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5. Seasonal Movements of Interest Rates

Our study of the seasonal movements of interest rates has three major objectives. One is to identify seasonal patterns in interest rate series, and to measure them where they are found to exist. The second is to make seasonal adjustments in those interest rate series requiring them in order to use the adjusted series for cyclical analysis and other purposes. The third is to find what seem to be the causes of these seasonal patterns and see what this may contribute to an understanding of interest rates generally.

If seasonal patterns of movement were fairly substantial and constant both in amplitude and timing, it would be relatively simple to identify them, measure them, and correct for them. Something approaching this regularity is often found when economic variables are significantly dependent upon seasonal climatic conditions. Undoubtedly interest rates are affected in some measure by economic variables that are subject to this type of seasonal pattern, but they are much more influenced by man-made seasonal phenomena that prove to be highly unstable over any extended period of time. Adjustment for these "man-made" seasonal movements is just as important for business cycle study as is adjustment for any other seasonal behavior, but the identification of shifting seasonal patterns is extremely difficult.

Seasonal fluctuations in the volume of funds required by manufacture and trade are highly important, and probably are the main cause of the seasonal high in bill rates in December. The extent of counterseasonal open-market operations by the Federal Reserve is a second factor of great importance. But perhaps the dominant factor determining seasonal movements in interest rates has been the seasonal pattern of federal tax collections. This pattern has, moreover, changed substantially over the decade studied, altering the seasonal in interest rates.

A major characteristic of any seasonal adjustment under these conditions is that the adjustment will commonly vary from year to year. Yet the process of identifying a seasonal pattern is ordinarily one of averaging several years together in order to weed out entirely irregular movements. In consequence, seasonal adjustment in cases where the pattern itself shifts must be an uneasy compromise. A major June decline that might have resulted from an episodic or even a cyclical cause can influence averages that include several previous and succeeding Junes, giving the appearance of a seasonal low extending over several years. At the same time, a change in a true seasonal movement may be fairly sudden in fact, but it will be spread out and softened by the averaging process of the adjustment procedure. If the causes of the seasonal pattern could be adequately identified and isolated, a regression procedure might avoid these difficulties, but our work is not yet advanced enough to utilize this approach.

Brown experimented with many adjustment techniques in order to attempt a judgment on the existence and size of seasonal patterns in various interest rate series. Our final adjustments were made by the Bureau of the Census Method II developed by Julius Shiskin. This is a highly sophisticated procedure, and we know of none better when changes in seasonal patterns are not too sharp, but our findings will be badly misread if the limitations referred to above are not kept in mind.

The major part of this summary relates to seasonal patterns during 1951–60, when evidence of them is most convincing. Following this discussion, I shall comment briefly on the analysis for the period since 1960.

Treasury Bills, 1951–60

The clearest evidence of a seasonal pattern is for short-term securities, especially three-month Treasury bills. The seasonal-adjustment factors show a high in December during all ten years 1951–60, and a low in June or July in nine of the ten years. Not only was this pattern extremely stable but its amplitude widened with a remarkably consistent trend over the decade. Statistics showing the high of the monthly adjustment factors as a percentage of the mean for the year reveal the following nearly continuous upward trend beginning in 1951: 106.2,

107.7, 108.8, 110.0, 110.4, 111.2, 111.4, 111.9, 111.7, 112.0. The variation of lows below their average shows an even greater regularity of decline: 97.8, 96.7, 95.2, 94.1, 91.9, 90.0, 88.5, 88.0, 87.4, 87.5. Subject to the uncertainty imposed by the averaging process, these data suggest a fairly stable seasonal pattern during the fifties. Seasonality is also confirmed by other tests, such as the F test, which reveals significance well below the 1 per cent level.[1]

The lower panel of Chart 7 depicts the pattern of weekly adjustment factors on bills for 1960. The two upper panels reveal not only a picture of regularities but also some feeling for the shifts in behavior over time. It should be emphasized that this record provides no basis for future prediction unless the study of causation suggests that the underlying reasons for the pattern will probably persist. As we show below, such a prediction beyond 1960 would be highly inappropriate in this case.

The significance of these seasonal movements may be more fully understood if they are compared with other types of change. The movements of the original series over the period 1951–61 can be divided into three components: seasonal movement, cyclical-secular movement, and irregular movements. The ratio of the average monthly amplitude of one type of movement to that of another gives a measure of their importance in terms of size. Thus the ratio of the seasonal to the cyclical for Treasury bills during the decade 1951–60 was .93. The indication is that from month to month the seasonal movements were almost as large as the cyclical, on the average. The average monthly "irregular" movement was virtually equal to the seasonal, the ratio of seasonal to irregular being .99. The ratio of the seasonal movement to the average monthly change of the original series was .55. Clearly the seasonal movements were highly significant, not only in their regularity but also in their quantitative importance.

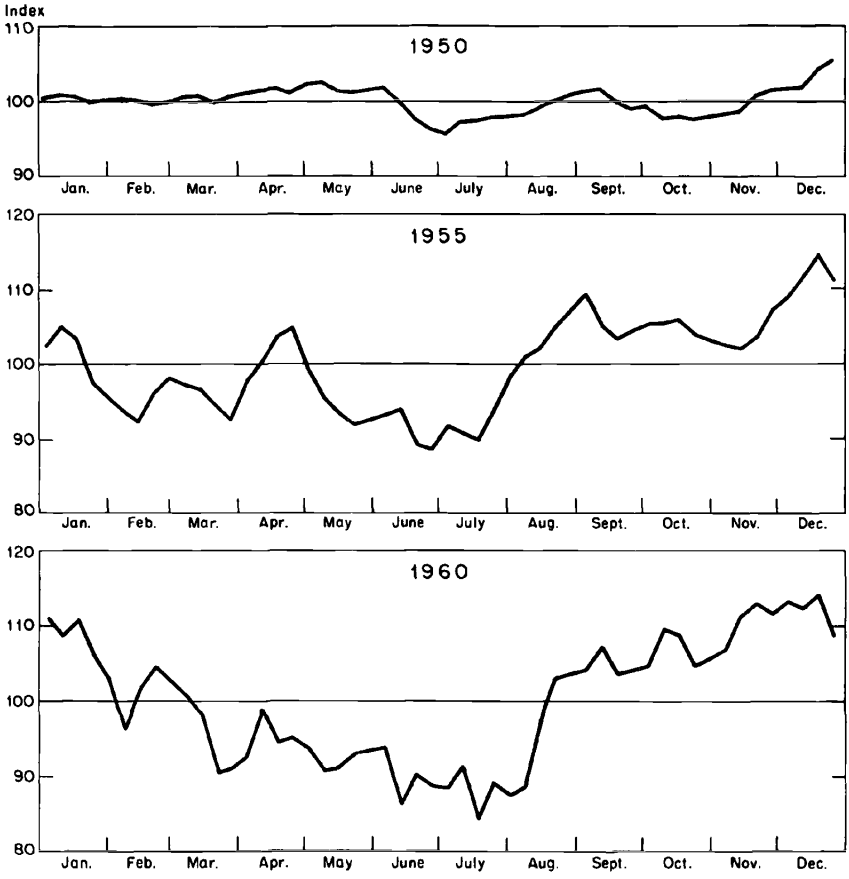
Other Short-Term Interest Rates, 1951–60

Table 5 summarizes some of Brown's findings about the seasonal pattern of yields on bills and other series. Two other short-term rates were examined. The over-all pattern of behavior of yields on bankers' ac-

[1] The F test for the statistical significance of estimates of seasonal factors is described in *Seasonal Adjustment on Electronic Computers,* OECD, 1961, pp. 248–252.

CHART 7

Weekly Seasonal Adjustment Factors, Three-Month Treasury Bills, 1950, 1955, 1960



ceptances was remarkably similar to that of Treasury bills, both in timing and amplitude. The F test indicated significance slightly higher even than for bills, though the difference was not great.

The study of commercial paper reveals some interesting properties. Seasonal highs are not in December but October, every year from 1952 to 1959; in 1960, the high moved to December. This pattern is much closer to that of long-terms than to bills. The lows on commercial paper seasonals were in March from 1953 through 1956, also similar

TABLE 5

Characteristics of Seasonal Patterns in Selected Interest Rates, 1951-60

A. Seasonal Highs and Lows
(average for year = 100)

Year	Seasonal Index High	Seasonal Index Low	Year	Seasonal Index High	Seasonal Index Low
		Three-Month Treasury Bills			
1951	Dec. 106.2	July 97.8	1956	Dec. 111.2	July 90.0
1952	Dec. 107.7	Feb. 96.7	1957	Dec. 111.4	July 88.5
1953	Dec. 108.8	June 95.2	1958	Dec. 111.9	July 88.0
1954	Dec. 110.0	June 94.1	1959	Dec. 111.7	July 87.4
1955	Dec. 110.4	July 91.9	1960	Dec. 112.0	July 87.5
		Bankers' Acceptances			
1951	Feb. 102.0	July 96.9	1956	Dec. 109.2	July 90.6
1952	Feb. 102.2	July 96.9	1957	Dec. 109.8	July 89.7
1953	Dec. 103.2	July 96.1	1958	Dec. 109.8	July 89.7
1954	Dec. 105.6	July 94.5	1959	Jan. 110.9	June 90.0
1955	Dec. 107.7	July 92.4	1960	Jan. 111.9	June 90.1
		Commercial Paper			
1951	June 102.2	Dec. 97.5	1956	Oct. 107.2	Mar. 95.8
1952	Oct. 103.1	Nov. 97.8	1957	Oct. 107.5	July 94.3
1953	Oct. 104.4	Mar. 97.2	1958	Oct. 107.4	July 93.6
1954	Oct. 105.5	Mar. 96.1	1959	Oct. 107.4	July 93.2
1955	Oct. 106.7	Mar. 95.7	1960	Dec. 107.3	July 93.2
		Corporate Bonds, Moody's Aaa			
1951	June 101.3	Feb. 98.8	1956	Sept. 102.4	Feb. 98.0
1952	June 101.3	Feb. 98.6			Mar. 98.0
1953	June 101.2	Feb. 98.6	1957	Sept. 102.4	Feb. 97.9
1954	Sept. 101.6	Mar. 98.4			Mar. 97.9
1955	Sept. 102.0	Mar. 98.2	1958	Sept. 102.0	Feb. 98.1
					Mar. 98.1
			1959	Oct. 101.5	Mar. 98.1
			1960	Dec. 101.3	Mar. 98.2
		Corporate Bonds, Moody's Baa			
1951	July 101.6	Feb. 98.5	1956	Oct. 101.5	Mar. 98.4
1952	July 101.3	Mar. 98.4	1957	Oct. 101.8	Mar. 98.4
1953	June 100.9	Mar. 98.3	1958	Oct. 102.0	Apr. 98.3
	July 100.9		1959	Oct. 101.9	Apr. 97.9
	Sept. 100.9		1960	Oct. 101.7	Apr. 97.8
1954	Sept. 101.2	Mar. 98.3			
1955	Sept. 101.2	Mar. 98.3			
	Oct. 101.2				

(continued)

TABLE 5 (concluded)

			U. S. Government Long-Term Bonds			
1951	May	101.5	Feb. 99.4	1956	Sept. 101.7	Apr. 98.8
			Aug. 99.4	1957	Sept. 102.3	Apr. 98.3
			Oct. 99.4	1958	Sept. 102.6	Apr. 98.4
1952	May	101.4	Oct. 99.3	1959	Sept. 102.5	Mar. 98.6
1953	June	101.5	Oct. 99.1	1960	Sept. 102.2	Mar. 98.1
1954	June	101.4	Mar. 99.1			
1955	Aug.	101.3	Mar. 99.0			
			State and Local Bonds, Moody's Aaa			
1951	June	104.8	Jan. 97.9	1956	Sept. 104.1	Feb. 95.9
1952	June	104.9	Feb. 98.1	1957	Sept. 105.8	Feb. 95.7
1953	June	104.9	Nov. 98.0	1958	Sept. 105.8	Feb. 96.2
1954	June	103.2	Feb. 97.7	1959	Oct. 104.9	Apr. 95.4
1955	Sept.	102.8	Feb. 96.8	1960	Oct. 104.6	Apr. 95.7

B. Relative Amplitudes and F-Ratios

	Average Monthly Rise or Fall, Original Series, in Basis Points	Ratios of Average Monthly Rise or Fall			F-Ratios[a]
		Seasonal to Original	Seasonal to Trend-Cycle	Seasonal to Irregular	
Three-month Treasury bills	8.45	.55	.93	.99	3.38
Bankers' acceptances	3.81	.61	.70	1.04	3.77
Commercial paper	3.77	.50	.65	.75	1.95
Corporate bonds, Moody's Aaa	1.47	.47	.75	.81	1.84
Corporate bonds, Moody's Baa	1.09	.53	.81	1.07	n.a.
U.S. government long-term bonds	2.00	.35	.62	.53	.88
State and local bonds, Moody's Aaa	3.10	.51	1.00	.84	2.08

[a]The .99 level is 2.41; the .95 level, 1.87.

to the pattern for corporate bonds, after which low points shifted to July, matching the behavior of Treasury bills. The amplitude of seasonals on commercial paper was usually noticeably lower than that on three-month Treasury bills. The F test showed much less statistical significance in the seasonal pattern, but even this series appears to be significant at about the 4 per cent level.

Long-Term Securities, 1951–60

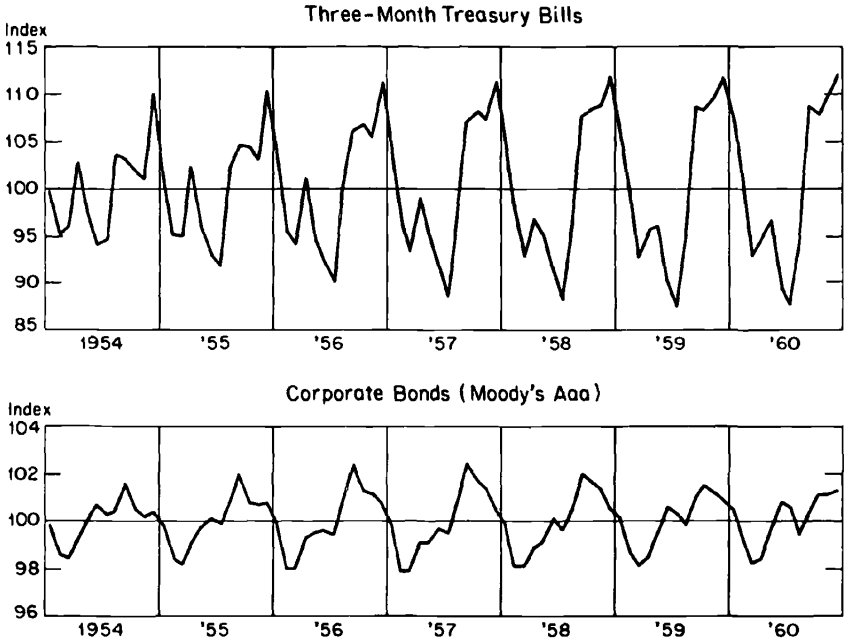
The seasonal highs of Moody's Aaa corporates were in September from 1954 through 1958, and then successively in October and December. A puzzle is presented, however, by the years 1951 through 1953, when the high was in June. The extreme cyclical tightness of 1953 cannot provide more than a limited part of the explanation since the ratio of observed data to the fifteen-month moving average showed highs in June or July every year but one from July 1949 to 1954. Chart 8 compares the 1954–60 patterns for Treasury bills and corporate bonds.[2] It will be seen that, unlike bills, bond seasonals move almost uninterruptedly and sharply from their lows in February or March to their highs in September, although the increasingly pronounced drop in July and August corresponds to the low point in bills at about the same time. After the September highs a sharp decline contrasts severely with the "leveling but still rising" movement of Treasury-bill seasonals.

The evidence of a true seasonal in highest-grade long-term corporates is weak, as indicated by low amplitude, by a fundamental change in timing over the decade, and by statistical significance that just reaches the 5 per cent level. On the other hand, Table 5 reveals that the amplitude of seasonal movements in long-term rates is nearly as large, relative to cyclical or other types of movements, as in short-term rates. It may be that the small magnitude of seasonal amplitudes reflects the tendency for all long-term rate movements to be small

[2] Note that the scale for bonds is wider than that for bills. Differences in the Treasury-bill series shown here from those in Chart 7 result from the fact that Chart 7 is based on weekly series running through 1960; whereas Chart 8 is based on monthly data running through 1964. We find that weekly series are indispensable for analysis of causation of seasonal movements, but that the monthly can serve for crude comparisons between seasonals over time or between series for different variables.

CHART 8

Seasonal Adjustment Factors, Treasury Bills and Corporate Bonds, 1954–60



NOTE: The scale for bonds is wider than that for bills. Differences in the Treasury-bill series shown here from those in Chart 7 result from the fact that Chart 7 is based on weekly series, whereas Chart 8 is based on monthly data. We find that the weekly series are indispensable for analysis of causation of seasonal movements, but the monthly can serve for crude comparisons between seasonals over time or between series for different variables.

rather than a particular failure of longs to respond to seasonal movements.

The seasonal on government long-terms is considerably less convincing even than that on highest-grade corporates, though it is in many ways quite similar. The range of seasonal movements was generally smaller than that on Aaa corporates, and the F test would deny any confidence whatever in the existence of a seasonal.

The timing of cyclical yield movements on state and local issues follows the same pattern as that on governments and highest-grade corporates. The amplitude of state and local seasonals was distinctly

higher than that on the other long-terms examined thus far, but much lower than seasonals on short-terms. At about the 3 per cent level, the F test supports the hypothesis that there is a seasonal on these securities.

Among the other long-term securities tested, perhaps the most interesting evidence pertains to corporate Baa securities. Despite a very small amplitude of seasonal movement, the existence of a seasonal is supported by the F test. The timing of the pattern was similar but not identical to that of Aaa corporates.

Seasonal Movements Since 1960

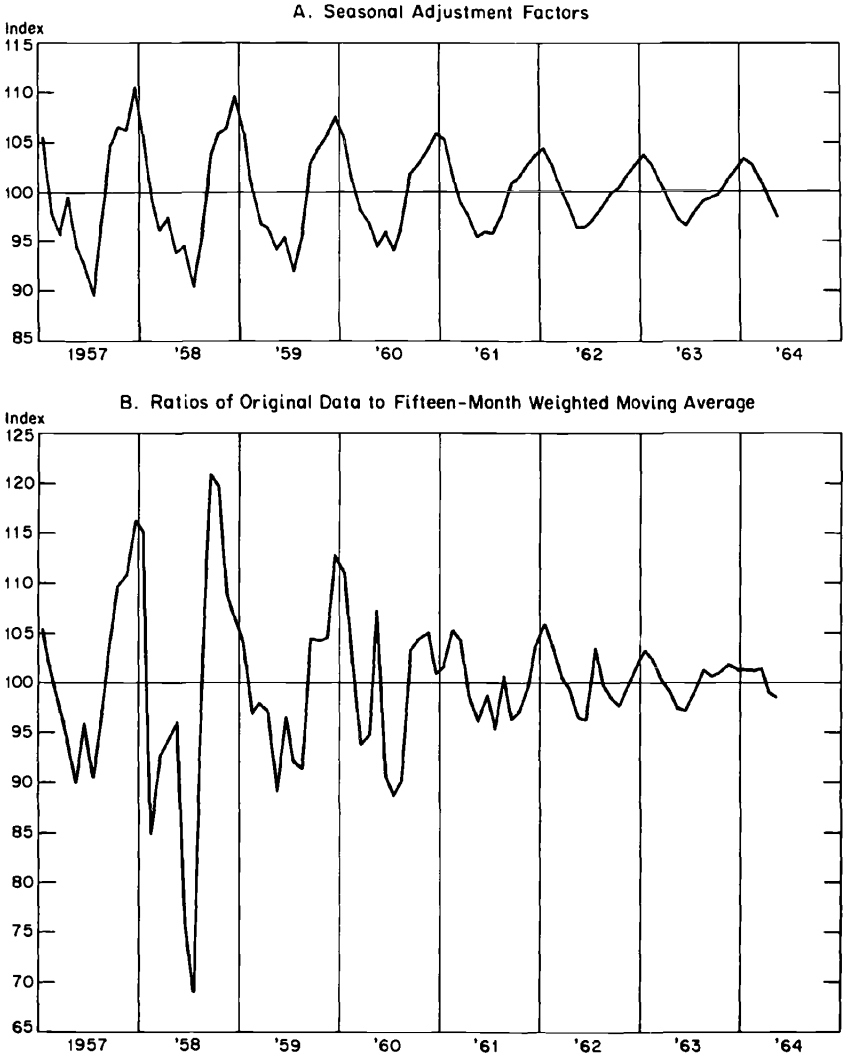
Beginning modestly in 1960 but becoming much more noticeable in 1961 and 1962, there has been a sharp diminution in or even elimination of the seasonal movements of interest rates. The change is most clearly seen in the behavior of bill rates, since they revealed the sharpest seasonals in the preceding period, but bankers' acceptances appear to experience an almost identical change. The former seasonal in Aaa long-terms appears to be modified in timing and substantially reduced in amplitude.

As Shiskin has emphasized, his final adjustment pattern is inappropriate in such cases as this, where sharp changes in seasonal patterns occur. The reason is that the averaging process gives the seasonal patterns implied for each year a significant imprint from seasonal movements occurring back to five years before. Yet the steady and marked decline in seasonals can be seen even by his measure, as shown in panel A of Chart 9.

In a late stage of Shiskin's seasonal adjustment process he presents a series showing the ratio of observed rates to a weighted fifteen-month moving average of the rates. This series represents a highly sophisticated seasonal pattern that does not include the type of averaging that blurs one year's seasonal with that of neighboring years. It is possible with this series, plotted in panel B of Chart 9, to observe the nature and timing of seasonal changes after 1959. Clearly there was a sharp diminution in amplitude from 1959 to 1960 and 1961, after which further diminution continued in a smaller degree. In addition to this, the nature of the movements within the year became somewhat more erratic. Indeed, the variation among the occasional mid-year highs is

CHART 9

Seasonal Adjustment Factors and Ratios to Moving Averages, Three-Month Treasury Bills, 1957–64



such that, if we take an average seasonal pattern for the period 1961–63, the seasonal pattern would appear to be almost though not wholly eliminated. The resulting pattern for these three years is almost identical with that shown in panel B, Chart 10 (discussed below).

In view of the erraticism of the post-1960 behavior it would seem to me premature to dogmatize about the "true" seasonal behavior during this period; each observer may judge for himself on the evidence presented. In panel A, Chart 10, we show the actual bill rates over the years 1957 through 1963. The imprint of a U-shaped seasonal can be readily seen through mid-1960, distorted though it is by cyclical and other forces, but there is virtually no subsequent evidence of it. In 1961 and 1963 the right arm may persist, but that is about all.

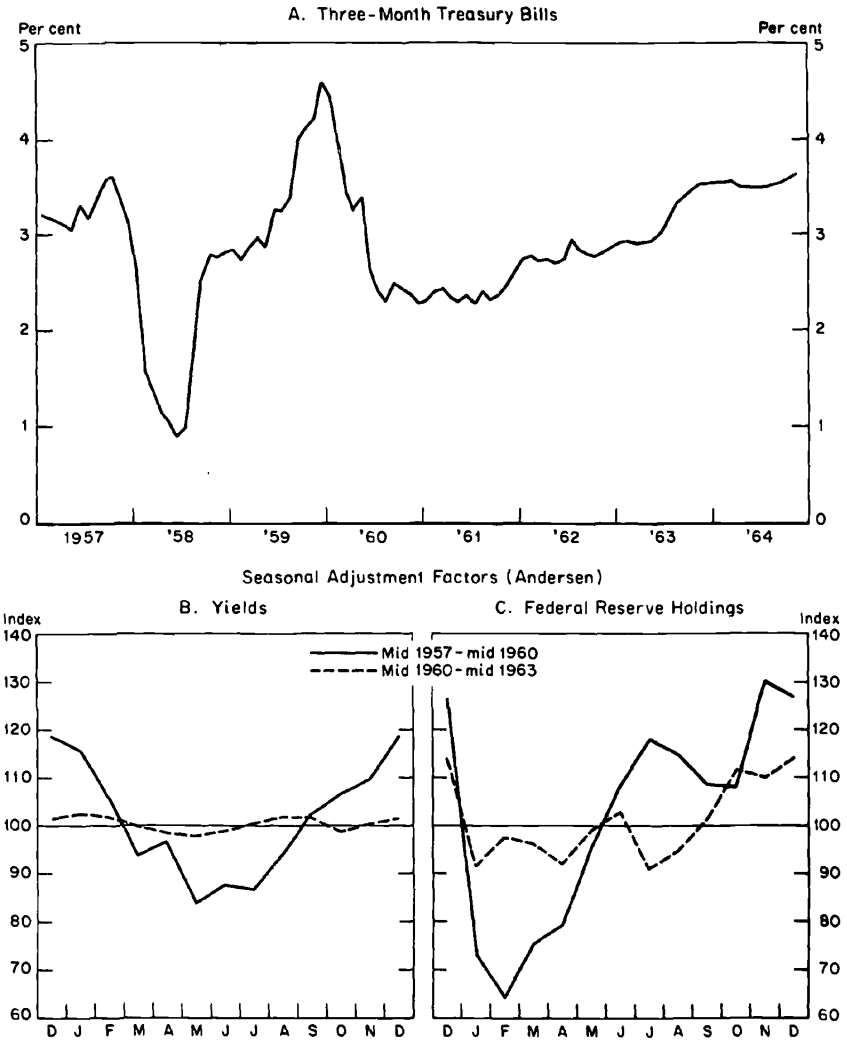
Leonall Andersen at the Federal Reserve Bank of St. Louis has explored the same questions discussed here. In that bank's monthly *Review* for April 1964, he compares seasonals (derived by the link-relative method) for the period mid-1960 to mid-1963 with seasonals similarly derived for mid-1957 to mid-1960. Panels B and C, Chart 10, are copied directly from his figures. His results on the changes in the seasonal behavior of Treasury bills are clearly consistent with our own findings.

Reasons for this change are not hard to find. They are revealed by examination of the causes of pre-1960 seasonals and the subsequent behavior of these causal factors. The December high appears to reflect in part regular tightening of the money market that pre-Christmas business brings—or rather, that part of it which is not wholly erased by Federal Reserve actions to supply funds toward year's end and to reabsorb them immediately after Christmas. Chart 7 clearly shows this rise in rates from mid-November or earlier until late December; although the curves are not identical, a similar movement is observed throughout the entire decade.

In addition to underlying forces such as this one that reflect seasonal needs for funds to finance industry and commerce, the statistical evidence indicates the impact of Treasury finance. As Chart 7 shows, the seasonal on bills during the fifties fell to a low in late March, rose briefly, and continued falling until June or July. Similarly, it rose sharply in August and continued upward to December. Corresponding to this is the fact that from 1951 through 1960 the Treasury borrowed net during the second half of every year (presumably pushing up rates) and repurchased securities net the first half of every year but two

CHART 10

Actual Yields and Seasonal Factors, 1957–64



(reducing rates). Especially toward the end of the decade, this annual imbalance in Treasury finance is reflected in a wide annual fluctuation in the volume of bills outstanding. In 1960, for example, this figure dropped from $41.2 billion at the end of January to $33.4 billion at the end of June, and then rose to $39.4 billion by the end of December. Following 1960, however, the pattern was much flatter. In 1961 the outstanding volume fell only from $39.7 billion to $36.7 billion, and then rose to $43.4 billion. In 1962 the amounts in billions were 43.9, 42.0, and 48.2; in 1963 they were 48.9, 47.2, and 51.5. The substantial increase of bills which the Treasury supplied the market during these four years was carried out by preventing the former decline in supply from January to midyear while maintaining a fairly substantial increase during the last half of the year.

This behavior of the Treasury with respect to bills was not compensated for by opposite changes in other instruments. Net repayments to the public during the first six months of the year fell from $5.7 billion in 1960 to $2.4 billion in 1961, and were replaced by net borrowing in 1962 amounting to $0.4 billion. In 1963 net repayments appeared again, but only in the amount of $0.6 billion. Borrowing in the second half continued in amount similar to those of earlier years.

These changes in the federal pattern of borrowing and repayment are not wholly explained by an underlying change in federal receipts and expenditures on nonborrowing accounts. In these categories the excess of receipts over expenditures in the first half of the year was, to be sure, sharply reduced as compared with earlier years, but it still ranged between $2.5 and $5 billion, a substantial sum. What all this means is that the Treasury permitted its cash balances to rise and fall more in line with its pattern of nonborrowed receipts and expenditures, stabilizing the annual supply of securities to the market instead of stabilizing its cash position. One reason was presumably the recognition that a convenient way to raise short-term rates in the face of balance-of-payments deficits was to borrow funds ahead of actual need, raising rates during the period of seasonal low. Although, to finance continuing deficits, borrowing continued to take place in the second half of the year, this could be much smaller than would have been required if repayment of debt during the first six months had been continued.

There is evidence that Federal Reserve behavior, like that of the

Treasury, played a part in the extinction, or at least reduction, of bill-rate seasonals. The wide variety of influences determining Federal Reserve actions makes the analysis too complex for brief treatment, but two facts are significant. One is brought out by Andersen in his review of the actions of the Federal Open Market Committee following March 3, 1959, as reported in the *Annual Report* of the Board of Governors. On that date the policy of the major part of the fifties was repeated, namely, to support no pattern of yields in the government securities market. By September 13, 1960, a hint of policies to limit seasonal strains was given. In succeeding meetings this shift in attitude was continued, with emphasis especially on reducing seasonal downward pressures on short-term rates. Andersen's comparison of seasonal movements before and after mid-1960 is applied to a variety of monetary variables, but the most pronounced change in seasonal behavior relates to bill holdings by the Federal Reserve, where a pattern that partly supported the seasonal movements of yields during the late fifties was replaced by a near-horizontal curve that looks much like that for bill rates (panels B and C, Chart 10). This is consistent with a second fact, brought out by Brown's analysis. He examined the movement of bills in the hands of the public, where the action of the Federal Reserve and that of the Treasury Trust Accounts is added to that of the Treasury alone, as reviewed above. The pattern of these half-yearly changes indicates that the effects of Treasury actions were fully reflected in the volume of bills publicly held.

Summary and Implications

To review briefly, short-term rates showed clear and convincing evidence of a seasonal pattern from 1951 through 1960, though both the causes and the seasonals themselves have largely faded since that time. While these seasonals existed, their amplitude was substantial, running from about 90 per cent to 110 per cent of their average for the year. Their timing was quite consistent over the decade, and among the three series studied (Treasury bills, bankers' acceptances, and commercial paper) highs were in December and lows in June or July.

In partial contrast to this record, long-terms revealed less convincing evidence of a clear seasonal. Their seasonal amplitude was much lower than in the case of shorts, and what seasonal did appear shifted

over time. The major character of this shift may be described as follows: during the early part of the decade their high periods are in or near June, after which these shift to September. Low points are quite consistently in February or March. Except for the Baa's the F tests indicate seasonality at a lower level of significance than for the shorts.

These summary comments on the general nature of seasonal patterns in various types of securities probably suggest considerably more regularity than is justified by the facts. This is partly due to the powerful smoothing process of the Shiskin method, whereby the pattern in the seasonal factors each year tends to be similar to the one before and the one after. Moreover, because when we speak only of highs and lows, we do not reveal the diversity of shapes between these points. Even after giving full weight to these considerations, we felt no hesitation about recommending an adjustment for seasonals on the short-term series during the 1950's and 1960. Our question concerned only long-terms. Despite some misgivings in this area, however, we decided that all series should be adjusted for that period. We were led to this conclusion partly by the great similarity in patterns of apparent seasonals on different long-term series, together with acceptable results of F tests on all but one. Furthermore, it seemed at least as reasonable to do this as to draw lines somewhere down the middle, adjusting some and not others. Since 1960, in contrast to the preceding decade, the Treasury and the monetary authorities have been motivated to eliminate, partly or wholly, the seasonal movement in interest rates. In this they have largely succeeded, and the case for any seasonal adjustment of interest rates during this period is far from clear.

A few suggestions may be ventured concerning the implications of this study for an understanding of the determinants of interest rates. When one obtains the detailed view of seasonal behavior that is afforded by weekly seasonals, it clearly appears that during the decade of the fifties the timing of seasonals on longs and shorts moved closer and closer together. It seems that the capital market was becoming ever more perfect in the sense that substitution across the maturity range continually reduced seasonal disparities in timing between the series. Yet the distinction between longs and shorts was by no means obliterated. The patterns of bills and acceptances are much more similar to one another than to longs. The pattern for commercial

papers has been somewhere between that for other shorts and longs, though shifting closer to bills during the latter part of the decade. It may be of interest to note that Cagan's cyclical study leads to a parallel observation: throughout the longer period of his observations, there was a steady diminution of disparities between the timing of different interest rate series.

A question of great theoretical and practical interest is how far and how long can the monetary authorities shape interest rates? We are reminded of the classical view that changes in the supply of money can, in the long run, influence price levels but not interest rates.[3] This contrasts sharply with the more modern emphasis on a short-run world in which interest rates are believed to be subject to effective control through monetary action. A seasonal analysis cannot take us far toward the solution of a problem such as this, but it is significant to note the strong evidence that interest rates can be greatly changed by altering the supply of Treasury securities in the hands of the public. An increase averaging somewhere around $6 billion during a half-year in the supply of bills to the market appears to have been a major factor in eliminating a seasonal drop in bill rates amounting to something in the neighborhood of 15 to 25 per cent of their peak levels.

It should be recognized that the preceding statement is a great over-simplification, for there were always hosts of influencing factors acting and reacting upon each other. Furthermore, it should be recognized that the unequal flow of bills to and from the market which we have here associated with the seasonal movement in the late fifties was not present during the first half of the decade, though the seasonal in the bill rate was. This observation suggests another implication of the way in which markets are tied together. In the earlier period, though the supply of bills in the hands of the public did not vary greatly on a seasonal basis, it was still true that government net borrowing followed a similar pattern to that reflected by bill supply in the late fifties: repayment of debt in the spring and borrowing in the fall.

The disappearance, or near so, of seasonals since 1960 has been shown to support the explanations provided here for the seasonal rate behavior of interest rates.

[3] See, for example, David Ricardo, *Principles of Political Economy and Taxation*, Everyman's Library ed., New York, 1948, p. 246.