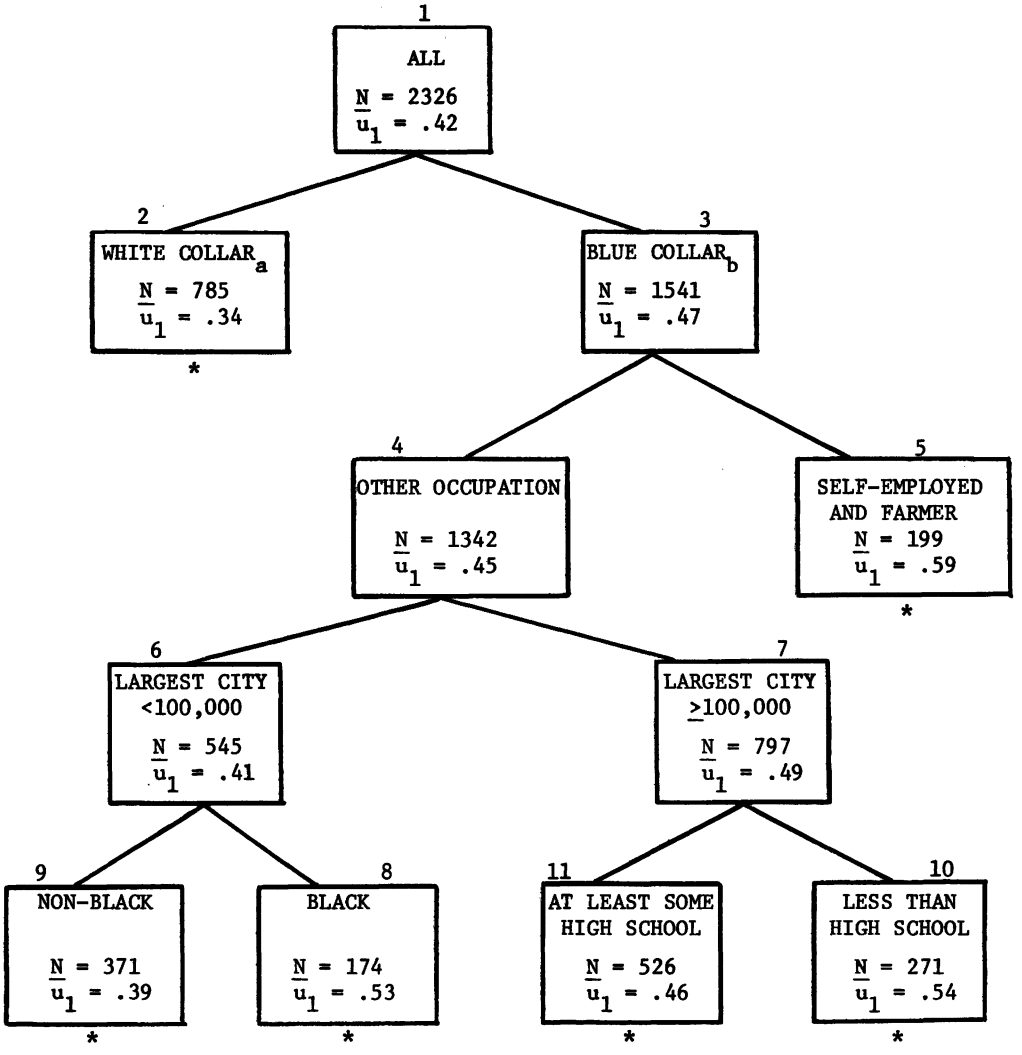
Another interesting result that may be drawn from Table 2 is that, while the correlation between level and relative trend is positive for the sample as a whole, it is negative for several subgroups (i.e, groups 8, 9, and 10). An exam-

Figure 1

AID on Instability (u_1) of Head's Labor Income

(same head and in the labor force at least 1500 hours each year)

Variation explained = 7.1%



[a]White collar group includes: professionals, managers, clerical and sales workers and miscellaneous occupations.

[b]Blue collar group includes: self-employed, craftsmen, operatives, laborers and farmers.

---

ination of the income level reveals that these three groups represent the lowest income groups in the sample. As a result, we suspect that the negative correlations reflect the fact that small absolute changes are likely to represent large relative changes for those with very low incomes. Thus, our choice of relative rather than absolute measure of trend leads to negative correlations for the lowest income groups. Since the results depend so heavily on the measure used, care must be exercised in their interpretations.

A comparison of our instability measure (u_1) with a measure which corresponds closer to economic difficulties (i.e., sum of relative declines in income) results in the same ordering of the six subgroups. The self-employed and farmer groups, for example, have both the highest instability and the highest relative decline from previous-peak income. The latter measure, however, indicates that this group suffered twice the declines of any other subgroup; whereas the instability measure suggests only slightly higher instability for the group. Thus, while the two measures yield a similar ordering of the groups, the relative decline measure may more accurately describe the severity of the economic difficulties.

Conclusion

In this paper we analyzed the relationship among three dimensions of economic welfare: level, trend, and instability. We observed, for example, a negative correlation between level and instability and between relative trend and instability; between level and relative trend, on the other hand, we observed a positive correlation.

However, an examination of these correlations within selected subgroups revealed substantial differences across groups. Since our conclusions depend heavily on the subgroups selected for analysis, as well as the measures chosen to represent the welfare dimensions, further research in this area is required.

Footnotes

[a]This analysis as well as the data collection for the Panel Study of Income Dynamics was funded by the Office of Economic Opportunity.

[1]See Milton Friedman, A Theory of the Consumption Function, Princeton University Press, 1957.

[2]For a complete description of the study see: James Morgan, et. al., A Panel Study of Income Dynamics, Study Design, Procedures, Available Data, 1968-1971. Institute for Social Research, 1971.

[3]Variables which proved unimportant include: age, sex, region, and size of family.

Table 2

Level, Trend, Instability, and Their Correlations for Various Subgroups

			Group Average				Correlation Of:		
roup umber	Description	N	Level	Absolute Trend	Relative Trend	Insta-bility	Level & Relative Trend	Level & Insta-bility	Relative Trend & Insta-bility
2	A. White collar	785	$11,602	$1,086	.092	.34	.02	-.01	-.40
	B. Blue collar								
5	1. Self-employed and farmers	199	7,643	341	.025	.59	.16	-.07	-.11
	2. Other occupations								
	a. Largest city <100,000								
8	1) Black	174	4,450	427	.105	.53	-.15	-.17	-.51
9	2) Non-black	371	7,149	549	.079	.39	-.05	-.10	-.37
	b. Largest city ≥100,000								
10	1) Less than high school	271	6,681	398	.060	.54	-.04	.17	-.48
11	2) Some high school or more	526	8,494	513	.058	.46	.06	-.07	-.39
1	ALL	2326	9,250	734	.074	.42	.07	-.10	-.37

Notes: Level = 4-year average of head's labor income
Trend = least-squares regression of income on "time."
Instability = proportion of variance unexplained by regression

Table 3

Instability and Sum of Relative Declines for Selected Subgroups

Group Number	Description	Instability (u_1)	Sum of Relative Declines: Previous Year	Sum of Relative Declines: Previous High
2	A. White collar	.34	9.7	12.1
	B. Blue collar			
5	1. Self-employed and farmers	.59	36.4	49.9
	2. Other occupations			
	a. Largest city <100,000			
8	1) Black	.53	20.1	24.5
9	2) Non-black	.39	16.6	18.2
	b. Largest city ≥100,000			
10.	1) Less than high school	.54	20.1	24.6
11	2) Some high school or more	.46	14.2	20.7
1	ALL	.42	15.5	19.8