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IV

Gains in Accuracy from Additional Information

Gains Through Successive Revisions

Each successive forecast and estimate contains more information relevant to the period covered than the preceding one. Does the additional information lead to a steady reduction in error? More specifically, is A_j a more accurate prediction of A_n than is A_{j-1}? The error statistics shown thus far indicate that on the whole the answer is yes. Revised forecasts and estimates show a reduction in over-all error achieved by both a reduction in bias and an increase in efficiency.

In the sequence of forecasts and estimates of annual levels of GNP and its major components, the greatest gains in accuracy occur in the forecasts (see Chart 1). Theil finds a similar result for the Dutch data. The official Dutch forecasts show a much larger reduction in error than do the official estimates.[31] One would expect this to be the case. New information about the early part of year T, which would induce a revision in a forecast, prepared in year $T - 1$, of the value of the variable in year T, amounts to considerably more than the increments of information that become available after year T has passed and which would cause revisions in the official estimates.

In the case of quarterly data, Table 7 shows that there is a fairly steady reduction in error both in the estimates of levels and of changes. Moreover, except for estimates of the levels of government expenditures on goods and services, the revised estimates are more accurate than N for those components whose provisional estimates were less accurate.

[31] Theil, *Applied Economic Forecasting*, Chapter 5.

Table 8 shows how rapidly errors in the provisional estimates of quarterly levels and changes are reduced through successive revision. For this purpose, the total error eliminated is measured by the root mean square error of the provisional estimates ($\sqrt{M_0}$). $\sqrt{M_0}$ is reduced by the three annual July revisions to $\sqrt{M_1}$, $\sqrt{M_2}$, and $\sqrt{M_3}$ and then eliminated by the 1965 major benchmark revision. The percentage reduction in $\sqrt{M_0}$ resulting from each of these revisions is given in the table.

It is clear that major benchmark revisions are the most important. As a rough average, nearly 60 per cent of the error in the initial estimates remains until these revisions occur.[32] The first July revision tends to be the most important of the three annual revisions, eliminating as much as one-quarter to one-third of the error in levels. It has somewhat less effect on the errors in changes.

The revisions do not reduce errors in every case. For example, no reduction is shown in the errors in estimates of levels in government expenditures on goods and services, nor is there any decrease after the second annual July revision in the errors in estimating quarterly changes in expenditures on consumer durables and new construction.

It might seem from Table 8 that it takes a rather long time to achieve substantial reductions in the errors. Table 9 explores the possibility that the errors could have been reduced more rapidly. Each successive revision is correlated with the errors eliminated in subsequent revisions. Correlations significantly different from zero would suggest that subsequent revisions could be predicted from earlier revisions. If this were the case, linear adjustments of the revisions could result in a more rapid reduction of error. The evidence in Table 9, however, indicates no strong potential for such corrections. Most of the correlations are not statistically different from zero and, but for a few exceptions, those that are significant are fairly weak. Nevertheless, the preponderance of negative signs is striking and suggests that small (large) early revisions are likely to be followed by larger (smaller) revisions.

[32] The reduction in error attributed in Table 8 to benchmark revisions was achieved through two major revisions. Errors in the data for the 1947 II–1954 IV period were primarily eliminated by the major revision of 1958 and errors in the later data, 1955 I–1961 IV, were eliminated by the 1965 revision. Although the figures for the earlier period were also revised in 1965, the statistical revisions of these data were fairly small (for GNP, they average $2.5 billion, without regard to sign).

TABLE 8. Per Cent of Error in Provisional Estimates of Quarterly Levels and Changes in Gross National Product and Its Components Eliminated in Each Successive Revision, 1947 II–1961 IV[a]

Line	Variable	QUARTERLY LEVELS: Annual July Revisions First (1)	Second (2)	Third (3)	Major Benchmark Revisions[b] (4)	QUARTERLY CHANGES: Annual July Revisions First (5)	Second (6)	Third (7)	Major Benchmark Revisions[b] (8)
1	Gross National Product	26.7%	9.5%	5.7%	58.1%	9.4%	15.6%	12.5%	62.5%
2	Personal Consumption Expenditures	36.4	1.8	5.4	56.4	25.0	6.2	6.2	62.5
3	Durables	21.9	15.6	9.4	53.1	0.0	10.0	c	c
4	Nondurables	10.0	10.0	10.0	70.0	10.0	10.0	10.0	70.0
5	Services	32.1	7.5	3.8	56.6	25.0	0.0	0.0	75.0
6	Gross Private Domestic Investment	18.4	10.2	8.2	63.3	14.8	14.8	11.1	59.2
7	Producers' durable equipment	25.6	10.2	5.1	59.0	22.2	11.1	0.0	66.7
8	New construction	16.4	7.3	3.6	72.7	14.3	14.3	c	c
9	Change in business inventories	35.7	14.3	10.7	39.3	25.8	16.1	9.7	48.4
10	Gov't. Expenditures on Goods and Services	c	c	c	c	7.7	7.7	7.7	76.9
11	Federal	3.3	3.3	3.3	90.0	c	0.0	9.1	90.9
12	State and local	28.6	14.3	0.0	57.1	25.0	0.0	0.0	75.0
13	Net Exports	3.2	3.2	3.2	90.3	5.9	0.0	47.0	47.0

[a]Percentage of error eliminated in the first July revision is computed as $100 \times \left(\frac{\sqrt{M_0} - \sqrt{M_1}}{\sqrt{M_0}}\right)$; in the second July revision, $100 \times \left(\frac{\sqrt{M_1} - \sqrt{M_2}}{\sqrt{M_0}}\right)$; in the third July revision, $100 \times \left(\frac{\sqrt{M_2} - \sqrt{M_3}}{\sqrt{M_0}}\right)$; and in the 1965 major benchmark revision, $100 \times \left(\frac{\sqrt{M_3}}{\sqrt{M_0}}\right)$, where $\sqrt{M_0}$ is the root mean square error of A_0, $\sqrt{M_1}$ is the root mean square error of A_1, etc. The root mean square errors are from Table 7.

[b]Statistical revisions only. Errors eliminated by the 1958 major benchmark revision as well as the 1965 revision are included in these figures.

[c]The root mean square error was not reduced by these revisions (see Table 7).

There are some difficulties, however, in looking only at the reductions in the root mean square error statistics as shown in Table 8 to determine whether or not the revisions have reduced error. For example, reduction in an unusually large error may more than offset small increases in several errors. Moreover, cases in which a revision does not occur are included and would appear as no reduction of error in the summary statistics.

Each revision in the estimates of quarterly changes is classified in Table 10 according to whether it reduces or increases the previous error. That is, the error is considered reduced if the jth revision makes ΔA_j a more accurate estimate of ΔA_n (the quarterly change as indicated by the 1965 statistically revised estimates) than was ΔA_{j-1}. There are five possible outcomes of such comparisons: the revision may (1) make ΔA_j exactly equal to ΔA_n; (2) be in the correct direction but not large enough so ΔA_j is between ΔA_{j-1} and ΔA_n; (3) overshoot but nonetheless bring ΔA_j closer to ΔA_n than was ΔA_{j-1}; (4) overshoot with the result that ΔA_j is the same or further from ΔA_n than was ΔA_{j-1}; and (5) be in the wrong direction and make ΔA_j even further from ΔA_n than was ΔA_{j-1}. The first three outcomes are successes inasmuch as they result in reductions of errors; the last two are considered failures. Cases in which a revision does not occur (i.e., $\Delta A_j = \Delta A_{j-1}$) are excluded from the counts.

The gains in accuracy suggested by Table 7 appear more modest in Table 10. As we could expect from the fact that the summary statistics of error are reduced, revisions decrease error more than 50 per cent of the time (Table 10, column 2). But not much more. An average over all of the detailed components and all of the revisions is that 60 per cent of the revisions decreased error, but 40 per cent of them increased it.[33]

Revisions of the advance estimates (R_0) are included in Table 10. These revisions, published only one month after the advance figures appear, are least successful of all. Only about one-half of them reduce error. In other words, only one-half of the advance estimates were closer to the final (1965) figures than the provisional estimates were.[34]

[33] Theil (*Applied Economic Forecasting*, p. 146) presents similar results for the Dutch data. About 64 per cent of the revisions in estimates of annual change reduce error. He finds revisions of forecasts show about the same success; on the average, 66 per cent reduce error.

[34] Stekler, *Data Revisions and Economic Forecasting*, Table 5, shows similar results for comparisons of the advance and provisional estimates with earlier data—that available in July 1964. His comparisons cover the 1956–64 period.

TABLE 9. Coefficients of Correlation Between Successive Revisions and Errors Eliminated in Subsequent Revisions of Estimates of Quarterly Levels and Changes in Gross National Product and Its Components[a], 1947 II–1961 IV

		ANNUAL JULY REVISIONS					
		Quarterly Levels			Quarterly Changes		
Line	Variable	$r_{R_1\epsilon_1}$ (1)	$r_{R_2\epsilon_2}$ (2)	$r_{R_3\epsilon_3}$ (3)	$r_{R_1\epsilon_1}$ (4)	$r_{R_2\epsilon_2}$ (5)	$r_{R_3\epsilon_3}$ (6)
1	Gross National Product	−.0823	.0532	.0512	.0425	−.1432	−.2176
2	Personal Consumption Expenditures	.0641	−.2925*	.1505	.2797*	−.1585	.1837
3	Durables	−.3594	−.1587	−.2082	−.3139*	.1645	−.5605**
4	Nondurables	−.0984	−.1005	−.0099	−.1892	−.1032	−.2646*
5	Services	−.2003	−.7401**	−.4950**	−.0135	−.1821	−.4125**
6	Gross Private Domestic Investment	−.0429	.0320	.0701	−.1809	−.0540	−.0618
7	Producers' durables	.1303	.1451	−.0442	−.0151	−.2040	−.4607**
8	New construction	.1332	.4108**	.1894	−.1914	−.0241	−.3117*
9	Change in business inventories	−.0453	.0740	−.1357	−.0651	−.0229	−.0686
10	Gov't. Expend. on Goods and Services	−.2464	−.0566	−.1565	−.4184**	.0345	−.2248
11	Federal government	−.1482	.0118	−.1188	−.4713**	−.0266	−.2153
12	State and local governments	−.0874	−.0689	−.3590**	−.3539**	−.0770	−.3407**
13	Net Exports of Goods and Services	.0267	−.3122*	−.2149	−.0833	−.1315	.0842

NOTE: * denotes statistically different from zero at the 5 per cent level; ** denotes statistically different from zero at the 1 per cent level.

[a]The provisional estimates (A_0) refer to quarter t of year T. The date and notation of the revisions and errors are:

Date Published		
July, $T+1$	First July revisions:	$R_1 = A_0 - A_1$
July, $T+2$	Second July revisions:	$R_2 = A_1 - A_2$
July, $T+3$	Third July revisions:	$R_3 = A_2 - A_3$

The remaining error is defined $\epsilon_1 = A_1 - A_n$, $\epsilon_2 = A_2 - A_n$, and $\epsilon_3 = A_3 - A_n$.

TABLE 10. Successive Revisions in Estimates of Quarterly Change in Gross National Product and Its Components Classified According to Success or Failure of Revisions[a]

Line	Description of Revisions	Interval Between ΔA_j and ΔA_{j+1}	Period Covered	Number of Revisions[b] (1)	Percentage Distribution of Revisions According to Effect on Previous Error		Probability of At Least As Many Error Reductions[c] (4)
					Error Reduced (2)	Error Increased (3) (per cent)	
			GROSS NATIONAL PRODUCT				
1	R_0: ΔA_{00} to ΔA_0	1 mo.	1950–61	42	52.4	47.6	.383
2	R_1: ΔA_0 to ΔA_1	8–17 mos.	1947–61	59	55.9	44.1	.184
3	R_2: ΔA_1 to ΔA_2	12 mos.	1947–61	56	75.0	25.0	.001
4	R_3: ΔA_2 to ΔA_3	12 mos.	1947–61	57	68.4	31.6	.003
			PERSONAL CONSUMPTION EXPENDITURES				
5	R_0	1 mo.	1950–61	44	59.1	40.9	.127
6	R_1	8–17 mos.	1947–61	59	59.3	40.7	.078
7	R_2	12 mos.	1947–61	57	52.6	47.4	.349
8	R_3	12 mos.	1947–61	53	56.6	43.4	.171
			CONSUMER DURABLES				
9	R_0	1 mo.	1950–61	39	53.8	46.2	.320
10	R_1	8–17 mos.	1947–61	53	45.2	54.8	.756
11	R_2	12 mos.	1947–61	50	56.0	44.0	.202
12	R_3	12 mos.	1947–61	39	53.9	46.1	.320
			CONSUMER NONDURABLES				
13	R_0	1 mo.	1950–61	42	45.2	54.8	.734
14	R_1	8–17 mos.	1947–61	46	56.5	43.5	.192
15	R_2	12 mos.	1947–61	51	66.7	33.3	.009
16	R_3	12 mos.	1947–61	46	45.7	54.3	.730
			CONSUMER SERVICES				
17	R_0	1 mo.	1950–61	41	70.7	29.3	.004
18	R_1	8–17 mos.	1947–61	56	69.6	30.4	.002
19	R_2	12 mos.	1947–61	48	56.2	43.8	.197
20	R_3	12 mos.	1947–61	48	58.3	41.7	.127
			GROSS PRIVATE DOMESTIC INVESTMENT				
21	R_0	1 mo.	1950–61	43	41.9	58.1	.859
22	R_1	8–17 mos.	1947–61	55	63.6	36.4	.022
23	R_2	12 mos.	1947–61	58	58.6	41.4	.096
24	R_3	12 mos.	1947–61	56	60.7	39.3	.056
			PRODUCERS' DURABLE EQUIPMENT				
25	R_0	1 mo.	1952–61	22	54.5	45.5	.343
26	R_1	8–17 mos.	1947–61	52	53.8	46.2	.293
27	R_2	12 mos.	1947–61	49	61.3	38.7	.060
28	R_3	12 mos.	1947–61	41	46.4	53.6	.683

TABLE 10. (concluded)

Line	Description of Revisions	Interval Between ΔA_j and ΔA_{j+1}	Period Covered	Number of Revisions[b] (1)	Percentage Distribution of Revisions According to Effect on Previous Error: Error Reduced (2)	Error Increased (3) (per cent)	Probability of At Least As Many Error Reductions[c] (4)
			NEW CONSTRUCTION				
29	R_0	1 mo.	1952–61	23	34.8	65.2	.930
30	R_1	8–17 mos.	1947–61	56	62.5	37.5	.017
31	R_2	12 mos.	1947–61	41	53.7	46.3	.324
32	R_3	12 mos.	1947–61	25	60.0	40.0	.165
			CHANGE IN BUSINESS INVENTORIES				
33	R_0	1 mo.	1952–61	35	37.1	62.9	.937
34	R_1	8–17 mos.	1947–61	54	61.1	38.9	.052
35	R_2	12 mos.	1947–61	58	62.0	38.0	.034
36	R_3	12 mos.	1947–61	57	68.4	31.6	.003
			GOV'T. EXPENDITURES ON GOODS AND SERVICES				
37	R_0	1 mo.	1950–61	45	48.9	51.1	.562
38	R_1	8–17 mos.	1947–61	57	54.4	45.6	.257
39	R_2	12 mos.	1947–61	50	60.0	40.0	.081
40	R_3	12 mos.	1947–61	44	52.3	47.7	.386
			FEDERAL GOVERNMENT				
41	R_0	1 mo.	1953–61	34	55.9	44.1	.252
42	R_1	8–17 mos.	1947–61	54	40.7	59.3	.914
43	R_2	12 mos.	1947–61	50	54.0	46.0	.290
44	R_3	12 mos.	1947–61	36	52.8	47.2	.374
			STATE AND LOCAL GOVERNMENTS				
45	R_0	1 mo.	1953–61	17	52.9	47.1	.415
46	R_1	8–17 mos.	1947–61	50	54.0	46.0	.290
47	R_2	12 mos.	1947–61	48	64.5	35.5	.022
48	R_3	12 mos.	1947–61	42	57.1	42.9	.112
			NET EXPORTS				
49	R_0	1 mo.	1950–61	36	58.3	41.7	.163
50	R_1	8–17 mos.	1947–61	56	60.6	39.4	.056
51	R_2	12 mos.	1947–61	46	56.5	43.5	.192
52	R_3	12 mos.	1947–61	36	58.3	41.7	.163

[a]See Table 7, note b for description of the changes used.

[b]Excludes cases in which no revision occurs (i.e., $\Delta A_j = \Delta A_{j-1}$).

[c]Based on the proportion of all revisions accounted for by the number resulting in error reductions. Probabilities are taken from NBER tables of Cumulative Binomial Probability Distributions.

The results in Table 10 (as well as in Tables 5 and 6) suggest that revisions of the advance estimates after only one month (R_0) may not be worth making. They are often reversed by the revisions made the following July (R_1). Moreover, the increases in accuracy resulting from these early revisions (R_0) are relatively small on the average and may not outweigh their costs.

Although there are a few exceptions, revisions which occur the following July (R_1) are considerably more successful. For more components, the second July revisions (R_2) are even more successful, though the third July revisions (R_3) are somewhat less so.

In most cases, however, the per cent of revisions reducing error is not strikingly over 50 per cent and it might therefore be contended that the results arise merely from chance. Suppose this contention were correct and that the revisions are random in the sense that they are as likely to increase error as to reduce it. What then would be the probabilities of observing at least as many error reductions as those found in column 2? The probabilities are given in column 4 of the table.[35] For these sample sizes (column 1), it would be necessary for the revisions to reduce error at least two-thirds of the time in order for there to be a smaller than 1 per cent probability that the results arise merely from chance. Consequently, in very few cases (6 lines out of the 52 lines of the table) would we reject, at the 1 per cent level, the hypothesis that the revisions are as likely to increase as to reduce error. The hypothesis would, however, be rejected at higher significance levels: it would be rejected at the 20 per cent level in 28 of the 52 cases; at the 33 per cent level, in 37 cases; and at the 50 per cent level, in 43 cases.

Since in general we would surely be willing to accept a greater than 1 per cent probability—indeed, up to 50 per cent—that the results arise merely from chance, we conclude that the three annual July revisions were on the whole successful, but revisions of the advance estimates after only one month were considerably less so. In terms of

[35]Some of the assumptions underlying the use here of the binomial distribution are not met and therefore the probabilities in Table 10 should be viewed with reservation. Most important is the assumption that the revisions are independent—both with respect to time (i.e., the jth revision of the estimate of change from period t to $t+1$, $R_{j_{t+1}}$, is unrelated to R_{j_t}, the revision of the change from period $t-1$ to t) and to each other (i.e., R_{j_t} is unrelated to R_{j+1_t}). There are a few small significant correlations between R_{j_t} and $R_{j_{t+1}}$ and between $R_{j_{t+1}}$ and R_{j+1_t}, but there is no widespread indication of strong interdependence among the revisions.

the *magnitude* of error reduced, the three annual July revisions eliminated about 40 per cent of the error in the provisional estimates that is due to incomplete primary data. The major part of this error remains until a major benchmark revision occurs.

Gains Over Time

One might expect the accuracy of the early GNP statistics to have improved over the years—partly as a return from the improvements throughout the postwar period in up-to-date reporting of economic statistics and in the mechanics of data processing and partly from the cumulated experience with past errors in the early GNP data. A major aim of Stekler's paper was to determine whether or not the accuracy of the provisional estimates has in fact improved.[36] As noted earlier, he compares the accuracy of the provisional estimates of quarterly change in GNP and its components during the 1956 I–1964 I period with that shown by Zellner for the 1947 II–1955 IV period and concludes the quality of the early figures has improved.

We have seen, however, that the errors in the early data resemble extrapolation errors. This finding raises the possibility that the apparent increase in accuracy may have come merely because many GNP series were smoother in the latter part of the postwar period and could be extrapolated more accurately. If this were the case, the apparent improvement would be unlikely to persist throughout any future periods in which the variables display greater fluctuations. Thus evidence of a genuine improvement in the early statistics would require a decline in their errors relative to extrapolation errors.

A second question arises from the fact that both Zellner's and Stekler's studies include as "final" data estimates that have not been subject to a major benchmark revision. Zellner compared the provisional estimates with data revised through July 1956 and Stekler compared them with data revised through July 1964. The final data for both studies were altered by the major benchmark revisions of 1958 and 1965. Since we have seen that the benchmark revisions are the most important of the revisions (cf. Table 8), an obvious question is whether Stekler's conclusions would hold if the initial estimates for both the early and later periods were compared with benchmark revised estimates.

[36] Stekler, *Data Revisions and Economic Forecasting.*

TABLE 11. Errors in Provisional Estimates of Quarterly Levels and Changes in Gross National Product and Its Components, 1947–54 Compared with 1955–61[a]

(billion dollars)

Line	Variable	Period Covered	Quarterly Levels: Mean Error (1)	Quarterly Levels: Standard Deviation of Error (2)	Quarterly Levels: Root Mean Square Error (3)	Quarterly Levels: Relative Root Mean Square Error[b] (4)	Quarterly Changes: Mean Error (5)	Quarterly Changes: Standard Deviation of Error (6)	Quarterly Changes: Root Mean Square Error (7)	Quarterly Changes: Relative Root Mean Square Error[b] (8)
1	Gross National Product	1947–54	−5.0	3.9	6.3	1.125	−1.0	3.8	3.9	.848
2		1955–61	−12.8	4.6	13.6	2.386	−0.4	2.9	2.9	.483
3	Personal Consumption Expenditures	1947–54	−2.6	3.3	4.1	1.139	−0.9	1.4	1.7	.500
4		1955–61	−6.4	2.0	6.7	3.190	−0.5	1.4	1.5	.714
5	Durables	1947–54	−2.0	1.5	2.5	1.190	−0.2	0.6	0.7	.350
6		1955–61	−3.3	2.0	3.8	2.375	−0.2	1.1	1.1	.733
7	Nondurables	1947–54	4.5	2.2	5.0	2.941	−0.3	1.2	1.2	.706
8		1955–61	2.0	1.6	2.6	2.889	−0.1	0.8	.8	1.000
9	Services	1947–54	−5.0	1.1	5.1	10.200	−0.4	0.8	0.9	1.125
10		1955–61	−5.2	1.8	5.5	11.000	−0.2	0.6	0.6	1.200
11	Gross Private Domestic Investment	1947–54	−2.4	3.9	4.6	1.022	−0.1	3.1	3.0	.625
12		1955–61	−4.6	2.6	5.2	1.209	0.2	2.2	2.2	.478
13	Producers' Durables	1947–54	4.5	2.2	4.9	4.900	0.3	1.0	1.0	.909
14		1955–61	−0.3	2.1	2.1	1.909	0.3	0.7	0.8	.727
15	New Construction	1947–54	−6.5	1.6	6.7	6.091	−0.2	0.7	0.7	.700
16		1955–61	−2.9	2.7	3.9	3.900	−0.0	0.7	0.7	.875

TABLE 11. (concluded)

Line	Variable	Period Covered	Quarterly Levels: Mean Error (1)	Standard Deviation of Error (2)	Root Mean Square Error (3)	Relative Root Mean Square Error[b] (4)	Quarterly Changes: Mean Error (5)	Standard Deviation of Error (6)	Root Mean Square Error (7)	Relative Root Mean Square Error[b] (8)
17	Change in Business Inventories	1947–54	−0.2	3.2	3.2	.821	−0.3	3.8	3.8	.905
18		1955–61	−1.4	1.8	2.3	.719	−0.0	2.2	2.2	.595
19	Gov't. Expenditures on Goods and Services	1947–54	3.7	1.5	3.9	1.345	−0.1	1.5	1.5	.714
20		1955–61	0.3	1.3	1.4	1.167	−0.1	1.0	1.0	.909
21	Federal	1947–54	3.7	1.5	4.0	1.379	−0.1	1.4	1.4	.700
22		1955–61	0.1	1.2	1.2	1.200	−0.1	0.8	0.8	.889
23	State and Local	1947–54	0.1	0.4	0.4	1.333	−0.0	0.4	0.4	1.333
24		1955–61	0.2	0.9	0.9	2.250	−0.1	0.4	0.4	1.000
25	Net Exports	1947–54	−3.4	1.7	3.8	3.455	−0.2	2.3	2.2	1.833
26		1955–61	−1.8	0.7	1.9	1.900	0.1	0.6	0.6	.667

NOTE: Details in column (1) and (5) may not sum to aggregates because of rounding.

[a]See notes to Table 2 for a description of the estimates and their sources. For a description of the error statistics see Table 1, note c.

[b]Relative root mean square error is the root mean square error of the provisional estimates, M_0, divided by M_X, where $\sqrt{M_X} = \sqrt{(1 - r^2)S^2_{A_n}}$ and r is the serial correlation in A_n.

The error statistics in Table 11 show that the answer to the second question is yes. A substantial decrease in the absolute errors in the provisional estimates of quarterly change is still shown between the early (1947–54 in this case) and the later (1955–61) period. For most variables, there was a reduction in the mean error as well as in the variability of the errors (columns 5 and 6).

However, there has been a much less striking decline in the errors relative to extrapolation errors ($\sqrt{M_X}$). Although the root mean square errors were smaller in eleven of the thirteen series, the relative errors declined in only six. Two of the six, however, are variables generally thought least reliable: change in business inventories and net exports.

Comparisons of quarterly level errors in the two periods give results somewhat different than those for changes. Here absolute and relative errors move together. Although errors in the levels of GNP and two major components, personal consumption expenditures and gross private domestic investment, have increased, errors in the levels of seven other series have decreased.

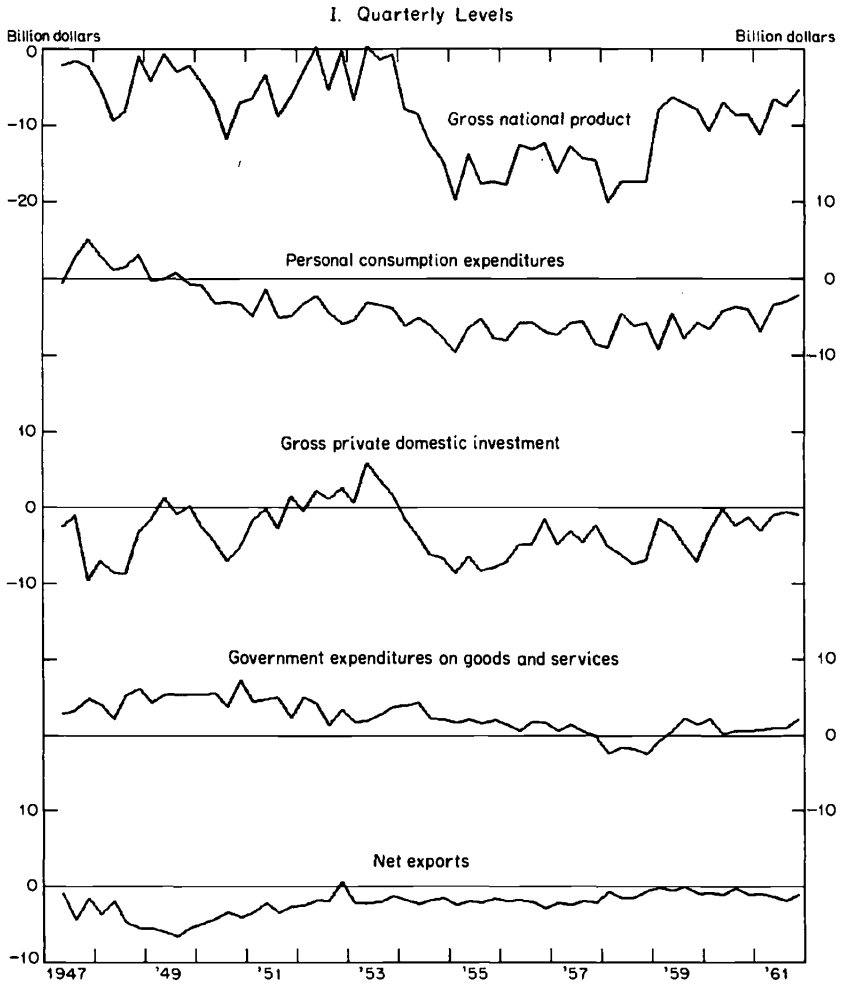
While there is certainly evidence of genuine improvement over time in some of the early series, it is by no means as widespread as comparisons of the absolute error statistics would suggest. The greatest improvements in accuracy have been in the data on producers' durable equipment, change in business inventories, and net exports of goods and services.

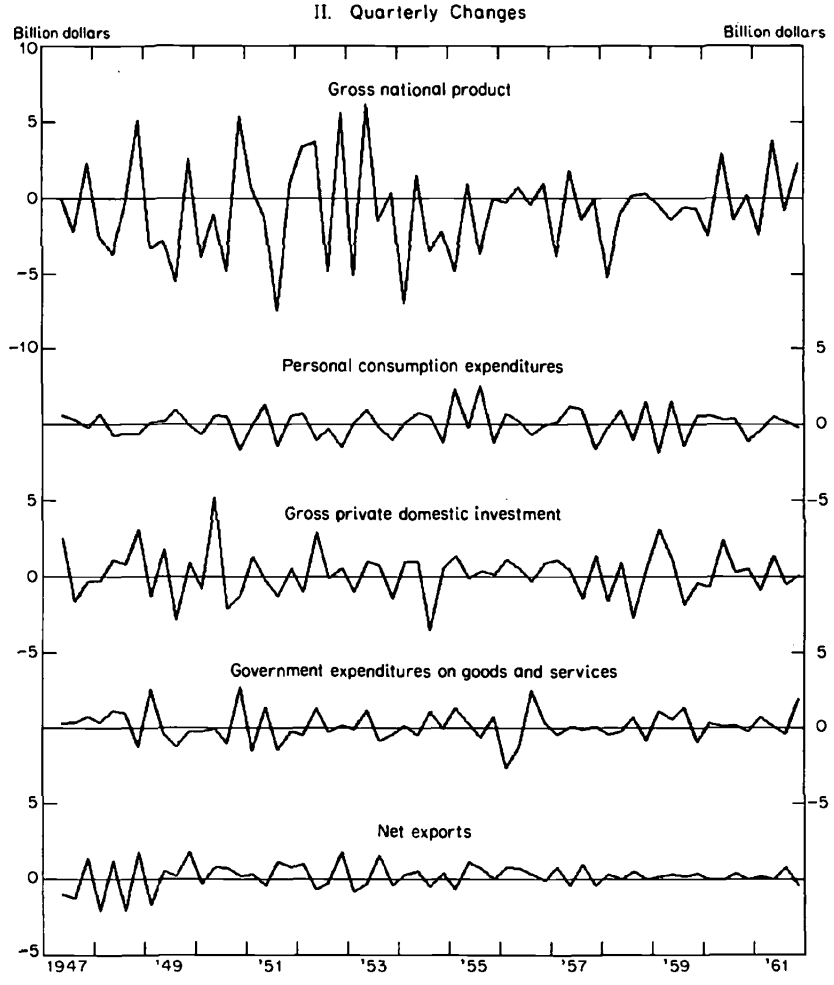
The quarterly level and change errors in GNP and its components are shown in Chart 4. The most pronounced differences between the first and second half of the period occur in total GNP. There has been an improvement in the accuracy of the quarterly change estimates, but not in quarterly levels.

The within year patterns of GNP change errors bear a striking similarity to the seasonal pattern in GNP (as shown in Chart 6 below), which would suggest that most of the improvement in GNP change estimates has come from a more accurate seasonal adjustment of the initial GNP figures.[87]

[87] This would be consistent with the conclusion that the producers' durables and the inventory components improved most over time. Accuracy of the anticipated plant and equipment expenditures series was greatly improved by the introduction of a seasonal adjustment. The early figures on inventory changes tended to be over-adjusted until about 1957 (see Chart 6 below).

CHART 4. Errors in Provisional Estimates of Quarterly Levels and Changes in Gross National Product and Its Major Components, 1947 II–1961 IV




II. Quarterly Changes
Billion dollars
Billion dollars
Gross national product
Personal consumption expenditures
Gross private domestic investment
Government expenditures on goods and services
Net exports
1947
'49
'51
'53
'55
'57
'59
'61