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AN ANALYSIS OF THE DETERMINANTS OF THE YIELDS ON INDIVIDUAL MUNICIPAL SECURITIES

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PREFACE

This working paper is the final version of an unpublished paper originally presented at the 1981 meeting of the Western Finance Association. The paper was referenced frequently in an article by one of the authors in the May/June 1982 issue of the Federal Reserve Bank of Richmond Economic Review entitled "Determinants of Individual Tax-Exempt Bond Yields: A Survey of the Evidence." We are putting the paper in the Working Paper series at this time in order to facilitate its distribution.

I. INTRODUCTION

This study presents the results of a comprehensive regression analysis of the determinants of tax-exempt municipal bond yields.[1] A substantial literature on the factors influencing municipal yields has developed over the last decade.[2] Factors that have been frequently considered as a determinants of the yields on individual municipal bonds are: (1) broad conditions in the national bond markets at the time of issue; (2) the risk that the issuer might default; (3) the characteristics of the issue such as its size, any call provisions, and whether the issue is a general obligation issue or a revenue issue; and (4) the conditions surrounding the underwriting of the issue including whether the issue was competitive or negotiated and, if competitive, the number of bids received from underwriters. In addition to these factors, some studies have indicated that yields may also be influenced by supply and demand conditions in local and regional markets and by the manner in which underwriters set coupons. In addition to their technical and academic interest, the results of some of these studies have been directed at what is perhaps the major policy issue involving the municipal market at present: namely, whether commercial banks should be permitted to underwrite all revenue bonds.[3]

Municipal bonds are sold in serial issues which include securities of several maturities, and most previous studies have treated the entire serial as the analytical unit. Typically, the dependent variable in the regressions in these studies has been a composite measure of the yields on

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[1]The study grew out of an earlier analysis by the authors for the Federal Reserve's Ad Hoc Subcommittee on Full Insurance of Government Deposits. See the Final Report and Recommendations of the Subcommittee [28, pp. 57-73].

[2]The principal studies are included among the references. The references include a detailed table summarizing the central focus and results of previous regression models of the municipal market.

[3]See section VIII below.

all of the bonds in the serial such as net interest cost (NIC) or true interest cost (TIC).[4] The studies have then attempted to specify independent variables representative of the entire serial.

In our view this approach has four deficiencies. First, treating the entire serial as the analytical unit makes it difficult and in some cases impossible to analyze particular factors affecting yields that are closely related to individual bonds within the serial. For example, many serials contain some shorter term securities that are not callable and some longer term ones that are. It is therefore very difficult to devise a variable that adequately measures differences in call provisions across entire serial issues. Second, as explained in section II, the procedures that must be used to specify national market conditions under this approach--obviously a key determinant of the yields of individual issues--are vulnerable to measurement errors that may bias some of the regression coefficients. Third, NIC and TIC include both the compensation to the underwriter and the return to the investor. For this reason it is frequently difficult to determine whose behavior a coefficient is measuring. Finally, this approach precludes analysis of whether the affect of a particular factor on yields varies across maturities and, if so, in what way. As noted in the sections that follow, there are obvious reasons to expect the effect of such factors as call provisions and coupon-setting practices to change with maturity. There are also less obvious reasons for expecting such variation. In particular, since commercial banks--which are major purchasers of municipal bonds--appear to hold primarily short- and intermediate-term bonds, there

[4] Speaking roughly, NIC is a weighted average of the coupons on the individual bonds in a serial. TIC is the internal rate of return. For precise definitions and a detailed discussion of these measures see Hopewell and Kaufman [32, pp. 531-533].

is reason to believe that the structure of the municipal market varies across maturities due to habitat effects. Under these circumstances one would expect the effects of a number of the factors influencing yields to vary across maturities.

The approach taken here avoids these problems by breaking the serials down into individual securities and estimating separate equations for four separate maturities: 5 years, 10 years, 15 years, and 20 years. The structure of the equations can be seen in Table 1. As the table indicates, the dependent variable in each equation is the reoffer yield for the maturity in question. Where appropriate or necessary, the independent variables are defined by maturities. For example, the variable that measures national market conditions in each equation is the reoffer yield on high-grade general obligation bonds for that maturity. We believe this approach is an important methodological contribution to the literature on municipal yields. The procedure permitted us to derive new information on the determinants of municipal yields, especially with respect to the effects of local pledging requirements against government deposits, call provisions, and coupon-setting practices. It also allowed us to refine some of the results of earlier studies.

The data for this analysis were taken from a sample of 914 serials issued between March 1977 and 1978. Approximately three-quarters of the issues were general obligation issues; the remainder were revenue issues. The sample contained approximately 100 negotiated issues. Nearly all of the negotiated issues were revenue issues. Data were collected for each of the four maturities noted above.[5]

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[5]Appendix A contains a summary listing of the variables and data used in this study.

Tables 1-4 present the regression results. Tables 1 and 2 show the results for the full sample and for the general obligation bonds, respectively. Table 3 presents the results for all revenue issues, and Table 4 show the results for the revenue issues that were sold competitively.

The statistical quality of the full sample regressions in Table 1 is quite high overall. For purposes of comparison, we ran a regression using the analytical approach of most earlier studies with NIC as the dependent variable and the independent variables respecified as necessary to fit the full-serial framework. Specifically, the national market conditions and call provision variables were respecified, and the variables indicating coupon efficiency as defined in section VI were dropped. Table 5 presents the results. The statistical quality of this regression is generally lower than that of the equations in Table 1. Further, the results for several of the particular independent variables such as the call provision variables are considerably weaker in this equation than the results for the corresponding variables in the equations in Table 1. The reader may find it instructive to compare specific coefficients when evaluating the detailed results of this study.

The remainder of the study consists of eight sections. Sections II-VIII each deal with one factor affecting yields. Each of these sections summarizes the results of earlier studies and presents the results of the present study with respect to that factor. Section IX summarizes the principal results of this study and offers a few concluding remarks.

Table 1

Regression Results: General Obligation and Revenue Bonds Combined

	Dependent Variable: / Independent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
1.	Constant			.197 (2.03)	.773 (5.15)	.500 (2.67)	.208 (0.89)
	National Market Conditions						
2.	5-Year Aaa Rate	$RMUN_5$	+	.982 (52.95)			
3.	10-Year Aaa Rate	$RMUN_{10}$	+		.886 (29.94)		
4.	15-Year Aaa Rate	$RMUN_{15}$	+			.959 (26.99)	
5.	20-Year Aaa Rate	$RMUN_{20}$	+				1.010 (23.82)
	Regional Market Conditions						
6.	Secured Deposits/ Total Deposits	PLDG	-	-9.578 (-6.62)	-12.527 (-7.945)	-9.817 (-6.00)	-4.459 (-2.27)
7.	(Secured Deposits/ Total Deposits)*ln Issue Size	PLDG*lnSIZE	+	.768 (5.06)	1.041 (6.33)	.779 (4.58)	.311 (1.53)
8.	Stock of Bonds Outstanding/ Personal Income	STOCK/PI	+	.946 (9.39)	.981 (9.05)	.936 (8.14)	.708 (5.43)

Table 1 (continued)

Independent Variable: / Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
Issuer Characteristics						
9. Aa	Aa	+	.305 (2.52)	.349 (2.63)	.201 (1.45)	.166 (1.08)
10. A1	A1	+	.351 (8.06)	.437 (9.20)	.474 (9.87)	.512 (9.28)
11. A	A	+	.515 (11.39)	.629 (12.75)	.629 (12.31)	.599 (10.10)
12. Baa1	Baa1	+	.566 (12.40)	.668 (13.23)	.666 (12.93)	.669 (11.26)
13. Baa	Baa	+	1.040 (21.01)	1.129 (20.74)	1.022 (17.91)	.906 (13.13)
14. Northern Industrial City Dummy Variable	NICD	+	.534 (11.74)	.573 (11.15)	.634 (12.37)	.577 (8.62)
Issue Characteristic: Call Risk and Call Provisions						
15. Call Risk, 10-Year Maturity	CR_{10}	+		.324 (1.68)		
16. Call Risk, 15-Year Maturity	CR_{15}	+			.503 (3.02)	
17. Call Risk, 20-Year Maturity	CR_{20}	+				.367 (2.46)

Table 1 (continued)

	Dependent Variable: / Independent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
18.	CR_{10}*ln Years to First Call	CR_{10}*lnYFC	-		-.147 (-1.57)		
19.	CR_{15}*ln Years to First Call	CR_{15}*lnYFC	-			-.208 (2.91)	
20.	CR_{20}*ln Years to First Call	CR_{20}*lnYFC	-				-.128 (-2.09)
	Issue Characteristic: Inefficient Coupons						
21.	5-Year Premium	PRE_5	+	.016 (1.65)			
22.	10-Year Premium	PRE_{10}	+		.004 (0.29)		
23.	15-Year Premium	PRE_{15}	+			.018 (0.39)	
24.	15-Year Discount	DIS_{15}	+			.461 (2.69)	
25.	20-Year Discount	DIS_{20}	+				.161 (6.05)
	Other Issue Characteristics						
26.	Issue Size	SIZE	-	-1.714×10^{-6} (-2.17)	-2.428×10^{-6} (-2.85)	-2.425×10^{-6} (-2.79)	-1.108×10^{-6} (-1.05)

Table 1 (continued)

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
27. Issue Size Squared	$SIZE^2$	+	6.880×10^{-12} (1.83)	7.120×10^{-12} (1.80)	6.378×10^{-12} (1.60)	1.520×10^{-12} (0.30)
28. Revenue Dummy Variable	RDUM	+	.063 (2.80)	.079 (3.26)	.112 (4.35)	.104 (3.84)
Underwriter Conditions						
29. ln Number of Bids	lnBIDS	-	-.092 (-4.39)	-.121 (-5.30)	-.181 (-7.69)	-.175 (-6.49)
30. ln Range of Bids	lnRANGE	+	.336 (3.27)	.456 (3.93)	.557 (4.62)	.510 (3.69)
31. Negotiated Issue Dummy Variable	NDUM	+	.101 (2.63)	.138 (3.36)	.136 (3.31)	.126 (2.65)
Corrected R^2			.840	.748	.761	.739
Standard Error			.222	.246	.246	.240
Number of Observations			858	874	827	619

Note: t-statistics are in parenthesis.

See Appendix for sources and definitions of variables.

Table 2

Regression Results: General Obligation Bonds

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
1. Constant			.304 (2.87)	.874 (5.38)	.837 (4.13)	.484 (1.91)
National Market Conditions						
2. 5-Year Aaa Rate	$RMUN_5$	+	.949 (47.00)			
3. 10-Year Aaa Rate	$RMUN_{10}$	+		.854 (26.79)		
4. 15-Year Aaa Rate	$RMUN_{15}$	+			.888 (23.27)	
5. 20-Year Aaa Rate	$RMUN_{20}$	+				.959 (20.85)
Regional Market Conditions						
6. Secured Deposits/ Total Deposits	PLDG	-	-8.949 (-5.33)	-12.044 (-6.68)	-9.237 (-4.94)	-4.417 (-2.02)
7. (Secured Deposits/ Total Deposits)*ln Issue Size	PLDG*lnSIZE	+	.699 (3.91)	.981 (5.12)	.713 (3.60)	.309 (1.35)
8. Stock of Bonds Outstanding/ Personal Income	STOCK/PI	+	.936 (7.93)	.975 (7.91)	.984 (7.63)	.731 (4.96)

Table 2 (continued)

Independent Variable: / Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
Issuer Characteristics						
9. Aa	Aa	+	.449 (3.61)	.515 (3.84)	.373 (2.66)	.299 (1.87)
10. A1	A1	+	.410 (8.09)	.538 (9.88)	.546 (9.93)	.572 (8.89)
11. A	A	+	.540 (10.62)	.673 (12.33)	.655 (11.52)	.651 (9.35)
12. Baa1	Baa1	+	.633 (13.04)	.746 (14.36)	.735 (13.85)	.748 (11.78)
13. Baa	Baa	+	1.078 (21.51)	1.179 (21.78)	1.045 (18.34)	.926 (13.31)
14. Northern Industrial City Dummy Variable	NICD	+	.549 (11.25)	.576 (10.70)	.647 (12.00)	.610 (7.80)
Issue Characteristic: Call Risk and Call Provisions						
15. Call Risk, 10-Year Maturity	CR_{10}	+		.530 (2.50)		
16. Call Risk, 15-Year Maturity	CR_{15}	+			.585 (3.30)	
17. Call Risk, 20-Year Maturity	CR_{20}	+				.308 (1.99)

Table 2 (continued)

	Dependent Variable: / Independent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
18.	CR_{10}*ln Years to First Call	CR_{10}*lnYFC	–		–.245 (–2.40)		
19.	CR_{15}*ln Years to First Call	CR_{15}*lnYFC	–			–.252 (–3.31)	
20.	CR_{20}*ln Years to First Call	CR_{20}*lnYFC	–				–.109 (–1.70)
	Issue Characteristic: Inefficient Coupons						
21.	5-Year Premium	PRE_5	+	.004 (0.31)			
22.	10-Year Premium	PRE_{10}	+		–.010 (–0.57)		
23.	15-Year Premium	PRE_{15}	+			–.028 (–0.48)	
24.	15-Year Discount	DIS_{15}	+			.352 (2.17)	
25.	20-Year Discount	DIS_{20}	+				.169 (6.47)
	Other Issue Characteristics						
26.	Issue Size	SIZE	–	-5.548×10^{-7} (–0.54)	-1.411×10^{-6} (–1.28)	-1.888×10^{-6} (–1.67)	-1.612×10^{-6} (–1.30)

Table 2 (continued)

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
27. Issue Size Squared	$SIZE^2$	+	-6.298×10^{-13} (-0.11)	2.394×10^{-12} (0.39)	3.958×10^{-12} (0.64)	4.410×10^{-1} (0.68)
Underwriter Conditions						
28. ln Number of Bids	lnBIDS	-	-.085 (-4.00)	-.115 (-5.06)	-.183 (-7.78)	-.187 (-6.63)
29. ln Range of Bids	lnRANGE	+	.407 (3.81)	.515 (4.38)	.572 (4.66)	.478 (3.32)
Corrected R^2			.861	.793	.792	.765
Standard Error			.211	.226	.226	.225
Number of Observations			645	647	608	454

Note: t-statistics are in parentheses.

See Appendix for sources and definitions of variables.

Table 3

Regression Results: Revenue Bonds

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
1. Constant			-.075 (-0.34)	.428 (1.25)	-.251 (-0.59)	-.221 (-0.41)
National Market Conditions						
2. 5-Year Aaa Rate	$RMUN_5$	+	1.084 (25.37)			
3. 10-Year Aaa Rate	$RMUN_{10}$	+		1.004 (14.26)		
4. 15-Year Aaa Rate	$RMUN_{15}$	+			1.129 (12.51)	
5. 20-Year Aaa Rate	$RMUN_{20}$	+				1.085 (9.93)
Regional Market Conditions						
6. Secured Deposits/ Total Deposits	PLDG	-	-4.694 (-1.34)	-7.461 (-1.86)	-5.944 (-1.47)	-2.192 (-0.45)
7. (Secured Deposits/ Total Deposits)*ln Issue Size	PLDG*lnSIZE	+	.344 (1.00)	.615 (1.57)	.445 (1.13)	.102 (0.21)
8. Stock of Bonds Outstanding/ Personal Income	STOCK/PI	+	.937 (4.40)	.901 (3.65)	.729 (2.72)	.500 (1.52)

Table 3 (continued)

Dependent Variable: / Independent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
Issuer Characteristics						
9. Aa	Aa	+	-.701 (-1.87)	-.613 (-1.45)	-.824 (-1.96)	-.618 (-1.39)
10. A1	A1	+	.139 (1.41)	.172 (1.60)	.262 (2.43)	.316 (2.64)
11. A	A	+	.326 (3.03)	.392 (3.32)	.445 (3.75)	.423 (3.27)
12. Baa1	Baa1	+	.139 (1.08)	.182 (1.22)	.278 (1.70)	.257 (1.58)
13. Baa	Baa	+	.518 (2.17)	.657 (2.74)	.825 (3.47)	.699 (1.97)
14. Northern Industrial City Dummy Variable	NICD	+	.364 (3.16)	.419 (3.09)	.436 (3.26)	.382 (2.86)
Issue Characteristic: Call Risk and Call Provisions						
15. Call Risk, 10-Year Maturity	CR_{10}	+		-.106 (-0.25)		
16. Call Risk, 15-Year Maturity	CR_{15}	+			.385 (0.96)	
17. Call Risk, 20-Year Maturity	CR_{20}	+				.250 (0.59)

Table 3 (continued)

	Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
18.	CR_{10}*ln Years to First Call	CR_{10}*lnYFC	-		.072 (0.33)		
19.	CR_{15}*ln Years to First Call	CR_{15}*lnYFC	-			-.092 (-0.56)	
20.	CR_{20}*ln Years to First Call	CR_{20}*lnYFC	-				-.024 (-0.14)
	Issue Characteristic: Inefficient Coupons						
21.	5-Year Premium	PRE_5	+	.021 (1.13)			
22.	10-Year Premium	PRE_{10}	+		.028 (0.99)		
23.	15-Year Premium	PRE_{15}	+			.085 (1.06)	
24.	15-Year Discount	DIS_{15}	+			1.028 (0.88)	
25.	20-Year Discount	DIS_{20}	+				.027 (0.22)
	Other Issue Characteristics						
26.	Issue Size	SIZE	-	-1.904×10^{-6} (-1.25)	-3.075×10^{-6} (-1.78)	-2.642×10^{-6} (-1.54)	7.344×10^{-7} (0.34)

Table 3 (continued)

	Independent Variable: / Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
27.	Issue Size Squared	$SIZE^2$	+	9.140×10^{-12} (1.49)	9.789×10^{-12} (1.42)	7.089×10^{-12} (1.04)	-5.295×10^{-12} (-0.55)
	Underwriter Conditions						
28.	ln Number of Bids	lnBIDS	–	-.092 (-1.68)	-.123 (-1.96)	-.172 (-2.70)	-.070 (-1.03)
29.	ln Range of Bids	lnRANGE	+	-.067 (-0.23)	.027 (0.08)	.305 (0.85)	.435 (1.16)
30.	Negotiated Issue Dummy Variable	NDUM	+	.132 (1.84)	.196 (2.42)	.205 (2.60)	.267 (3.01)
	Corrected R^2			.788	.599	.660	.641
	Standard Error			.240	.285	.281	.271
	Number of Observations			213	227	219	165

Note: t-statistics are in parentheses.

See Appendix for sources and definitions of variables.

Table 4

Regression Results: Competitive Revenue Bonds

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
1. Constant			.011 (0.04)	.646 (1.94)	.228 (0.56)	.211 (0.45)
National Market Conditions						
2. 5-Year Aaa Rate	$RMUN_5$	+	1.041 (20.70)			
3. 10-Year Aaa Rate	$RMUN_{10}$	+		.929 (13.37)		
4. 15-Year Aaa Rate	$RMUN_{15}$	+			1.024 (12.32)	
5. 20-Year Aaa Rate	$RMUN_{20}$	+				1.015 (11.19)
Regional Market Conditions						
6. Secured Deposits/ Total Deposits	PLDG	-	-.244 (-0.06)	.017 (0.00)	.626 (0.15)	3.477 (0.79)
7. (Secured Deposits/ Total Deposits)*ln Issue Size	PLDG*lnSIZE	+	-.152 (-0.35)	-.195 (-0.46)	-.287 (-0.65)	-.493 (-1.08)
8. Stock of Bonds Outstanding/ Personal Income	STOCK/PI	+	1.061 (5.12)	1.017 (4.69)	.717 (2.97)	.161 (0.53)

Table 4 (continued)

	Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
	Issuer Characteristics						
9.	Aa	Aa	+	-.278 (-0.62)	-.240 (-0.55)	-.660 (-1.50)	-.751 (-1.84)
10.	A1	A1	+	.197 (1.48)	.271 (2.27)	.297 (2.52)	2.96 (2.70)
11.	A	A	+	.412 (3.24)	.485 (3.82)	.465 (3.61)	.406 (3.36)
12.	Baa1	Baa1	+	.142 (1.14)	.163 (1.25)	.198 (1.41)	.281 (2.19)
13.	Baa	Baa	+	.509 (2.33)	.553 (2.40)	.724 (3.19)	.795 (2.86)
	Issue Characteristic: Call Risk and Call Provisions						
14.	Call Risk, 10-Year Maturity	CR_{10}	+		.649 (0.64)		
15.	Call Risk, 15-Year Maturity	CR_{15}	+			.463 (0.76)	
16.	Call Risk, 20-Year Maturity	CR_{20}	+				.283 (0.51)
17.	CR_{10}*ln Years to First Call	CR_{10}*lnYFC	-		-.317 (-0.65)		

Table 4 (continued)

	Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
18.	CR_{15}*ln Years to First Call	CR_{15}*lnYFC	-			-.179 (-0.69)	
19.	CR_{20}*ln Years to First Call	CR_{20}*lnYFC	-				-.126 (-0.53)
	Issue Characteristic: Ineffcient Coupons						
20.	5-Year Premium	PRE_5	+	.005 (0.22)			
21.	10-Year Premium	PRE_{10}	+		-.012 (-0.47)		
22.	15-Year Premium	PRE_{15}	+			.086 (1.39)	
23.	15-Year Discount	DIS_{15}	+			1.297 (1.33)	
24.	20-Year Discount	DIS_{20}	+				.003 (0.03)
	Other Issue Characteristics						
25.	Issue Size	SIZE	-	3.390×10^{-6} (1.29)	3.672×10^{-6} (1.61)	4.137×10^{-6} (1.81)	6.307×10^{-6} (2.79)
26.	Issue Size Squared	$SIZE^2$	+	-2.581×10^{-11} (-1.86)	-2.608×10^{-11} (-2.49)	-2.706×10^{-11} (-2.60)	-3.097×10^{-11} (-3.06)

Table 4 (continued)

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	5-Year Reoffer Yield to Maturity (IS_5)	10-Year Reoffer Yield to Maturity (IS_{10})	15-Year Reoffer Yield to Maturity (IS_{15})	20-Year Reoffer Yield to Maturity (IS_{20})
Underwriter Conditions						
27. ln Number of Bids	lnBIDS	-	-.100 (-1.96)	-.130 (-2.44)	-.165 (-3.10)	-.034 (-0.64)
28. ln Range of Bids	lnRANGE	+	.044 (0.16)	.178 (0.64)	.525 (1.85)	.468 (1.69)
Corrected R^2			.813	.656	.686	.691
Standard Error			.207	.218	.214	.194
Number of Observations			118	128	122	106

Note: t-statistics are in parentheses.

See Appendix for sources and definitions of variables.

Table 5

Regression Results: NIC Model

Independent Variable: \ Dependent Variable:	Symbol	Expected Sign	Net Interest Cost (NIC)
1. Constant			-.656 (-1.60)
National Market Conditions			
2. Average Maturity	AVMAT	+	.036 (4.00)
3. Average Maturity*Spread Between 20-Year Aaa Rate and 5-Year Aaa Rate	AVMAT*$(RMUN_{20} - RMUN_5)$	+	.009 (1.08)
4. Average Rate on Aaa Bonds	$(RMUN_5 + RMUN_{10} + RMUN_{15} + RMUN_{20})/4$	+	1.103 (13.55)
Regional Market Conditions			
5. Secured Deposits/Total Deposits	PLDG	-	.323 (0.11)
6. (Secured Deposits/Total Deposits)* ln Issue Size	PLDG*lnSIZE	+	-.293 (-0.94)
7. Stock of Bonds Outstanding/ Personal Income	STOCK/PI	+	.859 (4.11)

Table 5 (continued)

Dependent Variable: / Independent Variable:	Symbol	Expected Sign	Net Interest Cost (NIC)
Issuer Characteristics			
8. Aa	Aa	+	.161 (0.61)
9. A1	A1	+	.506 (5.46)
10. A	A	+	.777 (8.07)
11. Baa1	Baa1	+	.800 (8.29)
12. Baa	Baa	+	1.256 (12.05)
13. Northern Industrial City Dummy Variable	NICD	+	.580 (6.01)
Issue Characteristics			
14. Basic Call Risk	CR	+	.427 (1.68)
15. Basic Call Risk*ln Years to First Call	CR*lnYFC	–	–.202 (–1.90)

Table 5 (continued)

Dependent Variable: / Independent Variable:	Symbol	Expected Sign	Net Interest Cost (NIC)
16. Issue Size	SIZE	-	7.091×10^{-6} (4.69)
17. Issue Size Squared	$SIZE^2$	+	-3.826×10^{-11} (-5.89)
18. Revenue Dummy Variable	RDUM	+	.269 (5.56)
Underwriter Conditions			
19. ln Number of Bids	lnBIDS	-	-.170 (-3.87)
20. ln Range of Bids	lnRANGE	+	.495 (2.22)
21. Negotiated Issue Dummy Variable	NDUM	+	.170 (2.19)
Corrected R^2			.591
Standard Error			.477
Number of Observations			887

Note: t-statistics are in parentheses.

See Appendix for sources and definitions of variables.

II. NATIONAL MARKET CONDITIONS

Background and Previous Studies

Virtually all previous studies that have used cross-sectional regressions and individual issue data have included measures of overall conditions in the national municipal bond market as independent variables. As pointed out in the introduction, most of these studies have used either net interest cost (NIC) or the internal rate of return (TIC) as dependent variables in their regressions. By their nature, both NIC and TIC are composite measures of the yields of all of the individual bonds in a serial issue. Consequently, the national market variables used in these studies have been constructed to fit these composite dependent variables. In constructing these national market variables, the studies as a group have taken account of three factors: (1) the overall level of market rates at the time of issue, (2) the slope of the national yield curve at the time of issue, and (3) either the average maturity or the longest maturity of the bonds in a serial.

The relevance of each of these three factors can be illustrated using Figure II-1, which shows two possible yield curves in the national bond market. Assume that yield curve 1 is the yield curve in the market at the time a particular municipal serial is issued. In attempting to measure the effect of market conditions on the composite yield of that serial, the height of the yield curve, which reflects the general level of market rates, is clearly one relevant factor. Further, given the height of the curve, (1) the shape of the curve and (2) the maturity distribution of the individual bonds in the serial (as measured, for example, by the average maturity of the bonds in the serial) are also relevant factors since together they reflect the yields on competing issues of comparable average maturity in the national market.

Previous studies have specified these factors in various ways. For example, Hendershott and Kidwell [15] included three separate variables to cover the three factors: (1) an average across several maturities of the weekly Salomon Brothers indexes for high-grade municipal bonds at the time of issue; (2) the final maturity of the issue; and, (3) an index of the shape of the yield curve at the time of issue.[1] Some of the other studies have used similar specifications.[2]

In our judgment many of these specifications are subject, to one degree or another, to measurement error that may bias the regression results. The central difficulty is that these specifications implicitly assume that the national market yield curve has some particular form (linear in most of the studies) that does not change over the period analyzed. Figure 1 illustrates the nature of the problem in a simplified manner. Suppose that the specification of the national market variable assumed that the yield curve had the linear form of yield curve 1 in the graph at the time of issue, but the actual curve was nonlinear like yield curve 2. If the average maturity of a particular serial in the sample were 15 years, a specification based on yield curve 1 would indicate 5.0 percent as an appropriate index of current market yields, whereas a correct specification based on yield curve 2 would indicate 5.5 percent.

In this example, the measurement error would be a function of both the maturity characteristics of a particular serial and the shape of the actual yield curve at the time of issue. Consider first maturity characteristics. The error would be greatest for serials with a 15-year average maturity,

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[1] Specifically, the third variable is $(i_{20}-i_1)\cdot\ln$ final maturity, where the i's are the Salomon Brothers indexes for the indicated maturities.

[2] See, for example, Sorenson [23] and Beebe [2].

diminishing as average maturity diverged either upward or downward from 15 years. Consequently, even if the shape of the actual yield curve were fairly constant over the period covered by the study, the measurement error would be correlated with any other independent variable that included average maturity or was correlated with average maturity. In these circumstances coefficients would not only be biased, but the direction of the bias would be unknown.[3] A second problem would arise if the shape of the yield curve changed over the period covered by the study. In this case the measurement error would be a function of movements in the yield curve and therefore would be correlated with any other variable in the equation affected by the same underlying forces as the yield curve. For instance, the shape of the yield curve is influenced by interest rate expectations. As discussed in section V, call risk, another factor believed to influence municipal yields, is also dependent on interest rate expectations. Consequently, errors in measuring national market conditions could bias the coefficients of any call risk variable included in the same regressions.[4]

Our Approach and Results

As indicated in the introduction, our procedure avoids this difficulty. Specifically, we broke down the serials in our sample by maturity and ran separate regressions for each of four maturities: 5-, 10-, 15-, and 20-year bonds. Therefore, the dependent variable in each regression is the reoffer yield for a specific maturity rather than a composite yield such as NIC. For that reason it is possible to use a very simple variable to capture the effect of national market conditions: namely, the current reoffer yield on Aaa-rated general obligation bonds of corresponding maturity.

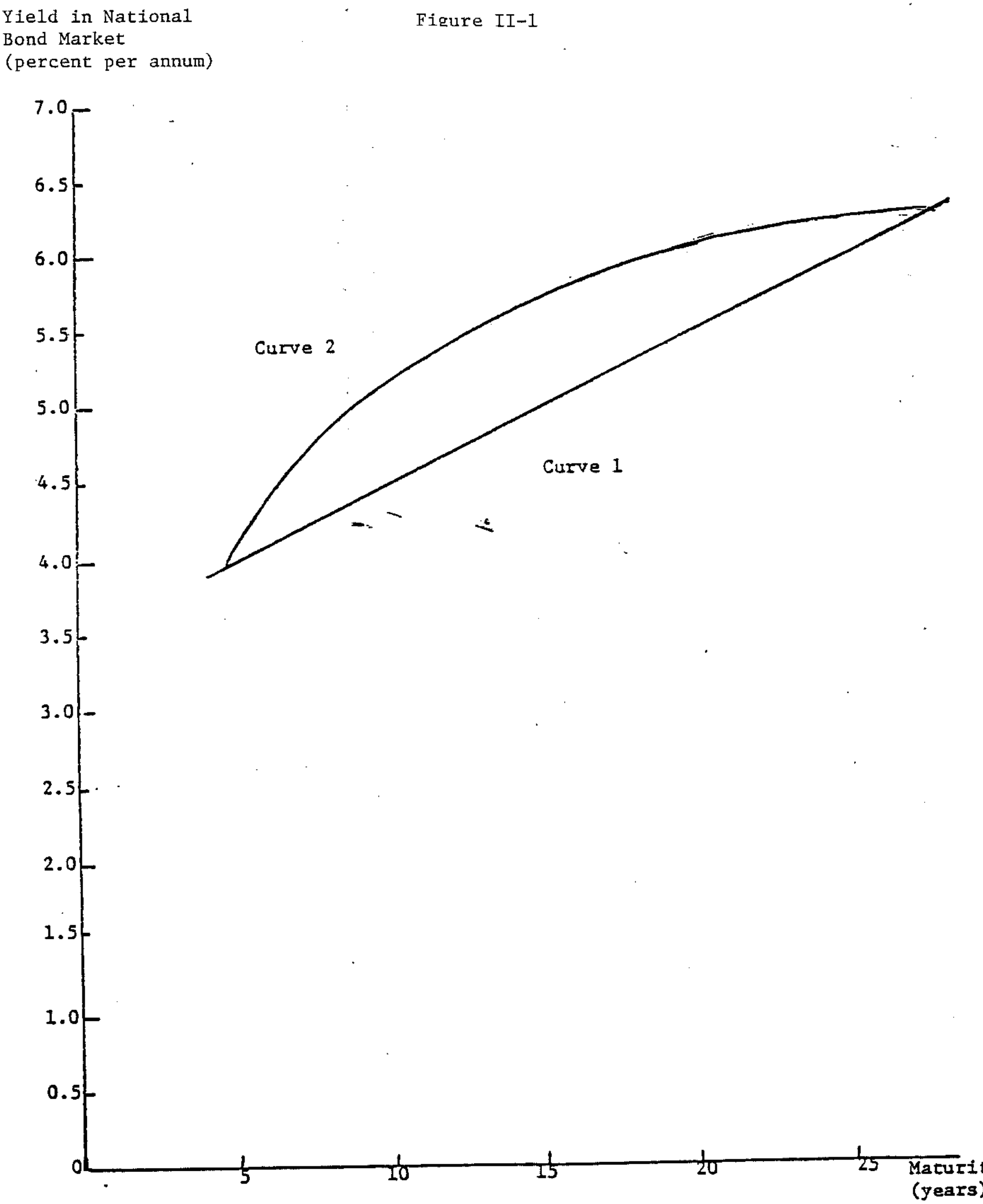
[3]See Maddala [37, ch. 13].

[4]The shape of the tax-exempt yield curve changed substantially over the period of our study.

The straightforward character of the national market conditions variable in our model is one advantage of our approach. The most important advantage of our procedure, however, is that it requires no assumption, explicit or implicit, about the form or stability of the market yield curve and therefore reduces the risk of measurement errors of the sort described above.

Our regression results for this variable are indicated in Tables 1-4 and can be summarized succinctly. Not surprisingly, the coefficients of the variable are highly significant in all of our regressions. Further, the coefficients in many of the equations have the reassuring property of being close to unity, which suggests that the equations are well specified. For example, the coefficients range between 0.96 and 1.01 for the 5-, 15-, and 20-year equations in our full-sample regressions (Table 1). The divergence at the 10-year maturity, where the estimated coefficient is 0.89, is somewhat greater.

Figure II-1


Yield in National
Bond Market
(percent per annum)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
Curve 2
Curve 1
5
10
15
20
25
Maturi
(years

III. REGIONAL MARKET CONDITIONS

Background and Theory

This section deals with the effects on reoffer yields of conditions in the regional markets where particular bonds are issued. If the municipal bond market is efficient, one might expect arbitrage to eliminate all but temporary differentials between the yields on comparable bonds issued in different locations. There are, however, a number of factors that probably work to prevent arbitrage from eliminating interregional differentials completely. Many municipal issues are relatively small and are handled by regional underwriters that sell primarily in regional markets. The cost to an investor in one state of obtaining information about, say, a local sewer bond issued in a different state might be considerable. Further, the income from a municipal bond is typically exempt from state and local taxes in the state of issue but not in other states. For these reasons, at least one previous study of the municipal market has suggested that the market is geographically segmented, particularly for smaller issues.[1] If such segmentation in fact exists, one would expect supply and demand conditions in regional markets to affect reoffer yields.

Figure III-1 attempts to illustrate, in a highly simplified manner, the nature of regional market segmentation. The diagram indicates the supply and demand for the stock of bonds issued in, for example, Virginia. The effect of the various factors noted in the preceding paragraph is to open a range within which the yield on bonds issued in Virginia (RVA) can vary independently of bond yields in the national market (RMUN). The terms k_{NR} and k_R represent the various segmenting factors expressed as a proportion of either RVA or RMUN. More specifically, k_{NR} represents the factors that

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[1]See Hendershott and Kidwell [15].

produce a difference between the (net) yield that a nonresident of Virginia can earn on Virginia bonds and the yield he can earn on a Virginia bond. Such factors include, among other things, (1) the difference between the cost of obtaining information on Virginia bonds and the cost of obtaining information on non-Virginia bonds, including bonds issued in the nonresident's own state or region, and (2) any state tax that the nonresident might have to pay on the income from Virginia bonds that he would not have to pay on bonds issued in his own state. Similar, k_R represents the factors that produce a difference between the yield that a Virginia resident can earn on Virginia bonds and the yield he can earn on bonds issued elsewhere. k_{NR} sets a limit, given by $\frac{RMUN}{(1-k_{NR})}$, on the extent to which RVA can rise relative to RMUN. For RVA> $\frac{RMUN}{(1-k_{NR})}$, nonresidents would purchase Virginia bonds, thereby forcing RVA back down to the limit. Similarly, k_R sets a limit, RMUN $(1-k_R)$, on the extent to which RVA can fall relative to RMUN. Below this limit residents would purchase non-Virginia bonds. Between the two limits, as the diagram indicates, regional demand and supply factors can affect RVA independently of RMUN.

We included three variables in our model to capture regional demand and supply effects: pledging requirements against state and local government deposits, the stock of state and local bonds already outstanding, and state tax rates.[2] In addition to these variables, we included variables reflecting the size of an issue to test whether regional effects depend on issue size.

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[2]The structure of our model implicitly assumes that regional markets conform closely to state boundaries. This assumption seems reasonable since one of the most important factors that might produce regional segmentation, state tax laws, relates specifically to states.

Pledging requirements. On the demand side we included a variable (PLDG) designed to measure the stringency of collateral or "pledging" requirements against state and local deposits in the state of issue. Some states require banks to hold securities equal to 100 percent or more of the value of their deposit liabilities to the state and its political subdivisions. Other states have less stringent requirements, and still others have no requirements or very low requirements.[3] Those states that impose such requirements invariably accept as eligible collateral U. S. government and agency securities and securities issued by the state in question and its political subdivisions. Therefore, one would expect the demand for municipal securities to be higher in states with relatively stringent requirements than in states with more lenient requirements, and there is evidence to support this contention.[4] In terms of Figure III-1, the demand curve would shift to the right across states as pledging requirements became progressively more stringent. In these circumstances, reoffer yields would vary inversely with the stringency of pledging requirements.

Stock of state and local bonds outstanding. To measure regional supply effects we included the ratio of the currently outstanding stock of state and local bonds to state personal income (STOCK/PI) for the state in which a bond was issued. If the municipal market is geographically segmented, a large outstanding stock of bonds issued by units in the same state would put upward pressure on the reoffer yields of new bonds issued in that state.

State tax rates. As suggested in the discussion of Figure III-1 above, one of the factors affecting the limits within which the yields on the bonds issued in a given state can rise or fall relative to national market

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[3]For a list of pledging requirements as of 1979, see the final report of the Federal Reserve's Ad Hoc Subcommittee on Full Insurance of Government Deposits [28, p. 44-45].

[4]See Ratti [45].

yields is state tax rates. For a particular state--such as Virginia in the diagram--there are two separate effects. First, state or local tax rates in states other than Virginia affect k_{NR} and hence the upper limit in the diagram. Second, the Virginia tax rate affects k_R and therefore the lower limit in the diagram. Specifically, the higher the Virginia tax rate, the lower would be the lower limit on the yields on bonds issued in Virginia. In general, therefore, higher in-state tax rates would be expected to reduce reoffer yields. Our model included the maximum state tax rates[5] applicable to both individuals and commercial banks in the state in which a bond was issued in an effort to capture the latter effect. It should be noted that this effect might be empirically weak, since the position of the lower limit in Figure III-1 would only affect yields in those cases where the supply curve intersected the lower horizontal portion of the demand curve.

Issue size.[6] The fourth and final variable we included that is related to regional supply and demand effects was issue size. As pointed out above, information costs are one factor that might produce geographic market segmentation, with higher information costs increasing the degree of segmentation. With reference to Figure III-1, such costs influence k_{NR} and k_R and hence the upper and lower limits on yields shown on the graph. More specifically, higher information costs widen the range between the limits and conversely. But information costs per dollar of par value almost certainly decline as issue size rises. It follows that the magnitude of both the pledging and outstanding stock effects diminish as issue size

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[5]These maximum rates are intended to serve as proxies for average rates since data on average rates are not available.

[6]Additional effects of issue size that are conceptually separate from those discussed here are discussed in section VII.

rises.[7] We included variables in our model to capture this effect of issue size. As noted below, a similar specification was used previously by Hendershott and Kidwell [15].

Against this background, our hypotheses regarding regional demand and supply effects can be specified formally as follows:

$$\text{(III-1)} \qquad REOFF = B_1 + \overset{-}{B_2}PLDG + \overset{+}{B_3}STOCK/PI + \overset{-}{B_4}STR + \overset{+}{B_5}PLDG \cdot \ln SIZE + \overset{-}{B_6}(STOCK/PI) \cdot \ln SIZE + B_7\bar{x} ,$$

where REOFF is the dependent variable, STR is the maximum in-state tax rate, SIZE is issue size, and $\bar{x}$ is a vector of the other explanatory variables in the model. The multiplicative terms involving SIZE are constructed to capture the partial offsets to the pledging and outstanding stock effects described above. The expected sign of each coefficient is shown above the coefficient.

Results of Previous Studies

Relatively few previous studies have included variables designed to capture the effects of regional demand and supply conditions on municipal yields. To our knowledge two studies have analyzed the pledging effect.[8] A

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[7]In terms of Figure III-1, the partial offset to the pledging effect can be interpreted roughly as reflecting those cases in our sample where relatively low information costs due to relatively large issue size lower the upper limit on yields to the extent that the supply curve intersects the demand curve in the upper horizontal portion of the demand curve. In these cases increased demand due to pledging requirements would either have no effect on yields or a diminished effect compared to those cases where the supply curve intersects the demand curve in the upward sloping portion of the curve. Similarly, the partial offset to the outstanding stock effect would reflect the impact of information costs on the lower limit on yields.

[8]Advisory Commission on Intergovernmental Relations [1] and Ad Hoc Subcommittee [12]. Only the ACIR study is discussed here since the present study is an extension of the work done by the authors for the Ad Hoc Subcommittee.

regression analysis carried out in connection with a study of public deposit insurance for the Advisory Commission on Intergovernmental Relations (ACIR) included dummy variables constructed to measure the pledging effect.[9] The pledging dummies were based on a classification of states among "high-pledge," "moderate-pledge," and "low-pledge" categories according to the stringency of requirements. The results of the analysis suggested that pledging requirements reduced NIC in the "high-pledge" states from about 5 basis points to about 20 basis points. Further, the effect appeared to be more consistently significant in the later years of the period due to the apparent substitution of municipal securities for Treasury and agency securities as collateral for public deposits by banks in the late 1960's and early 1970's.[10] Contrary to our hypothesis, the ACIR results suggested that the effect was somewhat greater on large issues than on small issues. The ACIR model, however, was much less fully specified than the present model. Moreover, it used NIC as the dependent variable and was therefore subject to the shortcomings of NIC models discussed earlier.

The ACIR model also included a measure of the outstanding stock of state and local debt similar to ours. This variable was significant and had the expected (positive) sign in a majority of the ACIR regressions. It was more consistently significant and its coefficients were larger in regressions for the smaller issues in the study's sample, which is consistent with the view that regional supply effects on yields diminish as issue size increases.

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[9] The ACIR study drew on a sample of 21,437 new general obligation bonds issued between 1966 and 1974. Separate regressions were run (1) for issues greater than and less than $5 million, respectively, and (2) for each year.

[10] Ad Hoc Subcommittee [12, pp. 30-32].

Hendershott and Kidwell [15] used a version of the standard NIC model to measure regional supply effects on bonds issued in Indiana between 1970 and 1974.[11] Their model included a variable designated WTISS that measured the recent volume of new municipal securities issued by Indiana units relative to the recent volume of new issues in the national market. This variable corresponds to the STOCK/PI variable in the present model. In addition to WTISS, Hendershott and Kidwell also entered a multiplicative term, WTISS·lnSIZE, to measure the impact of issue size on the supply effect. As expected, the coefficient of WTISS was positive and the coefficient of WTISS·lnSIZE was negative. Both coefficients were significant at the one percent level. Hence, Hendershott and Kidwell's results suggested that a regional supply effect existed, but that the effect was inversely related to issue size. In a related but separate analysis[12] Hendershott and Kidwell concluded that at least part of the effect washed out over a three-month period. They could not determine whether or not there was any permanent effect. If the effect were temporary, it might reflect market frictions and transactions costs rather than permanent market segmentation.

None of the earlier studies reviewed in the preparation of the present study analyzed the effect of state tax rates on yields.

Results of the Present Study

The results of our analysis extend and refine the results of previous studies. In particular, since our analysis included separate

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[11] Hendershott and Kidwell's sample included 389 bonds. They present the results of two separate analyses. Reference here is to the micro analysis described on pp. 342-345.

[12] Reference here is to Hendershott and Kidwell's macro analysis, pp. 340-342.

regressions according to maturity, we were able to investigate whether the regional demand and supply effects we analyzed differed systematically across maturities. It appears that commercial banks hold relatively few municipal bonds with maturities exceeding 15 years. In contrast, fire and casualty companies, the other major institutional buyers of municipals, apparently hold primarily longer maturities.[13] Therefore, for the reasons given below, the effects of both the pledging variable and the outstanding stock variable might differ between the 5-, 10-, and 15-year issues on the one hand and the 20-year issues on the other.

Pledging effect. Although the dummy variable included to measure the pledging effect in the ACIR study performed well, it only differentiated among states on the basis of the character of their pledging requirements and took no account of differences in the proportion of short-term assets held by state and local government units in the form of bank deposits as opposed to other assets. Clearly, both the stringency of pledging requirements and the relative volume of government funds held in bank deposits are relevant if pledging requirements do in fact influence municipal yields. The basis pledging variable (PLDG) used in our regressions was the percentage of total deposits in a state subject to pledging requirements, which should capture both dimensions of the pledging effect.

This variable worked well in our full sample and general obligation bond equations. Its coefficients had the expected sign and were highly significant at the 5-, 10-, and 15-year maturities. The coefficient was much smaller in the 20-year regressions and, although still significant, was less highly significant than at the shorter maturities. This pattern was expected since banks are less important participants at the long end

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[13] See Hendershott and Koch [30, pp. 24-25].

of the market. The results for the product of the pledging variable and issue size (PLDG·lnSIZE) are discussed below. The pledging variable was not highly significant in any of the revenue bond equations. This result may reflect the ineligibility of revenue bonds as collateral in some states with high pledging requirements.

Effect of stock outstanding. The coefficients of the outstanding stock variable had the expected sign and were highly significant in all of our full sample equations. Since this variable measures the outstanding stock of regional bonds rather than the flow of new issues, these results imply that an increase in the supply of regional issues has a permanent rather than a temporary effect on the yields of new regional issues as long as the increase is reflected in the ratio of the stock of regional issues to regional income. This implication differs from the results of Hendershott and Kidwell's analysis, which as noted above was inconclusive on this point.

Interestingly, the pattern of the coefficients of this variable across maturities is similar to the pattern of the pledging variable coefficients. Although the coefficient of the stock variable is significant at the 20-year maturity, it is markedly smaller than the coefficients at the shorter maturities. This characteristic of the stock variable coefficients, like the pattern of the pledging variable coefficients, may reflect the apparently greater participation of commercial banks in the market at the 5-, 10-, and 15-year maturities. The structure of the banking industry and banking markets is still largely regional and local in character. Since bank activity in the municipal market appears to be heavier at the 5- to 15-year maturities, the municipal market may be geographically segmented to a greater degree at these maturities than at the longer maturities; that is, the range between the limits in Figure III-1 may be wider for the shorter maturities. This condition would be consistent with the pattern of the coefficients.

State tax rates. None of the variables we included to capture the effect of differences in state tax rates was significant. This result is not entirely surprising. As noted in the discussion of Figure III-1 above, state tax rates would only be expected to affect yields in states with relatively low stocks of bonds outstanding.

Issue size. As indicated by equation III-1, our hypothesis specified that issue size should enter the equations multiplicatively with both the pledging variable and the stock variable. Neither STOCK/PI nor (STOCK/PI)·lnSIZE was significant, however, when both variables were entered due, we believe, to multicollinearity.[14] In contrast, PLDG·lnSIZE, had the expected sign and was significant at the 5-, 10-, and 15-year maturities in the full sample and general obligation equations, where the basic pledging effect is strongest. Moreover, the effect of variations in issue size on the estimated numerical magnitude of the full pledging effect is plausible. From equation III-1 the full pledging effect in our model is $B_2 \cdot PLDG$ + $B_5 \cdot lnSIZE \cdot PLDG$, which can be rewritten $(B_2 + B_5 \cdot lnSIZE)PLDG$. Using the estimated coefficients in the 10-year full sample equation, the total coefficient of PLDG varies from -3.661 for a $5 million issue to -0.542 for a $100 million issue.[15] The average magnitude of PLDG in states with relatively high pledging requirements is about 0.10 higher than in states with relatively low pledging requirements. Consequently, our results suggest that at the 10-year maturity, relatively high pledging requirements

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[14] The correlation coefficient between the two variables was .949.

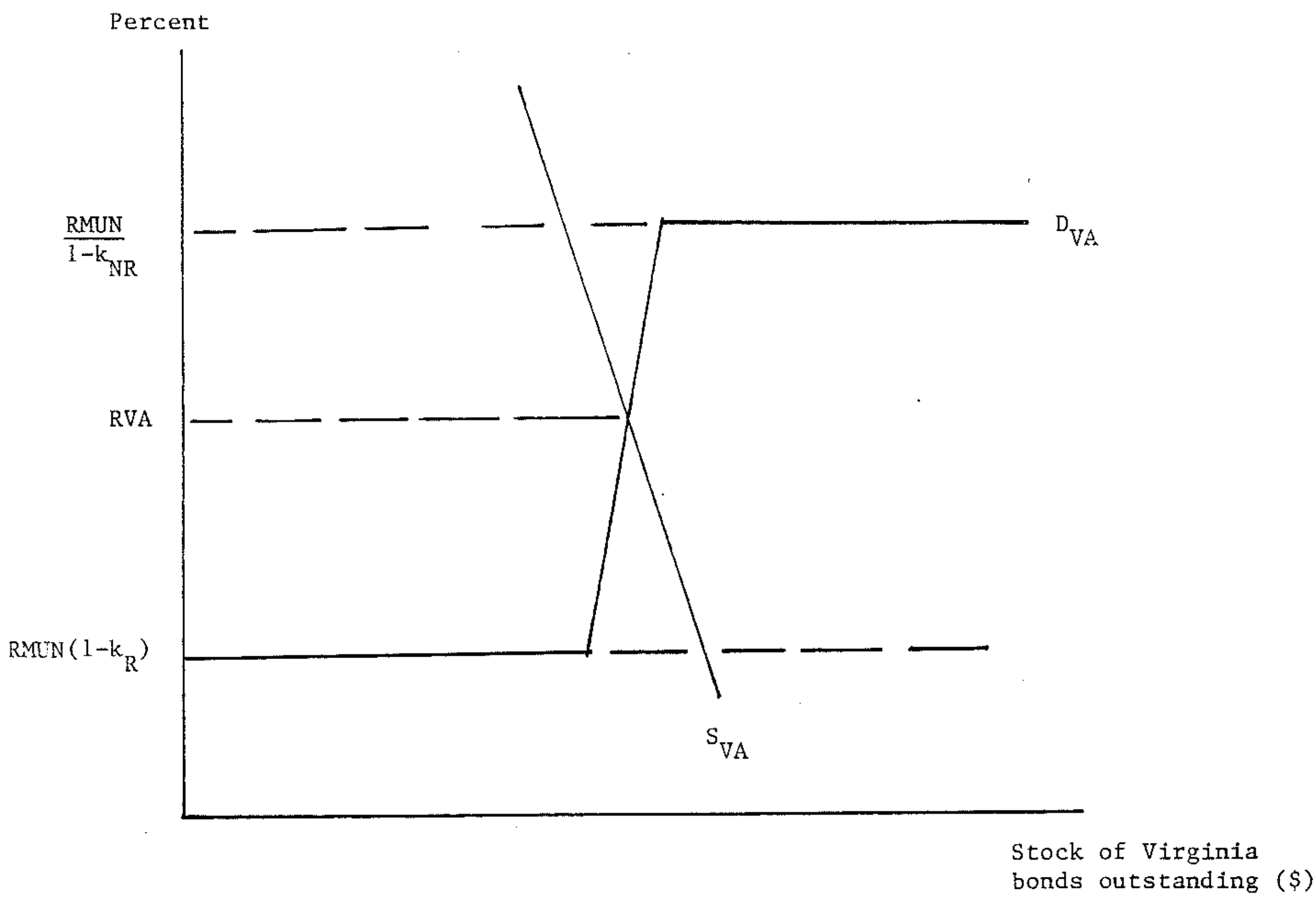
[15] Issue size data in this study are expressed in thousands of dollars.

reduce reoffer yields on the order of 35 basis points for small issues to 5 basis points or less for issues exceeding $100 million. We conclude that one of the effects of rising issue size on reoffer yields is to diminish the impact of the pledging effect.

Summary. The results described in this section suggest strongly that regional demand and supply effects exist in the municipal bond market. The magnitude of both the pledging and outstanding stock effects was greater at the 5-, 10-, and 15-year maturities than at the long end of the market, which may reflect heavier commercial bank activity at the shorter maturities. Finally, our results indicate that the strength of the pledging effect diminishes as issue size increases.

FIGURE III - 1

REGIONAL MARKET SEGMENTATION



IV. ISSUER CHARACTERISTIC: DEFAULT RISK

Background and Approach of Previous Studies

Default risk refers to the possibility that a bond issuer may not meet its obligations or may not meet them on time. One would expect default risk to affect the yield to maturity of a bond because a higher promised yield to maturity is necessary to achieve a given expected yield. Also, investors may demand a higher expected yield on a risky bond relative to the yield on a risk-free bond in compensation for the risk involved.

Risk premiums may vary among municipal bonds in a given data sample because of differences across issuers with respect to such measurable economic and fiscal conditions as the unemployment rate, the ratio of pension benefits to assets, or the volume of short-term debt per capita.[1] Or, even with these conditions unchanged, risk premiums might vary because investor perception of default risk changes for other reasons or investor tolerance for risk changes over the time period covered by the data sample.[2]

Previous studies of municipal bond yield differentials have generally used one of two approaches to measure the effect of default risk. A small number of studies interested primarily in default risk (for example [9, 10, 13]) have specified the economic and fiscal characteristics believed to influence risk premiums and entered them directly into yield spread regressions.

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[1]This list is taken from Browne and Syron [9].

[2]Although the second category has somewhat less intuitive appeal than the first, we believe it can be important. For example, it seems unlikely that the extraordinary rise in municipal bond risk premiums in 1975 and 1976 was due solely to a deterioration in the economic and financial conditions of lower rated issuers. Browne and Syron [9] found that an equation with economic and financial conditions as explanatory variables understated the yields of four Northern industrial cities in 1976 by at least 90 basis points in each case.

The second approach is to enter dummy variables for the various rating categories of the rating agencies. As indicated in the annotated references at the conclusion of this study, virtually all comprehensive cross-section studies of municipal yield differentials have used this second approach. This approach forces the risk premiums of all like-rated bonds to be equal over the entire time period covered by the data sample. Consequently, if fundamentals deteriorate but the rating agencies do not change ratings, or are slow to change them, errors will be introduced into the equation.

If risk premiums vary systematically over time, say with the business cycle or with a trend, then the use of the dummy variable technique could introduce errors that are correlated with one of the other independent variables included in municipal yield regressions. It is impossible to know *a priori* to what extent such problems may exist. The potential problem is greater the longer the time period covered by the data sample and the more variable risk premiums are over the period covered by the sample. Risk premiums generally declined over the period covered in a well-known study by Reuben Kessel [17]. As a result Kessel had to introduce four trend variables in order to offset the errors introduced into his equations by the default risk dummy variables.[3]

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[3] There is reason to believe that this procedure was not successful. Kessel reports a negative and highly significant coefficient for issue size, which has a strong upward trend over his 9-year estimation period (1959-1967) due to inflation. This coefficient could be picking up the negative trend in risk premiums that occurred over the period.

Results of the Present Study

Default risk. We used a variant of the second method described above that corrects for most of its deficiencies. Specifically, we used Moody's long-term municipal bond yield series to construct three default risk yield series: Aa-Aaa, A-Aaa, and Baa-Aaa. We then multiplied these spreads by five rating category dummy variables:[4]

Aa	=	AaDum·(Aa-Aaa)
A1	=	A1Dum·(A-Aaa)
A	=	ADum·(A-Aaa)
Baa1	=	Baa1Dum·(Baa-Aaa)
Baa	=	BaaDum·(Baa-Aaa)

This procedure forces risk premiums on like-rated bonds in the sample to conform with risk premiums implied by Moody's yield series at the date of issue.[5]

The coefficients of the five default risk variables are shown in Table 1. As in other studies these coefficients are highly significant. *A priori*, we expected the coefficients of Aa, A, and Baa to be fairly close to 1. The coefficient of Baa met this expectation. However, the coefficient of A was smaller than expected and the coefficient of Aa was far smaller than expected. Furthermore, the t-statistics of the Aa coefficients are well below those of the coefficients of the other default risk variables. We have no ready explanation for these results. It appears that the Aa risk premium as measured by the difference between Moody's Aa and Aaa yield series is not

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[4]Yield series for Baa1-rated and A1-rated bonds were not available. The implicit assumption is that the Baa1-Aaa spread moves proportionately to the Baa-Aaa spread and the A1-Aaa spread moves proportionately to the A-Aaa spread.

[5]An alternative approach to the problem of changing risk premiums for a given rating category over the sample period is to include a cyclical economic variable, such as the percentage change in GNP. This approach was used in [5, 20, 21].

a good indicator of the risk premium on newly issued Aa-rated bonds in our data sample. As noted below, a standard dummy variable performs better in our regressions than our variable Aa measure.

To investigate the possible hazards of using the unweighted rating category dummy variables, we re-ran the regressions with these as our default risk measures. There was very little change in the equations. The standard errors rose by only 3 to 4 percent. The only noticeable change in the coefficients was a drop in the national market conditions coefficient that was offset by a rise in the constant. The t-statistics of the variables were little changed. Consequently, it appears that over the period covered by our data, the use of unweighted rating category dummy variables creates no serious problems. However, this conclusion should not be generalized to other periods of greater variability of risk premiums, such as 1975 and 1976.

Default risk of Northern industrial cities. In addition to the basic default risk measures discussed above, we also included in our regressions a dummy variable set equal to 1 for the issues of large Northern industrial cities (NICD): Boston, Chicago, Cleveland, Detroit, Philadelphia, and Pittsburgh.[6] This variable was entered on two grounds. First, following the 1975 financial crisis in New York City there were numerous reports (for example [41]) that the publicity surrounding this crisis was pushing up the borrowing costs of other Northern industrial cities. Second, a study by Browne and Syron [9] indicated that the yields of many Northern industrial cities rose sharply relative to Aaa yields from 1975 to 1976 and that in at least some cases this rise could not be explained by changes in the basic economic and financial condition of the issuer.

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[6] On the basis of Browne and Syron's work [9] we could have also included Newark and Buffalo. However, there are no Newark bonds in our sample, and the two Buffalo issues in our sample were removed because we did not have complete data for these issues.

Our results show a large and highly significant effect of the NICD dummy variable on reoffering yields. The coefficients across the four maturity regressions were:

5-year	10-year	15-year	20-year
.53	.58	.65	.58
(11.54)	(11.08)	(12.41)	(8.62)

We also ran our regressions with dummy variables for the issues of each of the six cities individually. These results are reported in Table IV-1.

There are three possible interpretations of the NICD results. The first is that the discrete rating categories cover a wide ground and NICD is simply picking up the fact that these issues consistently fall at the tail end of the range covered by their rating category. This explanation can be dispensed with immediately. The largest coefficient that could be justified on this basis is about 10 basis points. As shown in Table IV-3, which is discussed below, 10 basis points is about half of the largest distance between the coefficients of any two adjacent rating category dummy variables.

The second explanation is that the economic and financial conditions affecting the risk premium on these issues changed, but Moody's didn't change its ratings before the specific issues in the sample were sold. The third explanation is that these conditions did not change but that risk premiums nevertheless rose for some other reason such as the publicity surrounding the New York crisis.

One useful piece of evidence in choosing between the two latter explanations is the subsequent behavior of Moody's. If there was a change in issuer conditions not reflected in Moody's ratings at the time of issue, one would expect that eventually Moody's would lower its ratings. We compared Moody's ratings at the end of 1981 on the issues in our sample to the ratings at the time of issue. As shown in Table IV-2, ratings of 15 of the 30 issues had been dropped, none had been raised and 15 were unchanged. Furthermore, ratings for five of the six cities had been dropped. On balance we feel the only conclusion that can be drawn from these results is that most of the "unexplained" risk premiums on issues of Northern industrial cities in our study reflects the relatively slow reaction of Moody's, as compared with investors, to deteriorating conditions in these cities.

Default risk and term-to-maturity. Since our analysis includes equations for four maturities, we were able to analyze the effect of risk premiums on yields across maturities. Van Horne [49] surveyed the evidence from three studies on the relation between risk premiums and maturity in the corporate bond market and found that evidence from two of the three supported the notion that the lower the grade of the bond, the higher short-term default risk premiums are in relation to long-term risk premiums. The rationale Van Horne offered for the inverse relation between risk premiums and maturity for lower grade bonds was that "for these grades, the probability of default may increase as the final redemption date grows nearer and the company is unable to improve its financial condition" [49, p. 166]. This situation creates a "crisis-at-maturity." Van Horne emphasized that the relationship between risk structure and maturity can change over time, especially during economic downturns when crisis-at-maturity may grow in importance. He did not specifically address the question of how far out the pattern of risk premiums is influenced by crisis-at-maturity. However, charts reproduced in his book indicate that significant effects occur at least out to the 10-year maturity.

There is little evidence on the relationship between risk premiums and maturity in the municipal market. Looking at data for the 1940's and 1950's, Robinson [46] concluded that the differential between the yields of Baa-rated and Aaa-rated bonds widened as maturity lengthens. This finding is not consistent with a crisis-at-maturity in the municipal market in the years studied by Robinson.

Our data is well suited to examine the relationship between risk premiums and maturity in the municipal market because it includes only new issues, it spans four maturities, and it can be limited to a data set that is completely consistent across maturities. To estimate the relationship between risk and maturity we ran the four maturity regressions using only general obligation issues that offered all four maturities. This limited the sample to 437 observations for each regression. Also, for the purposes of this section we used the default risk dummy variables so that we could easily compare coefficients across rating categories and maturities.

The default risk coefficients are shown in Table IV-3. There are two major results. First, in every case the coefficients of a particular rating category increase with maturity. In particular, risk premiums rise as much or more from the 5- to 10-year maturity for the low-grade bonds as they do for the high-grade bonds. Second, the slope of the term-to-maturity curve steepens from Aa to A1, from A1 to A, and from A to Baa1. Only from Baa1 to Baa is there a drop in the slope. The net increase in risk premiums going from the 5-year maturity to the 20-year maturity are:

Aa	.028
A1	.128
A	.150
Baa1	.220
Baa	.166

As noted above, Van Horne suggests that crisis-at-maturity is especially likely to push up risk premiums on shorter term issues in periods of economic weakness. There were no recessions during our sample period. However, there were two periods of relatively high risk premiums on low-grade municipal bonds. These occurred in (1) the first few months of 1977 when these premiums were still substantially above normal after reaching the peaks of 1976 and (2) the second half of 1978 when there were widespread expectations of an impending recession.

In order to test the thesis that the relationship between risk premiums and term-to-maturity may change as the perceived level of risk changes, we divided our initial sample into two subsets: (1) bonds issued in "high-risk" periods (when Baa-Aaa was greater than or equal to 78 basis points) and (2) bonds issued in "low-risk" periods (when Baa-Aaa was less than 78 basis points[7]). The "high-risk" issues include all of those issued in the first four months of the sample period, most of those issued in the last five months, and a small number of other issues. Because of the relatively small sample sizes, the "high-risk" set includes only 10 Baa1-rated and 12 Baa-rated issues while the "low-risk" set includes 31 Baa1-rated issues and 15 Baa-rated issues.

The results of this experiment are shown in Table IV-4 and graphed in Chart IV-1. There is very little difference in the slopes of the term-to-maturity curves for the five risk categories over the two subperiods. In particular, in both periods the net increase in yields from the 5- to 20-year maturity goes from about 3 basis points for Aa-rated issues to about 20 basis points for Baa1-rated issues. The slopes of the Baa1-rated curves are virtually identical in both subperiods, although the slope of the Baa-rated curve is somewhat flatter from the 10- to 20-year maturities in the high-risk period.

These results provide no indication that crisis-at-maturity had an effect on the yield curve of lower rated bonds in any part of the period

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[7] The cut-off point of 78 basis points was chosen arbitrarily so that the high-risk sample would include almost all the issues in the beginning and ending months of the sample. There are 183 observations in the high-risk group and 254 issues in the low-risk group.

covered by our data sample. Admittedly, this is not a strong test of whether crisis-at-maturity affects the relationship between low-grade bond risk premiums and term-to-maturity in the municipal market because our "high-risk" period does not include a recession. Nevertheless, the "high-risk" period was clearly a period of heightened investor concern over default on low-grade bonds, as evidenced by the fact that the Baa coefficients averaged more than 50 percent higher in that period than in the "low-risk" period.

TABLE IV-1

Coefficients of Northern Industrial City Dummy Variables

	5-year		10-year		15-year		20-year	
	number of issues	coefficient (t-statistic)	number of issues	coefficient (t-statistic)	number of issues	coefficient (t-statistic)	number of issues	coefficient (t-statistic)
Boston	3	.30 (2.29)	2	.30 (1.71)	1	.53 (2.10)	1	.49 (1.98)
Chicago	6	.19 (2.07)	6	.25 (2.42)	6	.30 (2.95)	3	.36 (2.60)
Cleveland	3	.45 (3.51)	3	.49 (3.38)	3	.49 (3.41)	3	.46 (3.26)
Detroit	10	.78 (10.48)	9	.82 (9.51)	10	.86 (10.31)	0	---
Philadelphia	6	.75 (7.95)	6	.82 (7.85)	6	.90 (8.57)	6	.87 (8.30)
Pittsburgh	1	.20 (.88)	1	.13 (.54)	2	.40 (2.25)	2	.35 (2.05)

TABLE IV-2

Moody's Rating Changes for Northern Industrial City Bonds
Subsequent to Issue Date

Date of Issue	Issuer	Rating at Time of Issue	Rating at End of 1981	Change
11-1-77	Boston	Baa	Ba	lowered
3-21-78	Boston	Baa	Ba	lowered
11-1-78	Boston Metropolitan District	A1	A1	
8-16-77	Chicago	Aa	A	lowered
12-1-77	Gr. Chicago Sanitary District (GO)	Aa	Aa	
5-3-78	Chicago Board of Education	A	B	lowered
5-23-78	Chicago Park District	Aa	A1	lowered
7-20-78	Gr. Chicago Sanitary District (Revenue)	A1	A	lowered
7-26-78	Chicago, Single Family Mortgage	A1	A1	
6-22-77	Cleveland	A	Ba1	lowered
10-27-77	Cleveland, Water	A1	Ba	lowered
9-14-78	East Cleveland City School District	A	A	
5-4-77	Detroit	Baa	Ba	lowered
6-1-77	Detroit School District	A	A	
7-13-77	Detroit	Baa	Ba	lowered
11-9-77	Detroit School District	A	A	
12-14-77	Detroit	Baa	Ba	lowered
5-24-78	Detroit	Baa	Ba	lowered
8-9-78	Detroit City School District	A1	A1	
10-24-78	Detroit School District (Qualified)	A	A	
11-28-78	Detroit	Baa	Ba	lowered
12-5-78	Detroit School District	A	A	
3-22-77	Philadelphia	Baa	Baa	
5-24-77	Philadelphia	Baa	Baa	
10-14-77	Philadelphia, Water & Sewer	A	A	
1-4-78	Philadelphia	Baa	Baa	
6-27-78	Philadelphia Gas Works	A	A	
12-7-78	Philadelphia, Water & Sewer	A	A	
6-1-77	Pittsburgh	A	Baa	lowered
6-7-78	Pittsburgh	Baa1	Baa	lowered

TABLE IV-3

Coefficients of Default Risk Dummy Variables

	5-year	10-year	15-year	20-year
Aa	.113 (3.52)	.116 (3.21)	.135 (3.67)	.141 (3.94)
A1	.276 (7.41)	.331 (7.92)	.401 (9.69)	.404 (9.96)
A	.310 (7.58)	.367 (7.99)	.437 (9.50)	.460 (10.22)
Baa1	.470 (9.00)	.546 (9.37)	.626 (10.65)	.690 (11.98)
Baa	.692 (11.61)	.748 (11.16)	.796 (11.80)	.858 (12.89)

Note: Data set includes 437 general obligation issues that were reoffered in all of the four maturities.

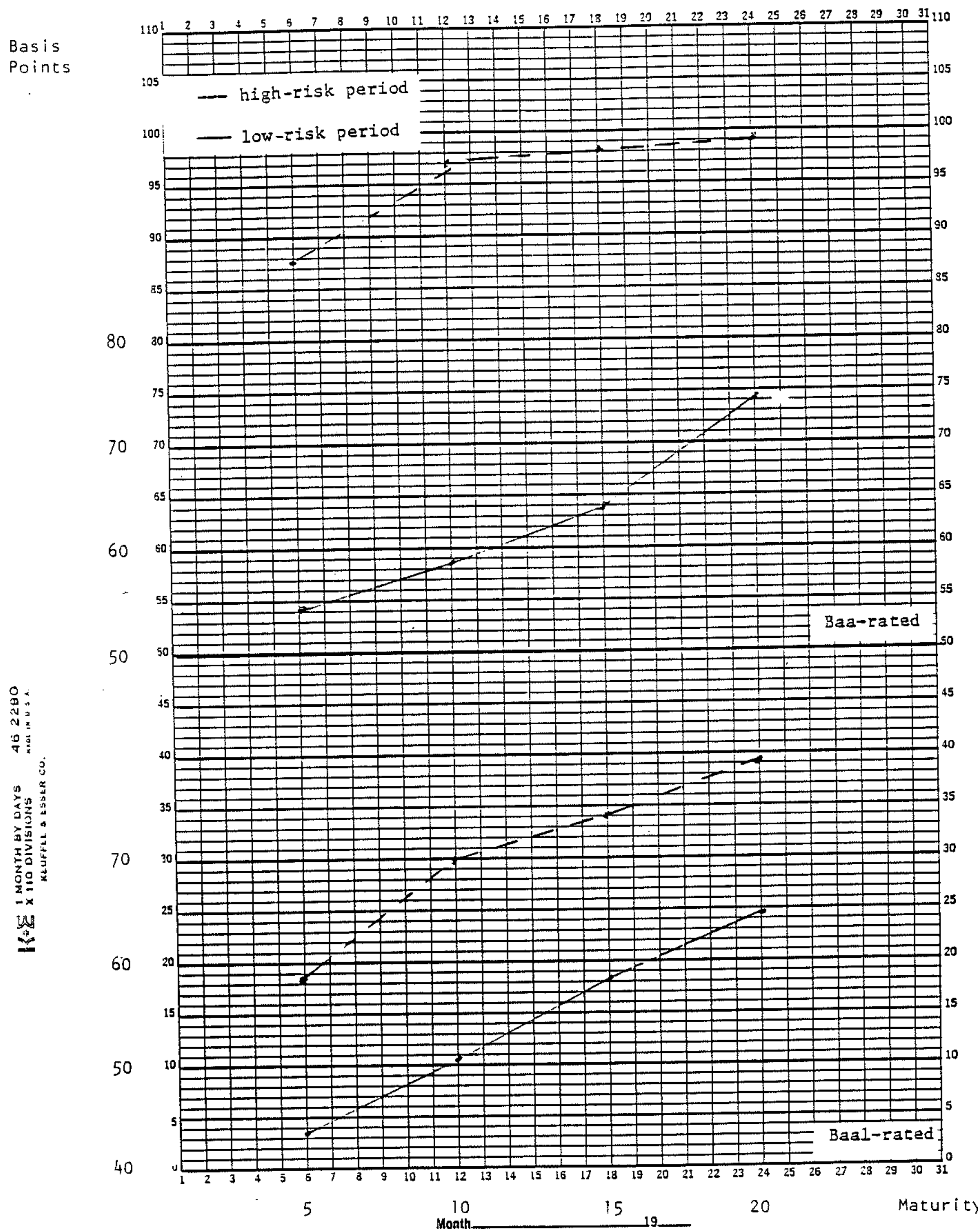
TABLE IV-4

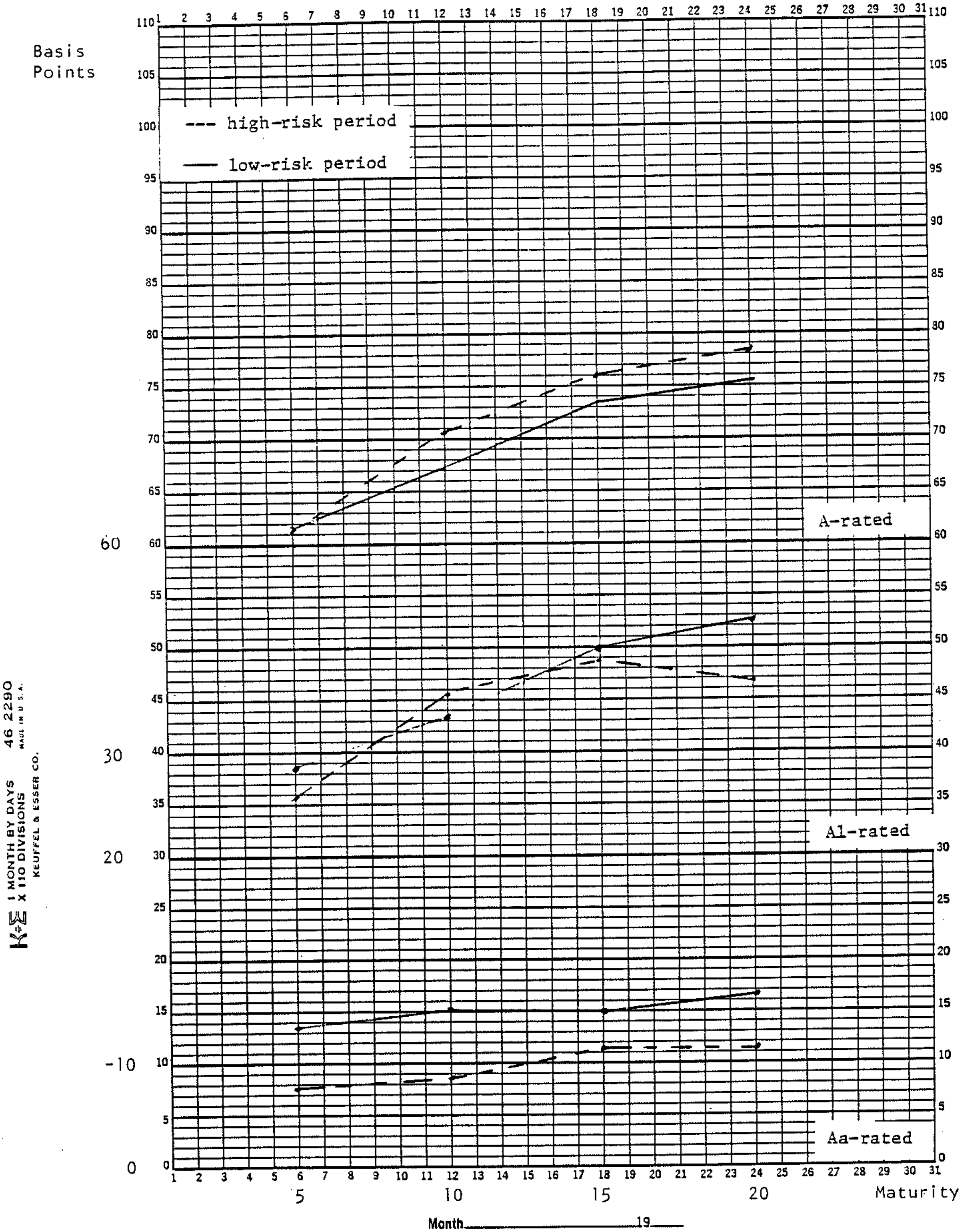
Coefficients of Default Risk Dummy Variables

	5-year	10-year	15-year	20-year
High-Risk Periods				
Aa	.078 (1.46)	.084 (1.37)	.116 (1.87)	.113 (1.90)
A1	.259 (4.06)	.354 (4.92)	.389 (5.42)	.368 (5.34)
A	.312 (4.40)	.407 (5.01)	.461 (5.55)	.483 (6.11)
Baa1	.589 (5.83)	.700 (6.08)	.741 (6.32)	.794 (7.06)
Baa	.877 (9.06)	.972 (8.76)	.983 (8.71)	.990 (9.03)
Low-Risk Periods				
Aa	.134 (3.62)	.151 (3.69)	.150 (3.53)	.164 (3.32)
A1	.284 (6.73)	.333 (7.09)	.401 (8.47)	.425 (3.80)
A	.315 (6.84)	.371 (7.29)	.434 (8.39)	.454 (8.71)
Baa1	.436 (7.51)	.505 (7.94)	.582 (8.93)	.648 (8.55)
Baa	.543 (7.74)	.584 (7.49)	.638 (8.05)	.745 (9.61)

Note: High-risk data set includes 183 issues and low-risk data set includes 254 issues. All issues are general obligations that were reoffered in all four of the maturities.

CHART IV-1
Default Risk Premiums and Maturity in High and Low Risk Periods




Basis Points
--- high-risk period
—— low-risk period
A-rated
A1-rated
Aa-rated
60
30
20
-10
0
5
10
15
20
Maturity
Month 19
K+E 1 MONTH BY DAYS X 110 DIVISIONS
KEUFFEL & ESSER CO.
46 2290

V. ISSUE CHARACTERISTIC: CALL RISK AND CALL PROVISIONS

Background

It has been well established, at least in the corporate bond market, that the risk that a bond will be called by its issuer prior to maturity can increase its yield to maturity at the time of sale.[1] Approximately 60 percent of the general obligation issues in our sample and all but one of the revenue issues contained callable bonds. Unlike taxable bonds, callable municipal bonds have call provisions that vary widely across issues. By far the most important call provisions are (1) the number of years to the first call date and (2) the price paid by the issuer if the issuer in fact calls the bond.

The data on years to first call for the bonds in our sample are shown in Table V-1. These data are shown by maturity to highlight the fact that while a particular serial issue may be "callable," some of the bonds that comprise the issue may not be callable at all because they mature before the first call date.[2] Only 0.7 percent of the callable issues in our full sample 5-year regression had an initial call date prior to maturity. This figure rises to 10.6 percent for the 10-year regression, 88.1 percent for the 15-year regression, and 98.2 percent for the 20-year regression.

The data on call price as of the first call date are shown in Table V-2 for the 15-year regression. The table includes only those issues in the regression that are callable prior to maturity. The tables show that while a call price of $103 per hundred par value at the time of years to first call is most common, call prices fall over a wide range including par. The pattern of call prices for dates after the first call date varies across bonds. In some cases the call price of a bond drops quickly to par while in other cases it

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[1]See, for example, [51].

[2]Only one initial call date is specified for serial issues. Hence the number of years to first call is the same for all securities in the serial.

declines gradually. Occasionally, the call price is expressed as a function of the number of years remaining before maturity. In no case, however, does the call price fall below par.

The extent to which the possibility that a municipal bond may be called affects its yield should depend on the pattern of interest rate expectations over the life of the bond. Ceteris paribus, the lower the expected future level of interest rates relative to current rates, the greater the probability that the issuer will find it profitable to call the issue. This factor is referred to as "basic call risk" throughout this paper. A plausible hypothesis is that yields increase with an increase in basic call risk.

The effect of call risk on a bond's yield should also depend on the extent to which the bond's call provisions make it less likely that the bond will be called. As noted above, the two major call provisions of tax-exempt bonds that vary across issues are years to first call and call price. It seems reasonable to presume that the effect of variations in these call provisions on yields is itself dependent on the existing state of interest rate expectations. In a period when basic call risk is viewed by investors as significant, variations in years to first call or call price across tax-exempt issues would be expected to produce variations in yields. By the same token, in a period when basic call risk is viewed by investors as negligible, variations in call provisions across bonds should have a negligible effect on yields.

Given the state of basic call risk, the expected effect of variation in years to first call on yields is straightforward: the increase in yields associated with an increase in basic call risk should be smaller the greater the number of years to first call. Similarly, call price is important because the higher the call price, the lower the probability that the market price of a bond will rise enough for the issuer to find the call option attractive. Consequently, the increase in yields associated with an increase in basic call risk should be smaller for high call prices than for low call prices.

There are two complications in analyzing the effect of call price on municipal yields. First, while the protection offered by years to first call is fully captured by one number, the call price at a given point in time, such as the first call date, is only a proxy for the price over the whole period between the first call date and maturity. Second, the probability that the price of a bond will rise above its call price after the first call date depends not only on the call price but also on the initial price of the bond. Short- and intermediate-term municipal bonds are often sold at a premiums, while long-term bonds are often sold at a discount.[3] Clearly, a 20-year bond sold at a deep discount has negligible call risk regardless of its call price or other call provisions. Conversely, an intermediate-term bond that is sold at a premium is subject to additional call risk.

In our empirical specification below we use the call price at the first call date as a proxy for the call price over the entire period between the first call date and maturity. We subtract from this call price the price of the bond at the first call date calculated using the bond's original yield to maturity. The difference is a measure of the gap that has to be overcome by falling interest rates before the market price of the bond rises to its call price. The bigger this gap at the first call date, the greater the decline in interest rates necessary to make call profitable to the issuer.

Previous Studies

The approach used in previous studies to capture the effect of call provisions on municipal bond yields has been to include either (1) a dummy

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[3]The reasons for these practices are discussed in section VI.

variable specifying whether or not the issue is callable or (2) a variable for the number of years to first call.[4] The predicted sign of the call dummy coefficient is positive while the predicted sign of the years to first call coefficient is negative. The empirical results in these studies have been generally disappointing. In only four studies [15, 19, 20, 22] did all reported regressions have statistically significant call variable coefficients with the predicted sign. In seven studies [4, 11, 12, 17, 18, 23, 24] the results of some reported regressions were significant while the results of others were not, and in six studies [3, 6, 7, 14, 16, 21] all call variable coefficients were insignificant. Of those studies reporting significant coefficients for the call dummy variable, the coefficients with one exception ranged from 11 to 35 basis points.[5]

The generally poor results of these studies stem from the complications discussed above. First, the dummy variable technique forces the effect of call risk to be constant over the whole period covered by a study's data sample, which ignores the effect of interest rate expectations on call risk. Second, as pointed out in the introduction, most previous studies have used the entire serial issue as the analytical unit and, consequently, have used aggregate interest rate measures such as NIC or TIC as dependent variables. This approach cannot accurately estimate call effects because a serial issue is a conglomeration of bonds, some of which may be callable and some of which may not be callable. Further, even among callable bonds within a given serial issue there is typically wide variation in the difference between maturity

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[4]An exception is Kidwell [18] who tested for other call features. Years to first call, however, was the only call variable that had a significant coefficient with the predicted sign in any of his regressions.

[5]Specifically, [4, 15, 19, 20] reported coefficients of .346, .148, .110, and .137, respectively. Study [24] reported a coefficient of .995 for general obligation issues and a coefficient of .198 for all issues.

and the first call date and in the difference between call price and the initial price of the bond.[6]

Results of the Present Study

Procedure. Our approach to measuring the effects of basic call risk and call provisions is designed to avoid the difficulties in previous studies. The procedure has three steps.

(1) First, we specify a basic call risk variable (CR) that is solely a function of interest rate expectations.[7] This variable is defined as:

$$\text{(V-1)} \qquad CR = \text{call dummy}(1/e^{SPR})$$

where the call dummy indicates whether or not the issue is callable and SPR is the spread between 20- and 7-year U.S. government bond yields.[8] This function form has the desired feature that as the spread becomes very large, the effect of basic call risk approaches zero. The assumption underlying the use of this proxy is that in 1977 and 1978, changes in the U.S. bond yield curve were determined by changes in interest rate expectations.

We construct three specific basic call risk variables, one each for the 10-year, 15-year, and 20-year regressions. (No call variables are

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[6]Also, as discussed earlier, the use of the serial issue as the analytical unit requires the use of aggregate national market conditions variables that may bias the coefficients of the call variables. For instance, an average maturity variable, which might be included to reflect the position of an "average" bond in a serial on the yield curve, might also pick up call effects by measuring the proportion of bonds in an issue that are callable.

[7]The choice of interest rate expectations as the "basic" determinant of call risk in our specification is somewhat arbitrary. In reality, call risk for a particular issue depends jointly on interest rate expectations, years to first call, call price, and the initial price of the bond. As indicated in what follows, however, we have built our analysis of the effect of call risk on yields around this factor. One advantage of focusing on interest rate expectations is that our results can be more easily compared to studies of the corporate bond market where interest rate expectations are generally the sole determinant of call risk.

[8]Since the most common years to first call is 10 years we would have preferred to use the spread between the 20- and 10-year U.S. yields. We used Salomon Brothers weekly data, however, and a 10-year maturity yield was not available.

included in the 5-year regressions because virtually none of the 5-year securities in our sample are callable.) Each of these variables is set at zero if years to first call for a particular issue is greater than the maturity of the bond in question. For instance, the call risk variable for the 10-year maturity (CR_{10}) is specified as:

$$\text{(V-2)} \qquad \begin{aligned} CR_{10} &= 0 \text{ if } YFC \geqq 10 \\ CR_{10} &= CR \text{ if } YFC < 10 \end{aligned}$$

(2) Second, we enter years to first call to the model multiplicatively with basic call risk. For the 10-year regressions, the years to first call variable (YFC_{10}) is:

$$\text{(V-3)} \qquad YFC_{10} = YFC \cdot CR_{10} \ .$$

If YFC is greater than ten, then CR_{10} will be set at zero and YFC_{10} will also be zero. However, if YFC is less than 10 years, the total call effect is:

$$\text{(V-4)} \qquad \overset{+}{c_1} CR_{10} + \overset{-}{c_2} YFC \cdot CR_{10} \ ,$$

where c_1 and c_2 are the estimated regression coefficients. This specification has the desirable property that the effect of a large YFC can only be to diminish the effect of whatever basic call risk is present at the time of issue. In contrast, if YFC were entered by itself in the regression, the implication would be that a large YFC could have a negative effect on yields even in periods when basic call risk is negligible.

(3) Finally, a set of three variables for call price (CP) are constructed. As indicated above, the variable is measured at the time of years to first call as the difference between call price and the price of the bond calculated using the bond's original yield to maturity. This variable is also entered multiplicatively with the basic call risk variable. Consequently, the total call effect in our regressions is:

$$\text{(V-5)} \qquad \overset{+}{c_1 CR_{10}} + \overset{-}{c_2 YFC \cdot CR_{10}} + \overset{-}{c_3 CP_{10} \cdot CR_{10}}$$

$$\text{(V-6)} \qquad \text{or} \qquad (c_1 + c_2 YFC + c_3 CP_{10}) \cdot CR_{10}$$

where c_1, c_2, and c_3 are the coefficients of the estimated equation.

Before discussing the results, two points about our specification need to be acknowledged. First, our approach assumes that the adjustment to changing interest rate expectations is made solely through the yield on callable bonds. This in turn assumes that state and local governments do not alter years to first call and call prices to offset the effect of changing interest rate expectations on callable bond yields. An examination of our data for callable bonds strongly supports this assumption. The correlation coefficients among the interest rate expectation and call provision variables are shown in Table V-3. Neither the years to first call nor the call price as of the first call date are significantly correlated with interest rate expectations or the level of interest rates.[9] The second aspect of our specification is that, as noted above, the call price at the first call date is used as a proxy for the call price over the entire period between the first call date and the maturity date.

Results. As shown in Table 1 the coefficients of the basic call risk variable by itself and the years to first call variable have the expected sign and are highly significant in the 15- and 20-year full sample regressions. The t-statistics in the 10-year regression drop sharply, but are still significant at the 10 percent level. The coefficients of the call price variable generally were not significant and in one instance the coefficient was significant with the wrong sign. Consequently, this variable was dropped from the reported equations.[10]

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[9]The lack of correlation between the level of interest rates and years to first call was also found by Kidwell [35].

[10]We beleive the most plausible explanation for the poor performance of the call price variable is that it is too crude to serve as a proxy for the

The sum of the coefficients of the basic call risk variable (i.e. $c_1 + c_2 \cdot \ln(YFC)$) are shown in Table V-4 for different values of YFC. (The table can also be read as the effect of call risk on yields for a spread (SPR) of 0--i.e. a value of CR of 1--which is about one-third from the bottom of the range of the spread variable.) The pattern of coefficients across and within maturities generally conform to _a priori_ expectations. First, for a given YFC the coefficients rise with the maturity of the bond. The only exception to this is the coefficients of the 15- and 20-year maturities at low levels of YFC. Second, the sum of the coefficients of the basic call risk variable for a particular maturity approach 0 as YFC approaches maturity. For all three maturities the sum of the coefficients have the undesirable property of dropping below 0 when YFC equals maturity. In the 10- and 20-year regressions, however, these negative value are very close to 0 (-.017 and -.029, respectively).

The total call effect for the 20-year regression is shown in Chart V-1 over the range of the yield spread used in our regressions. The effect for a 20-year bond with 5 years to first call ranged from 8 to 22 basis points over the 1977-78 period. For a bond with 10 years of call protection, the effect was only 3 to 9 basis points. These call effects are fairly small compared to the maximum effect reported in corporate bond studies. Municipal bond rates were low in the 1977-78 period relative to the three preceding years, however, and one would therefore expect the call effect to be relatively weak in this period. Larger effects might well occur in high interest rate periods.

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behavior of call price over the entire period between the initial call date and the maturity date. An alternative explanation is that multicolinearity exists between the call price variable and other variables, to be discussed in the next section, that were included to capture the effects of discounts and premiums on yields. We investigated this latter explanation by rerunning the regressions using only par bonds. The call price coefficients, however, remained insignificant.

As noted in the introduction, Table 5 shows the results of a re-estimation of our basic equation using NIC as the dependent variable and incorporating the national market conditions variables typically used in NIC equations. The results for the call coefficients in this regression were similar to the relatively weak results in the 10-year regression discussed above and, like the 10-year regression results, were significantly weaker than the results in our 15- and 20-year regressions.

TABLE V-1

Years to First Call of Bonds
in Regressions

	5-year regression	10-year regression	15-year regression	20-year regression
Total number of observations	860	876	829	620
Total number of issues not callable	270	265	243	166
<u>Number of years to first call</u>				
1 ≤ and < 5	4	4	3	3
5 ≤ and < 10	59	61	52	32
10 ≤ and < 15	451	470	461	351
15 ≤ and < 20	68	68	62	60
Greater than or equal to 20	8	8	8	8
(memo item: equal to 10)	359	376	371	283

TABLE V-2

Call Price at Time of First Call for Bonds
in 15-Year Regression
(Includes only bonds in regression callable
in less than 15 years)

Call price	Number of issues
Equals 100	112
100 < and ≤ 101	25
101 < and ≤ 102	104
102 < and ≤ 103	246
103 < and ≤ 104	20
greater than 104	9
TOTAL	516

TABLE V-3

Correlation Coefficients Among Call Variables

	20-Year Aaa Rate	Basic Call Risk	YFC	Call Price at YFC for 20-Year Maturity
20-Year Aaa Rate	1	.805	.075	-.064
Basic Call Risk		1	.069	-.088
YFC			1	-.366
Call Price at YFC for 20-Year Maturity				1

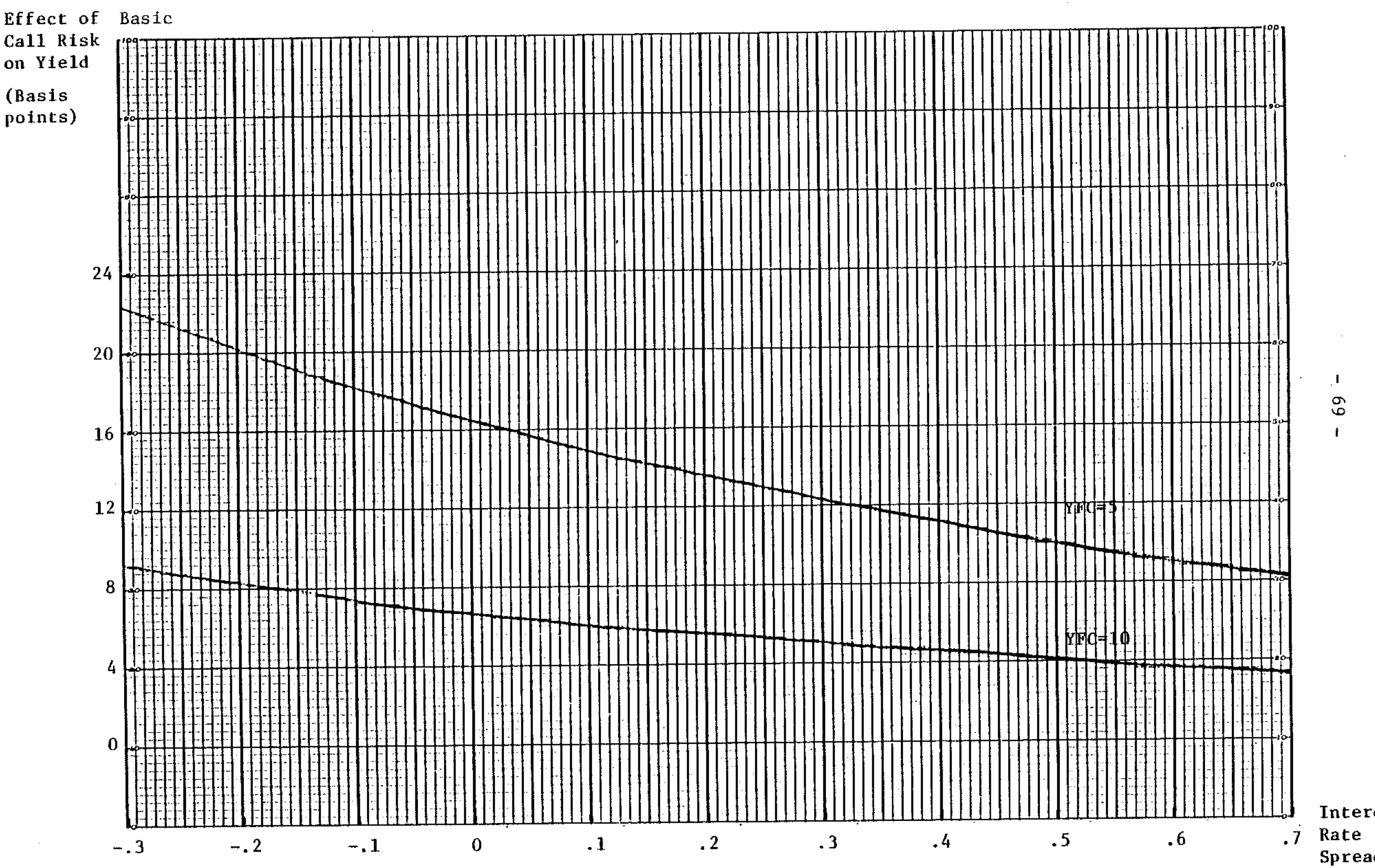
TABLE V-4

Total Coefficients of Basic Call Risk (CR)
for Different Values of Years to First Call

Years to First Call	Maturity 10	Maturity 15	Maturity 20
5	.093	.173	.165
7	.040	.102	.118
10		.027	.068

CHART V-1

Total Effect of Basic Call Risk on Yield Implied by Regression Coefficients



VI. ISSUE CHARACTERISTIC: INEFFICIENT COUPONS

Background and Results of Previous Studies

In the municipal market, new short- and intermediate-term issues are often sold at a premium while long-term issues are often, but less frequently, sold at a discount. In the former case the issue carries a coupon below its yield to maturity.

Hopewell and Kaufman [32] have labeled a municipal bond's coupon "inefficient" if it is above or below the bond's yield to maturity. The data on inefficient coupons for our sample of bonds is shown in Table VI-1 for premium bonds and in Table VI-2 for discount bonds. Table VI-1 shows that at the 5-year maturity, 84.2 percent of the issues had coupons that exceeded yield to maturity and 44.3 percent had coupons that exceeded yield to maturity by more than one percentage point. These percentages drop sharply for the longer maturities. Only 14.9 percent of the issues at the 10-year maturity and almost none at the 15-year maturity had coupons more than 1 percentage point above yield to maturity. The size of discounts in our sample is much smaller on average. As indicated by Table VI-2, 50.1 percent of the issues at the 20-year maturity had coupons below yield to maturity, but only 5.2 percent of these were more than one percentage point below.

The reason municipal bonds often have inefficient coupons is that the winning bid on a municipal issue is determined on the basis of net interest cost (NIC). The essential feature of NIC is that it does not assign time value to money. Hence:

> Because investors place time value on coupons, coupons on early maturities can be sold by the underwriters at higher prices than coupons on later maturities summing to the same dollar amount. Yet, under NIC, these coupons do not cost the underwriter any extra. Thus, to maximize their revenues from the sale of the bonds, the underwriters are encouraged to place the highest coupons on the earliest maturities....To obtain a low NIC, compensating low coupons are placed on the most distant maturities [32, p. 534].

Hopewell and Kaufman [32, 33] have explored the costs to municipal governments of awarding bonds sold competitively to underwriters on the basis of NIC bidding as opposed to true interest cost (TIC) bidding. Hopewell and Kaufman break these costs down into two components. The first cost arises because the lowest NIC bid may not be the same as the lowest TIC bid. The second cost--which is our focus here--arises because investors, according to Hopewell and Kaufman, will only purchase bonds with inefficient coupons at higher yields to maturity than bonds with efficient coupons that are otherwise similar in all respects. Consequently, yields, calculated on a TIC basis, will be higher under NIC bidding than under TIC bidding.

Hopewell and Kaufman estimated the cost to an issuer of accepting the wrong bid as the difference between the present value of the coupon stream of the low NIC bid and that of the low TIC bid. They measured the cost of inefficient coupons--the second cost noted above--by (1) specifying an "efficient" yield curve for the lowest TIC bid and (2) then calculating the difference between the present value of the coupon stream generated by this efficient curve and the present value of the actual stream of inefficient coupons.[1] Hopewell and Kaufman approximated the efficient curve on the basis of their own judgment regarding the yields that would be required to sell par bonds for the issue at different maturities, holding all other characteristics of the issue constant.

Hopewell and Kaufman gave different explanations for the effect of high and low inefficient coupons on reoffering yields. The most powerful factor they cited was the capital gains tax liability incurred on low coupon

[1]The discount rate used to calculate the present value of all three coupon streams is the low TIC bid. The choice of the appropriate rate of discount is discussed in [32, p. 533].

discount bonds. Par bonds are not subject to any taxes, while discount bonds may be subject to capital gains tax on the discount at maturity, and in any case investors appear to believe they are subject to tax.[2] Consequently, a higher reoffer yield is required on a discount bond in order to earn the same after-tax yield as on an otherwise comparable par bond. Hopewell and Kaufman also cited a number of other factors that may further inflate the yield of a discount bond [33, p. 284-285]:

> Low coupon bonds have longer duration than current coupon bonds of comparable maturity and thus are more volatile in price for a given change in interest rates. To the extent liquidity premiums exist and increase with term to duration, the creation of low coupon bonds results in the creation of riskier bonds than otherwise on which investors demand correspondingly greater compensation, even after adjustments for [tax] difference....Some investors may also view discount bonds unfavorably because of the lack of cash flow or reduced marketability and demand a compensating penalty yield.

Hopewell and Kaufman also offered an explanation for the effect of high inefficient coupons on yields [32, p. 535]:

> High coupon bonds that force bonds to sell at larger premiums subject investors to additional costs and/or risks associated with the reinvestment of coupon payments. Risk averse investors find these bonds less attractive than par bonds and purchase them only at a higher yield.

This explanation, it might be noted, seems less persuasive than the explanation for discount bonds since if these factors were important, they should have the opposite effect on discount bonds.

In their empirical work, Hopewell and Kaufman [33] concluded that both high and low inefficient coupons raise reoffering yields. The measured effect of high coupons, however, was much smaller. They also concluded that in the case of most issues, capital gains tax liability by itself is insufficient

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[2]According to a publication of the Securities Industry Association [26, p. 9], capital gains are exempt from taxation only when the <u>issuer</u> issues them to the underwriter at a discount. If, in contrast, the underwriter purchases an entire serial issue of bonds at a single unallocated price not less than their total par value and some of the bonds are reoffered by the dealer at a discount,

to explain the magnitude of the additional yield required on discount bonds.[3]

Approach and Results of the Present Study

Procedure. We developed a direct test of Hopewell and Kaufman's theory that inefficient coupons raise reoffering yields by including measures of the inefficiency of an issue's coupons as independent variables in our regressions. Specifically, we calculated a variable for high inefficient coupons and a variable for low inefficient coupons for each maturity in our sample. For example, the high inefficient coupon variable for the 5-year maturity is the difference between a 5-year issue's coupon and its yield to maturity. The difference is set at zero if the bond is selling at a discount. Similarly, the low inefficient coupon variable is the difference between an issue's yield to maturity and its coupon.[4]

This approach to the analysis of coupon rate effects has three desirable features. First, in contrast to Hopewell and Kaufman's procedure, it does not require judgments on our part as to what the efficient yield curve is for a particular issue. Second, it separately tests for the influence of high and low coupons. This is important since, as noted above, the explanations given by Hopewell and Kaufman for the two effects are different. Third, if Hopewell and Kaufman are correct, then our regressions add a set of variables

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the capital gain is not tax-exempt. This interpretation has been challenged, however, in a recent article by Braswell, Reinhart, and Hasselback. (See Ronald C. Braswell, Walter J. Reinhart, and James R. Hasselback, "The Tax Treatment of Municipal Discount Bonds," Financial Management, Spring 1982.) These writers conclude that if an investor buys a new discount bond from an underwriter, the discount is treated as tax-free interest income regardless of the circumstances under which the underwriter acquired the bond from the issuer.

[3] Hopewell and Kaufman [32, p. 538] also found the costs of inefficient coupons to state and local governments were much higher than the costs of accepting the wrong bid.

[4] In practice virtually no 5-year or 10-year bonds are sold at discounts and virtually no 20-year bonds are sold at premiums. Consequently, only the 15-year regression includes both high and low coupon variables.

that have been missing from all previous cross-section regression studies of tax-exempt yield differentials.

As a preliminary, it will be useful to calculate the expected coefficients of the low coupon variable in our 15- and 20-year regressions under the assumption that low coupons influence reoffering yields only because of the capital gains tax effect discussed above. An abbreviated version of our regression model is

$$\text{(VI-1)} \qquad R = EC + \beta(R\text{-}COUP),$$

where R is a bond's actual yield to maturity, COUP is its actual coupon and EC is the implicit efficient coupon. That is, EC is the yield to maturity the bond would carry if its yield and its coupon were equal. Since in this hypothetical case the only cost of the inefficiency of the actual coupon is the capital gains tax, the efficient coupon is the investor's after tax yield.

Tables VI-3 and VI-4 show values of β for different levels of interest rates and for different levels of (R-COUP) and EC.[5] In making the calculations shown in Tables VI-3 and VI-4 we used the 48 percent capital gains tax rate of commercial banks, which are collectively the largest investors in the municipal market and which have the highest capital gains tax rate. Hence, the computed values for β are the maximum one would expect if capital gains taxes were the only force pushing up the yield on discount bonds. The tables indicate that β falls moderately with an increase in the level of interest rates and rises moderately with an increase in the size of the discount. For the 20-year maturity the value of β for the typical discount bond in our sample is about 16 to 17 basis points, while for the 15-year maturity the value is about 20 to 22 basis points.

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[5] These values were calculated as follows. First, the after-tax yield and capital gains tax rate was plugged into the after-tax yield to maturity formula to calculate the price of a bond with a given coupon and maturity. This price was then plugged into before-tax yield-to-maturity formula to derive the before-tax yield-to-maturity.

Regression results. Our results strongly support the view that low coupons raise reoffering yields. The coefficient in the 20-year regression in Table 1 is .16 and the t-statistic is over 6. The coefficient in the 15-year regression jumps sharply to .46 while the t-statistic falls to 2.69.

We considered two explanations for the unexpectedly large difference between the coefficients in the 15- and 20-year equations. First, as noted in the discussion of call effects, there is no variable in the regressions that accurately captures the effect of the call protection provided by call price. It is reasonable to presume that this "missing" variable would be correlated with the low coupon variable because low coupons increase the gap between call price and the initial price of a bond. This correlation would bias the coefficient of the low coupon variable downward, and this bias would be greater in the 20-year equation than in the 15-year equation. Consequently, we reran the regressions with only noncallable bonds. The resulting coefficients are compared to the original coefficients in Table VI-5. There was some narrowing of the gap between the 15- and 20-year discount bond coefficients, but the gap remained substantial.

A plausible behavioral interpretation of the remaining gap is that it reflects the larger impact of commercial bank behavior at the 15-year maturity. According to Hobby [31] bank holdings of municipals fall off sharply above the 10-year to 15-year maturity range. Since commercial banks have a higher capital gains tax rate than individuals, who are the second largest group of investors in municipal securities, one might expect the marginal investor at the 15-year maturity to have a higher capital gains tax rate than the marginal investor at the 20-year maturity. This difference would tend to raise the coefficient of the low coupon variable in the 15-year regression relative to the coefficient in the 20-year regression.

This interpretation has two implications. First, since it assumes that the capital gains tax rate of the marginal investor at the 20-year maturity is less than the bank capital gains tax rate used in constructing Table VI-3, the coefficients of the low coupon variable in both the 15- and 20-year regressions support Hopewell and Kaufman's conclusion that the yields on discount bonds reflect more than an adjustment to equate after-tax yields. This is true because the estimated coefficient in the 15-year equation exceeds the coefficients calculated in Table VI-4, and the estimated coefficient in the 20-year equation exceeds the coefficients that would have appeared in Table VI-3 if a lower tax rate had been used in constructing the table. Second, this interpretation of the coefficients implies that there are habitat effects on the tax-exempt yield curve.

The results for the high coupon variables are much weaker. The coefficient in the 5-year regression, which has the largest premiums, is approximately 2 basis points and is significant only at the 10 percent level using a two-tail test. The coefficients of the high coupon variables in the other maturity regressions were not significant.[6]

<u>State and local government behavior.</u> Silber [47, p. 13] has observed that despite the evidence on the costs to state and local governments of using NIC bidding put forward by Hopewell and Kaufman, "the practice has not been abandoned by municipalities--an observation worth recalling when trying to apply a pure profit-maximizing model to local government decisions." Our data on discounts and premiums in conjunction with our regression results suggest

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[6] In at least one reference Hopewell and Kaufman imply that the effect of premiums on reoffering yields is limited to "large" premiums, although it is not clear from their explanations why the impact of premium coupons on yields should be discontinuous. As a rough test of this explanation we redefined our high coupon variable so that all values less than one percentage point were set equal to zero. There was no net improvement in the performance of the high coupon coefficients. In two maturities the t-statistic fell, and in one maturity it rose.

that Silber may have been too harsh in his judgment of state and local government behavior. As Hopewell and Kaufman note [33, p. 295], the costs to governments of NIC bidding can be reduced or eliminated not only by moving to another bidding procedure, but also by putting constraints on the types of bids accepted. Our data show that in the 1977-78 period the number of issues with large premiums was very large while the number with large discounts was very small. Hopewell and Kaufman do not report their discount and premium data in detail. A reading of their articles, however, indicates that in their 1973 data the relative use of premiums was less while the use of discounts was considerably greater.

Both our results and Hopewell and Kaufman's results indicate that discount bonds impose by far the greatest cost on governments. The small number of large discounts in the 1977-78 period suggest that governments have recognized these costs and reacted by putting constraints on the use of low coupons in NIC bidding.

TABLE VI-1

Inefficient Coupons: Premiums

Spread Between Coupon and Yield to Maturity
of Bonds in Sample
(percentage points)

	5-year maturity	10-year maturity	15-year maturity
Equal to 0 (or negative)	140	306	622
0 < and ≤ 0.5	123	332	207
0.5 < and ≤ 1.0	230	129	11
1.0 < and ≤ 1.5	142	50	9
1.5 < and ≤ 2.0	104	51	2
2.0 < and ≤ 2.5	95	26	0
2.5 < and ≤ 3.0	36	3	0
3.0 < and ≤ 3.5	6	2	0
3.5 < and ≤ 4.0	6	2	0
4.0 < and ≤ 4.5	2	0	0
greater than 4.5	1	0	0
Total	885	901	851

TABLE VI-2

Inefficient Coupons: Discounts

Spread Between Yield to Maturity and Coupon
of Bonds in Sample
(percentage points)

	15-year maturity	20-year maturity
Equal to 0 (or negative)	670	317
0 < and ≤ 0.5	181	272
0.5 < and ≤ 1.0	0	13
1.0 < and ≤ 1.5	0	16
1.5 < and ≤ 2.0	0	11
2.0 < and ≤ 2.5	0	5
greater than 2.5	0	1
Total	851	635

TABLE VI-3

Before- and After-Tax Yields on Discount Bonds
Maturity = 20 Years
Capital gains tax rate = 48%

Actual Coupon		Efficient Coupon (After-Tax Yield) 4-1/2	5	5-1/2	6	6-1/2	7
4	R (before-tax yield)	4.63	5.24	5.84	6.43	7.01	7.57
	R-EC	.13	.24	.34	.43	.51	.57
	R-COUP	.63	1.24	1.84	2.43	3.01	3.57
	(R-EC)/(R-COUP)	.21	.19	.18	.18	.17	.16
5	R (before-tax yield)			5.60	6.19	6.77	7.34
	R-EC			.10	.19	.27	.34
	R-COUP			.60	1.19	1.77	2.34
	(R-EC)/(R-COUP)			.17	.16	.15	.15
6	R (before-tax yield)					6.58	7.15
	R-EC					.08	.15
	R-COUP					.58	1.15
	(R-EC)/(R-COUP)					.14	.13

TABLE VI-4

Before- and After-Tax Yields on Discount Bonds
Maturity = 15 Years
Capital gains tax rate = 48%

Actual Coupon		Efficient Coupon (After-Tax Yield) 4-1/2	5	5-1/2	6	6-1/2	7
4	R (before-tax yield)	4.67	5.32	5.96	6.59	7.21	7.81
	R-EC	.17	.32	.46	.59	.71	.81
	R-COUP	.67	1.32	1.96	2.59	3.21	3.81
	(R-EC/R-COUP)	.25	.24	.23	.23	.22	.21
5	R (before-tax yield)			5.64	6.27	6.88	7.49
	R-EC			.14	.27	.38	.49
	R-COUP			.64	1.27	1.88	2.49
	(R-EC/R-COUP)			.22	.21	.20	.20
6	R (before-tax yield)					6.61	7.22
	R-EC					.11	.22
	R-COUP					.61	1.22
	(R-EC/R-COUP)					.18	.18

TABLE VI-5

Low Coupon Variable Coefficients

	Full Sample		Noncallable Bonds	
	Coefficient	Number of Bonds	Coefficient	Number of Bonds
15-year maturity: discount	.461 (2.69)	827	.357 (1.71)	313
20-year maturity: discount	.161 (6.05)	619	.192 (5.01)	174
Difference between 15- and 20-year discount coefficients	.300		.165	

VII. OTHER ISSUE CHARACTERISTICS

In addition to call provisions and coupon characteristics we included two other issue characteristics in our regression model: (1) the size of the issue and (2) whether or not the issue was a revenue bond. Numerous previous studies of the municipal bond market have included one or both of these variables. In most of these studies, however, little or no attempt was made to explain the rationale for their inclusion.

Issue Size[1]

Previous studies. A large number of earlier regression studies of municipal yields have included issue size, usually in either simple linear or logarithmic form, as an independent variable. The results of these studies fall into a fairly clear pattern, depending on whether the dependent variable was (1) the reoffer yield or (2) either NIC or TIC. Four studies found a significant relationship between reoffer yields and size. Two of these studies [17, 21] found a simple negative relationship, and none found a simple positive relationship. In contrast, of the nine studies that found a significant relationship between NIC or TIC and size, eight studies [2, 3, 4, 6, 7, 15, 19, 24] found a simple positive relationship. This pattern of results suggests two tentative conclusions. First, since the regressions with reoffer yields as dependent variables reflect investor behavior, it appears that investors are willing to accept lower yields on securities in larger issues. Second, if the relationship between reoffer yields and size is in fact negative, the results of the studies with NIC or TIC as the dependent variable, which reflect the net effect of size on the sum of the reoffer yield and the underwriter

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[1]This section is concerned only with the direct effect of issue size on yields. Other effects of size that are related to the effects of demand and supply conditions in regional markets are discussed in section III.

spread, imply that underwriter spreads are larger for large issues. The underlying reasons for these relationships, however, are uncertain. As noted below, investors may be willing to accept lower yields on larger issues because securities that are part of large issues may be less costly to resell in secondary markets. The results of the study by Kessel [17] are consistent with the view that the apparently larger underwriter spreads on large issues reflect less underwriter competition for large issues than for small issues, but it is by no means certain that this interpretation is correct.[2]

In addition to this uncertainty regarding the interpretation of the coefficients of size in previous studies, some of these coefficients may be biased. In particular, both of the studies that found a negative relationship between reoffer yields and size [17, 21] covered an eight-year period characterized by a high inflation rate. Since the size data in both studies was in current dollars and therefore contained an inflation trend, the size coefficients may be biased by spurious correlation between the trend in issue size and trend in the dependent variable. For example, Kessel's study [17] covered a period during which there was a significant downward trend in the spread between Aaa bonds and lower rated bonds. The highly significant negative coefficient on size in Kessel's equations may therefore simply reflect spurious negative correlation between the trends in size and risk premiums over the period.[3]

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[2] In Kessel's model size affects underwriter spreads both (1) directly and (2) indirectly through its effects on the number of bids. It is the (positive) indirect effect that is consistent with the competitive interpretation noted in the text. The direct effect was negative. Kessel [17; p. 718] believed this latter result indicated the existence of economies of scale in underwriting.

[3] Tanner [25] noted this weakness in Kessel's results.

A recent study with the reoffer yield as the dependent variable by Benson, Kidwell, Koch, and Rogowski [BKKR, 5], however, avoided this potential bias. This study covered the nine-year period between 1966 and 1975, but the authors converted the issue size data in their sample to constant 1972 dollars, thereby eliminating the inflation trend from the data. The specification of size that apparently worked best in this analysis was quadratic, $c_1 \cdot SIZE + c_2 SIZE^2$, with $c_1<0$ and $c_2>0$. That is, the estimated relationship was u-shaped, with increases in size exerted a downward impact on yields up to some point and an upward effect thereafter. BKKR regarded issue size as a proxy for the difficulty faced by an underwriter in marketing the bonds in an issue, which, in turn, was directly affected by the prospective cost to investors of reselling the bonds in secondary markets. Specifically, since typically only the bonds of relatively large volume issuers are actively traded in secondary markets, marketability increases, and therefore reoffer yields decrease, as issue size increases up to some point. Beyond this level, however, underwriters have difficulty placing large issues due to market congestion at the time of the sale, and therefore yields rise relative to the yields on smaller issues. BKKR estimated the turning point to be $26 million in 1972 dollars. BKKR's results, then, indicate that reoffer yields do not decline indefinitely as issue size increases.

Results of the present study. We entered issue size in our regression equations in several forms. Since the time period covered by our data is relatively short, the risk of bias due to trend was small. The results were highly sensitive to the particular specification used. The specification that worked best was identical to the quadratic relationship used by BKKR. As indicated in Table 1, the coefficients have the proper sign in all of the equations. The coefficients of the linear term are significant at the 1 percent level in the 5-, 10-, and 15-year equations. The squared term is significant at the 5 percent level in the 15-year equation. Neither term is significant in the 20-year equation. The principal difference between our results and the BKKR results is that the estimated coefficients in our equations implied that the size at which yields stop declining and begin rising is larger than the BKKR estimate. Our estimate was approximately $170 million in 1978 dollars or approximately $115 million in 1972 dollars compared to BKKR's $26 million.

Aside from this difference, our results tended to confirm the results of the BKKR study and the interpretation of those results offered there. Here as elsewhere in our study, the difference between the results for the 20-year equation and the results for the shorter maturity equations may reflect habitat effects. In this instance it may be that the stronger relationship in the shorter maturity equations reflects, for example, a greater concern on the part of commercial banks than among individual investors with the relative ease and cost of selling specific municipal bonds prior to maturity.

Revenue Bonds

Many previous regression studies of the determinants of municipal bond yields for which the data included both revenue and general obligation issues [for example, 3, 4, 8, 15, 16, 17, 18, 19, 20, 21] have included a revenue bond dummy variable to capture any systematic difference between the yields on general obligation bonds and revenue bonds not captured by the other explanatory variables in the equations. The coefficients of the revenue dummies in all of these studies have been positive and significant.

Previous studies have put forward two explanations for this result. First, Hopewell and Kaufman [16; p. 1656] argued that most investors believe that revenue bonds carry a greater default risk than otherwise comparable bonds and that this increased risk is not reflected in bond ratings. Second, it has been argued that the upward effect of revenue status on yields reflects ineligibility of banks to underwrite many revenue bonds. In this regard, Kessel's study [17] was the first to include a revenue dummy. Kessel's coefficient indicated that revenue status raised reoffer yields approximately 8.5 basis points. Although Kessel himself did not attempt to explain this result, Silber [47; p. 20] subsequently argued that the result reflected a direct effect of the ineligibility of commercial banks to underwrite revenue bonds on revenue bond yields over and above the indirect effect of bank ineligibility arising through the underwriter bidding process.[4] This direct effect might reflect, among other things, an investor perception that bonds sold through banks carry the bank's tacit endorsement. Further, Silber suggested [47; p. 14] that banks would be more likely to make secondary markets for bonds they were eligible to underwrite. Silber's interpretation of Kessel's estimate however, is a controversial matter as indicated in the discussion of the effect of underwriter competition on municipal yields in the next section.

As shown in Table 1, our estimates indicate that revenue status raises reoffer yields from about 6 basis points at the 5-year maturity to 10 to 11 basis points at the 15- and 20-year maturities. These estimates are close to Kessel's estimate but somewhat below the estimates in several other studies. In our view, the most plausible explanation of the impact of revenue status is that revenue bonds are generally more costly and more difficult for investors to sell before maturity than general obligation bonds.[5]

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[4] Silber's interpretation was possible because Kessel used pre-1968 data. Before 1968 banks were eligible to underwrite all general obligation bonds but were ineligible to underwrite virtually all revenue bonds. Since that date banks have gained the authority to underwrite some revenue bonds.

[5] This appears to be the case whether or not the revenue bond is eligible to be underwritten by banks.

Revenue bonds appear to have less well developed secondary markets and to be subject to higher bid-ask spreads when resold than otherwise comparable general obligation bonds. In these circumstances one would expect investors to demand higher yields for revenue bonds. Although this explanation appeals to us more strongly than the others we have seen, it too is essentially an ex post rationalization. It will probably be necessary to include more explicit measures of the cost of selling bonds prior to maturity to resolve this issue.

VIII. UNDERWRITER CONDITIONS

Background

This section deals with the effects of the conditions surrounding the underwriting of municipal securities on reoffer yields. The specific underwriter conditions analyzed were: (1) whether an issue was sold to the underwriter through competitive bidding or through negotiation with a single underwriter, (2) the number of bids received by an issue if it was a competitive issue, and (3) the range of bids. Virtually all general obligation bonds are required by law to be sold competitively. Revenue bonds are sold both competitively and through negotiation. The number of bids received on competitive issues varies substantially across issues. Table VIII-1 provides bidding data for the 793 competitive issues in our sample. The median number of bids for all issues was four. The table also shows the number of bids received by issues in each rating category. As the table indicates, issues rated Baa1 and below generally received fewer bids than higher rated issues. The range of bids also varies considerably across issues. Table VIII-2 indicates the range of bids for all issues in the sample that received four bids.

A substantial body of literature dealing with these effects has developed in recent years,[1] most of it aimed at contributing to the debate over whether or not commercial banks should be allowed to underwrite all revenue bonds.[2] We have not attempted to break major new ground in this area.

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[1] The most important recent studies in this area are Kessel [22], Cagan [11], Cagan [12], Mussa [39], Mussa [40], Bierwag, Hopewell and Kaufman [6], Bierwag, Hopewell, Kaufman and Leonard [7], Hopewell and Kaufman [16], and Benson [4]. See also the survey of this research by Silber [47].

[2] The Glass-Steagall Act of 1933 prohibited commercial banks from underwriting securities except for U.S. government securities and general obligation municipal bonds. The Housing and Urban Development Act of 1968 permitted banks to underwrite municipal revenue bonds issued to finance housing, university or dormitory projects. Further, the Comptroller of the

In particular, this portion of our analysis is not complete enough to permit us to take a firm position regarding whether or not permitting banks to underwrite revenue bonds would lower reoffer yields on these bonds. Nonetheless, our results both reinforce some of the results of earlier studies in this area and refine others with the benefit of a large recent sample of new issues. In addition, our breakdown of the analysis by maturities provides additional information regarding how the impact of underwriter conditions differs across maturities.

The basic model that has been used to analyze the potential impact of permitting commercial banks to underwrite all revenue bonds was developed by Kessel [17]. Kessel's model consisted of two pairs of recursive equations:

$$\text{(VIII-1)} \qquad \text{BIDS} = f(\bar{x}_1, \overset{-}{\text{RDUM}})$$

$$\text{(VIII-2)} \qquad \text{UNDSPD} = f(\bar{x}_2, \overset{-}{\text{BIDS}})$$

$$\text{(VIII-1)} \qquad \text{BIDS} = f(\bar{x}_1, \overset{-}{\text{RDUM}})$$

$$\text{(VIII-3)} \qquad \text{REOFF} = f(\bar{x}_3, \overset{-}{\text{BIDS}}, \overset{+}{\text{RDUM}})$$

where BIDS is the number of bids, UNDSPD is the underwriter's spread, REOFF is the reoffer yield, RDUM is a dummy variable set equal to 1 if the issue is a revenue issue, and the $\bar{x}$'s are vectors of other variables believed to affect the respective dependent variables. Kessel used the revenue dummy variable as a proxy for bank ineligibility to underwrite an issue. This procedure was appropriate since Kessel used pre-1968 data. Before 1968 virtually all revenue bonds were ineligible, while general obligation bonds were eligible. As indicated by the signs above the explanatory variables in these equations, Kessel hypothesized (1) that bank ineligibility reduced the number of bids and (2) that the reduction in the number of bids, in turn, increased underwriter spreads and raised reoffer yields. As indicated by

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Currency may rule that a municipal revenue bond is in effect a general obligation bond eligible to be underwritten by national banks if the bond is backed by the full faith and credit of the issuer.

equation (VIII-3), Kessel also entered the revenue dummy directly in his reoffer yield equation. Kessel himself offered no explicit rationale for this specification. As pointed out in the preceding section, however, Silber [47, p. 20] argued that the revenue dummy, the coefficients of which were positive and significant in Kessel's equations [17, table 8, p. 725], captured a direct effect of bank ineligibility on reoffer yields over and above the indirect effect working through the bidding process.

While some of the more recent models used to analyze the bank eligibility issue have been specified more fully than Kessel's model, most of them are variations of Kessel's basic structure. In any case, the equations estimated in the present study correspond to equation (VIII-3) above. Formally, our model with respect to the present section is:

$$\text{(VIII-4)} \qquad \text{REOFF} = f(\bar{x}_4, \overset{-}{\text{BIDS}}, \overset{+}{\text{RANGE}}, \overset{+}{\text{NDUM}}),$$

where RANGE is the range of bids, NDUM is a dummy variable indicating negotiated issues, and $\bar{x}_4$ is a vector of the other explanatory variables in the equation. The revenue dummy variable was discussed in Section VII and therefore is not included here.[3] As discussed below, reoffer yields are expected to decline with an increase in the number of bids, rise with an increase in the range of bids, and rise if the issue is negotiated.

Results of Previous Studies: The Debate Over the Effect of Bank Eligibility

Many previous studies of the determinants of municipal bond yields have also advanced one or more of the three hypotheses just listed. A variety of rationales, however, has been used to explain them.

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[3]Further, since some revenue bonds were eligible to be underwritten by banks in the period covered by our sample, the revenue dummy cannot be used as a proxy for bank eligibility as in Kessel's study.

The effect of the number of bids. Although one would expect a relationship between the number of bids and underwriter spreads, it is not immediately obvious why the number of bids should affect reoffer yields. Reoffer yields would presumably reflect conditions in the primary securities markets in which bonds are sold rather than competitive conditions among underwriters. Kessel's study [17] and several other studies [11, 12, 20, 50], however, have found a statistically significant inverse relationship between reoffer yields and the number of bids. Several explanations have been offered for these results. West [50] believed that the observed relationship reflected collusion among underwriters. Specifically, West postulated that colluding underwriters agreed to limit the number of bids for an issue. The winning bidder then reoffered the securities at higher than market yields to underwriters who had voluntarily refrained from bidding. If it were sufficiently widespread, this practice would produce an inverse relationship between yields and the number of bids.

The search theory rationale. Kessel [17, pp. 728-730] offered an alternative explanation based on Stigler's thesis [48] regarding search and the economic value of information. Kessel hypothesized that information regarding potential buyers of a new municipal issue varied across underwriters. Each underwriter knew some prospective buyers not identified by other underwriters. On this basis Kessel suggested that the number of bids was a proxy for the extent to which prospective final buyers of the securities in an issue had been identified and informed about an issue: the larger the number of bids, the greater the search and therefore the lower the reoffer yield. This rationale has been embraced by several subsequent writers including Benson [4], Cagan [11, 12] and Silber [47].

As noted earlier, both Kessel's study and the two studies by Cagan cited above found that an increase in the number of bids tended to reduce reoffer yields. Cagan's sample consisted entirely of 15-year revenue bonds issued between 1973 and 1978. Kessel's sample included both 20-year general obligation and 20-year revenue bonds issued between 1959 and 1967; however, Kessel provided separate regression results for the two types of issues. Cagan's coefficients were higher than Kessel's. Specifically, Cagan's results suggested that a unit increase in the log of bids reduced reoffer yields on revenue issues by approximately 20 to 30 basis points. Kessel's results indicated a reduction on the order of 15 basis points for both general obligation and revenue bonds. In addition to this evidence on the effect of the number of bids on reoffer yields, the results of a large number of other studies indicated that an increase in the number of bids reduced total issuer costs as measured by NIC or TIC. All of these results are summarized in Table VIII-3.

The effect of the range of bids. In a recent study Benson [4] attempted to extend the application of search theory to the analysis of municipal bond yields. Benson argued that the number of bids captured only part of the total effect of underwriter search on yields. Specifically, he argued that the "intensity" of underwriter search varied across issues receiving the same number of bids due to variations in underwriter expectations regarding the benefits and costs of search across particular issues. For example, issue A and issue B might both receive bids from the same two underwriters. Potential search, as determined by the limited resources of these two underwriters, would therefore be the same for both issues. If both underwriters expected to make a larger profit from underwriting issue A than issue B, however, they both might work harder to win issue A.[4] Benson assumed that the intensity of search varied inversely with the dispersion of bids.

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[4] See Benson [4, pp. 873-874].

On the grounds that more intense search should uncover buyers willing to accept lower yields, Benson hypothesized a positive correlation between municipal yields and the variance of bids.

Benson tested his hypothesis using a model with TIC as the dependent variable and a sample of bonds issued during three months in 1973. He concluded that his results supported his hypothesis in the case of general obligation bonds but not in the case of revenue bonds. Benson speculated that the apparent absence of a search intensity effect on revenue bond yields reflected the more specialized character of the revenue market and the correspondingly greater ease with which potential buyers of revenue bonds can be identified. We included the range of bids in the present study in order to retest Benson's hypothesis using a larger sample of more recent issues.[5]

The effect of underwriting through negotiation. The other hypothesis noted above was that, ceteris paribus, reoffer yields are higher for negotiated issues than for competitive issues. Negotiated issues might carry systematically higher reoffer yields than otherwise comparable competitive issues for several reasons. First, following the search thesis, an underwriter who does not have to go through the competitive bidding process might conduct a less thorough search for buyers than an underwriter who does.[6] Second, many municipal bonds are small and, as indicated in section III of this study, appear to be sold in geographically segmented local and regional markets. Many of these

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[5]As Benson himself noted, the variance of bids is conceptually superior to the range of bids as a measure of both the dispersion of bids and the intensity of search. As indicated below, however, the range of bids worked well in our regressions.

[6]Those who favor allowing banks to underwrite all revenue issues argue that since many ineligible revenue bonds are sold through negotiation, bank entry would lower issuer costs by (1) increasing the competitive pressure on underwriters in negotiated transactions to negotiate terms more favorable to issuers and (2) inducing issuers to switch to competitive bidding. See Silber [47, pp. 25-28].

local markets are probably imperfectly competitive. If so, it may frequently be in an underwriter's interest to enhance the market appeal of an issue by setting reoffer yields a few basis points above going rates, and it is reasonable to presume that an underwriter would be in a better position to exploit this opportunity in a negotiated sale than in a competitive sale.[7] Finally, many issues that are sold through negotiation appear to be small issues with relatively undeveloped secondary markets. Therefore, negotiated status, like issue size and revenue status in the preceding section, may be a proxy for relatively high costs of resale before maturity. We included in dummy variable for negotiated issues (NDUM) in our equations to control for these effects.

Previous studies have provided only limited and somewhat inconclusive evidence regarding the effect of sale via negotiation on yields. Joehnk and Kidwell [34] analyzed a sample of 730 paired competitive and negotiated bonds issued between 1970 and 1976 and found that the mean reoffer yield for negotiated issues exceeded the corresponding mean yield for competitive issues by 23 basis points in the case of general obligation bonds and by 27 basis points for revenue bonds.[8] Sorenson [23], in contrast, estimated that negotiation increased net interest cost by approximately 10 basis points, with most of the increase attributable to higher reoffer yields. Further, Sorenson estimated that negotiation actually reduced the net interest cost of lower rated issues that received only one or two bids.

The attack on the search theory interpretation. In recent years the search theory interpretation of the effects of underwriter conditions on reoffer

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[7] Joehnk and Kidwell [34] appear to believe that reduced competition raises the yields of negotiated issues.

[8] These comparisons were for 10-year maturities.

yields, and the related conclusion of many of the writers who have adopted this interpretation that permitting banks to underwrite all municipal bonds would reduce issuer costs for currently ineligible bonds, have been subjected to intense critical scrutiny.[9] In particular, Mussa [39, 40] has strongly challenged the search theory interpretation on intuitive grounds. Mussa argued that search costs varied across issues. Specifically, he argued that the search costs necessary to identify potential buyers would be low in the case of well-known borrowers with high credit ratings and high in the case of unfamiliar borrowers. For precisely that reason, well-known, high quality issues with low search costs would almost certainly attract more bids than issues requiring extensive search.[10] In short, Mussa stood the search theory interpretation on its head: rather than implying extensive search, a large number of bids implied relatively little search.

On this basis Mussa offered a different interpretation for the inverse statistical relationship between reoffer yields and the number of bids found in previous studies. Since the number of bids was likely to be highest for well-known issues of high intrinsic quality, Mussa argued that the number of bids variable in these studies was capturing the effect of certain quality characteristics not captured by the default risk category variables or any of the other explanatory variables included in the equations. In contrast to the

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[9] Although not directly relevant to the model used in the present study, a result obtained by Bierwag, Hopewell and Kaufman [6; pp. 20-21] has been a particularly important element in the case against expanding bank eligibility. In his 1978 study of revenue issues, Cagan [11] had included a variable indicating eligibility, the coefficient of which was negative and significant. As indicated above (see footnote 2 of this section) under present law eligibility to underwrite revenue bonds is closely correlated with the purpose for which the bond is being issued. Bierwag, Hopewell and Kaufman found that when they added a bond purpose variable to Cagan's model, the coefficient of the bank eligibility variable became insignificant.

[10] The data in Table VIII-1 support this contention.

search theory interpretation, Mussa's interpretation obviously does not support the argument that bank eligibility would lower the cost of issuing currently ineligible bonds.

Another possible interpretation of the number of bids coefficient that is consistent with Mussa's general argument is that the number of bids variable--like issue size, the revenue dummy variable and the dummy variable for negotiated issues--may be picking up marketability effects. That is, securities that are likely to be costly for investors to resell before maturity may be more difficult and less profitable for underwriters to handle and therefore may attract fewer bids.

Results of the Present Study

Effect of the number of bids. Our results strongly support the hypothesis that the number of competitive bids is negatively related to reoffer yields. The coefficient of the log of the number of bids is highly significant at each maturity in the equations using our full sample (Table 1) and in the general obligation equations (Table 2). The results in the regressions of all revenue issues (Table 3) are weaker due to the large proportion of negotiated issues in the revenue sample. The regressions for competitive revenue issues (Table 4), however, appear to indicate that the effect of an increase in the number of bids on revenue bond yields is about the same as the effect on general obligation yields. The coefficients in the competitive revenue equations for the 5-, 10-, and 15-year maturities are all within two basis points of the corresponding coefficients in the general obligation regressions. These results tend to confirm Kessel's findings [17, p. 726], which also suggested that the effects on revenue and general obligation yields were about the same. The lack of significance of the number of bids variable in the 20-year equation for competitive revenue issues is something of a mystery.

It is worth noting that in many cases the magnitudes of our coefficients are quite close to the corresponding estimates in other studies. For example, Kessel's estimate for 20-year general obligation bonds is -.14 (Table VIII-3) compared to -.19 in our equation for 20-year general obligation issues (Table 2). Further, as indicated in the introduction to this study, we also ran a regression using our basic model but with NIC as the dependent variable. Table 5 shows that the coefficient of the number of bids variable in this equation is -.17, which is close to the corresponding coefficients in a number of the NIC/TIC regressions listed in Table VIII-3.

Here as elsewhere in this study, our procedure of running separate regressions for four maturities allowed us to analyze how a particular coefficient varied across maturities. In this case the absolute value of the bids variable coefficient rose steadily in the full sample regressions, from -.09 at the 5-year maturity to about -.18 at both the 15- and 20-year maturities.

It would have been helpful if this result had made it possible to discriminate between the search theory rationale for the bids variable coefficient offered by the proponents of broader bank eligibility to underwrite municipal bonds and the alternative, intrinsic quality interpretation put forward by Mussa. Unfortunately, the absolute increase in the coefficient as maturity lengthens is consistent with both interpretations. From the standpoint of search theory, it might be argued that the marginal value of additional underwriter search is greater for long-term than for short- and intermediate-term securities. This argument would have some plausibility since commercial banks, which are relatively easy to identify as potential final purchasers of particular municipal securities, hold primarily short- and intermediate-term municipal securities in their portfolios.[11] The institutional demand for long-term securities appears to come primarily from fire and casualty companies. Since many of these companies operate nationally, it may be more difficult for underwriters to find institutional buyers for long-term securities, particularly in the case of small, local issues.

On the other hand, Mussa's argument that the bids variable is picking up the effects of quality differences not captures by the rating variables is also consistent with the behavior of the bids coefficients across maturities. It will be recalled from Section IV (see Table IV-3, p.52) that the coefficients of the default risk dummy variables also rose as maturity lengthened. It seems reasonable to presume that the effect on reoffer yields of any missing "intrinsic quality" variable that the number of bids variable might be picking up would vary across maturities in the same way that the effect of measured default risk varies across maturities. In short, the pattern of the number of bids variable coefficients across maturities in our equations does not provide us with a basis to choose between the search theory rationale and Mussa's alternative explanation.

In an effort to shed at least some additional light on the debate over the interpretation of the coefficient of the number of bids variable, we reran our regressions using general obligation issues having bonds at all four maturities for the "high risk" and "low risk" periods described in Section IV.[12] The results are shown in Table VIII-4. As the table indicates, the coefficients at each maturity are higher in absolute terms in the high-risk period than in either the full period or the low-risk period. We believe this result

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[11] See Hobby [31].

[12] See Section IV, pp. 48-49.

tends to support Mussa's intrinsic quality argument more strongly than the search theory interpretation. Higher intrinsic quality would almost certainly reduce yields more in a high-risk period than in a low-risk period, just as in Section IV a relatively high rating benefited an issuer more in high-risk period than in a low-risk period (see Table IV-4, p. 53). Therefore, the results shown in Table VIII-4 are consistent with Mussa's intrinsic quality interpretation in a straightforward way. It might be argued, in defense of the search theory interpretation, that an additional unit of search, as proxied by the number of bids, would tend to produce more potential buyers in a high-risk period than in a low-risk period. While not entirely implausible, this latter explanation strikes us as strained. On these grounds we believe that the results shown in Table VIII-4 favor Mussa's interpretation of the bid variable coefficient.

To summarize, our results with respect to the bids variable indicate (1) that an increase in the number of bids reduces reoffer yields on both general obligation and revenue bonds, (2) that the absolute magnitude of this effect increases progressively with maturity, and (3) that the magnitude of the effect at the 5-year, 10-year, and 15-year maturities is about the same for general obligation and competitive revenue bonds. Finally, as just noted, the behavior of the coefficient of the bids variable in periods of differing general risk appears to provide some limited support for Mussa's contention that the number of bids is a proxy for differences in the intrinsic quality of individual issues rather than for differences in underwriter search.

<u>The range of bids.</u> As indicated above, we included the range of bids in our regressions to test Benson's hypothesis regarding the intensity of search. On the surface our results appear to support the hypothesis. The range of bids coefficient has the correct sign and is highly significant in each of our full-sample regressions. Indeed, our results provide stronger

support for the hypothesis than Benson's own results in two respects. First, as pointed out above, Benson used TIC as the dependent variable in his tests. Therefore, it is not possible to determine whether variations in the range of bids is affecting reoffer yields or underwriter spreads on the basis of his results. The application of search theory to the analysis of the municipal bond market, however, is essentially a theory about how underwriter conditions affect reoffer yields. Regressions that have TIC as the dependent variable, therefore, are not valid tests of the search interpretation. Since our equations use reoffer yields as dependent variables, they constitute a valid test of Benson's hypothesis. Second, it will be recalled that Benson's results supported his hypothesis for general obligation bonds but not for revenue bonds. The results of our regression for competitive revenue issues (Table 4) are somewhat different. Although the range variable is not significant in the 5- and 10-year equations, it is significant at the 10 percent level in both the 15- and 20-year regressions using a two-tail test. Moreover, these coefficients are about the same size as the coefficients in the general obligation regressions (Table 2). This result suggests that if the overall search theory interpretation of the effect of underwriter conditions on municipal yields is valid, more intense search might reduce revenue reoffer yields as well as general obligation yields at the longer maturities.

As indicated above, however, there are important reasons to question the validity of the search theory interpretation of the coefficient of the number of bids. It is therefore appropriate to ask whether our results for the range of bids variable might also be interpreted differently. Following Mussa's logic, it seems reasonable to argue that the range of bids for well-known issues of high intrinsic quality would be smaller than for lower quality issues. Therefore, the range of bids variable in both Benson's equations and our equations may be picking up Mussa's intrinsic quality effect. In short, Mussa's argument regarding the interpretation of the coefficient number of bids variable would appear to apply with equal force to the coefficient of the range of bids variable.

Effect of sale by negotiation. The coefficients of NDUM in our full sample regressions (Table 1) ranged between 10 and 14 basis points and were all significant. Our estimate of the magnitude of the effect of sale via negotiation is therefore somewhat smaller than the Joehnk and Kidwell [34] estimate mentioned above but somewhat larger than Sorenson's [23] estimate. Since nearly all of the negotiated issues in our sample were revenue issues, it is also instructive to consider the coefficients for this variable in the revenue bond equations (Table 3). The coefficients in these equations, which are also generally significant, are somewhat higher than in the full sample regressions. Further, they rise progressively from approximately 13 basis points at the 5-year maturity, to about 20 basis points at the 10- and 15-year maturities, to about 27 basis points at the 20-year maturity. Our results indicate, therefore, that the effect of sale via negotiation becomes stronger as maturity lengthens. Unfortunately, these results do not appear to provide a basis for choosing among the various explanations of the effect of sale through negotiation discussed earlier in this section.

Table VIII-1

Number of Bids on Competitive Issues
in Sample
(Moody's Ratings)

Number of Bids	Number of Issues	Aaa	Aa	A1	A	Baa1	Baa
1	17	0	4	2	4	6	1
2	113	12	22	16	34	17	12
3	184	39	38	37	39	17	14
4	136	22	27	24	37	15	11
5	113	17	29	29	23	8	7
6	70	7	27	12	14	7	3
7	74	10	28	11	21	3	1
8	31	3	8	7	10	3	0
9	25	5	15	1	3	1	0
10	11	3	8	0	0	0	0
greater than 10	19	6	9	3	1	0	0
TOTAL	793	124	215	142	186	77	49
memo item:							
more than 4 bids	43.3%	41.1%	57.7%	44.4%	38.7%	28.6%	22.4%

Table VIII-2

Distribution by Range of Bids of Issues Receiving Four Bids

Range of Bids	
0 < and ≤ .05	23
.05 < and ≤ .10	36
.10 < and ≤ .15	31
.15 < and ≤ .20	22
.20 < and ≤ .25	4
.25 < and ≤ .30	4
.30 < and ≤ .35	5
.35 < and ≤ .40	4
greater than .40	7
TOTAL	136

Table VIII-3

Summary of Coefficients of Number of Bids in Previous Studies

Study (reference numbers)	Form of Variable	Estimated Coefficient (T-statistics in parenthesis)	Type of Bonds in Sample
A. Studies with Reoffer Yield as Dependent Variable:			
Cagan [11]	logarithmic	-.19 (2.9)	revenue
Cagan [12]	logarithmic	-.26 (3.8)	revenue
Kessel [17]	logarithmic	-.14 (27.0)	general obligation
Kessel [17]	logarithmic	-.16 (15.7)	revenue
Kidwell and Trzcinka [20]	logarithmic	-.2089 (13.91)	general obligation and revenue
B. Studies with NIC or TIC as Dependent Variable:			
Beebe [2]	logarithmic	-.14 (2.62)	general obligation
Beebe [2]	logarithmic	-.16 (1.87)	general obligation
Benson [3]	logarithmic	-.26 (significant)	general obligation and revenue

Table VIII-3 con't

Study (reference numbers)	Form of Variable	Estimated Coefficient (T-statistics in parenthesis)	Type of Bonds in Sample
Benson [4]	logarithmic	-.189 (4.79)	general obligation
Benson [4]	logarithmic	-.242 (3.85)	revenue
Bierwag, Hopewell, and Kaufman [6]	logarithmic	-.272 (8.21)	revenue
Bierwag, Hopewell, Kaufman and Leonard [7]	logarithmic	-.213 (4.05)	revenue
Hendershott and Kidwell [15]	linear	-.050 (6.40)	general obligation and revenue
Hopewell and Kaufman [16]	uncertain	-.179 (6.260)	general obligation and revenue
Kidwell [18]	logarithmic	-.12 (3.6)	general obligation
Kidwell [18]	logarithmic	-.29 (5.2)	revenue
Kidwell and Koch [19]	logarithmic	-.143 (31.7)	general obligation and revenue
Sorenson [22]	logarithmic (3 or more bids).	-.338 (6.587)	revenue
Sorenson [23]	logarithmic (3 or more bids)	-.265 (7.148)	revenue

Table VIII-3 con't

Study (reference numbers	Form of Variable	Estimated Coefficient (T-statistics in parenthesis)	Type of Bonds in Sample
Swenson [24]	linear	-.3598 (7.22)	general obligation
Swenson [24]	linear	-.3442 (4.08)	revenue

Table VIII-4

Coefficients of Log of Number of Bids
(general obligation issues having all 4 maturities)

	full period	high-risk period	low-risk period
5-year	-.107 (4.41)	-.134 (3.01)	-.092 (3.16)
10-year	-.121 (4.56)	-.148 (2.95)	-.093 (2.98)
15-year	-.171 (6.15)	-.234 (4.53)	-.114 (3.44)
20-year	-.171 (6.12)	-.238 (4.86)	-.103 (2.97)
number of bonds:	437	183	254

IX. CONCLUSION

This paper has presented the results of a comprehensive regression analysis of the determinants of individual municipal bond yields. The distinguishing feature of our approach is the use of reoffering yields at four different maturities as dependent variables in our regressions. This approach enabled us to provide new information on many of the determinants of municipal bond yields, especially call provisions, coupons, and regional market conditions. It also permitted us to investigate how the effects of different determinants of municipal yields vary across maturities. We have gone to considerable length in the paper to compare our results to those of other papers using different procedures.

In view of the large number of determinants of municipal yields surveyed, the most effective way to summarize our results is to list them according to the sections in which they appeared in the paper:

III. Regional Market Conditions

a. Regional market conditions affect municipal bond yields. In particular, stringent pledging requirements reduce reoffering yields in a given state, while large supplies of bonds in a state raise reoffering yields. We believe a plausible explanation is the presence of differential tax rates and information costs that create a gap between the true after-tax yields earned by investors inside and outside a state on that state's bonds.

b. The magnitude of the effects of regional demand and supply conditions on reoffering yields is greater at the 5-, 10-, and 15-year maturities than at the 20-year maturity, apparently because of commercial bank activity in the market, which is heaviest at the shorter maturities.

c. As issue size increases, the effect of pledging requirements on an issue's reoffering yields diminishes.

IV. Default Risk

a. As in other studies, default risk was found to be a major determinant of a bond's reoffering yield.

b. Reoffering yields paid by Northern industrial cities were found to be systematically higher than yields on comparably rated bonds issued elsewhere. However, in light of the subsequent lowering by Moody's of the ratings of half of the Northern industrial city issues in our sample, it was concluded that this result largely reflected the relatively slow reaction of Moody's, as compared with investors, to deteriorating conditions in those cities.

c. The evidence from our study is that the relationship between risk premiums and maturity in the municipal market is positive over the whole range of maturities. Furthermore, the increase in risk premiums as maturity lengthens is generally greater the lower the rating category. We found no evidence of a "crisis-at-maturity" effect in the municipal market, even in periods of relatively high risk premiums.

V. Call Risk

a. The risk that a municipal bond might be called prior to maturity had a significant effect on its yield in the 1977-78 period covered by our study. The estimated effects were fairly small compared to those reported in corporate bond studies. However, the 1977-78 period was one of low tax-exempt rates relative to the previous three years and one might consequently expect call risk to be relatively small in this period.

b. The effect of call risk on the reoffering yield of a bond with a given set of call provisions is dependent on interest rate expectations.

c. The positive effect of call risk on yields of bonds of a given maturity declines with an increase in years to first call.

d. We were unable to capture any influence of call price on call risk. However, the pattern of call price provisions in between the time of first call and maturity varies greatly across issues and the simple proxy we used was unable to capture this variation.

VI. Inefficient Coupons

a. Low coupons had large effects on individual municipal bond yields in the 1977-78 period. A logical explanation for most of this effect was the perception among investors that discount bonds were subject to capital gains tax. However, the magnitude of the regression coefficients support the view that the effect of low coupons on reoffering yields was more than can be explained by capital gains taxes alone.

b. The coefficient of the low coupon variable was substantially higher at the 15-year maturity than at the 20-year maturity. A logical explanation for this difference is that it reflects the greater role of commercial bank behavior at the 15-year maturity.

c. The evidence for an effect of high coupons on reoffering yields was negligible.

d. These regression results, and the small number of large discount bonds in the 1977-78 period indicate that most governments have realized that discount bonds constitute by far the greatest cost to governments in terms of the additional yield required to induce investors to buy them and have acted on this realization by putting constraints on the use of low coupons in NIC bidding.

VII. Other Issue Characteristics

a. Our results tend to support the view that issue size initially has a negative effect on reoffering yields, but that after a certain point increases in issue size raise yields. A plausible explanation of this pattern is that it represents a combination of marketability and supply effects, as Benson, Kidwell, Koch and Rogowski [5] have argued. Further research on the relationship between issue size and bid-ask spreads might be useful in understanding the effect of size on yields.

b. Revenue bonds have higher yields than comparably rated general obligation bonds. However, it is not clear whether this difference is due to default risk not captured by the rating category dummy variables, poorer marketability of revenue bonds, or bank ineligibility to underwrite most revenue bonds.

VIII. Underwriter Conditions

a. The number of bids on a competitively sold municipal bond is negatively and significantly correlated to that issue's reoffering yield.

b. The estimated effect of the number of bids on revenue and general obligation bonds is about the same. The absolute magnitude of the effect increases with maturity.

c. The results of our full period regressions did not provide us with a basis on which to choose between the search theory rationale and Mussa's "missing variable" explanation for the correlation between the number of bids and reoffering yields. However, when the sample period was divided into "high-risk" and "low-risk" subperiods, the coefficient of the number of bids was significantly higher in the high-risk period. We believe this result tends to support Mussa's argument that the number of bids is correlated to a missing "intrinsic quality" variable.

d. Our results support Benson's conclusion that the dispersion of bids is positively correlated with yields. Further, our results suggest that this effect exists for revenue issues as well as general obligation issues. This result, however, is subject to the same interpretive difficulty as the result regarding the effect of the number of bids.

e. Negotiated issues have higher yields than comparably rated general obligation issues and the magnitude of the differential increases with maturity. There are three possible interpretations of this result, and we were unable to distinguish among them on the basis of our regression results.

This summary suggests two general comments about the direction of any future research regarding the determinants of municipal bond yields. First, neither our regressions nor those of any of the earlier studies include a direct measure of marketability. Yet it is entirely reasonable to expect that differences in marketability among municipal bonds affects the relative reoffering yields of these bonds. In the absence of a direct measure of marketability, it is possible that the coefficients of the revenue bond dummy variable, the negotiated dummy variable, and the underwriter competition variables are picking up differences in marketability across issues. Consequently, we believe the most useful addition to the standard regression model of the municipal market at this juncture would be a direct measure of marketability, i.e. the bid-ask spread of bonds in the issue after they began trading in the secondary market. Unfortunately, there is virtually no published data on bid-ask spreads in the municipal market.

A second concluding comment relates to the need for a more rigorous articulation of the theories underlying some of the variables that have been used in both this and other papers on municipal yields. Most important in this regard would be a theory convincingly linking the underwriter competition variables to aggregate search. In the absence of a convincing theory, the uncertainty over the interpretation of the coefficients of the underwriter competition variables will persist. It would also be desirable to have a more rigorous theory of how regional market conditions affect the relative yields on municipal bonds.

APPENDIX

DESCRIPTION OF DATA USED IN REGRESSIONS

Basic Series	Source	Construction	Other Comment
(1) Net interest cost (NIC)	Moody's Bond Survey		
(2) Size (SIZE)	Moody's Bond Survey		size is for total issue
(3) Average maturity (AVMAT)	Moody's Bond Survey		
(4) Dummy variable for Aa-rated issues (AADUM)	Moody's Bond Survey	Dummy variable = 1 if sample issue rated AA by Moody's, 0 otherwise	
(5) Dummy variable for A1-rated issues (A1DUM)	Moody's Bond Survey	Dummy variable = 1 if sample issue rated A1 by Moody's, 0 otherwise	
(6) Dummy variable for A-rated issues (ADUM)	Moody's Bond Survey	Dummy variable = 1 if sample issue rated A by Moody's, 0 otherwise	
(7) Dummy variable for Baa1-rated issues (BAA1DUM)	Moody's Bond Survey	Dummy variable = 1 if sample issue rated BAA1 by Moody's, 0 otherwise	
(8) Dummy variable for Baa-rated issues (BAADUM)	Moody's Bond Survey	Dummy variable = 1 if sample issue rated BAA by Moody's, 0 otherwise	
(9) Supply (SUPPLY)	monthly municipal bond sales section of The Weekly Bond Buyer	Supply is average of monthly data using months t (current month), t-1, and t-2 if date of sample issue is in second half of month; months t-1, t-2, and t-3 if date of sample issue is in first half of month.	
(10) Personal income (PI)	U.S. Department of Commerce Survey of Current Business (April 1979)	State personal income is for current quarter if date of sample issue is in second half of quarter, preceding quarter if date of sample issue is in first half of quarter.	

Basic Series	Source	Construction	Other Comment
(11) Call weight (CW)	Salomon Brothers Bond Market Roundup	Salomon Brothers yield index for 20-year U.S. Government bonds minus Salomon Brothers yield index for 7-year U.S. Government bonds for week of sample issue.	
(12) Dummy variable for medium pledging state (PL76M)	Ad Hoc Subcommittee on Full Insurance of Government Deposits, Conference of Presidents, Federal Reserve System, Final Report and Recommendations, Washington, D.C. (September 4, 1979).	Dummy variable = 1 if state of sample issue a moderate-pledge state, 0 otherwise.	On the basis of a detailed analysis of pledging laws and practices in each state with respect to that state's own state and local deposits, each state was classified as either a high-pledge, moderate-pledge, or low-pledge state.
(13) Dummy variable for high pledging state (PL76H)	Ad Hoc Subcommittee on Full Insurance of Government Deposits, Conference of Presidents, Federal Reserve System, Final Report and Recommendations, Washington, D.C. (September 4, 1979).	Dummy variable = 1 if state of sample issue a high-pledge state, 0 otherwise.	On the basis of a detailed analysis of pledging laws and practices in each state with respect to that state's own state and local deposits, each state was classified as either a high-pledge, moderate-pledge, or low-pledge state.
(14) Years to first call (YFC)	Moody's Municipal and Government News Reports		
(15) Deposit Pledging Variable: ratio of estimated public deposits secured by pledged assets to total deposits at commercial banks in state of sample issue, June 1978 (PLDG)	FDIC, Assets and Liabilities of Commercial and Mutual Savings Banks	The estimates of the portions of public deposits secured by pledged assets in each state were calculated by assuming that 85 percent of total state and local deposits were secured by pledged assets in the high-pledge states, the remaining 15 percent consisting mainly of deposits covered by FDIC insurance. It was further assumed that 55 percent of state and local deposits were secured in the moderate-pledge states, and 15 percent were secured in the low-pledge states.	

Basic Series	Source	Construction	Other Comments
(16) Reoffering yield-to-maturity for 5- or 6-year issue (IS_5)	Moody's Bond Survey		Moody's switched from 5- to 6-year maturity in the 5/22/78 issue of the Bond Survey.
(17) Reoffering yield-to-maturity for 9- or 10-year issue (IS_{10})	Moody's Bond Survey		Moody's switched from 10- to 9-year maturity in the 5/22/78 issue of the Bond Survey.
(18) Reoffering yield-to-maturity for 15-year issue (IS_{15})	Moody's Bond Survey		
(19) Reoffering yield-to-maturity for 20-year issue (IS_{20})	Moody's Bond Survey		
(20) Yield index for 5- or 6-year AAA general obligation bonds ($RMUN_5$)	Salomon Brothers Bond Market Roundup		The Salomon Brothers indexes are for 5- and 10-year maturities throughout. For the period when the reoffering yields from Moody's Bond Survey are for 6- and 9-year maturities, the 6- and 9-year AAA yield indexes are constructed from the 5- and 10-year Salomon Brothers indexes using linear interpolation. (The average spread between the 5- and 10-year indexes over this period is only 21 basis points. Consequently, an alternate assumption with respect to the shape of the yield curve between 5- and 10-years has very little effect on the constructed 6- and 9-year indexes.)
(21) Yield index for 9- or 10-year AAA general obligation municipal bonds ($RMUN_{10}$)	Salomon Brothers Bond Market Roundup		

	Basic Series	Source	Construction	Other Comments
(22)	Yield index for 15-year AAA general obligation municipal bonds ($RMUN_{15}$)	Salomon Brothers Bond Market Roundup		
(23)	Yield index for 20-year AAA general obligation municipal bonds ($RMUN_{20}$)	Salomon Brothers Bond Market Roundup		
(24)	Premium for 5- or 6-year maturity (PRE_5)	(a) yield to maturity from Moody's Bond Survey (b) coupon from Moody's Municipal & Government News Reports	Difference between coupon and yield to maturity for 5- or 6-year maturity; set equal to zero if negative.	Coupon chosen to correspond with yield to maturity before and after switch from 5 to 6 years.
(25)	Premium for 9- or 10-year maturity (PRE_{10})	(a) yield to maturity from Moody's Bond Survey (b) coupon from Moody's Municipal & Government News Reports	Difference between coupon and yield to maturity for 9- or 10-year maturity; set equal to zero if negative.	Coupon chosen to correspond with yield to maturity before and after switch from 10 to 9 years.
(26)	Discount for 15-year maturity (DIS_{15})	(a) yield to maturity from Moody's Bond Survey (b) coupon from Moody's Municipal & Government News Reports	Difference between yield-to-maturity and coupon for 15-year maturity; set equal to zero if negative.	
(27)	Premium for 15-year maturity (PRE_{15})	(a) yield to maturity from Moody's Bond Survey (b) coupon from Moody's Municipal & Government News Reports	Difference between coupon and yield-to-maturity for 15-year maturity; set equal to zero if negative.	
(28)	Discount for 20-year maturity (DIS_{20})	(a) yield to maturity from Moody's Bond Survey (b) coupon from Moody's Municipal & Government News Reports	Difference between yield-to-maturity and coupon for 20-year maturity; set equal to zero if negative.	

	Basic Series	Source	Construction	Other Comments
(29)	Call premium for 10-year maturity (CP_{10})	Moody's Municipal & Government News Reports	Difference between call price and par at the time of years to first call; set equal to zero if years to first call greater than or equal to 10.	
(30)	Call premium for 15-year maturity (CP_{15})	Moody's Municipal & Government News Reports	Difference between call price and par at the time of years to first call; set equal to zero if years to first call is greater than or equal to 15.	
(31)	Call premium for 20-year maturity (CP_{20})	Moody's Municipal & Government News Reports	Difference between call price and par at the time of years to first call; set equal to zero if years to first call is greater than or equal to 20.	
(32)	Dummy variable for callable issues (CDUM)	Moody's Municipal & Government News Reports	Dummy variable = 1 if issue is callable, 0 otherwise.	
(33)	Dummy variable for revenue bonds (RDUM)	Moody's Municipal & Government News Reports	Dummy variable = 1 if issue a revenue bond, 0 otherwise.	
(34)	Dummy variable for negotiated issues (NDUM)	Monthly municipal bond sales section of The Weekly Bond Buyer	Dummy variable = 1 if sample issue a negotiated sale, 0 otherwise.	
(35)	Number of competitive bids if not negotiated sale (BIDS)	Monthly municipal bond sales section of The Weekly Bond Buyer		
(36)	Range of competitive bids (RANGE)	Monthly municipal bond sales section of The Weekly Bond Buyer		

Basic Series	Source	Construction	Other Comments
(37) Estimate of long-term debt outstanding in state in month of issue (STOCK)	(a) annual stock data from Government Finances in 19-, USDC, Bureau of the Census (b) monthly supply data from The Weekly Bond Buyer (monthly municipal bond sales section)	The monthly stock estimate is calculated as the stock at the end of the previous fiscal year plus the cumulative monthly supply minus the cumulative estimate of the amount of debt retired in the fiscal year to date. The monthly estimate for retired debt is calculated by subtracting the year-end stock from the sum of the beginning of year stock plus the total monthly supplies over the year and dividing by 12.	
(38) Variable risk premium for Baa-rated bonds (BAA-AAA)	Moody's Municipal & Government News Reports	Difference between Baa and Aaa municipal bond indexes for long maturities.	average for week ending Thursday
(39) Variable risk premium for A-rated bonds (A-AAA)	Moody's Municipal & Government News Reports	Difference between A and Aaa municipal bond indexes for long maturities.	average for week ending Thursday
(40) Variable risk premium for Aaa-rated bonds (AA-AAA)	Moody's Municipal & Government News Reports	Difference between AA and Aaa municipal bond indexes for long maturities.	average for week ending Thursday

References with Tax-Exempt Bond Yield Regressions

Article	Central Focus and Conclusion	Data	Regressions Reported	Dependent Variable	Regional Market Conditions: pledging variables	Regional Market Conditions: other demand variables	Regional Market Conditions: supply variables	Issuer Characteristics: rating category dummy variables	Issuer Characteristics: purpose of issue dummy variables	Issuer Characteristics: other default risk variables	Issue Characteristics: call dummy variable	Issue Characteristics: other call variables	Issue Characteristics: coupon variables	Issue Characteristics: revenue bond dummy variable	Issue Characteristics: size of issue	Underwriter Conditions: number of bids	Underwriter Conditions: dispersion of bids	Underwriter Conditions: negotiated dummy variable	Underwriter Conditions: bank eligibility dummy variable	Other
1. Advisory Commission on Intergovernmental Relations. **The Impact of Increased Insurance on Public Deposits.** Study prepared for the Committee on Banking, Housing and Urban Affairs, United States Senate. Washington: Government Printing Office, 1977.	**The Pledging Effect:** Bonds from states with high pledging requirements sell at lower yields than bonds from states with low pledging requirements. Hence, interest costs on bond issues from high pledging states would increase if these pledging requirements were substantially reduced or supplemented by full insurance on public deposits.	21,437 general obligation issues; 1966-74	For each year: 1. bonds less than $5 million 2. bonds greater than $5 million	NIC	x	x	x	x							x					
2. Beebe, Jack H. "The Effect of Proposition 13 on California Municipal Debt." Economic Review, Federal Reserve Bank of San Francisco (Winter 1979), pp. 25-38.	**Default Risk:** The effect of Proposition 13 on Californa municipal bond yields varied according to the type of bond (GO, revenue, tax-allocation, or lease-purchase).	367 California issues; 1977-78	1. GO 2. revenue 3. tax allocation 4. lease-purchase	NIC				x		x					x	x		x		
3. Benson, Earl D. "Municipal Bond Interest Cost, Issue Purpose and Proposition 13," **Governmental Finance**, September 1980, pp. 15-19.	**Revenue versus GO bonds:** The Proposition 13-inspired tax revolt and the New York City crisis have altered the way investors view the basic GO-revenue relationship.	2904 issues sold competitively; 1976-79	1. inclusive 2. utility 3. school 4. college 5. hospital 6. various purposes	NIC				x			x			x	x	x	x			
4. --- ----. "The Search for Information by Underwriters and Its Impact on Municipal Interest Cost." **The Journal of Finance**, 34 (September 1979), pp. 871-885.	**Underwriter Competition:** Municipal interest cost is significantly related not only to the number of underwriter bids received but also to the dispersion of bids, which is used as a proxy for the intensity of underwriter search.	319 issues sold competitively; June-August 1973	1. inclusive 2. GO 3. revenue	TIC				x	x		x			x	x	x	x			
5. Benson, Earl D., David S. Kidwell, Timothy W. Koch, and Robert J. Rogowski. "Systematic Variation in Yield Spreads for Tax-Exempt General Obligation Bonds," **Journal of Financial and Quantitative Analysis** (December 1981), pp. 685-702.	**Default Risk and Segmentation by Investment Grade:** Yield spreads between tax-exempt general obligation bonds of different bond ratings vary systematically with changes in economic activity and commercial bank investment activity.	10,165 general obligation bonds sold competitively; 1966-75	1. inclusive 2. Aa 3. A 4. Baa 5. noninvestment	10-year reoffering yield				x		x					x	x				x
6. Bierwag, G. O., Michael H. Hopewell, George G. Kaufman. **Bank Eligibility to Underwrite Municipal Revenue Issues and the Cost of Borrowing: An Empirical Analysis.** New York: Securities Industry Association, 1979.	**Underwriter Competition:** There is no convincing statistical evidence that permitting banks to underwrite municipal revenue bonds has resulted in any cost savings to issuers.	815 revenue issues; 1973-76	1. negotiated 2. competitive	NIC				x	x	x		x			x	x			x	

Article	Central Focus and Conclusion	Data	Regressions Reported	Dependent Variable	Regional Market Conditions: pledging variables	Regional Market Conditions: other demand variables	Regional Market Conditions: supply variables	Issuer Characteristics: rating category dummy variables	Issuer Characteristics: purpose of issue dummy variables	Issuer Characteristics: other default risk variables	Issue Characteristics: call dummy variable	Issue Characteristics: other call variables	Issue Characteristics: coupon variables	Issue Characteristics: revenue bond dummy variable	Issue Characteristics: size of issue	Underwriter Conditions: number of bids	Underwriter Conditions: dispersion of bids	Underwriter Conditions: negotiated dummy variable	Other: bank eligibility dummy variable
7. Bierwag, G. O., Michael H. Hopewell, George G. Kaufman, and Paul A. Leonard. **Commercial Bank Eligibility to Underwrite Municipal Revenue Issues and the Cost of Borrowing: Additional Evidence for 1979.** Eugene, Oregon: Center for Capital Market Research, University of Oregon, 1980.	**Underwriter Competition:** same as above.	396 revenue issues; 1979	1. negotiated 2. competitive	NIC				×	×			×			×	×			×
8. Broaddus, Alfred and Timothy Cook. "An Analysis of the Determinants of the Yields on Individual Municipal Securities." Federal Reserve Bank of Richmond. Unpublished paper presented at 1981 meeting of Western Finance Association.	**Coupon and Call Effects, Regional Market Conditions, and Maturity Effects:** Analysis of many determinants of tax-exempt bond yields requires the use of reoffering yield as dependent variable; call provisions and coupons affect tax-exempt bond yields; regional market conditions influence tax-exempt bond yields; the impact of many determinants of tax-exempt bond yields varies systematically across maturity.	914 issues, 4 maturities; 1977-78	1. inclusive 2. general obligation 3. revenue 4. competitive revenue	5-, 10-, 15-, and 20-year reoffering yields and NIC	×		×	×		×	×	×	×	×	×	×	×	×	
9. Browne, Lynn E. and Richard F. Syron. "Big City Bonds After New York." New England Economic Review, Federal Reserve Bank of Boston (July/August 1977), pp. 3-15.	**Default Risk:** A city's unemployment rate, ratio of pension benefits to assets, and short-term debt per capita are significant determinants of big city default risk premiums; the bonds of four Northeastern cities had large "unexplained" risk premiums in 1976.	29 general obligation bonds of large cities; 1976	inclusive	8-year secondary market yield						×									
10. Browne, Lynn E. and Richard F. Syron. "Municipal Market Since the New York City Crisis." New England Economic Review, Federal Reserve Bank of Boston (July/August 1979), pp. 11-26.	**Default Risk:** A city's unemployment rate, short-term debt per capita, and region are significant determinants of big city default risk premiums.	29 general obligation bonds of large cities; 1978	inclusive	6-year secondary market yield						×									
11. Cagan, Phillip. **The Interest Saving to States and Municipalities from Bank Eligibility to Underwrite All Nonindustrial Municipal Bonds.** Washington, D. C.: Dealer Bank Association, 1978.	**Underwriter Competition:** Bank eligibility reduces reoffering yields on municipal bonds.	503 issues; 1973-76	1. competitive 2. competitive revenue 3. negotiated revenue	15-year reoffering yield				×				×			×	×			×
12. ———. **The Interest Saving to States and Municipalities from Bank Eligibility to Underwrite All Nonindustrial Municipal Bonds: A Supplemen-**	**Underwriter Competition:** same as above.	835 issues; 1973-78	1. competitive 2. competitive revenue 3. negotiated	15-year reoffering yield				×				×			×	×			×

Article	Central Focus and Conclusion	Data	Regressions Reported	Dependent Variable	Regional Market Conditions: pledging variables	Regional Market Conditions: other demand variables	Regional Market Conditions: supply variables	Issuer Characteristics: rating category dummy variables	Issuer Characteristics: purpose of issue dummy variables	Issuer Characteristics: other default risk variables	Issue Characteristics: call dummy variable	Issue Characteristics: other call variables	Issue Characteristics: coupon variables	Issue Characteristics: revenue bond dummy variable	Issue Characteristics: size of issue	Underwriter Conditions: number of bids	Underwriter Conditions: dispersion of bids	Underwriter Conditions: negotiated dummy variable	Underwriter Conditions: bank eligibility dummy variable	Other
13. Hastie, K. Larry. "Determinants of Municipal Bond Yields," **Journal of Financial and Quantitative Analysis** (June 1972), pp. 1729-1748.	**Default Risk and Marketability:** Municipal bond yields are a function of the bond's default risk and marketability. Relative significance of various factors depends on whether banks or individuals are dominating the market.	644 noncallable general obligation bonds; 1957, 1960, 1963, 1965, 1967	1. 1957 2. 1960 3. 1963 4. 1965 5. 1967	secondary market yield between 15 and 25 years						x										x
14. Heins, A. James. "The Interest Rate Differential Between Revenue Bonds and General Obligation Bonds: A Regression Model." **National Tax Journal**, 15 (December 1962), 399-405.	**Revenue versus GO Bonds:** Revenue bonds have higher yields than GO bonds of equal rating.	471 issues; 1956-59	1. GO 2. revenue	NIC				x	x		x				x			x		
15. Hendershott, Patric H., and David S. Kidwell. "The Impact of Relative Security Supplies: A Test with Data from a Regional Tax-Exempt Bond Market." **Journal of Money, Credit and Banking**, 10 (August 1978), 337-47.	**Regional Market Conditions:** An increase in the relative supply of small-size tax-exempt bonds in a regional market increases both regional borrowing costs and costs of particular bond issues relative to those nation-wide.	389 issues sold competitively in Indiana; 1970-74	inclusive	NIC			x	x			x			x	x	x				
16. Hopewell, Michael H., and George G. Kaufman. "Commercial Bank Bidding on Municipal Revenue Bonds: New Evidence." **The Journal of Finance**, 32 (December 1977), 1647-1656.	**Underwriter Competition:** Revenue bonds carry higher interest costs primarily because market participants believe them to carry greater risks than GO bonds comparable in other characteristics. Permitting banks to bid on these bonds would not increase the number of bids on the average	340 issues sold competitively; June-August 1973	inclusive	TIC				x	x		x			x	x	x			x	
17. Kessel, Reuben. "A Study of the Effects of Competition on the Tax-Exempt Bond Market." **Journal of Political Economy**, 79 (July/August 1971), 706-738.	**Underwriter Competition:** Reoffering yields decline as the number of bids increase, because bids constitute search by issuers for those who most prize the bonds they have to sell; bank eligibility decreases reoffering yields indirectly by increasing the number of bids.	6503 issues sold competitively; 1959-67	1. inclusive 2. GO 3. revenue	20-year reoffering yield				x				x		x	x	x				x
18. Kidwel, David S. "The Exante Cost of Call Provisions on State and Local Government Bonds." **Journal of Economics and Business**, 30 (Fall 1977), 73-78.	**Call Provisions:** The shorter the call deferment period, the higher the exante interest cost of a general obligation issue.	340 issues sold competitively; summer of 1973	1. GO 2. revenue 3. callable 4. callable GO 5. callable revenue	TIC				x			x	x		x	x	x				

Article	Central Focus and Conclusion	Data	Regressions Reported	Dependent Variable	Regional Market Conditions: pledging variables	Regional Market Conditions: other demand variables	Regional Market Conditions: supply variables	Issuer Characteristics: rating category dummy variables	Issuer Characteristics: purpose of issue dummy variables	Issuer Characteristics: other default risk variables	Issue Characteristics: call dummy variable	Issue Characteristics: other call variables	Issue Characteristics: coupon variables	Issue Characteristics: revenue bond dummy variable	Issue Characteristics: size of issue	Underwriter Conditions: number of bids	Underwriter Conditions: dispersion of bids	Underwriter Conditions: negotiated dummy variable	Underwriter Conditions: bank eligibility dummy variable	Other
19. Kidwell, David S. and Timothy W. Koch. "The Behavior of the Interest Rate Differentials Between Tax-Exempt Revenue and General Obligation Bonds: A Test of Risk Preferences and Market Segmentation." The Journal of Finance, 37 (March 1982), 73-85.	**Revenue versus GO Bonds:** The yield differential between revenue bonds and similar general obligation bonds varies controcyclically with the level of economic activity. Significant segmentation exists between the markets for general obligation and revenue bonds.	20,466 issues sold competitively; 1966-75	inclusive	NIC				×	×		×			×	×	×				×
20. Kidwell, David S., and Charles A. Trzcinka. "Municipal Bond Pricing and the New York City Fiscal Crisis." University of Tennessee Working Paper, 1981.	**Default Risk:** The New York City fiscal crisis by itself did not lead to fundamental or long-lasting changes in investor risk perceptions, resulting in higher interest rates in the municipal bond market. However, there is evidence consistent with the hypothesis that New York raised the borrowing costs of large, economically depressed northern cities.	2309 issues of $1 million or more sold competitively; 1974-75	1. inclusive 2. June-July 1975 3. July-August 1975	10-year reoffering yield				×	×	×	×	×		×	×	×				
21. Rogowski, Robert J. "Underwriting Competition and Issuer Borrowing Costs in the Municipal Revenue Bond Market." Journal of Bank Research (Winter 1980), pp. 212-220.	**Underwriter Competition:** Eligibility of commercial banks to underwrite college revenue issues increases underwriting competition and reduces issuer borrowing cost.	621 college issues sold competitively; 1966-74	1. inclusive 2. revenue	20-year reoffering yield				×		×		×		×	×				×	
22. Sorenson, Eric H. "Bond Ratings Versus Market Risk Premiums." The Journal of Portfolio Management (Spring 1980), pp. 64-69.	**Default Risk:** Risk premiums on revenue bonds of the same credit rating differ depending on the purpose of the issue.	504 revenue issues; 1971-76	inclusive	NIC				×	×			×			×	×				×
23. ———. "Negotiated Municipal Underwritings: Implications for Efficiency." Journal of Money, Credit and Banking, 11 (August 1979), pp. 366-370.	**Underwriter Competition:** If an issue is subject to high demand uncertainty, negotiation can generate a cost savings relative to using competitive bidding.	504 revenue issues greater than $1 million; 1971-76	1. Baa and lower 2. A and higher	NIC				×	×			×			×	×				×
24. Swenson, "The Cyclical Behavior of the Net Interest Cost Between General Obligation Bonds and Revenue Bonds." National Tax Journal (March 1974), pp. 123-140.	**Revenue versus General Bonds:** Revenue bonds have a higher NIC than comparable general obligation bonds. No evidence was found of cyclical behavior in the difference between the NIC of revenue and general obligation bonds.	1942 issues of $750,000 million or greater issued in California, Indiana and Texas; 1955-70	1. inclusive 2. GO 3. revenue	NIC				×		×	×				×	×				
25. Tanner, J. Ernest. "The Determinants of Interest Cost on New Municipal Bonds: A Reevaluation." Journal of Business, 48 (January 1975), pp. 74-80.	**Regression Procedure:** Estimating "cross-section" tax-exempt bond yield regressions with data covering a long period of time may cause statistical problems.	67 issues sold in three 2-day periods	1. October 27-28, 1971 2. December 22-23, 1971 3. February 2-3, 1972	NIC				×							×	×				

Note: Excluded from the "Other" column are all variables used to capture national market conditions. Variables included here are:

[5, 19] variables to capture segmentation by class of bond;

[13] proxies for marketability;

[17] outstanding bonds of issuer;

[22, 23] first time issued.