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YIELDS ON PUBLIC UTILITIES

Public utilities differ in one primary respect from industrial companies: nearly all of them dispense first-order necessities, enjoy legal monopolies, and are subject much less than industrial companies to the changes in fortune brought about by the development of new products. In brief, public utilities are more stable than industrial companies and in general are so regarded by lenders.

For this reason lenders tend to be much more lenient with utilities than with industrial companies. They require typically that only 2 to 5 per cent of any given loan be amortized over its life—the expectation being that, at maturity, the outstanding balance will be refinanced.[1]

As a result, the average term of the typical utility tends to be much longer, relative to maturity, than the average term of the typical industrial loan. This, in turn, means that the typical utility will need less cash than an industrial company to make the required payments on a loan of any given size. For this reason, lenders generally do not require nearly as much coverage for a loan to a utility as for a loan to an industrial company.

In general the procedures used in this chapter are the same as those used in Chapter 3 for industrials. First, the variables checked in column 2 of Table 13 were tested to obtain the relevant variables. These are given in Table 33 together with their regression coefficients and the percentage impact of each on yield.

The most important variables, as Table 33 indicates, were X_{4r}, X_2, X_3, and X_{12}. In order to maintain conformity with the cross-

[1] Gas transmission companies, which have been classified here as utilities, are an exception to this generalization.

TABLE 33

Public Utilities: Significant Variables, Their Regression Coefficients and Percentage Impact on Yield

Variable	Regression Coefficient	Percentage Impact on Yield
X_2	-.0675	12
X_3	-.1355	5
X_{4r}	+.0830	15
X_5	+.0132	1
X_6	-.0105	1
X_7	+.0033	1
X_8	-.0099	1
X_{12}	-.0237	4
X_{13}	+.0644	2
X_{15}	-.0253	1

classified series on industrials, X_4 in its original form (coverage) and X_2 were used to construct the cross-classified series for utilities. A trade-off was found between these two variables, class intervals were established, and the original observations cross classified accordingly (Table 46 and Chart 14).

Mean values for each variable were obtained, as for industrials, and yields *computed* for each class quarterly (Table 47). The final computed series themselves are given in Table 46 and in Chart 14. The computed series are compared with their cross-classified counterparts in Chart 15.

A composite series was then computed, analogous to the computed composite series for industrials (Table 48). It is compared with yields on FHA mortgages and long-term governments in Chart 16.

Finally, both cross-classified and computed series were constructed for electric and telephone companies and for water and gas distribution companies. These series are given in Table 50 and in Chart 18.

Variables and Form of Function

The variables used to analyze utility issues are identical to those used to analyze industrial issues with one exception—the ratio of working capital to long-term debt (X_{14}). This ratio is not considered to be of any importance by many lenders and data on it were therefore often not available. The same initial form of function was used to analyze utility issues as was used to analyze industrial issues.[2]

THE SIMPLE CORRELATIONS

Table 34 provides, in matrix form, weighted average simple correlation coefficients, Y on each X, and each X on each other X. This table indicates, for example, that the weighted average correlation of Y with X_2 over the whole period was −.39. The number 2 immediately below this figure indicates 2 plus signs. Correspondingly, the correlation of Y with X_3 was −.51 and with X_4, −.30 and so forth. The correlation of X_2 with X_3 was +.17, and so forth.

Table 35 arrays the simple correlations of Y on each X in decreasing order of size. On the whole, the simple correlations are not quite as high for utilities as they were for industrials (see Table 17). But it is perhaps worth noting that the first eight variables listed in Table 35 are identical to the first eight listed in Table 17, although they do not appear in the same order in both tables.

Tables 36 and 37 give the simple correlation coefficients by major groups: size, duration, security, variability, profitability, and growth. The size variables are all highly intercorrelated and each is moderately correlated with average term and maturity.[3] The two

[2] See above, Ch. 3.
[3] Although less so than in the case of industrials.

TABLE 34

Public Utilities: Weighted Average Correlation Coefficients, Y on Each X and Each X on Each Other X, 1951–61

	Y	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}
Y	1.00																	
X_2	-.39 (2)	1.00																
X_3	-.51 (0)	+.17 (16)	1.00															
X_4	-.30 (2)	+.18 (18)	+.10 (17)	1.00														
X_5	+.20 (19)	+.14 (18)	-.33 (0)	+.07 (16)	1.00													
X_6	+.22 (20)	+.02 (10)	-.56 (0)	-.20 (4)	+.14 (15)	1.00												
X_7	+.13 (17)	-.05 (9)	+.01 (13)	-.08 (10)	+.01 (11)	-.02 (8)	1.00											
X_8	-.38 (2)	+.90 (22)	+.19 (17)	+.08 (15)	+.14 (17)	+.06 (14)	-.03 (10)	1.00										
X_9	-.11 (8)	-.04 (12)	+.08 (14)	+.27 (20)	+.05 (10)	+.05 (11)	-.02 (13)	-.02 (12)	1.00									
X_{10}	-.05 (9)	+.10 (14)	+.03 (13)	+.13 (17)	+.01 (12)	+.14 (16)	-.04 (7)	+.10 (15)	+.87 (22)	1.00								
X_{11}	+.20 (17)	-.27 (0)	-.19 (3)	-.31 (0)	-.02 (10)	+.15 (19)	-.06 (13)	-.19 (2)	-.25 (3)	-.18 (6)	1.00							
X_{12}	-.41 (2)	+.97 (22)	+.15 (17)	+.37 (20)	+.16 (18)	-.01 (10)	-.07 (8)	+.87 (22)	+.10 (13)	+.14 (15)	-.33 (0)	1.00						
X_{13}	-.43 (2)	+.17 (17)	+.87 (22)	+.11 (17)	-.31 (0)	-.50 (0)	.00 (12)	+.20 (18)	+.05 (12)	+.01 (13)	-.14 (3)	+.17 (16)	1.00					
X_{15}	+.17 (18)	+.06 (11)	-.09 (7)	-.57 (0)	+.07 (8)	+.22 (17)	-.02 (9)	+.11 (17)	-.04 (7)	+.08 (14)	+.02 (10)	-.01 (9)	-.07 (7)	1.00				
X_{16}	-.42 (2)	+.91 (22)	+.29 (20)	+.09 (16)	+.10 (17)	.00 (11)	-.03 (10)	+.99 (22)	+.03 (12)	+.10 (15)	-.20 (2)	+.86 (22)	+.25 (18)	+.09 (14)	1.00			
X_{17}	+.21 (18)	-.25 (1)	-.17 (3)	-.34 (2)	-.05 (9)	+.17 (19)	+.06 (13)	-.18 (3)	-.23 (2)	-.11 (8)	+.81 (22)	-.32 (1)	-.13 (4)	+.04 (14)	-.20 (3)	1.00		
X_{18}	-.26 (3)	+.18 (17)	+.35 (21)	+.24 (19)	-.09 (10)	-.14 (6)	.00 (8)	+.12 (16)	+.25 (16)	+.24 (14)	-.41 (0)	+.23 (17)	+.29 (21)	.00 (10)	+.16 (16)	-.34 (0)	1.00	
X_{19}	-.35 (4)	+.96 (22)	+.06 (16)	+.33 (21)	+.18 (18)	+.04 (13)	-.06 (7)	+.86 (22)	+.07 (14)	+.10 (14)	-.24 (0)	+.97 (22)	+.01 (14)	-.01 (10)	+.84 (21)	-.20 (1)	-.01 (10)	1.00

Note: Numbers in parentheses refer to number of positive relationships between the pairs of variables.

TABLE 35

Public Utilities: Weighted Average Correlation of Yield with Each Independent Variable, and Number of Plus Signs, 1951–61

Variable[a]	Correlation with Yield	Number of Plus Signs
X_3	-.51	0
X_{13}	-.43	2
X_{15}	-.42	2
X_{12}	-.41	2
X_2	-.39	2
X_8	-.38	2
X_{18}	-.35	4
X_4	-.30	2
X_{17}	-.26	3
X_6	+.22	20
X_{16}	+.21	18
X_{11}	+.20	17
X_5	+.20	19
X_{15}	+.17	18
X_7	+.13	17
X_9	-.11	8
X_{10}	-.05	9

[a]Quarter of year (X_1) not included.

last variables are highly intercorrelated. Two of the security variables (X_4 and Y_{14}) are moderately intercorrelated. The third, X_5, is virtually uncorrelated with the other two. The variability variables are highly intercorrelated, as are the growth variables; the two profitability variables are only moderately so.

TABLE 36

Public Utilities: Weighted Average Correlations Among Various Size and Duration Variables, 1951–61

		Size Variables					Duration Variables	
	Y	X_2	X_8	X_{12}	X_{15}	X_{18}	X_3	X_{13}
Y	1.00							
X_2	-.39	1.00						
X_8	-.38	+.90	1.00					
X_{12}	-.41	+.97	+.87	1.00				
X_{16}	-.42	+.91	+.99	+.86	1.00			
X_{19}	-.35	+.96	+.86	+.97	+.84	1.00		
X_3	-.51	+.17	+.19	+.15	+.29	+.06	1.00	
X_{13}	-.43	+.17	+.20	+.17	+.25	+.01	+.87	1.00

TABLE 37

Public Utilities: Weighted Average Correlations Within Various Classes of Independent Variables, 1951–61

Financial Security

	Y	X_4	X_5	X_{14}
X_4	-.30	1.00		
X_5	+.20	+.07	1.00	
X_{15}	+.17	-.57	+.07	1.00

Variability

	Y	X_{11}	X_{16}
X_{11}	+.20	1.00	
X_{17}	+.21	+.81	1.00

Profitability

	Y	X_{12}	X_{17}
X_{12}	-.41	1.00	
X_{18}	-.26	+.23	1.00

Growth

	Y	X_9	X_{10}
X_9	-.11	1.00	
X_{10}	-.05	+.87	1.00

TABLE 38

Public Utilities: Twenty-Two Regressions, Yield on Eighteen Variables, R^2, F, Probability of F, Degrees of Freedom, Semiannually, 1951–61

	R^2	F	$P_{F \leqq}$	Degrees of Freedom
1951				
1	.925	3.1	a	4
2	.835	3.9	.01	14
1952				
1	.806	1.8	a	7
2	.584	0.9	a	12
1953				
1	.839	2.0	a	7
2	.449	0.8	a	18
1954				
1	.895	6.2	.01	13
2	.903	9.3	.01	18
1955				
1	.832	5.2	.01	19
2	.803	3.2	.05	14
1956				
1	.912	3.4	a	6
2	.766	3.4	a	19
1957				
1	.805	5.1	.01	22
2	.828	7.3	.01	27
1958				
1	.650	2.6	.05	25
2	.591	1.8	a	22
1959				
1	.753	2.7	.05	16
2	.949	2.1	a	2
1960				
1	.850	7.9	.01	25
2	.964	7.5	.05	5
1961				
1	.832	8.00	.01	29
2	.980	3.1	a	1

[a]P_F greater than .05.

TABLE 39

Public Utilities: Significance of Each Variable, $X_2 - X_{19}$, When that Variable Was Introduced into Regression, Semiannually, 1951–61

	$^tX_2$	$^tX_3$	$^tX_4$	$^tX_5$	$^tX_6$	$^tX_7$	$^tX_8$	$^tX_9$	$^tX_{10}$
1951									
1	-1.44	-1.42	+0.35	-0.77	-0.95	-0.70	+0.21	+0.60	+1.12
2	-3.57	-3.96	-0.89	+2.06	-2.51	+0.51	-0.47	+1.02	-0.02
1952									
1	-2.17	-2.55	-1.56	-0.21	-1.08	-0.60	+0.52	-0.36	+0.61
2	+0.88	-0.23	+1.01	+0.92	+1.69	+1.39	+1.35	+1.09	-0.67
1953									
1	-0.41	-4.81	-0.19	+2.07	+1.47	+3.11	+0.36	+0.51	-0.12
2	+1.06	-2.04	-2.20	-0.29	-0.14	+0.64	+0.07	+0.07	+0.13
1954									
1	-3.30	-2.92	-2.29	-1.44	-1.48	+0.16	+3.33	-1.07	-2.07
2	-5.61	-2.00	-1.53	+3.30	+2.01	-0.42	-0.12	-1.99	+1.31
1955									
1	-1.57	-7.67	-2.77	-0.21	-0.61	-0.27	-1.31	-0.93	-0.97
2	-4.72	-3.76	-1.47	-0.70	-0.07	+0.88	+0.42	+0.57	-0.16
1956									
1	-1.41	-2.86	-1.68	+2.18	-0.47	+1.51	+0.98	+0.28	+1.49
2	-3.64	-5.16	-1.37	-0.39	-0.98	+0.42	+0.81	-0.10	-0.71
1957									
1	-0.77	-7.25	+0.91	+2.15	-3.40	+1.61	-1.16	+0.94	-0.03
2	-4.88	-3.29	-2.50	-0.59	-2.02	+1.79	-3.33	+1.00	-1.08
1958									
1	-0.98	-4.60	-3.14	+0.67	-1.36	+0.61	-2.40	+0.13	+1.28
2	-1.63	-2.70	-1.83	+0.00	-1.24	+0.36	-1.28	-0.69	+0.34
1959									
1	-4.23	-1.54	-2.38	+0.82	+1.03	-1.39	-3.22	+0.01	+0.40
2	-2.60	-3.03	-0.92	+1.27	-1.16	+1.62	-0.63	+0.68	-1.62
1960									
1	-3.93	-3.67	-2.99	+3.25	-1.29	-1.25	-1.13	-0.95	+1.44
2	-5.35	-2.95	-1.24	+1.99	-0.95	+2.00	+0.58	+0.96	+1.70
1961									
1	-3.93	-4.34	-1.86	+1.47	-0.26	+0.59	-3.70	+2.09	+2.07
2	-4.31	-0.88	-2.43	+1.28	-1.94	-0.65	-0.97	-1.96	+0.20
$\bar{t}$	-2.66	-3.35	-1.50	+0.86	-0.71	-0.54	-0.55	-0.01	+0.21

(continued)

TABLE 39 (concluded)

	$^tX_{11}$	$^tX_{12}$	$^tX_{13}$	$^tX_{15}$	$^tX_{16}$	$^tX_{17}$	$^tX_{18}$	$^tX_{19}$
1951								
1	+0.15	+0.36	+2.81	+0.47	-0.43	+2.80	--	--
2	-2.07	+1.24	+1.74	-0.74	+0.19	+0.33	+1.24	+0.38
1952								
1	+0.17	+2.16	+1.08	-1.02	-1.44	+0.06	--	--
2	-1.34	+0.79	+0.72	+1.07	+0.25	+0.31	+1.09	-0.54
1953								
1	-0.48	+1.23	-0.06	-0.54	-1.13	+0.44	-0.25	-0.49
2	-0.45	-0.58	+1.67	+0.21	-0.58	+0.55	+0.88	+0.05
1954								
1	-0.35	+1.17	+1.95	-1.32	-1.09	-1.61	+1.12	-0.06
2	+1.17	+1.14	+3.45	-2.54	+0.91	- .13	+0.56	+0.46
1955								
1	+1.01	+0.84	-0.53	-1.69	+0.59	-1.12	-1.40	+0.84
2	+0.89	+1.69	-0.66	-1.48	+0.85	-0.14	-0.03	+1.51
1956								
1	-1.21	+0.47	+0.22	-1.24	-0.97	-1.83	-1.54	+1.35
2	-0.27	+0.61	+0.55	-0.48	-0.41	+0.91	-0.20	+0.43
1957								
1	-1.51	+0.68	+0.28	+0.59	+0.58	+0.25	-0.54	+0.19
2	+0.20	+1.92	-1.24	+1.33	-2.14	+0.29	-0.94	+0.40
1958								
1	+0.32	-0.92	+0.47	+0.31	-0.29	+0.55	+0.71	+0.43
2	-0.52	+0.73	-1.85	-2.29	+0.82	+0.98	+0.12	+0.80
1959								
1	-0.72	-0.32	+1.39	+0.62	-0.21	-0.27	-0.70	-0.63
2	-0.40	-0.09	+0.17	-0.68	-0.56	+1.67	-0.22	-1.25
1960								
1	-1.83	+2.14	-0.04	+2.68	+0.76	-0.49	-1.64	-0.80
2	-0.00	+0.12	-3.91	+0.03	+0.56	+0.50	-0.95	-0.82
1961								
1	-0.11	-0.37	+0.56	+3.61	-0.38	+1.06	-0.70	+1.41
2	+0.37	-0.02	+2.40	-1.09	-0.95	-0.18	--	--
$\bar{t}$	-0.32	+0.68	+0.51	-0.20	-0.23	+0.22	-0.18	+0.28

See note a, Table 21.

THE STEPWISE REGRESSIONS

Next, twenty-two stepwise regressions were run, one for each of the twenty-two half years in 1951–61. As indicated above, the form of function used was identical to that used for industrials. Table 38 gives results, for the final equation, for each of these twenty-two cross sections: R^2, F, probability of F, and degrees of freedom. On the whole, the results are satisfactory, i.e., in most cross sections, the hypothesis used explains a large percentage of the variation in yield. In six cross sections R^2 is greater than .90; in sixteen, greater than .80.[4]

The Significant Variables

As in Chapter 3, the first step was to determine which variables show statistical significance when entered into the regression. For this purpose, the same three tests were used as for industrials: a $\bar{t}$ test, a sign test, and a distribution of 't's' test. If any variable showed significance by any one of these three tests, it was presumed to be significant when entered into the regression.[5]

Tables 39, 40, and 41 respond to the question of "significance when entered." Tables 39 and 40 suggest three conclusions.

1. Of the eighteen variables, only two (X_2 and X_8) show consistently high t's over the twenty-two cross sections.

2. Two additional variables, X_4 and X_5, show distributions which are markedly skewed in one direction or the other. Eight of the twenty-two t's for X_4 (36.4 per cent) are equal to or less than -2.00, and six of the twenty-two t's for X_5 (27.3 per cent) are equal to or greater than $+2.00$. One variable, X_{15}, shows 18.2 per cent of the t's in the tails—albeit equally divided between both.

[4] In most of the twenty-two cross sections, F would have been materially increased and R^2 not materially reduced had the last eight or ten variables not been used.

[5] For the purpose at hand, conservative procedure requires that mistakes, if any, should be in the direction of classifying "uncertain" variables as being significant.

TABLE 40

Public Utilities: $\bar{t}$'s and Distribution of t's, When Entered, Partial Regression Coefficients on $X_2 - X_{19}$

Coefficient	$\bar{t}$	Per Cent $\overline{\overline{<}}$-2.00	Per Cent $\overline{\overline{>}}$+2.00
b_2	-2.66	59.1	--
b_3	-3.35	77.3	--
b_4	-1.50	36.4	--
b_5	-0.86	--	27.3
b_6	-0.71	13.6	4.5
b_7	-0.54	--	9.1
b_8	-0.55	18.2	4.5
b_9	-0.01	--	4.5
b_{10}	+0.21	4.5	4.5
b_{11}	-0.32	4.5	--
b_{12}	+0.68	--	9.1
b_{13}	+0.51	4.5	13.6
b_{15}	-0.20	9.1	9.1
b_{16}	-0.23	4.5	--
b_{17}	+0.22	--	4.5
b_{18}	-0.18	--	--
b_{19}	+0.28	--	--

3. One other variable, X_8, shows skewness but not as much as the others: four of the twenty-two t's (18.2 per cent) are equal to or less than -2.00.

Table 41 gives the results of the sign test on each variable when that variable was entered into the regression. It shows, for example, that the sign of the coefficient on X_2 was positive twice and negative twenty times in twenty-two regressions, and that the sign of the coefficient on X_3 was negative twenty-two times. By this test, two

TABLE 41

Public Utilities: Number of Plus and Minus Signs Obtained on Partial Regression Coefficients and Binomial Probability of Obtaining at Least Larger Number if Actual Probability is .50

Coefficient	No. of Plus Signs	No. of Minus Signs	$P_B \gtreqless$
b_2	2	20	.000
b_3	0	22	.000
b_4	3	19	.000
b_5	14	8	.143
b_6	4	18	.002
b_7	15	7	.067
b_8	10	12	.416
b_9	13	9	.262
b_{10}	12	10	.416
b_{11}	8	14	.143
b_{12}	16	6	.026
b_{13}	15	7	.067
b_{15}	9	13	.262
b_{16}	9	13	.262
b_{17}	13	9	.262
b_{18}[a]	7	12	.180
b_{19}[a]	13	6	.084

[a]Insufficient degrees of freedom in three cross sections.

additional variables are presumed to be clearly significant (X_6 and X_{12}) and two marginally so (X_7 and X_{13}).

Trends were then fitted to those coefficients which had not otherwise shown significance (b_9, b_{10}, b_{11}, b_{16}, b_{17}, b_{18}, b_{19}), and also to b_{15}, which had behaved, when entered, in a somewhat ambiguous way. None of these coefficients showed trend, except b_{15} which showed strong trend ($P < .01$). Thus, we may presume that, in the absence of trend, X_{15} would probably have shown significance by the sign test or by the distribution of t's test, or both.[6]

Last, each of the seven variables which had shown no significance when entered, was examined in the light of subsequent variables. None showed significance as variables were added.

RERUN ON SIGNIFICANT VARIABLES

In order to determine whether all ten variables were independently significant, the regressions were rerun, semiannually,[7] with X_4 redefined (as for industrials). Quarter of year was added as a dummy variable in order to hold constant within each half year some of the effects of time. Table 42 gives R^2, F, and degrees of freedom for each of these twenty-two regressions. As we would expect, R^2 has been reduced (see Table 38). The size of the cross section has not been narrowed (as it was when industrials were rerun) but seven variables have been eliminated. On the other hand, 70 per cent or more of the variation in yield is being explained in sixteen of the twenty-two cross sections, and the statistical significance of the results has materially increased. Sixteen of the twenty-two F's are now significant at .01 or better, whereas only eight were significant when the regressions were run on eighteen variables.

The presumption is that had it been possible to narrow the cross section to three months, R^2 would not have been materially reduced and might, indeed, have been increased. This presumption was tested by running regressions for those quarters in which degrees of freedom $\geqq 10$. This test produced R^2 as follows: (1) third and fourth quarters of 1956 equaled .733 and .891, respectively, compared with .766 for the second half of 1956 with eighteen variables included; (2) first and second quarters of 1957 equaled .878 and .929, respectively, compared with .805 for the first half of 1957 with eighteen variables included; (3) first and second quarters of

[6] In any event, a coefficient cannot show trend unless it exists!

[7] They could not be rerun quarterly because not enough observations were available in some quarters.

TABLE 42

Public Utilities: Twenty-Two Regressions, Yield on Eleven Variables, R^2, F, Probability of F, Degrees of Freedom, Semiannually, 1951–61

	R^2	F	$P_{F \gtreqless}$	Degrees of Freedom
1951				
1	.672	1.7	a	11
2	.745	5.6	.01	21
1952				
1	.664	2.2	a	14
2	.445	1.4	a	19
1953				
1	.797	5.0	.01	14
2	.384	1.4	a	25
1954				
1	.783	6.5	.01	20
2	.841	12.0	.01	25
1955				
1	.766	7.7	.01	26
2	.706	4.6	.01	21
1956				
1	.663	2.3	a	13
2	.750	7.1	.01	26
1957				
1	.789	9.9	.01	29
2	.781	10.7	.01	34
1958				
1	.623	4.8	.01	32
2	.549	3.2	.05	29
1959				
1	.733	5.7	.01	23
2	.767	2.7	a	9
1960				
1	.814	12.7	.01	32
2	.941	17.3	.01	12
1961				
1	.799	13.0	.01	36
2	.941	8.6	.01	8

[a]P_F is greater than .05.

1958 equaled .710 and .650, respectively, compared with .650 for the first half of 1958 with eighteen variables included; (4) first and second quarters of 1961 equaled .916 and .915, respectively, compared with .832 for the first half of 1961 with eighteen variables included. These four comparisons were the only ones which could be made, but they provided some evidence that R^2 would have been very high had it been possible to narrow the cross section from six to three months.

Table 43 assesses the performance of each significant variable in the reruns. By the distribution of "t's" test (columns 1 and 2 of Table 43), all ten coefficients show a larger number of high or low

TABLE 43

Public Utilities: Twenty-Two Regressions, Yield on Eleven Variables, Number of Times t Was Greater Than +2.00 or Less Than -2.00 and Distribution of Plus and Minus Signs of Coefficients

Coefficients	t Greater Than +2.00	t Less Than -2.00	Distribution of Signs		$P_B \stackrel{=}{<}$
			Plus	Minus	
b_2	0	3	7	15	.067
b_3	0	10	0	22	.000
b_{4r}	6	0	17	5	.01
b_5	3	0	16	6	.026
b_6	0	2	5	17	.01
b_7	2	1	14	8	.143
b_8	1	6	10	12	.000
b_{12}	0	5	8	14	.143
b_{13}	3	1	16	6	.026
b_{15}	2	2	9	13	.262

See notes to Table 25.

t's than would be expected on the basis of chance alone—although b_6 is marginal. Of the ten coefficients, all but three also showed significance by the sign test, although b_2 was marginal.

IMPORTANCE OF VARIABLES

The question now is: Which of the foregoing ten variables are capable of exerting a substantial effect on yield? To determine this, an over-all regression was run with X_4 redefined as was done for industrials. Results are given in Table 44. Using the regression

TABLE 44

Public Utilities: "Over-All" Regression, Log Y on Eleven Variables, Regression Coefficients, Standard Errors, and Tests of Significance

Coefficient	$\bar{b}$	$\sigma_{\bar{b}}$	t	$P_t \overset{a}{\leq}$
Intercept	+.9710	.0795	+12.21	.001
b_1	+.8872	.0210	+42.32	.001
b_2	-.0675	.0173	- 3.91	.001
b_3	-.1355	.0153	- 8.84	.001
b_{4r}	+.0830	.0163	+ 5.09	.001
b_5	+.0132	.0036	+ 3.62	.001
b_6	-.0105	.0053	- 1.99	.05
b_7	+.0033	.0007	+ 4.85	.001
b_8	-.0099	.0042	- 2.33	.02
b_{12}	-.0237	.0069	- 3.43	.001
b_{13}	+.0644	.0205	+ 3.15	.01
b_{15}	-.0253	.0192	- 1.32	.20

[a]With 725 degrees of freedom, two tailed.
For this regression, R^2 = .856, F = 388.3, and $P_F \leq$ .001.

TABLE 45

Public Utilities: Percentage Impact of Each Variable on Yield When that Variable Increased by One Standard Deviation

Variable	b_i (1)	σ_{x_i} (2)	$b_i\ \sigma_{x_i}$ (3)	Antilog of Col. 3[a] (4)
X_2	-.0675	1.6583	-.11194	1.12
X_3	-.1355	.3684	-.04992	1.05
X_{4r}	+.0830	1.6520	+.13712	1.15
X_5	+.0132	.7736	+.01021	1.01
X_6	-.0105	.6060	-.00636	1.01
X_7	+.0033	4.2685	+.01409	1.01
X_8	-.0099	1.4487	-.01434	1.01
X_{12}	-.0237	1.7523	-.04153	1.04
X_{13}	+.0644	.2535	+.01633	1.02
X_{15}	-.0253	.2153	-.00545	1.01

[a]Signs ignored.

coefficients from this over-all regression, the percentage impact of each variable was calculated. Results are given in Table 45. Ranked in the order of their importance in this sense, the variables appear in much the same order for utilities as for industrials (X_{4r}, X_2, X_3, X_{12}, X_{13}, X_8, X_7, X_5, X_6, X_{15}).[8]

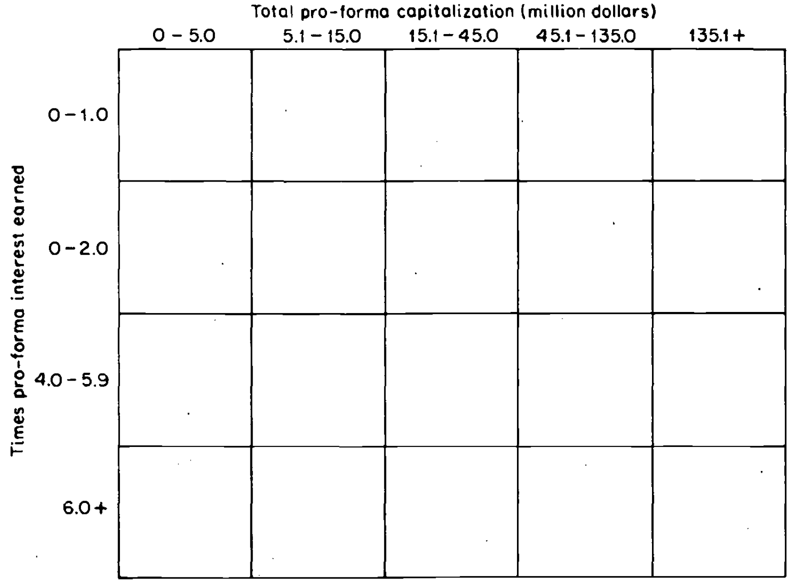
The Cross-Classified Series

As the first step in constructing a cross-classified series for public utilities, quarterly regressions were run on X_2 and X_4, as for in-

[8] X_{15}, which was deemed significant in the cross sections, showed only slight significance over all. But see Chart D-2.

CHART 13

Public Utilities: System of Cross Classification Used to Construct Eight Cross-Classified Yield Series, 1951–61



dustrials. Weighted averages were then struck over the forty-four coefficients on X_2 and the forty-four coefficients on X_4. These averages were, respectively, −.0210 and −.0437.[9]

With these weighted average coefficients in hand, class intervals were established for X_2 and X_4 such that the sum $b_2 \log X_2 + b_4 \log X_4$ (the X values taken at the mean value of each class interval) was approximately the same along each left-to-right diagonal.

The class intervals used (Chart 13) differ from the class-intervals used for industrials (Chart 6) primarily because the range of X_4 is much narrower for utilities than for industrials.

As for industrials, averages were obtained over the observations lying along each left-to-right diagonal. This procedure produced eight basic series, which were consolidated into three classes by

[9] Neither coefficient showed any trend over the period. Both showed a high degree of significance. The t for b_2 was −10.91 ($P_t = .001$) and for b_4, −6.56 ($P_t = .001$).

TABLE 46

Public Utilities: Yields on Direct Placements, Cross Classified and Computed, by Class, Quarterly, 1951–61

Year and Quarter	Cross Classified[a]		Computed	
	Class I	Class II	Class I	Class II
1951				
1	3.47	3.34[b]	3.68	3.49[b]
2	3.53	4.00	3.68	3.48[b]
3	3.57	4.20	3.74	3.98
4	3.74	3.94	3.80	4.04
1952				
1	3.52	3.81	3.59	3.53[b]
2	3.76	3.91	3.55	3.48[b]
3	3.98	3.75[b]	3.21	3.41
4	3.54	4.10	3.33	3.53
1953				
1	4.15	4.00[b]	3.93	4.22
2	3.92	4.13	4.15	4.45
3	4.21	4.38	4.12	4.31
4	4.26	4.03[b]	3.87	4.05
1954				
1	3.49	3.92	3.64	3.82
2	3.45	4.10	3.62	3.78
3	3.25	4.25	3.80	3.91
4	3.42	4.04	3.69	3.79
1955				
1	3.84	4.13	3.65	3.84
2	3.58	4.00	3.76	3.96
3	3.65	3.97	3.75	3.94
4	3.80	4.22	3.78	3.97
1956				
1	4.03	3.88[b]	3.98	4.10
2	4.09	4.33	4.24	4.36
3	4.50	4.75	4.45	4.63
4	4.88	5.04	4.77	4.96

(continued)

TABLE 46 (concluded)

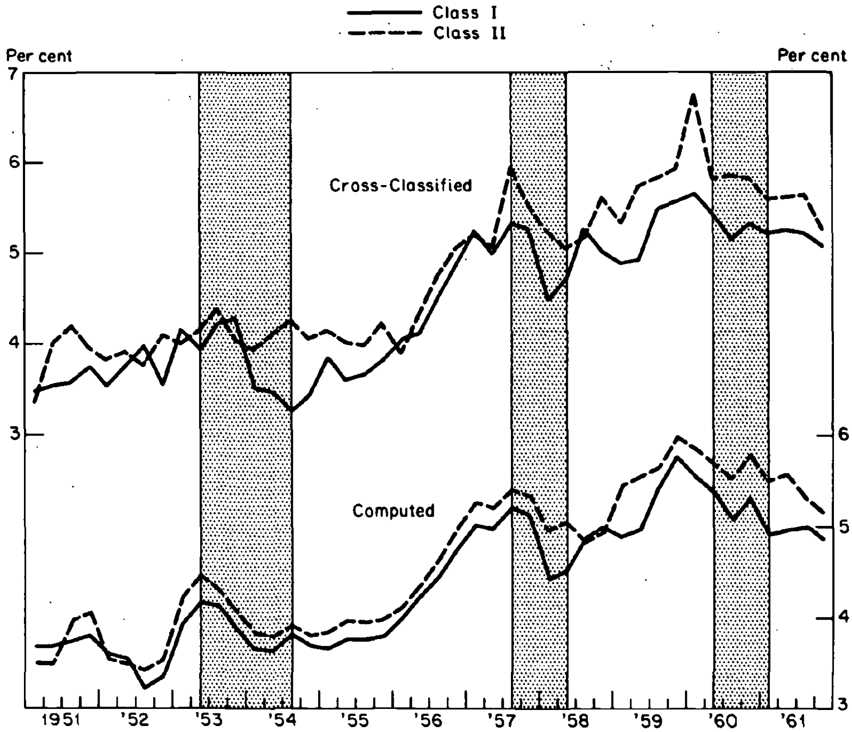
Year and Quarter	Cross Classified[a] Class I	Cross Classified[a] Class II	Computed Class I	Computed Class II
1957				
1	5.24	5.22[b]	5.03	5.26
2	4.98	5.05	4.96	5.19
3	5.33	5.95	5.20	5.39
4	5.26	5.50	5.13	5.32
1958				
1	4.47	5.21	4.41	4.95
2	4.72	5.05	4.51	5.05
3	5.26	5.16[b]	4.88	4.81[b]
4	5.00	5.62	4.99	4.93[b]
1959				
1	4.89	5.31	4.88	5.45
2	4.91	5.75	4.96	5.54
3	5.49	5.83	5.42	5.63
4	5.56	5.91	5.76	5.98
1960				
1	5.65	6.75	5.53	5.84
2	5.43	5.81	5.38	5.68
3	5.13	5.84	5.07	5.51
4	5.32	5.82	5.32	5.78
1961				
1	5.21	5.59	4.90	5.49
2	5.24	5.60	4.96	5.56
3	5.00	5.62	4.99	5.30
4	4.86	5.25	4.86	5.16

[a]Cross classification of original observations.

[b]Inconsistency.

CHART 14

Public Utilities: Yields on Direct Placements, Classes I and II Compared, Cross Classified and Computed, Quarterly, 1951–61



Shaded areas represent business contractions; white areas, expansions.
SOURCE: Table 46.

combining series 1, 2, and 3 into class I, series 4, 5, and 6 into class II, and series 7 and 8 into class III. The number of observations in class I was small [10] and the number of inconsistencies remained relatively large. Therefore, classes I and II were thrown together, thus reducing the number of series to two (columns 1 and 2 of Table 46 and Chart 14). The three original series were

[10] Ninety for the forty-four quarters out of about 800 observations in total.

then averaged to obtain a composite series based on the original data (column 1 of Table 48 and Chart 16).

The Computed Series

Computed series were obtained as follows:

1. Quarterly means were obtained for each underlying significant variable for each of the three consolidated series. These were then averaged to obtain over-all means, for each series separately and for each significant variable (Table 47).

TABLE 47

Public Utilities: Mean Values Used to Obtain Computed Series, by Class

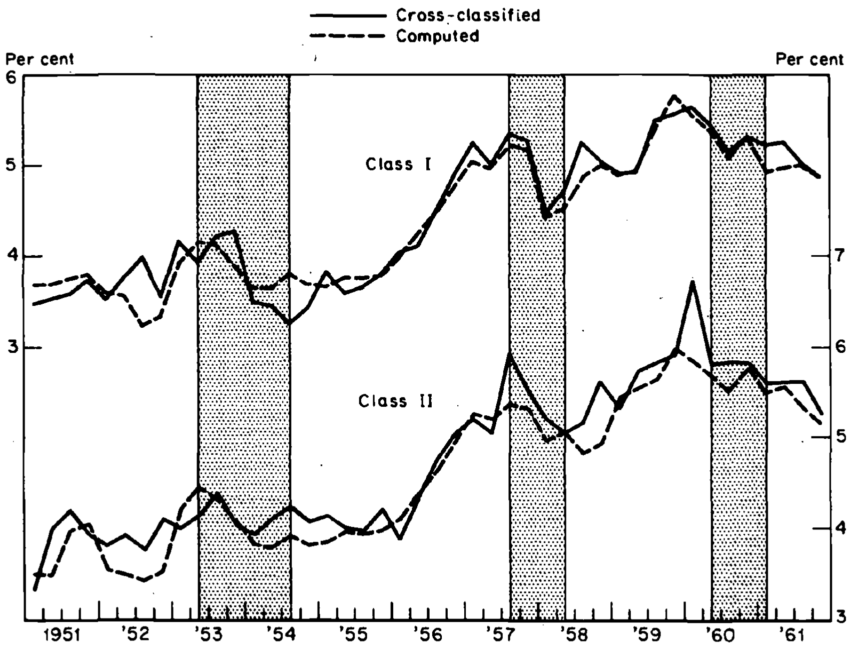
Variable	Units	Series IC	Series IIC	Series IIIC
X_2	Million dollars	121.5	15.5	4.3
X_3	Years	23.2	20.4	18.4
X_{4r}	Million dollars	2.1	0.4	0.1
X_5	a	0.3	0.4	0.2
X_6	b	1.3	1.4	1.6
X_7	Years	2.9	3.3	3.7
X_8	Million dollars	9.5	1.9	0.9
X_{12}	Million dollars	9.1	1.6	0.2
X_{13}	Years	26.9	24.8	23.1
X_{15}	Dollars of long-term debt per dollar of total capital	.49	.51	.58

[a]See note a, Table 29.

[b]For industrial classification, electric utilities and telephone companies = 1, water and gas distribution companies = 2, gas pipeline companies = 3, urban transport = 4, and "other" = 5. The figures here are an average of these code numbers.

CHART 15

Public Utilities: Cross-Classified Yield Series Compared with Computed Yield Series, by Class, Quarterly, 1951–61



Shaded areas represent business contractions; white areas, expansions.
SOURCE: Table 46.

2. The over-all mean values were then held rigidly constant and quarterly series were computed using the original semi-annual regression equations obtained from the "rerun." [11]

The series for classes I and II were then averaged. The two resulting *computed* series are given in columns 3 and 4 of Table 46. Chart 15 compares these computed series with their cross-classified counterparts.

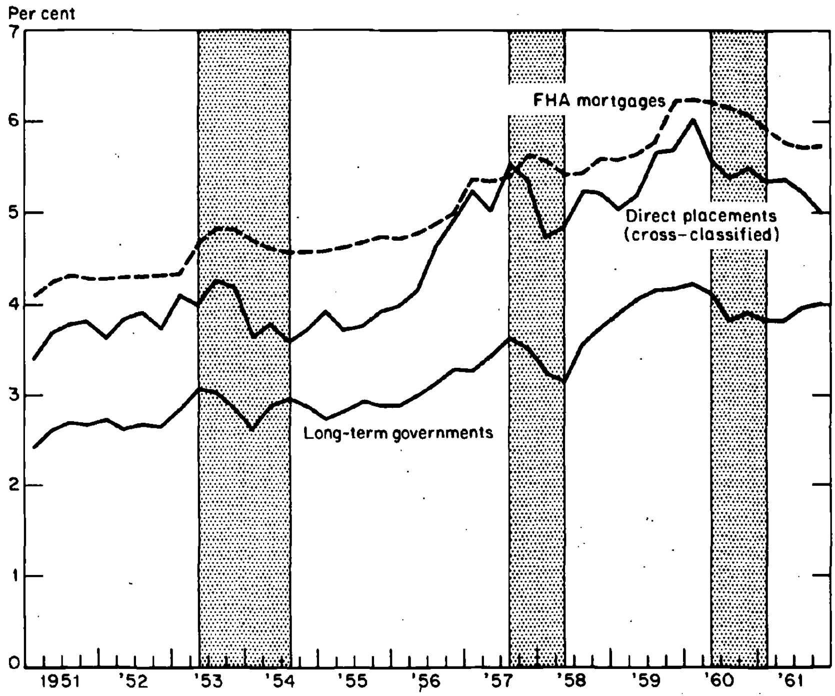
The three computed series were averaged to obtain a second composite series for utilities (column 2 of Table 48 and Chart 17).

A third composite series was obtained by computation, using

[11] Quarterly values were obtained by using the coefficients obtained for each half-year on quarter of the year.

CHART 16

Public Utilities: Yields on Direct Placements, Composite Cross Classified Compared with Yields on FHA Mortgages and Yields on Long-Term Governments, Quarterly, 1951–61



Shaded areas represent business contractions; white areas, expansions.
SOURCE: Table 48; *Federal Reserve Bulletin; Treasury Bulletin.*

1956 mean values for the X's (Table 49) and the regression equations given by the second rerun. This series thus holds all variables rigidly constant at their 1956 mean values (column 3 of Table 47 and Chart 17).

Additional Series

Various additional series for utilities were constructed.

1. Series based on *the original observations* were constructed for electric utilities and telephone companies together and water

TABLE 48

Public Utilities: Three Composite Yield Series Compared with Each Other and with Average Actual Yields in Sample, Quarterly, 1951–61

Year and Quarter	C_1 (1)	C_2 (2)	C_3 (3)	C_4 (4)
1951				
1	3.40	3.62	3.62	3.37
2	3.69	3.61	3.62	3.60
3	3.78	3.82	3.98	3.85
4	3.81	3.88	4.05	3.81
1952				
1	3.62	3.57	3.59	3.62
2	3.84	3.52	3.55	3.79
3	3.91	3.28	4.15	3.92
4	3.73	3.40	4.32	3.71
1953				
1	4.10	4.02	4.21	4.08
2	3.99	4.24	4.43	4.00
3	4.26	4.19	4.27	4.21
4	4.18	3.93	4.01	4.01
1954				
1	3.63	3.70	3.76	3.72
2	3.78	3.67	3.73	3.60
3	3.59	3.84	3.92	3.67
4	3.73	3.72	3.80	3.58
1955				
1	3.94	3.71	3.82	3.69
2	3.72	3.83	3.94	3.79
3	3.76	3.82	3.91	3.90
4	3.94	3.85	3.93	4.01
1956				
1	3.98	4.02	4.11	4.06
2	4.15	4.28	4.37	4.19
3	4.63	4.51	4.59	4.58
4	4.93	4.84	4.92	4.96

(continued)

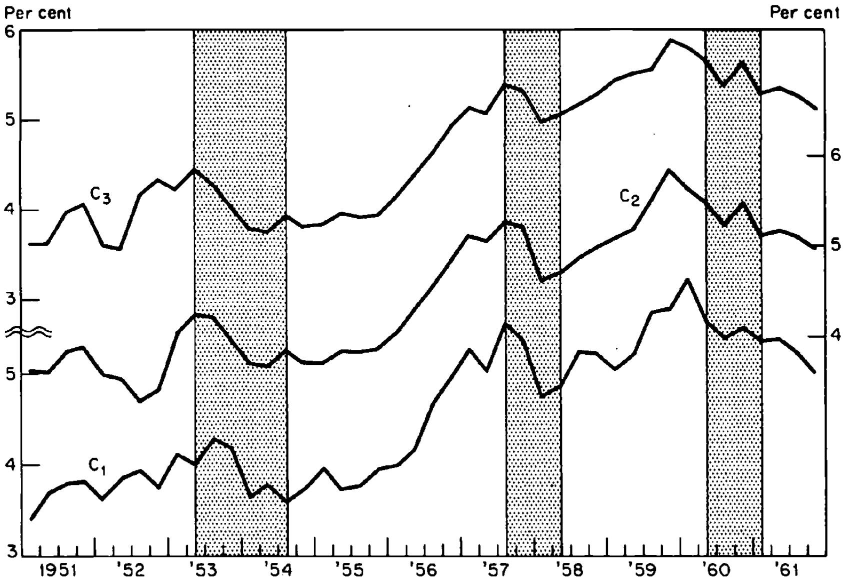
TABLE 48 (concluded)

Year and Quarter	C_1 (1)	C_2 (2)	C_3 (3)	C_4 (4)
1957				
1	5.24	5.11	5.13	5.15
2	5.00	5.04	5.06	5.06
3	5.53	5.26	5.38	5.48
4	5.34	5.19	5.31	5.30
1958				
1	4.72	4.59	4.75	4.62
2	4.83	4.69	4.85	4.76
3	5.23	4.85	4.94	5.06
4	5.21	4.97	5.06	5.17
1959				
1	5.03	5.07	5.22	5.01
2	5.19	5.15	5.30	5.18
3	5.66	5.49	5.53	5.55
4	5.68	5.83	5.87	5.79
1960				
1	6.02	5.63	5.79	5.71
2	5.55	5.48	5.63	5.64
3	5.37	5.22	5.36	5.53
4	5.49	5.47	5.62	5.47
1961				
1	5.34	5.10	5.28	5.29
2	5.36	5.16	5.34	5.35
3	5.21	5.10	5.25	5.15
4	4.99	4.96	5.11	4.95

Source: Col. 1, arithmetic averages of three cross-classified series; col. 2, arithmetic average of three computed series; col. 3, computed at 1956 mean values for each X; col. 4, arithmetic average over all actual yields on public utilities in sample.

CHART 17

Public Utilities: Three Composite Yield Series Compared with Each Other, Quarterly, 1951–61



Shaded areas represent business contractions; white areas, expansions.
SOURCE: Table 48.

TABLE 49

Public Utilities: Mean Values Used To Obtain Computed Composite Series

Variable	Units	Value
X_2	Million dollars	11.7
X_3	Years	18.5
X_{4r}	Million dollars	0.3
X_5	a	.40
X_6	b	1.6
X_7	Years	3.9
X_8	Million dollars	1.5
X_{12}	Million dollars	0.7
X_{13}	Years	23.6
X_{15}	Dollars of long-term debt per dollar of total capital	.55

[a]See note a, Table 29.
[b]See note b, Table 47.

TABLE 50

Electric and Telephone, and Water and Gas Distribution Direct Placements, Cross-Classified and Computed Yield Series, Quarterly, 1951-61

Year and Quarter	Electric and Telephone: Cross Classified (1)	Electric and Telephone: Computed (2)	Water and Gas Distribution: Cross Classified (3)	Water and Gas Distribution: Computed (4)
1951				
1	3.47	3.67	3.25	3.99
2	3.70	3.69	3.79	4.01
3	3.71	3.65	4.00	4.15
4	3.80	3.72	3.93	4.24
1952				
1	3.59	3.70	3.82	4.36
2	3.81	3.68	3.80	4.33
3	3.93	4.10	3.95	4.94
4	3.60	4.23	4.02	5.11
1953				
1	3.98	3.79	4.00	4.20
2	3.96	4.06	4.17	4.50
3	4.17	4.17	4.24	4.25
4	4.14	3.90	3.99	3.97
1954				
1	3.67	3.49	3.71	3.95
2	3.53	3.49	3.75	3.95
3	3.32	3.52	4.06	4.42
4	3.47	3.41	3.84	4.27
1955				
1	3.66	3.60	3.85	4.04
2	3.67	3.71	3.94	4.17
3	3.98	3.66	3.77	4.00
4	3.82	3.68	4.20	4.02
1956				
1	4.06	3.94	4.05	4.33
2	4.13	4.17	4.38	4.59
3	4.47	4.38	4.80	4.66
4	4.91	4.72	5.04	5.02

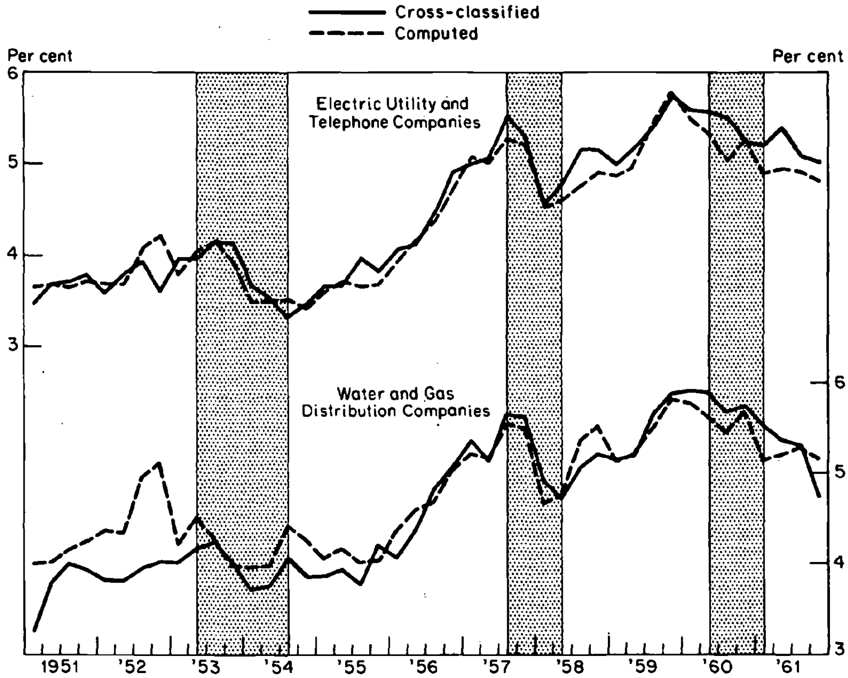
(continued)

TABLE 50 (concluded)

Year and Quarter	Electric and Telephone Cross Classified (1)	Electric and Telephone Computed (2)	Water and Gas Districution Cross Classified (3)	Water and Gas Districution Computed (4)
1957				
1	5.00	5.07	5.36	5.22
2	5.05	5.00	5.13	5.15
3	5.52	5.27	5.63	5.54
4	5.29	5.21	5.60	5.47
1958				
1	4.54	4.52	4.90	4.64
2	4.77	4.61	4.71	4.73
3	5.16	4.77	5.05	5.37
4	5.15	4.89	5.20	5.50
1959				
1	4.99	4.87	5.13	5.12
2	5.16	4.95	5.19	5.20
3	5.41	5.45	5.65	5.50
4	5.75	5.76	5.88	5.81
1960				
1	5.56	5.47	5.90	5.77
2	5.55	5.32	5.88	5.60
3	5.50	5.02	5.66	5.43
4	5.24	5.26	5.72	5.69
1961				
1	5.18	4.88	5.50	5.12
2	5.38	4.94	5.35	5.19
3	5.07	4.90	5.29	5.28
4	5.00	4.79	4.72	5.16

CHART 18

Electric and Telephone, and Water and Gas Distribution Companies: Yields on Direct Placements, Cross Classified and Computed, Quarterly, 1951–61



Shaded areas represent business contractions; white areas, expansions.
SOURCE: Table 50.

and gas distribution companies together. These series are given in columns 1 and 3 of Table 50, and in Chart 18.

2. A mean value was obtained for the period *as a whole* for each X separately for electric utilities and telephone companies, on the one hand, and water and gas distribution companies, on the other (Table 51). These mean values were held rigidly constant, and quarterly series were computed separately for each type of utility issue, using the original regression equations. These computed series are given in columns 2 and 4 of Table 48 and in Chart 18.[12]

[12] See footnote 25, Chapter 3.

TABLE 51

Public Utilities: Mean Values Used to Obtain Computed Series for Electric and Telephone and Water and Gas Distribution Placements

Variable	Units	Value: Electric and Telephone	Value: Water and Gas Distribution
X_2	Million dollars	62.4	16.6
X_3	Years	23.3	16.5
X_{4N}	Million dollars	1.2	0.5
X_5	a	0.3	0.5
X_6	b	1.0	2.0
X_7	Years	4.0	6.0
X_8	Million dollars	4.5	2.2
X_{12}	Million dollars	4.6	1.4
X_{13}	Years	27.0	22.3
X_{15}	Dollars of long-term debt per dollar of total capital	0.50	0.51

[a]See note a, Table 29.
[b]See note b, Table 47.