Volume Title: Annals of Economic and Social Measurement, Volume 2, number 1

Volume Author/Editor: NBER

Volume Publisher: NBER

Volume URL: http://www.nber.org/books/aesm73-1

Publication Date: 1973

Chapter Title: Measuring Current Economic Fluctuations

Chapter Author: Julius Shiskin

Chapter URL: http://www.nber.org/chapters/c9835

Chapter pages in book: (p. 1 - 15)

Annals of Economic and Social Measurement, 2/1, 1973

MEASURING CURRENT ECONOMIC FLUCTUATIONS

BY JULIUS SHISKIN*

This paper extends earlier studies on the separation of systematic movements in economic time series—the "signals"—from the irregular fluctuations—the "noise." While earlier studies were concerned primarily with historical relationships, this new study is concerned primarily with the most recent figures. It provides noise-signal ratios for current data for 18 principal economic indicators and demonstrates that the noise-signal ratio is higher for current than for historical observations. It concludes that we usually cannot tell whether a given series was rising or falling cyclically between the latest two months, but we usually can tell whether it was rising or falling between the current month and another about three months earlier.

I. THE ISSUES

Economists have found it useful to consider economic time series fluctuations as a composite of systematic and irregular movements. The systematic movements in the economy—the signals—reveal seasonal patterns, cyclical movements, and long-term trends. The irregular fluctuations—the noise—are a composite of erratic real world occurrences and measurement errors. Separation of the systematic components provides a better basis for studying causal factors and forecasting changes in economic activity. Separation of the irregular components provides a basis for balancing costs of reducing statistical errors against resultant gains in accuracy.

A substantial effort to measure the relative magnitudes of these different components has been made in recent years. This effort has been greatly facilitated by the availability of Census Method II which provides such measures at high speed and low cost. But this computer program, in common with other methods of decomposing time series, produces only measures of historical performance, whereas the greater interest is in the relative magnitudes of the components in the most recently available figures. Current measures of the components differ from historical measures partly because the moving average methods employed in Census Bureau Method II require estimates of data for future years and partly because reported figures for current months are often preliminary estimates, based upon incomplete returns.

This paper is addressed to the questions: (1) What happens to the noise-signal ratio as we move from historical to current observations? and (2) How can this ratio be useful in analyzing the most recent trends?

The method of the paper is to describe historical relationships, among the cyclical, seasonal and irregular factors, mostly on the basis of up-dated earlier studies. Measures of the impact of various measurement problems on current estimates of these factors for 18 principal U.S. economic indicators are then provided and interpreted.

* Adapted from a longer article prepared for Conference of European Statisticians meeting, June 26–30, 1972. The writer is greatly indebted to Dr. Marie D. Wann of OMB and Morton Somer of the U.S. Department of Commerce for valuable assistance in the preparation of this article.

II. Amplitudes of Different Types of Economic Fluctuations

Some years ago (1957) an analysis was made of the cyclical, seasonal, and irregular amplitudes of a set of about 150 series considered to be broadly representative of the various activities of the U.S. economy.[1] This study revealed that seasonal movements dominated other kinds of month-to-month movements in most current economic series. Seasonal movements are almost always larger than either irregular or cyclical movements, and are often larger than the other two types combined.

More specifically, for the 150 series studied, the average monthly amplitude of seasonal fluctuations exceeded that of the cyclical factor in 78 percent of the series, exceeded the irregular factor in 65 percent of the series, and exceeded the combined cycle-trend and irregular factors in 45 percent of the series. Furthermore, where the seasonal factor is larger than the other factors, it is often much larger. The seasonal factor is three or more times larger than the cyclical factor in 45 percent of the series, and three or more times larger than the cyclical and irregular fluctuations together in 11 percent of the series. These observations apply to intervals of one month; over longer spans the relative importance of the several components would, of course, be different (see Table I).[2]

TABLE I

Percent of Total Variation Contributed by Statistical Components of the Total Retail Sales Series, United States, 1960–1971

Component	Percent of Variation	
	Month-to-month	Twelve-month spans
Holiday	0.2	0.2
Trading day	33.0	5.1
Seasonal	65.2	0.0
Irregular	1.1	1.6
Trend-cycle	0.5	93.1
Total	100.0	100.0

Chart I illustrates the various types of economic fluctuations for retail sales in the U.S. The chart also shows the seasonally adjusted retail sales series in current dollar and in deflated form. Table I shows how seasonal and trading day fluctuations, which dominate the short-term movements, give way in relative importance to the trend-cycle factor when comparisons are made over longer periods. This indicates one major source of difficulty in discerning the underlying trend-cycle movements in current monthly figures, and the need to observe data over longer spans to make sound judgments on recent cyclical trends.

[1] Julius Shiskin, "Decomposition of Economic Time Series," *Science*, Vol. 128, No. 3338 (December 19, 1958), pp. 1539–1546.

[2] While the emphasis in the present paper is on monthly series, it should be noted that some economic data are collected on a quarterly basis, and many monthly series are summarized into quarterly aggregates, such as Gross National Product. For such series, a seasonal adjustment is performed on a quarterly basis using methods quite similar to those for monthly series.

Systematic and Irregular Components of Total Retail Sales, United States

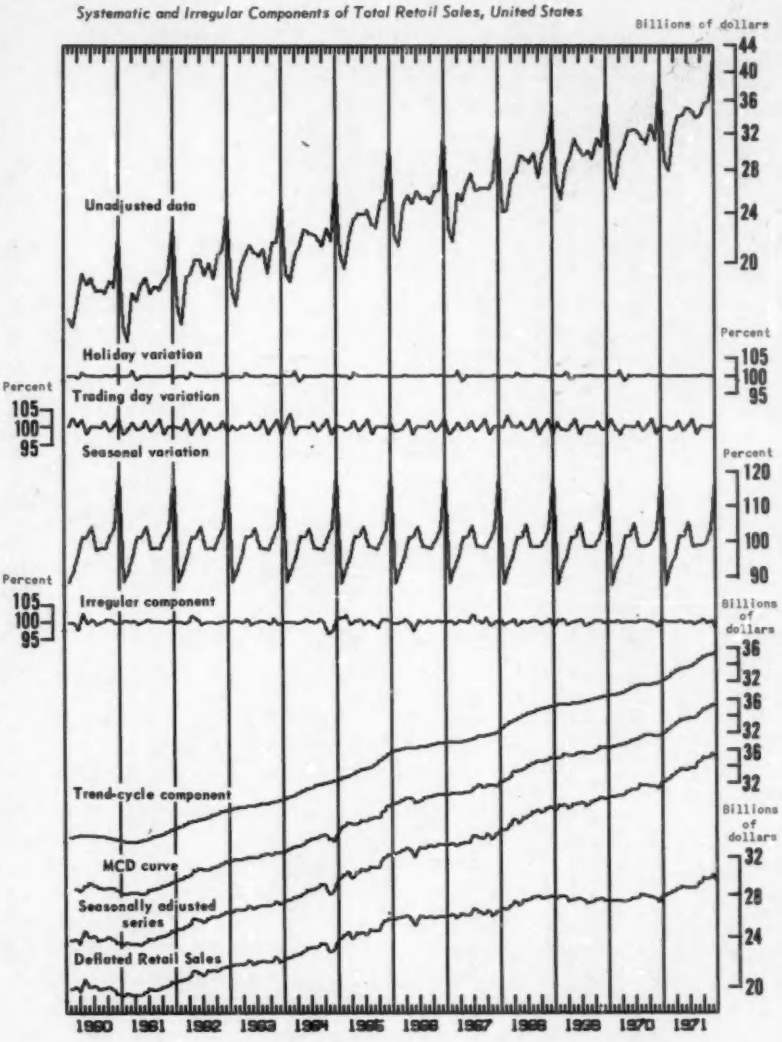

TABLE II

MEASURES OF THE AMPLITUDES OF DIFFERENT TYPES OF ECONOMIC FLUCTUATIONS 1965–1969—18 U.S. ECONOMIC INDICATORS

BCD No.	Series	$\bar{C}_1$	$\bar{S}_1$	$\bar{S}_{12}$	$\bar{I}_1$	$\bar{I}_1/\bar{C}_1$	$\bar{S}_{12}/\bar{C}_1$	$\bar{S}_{12}/\bar{S}_1$	$\bar{S}_{12}/\bar{I}_1$	*MCD*	*F*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
6.	Value of manufacturers' new orders, durable goods	0.80	4.94	0.31	2.36	2.97	0.39	0.06	0.13	3	34.8
28.	Private housing starts	1.96	11.71	0.61	5.70	2.91	0.31	0.05	0.11	4	128.1
29.	New building permits, private housing	2.51	9.87	0.62	5.91	2.36	0.25	0.06	0.11	3	131.1
41.	Employees on nonagricultural payrolls	0.30	0.61	0.05	0.10	0.35	0.18	0.09	0.51	1	250.3
47.	Index of industrial production	0.54	2.01	0.09	0.44	0.82	0.17	0.05	0.21	1	89.7
54.	Sales of retail stores	0.49	5.53	0.12	0.82	1.65	0.25	0.02	0.15	2	779.8
56.	Manufacturing and trade sales	0.53	3.73	0.13	1.21	2.27	0.24	0.03	0.11	3	118.3
65.	Manufacturers' inventories of finished goods, book value	0.63	0.76	0.06	0.18	0.29	0.10	0.08	0.35	1	108.8
71.	Manufacturing and trade inventories, book value	0.67	0.66	0.04	0.14	0.21	0.06	0.06	0.30	1	116.2
502.	Exports, excluding military aid	0.72	5.23	0.12	6.78	9.42	0.17	0.02	0.02	6	8.2
512.	General imports	1.27	3.75	0.18	4.76	3.76	0.14	0.05	0.04	5	8.2
750.	Wholesale prices, all commodities	0.28	0.15	0.04	0.17	0.62	0.13	0.24	0.20	1	9.7
781.	Consumer prices	0.32	0.08	0.04	0.09	0.29	0.12	0.44	0.40	1	13.9
842.	Civilian employment, total	0.20	0.83	0.06	0.22	1.13	0.32	0.08	0.28	2	175.5
843.	Unemployment, total	1.13	9.56	0.88	2.75	2.44	0.78	0.09	0.32	3	49.6
901.	Manufacturing shipments, total	0.57	4.26	0.18	1.01	1.77	0.32	0.04	0.18	2	146.1
902.	Manufacturing new orders, total	0.60	4.07	0.28	1.32	2.18	0.46	0.07	0.21	3	71.2
903.	Manufacturing inventories, total	0.72	0.30	0.04	0.13	0.18	0.06	0.14	0.33	1	65.4

Column 2. Average month-to-month change without regard to sign in the trend-cycle component.
Column 3. Average month-to-month change without regard to sign in the seasonal component.
Column 4. Average year-to-year change without regard to sign in the seasonal component.
Column 5. Average month-to-month change without regard to sign in irregular component.
Column 6. Ratio of column 5 to column 2.
Column 7. Ratio of column 4 to column 2.
Column 8. Ratio of column 4 to column 3.
Column 9. Ratio of column 4 to column 5.
Column 10. Number of months for cyclical dominance.
Column 11. F-ratio for test of stable seasonality. An F of 2.4 or more indicates stable seasonality present at the 1% level.

Measures of the amplitudes of different types of fluctuations are shown for 18 principal economic indicators in Table II. In addition to the measures usually shown, this table includes a measure of changing seasonality, the average year-to-year change in the seasonal factors (S_{12}) shown in Column 4. Like the other measures, this is computed by Census Method II, X-11 variant.[3] S_{12} is usually a small fraction of the month-to-month movements in other types of economic fluctuations (Cols. 7–9).

III. Reducing Noise in Current Observations

In addition to the irregular component, there are also other sources of "noise" which tend to obscure "signals." As will be shown, some of these noise components are readily measured on a historic basis, but they tend to be especially troublesome on a current basis, just when the need for the signal is greatest.

1. *Revisions in raw data.*[4] There is great pressure upon statistical agencies to issue figures promptly. Early figures usually must be based upon small samples or on partial returns, and revised later to provide more accurate estimates. Estimates resulting from these pressures raise questions about the acceptable accuracy of early estimates. Furthermore, there is always concern about the quality of final figures.

Interim estimates between first and final figures are often helpful, but they, too, are subject to question. Theoretically, new estimates should be issued as soon as additional data are received in order to make available the most accurate information for policy makers. Conceivably, in a survey like retail sales, where there is a continuous flow of returns, a new estimate could be prepared every day. But frequent revisions are also a nuisance and costly, and some contain no new information. Moreover, revisions tend to undermine public confidence in the statistics. For these reasons, a policy for limiting current revisions is desirable.

The U.S. Office of Management and Budget has recently issued a set of guidelines to Federal agencies having responsibility for major economic series. The guidelines are intended to provide general policy and procedures for balancing speed and accuracy in the release of economic data and for limiting revisions.

The first objective of the guidelines is to indicate a standard of acceptability of final figures for principal monthly and quarterly economic indicators. The adoption of this standard will have the eventual effect of improving the quality of final figures for the current economic indicators which do not now meet the standards. The guideline which has been adopted to achieve this objective is as follows:

Guideline I. With regard to final figures (or the last estimate made on a current basis), the goal should be to achieve a ratio of the amplitude of the average irregular

[3] Julius Shiskin, "Electronic Computers and Business Indicators," *The Journal of Business*, Vol. XXX, No. 4 (October, 1957), pp. 219–267 (reprinted as Occasional Paper No. 57 by the National Bureau of Economic Research, 1957, and as Chapter 17 of Business Cycle Indicators, 1961; also published in French under the title, "Calculateurs Electroniques et Indicateurs de Conjoncture," by the University de Bordeaux, France, 1960). See also Julius Shiskin, Allan H. Young, and John C Musgrave, "The X-11 Variant of the Census Method II Seasonal Adjustment Program," Technical Paper 15, Bureau of the Census, U.S. Department of Commerce (November, 1965), and Julius Shiskin, "Seasonal Adjustment," International Encyclopedia of the Social Sciences (1968).

[4] The form of the series prior to seasonal adjustment is sometimes referred to as raw data, unadjusted series, and original data. These terms are used interchangeably in this paper.

factor to the average cycle-trend factor ($\bar{I}/\bar{C}$) of less than 1.0. The reason is that the relation between the irregular and cyclical factor is basic to the principal use of economic indicators, that is, for analyzing short-term business conditions and prospects. This approach involves knowledge about C, the underlying cyclical trend of a series; I, the irregular factor; and E_m, the measurement error component of I.

It can be assumed that there is an inverse relation between E_m and cost; that is, it costs money to reduce E_m and money can be saved by allowing it to increase. Further, if estimates are based on a sample design, and if measurement of total error is not available, E_s (sampling error) can be substituted for E_m.

(a) If $\bar{I} < \bar{C}$, this relation is satisfactory because, then in most cases, the series is reflecting the underlying cyclical trend. E_m is not too large, and it can even be allowed to increase, if substantial savings can be attained.

(b) If $\bar{I} > \bar{C}$, then this relation may not be acceptable because, in most cases, the series will be reflecting irregular movements.

(1) When E_m is relatively small, so that a reduction cannot significantly affect $\bar{I}$, then stay with previous E_m or allow it to increase, depending upon costs.

(2) When E_m is relatively large, so that a reduction can significantly affect $\bar{I}$, then reduce E_m, preferably to the point where $\bar{I} < \bar{C}$, depending upon costs.

(3) If $\bar{I}/\bar{C}$ for a monthly series cannot be reduced to less than 6 without heavy costs, convert the series to quarterly time units.

(Composite series built up from collected series, e.g., Gross National Product and the Federal Reserve Index of Industrial Production, are excepted from this particular guideline.)

It is recognized that it may not be possible to calculate these measures until a series has been collected for 5 or 6 years. Although separate components of total error are difficult to measure, efforts should be made to account for as many components as possible.

The second objective is to set a standard for the accuracy of preliminary estimates. This would result in smaller revisions, although it may also have the effect of slowing down the release of preliminary estimates for some series. The guideline designed to achieve this objective follows:

Guideline II. Each survey resulting in two estimates should be organized so that differences between the preliminary and revised figures average less than $\frac{1}{2}$ the average month-to-month change in the revised figures, so that differences greater than $\frac{1}{2}$ the average month-to-month change do not occur more frequently than 25 percent of the time, and so that differences greater than the average change do not occur more than 5 percent of the time.

Historical records for each series, together with whatever may be expected as a result of recent changes in the survey, should be used as a basis for determining whether these criteria will be met. In the case of highly sensitive series, such as GNP, higher standards should be developed by the agencies on an *ad hoc* basis, and submitted to the Office of Management and Budget for review.

The third objective is to limit the number of preliminary estimates of final figures. This provision would reduce the total number of figures released on a

current basis for principal current economic indicators, and consequently the number of revisions issued.

Guideline III. An estimate for a principal economic indicator must be released regularly on a previously announced date within the month following the end of the reference period. A second estimate may be made within 60 days after the end of the reference period. If a second estimate is regularly made, the first figure should be designated "preliminary" and the second "revised." Except by prior arrangement with the Statistical Policy Division, Office of Management and Budget, no more than two estimates may be regularly issued within 60 days.

The fourth objective is to consolidate revisions occurring for various reasons, such as benchmark and seasonal revisions, and replacement of "preliminary" by revised figures. This would also reduce the number of published revisions.

Guideline IV. Revisions occurring for various reasons, such as benchmark and seasonal revisions and replacement of "preliminary" by revised figures, should, as far as possible, be consolidated and released simultaneously. Figures resulting from benchmarking and revisions in seasonal factors will, in general, be referred to as "final," though it is realized that in some series additional revisions will have to be made later.

Finally provision is made in these guidelines to eliminate biases in early estimates, as follows:

Guideline V. If revisions in preliminary estimates tend to occur significantly more frequently in one direction than another, then efforts should be made to reduce bias by improvements in the survey. If this is not feasible, an adjustment for bias in the preliminary figures should be developed. Separate analyses for expanding and contracting periods may be desirable.

We also considered a guideline eliminating small revisions which add little or no information. There was strong opposition to this proposal from the producers of statistics because of difficulties in balancing out their tables each month and maintaining accurate historical records. For this reason, we finally concluded that the unquestionable advantage to users of eliminating the nuisance of small revisions was not sufficient to justify such a guideline. However, the guidelines do not preclude nonpublication or elimination of small revisions.

Table III shows the revisions in the month-to-month changes in seasonally adjusted data for 12 principal monthly U.S. economic indicators and quarter-to-quarter changes in 3 principal gross national product aggregates, arising from revisions in the raw data. This table reveals that revisions of the first figures released compared with final figures usually average less than $\frac{1}{2}$ the average month-to-month change (Col. 6), the value we have tentatively taken as critical for current analysis, and used in the standards set forth above. These revisions have a wide range—from 21 to 86 percent of this change. However, the second figures released, usually about 30 days later, are much closer to the final figures. For all these series, the revisions of the change in the second figure released average well below $\frac{1}{2}$ the average month-to-month change (Col. 7). GNP figures, which are on a quarterly basis, show greater relative stability, but the standards should be higher for GNP because it is more important than most series, and also because revisions in the monthly series which are components of GNP tend to cancel out on a quarterly basis.

TABLE III

MEASURES OF REVISIONS IN SEASONALLY ADJUSTED DATA FOR SELECTED INDICATORS ARISING FROM REVISIONS IN THE RAW DATA

Part A—Monthly Series

Series*	Absolute average difference in percentage change due to revisions between: 1st and 2nd estimates (1)	1st and final estimates (2)	2nd and final estimates (3)	Absolute average month-to-month (or q.-to-q.) % change (4)	Standardized percentage change difference without regard to sign, due to revisions: Column (1) ÷ (4) (5)	Column (2) ÷ (4) (6)	Column (3) ÷ (4) (7)
6. Value of manufacturers' new orders, durable goods industries (1/60–9/70)	0.95	1.29	0.60	3.48	0.27	0.37	0.17
28. Private housing starts (7/60–9/70)	1.56	1.93	0.85	7.05	0.22	0.27	0.12
29. New building permits, private housing (10/61–9/70)	1.85	1.87	0.15	4.22	0.44	0.44	0.03
41. Employees on nonagricultural payrolls (1/60–9/70)	0.08	0.15	0.09	0.30	0.27	0.50	0.30
47. Index of industrial production (1/60–9/70)	0.11	0.19	0.11	0.91	0.12	0.21	0.12
48. Man-hours in nonagricultural establishments (3/67–9/70)	0.18	0.23	0.13	0.41	0.44	0.56	0.32
54. Sales of retail stores (1/60–9/70)	0.71	0.79	0.29	0.92	0.77	0.86	0.32
56. Manufacturing and trade sales (1/60–8/70)	0.20	0.25	0.09	1.01	0.20	0.25	0.09
65. Book value, manufacturers' inventories of finished goods (1/60–8/70)	—	0.33	—	0.60	—	0.55	—
71. Book value, manufacturing and trade inventories (1/60–8/70)	0.12	0.19	0.08	0.54	0.22	0.35	0.15
750. Wholesale prices, all commodities (3/67–10/70)	—	0.06	--	0.29	—	0.21	—
811. Index of leading indicators (1969–71)	0.48	0.47	0.22	0.86	0.56	0.55	0.26
Part B—Quarterly Series (annual rates of change)							
Gross National Product** (1967–1971)							
200. In current dollars	0.33	0.48	0.45	6.90	0.05	0.07	0.07
205. In constant dollars	0.36	0.67	0.54	3.42	0.11	0.20	0.16
211. Implicit price deflator	0.23	0.39	0.24	4.30	0.05	0.09	0.06

* Numbers preceding series titles are the identification numbers used in *Business Conditions Digest*, a publication of the U.S. Department of Commerce.

** May include the effects of some seasonal revisions.

These findings raise serious questions about the usefulness of some of our first preliminary estimates.

2. *Revisions in seasonal factors.* There are many different methods for adjusting time series for seasonal variations. Most yield good results for historical series, but all are less accurate for the most recent months. The deficiencies are due partly to the fact that seasonal factors for the most recent years are based upon estimated moving averages, but mainly because, as a practical matter, the most current months must be adjusted by forecasted seasonal factors. It is common practice to forecast seasonal factors one year ahead, and then to revise these factors when all the raw observations for the year have become available.

Table IV shows how large the month-to-month revisions of seasonal factors are, month by month, and how the average of such revisions compares with the average month-to-month change in the seasonal factors for the single latest year for which data are available (1970 or 1971). These revisions tend to be quite small relative to the month-to-month changes in the seasonal factors themselves. The critical question, however, concerns the effect of these revisions on the seasonally adjusted series. This is discussed in the last section of this paper which brings together measures of various types of noise affecting the interpretation of the seasonally adjusted series.

3. *Smoothing out irregular movements.* Irregular movements appear to be the major single culprit in obscuring the underlying cyclical trend. This is evident not only from the preceding table, but also from Table II which shows measures of the seasonal and irregular factor computed over 12-month spans. The major need in bringing out underlying current trends is to make allowance for the irregular factor. A statistical measure, Months for Cyclical Dominance (MCD), is helpful in selecting a technique for accomplishing this objective.[5]

The calculation of MCD requires eliminating the seasonal factor from a series, and then breaking down the seasonally-adjusted series into estimates of the cycle-trend and irregular components. The average month-to-month amplitude of the irregular factor remains about the same regardless of the span of months intervening between the two months being compared. That is, the average monthly amplitude of the irregular factor will be about the same when computed for consecutive months (January and February, February and March, etc.), for two-month spans (January and March, February and April, etc.), for three-month spans (January and April, February and May, etc.) and so on. In contrast, the cycle-trend factor cumulates uninterruptedly in one direction as the span increases, for periods usually lasting six months or more.

For some series, the average amplitude of the irregular factor is smaller than that of the trend-cycle even when the latter is measured over consecutive months. For most series, however, the average irregular factor is greater than the average cycle-trend factor on a monthly basis. However, there is some time span for which the average amplitude cycle-trend factor will overtake that of the irregular factor. Although any index involves information-loss, the span of months required to cause the ratio of the average monthly amplitude of the irregular to the cyclical

[5] For a more detailed discussion of the properties of MCD, see Julius Shiskin "Electronic Computers and Business Indicators," *The Journal of Business*, Vol. XXX, No. 4 (October, 1957), pp. 219–267.

** May include the effects of some seasonal revisions.

TABLE IV

MEASURES OF REVISIONS IN SEASONALLY ADJUSTED DATA FOR SELECTED INDICATORS ARISING FROM REVISIONS IN SEASONAL FACTORS

BCD #	Series* (1)		Jan.–Feb.	Feb.–Mar.	Mar.–Apr.	Apr.–May	May–June	June–July (2)	July–Aug.	Aug.–Sept.	Sept.–Oct.	Oct.–Nov.	Nov.–Dec.	Average without regard to sign (3)
6.	Value of manufacturers' new orders, durable goods	a. Preliminary	8.37	1.72	−1.28	−4.35	7.61	−16.20	2.75	13.23	−2.75	−4.09	0.69	5.73
		b. Final	11.49	0.34	0.95	−3.85	7.63	−14.00	0.22	13.78	−0.81	−5.04	0.49	5.33
		c. Difference	3.12	−1.38	2.23	0.50	0.02	1.80	−2.53	0.55	1.94	−0.95	−0.20	1.38
28.	Private housing starts	a. Preliminary	−9.10	47.21	−22.64	−4.44	−3.57	−9.97	3.72	−3.96	1.73	−15.55	−17.52	12.67
		b. Final	−6.68	52.05	18.94	−5.90	−0.52	−3.71	−0.81	−7.05	2.92	−11.53	−20.51	11.87
		c. Difference	2.42	4.84	−3.70	−1.46	3.05	6.26	−4.53	−3.09	1.19	4.02	−2.99	3.41
29.	New building permits, private housing	a. Preliminary	16.78	23.67	14.57	−4.07	−1.65	−10.40	−2.85	5.57	−2.11	−4.11	−14.71	9.14
		b. Final	13.95	20.41	19.54	0.00	−5.67	−9.99	−2.06	2.61	−1.86	−6.81	−11.74	8.60
		c. Difference	−2.83	−3.26	4.97	4.07	−4.02	0.41	0.79	−2.96	0.25	−2.70	2.97	2.66
41.	Employees on nonagricultural payrolls	a. Preliminary	−0.06	0.46	0.56	0.47	1.15	−1.04	0.14	0.39	0.18	0.07	0.52	0.46
		b. Final	−0.04	0.39	0.54	0.39	1.06	−1.08	0.10	0.50	0.23	0.08	0.37	0.43
		c. Difference	0.02	−0.07	−0.02	−0.08	−0.09	−0.04	−0.04	0.11	0.05	0.01	−0.15	0.06
47.	Index of industrial production	a. Preliminary	1.92	0.00	−0.40	−0.10	1.90	−5.20	−3.62	2.50	−0.10	−1.66	−2.08	1.77
		b. Final	2.14	0.70	−0.59	−0.10	2.19	−6.15	3.53	3.31	−0.19	−2.14	−2.99	2.18
		c. Difference	0.22	0.70	−0.19	0.00	0.29	−0.95	−0.09	0.81	−0.09	−0.48	−0.91	0.43
54.	Sales of retail sales	a. Preliminary	−7.00	13.65	0.83	5.65	0.29	−1.65	−2.86	−2.33	8.31	−4.31	22.34	6.29
		b. Final	−7.30	12.81	2.29	5.19	0.10	−1.64	−2.65	−2.42	7.66	−4.13	22.37	6.23
		c. Difference	−0.30	−0.84	1.46	−0.46	−0.19	0.01	0.21	−0.09	−0.65	0.18	0.03	0.40
56.	Manufacturing and trade sales	a. Preliminary	1.66	6.88	−0.42	0.49	3.08	−7.63	1.75	3.62	2.35	−3.64	5.80	3.39
		b. Final	1.64	6.58	0.09	0.39	3.39	−7.12	0.98	3.91	2.54	−3.94	5.67	3.30
		c. Difference	−0.02	−0.30	0.51	−0.10	0.31	0.51	−0.77	0.29	0.19	−0.30	−0.13	0.31
65.	Manufacturers' inventories of finished goods, book value	a. Preliminary	0.59	0.16	2.21	−1.49	−0.51	−2.02	−0.77	−0.89	−0.33	0.73	0.74	0.95
		b. Final	0.81	−0.10	0.92	0.51	−1.01	−1.92	−0.71	−1.09	0.02	0.53	0.59	0.75
		c. Difference	0.22	−0.26	−1.29	2.00	−0.50	0.10	0.06	−0.20	0.35	−0.20	−0.15	0.48

71. Manufacturing and trade inventories, book value	a. Preliminary	0.59	0.63	0.50	−0.15	−0.60	−0.86	−0.70	0.01	1.07	0.83	−1.75	0.70
	b. Final	0.62	0.75	0.44	−0.21	−0.66	−0.76	−0.56	0.11	1.11	0.74	−1.67	0.69
	c. Difference	0.03	0.12	−0.06	−0.06	−0.06	0.10	0.14	0.10	0.04	−0.09	0.08	0.08
502. Exports, excluding military aid	a. Preliminary	−4.69	13.49	−1.56	1.39	−6.89	−2.15	−5.90	4.05	11.99	−4.50	3.82	5.49
	b. Final	0.69	10.97	−0.44	1.13	−6.59	−3.72	−5.29	3.28	13.13	−5.96	3.38	4.96
	c. Difference	5.38	−2.52	1.12	−0.26	0.30	−1.57	0.61	−0.77	1.14	−1.46	−0.44	1.42
512. General imports	a. Preliminary	−5.97	16.51	−0.89	−9.54	12.08	−3.50	−9.34	9.68	0.40	−3.57	8.85	7.30
	b. Final	−7.32	16.89	−1.09	−8.45	12.79	−5.18	−8.48	8.13	2.11	−3.38	5.13	7.18
	c. Difference	−1.35	0.38	−0.20	1.09	0.71	−1.68	0.86	−1.55	1.71	0.19	−3.72	1.22
750. Wholesale prices, all commodities	a. Preliminary	0.26	−0.05	−0.20	0.16	0.09	0.05	−0.46	−0.04	−0.23	−0.04	0.22	0.16
	b. Final	0.13	−0.03	−0.22	0.17	0.06	0.06	−0.45	0.05	−0.19	−0.02	0.07	0.13
	c. Difference	−0.13	0.02	−0.02	0.01	−0.03	0.01	0.01	0.09	0.04	0.02	−0.15	0.05
781. Consumer prices	a. Preliminary	0.00	0.11	0.08	−0.09	0.10	0.09	−0.01	−0.09	0.05	−0.01	−0.03	0.06
	b. Final	−0.05	0.14	0.06	−0.06	0.12	0.05	−0.09	−0.03	0.03	−0.01	0.03	0.06
	c. Difference	−0.05	0.03	−0.02	0.03	0.02	−0.04	−0.08	0.06	−0.02	0.00	0.06	0.04
842. Employment, total	a. Preliminary	0.34	0.34	0.56	0.52	1.27	0.98	−0.31	−1.96	0.49	−0.06	−0.12	0.63
	b. Final	0.44	0.39	0.63	0.31	1.65	0.88	−0.40	−2.05	0.57	−0.05	−0.16	0.68
	c. Difference	0.10	0.05	0.07	−0.21	0.38	−0.10	−0.09	−0.09	0.08	0.01	−0.04	0.11
843. Unemployment total	a. Preliminary	3.11	−7.26	−10.12	−8.19	34.13	−5.17	−8.73	−2.96	−3.24	1.69	−3.09	7.97
	b. Final	4.38	−7.84	−10.79	−8.74	38.96	−6.85	−9.26	−3.57	−3.00	1.03	−3.73	8.92
	c. Difference	1.27	−0.58	−0.67	−0.55	4.83	−1.68	−0.53	−0.61	0.24	−0.66	−0.64	1.11
901. Manufacturing shipments, total	a. Preliminary	8.03	2.23	−1.45	−0.76	3.84	−13.05	5.79	6.99	−0.36	−3.13	−2.89	4.41
	b. Final	8.07	1.90	−1.40	−0.69	+4.59	−12.27	4.49	7.69	0.16	−3.69	−2.93	4.35
	c. Difference	0.04	−0.33	0.05	0.07	0.75	0.78	−1.30	0.70	0.52	−0.56	−0.04	0.47
902. Manufacturing new orders, total	a. Preliminary	7.75	1.43	−0.98	−3.02	5.47	−12.61	4.80	8.54	−1.69	−3.81	−1.93	4.73
	b. Final	9.36	0.64	−0.98	−2.62	5.95	−11.24	3.06	9.04	−0.47	−4.64	−1.91	4.54
	c. Difference	1.61	−0.79	0.00	0.40	0.48	1.37	−1.74	0.50	1.22	−0.83	0.02	0.81
903. Manufacturing inventories, total	a. Preliminary	0.48	−0.01	0.28	0.19	−0.62	−0.73	0.00	−0.51	−0.07	0.15	0.29	0.30
	b. Final	0.42	−0.04	0.36	0.15	−0.75	−0.58	0.06	−0.57	0.09	0.12	0.32	0.31
	c. Difference	−0.06	−0.03	0.08	−0.04	−0.13	0.15	0.06	−0.06	0.16	−0.03	0.03	0.08

Note: Preliminary factors were computed from data ending December 1969 or earlier. Final factors were computed from data through 1970, except for series 28 and 29 which go through 1971. The data above show changes in factors for consecutive months.

* Numbers preceding series titles are the identification numbers used in *Business Conditions Digest*, a publication of the U.S. Department of Commerce.

factor to fall below unity may be taken as an index of the months required for the cycle factor to become dominant over the irregular factor, on the average. This index is identified by the symbol MCD (Months for Cyclical Dominance).

A frequency distribution of MCD's is shown in Table V for 150 important economic time series, selected as broadly representative of the different activities of the U.S. economy, covering the interwar years 1919–39 and the post-World War II years 1947–56; for 1953–71 a smaller sample of 44 principal indicators selected for use in *Business Conditions Digest* is included. The smaller sample has been selected on the basis of studies of economic indicators by the National Bureau of Economic Research, a private nonprofit organization which is the accepted leader in this field.

TABLE V

MONTHS REQUIRED FOR CYCLICAL FACTOR TO DOMINATE THE IRREGULAR FACTOR

Months required for cyclical factor dominance	Percentage distribution of series according to measure, MCD*		
	150 series (1957)		44 series (1972)
	1919–39	1947–56	1953–71
1	23	27	34
2	29	21	25
3	25	23	18
4	14	11	5
5	5	10	5
6 or more	4	8	13
Total	100	100	100

* Months for Cyclical Dominance.

Table V provides a broad view of the relationship between the irregular and the cyclical factors in U.S. economic series. The larger sample shows that, on a month-to-month basis, the average change in the irregular factor is larger than that in the cyclical factor in about 75 percent of the series; over three-month intervals, it is larger in about 25 percent of the series; over six-month intervals, it is larger in less than 10 percent of the series. The smaller sample shows similar results, though the 44 principal indicators tend to be somewhat smoother than the 150 series selected earlier.

These results emphasize the importance of knowing the relative magnitudes of irregular and cyclical factors in interpreting current movements in economic series. They indicate that month-to-month movements of most seasonally adjusted series are not "cyclically significant"; for most series, meaningful economic trends are revealed only by spans of three months or longer.[6]

Month-to-month changes are, however, significant for many series, and this group (with MCD equal to one) includes such important series as the index of the

[6] It is to be noted, however, that monthly series still provide more information than quarterly series, because they permit three 3-month span comparisons each quarter.

leading indicators, the Federal Reserve index of industrial production, employment in nonagricultural establishments, the consumer price index, and manufacturing and trade inventories. MCD for the unemployment rate and for retail sales is two, for new business incorporations and new orders for durable manufacturers—three; for housing starts and the value of total construction contracts—five; and for liabilities of business failures—six. The measure MCD thus provides a guide for interpreting the short-term fluctuations of each series.

Comparisons of differences between figures a specified number of months apart are also shown by simple moving averages over variable spans. The consecutive values of a three-month moving average shows changes over three-month spans (counting from mid-month to mid-month), e.g., January–April, February–May, etc., a four-month moving average changes over four-month spans, a five-month moving average changes over five-month spans, and so on. If the period of a moving average is selected equal to MCD, the moving average will just be dominated, on the average, by the cycle-trend movements in the data.

Empirical studies show that for seasonally-adjusted series, moving averages of period equal to MCD all have about the same degree of smoothness. Consequently, MCD moving averages of highly irregular series, such as construction contracts and the number of business failures, will show their cyclical movements about as clearly as the data for such smooth series as nonagricultural employment and personal income.

Moving averages, however; suffer from the handicap of not reaching to the current month. Since they are centered at the middle month of the interval covered by the average, there are no values for the last month(s). Thus the advantage gained in smoothness is offset to some extent by the disadvantage lost in currency. Longer-term moving averages would, of course, result in smoother series, but they would be less current. The MCD span seems to offer a reasonable compromise between short- and long-term periods in developing smoothness and currency.

IV. Measures of Various Types of Noise

This brings us to the question: What information about current trends is there in the most recent monthly observations?

As pointed out above, our objective is to break down the original observations into seasonal, irregular, and trend-cycle components. Reasonably satisfactory methods for accomplishing this for historical data have been developed. In the case of current data, however, preliminary estimates are often not up to established standards of accuracy and are revised later. They must, nevertheless, be used in taking the next step toward isolating the trend-cycle component, namely, in making seasonal adjustments. Further, the seasonal factors that are used at that time, like the raw data, are also not up to the established standards, and must be revised later. Thus, estimates of the underlying cyclical trend in current observations suffer from these two limitations, as well as from our inability to separate the trend-cycle from the irregular movements.

Some estimates of the separate effects of using preliminary raw data and preliminary seasonal factors have been brought together in Table VI. They are shown along with the average historical cycle-trend and irregular factors and

TABLE VI

MEASURES OF TYPES OF STATISTICAL NOISE AND SIGNALS IN 18 U.S. ECONOMIC INDICATORS, 1965–1969

Series[1]	$\bar{C}$[2]	Average revisions in monthly changes in seasonally adjusted data arising from revisions in:		$\bar{I}$[3]	N[4]	$\bar{I}/\bar{C}$	N/S	MCD	MSD
		Original data	Seasonal factors						
(1)	(2)	(3)	(4)	(5)	(6) (3 + 4 + 5)	(7) (5/2)	(8) (6/2)	(9)	(10)
6. Value of manufacturers' new orders, durable goods	0.80	1.43	1.01	2.36	4.80	2.97	6.00	3	6
28. Private housing starts	1.96	1.82	1.93	5.70	9.45	2.91	4.82	4	5
29. New building permits, private housing	2.51	2.08	2.85	5.91	10.84	2.36	4.32	3	5
41. Employees on nonagricultural payrolls	0.30	0.14	0.08	0.10	0.32	0.35	1.07	1	2
47. Index of industrial production	0.54	0.19	0.18	0.44	0.81	0.82	1.50	1	2
54. Sales of retail stores	0.49	0.87	0.61	0.82	2.30	1.65	4.69	2	5
56. Manufacturing and trade sales	0.53	0.20	0.70	1.21	2.11	2.27	3.98	3	4
65. Manufacturers' inventories of finished goods, book value	0.63	0.31	0.12	0.18	0.61	0.29	0.97	1	1
71. Manufacturing and trade inventories, book value	0.67	0.20	0.08	0.14	0.42	0.21	0.63	1	1
502. Exports, excluding military aid	0.72	0	1.38	6.78	8.16	9.42	11.33	6	12
512. General imports	1.27	0	1.23	4.76	5.99	3.76	4.72	5	5
750. Wholesale prices, all commodities	0.28	0	0.14	0.17	0.31	0.62	1.11	1	2
781. Consumer prices	0.32	0	0.05	0.09	0.14	0.29	0.44	1	2
842. Civilian employment, total	0.20	0	0.12	0.22	0.34	1.13	1.70	2	2
843. Unemployment total	1.13	0	1.55	2.75	4.30	2.44	3.81	3	4
901. Manufacturing shipments, total	0.57	0.75[5]	0.54	1.01	2.30	1.77	4.04	2	5
902. Manufacturing new orders, total	0.60	0.64[5]	0.85	1.32	2.81	2.18	4.68	3	5
903. Manufacturing inventories, total	0.72	0.24[5]	0.10	0.13	0.47	0.18	0.65	1	1

[1] Numbers preceding series titles are the identification numbers used in *Business Conditions Digest*, a publication of the U.S. Department of Commerce.

[2] $\bar{C}$ is the average month-to-month percentage change without regard to sign in the cyclical component, a smooth flexible moving average of the seasonally adjusted series.

[3] $\bar{I}$ is the average month-to-month change without regard to sign in the irregular component obtained by dividing the cynical component into the seasonally adjusted series.

[4] N is that part of the average month-to-month change in a seasonally adjusted series arising from revisions in raw data and in seasonal factors plus average change in the historical irregular component. N does not represent total noise because current changes in the irregular factor tend to be greater than historical changes, because revisions in trading day factors are not included, and also because other possible contributions to noise have not yet been isolated or even identified.

[5] Revisions for the single year 1971.

several derived measures. However, this table does not cover all the factors creating noise in current observations, and the totals shown in Col. (6) are, therefore, probably understatements. For example, changes in preliminary estimates arising from revisions in trading day factors are not included. More important, the irregular change ($\bar{I}$), the average historical change in the irregular component (Col. 5), has been shown to be smaller than current measures of $\bar{I}$. Higher current measures of the irregular component arise in part from revisions in the trend-cycle component, which itself is affected not only by revisions in raw data and in seasonal factors, but also by the unavailability of all values of the series required at the time current estimates are computed. A limited study on adult male unemployment showed that current $\bar{I}$ for that series was higher than its historical $\bar{I}$ by about 40 percent.[7] On the other hand, the current cycle-trend ($\bar{C}$) is also probably higher than the historical measure used as the denominator in the ratios shown in Table VI. Consequently, the use of historical rather than current measures of $\bar{I}$ and $\bar{C}$ would not appear to affect substantially the new ratio and the conclusions below.

The data in Table VI suggest that on the average there is about twice as much noise in current observations than is indicated by the $\bar{I}/\bar{C}$ ratio. To take these factors into account another "noise" to "signals" ratio is included in the table (Col. 8). This ratio is computed by summing the revisions in the changes in the seasonally adjusted data arising from revisions in the raw data (Col. 3) and in the seasonal factors (Col. 4), and the historical average change in the irregular factor, $\bar{I}$ (Col. 5), and dividing this sum by the historical average change in the trend-cycle factor, $\bar{C}$ (Col. 2). To distinguish this ratio from the more familiar $\bar{I}/\bar{C}$ ratio, it is designated as the N/S ratio (Col. 8) and to distinguish the derived measure from the more familiar MCD (Months for Cyclical Dominance), the new derived measure is referred to as MSD (Months for Signal Dominance).

The MSD measures (Col. 10) suggest that for most series, one or two months must be added to the comparison span indicated by MCD (Col. 9). Moreover, for some of our most significant indicators (e.g., retail sales, new orders and exports), it appears that three or more months must be added to the comparison span suggested by MCD. Few indicators are left for which comparisons of current figures with those of the previous month are usually significant, i.e., series for which MSD is equal to 1.

This study points to the conclusion that we usually cannot tell from latest monthly statistical observations whether a given series was rising or falling between the latest two months for which data are available, except perhaps when movements are exceptionally large. We usually can tell, however, what happened to the underlying cyclical trend between the observation for the current month and another about three months earlier.

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U.S. Office of Management and Budget

[7] From an unpublished memorandum by Hyman B. Kaitz of the Bureau of Labor Statistics.

revisions in trading day factors are not included, and also because other possible contributions to noise have not yet been isolated or even identified.
[5] Revisions for the single year 1971.