"Stochastic Properties of Revisions in the Index of Leading Indicators," *Proceedings of the American Statistical Association, Business and Economic Statistics Section, 1987,* 712-717. Washington, DC: American Statistical Association, 1988.

STOCHASTIC PROPERTIES OF REVISIONS IN THE INDEX OF LEADING INDICATORS

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1. Introduction

> The Government's best-known tool for economic forecasting--the index of leading indicators--will undergo a major revision by the end of the year, ...
> The New York Times (May 29, 1987)

On the day of its release, the composite index of leading indicators is widely reported, and accorded much respect, in the popular and financial press. Among economists, however, the forecasting ability of the leading indicators is often treated with some skepticism. The simultaneous presence of both views reflects inadequate evaluation of the predictive power of the leading indicators. In particular, most available studies are limited by the use of final revised data.[2] The composite leading index (CLI) is extensively revised after each preliminary estimate; not only are revisions made as more complete historical data become available for the components, but ex post the statistical weights are updated and components are added or eliminated to improve leading performance. Forecasts constructed with an ex post, recomputed CLI may differ greatly from real-time forecasts based on the contemporaneous original construction CLI.

As a first step to providing an evaluation of the real-time forecasting performance of the CLI, it is of interest to examine and characterize the stochastic properties of the preliminary CLI releases and subsequent revisions. In section 2, a characterization of statistical revisions of the CLI within definitional regimes is given relative to the polar cases of efficient forecast error and measurement error, and temporal changes in this characterization are examined. In section 3, we study inter-regime revisions with respect to the informational content of the preliminary estimates relative to the final, revised, numbers. Section 4 concludes.

2. Characterization of Intra-Regime Revisions

While the information content and efficiency of preliminary estimates is a consideration in any real-time forecasting situation, it is especially important when evaluating the performance of the composite index of leading indicators. The CLI is extensively revised from its preliminary estimate to its final form, undergoing both definitional and statistical revisions. Toward the end of each month, the Bureau of Economic Analysis (BEA) produces a preliminary estimate of last month's composite leading index on the basis of incomplete and preliminary source data and may also revise the index for any one of the preceeding eleven months. Thus, each initial estimate is subject to up to eleven revisions. These statistical revisions in the CLI occur because of statistical revisions in the component indicators (due to larger and/or more representative samples as time passes, etc.) and also because of late-arriving data that are included, for example, in the first revision but not in the preliminary estimate. The currently available CLI data are not only of final, revised form, but the components have been reweighted and re-selected ex post to improve performance over the sample. These definitional revisions in the composite leading index have several different forms:

1) compositional changes due to changes in data availability, data timing, or cyclical lead performance;

2) changes in weights assigned to component indicators due to statistical updating as more data become available;

3) definitional changes in component indicators, which may be due to changes in subcomponent definitions or coverage, and so on.

A substantial number of definitional revisions have occurred in the CLI, as detailed in Appendix A, since its first presentation in the November 1968 Business Conditions Digest (BCD). For example, the last major revision of the CLI occurred in February of 1983 when the index updated statistical factors, incorporated historical revisions in the component data, and replaced two of the components (crude material price inflation and the change in liquid assets) with series that were broadly similar but produced a more consistent leading performance.

As shown by Mankiw, Runkle and Shapiro (1984) and Mankiw and Shapiro (1986), it is useful to classify the stochastic properties of revisions relative to the polar cases of measurement error and efficient forecast error. In this section, we perform such an analysis of the relative properties of CLI revisions, within definitional regimes, which enables us to ascertain whether the properties of the preliminary CLI estimates may be readily improved. We also examine the size and variability of intra-regime revisions relative to the size of the revised CLI value.

The intuition behind the efficient forecast error / measurement error dichotomy is simple: if a provisional estimate differs from the revised value by only measurement error, then the revision is uncorrelated with the revised value but correlated with the provisional information set. On the other hand, if a provisional estimate represents an efficient ("rational," or minimum mean squared error conditional on available information) forecast, then the revision is correlated with the revised value but uncorrelated with the provisional information set. By determining where the CLI revisions lie within this spectrum, we can gain insight into the potential for achieving improvement in the preliminary numbers. If the intra-regime revisions behave as efficient forecast errors, then they are optimal estimates of the final, revised numbers. To the extent that the final numbers produce the better forecasts, then, efficient forecast error revisions are desirable.

We examine two definitional regimes: February 1979 - December 1981 and January 1983 - January 1987. These represent timely and com-

Table 1
Analysis of the CLI, 1983-1987

VARIABLE	N	MEAN	STD DEV	T: MEAN=0
Y1	49	0.52	0.86	4.26
Y2	48	0.60	0.92	4.48
Y3	47	0.55	0.83	4.57
Y4	46	0.54	0.85	4.34
Y5	45	0.54	0.85	4.27
Y6	44	0.55	0.86	4.23
Y7	43	0.57	0.88	4.26
Y8	42	0.57	0.88	4.16
Y9	41	0.60	0.87	4.41
Y10	40	0.60	0.89	4.28
Y11	39	0.58	0.88	4.12
Y12	38	0.56	0.88	3.92
Y3Y1	47	0.03	0.45	0.49
Y5Y3	45	0.00	0.16	0.00
Y7Y5	43	0.01	0.16	0.29
Y9Y7	41	0.01	0.09	0.70
Y12Y9	38	-0.03	0.13	-1.46
Y5Y1	45	0.04	0.48	0.53
Y9Y5	41	0.02	0.18	0.86
Y12Y9	38	-0.03	0.13	-1.46
Y6Y1	44	0.04	0.47	0.58
Y12Y6	38	-0.01	0.16	-0.21
Y12Y1	38	0.07	0.49	0.82

Table 2

Pearson Correlation Coefficients,
Probability > |R| Under Ho: Rho=0,
and Number of Observations
Sample: 1983-1987

	Y1	Y5	Y9	Y12
Y5Y1	-0.23	0.33	0.28	0.28
	0.12	0.03	0.08	0.09
	45	45	41	38
Y9Y5	0.00	-0.11	0.09	0.07
	0.98	0.48	0.56	0.69
	41	41	41	38
Y12Y9	-0.06	-0.09	-0.15	-0.01
	0.72	0.60	0.35	0.97
	38	38	38	38

Table 3
Analysis of CLI, 1979-1981

VARIABLE	N	MEAN	STD DEV	T: MEAN=0
Y1	35	-.32	1.77	-1.07
Y2	34	-.24	1.55	-.88
Y3	33	-.26	1.57	-.96
Y4	32	-.23	1.56	-.84
Y5	31	-.15	1.57	-.53
Y6	30	-.17	1.60	-.58
Y7	29	-.20	1.62	-.68
Y8	28	-.20	1.61	-.64
Y9	27	-.14	1.64	-.44
Y10	26	-.14	1.61	-.45
Y11	25	-.16	1.61	-.48
Y12	24	-.21	1.64	-.63
Y3Y1	33	.08	.59	.79
Y5Y3	31	.01	.24	.15
Y7Y5	29	-.07	.13	-2.68
Y9Y7	27	-.01	.14	-.41
Y12Y9	24	.01	.21	.19
Y5Y1	31	.07	.57	.73
Y9Y5	27	-.08	.19	-2.03
Y12Y9	24	.01	.21	.19
Y6Y1	30	.04	.57	.42
Y12Y6	24	-.03	.27	-.61
Y12Y1	24	-.02	.74	-.14

Table 4
Pearson Correlation Coefficients,
Probability > |R| Under Ho: Rho=0,
and Number of Observations
Sample: 1979-1981

	Y1	Y5	Y9	Y12
Y5Y1	-0.54	-0.25	-0.25	-0.23
	0.00	0.17	0.20	0.28
	31	31	27	24
Y9Y5	-0.12	-0.13	-0.01	-0.03
	0.55	0.53	0.97	0.88
	27	27	27	24
Y12Y9	-0.39	-0.37	-0.37	-0.26
	0.06	0.08	0.07	0.22
	24	24	24	24

paratively long regimes and provide an interesting contrast in terms of behavior of the economy. For each date in each sample, we have twelve estimates available, which we denote Y1, Y2, ..., Y12, where Y1 is the preliminary number (in percentage-change form) and Y12 is the final revised number. We therefore have eleven non-overlapping revisions for each calendar date, defined by Y2Y1 $\doteq$ Y2 - Y1, ..., Y12Y11 $\doteq$ Y12 - Y11.

Consider first the January 1983 - January 1987 sample. The percentage-change CLI data, Y1,..., Y12 are shown in Appendix B. The increasing number of missing values, beginning in March 1986, reflects the new definitional regime that began in February 1987. The standard deviations of Y1, ..., Y12 are all in the neighborhood of .86, while the standard deviations of the revisions begin around .5 (for the earliest revisions) and eventually decrease to around .1 (for the last revisions). See table 1. Thus, the standard deviation of the revisions (particularly the early revisions) is quite large relative to the standard deviation of the percent-change CLI estimates. This implies that all of the CLI growth rate estimates, and particularly that of Y1, have large associated confidence intervals. The t-tests detect no bias in any of the revisions. The revision distribution generally tightens around a median of zero as we progress from Y2Y1 through Y12Y11.

If revisions are efficient forecast errors, then the variances of Y1 through Y12 should be monotonically increasing, because an efficient forecast is necessarily smoother than the series being forecast. Conversely, if revisions are measurement errors, then the variances of Y1,...

Y12 should be decreasing. The data are not very informative in this regard; the estimated standard deviations of Y1,..., Y12 display little variation. Perhaps the most interesting sequence of standard deviations is (.86, .92, .83), which corresponds to (Y1, Y2, Y3).

Correlations between levels and revisions are given in table 2. Under the null of efficient forecast errors, the above-diagonal entries should be significant, while the below-diagonal entries should be insignificant. The table appears roughly consistent with the rational forecast error scenario, but the revisions after the third contain little information. Thus, while the entries of the first above-diagonal row of the table appear significant (and large in absolute value), the other above-diagonal rows are insignificant. This may reflect the fact that, after the fifth revision, the Y's move too little to estimate correlations with precision.

The results for the earlier sample (1979-1981) are quite different.[3] There is a large dropoff in variance as we move from Y1 to Y2, which is not consistent with forecast efficiency. (See table 3.) The Mankiw-Shapiro correlations, reported in table 4, indicate a measurment error component, as evidenced by the lack of significant above-diagonal correlations as well as a highly significant below-diagonal correlation.

One obvious source of measurement error in the preliminary estimate is that it is based on incomplete data, for not all component indicators are included in the preliminary (and sometimes second and third) releases. The weights assigned to the component indicators in the CLI are very close to those of a simple arithmetic average (see Auerbach (1982)); that is:

$$CLI \approx 1/K \sum_{i=1}^{K} X_i .$$

If only (K-J) component indicators are available, the procedure adopted by the BEA amounts to taking an arithmetic average of the available series:

$$CLI^P = 1/(K-J) \sum_{i=1}^{K-J} X_i .$$

Note that such a procedure is formally equivalent to averaging all K component indicators, under the assumption that the missing indicators take values equal to the arithmetic average of the available indicators:

$$CLI^P = 1/K \left(\sum_{i=1}^{K-J} X_i + \sum_{i=K-J+1}^{K} [(1/(K-J)) \sum_{i=1}^{K-J} X_i] \right).$$

To the extent that better forecasts for the missing component indicators can be found, an element of measurement error is immediately introduced into the revisions. In the 1979-1981 sample, two components, net business formation and the change in inventories, were not available for any of the preliminary numbers, and inventory change was also omitted from 26 of 35 first revisions and from one second revision. For the later sample from 1983-1987, only the preliminary numbers suffer from omitted components; the inventory change is missing from each preliminary estimate and the change in credit is missing from 21 of 48 preliminary estimates. We can now see why the earlier sample revisions suffer relatively more than the later sample from measurement error contamination.

In summary, then, while there is some evidence that both the 1979-1981 and 1983-1987 revisions contain a measurement error component, the measurement error is more severe in the 1979-1981 sample. We have argued that this may be traced to the greater number of neglected series in the preliminary data for the first subsample. We also note that, even apart from the neglected preliminary component series, we have little reason to hope for "rational forecast error" revisions. In general, there is a myriad of reasons for the introduction of measurement error, not the least of which is measurement error in the revisions of the component indicators.[4]

3. Inter-Regime Revisions

We now turn to an analysis of the absolute magnitude of inter-regime revisions. It is readily apparent that any difference between *ex ante* and *ex post* CLI-based forecasts may be traced directly to the divergence between these two sets of CLI estimates. The size of revisions to the CLI provides an indication of the information content of the preliminary estimates. To the extent that use of *ex post* CLI data produces better forecasts, a high revision variability clearly vitiates the *ex ante* forecasting ability of the CLI. Over the entire sample from December 1968 to January 1987, the standard deviation of the revision from the preliminary estimate to the final number as given in January, 1987 is .86. Thus, for example, if the preliminary increase is 1.0 percent one can only be 80 percent confident that the final estimate will be greater than -.41 percent and less than 2.41 percent (assuming normality). Within the most recent period when definitional revisions are not a factor (January 1983 to January 1987, shown in the last row of table 1) this standard deviation is .49, and the corresponding 80% confidence interval is ±.80.[5] The revisions, regardless of origin, are large relative to the size of the actual (final) CLI change.

In order to measure the temporal behavior of this divergence between the *ex post* data currently available and the *ex ante* CLI data we examine, at each point in time since December 1969, a thirteen period moving average squared deviation D_t^q and absolute deviation D_t^a:

$$D_t^q = 1/13 \sum_{i=0}^{12} (CLI^{ep} - CLI^{ea})^2$$

$$D_t^a = 1/13 \sum_{i=0}^{12} |CLI^{ep} - CLI^{ea}|$$

The resulting D_t^q sequence is shown in figure 1 for both the case in which CLI^{ea} is the preliminary number (DTA) and the case in which CLI^{ea} is the first revision (DTB). The corresponding D_t^a sequences are shown in figure 2. Both (D_t^q) and (D_t^a) display the same qualitative behavior; as expected, however, the temporal movements in D_t^q are somewhat greater. Other things the same, we would expect a monotonic decline over time in our quadratic and absolute measures of variability, on the grounds that the sequence of CLI definitions since 1968 should presumably get progressively more close to the current definition. The data are not in accord with this view; while a downward trend is present in both (D_t^q) and (D_t^a), the progression is not at all monotonic, with clear peaks occurring around 1970-12, 1974-2 and 1980-12. It is of interest to note that the movements in volatility measures correspond only very roughly (even allowing for the twelve lags) to definitional changes in the CLI.

4. Conclusions

Our findings include the following:

1. The size of revisions within definitional regimes is high relative to the magnitude of the revised percent change in the CLI. For example, during 1983 -1987, an 80% confdence interval for the final estimate of the percentage change in the CLI is ± .8 percentage points, centered around the preliminary estimate.

2. Missing indicators in the preliminary CLI estimate lead to a measurement error component in the revision.

3. The measurement error component does not appear to be too severe in practice, and is much less pronounced in the most recent definitional regime (post 1983), in which the revisions roughly behave as efficient forecast errors.

4. The volatility of revisions across definitional regimes is high relative to the magnitude of the revised percent change in the CLI. Furthermore, time series of moving volatility measures display systematic and nonmonotonic movements since 1968.

Appendix A: History of the CLI in *Business Conditions Digest*

November 1968: The index is shown in the BCD for the first time. Data are given from 1948 (with January 1948=100) through October 1968. The index is trend-adjusted and comprises 12 components: Average workweek, manufacturing; Nonagricultural placements, all industries; Net business formation; New orders, durable goods; Contracts and orders, plant and equipment; Building permits, private housing; Change in manufacturing and trade inventories; Industrial materials prices; Stock prices; Corporate profits after taxes (Q); Ratio, price to unit labor cost, manufacturing; Change in consumer installment debt.

January 1969: The index is changed to 1963=100. No changes are made in composition or in statistical factors. Historical data are shown back to 1948.

September 1969: The index is revised back to 1948 to replace nonagricultural placements with average weekly initial claims for state unemployment insurance.

August 1970: The index is revised back to 1948 to incorporate historical revisions in the component data, updated statistical factors, and a new base year (1967=100). No changes are made in composition.

October 1973: The index is revised back to 1948 to incorporate historical revisions in the component data and updated statistical factors. No changes are made in composition.

May 1975: The index undergoes a major revision back to 1948. New statistical factors are computed. Eight components are replaced with new or improved series. (Dropped: initial claims for State unemployment insurance; new orders, durable goods; contracts and orders, plant and equipment; change in manufacturing and trade inventories; industrial materials prices; corporate profits after taxes (Q); ratio, price to unit labor cost, manufacturing; change in consumer installment debt. Added: layoff rate, manufacturing; new orders, consumer goods and materials (deflated); contracts and orders, plant and equipment (deflated); change in inventories on hand and on order (deflated); change in sensitive crude materials prices; vendor performance; money supply M1 (deflated); change in total liquid assets.)

November 1975: The index is revised to incorporate a new trend adjustment based on the new coincident index. No changes are made in composition. Historical data back to 1948 are shown in the December 1975 issue.

November 1976: The index is revised back to 1948 to incorporate historical revisions in component data, updated statistical factors, and new methods of trend and amplitude adjustments. No changes are made in composition.

March 1979: The index is revised back to 1948 to incorporate historical revisions in component data and updated statistical factors. The deflated M1 money supply is replaced by the deflated M2 money supply.

February 1982: The layoff rate in manufacturing is replaced by initial claims for unemployment insurance. (BLS no longer collects layoff data.) Only the last 12 months of the index are affected. Note that between February 1982 and January 1983 current data for the index excludes net business formation.

February 1983: The index is revised to incorporate historical revisions in component data, updated statistical factors, and changes in composition. Change in sensitive crude materials prices is replaced by a new change in sensitive materials prices series and change in total liquid assets is replaced by change in business and consumer credit outstanding. Historical data are shown back to 1948.

February 1987: Net business formation is dropped from the index.

APPENDIX B

CLI DATA

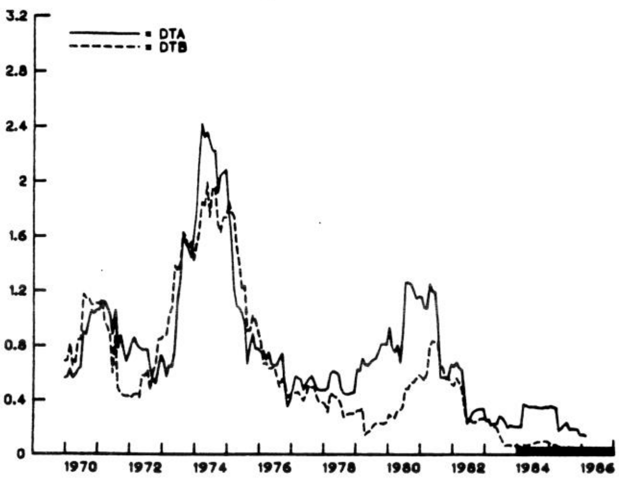
SAMPLE 1: 1983-1987

OBS	YEAR	MONTH	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
1	1983	1	3.6	3.5	3.2	3.0	2.9	3.0	3.1	3.1	3.1	3.1	3.1	3.1
2	1983	2	1.4	1.4	1.4	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.5
3	1983	3	1.5	2.2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9
4	1983	4	1.1	1.4	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.5	1.5	1.5
5	1983	5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.2	1.2
6	1983	6	1.0	1.9	1.9	1.8	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.9
7	1983	7	0.3	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.6
8	1983	8	-0.1	0.3	0.4	0.5	0.4	0.4	0.4	0.3	0.4	0.5	0.4	0.4
9	1983	9	0.9	1.0	0.8	0.8	0.9	0.9	1.1	1.1	1.0	0.8	0.8	0.7
10	1983	10	0.8	1.4	1.2	1.4	1.4	1.4	1.5	1.5	1.4	1.4	1.5	1.5
11	1983	11	-0.4	-0.2	-0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1
12	1983	12	0.6	0.1	0.2	0.7	0.7	0.5	0.6	0.6	0.6	0.6	0.6	0.6
13	1984	1	1.1	1.0	0.7	0.3	0.5	0.7	0.6	0.6	0.7	0.7	0.7	0.7
14	1984	2	0.7	1.3	1.5	1.4	1.4	1.6	1.6	1.5	1.5	1.5	1.5	1.2
15	1984	3	-1.1	-0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4
16	1984	4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
17	1984	5	-0.1	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.1
18	1984	6	-0.9	-1.3	-1.1	-0.9	-1.0	-0.9	-0.9	-0.9	-0.9	-0.9	-0.8	-0.9
19	1984	7	-0.8	-1.8	-1.7	-1.8	-1.8	-1.7	-1.8	-1.8	-1.7	-1.8	-1.7	-1.7
20	1984	8	0.5	-0.1	0.1	0.1	-0.1	0.2	0.2	0.4	0.4	0.4	0.3	0.3
21	1984	9	0.4	0.6	0.9	0.8	0.7	0.7	0.7	0.9	0.8	0.8	0.8	0.8
22	1984	10	-0.7	-0.5	-0.6	-1.0	-0.9	-1.0	-1.0	-0.9	-0.9	-0.9	-0.9	-0.9
23	1984	11	1.3	0.6	0.5	0.5	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5
24	1984	12	-0.2	-0.5	-0.5	-0.5	-0.6	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6	-0.6
25	1985	1	1.7	1.5	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
26	1985	2	0.7	0.5	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7
27	1985	3	-0.2	0.1	-0.1	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
28	1985	4	-0.2	-0.6	-0.5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5	-0.7	-0.7	-0.8
29	1985	5	0.7	0.1	0.3	0.3	0.3	0.2	0.3	0.2	0.1	0.0	-0.1	0.2
30	1985	6	1.0	0.4	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.3	0.4
31	1985	7	0.4	0.7	0.7	0.7	0.5	0.6	1.1	1.0	1.1	0.9	0.9	0.9
32	1985	8	0.7	0.9	0.8	0.9	0.9	0.5	0.5	0.5	0.5	0.4	0.4	0.4
33	1985	9	0.1	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.5	0.5
34	1985	10	0.3	0.4	0.6	0.9	0.9	0.8	0.8	0.8	0.6	0.6	0.6	0.6
35	1985	11	0.1	0.2	0.2	0.2	0.3	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0
36	1985	12	0.9	1.5	1.5	1.5	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
37	1986	1	-0.6	0.0	0.0	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
38	1986	2	0.7	0.9	0.8	1.0	0.8	0.9	0.9	0.8	0.8	0.8	0.9	0.6
39	1986	3	0.5	0.9	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	.
40	1986	4	1.5	1.3	1.3	1.2	1.3	1.3	1.3	1.2	1.3	1.2	.	.
41	1986	5	0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	.	.	.
42	1986	6	0.3	-0.4	-0.2	-0.3	-0.2	-0.2	-0.2	-0.2	.	.	.	.
43	1986	7	1.1	1.0	1.0	1.0	1.0	0.9	0.7	.	.	.	.	.
44	1986	8	-0.2	-0.1	-0.2	-0.2	-0.1	0.0	.	.	.	.	.	.
45	1986	9	0.4	0.2	0.2	0.2	0.1	.	.	.	.	.	.	.
46	1986	10	0.6	0.5	0.7	0.6	.	.	.	.	.	.	.	.
47	1986	11	1.2	0.9	0.9	.	.	.	.	.	.	.	.	.
48	1986	12	2.1	2.3	.	.	.	.	.	.	.	.	.	.
49	1987	1	-1.0	.	.	.	.	.	.	.	.	.	.	.

SAMPLE 2: 1979-1981

OBS	YEAR	MONTH	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
1	1979	2	-0.9	-0.4	-0.1	0.0	0.2	0.0	0.1	0.1	0.1	0.1	0.1	-0.2
2	1979	3	-0.5	0.3	0.5	0.3	0.3	0.2	0.4	0.4	0.4	0.2	0.6	0.6
3	1979	4	-3.3	-2.0	-2.1	-2.2	-2.3	-2.4	-2.4	-2.4	-2.4	-2.0	-1.9	-2.0
4	1979	5	0.4	0.3	0.2	0.1	0.2	0.3	0.3	0.2	0.6	0.6	0.7	0.8
5	1979	6	-0.1	-0.3	-0.3	0.3	0.4	0.3	0.4	0.1	0.1	0.1	0.1	0.1
6	1979	7	-0.4	-0.2	-0.3	-0.4	-0.4	-0.3	-0.7	-0.7	-0.8	-0.6	-0.4	-0.3
7	1979	8	0.0	0.1	-0.2	-0.2	-0.4	-0.5	-0.5	-0.6	-0.6	-0.7	-0.6	-0.8
8	1979	9	0.8	0.2	0.4	0.4	0.4	0.5	0.4	0.4	0.1	-0.1	0.0	0.0
9	1979	10	-0.9	-1.4	-1.0	-1.1	-1.4	-1.4	-1.5	-1.6	-1.6	-1.6	-1.6	-1.6
10	1979	11	-1.3	-1.2	-1.9	-1.9	-1.7	-1.7	-1.7	-1.6	-1.6	-1.6	-1.6	-1.6
11	1979	12	0.0	-0.2	-0.3	-0.2	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.3
12	1980	1	-0.7	-0.3	0.0	0.0	0.0	-0.1	-0.4	-0.4	-0.4	-0.4	-0.3	-0.4
13	1980	2	-0.2	-0.4	-0.4	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.5	-0.4	-0.4
14	1980	3	-2.6	-2.1	-2.4	-2.3	-2.2	-2.2	-2.2	-2.2	-2.2	-2.1	-2.0	-1.9
15	1980	4	-4.8	-4.1	-3.9	-4.0	-4.3	-4.3	-4.3	-4.2	-4.3	-4.0	-4.0	-4.0
16	1980	5	-2.4	-2.3	-2.3	-2.3	-2.4	-2.4	-2.4	-2.4	-2.2	-2.2	-2.2	-2.5
17	1980	6	2.5	1.5	1.0	1.0	1.0	0.9	0.8	0.8	0.8	0.8	0.7	0.7
18	1980	7	4.6	3.7	3.6	3.6	3.5	3.5	3.4	3.4	3.4	3.6	3.6	3.4
19	1980	8	1.9	1.7	2.1	2.0	2.0	1.9	1.9	1.9	2.2	2.2	2.1	2.0
20	1980	9	2.4	3.1	3.4	3.3	3.1	3.1	3.1	2.9	2.9	2.8	2.8	2.8
21	1980	10	0.9	0.7	0.6	0.7	0.8	0.8	0.6	0.6	0.5	0.5	0.4	0.4
22	1980	11	1.2	1.5	1.1	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
23	1980	12	-0.8	-0.9	-0.1	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
24	1981	1	-0.4	-0.4	-1.0	-0.9	-0.5	-1.0	-0.9	-0.8	-0.8	-0.8	-0.9	-0.9
25	1981	2	-0.4	-0.5	-0.4	-0.5	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	.
26	1981	3	1.4	1.8	1.0	1.1	1.1	1.2	1.2	1.2	1.1	1.1	.	.
27	1981	4	0.4	0.4	0.7	0.6	0.6	0.6	0.6	0.6	0.6	.	.	.
28	1981	5	-1.8	-1.5	-1.6	-1.7	-1.7	-1.7	-1.6	-1.6	.	.	.	.
29	1981	6	-1.3	-1.0	-0.8	-0.9	-0.8	-0.9	-0.9	.	.	.	.	.
30	1981	7	-0.1	0.4	0.3	0.0	0.1	0.1	.	.	.	.	.	.
31	1981	8	-0.5	-0.5	-0.6	-0.8	-0.7	.	.	.	.	.	.	.
32	1981	9	-2.7	-2.2	-2.1	-1.7	.	.	.	.	.	.	.	.
33	1981	10	-1.8	-1.6	-1.8	.	.	.	.	.	.	.	.	.
34	1981	11	-0.3	-0.2	.	.	.	.	.	.	.	.	.	.
35	1981	12	0.6	.	.	.	.	.	.	.	.	.	.	.

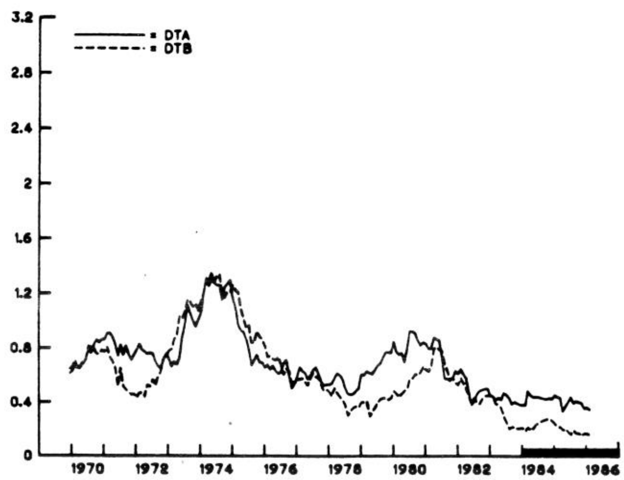
Figure 1
EX ANTE AND EX POST CLI
MEAN SQUARED DEVIATION, MOVING AVERAGE



FOOTNOTES

1. We would like to thank Bill Nelson, Suzanne Nace, and Gerhard Fries for outstanding research assistance and Barry Beckman for helpful information. The views expressed here are those of the authors and are not necessarily shared by the Federal Reserve System or its staff.
2. See, for example, Diebold and Rudebusch (1987a) and the references therein. Four exceptions to the use of final, revised data in CLI evaluation are Steckler and Schepsman (1973), Hymans (1973), Zarnowitz and Moore (1982), and Diebold and Rudebusch (1987b).
3. These data and further analysis are given in Diebold and Rudebusch (1987b).
4. For example, Mankiw, Runkle and Shapiro (1984) find substantial measurement error in money stock revisions.
5. The standard deviation for this sample is computed over 1983-1 1986-2, the last date for which final (i.e., eleventh revision) data are available.

Figure 2
EX ANTE AND EX POST CLI
MEAN ABSOLUTE DEVIATION, MOVING AVERAGE



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