MEASURING PRICE INSTABILITY

by

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INTRODUCTION

Prices for all commodities vary over time. The degree of instability for each commodity reflects characteristics of the industry.

In the non agricultural industries the technology has certain input-output relationships. Few random factors affect the output. However, in agriculture some random factors make these relationships uncertain. Weather and biological conditions can result in output that is far from that planned by the producer.

The coordination system within the marketing chain is also different for the two groups. In many non agricultural industries marketing arrangements, such as vertical integration and contracts ensure that the quantity produced will match the expected demand. So, within the marketing channels supply and demand are effectively coordinated. This is because mechanisms have been established to deal with the potential uncertainty of the system.

In agriculture where within the marketing chain there are all kinds of markets (mostly competitive), and it is not easy for mechanisms to be established, there is a coordination problem. The demand for orderly marketing for many agricultural commodities reflects the desire of some participants to eliminate this problem.

Common uncertainties for agricultural and non agricultural industries are the competitive behavior of participants, changes in consumer preferences, prices of substitutes and complements, foreign supply and demand conditions, the potential development of new technology, governmental policies and so on.

Each uncertainty contributes to prices instability. The instability in agriculture might be caused not only by exogenous factors such as weather, biological conditions, shifts in demand, etc., but also by the poorly coordinated system. A measure of instability will only partly reflect the coordination effectiveness.

Even if generally instability is undesirable from the producer, consumer and policy point of view, some degree of price variation is desirable. Prices must vary to effectively allocate commodities. Excessive instability is generally considered a problem.

But how predictable or unpredictable is instability? Some participants can predict at least some instability and to some degree. For example, the cycles in beef and hogs may permit a greater degree of predictability than shorter run fluctuations in markets, such as crops. In situations where there is predictable price variation, participants may adjust to their known economic environment. They can plan production based upon predictable cycles. However, if all plan to adjust to the cycle the cycle will be modified.

Moreover, the fixed capital inputs in production, processing and marketing causes unutilized capacity at certain times. Also, storage cost will be higher under more unstable (although predictable) markets than under stable ones. In the real world it is difficult to find much predictable instability.

Both predictable and unpredictable instability are of concern. So as a measure it is better to choose one of instability rather than a measure of predictability.

The variability existing in a set of prices can be explained by the uncertainties mentioned above, and some other sources. Changes in production technology or industry structure over time change the cost and, for competitive markets, prices in the long term follow the cost. Changes in some other macro-economic factors can also affect prices over time, such as inflation, interest rate, unemployment rate, and so on.

The variability caused by inflation can be eliminated by deflating the price data. The variability caused by some uncertainties or sources mentioned above, which usually follows a trend is not considered instability. The rest of variability can be said to be caused by participants behavior and by random factors (weather and biological conditions), and it is this variability that is considered as price instability.

The variability caused by the random factors can be eliminated as follows: As random factors affect the yield, the percentage changes in yield, multiplied by the price flexibility, will give the effect on price caused by random factors keeping acres planted constant (participants behavior). This effect can be subtracted before the trend has been removed. The variability after the trend has been removed is the instability caused by participants' behavior.

In this paper I will try to measure the variability caused by participants and random factors by three methods for 57 commodities and to compare the classifications the three methods rank the 57 commodities.

In the next chapter the instability measures found in the literature are described, as well as, the measure I suggest.

Measuring Instability

There are many instability measures in the literature. Each one has advantages and disadvantages. Despite the fact that the measures are different they have some similarities. We may find that the rank of commodities, according to their degree of instability, is quite similar for some measures.

Dalziell dissertation (M.S.U. 1985) describes some measures that appear in the literature. These are:

1. Variance
2. Coefficient of variation (CV)
3. Coefficient of variation about a trend (CVT)
4. Absolute coefficient of variation formulation
5. Firch measure
6. Coppock index
7. Average percentage change measures
8. Moving average measures
9. Tweeten's uncertainty index
10. Percentage range
11. INS measure

In the following there are some descriptions, strengths and weaknesses for each measure.

1. Variance

The classical measure of variability is the variance. It is defined as the mean of the square deviations from the mean. The standard deviation defined as the absolute value of the square root of the variance, is considered another measure. The variance is a dimensioned measure in the square of the original series. We can't compare the variance of two difference series. A high price commodity which is considered stable may have larger variance than a low price commodity which is considered unstable. Also, a change in units will change the variance by the square of the rate of change in units. Sometimes it is difficult to make comparisons even for the same series at different times.

Variance does not remove any trend. So a series with a constant change over time which may be considered stable, will have variance according to the slope of the series. So when there is a trend the variance will be a measure of trend rather than a measure of variability.

The fact that we calculate the variance taking squares makes it sensitive to outliers.

2. Coefficients of Variation (CV)

The coefficient of variation of a series is defined as the standard deviation divided by its mean. It is dimensionless and standardized. So we can compare the instability of different series (such as high price commodity and low price commodity).

This measure, like the variance, does not remove any trend.

3. Coefficient of Variation about a Trend (CVT)

This method first detrends the series. The standard deviation of the residuals divided by the mean of the original data, is the coefficient of variation about a trend.

To detrend the series we can use ordinary least squares regression, or to remove a linear trend only, we can use the minimization of the sum of the absolute deviations (by linear programming technique).

This method assumes that agents expect each time that prices will return to the long term trend, which may be a reasonable expectation, especially when fixed cost represents a large proportion of the total cost.

The measure is sensitive to outliers, but we can avoid that when we remove a linear trend by the minimization of the sum of the absolute deviations.

4. Absolute Coefficient of Variation Formulation

This is the mean of absolute deviations divided by the mean of the series. It is dimensionless, similar to the coefficient of variation and gives less weight to outliers than it.

5. Firch Measure

This uses the variance of the first differences of the natural logarithms of the data series. It is dimensionless, removes an exponential trend and gives a lot of weight to short run movements.

6. Coppock Index

This measure is the antilog of the square root of the Firch measure.

7. Average Percentage Change Method

We can describe three methods:

a) The average of the absolute value of the percentage period to period change.

b) The average of the square of the percentage period to period change.

c) The same as (b) except that the percentage is calculated over the beginning or the end of each interval depending on which is greater each period.

The (b) and (c) are sensitive to outliers. None of them removes any trend from the series.

8. Moving Average Method

This is the average of the absolute value of percentage differences of each data point from its (centered) moving average. The period over which the moving average is calculated is 3 or 5 years. This method is a measure of short run instability. It gives very little weight to intermediate run and cyclical fluctuations.

9. Tweten's Uncertainty Index

This measure is the absolute average annual percentage change minus the algebraic average percentage change. This somewhat removes a trend.

10. Percentage Range

There are two versions:

a) The difference between the lowest and highest values expressed as a percentage of the midpoint of the extremes.

b) The difference between the largest and smallest absolute percentage changes.

Neither measure detrends the series, and both are sensitive to the length of the series and to outliers.

11. The INS Measure

This is suggested by Dalziell in his dissertation (M.S.U. 1985), and is used to measure and rank the instability for 108 commodities.

This measure is defined as the variance of annual percentage changes. It is Var $(100 * \frac{dP}{P})$ where:

$$\frac{dP}{P} = \frac{P_t - P_{t-1}}{(P_t + P_{t-1})/2}$$

It uses the midpoint $(P_t - P_{t-1})/2$ of the change as a base to calculate the percentage change.

This measure exponentially detrends the series, is dimensionless and implicitly assumes that the next period price will grow from the current period at the average rate of growth of the series. It also gives more weight to period to period fluctuations and less weight to long term cycles.

Its disadvantages are the excess weight to outliers, the excess weight to the end points when it detrends the series, and that it implicitly assumes that agents know the long term exponential trend.

The D.B. Measure:

Another measure I suggest is the following: I remove the trend using ordinary least squares and finding the fitted values and the corresponding residuals. The percentages (Residual/Fitted Value)*100 are then calculated. The average of the absolute percentages is the DB measure of instability.

The detrending process can have any functional form. If we want to remove a linear trend, we can also use linear programming technique to minimize the sum of the absolute deviations. As the ordinary least squares is sensitive to outliers and the minimization of the sum of the absolute deviations is not, to remove a linear trend we can choose between the two methods depending on how we want to weigh outliers.

For this paper I removed a linear trend using ordinary least squares and then I calculated the percentages of the residuals to the fitted values and the average of these percentages.

A simple hypothetical example where the DB Measure is applied, is the following:

Assume the following data:

Time	Price
1	5
2	7
3	9
4	14

Assume also that the fitted line is:

P = 4 + 2* Time

The actual and fitted values, the residuals and the percentages will be as follows:

Time	Real Price	Fitted	Residuals	Percentages
1	5	6	+1	+17%
2	7	8	-1	-12.5%
3	9	10	-1	-10%
4	14	12	+2	+17%

The average of the absolute percentages is:

$$\text{Average} = \frac{17+12.5+10+17}{4} = 14\%$$

So the instability for this hypothetical data measured by the DB method is 14%.

Among the advantages of this method are:

- It is simple and meaningful being a percentage. It tells how percent on the average the real value deviates from the fitted one.
- It is dimensionless and different commodities can be ranked according to their degree of instability.
- It is a detrended measure. We can remove any trend as we are free to choose the functional form for the detrending process.
- When we want to remove a linear trend we have the option to detrend minimizing the sum of the absolute deviations and so to avoid the sensitivity of outliers.

- The method can compare the variability of a series at different times.
- It weights equally across the series not weighting greater the end points as other methods.

Among the disadvantages of this method are:

- It gives excessive weight to outliers when ordinary least squares is used to remove the trend.
- It implicitly assumes that agents know the long term removed trend and they expect that the next year's prices will be those of the trend.
- It includes the cycles variability (some argue that it must be included when instability is measured).

INSTABILITY AMONG COMMODITIES

I used the DB method described above to measure the instability for 57 commodities. These commodities are among the 108 for which Dalziell in his dissertation, measures the degree of instability using the INS and the CVT method. Fifteen of them are classified as the most unstable by the INS method, fifteen as the most stable and 27 have been selected randomly from the rest.

I used Time Series Processor (TSP) programming package for the calculations, removing a linear trend using ordinary least squares and then calculating the value of the DB measure for each commodity.

I classified these commodities according to their degree of instability by the DB measure, and compared the results with the classification by the INS and CVT as it appears in Dalziell's dissertation.

The data is the same as that used by Dalziell, taken from various issues of Agricultural Statistics. Prices are deflated by the Consumer Price Index (CPI) . The time period is from 1950 to 1983 but for some commodities this length of data is not available and a shorter period is used.

Table A presents the instability values for each of the 57 commodities and by the DB, INS and CVT method.

Commodities have been ranked according to the DB Measure. The values by the DB measure range from 2.3 to 30.8, by the INS from 0 to 2.57 and by the CVT from 0 to 2.3.

The instability values by the DB Measure are presented here in four quartiles.

I Quartile

No.	Common Name	DB
1	Tart cherries	30.8
2	Avocado	28.5
3	Sunflower	26.9
4	Popcorn	26.6
5	Tangelos	25.6
6	Olives	23.3
7	Dry peas	23.3
8	Spearmint	21.4
9	Lemons	21.3
10	Flaxseed	20.8
11	Almonds	20.7
12	Grapefruit	20.4
13	Temples	19.9
14	Figs	19.7

II Quartile

No.	Common Name	DB
15	Pecans	19.1
16	Limes	18.6
17	Filberts	18.6
18	Tangerines	17.4
19	Nectarines	17.4
20	Pears	16.9
21	Grapes	16.0
22	Apples	15.4
23	Sweet potatoes	14.3
24	Pomegranates	12.8
25	Garlic	12.8
26	Walnuts	12.6
27	Prunes	12.6
28	Plums	12.4

III Quartile

No.	Common Name	DB
29	Apricots	11.9
30	Artichokes	11.3
31	Hay	11.3
32	Sweet cherries	11.2
33	Watermelons	10.8
34	Papayas	10.6

III Quartile (Continued. . .)

No.	Common Name	DB
35	Eggs	10.6
36	Escarole	10.4
37	Fresh tomatoes	9.8
38	Brussel sprouts	9.8
39	Eggplants	9.4
40	Beets	9.2
41	Green peas	9.1
42	Peaches	9.1

IV Quartile

No.	Common Name	DB
43	Taro	8.0
44	Cantaloupe	7.6
45	Fresh cucumbers	7.5
46	Spinach	7.2
47	Honeydew melons	7.1
48	Green lima beans	7.1
49	Tobacco	7.0
50	Milk	6.6
51	Green peppers	6.5
52	Strawberries	6.3
53	Honey	5.6
54	Carnation	5.4
55	Bananas	4.7
56	Mushrooms	2.8
57	Tea roses	2.3

To test whether the classification by the three methods DB, INS, CVT, differ, the correlation coefficient and the Spearman rank correlation coefficient for each pair, were calculated. The correlation coefficient was calculated using the values of the measures ranking the commodities by the DB measure.

The rank correlation coefficient was calculated using ranks instead of values. When two values were the same the midpoint is used for both. Value series and rank series appear in Table B.

Computer calculated these coefficients which appear in Table C and are also presented here:

Corr. Coefficient (DB, INS) = .935
Corr. Coefficient (DB, CVT) = .961
Corr. Coefficient (INS, CVT) = .966
Spearman rank corr. coefficient (DBR, INSR) = .958
" " " " (DBR, CVTR) = .974
" " " " (INSR, CVTR) = .976

The high correlation coefficient indicates that there is a high degree of association among the series.

The test of significance of the Spearman rank correlation coefficient also indicates that there is a high degree of association as the calculated values exceed the value of statistical tables, which is .432. Level of significance .01.

Table D shows the rank differences between INS and DB measure. It was derived by taking the rank differences INS-DB and then ranking the commodities according to their rank difference.

Commodities with high negative rank differences are those which INS ranks relatively more unstable than DB. Because INS weighs more short run fluctuations than long term cycles relatively to the DB, it can be said that for these commodities, the short run fluctuations "dominate" the long term cycles. The opposite is true for commodities with positive rank differences.

Table E shows the rank differences between CVT and DB measure. As CVT like INS, weights more short run fluctuations than long term cycles relative to the DB, we can say again that for commodities with negative values the short run fluctuations "dominate" the long term cycles. The opposite is true for the positive rank differences.

CONCLUSION

I have presented a number of methods appearing in the literature and suggested a new one by which variability can be measured. None of the above measures is perfect. Each one uses its own mathematical and statistical approach to measure the variability of a variable.

For the purpose of measuring price instability three methods are considered. The coefficient of variation about a trend, CVT, the INS, suggested by Dalziell and the DB, which I suggest in this paper. The INS removes an exponential trend while the CVT and DB can remove any trend. To make comparisons a linear trend is removed for both CVT and DB. The three methods are used to measure the price instability for 57 commodities and to rank them according to the degree of instability.

The statistics, correlation coefficient and Spearman rank correlation coefficient were used to test the way the three measures rank the commodities. The tests show that there is a very high association, although the measures are not identical in what they identify as instability.

For more analysis the DB and CVT methods can be used removing a linear trend not by ordinary least squares, but by minimizing the sum of the absolute deviations. These measures will be less sensitive to outliers.

TABLE A

INSTABILITY MEASURES BY COMMODITY

	Common name	DB	INS	CVT
1.	Tart cherries	30.8	2.57	2.3
2.	Avocado	28.5	2.33	1.98
3.	Sunflower	26.9	1.81	2.1
4.	Popcorn	26.6	1.39	1.75
5.	Tangelos	25.6	1.50	1.53
6.	Olives	23.3	2.02	1.66
7.	Dry peas	23.3	1.86	2.0
8.	Spearmint	21.4	1.32	1.47
9.	Lemons	21.3	1.48	1.37
10.	Flaxseed	20.8	1.44	1.63
11.	Almonds	20.7	1.57	1.45
12.	Grapefruit	20.4	1.49	1.49
13.	Temples	19.9	1.67	1.55
14.	Figs	19.7	1.39	1.49
15.	Pecans	19.1	1.65	1.31
16.	Limes	18.6	1.48	1.43
17.	Filberts	18.6	.97	.86
18.	Tangerines	17.4	1.31	1.25
19.	Nectarines	17.4	1.14	1.19
20.	Pears	16.9	1.36	1.24
21.	Grapes	16.0	1.20	1.21
22.	Apples	15.4	1.08	1.0

	Common Name	DB	INS	CVT
23.	Sweet potatoes	14.3	1.15	1.06
24.	Pomegranates	12.8	1.25	1.0
25.	Garlic	12.8	1.03	1.14
26.	Walnuts	12.6	1.16	1.02
27.	Prunes	12.6	1.26	1.2
28.	Plums	12.4	1.24	.94
29.	Apricots	11.9	1.1	.95
30.	Artichokes	11.3	.76	.82
31.	Hay	11.3	.69	.80
32.	Sweet cherries	11.2	.93	.84
33.	Watermelon	10.8	.92	.75
34.	Papayas	10.6	1.15	1.11
35.	Eggs	10.6	.77	.69
36.	Escarole	10.4	.86	.78
37.	Fresh tomatoes	9.8	.62	.72
38.	Brussel sprouts	9.8	.68	.70
39.	Eggplants	9.4	.79	.76
40.	Beets	9.2	.58	.64
41.	Green peas	9.1	.6	.7
42.	Peaches	9.1	.57	.62
43.	Taro	8.0	.50	.44
44.	Cantaloupe	7.6	.56	.53
45.	Fresh cucumbers	7.5	.58	.49
46.	Spinach	7.2	.42	.53
47.	Honeydew melons	7.1	.57	.48
48.	Green lima beans	7.1	.49	.48

	Common Name	DB	INS	CVT
49.	Tobacco	7.0	.26	.24
50.	Milk	6.6	.37	.45
51.	Green peppers	6.5	.50	.47
52.	Strawberries	6.3	.51	.52
53.	Honey	5.6	0	0
54.	Carnations	5.4	.43	.39
55.	Bananas	4.7	.41	.35
56.	Mushrooms	2.8	.27	.22
57.	Tea roses	2.3	.19	.16

TABLE B

Value series and rank series

obs	DBR	DB	INSR	INS	CVTR	CVT
1	1.000000	30.80000	1.000000	2.570000	1.000000	2.300000
2	2.000000	28.50000	2.000000	2.330000	4.000000	1.980000
3	3.000000	26.90000	5.000000	1.810000	2.000000	2.100000
4	4.000000	26.60000	14.50000	1.390000	5.000000	1.750000
5	5.000000	25.60000	9.000000	1.500000	9.000000	1.530000
6	6.500000	23.30000	3.000000	2.020000	6.000000	1.660000
7	6.500000	23.30000	4.000000	1.860000	3.000000	2.000000
8	8.000000	21.40000	17.00000	1.320000	12.00000	1.470000
9	9.000000	21.30000	11.50000	1.480000	15.00000	1.370000
10	10.00000	20.80000	13.00000	1.440000	7.000000	1.630000
11	11.00000	20.70000	8.000000	1.570000	13.00000	1.450000
12	12.00000	20.40000	10.00000	1.490000	10.50000	1.490000
13	13.00000	19.90000	6.000000	1.670000	8.000000	1.550000
14	14.00000	19.70000	14.50000	1.390000	10.50000	1.490000
15	15.00000	19.10000	7.000000	1.650000	16.00000	1.310000
16	16.50000	18.60000	11.50000	1.480000	14.00000	1.430000
17	16.50000	18.60000	30.00000	0.970000	30.00000	0.860000
18	18.50000	17.40000	18.00000	1.310000	17.00000	1.250000
19	18.50000	17.40000	26.00000	1.140000	21.00000	1.190000
20	20.00000	16.90000	16.00000	1.360000	18.00000	1.240000
21	21.00000	16.00000	22.00000	1.200000	19.00000	1.210000
22	22.00000	15.40000	28.00000	1.080000	26.50000	1.000000
23	23.00000	14.30000	24.50000	1.150000	24.00000	1.060000
24	24.50000	12.80000	20.00000	1.250000	26.50000	1.000000
25	24.50000	12.80000	29.00000	1.030000	22.00000	1.140000
26	26.50000	12.60000	23.00000	1.160000	25.00000	1.020000
27	26.50000	12.60000	19.00000	1.260000	20.00000	1.200000
28	28.00000	12.40000	21.00000	1.240000	29.00000	0.940000
29	29.00000	11.90000	27.00000	1.100000	28.00000	0.950000
30	30.50000	11.30000	36.00000	0.760000	32.00000	0.820000
31	30.50000	11.30000	37.00000	0.690000	33.00000	0.800000
32	32.00000	11.20000	31.00000	0.930000	31.00000	0.840000
33	33.00000	10.80000	32.00000	0.920000	36.00000	0.750000
34	34.50000	10.60000	24.50000	1.150000	23.00000	1.110000
35	34.50000	10.60000	35.00000	0.770000	40.00000	0.690000
36	36.00000	10.40000	33.00000	0.860000	34.00000	0.780000
37	37.50000	9.800000	39.00000	0.620000	37.00000	0.720000
38	37.50000	9.800000	38.00000	0.680000	38.50000	0.700000
39	39.00000	9.400000	34.00000	0.790000	35.00000	0.760000
40	40.00000	9.200000	41.50000	0.580000	41.00000	0.640000
41	41.50000	9.100000	40.00000	0.600000	38.50000	0.700000
42	41.50000	9.100000	43.50000	0.570000	42.00000	0.620000
43	43.00000	8.000000	47.50000	0.500000	51.00000	0.440000
44	44.00000	7.600000	45.00000	0.560000	43.50000	0.530000
45	45.00000	7.500000	41.50000	0.580000	46.00000	0.490000
46	46.00000	7.200000	51.00000	0.420000	43.50000	0.530000
47	47.50000	7.100000	43.50000	0.570000	47.50000	0.480000
48	47.50000	7.100000	49.00000	0.490000	47.50000	0.480000
49	49.00000	7.000000	55.00000	0.260000	54.00000	0.240000
50	50.00000	6.600000	53.00000	0.370000	50.00000	0.450000
51	51.00000	6.500000	47.50000	0.500000	49.00000	0.470000
52	52.00000	6.300000	46.00000	0.510000	45.00000	0.520000
53	53.00000	5.600000	57.00000	0.000000	57.00000	0.000000
54	54.00000	5.400000	50.00000	0.430000	52.00000	0.390000
55	55.00000	4.700000	52.00000	0.410000	53.00000	0.350000
56	56.00000	2.800000	54.00000	0.270000	55.00000	0.220000
57	57.00000	2.300000	56.00000	0.190000	56.00000	0.160000

TABLE C

Computer results for correlation coefficients and Spearman rank correlation coefficients

SMPL 1 - 57
57 Observations

Series	Mean	S.D.	Maximum	Minimum
DB	13.724561	6.9661754	30.800000	2.3000000
INS	1.0210526	0.5461151	2.5700000	0.0000000
CVT	0.9868421	0.5244628	2.3000000	0.0000000

	Covariance	Correlation
DB,DB	47.676238	1.0000000
DB,INS	3.4932723	0.9346320
DB,CVT	3.4510249	0.9614480
INS,INS	0.2930094	1.0000000
INS,CVT	0.2717858	0.9658610
CVT,CVT	0.2702356	1.0000000

SMPL 1 - 57
57 Observations

Series	Mean	S.D.	Maximum	Minimum
DBR	29.000000	16.595503	57.000000	1.0000000
INSR	29.000000	16.596579	57.000000	1.0000000
CVTR	29.000000	16.596848	57.000000	1.0000000

	Covariance	Correlation
DBR,DBR	270.57895	1.0000000
DBR,INSR	259.29825	0.9582469
DBR,CVTR	263.48684	0.9737102
INSR,INSR	270.61404	1.0000000
INSR,CVTR	264.15789	0.9761268
CVTR,CVTR	270.62281	1.0000000

TABLE D

Rank Differences Between DB and INS Measure
Example: Papayas are ranked 34th by DB and 24th by INS. Rank difference = -10

	Common Name	Rank difference
1.	Papayas	-10
2.	Pecans	-8
3.	Prunes	-7.5
4.	Temples	-7
5.	Plums	-7
6.	Strawberries	-6
7.	Limes	-5
8.	Eggplants	-5
9.	Pomegranates	-4.5
10.	Pears	-4
11.	Honeydew melons	-4
12.	Carnations	-4
13.	Olives	-3.5
14.	Walnuts	-3.5
15.	Fresh cucumbers	-3.5
16.	Green peppers	-3.5
17.	Almonds	-3
18.	Escarole	-3
19.	Bananas	-3
20.	Dry peas	-2.5
21.	Grapefruit	-2
22.	Apricots	-2
23.	Mushrooms	-2
24.	Green peas	-1.5
25.	Sweet cherries	-1
26.	Watermelon	-1
27.	Tea roses	-1
28.	Tangerines	-.5

TABLE D (Continued)

Common Name	Rank difference
29. Tart cherries	0
30. Avocado	0
31. Figs	.5
32. Eggs	.5
33. Brussel sprouts	.5
34. Grapes	1
35. Cantaloupe	1
36. Sweet potatoes	1.5
37. Fresh tomatoes	1.5
38. Beets	1.5
39. Green lima beans	1.5
40. Sunflower	2
41. Peaches	2
42. Lemons	2.5
43. Flaxseed	3
44. Milk	3
45. Tangelos	4
46. Honey	4
47. Garlic	4.5
48. Taro	4.5
49. Spinach	5
50. Artichokes	5.5
51. Apples	6
52. Tobacco	6
53. Hay	6.5
54. Nectarines	7.5
55. Spearmint	9
56. Popcorn	10.5
57. Filberts	13.5

TABLE E

Rank Differences Between DB and CVT Measures
This table is derived the same as Table D

	Common Name	Rank Difference
1.	Papayas	-11.5
2.	Strawberries	-7
3.	Prunes	-6.5
4.	Temples	-5
5.	Eggplants	-4
6.	Dry peas	-3.5
7.	Figs	-3.5
8.	Flaxseed	-3
9.	Green peas	-3
10.	Limes	-2.5
11.	Garlic	-2.5
12.	Spinach	-2.5
13.	Pears	-2
14.	Grapes	-2
15.	Escarole	-2
16.	Green peppers	-2
17.	Carnations	-2
18.	Bananas	-2
19.	Grapefruit	-1.5
20.	Tangerines	-1.5
21.	Walnuts	-1.5
22.	Sunflower	-1
23.	Apricots	-1
24.	Sweet cherries	-1
25.	Mushrooms	-1
26.	Tea roses	-1
27.	Olives	-.5
28.	Fresh tomatoes	-.5
29.	Cantaloupe	-.5
30.	Tart cherries	0

TABLE E (Continued. . .)

Common Name	Rank Difference
31. Honeydew melons	0
32. Green lima beans	0
33. Milk	0
34. Peaches	.5
35. Popcorn	1
36. Pecans	1
37. Sweet potatoes	1
38. Plums	1
39. Brussel sprouts	1
40. Beets	1
41. Fresh cucumbers	1
42. Artichokes	1.5
43. Avocado	2
44. Almonds	2
45. Pomegranates	2
46. Nectarines	2.5
47. Hay	2.5
48. Watermelon	3
49. Tangelos	4
50. Spearmint	4
51. Honey	4
52. Apples	4.5
53. Tobacco	5
54. Eggs	5.5
55. Lemons	6
56. Taro	8
57. Filberts	13.5