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MEASUREMENT AND PRESENTATION
OF BASIC DATA

ANNUAL LEVEL FORECASTS

The peak of what may be called the forecasting season is at the end
of the year when predictions are made for the following calendar year.
After the close of the year to which the forecasts refer, early estimates
of the actual magnitudes become available; the forecasts can then be
appraised by comparisons with these estimates.

Table 1 gives the results of such an appraisal for the eight sets of
forecasts of GNP covering the years 1953–63. There is a column for
each year which starts at the top with a figure representing the first
annual estimate of GNP (line 1) reported by the Department of Com-
merce. Beneath that value (A_t) is listed the estimated error of meas-
urement, which is the difference between the first estimate of GNP and
the current (August 1965) figure for GNP (A_t'). In other words, the data
revisions, cumulated from the first figure published by the source up
to date, are taken to measure the detectable inadequacies of observa-
tion (line 2). The errors of forecast are then presented in the form of
deviations from A_t of the predictions of GNP for the given year, that is,
the forecast level minus "actual" level (lines 3–10).

The argument in favor of this approach is that the early estimates
have probably more in common with the data inputs used by the fore-
caster than the subsequently revised figures. In fact, when the subse-
quently revised figures are used, which amounts to making the fore-
caster responsible for estimating the future revisions of the data, the
errors tend to be considerably larger. This is readily verified in Table
1, where deviations of the predicted from the latest revised figures can
be calculated for any given year simply by adding the listed errors
(lines 3–10) to the revisions (line 2). Such recomputations usually result

TABLE 1 *(concluded)*

	1953 (1)	1954 (2)	1955 (3)	1956 (4)	1957 (5)	1958 (6)	1959 (7)	1960 (8)	1961 (9)	1962 (10)	1963 (11)	Average Error, All Years — With Regard to Sign (12)	Average Error, All Years — Without Regard to Sign (13)
	Actual Values of GNP and Errors of Forecasts in Each Year												
	Average Forecast Errors												
11. With regard to sign	-11.1	-1.4	-19.5	-10.8	-6.3	+2.6	-10.7	+7.4	-9.8	+8.7	-12.9	-5.2[e]	
12. Without regard to sign	11.1	6.7	19.5	10.8	6.6	4.3	11.5	7.4	10.2	8.7	15.0		10.0[e]
	Errors in Extrapolations												
13. Extrapolating level of previous year	-19.2	+7.7	-26.7	-21.5	-19.7	+2.6	-37.8	-21.1	-16.9	-35.2	-30.3	-19.8	21.7
14. Extrapolating past average change	-3.6	+34.2	-14.7	-3.5	-3.8	+19.3	-23.0	-4.3	-0.1	-10.1	-11.4	-1.9	11.6

[a]First estimates by the Department of Commerce for the preceding year, which appear in February. These figures are not comparable from year to year because of revisions.

[b]Obtained by subtracting the current (August 1965) figures for GNP from the preliminary estimates in line 1.

[c]Measured from the first estimates of GNP in line 1. The annual figures for sets A, C, D, and E were in some cases obtained by averaging forecasts for the first and second half or for the four quarters of the coming year.

[d]These forecasts are typically made in terms of base-period prices. For the purpose of these comparisons, they have been converted to current dollars, using actual prices for the forecast year. Since this eliminates the possibility of error in forecasting prices, it probably reduces the error in this set relative to the others.

[e]These figures are averages of all entries in lines 3–10, columns 1–11 (*not* averages of the entries in lines 11 and 12, which are different because the number of observations are not the same in each column).

TABLE 1

Eight Sets of Annual Forecasts of GNP: Individual and Average Errors and Comparisons with Simple Extrapolations, 1953-63

(billion dollars)

	Actual Values of GNP and Errors of Forecasts in Each Year											Average Error, All Years	
	1953 (1)	1954 (2)	1955 (3)	1956 (4)	1957 (5)	1958 (6)	1959 (7)	1960 (8)	1961 (9)	1962 (10)	1963 (11)	With Regard to Sign (12)	Without Regard to Sign (13)
Actual Value and Error of First Estimate													
1. First estimate[a]	367.2	357.2	387.2	412.4	434.4	437.7	479.5	503.2	521.3	553.9	585.0		
2. Error[b]	+2.6	-7.6	-10.8	-6.8	-6.7	-9.6	-4.1	+0.6	+1.2	-6.4	-4.2	-4.7	5.5
Forecast Errors[c]													
3. Set A		-10.2	-25.5	-11.4	-6.4	+1.8	-8.6	+7.7	-11.0	+9.3	-17.2	-7.2	10.9
4. Set B	-7.2	+8.8	-17.2	-10.4	-4.4	+11.3	-4.5	+5.8	-7.3	+12.1	-18.0	-2.8	9.7
5. Set C						-2.3	-9.1	+8.5	-16.3	+12.4	-12.3	-3.2	10.2
6. Set D				-8.7	-7.0	+1.0	-17.0	+8.6	-13.5	+0.6	-19.2	-6.9	9.4
7. Set E	-19.0	+2.0	-25.8	-20.1	-15.3	+7.9	-28.0	+5.3	-10.3	+4.6	-20.0	-10.8	14.4
8. Set F	-6.2	-5.2	-16.1	-6.4	-6.9	-4.4	-4.5	+6.8	-12.5	+11.1	-9.0	-4.8	8.1
9. Set G[d]	-12.0	+5.2	-9.6	-6.5	+1.0	+4.4	+3.3	+10.7	+1.8	+12.9	+8.4	+1.8	6.9
10. Set H		-8.7	-22.7	-12.2	-5.4	+1.1	-16.9	+5.6	-9.0	+6.3	-15.6	-7.8	10.4

(continued)

in increased errors because the numbers added frequently agree in sign.
It will be noted that in most years forecasts tended to underestimate
the preliminary figure for GNP (the listed errors are negative), while
revisions tended to raise the preliminary figures (most of the entries in
line 2 are also negative).

Going further down the table, averages of the individual forecast
errors are shown for each year, with and without regard to sign (lines
11–12). The figures at the right end of the table summarize the record
of each forecast set over the entire period covered; again, averages of
the forecast errors are given with and without regard to sign (columns
12 and 13).

This arrangement makes it possible to compare the forecasters' per-
formance in and between any of the years. Reading across the table,
one can see how a forecaster has done in any year and compare his
individual errors with each other and with the corresponding averages.
Reading down, one can compare the accuracy of different forecast
sources in any year and on the average over time.[1]

In addition, the table presents the errors of two simple types of ex-
trapolation which provide common standards for screening the fore-
casts. The first (line 13) consists in projecting forward the last known
(or estimated) value of GNP: the level of the series the following year
is assumed to be equal to that of the preceding year. The second,
which is far more effective (line 14), is an extrapolation of the past
average change as it could have been computed from the postwar
record of GNP available up to the time the forecast was made.

These models, labeled N1 and N2* respectively, will be used ex-
tensively in this study as standards for evaluating forecasts, along with
some other types of extrapolation. It should be noted here that the
projections of the preceding year levels give results that are decidedly
inferior to the forecasts proper, at least for the GNP series (this is
not necessarily true for all other variables to be examined). The trend
projections, which are based on the average changes computed from
data beginning in 1947, are quite good in years of relatively moderate
growth, as would be expected, but much worse in periods of booms,
and very poor in recession years. As a result, they yield a small mean
arithmetic error (only one of the eight forecast sets did as well in this

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[1] Note, however, that not all of the averages in columns 12 and 13 relate to the
same periods, which impairs their comparability.

respect) but a much larger mean absolute error (only one of the fore-
casts did worse here, although some were just a little better and the
differences may not be significant).[2]

Table 1 illustrates a simple and effective way of organizing basic
data on forecasts. Makers and users of forecasts can readily adopt such
a form to keep a running score of their own or other people's predic-
tive successes and failures. It can suit a variety of needs because it can
be applied to forecasts of different variables for different time units
and periods, along with other types of summary measures of error and
benchmark extrapolations. To economize space I shall not introduce
such additional applications here; they will be used at later times in
the text.

RECORDED AND PREDICTED CHANGES

A different but also informative way of presenting basic forecasting
data is illustrated in Table 2, where the changes in recorded GNP
figures are compared with the changes that were predicted. Again,
the earliest annual estimates published by the Department of Com-
merce serve as the basis of these comparisons, but the latest figures are
also shown (compare lines 1 and 2).

The predicted changes should be measured from the estimate of the
current position which the forecaster used as the starting point. Where
such estimates are not reported, problems arise which will be discussed
later. Three types of error can be distinguished in comparing the pre-
dicted with the actual changes: underestimation, overestimation, and
directional or turning-point errors which involve differences in sign.
Where the predicted change has the same sign as the recorded change
but is smaller (larger) than the latter, an error of underestimation
(overestimation) occurs. In Table 2, the predicted changes are marked
with different symbols to identify the under- and overestimates and
the directional errors. The symbols refer to the comparisons of pre-
dicted changes with the recorded changes according to the first esti-
mates. The same procedure is followed for the averages, which are
taken over the forecasts from different sources in each year (line 11)
and over time for each source, with and without regard to sign (col-
umns 12 and 13). In each case, the average predicted change is com-

2 Compare the figures in columns 12 and 13 of the table.

TABLE 2

Eight Sets of Forecasts of Annual Changes in GNP: Individual and Average Predictions, Average Errors, and Comparisons with Simple Trend Extrapolations, 1953-63

(billion dollars)

	Actual and Predicted Changes and Errors											Average Predicted Changes and Errors, All Years	
												With Regard to Sign	Without Regard to Sign
	1952 -53	1953 -54	1954 -55	1955 -56	1956 -57	1957 -58	1958 -59	1959 -60	1960 -61	1961 -62	1962 -63		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Recorded Changes[a]													
1. First estimate	19.2	-7.7	26.7	21.5	19.7	-2.6	37.8	21.1	16.9	35.2	30.3	19.8[b]	21.7[b]
2. Latest estimate	19.1	.2	33.2	21.2	21.9	6.2	36.3	20.2	16.3	40.2	28.9	22.2[b]	22.2[b]
Predicted Changes[c]													
3. Set A		-22.1§	5.7*	14.0*	17.6*	3.9[T]	34.8*	32.3§	7.3*	43.4§	14.6*	15.2*	19.6*
4. Set B	14.0*	-3.0*	14.0*	15.0*	19.0*	13.0[T]	34.0*	29.0§	10.0*	46.0§	13.0*	18.5*	19.1*
5. Set C				16.5*	16.7*	0.8[T]	33.4*	34.0§	2.1*	45.3§	19.3*	22.5*	22.5*
6. Set D						2.1[T]	27.6*	31.3§	3.4*	36.0§	12.7*	18.3*	18.3*
7. Set E	4.1*	-9.9§	5.3*	6.4*	8.5*	10.0[T]	18.4*	24.8§	3.2*	41.7§	12.2*	11.3*	13.1*
8. Set F	15.8*	-14.0§	14.5§	19.0*	15.8*	-0.7*	38.0§	31.0§	5.6*	45.3§	22.2*	17.5*	20.2*
9. Set G	8.5*	-3.6*	19.0*	17.3*	21.4§	5.9[T]	44.1§	33.5§	19.8§	46.7§	38.7§	22.8§	23.5§
10. Set H		-22.2§	7.5*	13.0*	18.3*	2.2[T]	27.7*	28.3§	7.9*	41.7§	16.3*	14.1*	18.5*

Note: Set C shows 16.5* and 16.7* in the 1955-56 and 1956-57 columns respectively; Set D begins with the 1957-58 column.

(continued)

TABLE 2 *(concluded)*

	1952 (1)	1953 (2)	1954 (3)	1955 (4)	1956 (5)	1957 (6)	1958 (7)	1959 (8)	1960 (9)	1961 (10)	1962 (11)	With Regard to Sign (12)	Without Regard to Sign (13)
	\-	\-	\-	Actual and Predicted Changes and Errors								Average Predicted Changes and Errors, All Years	
	-53	-54	-55	-56	-57	-58	-59	-60	-61	-62	-63		
Average Predicted Changes and Errors													
11. Average change for sets A–H	10.6*	-12.5§	11.0*	14.5*	16.8*	4.6ᵀ	32.2*	30.5§	7.4*	43.3§	18.6*	17.3*	19.2*
12. Average error with regard to sign	-8.6	-4.8	-15.7	-7.0	-2.9	+7.2	-5.6	+9.4	-9.5	+8.1	-11.7	-3.1	8.2
Extrapolated Changes and Errors (N2*)													
13. Extrapolated change	19.6§	20.7ᵀ	15.5*	21.7§	19.9§	20.4ᵀ	21.6*	18.4*	16.8*	25.3*	20.5*	20.0§	20.0*
14. Error of extrapolation	+0.4	+28.4	-11.2	+0.2	+0.2	+23.0	-16.2	-2.7	-0.1	-9.9	-9.8	+0.2ᵈ	9.3ᵈ

*Underestimate.

§Overestimate.

ᵀTurning-point error.

ᵃLine 1 is based on first Commerce estimates for the preceding year, which appear in February. Line 2 is based on published figures available currently (August 1965). See Table 1, lines 1 and 2 and notes.

ᵇThese figures show the changes between 1952 and 1963 (averages of entries in lines 1 and 2, columns 1–11). For comparison with forecasts A and H (1953–63), the appropriate arithmetic and absolute averages are 19.9 and 22.0; with forecasts C (1957–63), 23.1 and 24.0; and with forecasts D (1955–63), 22.5 and 23.1.

ᶜFor description of the forecast sets, see text above and Table 1, notes c and d.

ᵈAverages of the error figures in columns 1–11.

pared with the corresponding recorded change, either in the given year (columns 1–11) or for the whole period (columns 12 and 13).

The errors of the individual change forecasts can be computed by subtracting the "observed" figures (line 1) from the corresponding "predicted" figures (lines 3–10).[3] The arithmetic averages of these errors for all forecasts are listed in line 12. Compared with the corresponding average errors for the level forecasts in Table 1 (line 11), they turn out to be generally smaller. This difference, which is due to the errors in the current base estimates, will be given some attention later in this paper.

The two lines at the bottom of Table 2 refer to the change forecasts based on the trend extrapolation model N2* (see Table 1, line 14, and text above). The errors of these mechanical forecasts average out to a very small figure, less than the simple over-all average of the forecasts proper (compare the entries in lines 12 and 14 of column 12). But in some years, especially in the intervals covering the recessions of 1954 and 1958, the errors of the average change extrapolations were, understandably, very large. Taken without regard to sign, the errors of the changes predicted by means of the N2* model averaged a little higher than the errors made by forecasters.[4]

[3] Errors in terms of the revised rather than preliminary data would be obtained by using the entries in line 2 instead of those in line 1.

[4] Compare the entries in lines 12 and 14 of column 13. These are crude comparisons because they ignore the gaps in the table due to late starts or intermittent forecasting, but calculations limited to the periods actually covered by the forecasts would lead to similar conclusions or to results somewhat more favorable to the forecasters as a group.