VI

Revisions in Major Patterns of Change

The variance of GNP over time consists mainly of short-term cyclical and seasonal, and longer term, trend movements. This section compares the initial estimates of these major patterns of change with the successively revised estimates.[39]

Cyclical Changes

Short-term movements in GNP, computed by using the most recent estimates available at a given time, t, are subject to future revision. For example, a segment of quarterly values of GNP, observed in period t and going two years into the past,

$$A_{0_t}, A_{0_{t-1}}, A_{0_{t-2}}, A_{1_{t-3}}, A_{1_{t-4}}, A_{1_{t-5}}, A_{1_{t-6}}, A_{2_{t-7}}$$

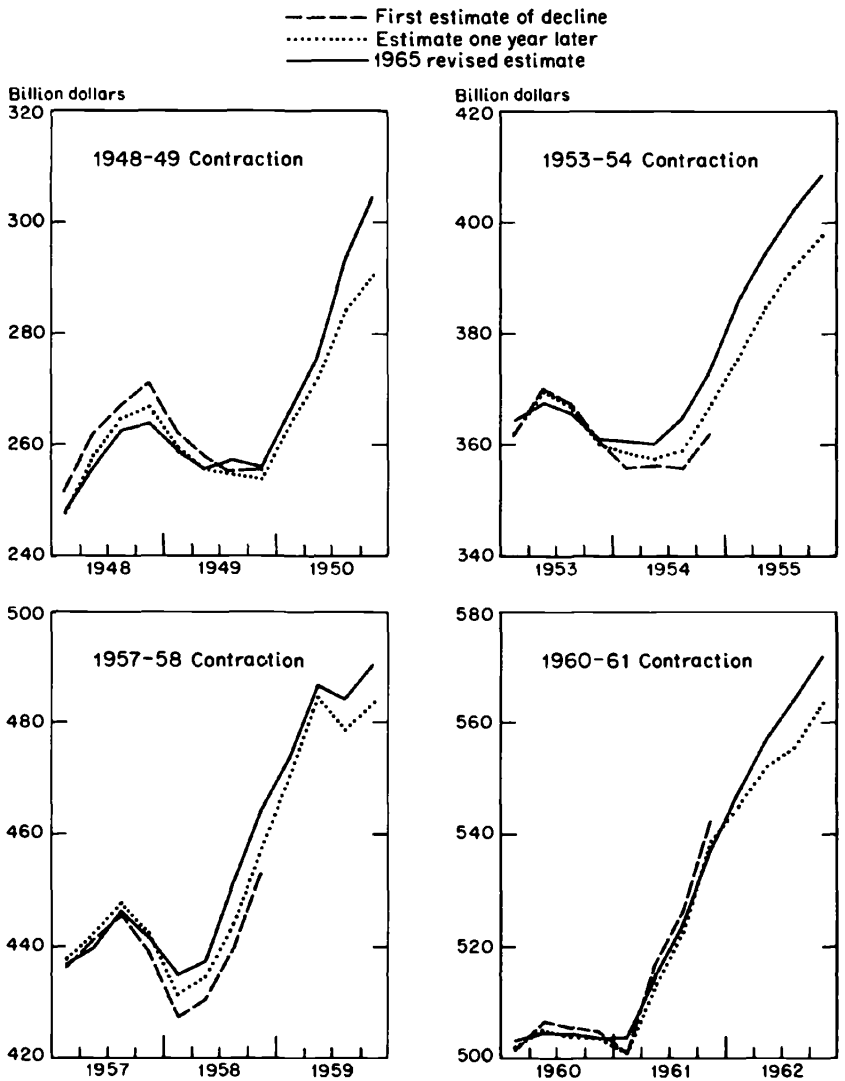
is revised and the estimates of GNP for the same periods become

$$A_{1_t}, A_{1_{t-1}}, A_{1_{t-2}}, A_{2_{t-3}}, A_{2_{t-4}}, A_{2_{t-5}}, A_{2_{t-6}}, A_{3_{t-7}}$$

approximately one year later. As noted earlier, the initial estimate of GNP for a given period is typically revised at least five times. Thus the magnitudes of cyclical expansion or decline might appear quite different in retrospect than they would seem to a current observer watching each cyclical phase as it unfolds.

[39] Unless otherwise noted, the fully revised 1965 data are used throughout this section. (That is, the 1965 data include both statistical and definitional revisions.) This has been done mainly to simulate more accurately the patterns of change in GNP and its components as they would appear to users.

CHART 5. First and Revised Estimates of the Decline in GNP During Four Postwar Contractions and the First Year of Recovery



AMPLITUDES. Chart 5 compares the first and revised (1965) estimates of the path of GNP decline and of the first year of recovery for each of the four postwar contractions. Two- and three-year segments of the most recent series available at the time are shown and they are compared with the 1965 estimates of the period.

The first estimates tend to overstate levels in the vicinity of peaks and underestimate in the vicinity of troughs, although there are some exceptions. The over-all impression is one of overestimation of cyclical declines.

Estimates of the strength of the recoveries show a mixed picture. The magnitudes of the recoveries after the 1949 and 1954 troughs are underestimated, approximately correct after 1958, and slightly overstated in 1961 and then understated in 1962. The effect of the 1959 steel strike is overestimated by the first figures.

Three of the eight turning points are incorrectly dated by the first estimates (1949, 1954, and 1961); two are instances of late dating.

Table 13a shows the revisions in the magnitude of two estimates of gross national product decline from peak to trough for the four postwar contractions. As suggested by Chart 5, the magnitude of the decline in each of the four contractions has been consistently revised downward and substantially so for both estimates of GNP.

Table 13b shows the revisions in the magnitude of two estimates of GNP increase from trough to peak for three postwar expansions. The revisions are mixed: the increase during the 1949–53 expansion was revised downward, the increase during 1954–57 was revised upward, and the increase during 1958–60 was revised mainly downward.

The initial estimates tend to overestimate peak and underestimate trough levels, except for the peak in 1957 which was underestimated by both the expenditures and income estimates. The estimates of GNP based on income show somewhat less bias at troughs and peaks. Consequently, they show less bias in the initial estimates of the magnitude of cyclical decline or expansion.

The magnitudes of the 1948–49 and 1960–61 contractions appear slightly more severe when measured by the income than by the product estimates; the opposite is true for the 1953–54 and 1957–58 declines. The product estimates show the 1957–58 decline, when measured by the absolute decrease, to be the most severe, while the income estimates show the most severe decline was in 1947–49.[40] In terms of percentage decline, both estimates show 1948–49 to have been the most severe, followed by 1957–58, 1953–54, and 1960–61.

The initial overestimate of the severity of GNP decline in all four

[40] This is true only for the 1965 estimates. Prior to 1965, the estimates based on income also showed the 1957–58 decline as the most severe.

TABLE 13A. Revisions in Two Estimates of Peak to Trough Decline in GNP During Four Postwar Contractions, Classified by First to Latest Date Decline Measured
(billion dollars)

Date Decline Measured[a]		GROSS NATIONAL PRODUCT				GROSS NATIONAL PRODUCT, EXCLUSIVE OF STATISTICAL DISCREPANCY			
		Level at		Peak to Trough Change		Level at		Peak to Trough Change	
		Peak[b] (1)	Trough[b] (2)	Absolute (3)	Percentage (4)	Peak[b] (5)	Trough[b] (6)	Absolute (7)	Percentage (8)
1948–49 CONTRACTION									
February	1950	270.3	255.2	−15.1	−5.6				
July	1950	266.8	253.8	−13.0	−4.9	271.1	255.7	−15.4	−5.7
July	1951	267.0	255.5	−11.5	−4.3	269.7	255.1	−14.6	−5.4
July	1952	267.0	256.8	−10.2	−3.8	269.7	255.8	−13.9	−5.2
Major Revision	1954	264.0	255.5	−8.5	−3.2	266.0	253.5	−12.5	−4.7
Major Revision	1958	265.9	257.0	−8.9	−3.3	267.1	255.5	−11.6	−4.3
Major Revision	1965	263.9	255.0	−8.9	−3.4	266.1	253.8	−12.3	−4.6
1953–54 CONTRACTION									
August	1954	369.9	356.0	−13.9	−3.8				
July	1955	369.3	357.6	−11.7	−3.2	367.4	359.9	−7.5	−2.0
July	1956	367.4	358.5	−8.9	−2.4	363.8	355.6	−8.2	−2.2
July	1957	367.4	358.7	−8.7	−2.4	363.8	356.5	−7.3	−2.0
Major Revision	1958	368.8	358.9	−9.9	−2.7	366.8	359.7	−7.1	−1.9
Major Revision	1965	367.5	360.4	−7.1	−1.9	364.5	357.6	−6.9	−1.9
1957–58 CONTRACTION									
May	1958	440.0	422.0	−18.0	−4.1				
July	1958	445.6	425.8	−19.8	−4.4	444.9	427.5	−17.4	−3.9
July	1959	447.8	431.0	−16.8	−3.8	447.5	432.2	−15.3	−3.4
July	1960	448.3	432.0	−16.3	−3.6	448.9	434.5	−14.4	−3.2
July	1961	448.3	432.9	−15.4	−3.4	448.9	434.8	−14.1	−3.1
Major Revision	1965	446.3	434.7	−11.6	−2.6	445.6	435.0	−10.6	−2.4
1960–61 CONTRACTION									
May	1961	505.0	499.8	−5.2	−1.0				
July	1961	506.4	500.8	−5.6	−1.1	509.3	503.4	−5.9	−1.2
July	1962	504.8	500.8	−4.0	−.8	509.3	503.9	−5.4	−1.1
July	1963	504.1	500.4	−3.7	−.7	508.0	503.2	−4.8	−.9
July	1964	504.1	501.4	−2.7	−.5	508.0	503.9	−4.1	−.8
Major Revision	1965	504.7	503.3[c]	−1.4[c]	−.3[c]	507.4	502.2[c]	−5.2[c]	−1.0[c]

NOTE: Footnotes follow Table 13b.

TABLE 13B. Revisions in Two Estimates of Trough to Peak Increase in GNP During Three Postwar Expansions Classified by First to Latest Date Increase Measured
(billion dollars)

Date Increase Measured[a]		GROSS NATIONAL PRODUCT				GROSS NATIONAL PRODUCT, EXCLUSIVE OF STATISTICAL DISCREPANCY			
		Level at		Trough to Peak Change		Level at		Trough to Peak Change	
		Trough[b] (1)	Peak[b] (2)	Absolute (3)	Percentage (4)	Trough[b] (5)	Peak[b] (6)	Absolute (7)	Percentage (8)
				1949–53 EXPANSION					
August	1953	256.8	372.4	115.6	45.0				
Major Revision	1954	255.5	369.9	114.4	44.8	253.5	367.3	113.8	44.9
July	1955	255.5	369.3	113.8	44.5	253.5	367.4	113.9	44.9
July	1956	255.5	367.4	111.9	43.8	253.5	363.8	110.3	43.5
Major Revision	1958	257.0	368.8	111.8	43.5	255.5	366.8	111.3	43.6
				1954–57 EXPANSION					
November	1957	358.7	439.0	80.3	22.4	356.5	436.5	80.0	22.4
Major Revision	1958	358.9	445.6	86.7	24.2	359.7	444.9	85.2	23.7
July	1959	358.9	447.8	88.9	24.8	359.7	447.5	87.8	24.4
July	1960	358.9	448.3	89.4	24.9	359.7	448.9	89.2	24.8
Major Revision	1965	360.4	446.3	85.9	23.8	357.6	445.6	88.0	24.6
				1958–60 EXPANSION					
August	1960	432.0	505.0	73.0	16.9				
July	1961	432.9	506.4	73.5	17.0	434.8	509.3	74.5	17.1
July	1962	432.9	504.8	71.9	16.6	434.8	509.3	74.5	17.1
July	1963	432.9	504.1	71.2	16.4	434.8	508.0	73.2	16.8
Major Revision	1965	434.7	504.7	70.0	16.1	435.0	507.4	72.4	16.6

[a]Dates refer to the SCB issue in which the level estimates are published. Major revisions of the estimates are from *SCB* supplements: *National Income* (1954 revision) and *U.S. Income and Output* (1958 revision). The 1965 revision is taken from the August 1965 *SCB*.

[b]The peak and trough dates used are specific cycle dates for GNP. They are:

Contraction	Peak	Trough
1947–49	IV 1948	IV 1949
1953–54	II 1953	II 1954
1957–58	III 1957	I 1958
1960–61	II 1960	I 1961

One exception to the use of these dates is noted in footnote c below.

[c]The major revision of 1965 changed the date of the trough from 1961 I to 1960 IV. The figures refer to a 1960 IV trough.

postwar contractions was the consequence of underestimating the rise in personal consumption expenditudes and overestimating the decline in gross private domestic investment. The revisions in the initial estimates of peak to trough change in the major components of GNP are shown in Table 14a.

There was an initial overestimate of the decline or underestimate of the rise in consumption expenditures on goods during all four contractions. The rise in expenditures on services tended to be underestimated only in 1953–54 and 1957–58.

The decrease in the change in business inventories was consistently and substantially overstated by the early estimates. The decreases in expenditures on producers' durable equipment were initially underestimated except in 1953–54 and 1960–61. There appears to have been little systematic bias in the initial estimates of change in new construction expenditures.

Changes in federal government expenditures on goods and services tended to be overestimated except in 1957–58. The rise in state and local government expenditures was underestimated except during 1960–61.

Revisions of the first estimates of trough to peak change in the major components of GNP are shown in Table 14b. The overestimates of the change in gross private domestic investment, particularly the change in business inventories, were mainly responsible for the initial overestimates of GNP change during the expansions of 1949–53 and 1958–60. The expansion of 1954–57 was underestimated by the first estimates of all the components except two: consumption expenditures on nondurables and state and local government expenditures on goods and services.

Although most of the components have contributed to the bias in the initial estimates of GNP change during periods of business cycle expansion and contraction, the role of the inventories component has been predominant. It is well known that change in business inventories is one of the weaker components in terms of accuracy, but the consequences of its measurement errors for this use of GNP statistics are perhaps less known.

TURNING-POINT DATES. Table 15 shows the effect revisions have had on the timing of major turns in GNP. Although the timing of peaks

TABLE 14A. Revisions in Estimates of Peak to Trough Changes in Major Components of GNP During Four Postwar Contractions, Classified by First to Latest Date Change Measured
(billion dollars)

Date Change Measured[a]		ESTIMATES OF PEAK TO TROUGH CHANGES IN MAJOR COMPONENTS[b]							
						Gross Private Domestic Investment			
		Personal Consumption Expenditures					Change in Business Inventories	Producers' Durable Equipment	New Construction
		Total (1)	Nondurables (2)	Durables (3)	Services (4)	Total (5)	(6)	(7)	(8)
				1948–49 CONTRACTION					
February	1950	−1.1	−5.6	2.3	2.1	−14.3	−12.7	−2.5	.8
July	1950	1.9	−3.5	3.1	2.2	−15.6	−13.7	−2.2	.4
July	1951	2.5	−3.1	2.6	3.0	−15.2	−13.3	−2.4	.4
July	1952	3.2	−2.3	2.5	3.0	−14.7	−12.6	−2.5	.4
Major Revision	1954	3.4	−2.8	2.8	3.3	−13.3	−11.2	−2.6	.6
Major Revision	1958	3.2	−2.9	3.2	3.0	−13.3	−9.6	−4.1	.5
Major Revision	1965	2.2	−2.9	3.2	2.0	−12.5	−9.6	−3.1	.1
				1953–54 CONTRACTION					
August	1954	2.3	.4	−1.5	3.4	−10.3	−9.2	−2.2	1.1
July	1955	3.7	.7	−1.6	4.6	−8.1	−7.2	−2.2	1.1
July	1956	3.6	.5	−1.4	4.5	−5.3	−4.8	−1.6	1.1
July	1957	3.6	.3	−1.4	4.8	−5.2	−4.6	−1.6	.9
Major Revision	1958	3.2	.2	−1.2	4.3	−5.7	−5.8	−1.1	1.1
Major Revision	1965	4.5	.2	−1.0	5.1	−5.7	−5.9	−.9	1.1
				1957–58 CONTRACTION					
May	1958	−2.4	−1.0	−3.5	2.1	−14.7	−12.0	−3.0	.3
Major Revision	1958	−2.1	−.7	−4.1	2.7	−17.1	−11.7	−5.1	−.3
July	1959	−.9	−.2	−4.0	3.4	−15.5	−9.6	−5.2	−.7
July	1960	−1.0	.0	−4.4	3.5	−15.2	−9.4	−4.8	−1.0
July	1961	−1.3	−.2	−4.4	3.4	−13.7	−8.0	−4.8	−.9
Major Revision	1965	.7	.1	−2.7	3.3	−13.1	−8.6	−3.4	−1.1
				1960–61 CONTRACTION					
May	1961	−.2	−.5	−4.3	5.7	−14.5	−9.8	−3.0	−1.7
July	1961	.8	.4	−5.9	6.3	−14.8	−9.4	−4.4	−1.1
July	1962	.6	.9	−5.0	4.7	−13.4	−8.0	−4.0	−1.4
July	1963	1.0	.9	−4.5	4.6	−13.7	−8.5	−3.8	−1.4
Major Revision	1965	1.4[c]	.5[c]	−2.3[c]	3.3[c]	−8.4[c]	−6.3[c]	−1.4[c]	−.7[c]

TABLE 14A. (concluded)

Date Change Measured[a]		ESTIMATES OF PEAK TO TROUGH CHANGES IN MAJOR COMPONENTS[b]			
		Gov't Expenditures on Goods and Services			Net Exports
		Total (9)	Federal (10)	State and Local (11)	Total (12)
		1948–49 CONTRACTION			
February	1950	3.4	1.6	1.9	−3.0
July	1950	2.5	.7	1.8	−1.7
July	1951	3.0	.9	2.1	−1.7
July	1952	3.0	.9	2.1	−1.7
Major Revision	1954	3.2	1.1	2.1	−1.8
Major Revision	1958	2.1[d]	−.5[d]	2.6	−.9[d]
Major Revision	1965	3.0	.6	2.4	−1.7
		1953–54 CONTRACTION			
August	1954	−8.3	−10.9	2.6	2.3
July	1955	−9.5	−12.4	3.0	2.2
July	1956	−10.0	−13.0	3.0	2.8
July	1957	−9.9	−12.9	3.0	2.8
Major Revision	1958	−8.9[d]	−11.8[d]	3.0	1.5[d]
Major Revision	1965	−7.6	−10.4	2.9	1.6
		1957–58 CONTRACTION			
May	1958	1.0	−1.1	1.9	−1.7
Major Revision	1958	3.7	1.2	2.5	−3.1
July	1959	3.3	.4	2.3	−3.1
July	1960	3.2	.6	2.6	−3.4
July	1961	2.9	.6	2.3	−3.4
Major Revision	1965	3.6	.6	2.0	−2.9
		1960–61 CONTRACTION			
May	1961	6.1	3.0	3.1	3.3
July	1961	5.4	1.8	3.5	3.0
July	1962	5.8	2.3	3.5	2.9
July	1963	5.8	2.5	3.3	3.1
Major Revision	1965	3.1[c]	1.6[c]	1.4[c]	2.6[c]

NOTE: Footnotes follow Table 14b.

TABLE 14B. Revisions in Estimates of Trough to Peak Changes in Major Components of GNP During Three Postwar Expansions, Classified by First to Latest Date Change Measured
(billion dollars)

Date Change Measured[a]		ESTIMATES OF TROUGH TO PEAK CHANGES IN MAJOR COMPONENTS[b]							
						Gross Private Domestic Investment			
		Personal Consumption Expenditures					Change in Business Inventories (6)	Producers' Durable Equipment (7)	New Construction (8)
		Total (1)	Nondurables (2)	Durables (3)	Services (4)	Total (5)			
				1949–53 EXPANSION					
August	1954	47.4	23.0	5.7	18.7	30.0	14.2	8.7	7.1
Major Revision	1954	47.3	23.0	5.2	19.2	26.8	11.7	7.7	7.3
July	1955	47.9	23.1	5.5	19.4	25.9	10.8	7.5	7.6
July	1956	47.9	23.2	5.5	19.3	24.4	9.4	7.3	7.6
Major Revision	1958	49.3	22.3	7.1	19.7	22.3	8.4	6.0	7.9
Major Revision	1965	51.3	23.2	7.2	21.0	21.6	8.5	5.6	7.6
				1954–57 EXPANSION					
November	1957	48.6	22.4	5.8	20.3	17.2	3.5	7.9	5.9
Major Revision	1958	51.8	21.7	8.2	21.9	19.5	4.9	7.1	7.7
July	1959	51.7	20.9	8.7	22.1	20.7	5.4	8.1	7.3
July	1960	52.2	20.9	8.7	22.5	20.4	5.2	8.0	7.3
Major Revision	1965	49.2	20.3	8.1	21.0	20.7	5.9	8.7	6.1
				1958–60 EXPANSION					
August	1960	41.3	13.8	8.0	19.4	23.1	12.2	5.4	5.5
July	1961	42.5	13.8	8.8	19.8	20.7	10.9	4.5	5.4
July	1962	42.5	13.1	9.3	20.1	19.6	9.9	4.3	5.4
July	1963	42.3	13.5	9.2	19.6	19.4	9.7	4.3	5.4
Major Revision	1965	41.8	14.2	8.2	19.2	18.7	9.3	5.5	3.9

TABLE 14B. (concluded)

Date Change Measured[a]		ESTIMATES OF TROUGH TO PEAK CHANGES IN MAJOR COMPONENTS[b]			
		Gov't. Expenditures on Goods and Services			Net Exports
		Total (9)	Federal (10)	State and Local (11)	Total (12)
		1949–53 EXPANSION			
August	1954	40.2	34.4	5.8	−2.0
Major Revision	1954	43.2	37.7	5.5	−2.8
July	1955	42.0	36.5	5.4	−2.0
July	1956	42.1	36.7	5.4	−2.5
Major Revision	1958	43.0[c]	37.3[c]	5.6	−2.8[c]
Major Revision	1965	43.3	37.7	5.6	−3.7
		1954–57 EXPANSION			
November	1957	11.1	2.3	8.8	3.4
Major Revision	1958	11.4[c]	2.6[c]	8.8	4.0[c]
July	1959	12.2	2.6	9.6	4.3
July	1960	12.5	2.9	9.6	4.3
Major Revision	1965	12.3	2.3	9.9	3.8
		1958–60 EXPANSION			
August	1960	8.5	1.1	7.4	.3
July	1961	9.8	2.3	7.6	.6
July	1962	9.2	2.5	6.7	.7
July	1963	9.1	2.3	6.8	.6
Major Revision	1965	8.6	1.7	7.0	.9

[a]See note a to Tables 13a and 13b for source of data.
[b]See note b to Tables 13a and 13b for peak and trough dates used.
[c]The figures refer to a 1960 IV trough.
[d]Figures are not comparable to preceding figures in the column because of a definitional change. The major revision of 1958 changed the treatment of federal government international transfer payments. Cash grants to foreign countries are no longer a component of GNP (i.e., no longer included in federal government purchases of goods and services and deducted from exports of goods and services).

TABLE 15. Revisions of Major Turning Point Dates in Two Estimates of Gross National Product

Date of Publication and Source[b]	Dates of Peaks: GNP	Dates of Peaks: GNP, Exclusive of Statistical Discrepancy	Date of Publication and Source[b]	Dates of Troughs[a]: GNP	Dates of Troughs[a]: GNP, Exclusive of Statistical Discrepancy
I. *1948–49 Contraction*					
May 1949 (*SCB*)	1948 IV		January 1950 (*ERP*)	(1949 IV)	
August 1949 through August 1965 (*SCB*)		1948 IV	February 1950 (*SCB*)	1949 III	
			May 1950 (*SCB*)	1949 III	(1949 IV)
			July 1950 through August 1965 (*SCB*)	1949 IV	1949 IV
II. *1953–54 Contraction*					
October 1953 (*EI*)	1953 II		July 1954 (*EI*)	(1954 II)	
February 1954 through August 1965 (*SCB*)		1953 II	August 1954 (*SCB*) through October 1954 (*EI*)	1954 I	
			November 1954 (*SCB*)	(1954 III)	1954 I
			January 1955 (*ERP*) through May 1955 (*SCB*)	1954 III	1954 I
			July 1955 (*SCB*)	1954 II	1954 I
			July 1956 through July 1957 (*SCB*)	1953 IV	1953 IV
			July 1958 (*SCB*)	1954 II	1954 I
			August 1965 (*SCB*)	1954 II	1953 IV

TABLE 15. (concluded)

Date of Publication and Source[b]	Dates of Peaks: GNP	Dates of Peaks: GNP, Exclusive of Statistical Discrepancy	Date of Publication and Source[b]	Dates of Troughs[a]: GNP	Dates of Troughs[a]: GNP, Exclusive of Statistical Discrepancy
III. *1957–58 Contraction*					
January 1958 (*ERP*) through August 1965 (*SCB*)	1957 III		July 1958 through August 1965 (*SCB*)	1958 I	
February 1958 through August 1965 (*SCB*)		1957 III	October 1958 (*EI*) through August 1965 (*SCB*)		1958 I
IV. *1960–61 Contraction*					
October 1960 (*EI*) through August 1965 (*SCB*)	1960 II		July 1961 (*EI*) through July 1963 (*SCB*)	1961 I	
December 1960 (*EI*) through May 1961 (*EI*)		1960 III	October 1961 (*EI*) through July 1964 (*SCB*)		1961 I
July 1961 (*EI*) through August 1965 (*SCB*)		1960 II	August 1965 (*SCB*)	1960 IV	1960 IV

[a]Dates in parentheses indicate the given quarter was lower than the preceding quarter. Since data for the succeeding quarter were not available, the designation of a trough is uncertain.

[b]SCB stands for *Survey of Current Business*, EI for *Economic Indicators*, and ERP for the *Economic Report of the President*.

was unaffected, the dates of the low points in three of the four cyclical declines in GNP were changed. Only the date of the trough in 1958 appears the same throughout the early and successively revised figures.

As Chart 5 shows, however, the troughs of the declines beginning in 1948, 1953, and 1960 are not marked by a single quarter, or turning point, but rather by a leveling off period, or turning zone. In these cases, even small revisions in the estimates are sufficient to change the low point by one or even two quarters. The flat trough of the 1953–54 contraction is the most pronounced and, as Table 15 shows, the low point of this decline differs by as much as three quarters in the product data and by one quarter in the income data.

Now and then the suggestion comes up that a chronology of business cycles ought to be based on the cyclical timing of a single measure of aggregate economic activity: for example, gross national product or industrial production. The frequent revisions of GNP, and the differences between the income and expenditure estimates, are two of the difficulties associated with relying exclusively on the timing of GNP to date business cycles.[41]

Revisions are by no means limited to gross national product statistics. Stekler's study shows that the dates of major turning points in the Federal Reserve Board's Index of Industrial Production have undergone considerable revision as a result of both changes in weights and methods of reporting.[42] Unlike the revisions of GNP which have mainly affected troughs, revisions in the production index have primarily changed peaks. Moreover, the differences in timing are fairly large. For example, the 1948 peak in production first appeared to be in November, then in August, and later in July. Similarly, the 1953 peak is first shown in March, but the revised data show it in July. The dates of other major turns in industrial production were altered by no more than one month.

The foregoing discussion has shown some of the difficulties that errors in the early GNP statistics create for those who would use movements in GNP as an indicator of current business conditions. Most

[41] For a discussion of the problems, see Victor Zarnowitz, "On The Dating of Business Cycles," *Journal of Business*, April 1963, pp. 197–199. This article is a reply to George W. Cloos, "How Good Are The National Bureau's Reference Dates?," *Journal of Business*, January 1963. The exchange is continued in the July and October issues of the same journal.

[42] Stekler, *op. cit.*, Table 8.

serious for policy makers are the misleading ideas of magnitude that may be engendered by the first estimates of cyclical decline in GNP and of the strength of the early recovery.

Revisions of Seasonal Factors

Part of the revision in estimates of quarterly GNP is due to revision of the factors used to adjust the estimates for seasonal variation. The accuracy of the seasonal adjustment is especially important in those series regularly consulted by students of business cycles. In the case of GNP, as Moore points out,[43]

> Sometimes the seasonal change is many times larger than the nonseasonal. . . . When this happens at a crucial turn in the business situation, the precise magnitude of the seasonal adjustment is of very great importance. For example, between the third and fourth quarters of 1948 seasonally adjusted GNP rose by $2 billion, then in the next quarter it fell $4 billion, marking the beginning of the 1949 recession. But the seasonal adjustment had eliminated a rise of nearly $15 billion between the third and fourth quarters and a decline of $21 billion between the fourth quarter and the first. . . . A year later there were equally dramatic changes marking the revival.

Estimating the seasonal movements in current data and adjusting these data to exclude seasonal variation is an example of a particular type of forecasting. Up-to-date seasonally adjusted series require forecasts of the magnitude of the seasonal component of current change in the level of the variable. Such forecasts usually depend on the periodic and recurrent nature of seasonals; that is to say they are based entirely on the variable's historical performance.

More accurate estimates of the seasonal factors for each of a given year's four quarters can be obtained once data covering the full year are in. These factors take the place of the forecast factors when the provisional estimates of GNP are revised in July following their initial publication.

The OBE's indirect method of adjusting GNP for seasonal variation

[43] Geoffrey H. Moore, "Seasonal Adjustment of the Income and Product Series," *A Critique of the U. S. Income and Product Accounts,* Studies in Income and Wealth, Vol. 22, Princeton University Press for the National Bureau of Economic Research, 1958, pp. 551–552.

is cause for further revision of the seasonal factors. Seasonally adjusted GNP is obtained by summing the seasonally adjusted components. As more reliable data become available, some components are revised. Often these data have slightly different seasonals and, once they are incorporated into the estimates, slightly alter the implicit seasonal factors of GNP.[44]

Revisions in the seasonal factors were mainly responsible for the changes in the dates of the 1949, 1954, and 1961 troughs. This can be demonstrated by using the August 1965 quarterly seasonal factors to adjust the earlier sets of GNP estimates.[45] When the implicit seasonal factors for 1949, estimated in 1965, are used to adjust the first and revised product estimates, a fourth quarter 1949 trough would appear in the first throughout the revised estimates (Table 15).

Similarly, when the implicit seasonals for 1953–54, estimated in August 1965, are used to adjust the initial and revised estimates, a second quarter 1954 trough would appear throughout each set of estimates of the period (Table 15). However, the 1953–54 product estimates which were revised in July 1955–57 would show a double bottom with troughs also occurring in the fourth quarter of 1953. Finally, when the 1965 factors are used to adjust each set of estimates, the low point of the decline beginning in 1960 appears without exception in the fourth quarter of 1960.

The source of some of these differences could perhaps be traced to the OBE's indirect method of adjusting GNP for seasonal variation. While this procedure has the desirable property of having the adjusted components add to the adjusted total, it may also have the undesirable property of giving the seasonal factors of volatile components, which are likely to be affected substantially by irregular movements, too great an influence on the seasonal factors derived for GNP.

One such volatile component is the change in business inventories and it exerts a strong influence on the seasonal pattern of GNP. As Chart 6 shows, the seasonal pattern in inventories (Panel 2) is exactly

[44] The OBE does not publish a series of implicit GNP seasonal factors. Both adjusted and original quarterly data are published, however, and it is possible to derive the implicit seasonals. Multiplicative factors (i.e., ratios of original to adjusted estimates) were used in the experiments reported in the text below.

[45] Although unadjusted quarterly data were not published along with the adjusted data in the OBE's preliminary report article on the 1965 major revision (*op. cit.*), the OBE kindly furnished these data.

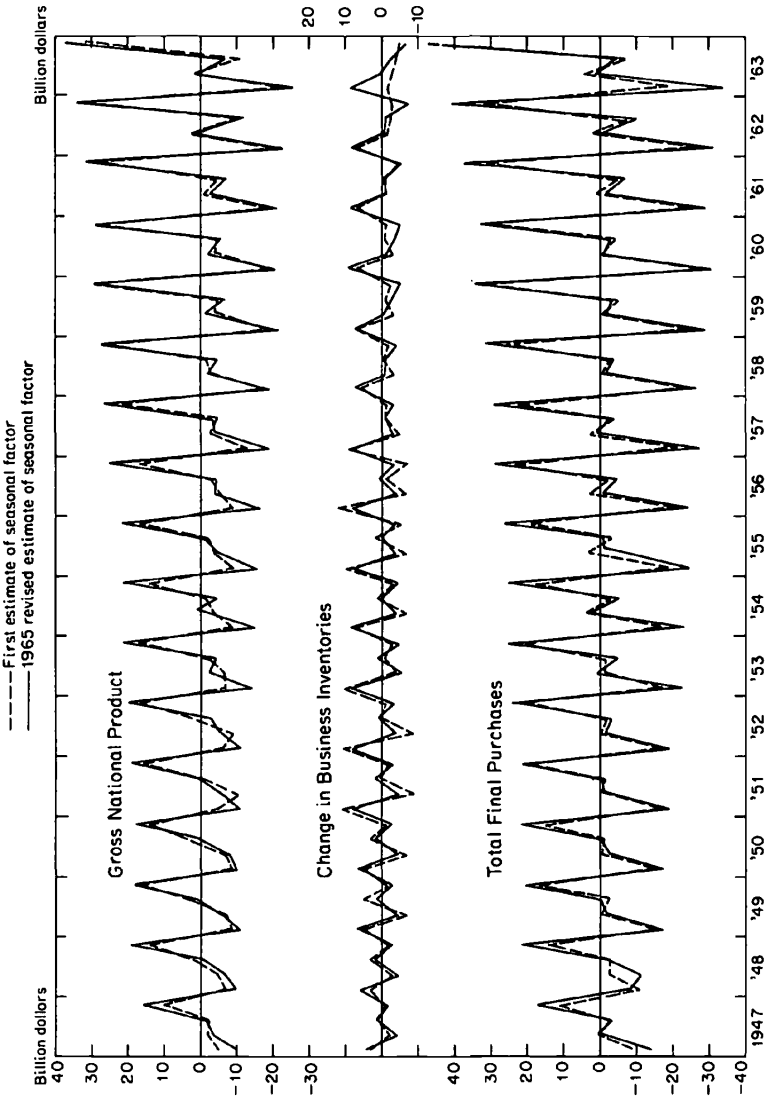


CHART 6. First and Revised Estimates of the Implicit Seasonal Factors for Gross National Product, Change in Business Inventories, and Total Final Purchases, 1947–63

the opposite of the seasonal pattern of total final purchases (Panel 3).[46] The seasonal pattern of total final purchases increases moderately from the first to the second quarter, declines slightly from the second to the third, increases sharply from the third to the fourth, and decreases very sharply from the fourth to the first quarter of the next year.

The seasonal pattern of GNP is the net result of these two opposite patterns. It reflects mainly final purchases except for the second to third quarter movement. The pattern of the second to third quarter seasonal movement in GNP has changed over the years. From 1947 to 1952, there was a moderate rise from the second to the third quarter, a very slight decrease from 1952–57, and an increasingly greater decrease since 1958.

As can be seen from Chart 6, the initial seasonal factors have tended to understate the seasonal amplitudes in GNP and in final purchases. The initial factors for the change in business inventories show less bias, although the seasonal amplitudes were somewhat overstated from 1950–56 and understated from 1956–63.

It is important to note that the revisions do not change the seasonal pattern in GNP. Although it has changed somewhat over the years, for a given year, the pattern shown in the provisional estimates is essentially the same one that is shown in the revised estimates. From a broad point of view then, the forecasts of the seasonal component of current changes have been accurate ones.

But accurate forecasts of the seasonal *patterns* are not sufficient. For any series in which the seasonal movements are often considerably larger than the nonseasonal, small errors in the seasonal factors are enough to alter the direction of change in the adjusted series. In the case of GNP, the revisions clearly illustrate that, at certain crucial times in the business situation, an economist may not know whether the series increased or decreased during the previous quarter.

Postwar Trends

Throughout the postwar period 1947–63, the movements in gross national product show a strong upward trend with cyclical fluctuations

[46] The seasonal pattern in inventories can alternatively be viewed as similar to, but lagging the seasonal pattern in, final purchases by one quarter.

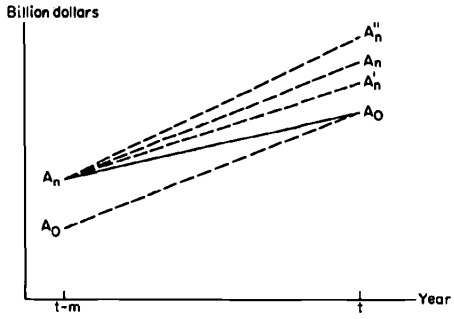


FIGURE 1

about the trend. The rate of increase, however, has not been steady; the rise was stronger during the first than during the second half of the period.

Before turning to a comparison of the first and revised average rates of increase in GNP, let us consider how they might be expected to differ. It is often suggested the revisions merely raise the level of the estimates; that they have no systematic effect on the changes. In other words, the revisions might be considered simply the sum of a constant and a random term whose expected value is zero. This is not quite the case for GNP revisions. Although the revisions raise the level of the estimates on the average, we have seen that part of the variation about the mean revision is systematic: it is partly cyclical and partly seasonal.[47]

Suppose, however, the revisions do not affect the longer term movement such that the trend in GNP over m years is the same from one set of estimates to another. Figure 1 above illustrates this special case. After n revisions, the difference between the provisional and revised estimates $(A_0 - A_n)$ is a constant and the change in the provisional estimates from year $T - m$ to T $(A_{0_T} - A_{0_{T-m}})$ is the same as the change in the revised estimates $(A_{n_T} - A_{n_{T-m}})$. But these are not the changes that an observer, standing in year T and reviewing the rise in GNP over the past m years, would note. He could not of course look at the slope of the segment A_nA_n—the value of A_n in year T would not be available until several years later. Typically he would look at the slope of A_nA_0 rather than A_0A_0, which is to say he would use the series of most recent estimates available

[47] See, for example, Charts 5 and 6 and Table 3.

in year T. This series, as we have noted, is a mix of $A_0, A_1, \cdots, A_n$. Given that the revisions raise the level of the estimates, changes over several years computed from these mixed vintage data will always underestimate the increase.

It is impossible to determine a priori whether changes computed from the set of provisional estimates would overestimate or underestimate the changes computed from fully revised data and, therefore, whether or not they would be more accurate than changes computed from mixed data. They would of course exceed the rises shown by the data of mixed vintage, as long as the revisions raise the level of the estimates. For the special case in which the revisions raise the estimates by a constant amount (from A_0 to A_n in Figure 1), the provisional estimates would correctly state the rise (i.e., the slope of A_0A_0 is exactly the same as the slope of A_nA_n). If the magnitude of the revisions tends to increase over the years (e.g., in Figure 1, the revision in year $T - m$ is A_0 to A_n and from A_0 to A_n'' in year T), the provisional estimates would be underestimates. The opposite would be true if the size of the revisions tended to decrease (from A_0 to A_n in year $T - m$ to A_0 to A_n' in year t).[48]

These are somewhat surprising results. An increase in the magnitude of the revisions would suggest a deterioration over the years in the accuracy of the provisional estimates. Nonetheless, changes computed from this set of estimates would more closely resemble the changes in the fully revised figures than would the changes computed from the series of most recently available estimates. Only if the revisions show a decrease over time would changes computed from the most recent data be likely to be as accurate as the changes computed from provisional estimates. Even then, the changes based on mixed vintage data would underestimate the rise.

The extent of underestimation (or possibly overestimation on the part of the provisional estimates) depends on the magnitude of the revisions and the period of time the change covers. The average annual rates of change given in Table 16 suggest that, although the amount of underestimation is very small, there is a persistent bias in the changes computed from the most recent series available (i.e., mixed vintage data). In every case these rates of change are less than those shown by

[48]The slope of A_0A_0 exceeds that of A_nA_n' indicating the provisional estimates would overstate the rise. In the opposite case, the slope of A_0A_0 is less than that of A_nA_n''.

TABLE 16. First Compared with Revised Average Annual Rates of Increase in Two Estimates of GNP: 1947–63 and Subperiods

Line	Set of Estimates Used[a]	Average Annual Rate of Increase During: 1947–55 (1)	1955–63 (2)	1947–63 (3)
		(per cent)		
	GROSS NATIONAL PRODUCT			
1	Major revision 1965	7.02	5.03	6.05
2	Major revision (statistical) 1965	7.11	5.10	6.10
3	Most recent available in Feb. 1964	6.83	4.95	5.95
4	Most recent available in Feb. 1956	6.60	—	—
5	Provisional	6.75	5.29	6.02
	GROSS NATIONAL PRODUCT, EXCLUSIVE OF THE STATISTICAL DISCREPANCY			
6	Major revision 1965	7.00	5.11	6.05
7	Major revision (statistical) 1965	7.09	5.19	6.14
8	Most recent available in Feb. 1964	6.79	5.01	5.98
9	Most recent available in Feb. 1956	6.59	—	—
10	Provisional	6.55	5.36	5.94

[a]Estimates are taken from the *Survey of Current Business*. Figures for the 1965 major revision are from the August 1965 issue. Statistical revisions are from an unpublished tabulation furnished by the OBE. The provisional estimates are from the February issues of the *Survey* of the relevant year (for example, the estimate of 1947 is from the February 1948 *Survey*).

the 1965 revised data (lines 3 and 4 compared to lines 1 and 2 and lines 8 and 9 compared to lines 6 and 7).[49]

One of the striking features of the figures in Table 16 is the very small difference in the average rates of change for a given period. There is but the slightest difference between the rates computed from the first and from the most recent figures. Thus fairly large differences in the revisions of levels create only small differences in estimates of average rates of change over several years.[50] For the estimates of GNP based on

[49] Average rates of change, depending as they do on only the base and final figures, are sensitive to unusual values. For this reason annual data are used in Table 16 and the periods are chosen to minimize as much as possible the cyclical differences among them. The years 1947, 1955, and 1963 were each rather good business years.

[50] The 1965 statistical revisions raised the level of the provisional estimates of GNP in 1947, 1955, and 1963 by 3.3, 16.2, and 15.8 billions, respectively. The

income, however, the rates computed with provisional data underestimate the rates computed with mixed vintage data during the 1947–55 and 1947–63 periods. This is unusual and it is because subsequent revisions lowered rather than raised the provisional estimates of the value of GNP in 1947.

Without exception, the different sets of data show that the increase in GNP during the second half of the period was at a lower rate than during the first half (column 2 compared to column 1). Because trend estimates based on the most recent series available tend to underestimate, one might have expected the major revision of 1965 to reduce the differential between the rates of increase in 1947–55 and 1955–63. Instead, it appears this differential has been widened in the course of revising the estimates. It is smallest in the rates computed from the provisional estimates and steadily increased in the revised data.[51]

Table 17 shows the average rates of increase during 1947–55 and 1955–63 in three major GNP components. The early figures underestimate the rates of increase in consumption expenditures during both periods and in government expenditures during 1947–55. The rate of growth in gross private domestic investment is overestimated in both periods.

All three components show a decline in the rate of increase during the second half of the postwar period. The slowdown is most pronounced in gross private domestic investment and in government expenditures.

To sum up, the initial estimates underestimate when compared with revised estimates of long-term movements in GNP during 1947–63. The main source of this underestimation is in the personal consumption expenditures. Long-term changes in gross private domestic investment are

total revisions (statistical plus definitional) are smaller, namely, 1.7, 10.8, and 4.1 billions. Note from these figures (and from Chart 4) that the magnitude of the revisions does not show a steady trend over the 1947–63 period. However, since the 1963 figure is subject to future revision, the revisions given above (15.8 and 4.1 billions) are not strictly comparable to those of the 1947 and 1955 figures. The 1965 major revision was strictly speaking only a second annual July revision of the estimates of GNP in 1963.

[51] Because revisions have generally been upward, it is reasonable to expect that subsequent revisions will raise the value of GNP in 1963, thus increasing the average rate of change from 1955–63. That is, the increase in the differential may be an illusion. It is unlikely that the differential would vanish—assuming that the figure for 1955 is correct, the level of GNP in 1963 would have to be revised upward by $100 billion to eliminate the difference in the rate of increase between 1947–55 and 1955–63.

TABLE 17. First Compared with Revised Average Annual Rates of Increase in Three Major GNP Components: 1947–55 and 1955–63

Line	Major GNP Component[b]	Period Covered	Average Annual Rate of Change Using:[a] Provisional Estimates (1)	Most Recent Series Available Feb. 1956 (2)	Most Recent Series Available Feb. 1964 (3)	1965 Major Revision Total[c] (4)	1965 Major Revision Statistical (5)
				(per cent)			
1	Personal Consumption Expenditures	1947–55	5.50	5.45	5.66	5.91	6.04
2	Personal Consumption Expenditures	1955–63	4.66		4.42	4.93	5.07
3	Gross Private Domestic Investment	1947–55	9.98	9.07	9.29	8.93	9.20
4	Gross Private Domestic Investment	1955–63	4.14		3.25	3.23	3.39
5	Government Expenditures	1947–55	12.93	12.97	12.87	14.58	13.37
6	Government Expenditures	1955–63	6.43		6.49	6.48	6.08

[a]See note a, Table 16, for sources of data.
[b]Net exports excluded because of negative values.
[c]Total revised estimates (statistical plus definitional revisions).

overestimated by the early figures. The rate of change in government expenditures was slightly underestimated during 1947–55 while, during 1955–63, it was slightly overestimated.

Underestimation of the aggregate's change comes about from two simple facts: GNP levels are revised upward on the average; and, at a given point in time, estimates of the most recent levels have not been revised as much as the estimates of past levels. Most users of GNP data prefer to use the series of best estimates available even though it is in fact the series containing the greatest differences over time in the accuracy (or vintage) of the estimates. If the magnitude of the revisions does not change systematically over the years (i.e., if there is no upward or downward trend in the revisions, such that they are best described by a constant), long-term changes computed from the set of provisional

estimates are more accurate than those computed from the series of latest estimates available.

Comparison of Trend and Cyclical Errors

It is important to distinguish between the characteristics of the errors of the first estimates of long-term movements, or trends, and the errors of the shorter term cyclical changes. The foregoing discussion of trend errors is based on the assumption that the initial estimates of levels are raised in each of the n successive revisions and this is generally true. The exceptions are for levels in the vicinity of cyclical peaks.[52] These estimates have been lowered by the revisions, except for the 1957 peak. If the revisions merely raised the level of the estimates, increases in GNP would be understated and decreases overstated. As we have seen, cyclical (peak to trough) decreases are overstated, but two of the three cyclical (trough to peak) increases are overstated also.

There appears then to have been a systematic difference between cyclical errors and long-term trend errors in the provisional estimates of GNP. The cyclical errors reflect primarily the overestimation of the rise and fall in inventory investment, while the trend errors in the aggregate are dominated by the underestimation errors in personal consumption expenditures.

The two types of error cause the early figures to overestimate cyclical changes and underestimate the trend in GNP. In periods of business cycle contraction, the two kinds of error reinforce each other and cause the initial estimates to exaggerate substantially the severity of peak to trough decline. The errors tend to offset each other during periods of expansion. From 1947 to 1963, the quarters of expansion have greatly outnumbered the quarters of business cycle contraction. Thus an average over the period of the first estimates of quarter-to-quarter changes in GNP would differ little from an average of the revised estimates. This has apparently created the widespread, but mistaken, belief that the revisions have merely raised the level of GNP estimates and have had little systematic effect on the movements.

[52] There are some others; for example, in 1947, 1952, and late 1962. It is tempting to conjecture that these may be associated with periods of retardation and therefore somewhat similar to periods of business cycle contraction.