

Impact of Information Asymmetry on Municipal Bond Yields: An Empirical Analysis

¹Kenneth Daniels and ²Demissew Diro Ejara

¹Department of Finance, Insurance and Real Estate, School of Business,
Virginia Commonwealth University, Richmond, Virginia 23284-4000

²Department of Economics and Finance, University of New Haven,
West Haven, Connecticut 06516

Abstract: Problem statement: There is a significant difference between the interest rates on the GO and the RV municipal bonds. We sought explanation for this difference in differences in information asymmetry between the two types of municipal bonds. GO bonds finance general municipality expenditures and repayment is from general tax revenues. RV bonds finance special projects and repayment is from cash flows of the special projects. These projects are assumed to be more asymmetric than the general municipality tax revenues. Previous studies examined this issue but did not explicitly consider the information asymmetry differences. **Approach:** We used issue transaction spread as a proxy for information asymmetry. Average spread for RV bonds is 1.172% while that for GO bonds is 0.892%. We controlled for external economic factors, issue and issuer features and contractual terms that might affect yield on debt. We used two-step regression analyses to explain yields on the two types of municipal bonds. **Results:** RV bonds cost 74 basis points more on the average than GO bonds. After controlling for external economic factors, issue and issuer features and contract terms, the difference shrank to an average of 44 basis points. Issue transaction spread, our proxy for information asymmetry and credit rating were important determinants of bond yields. **Conclusion/Recommendations:** Issue transaction spread, as a proxy for information asymmetry, explained differences in bond yields. Other variables that affect yield differences were credit rating, maturity, economic activities, contract terms and other issue and issuer features. Still, there remained an unexplained difference in the yields between RV and GO bonds of 44 basis points that we left for further research. This difference was inversely related to the credit rating of the bond.

Key words: Municipal bonds, bond yields, information asymmetry, revenue bonds, general obligation bonds, credit rating

INTRODUCTION

States, counties, cities, school districts and other local government units, called collectively municipalities, issue two broad categories of bonds. These are General Obligation (GO) bonds and Revenue (RV) bonds. GO bonds finance the general operation of the municipality and repayment is from the tax and other general revenues of the municipality. GO bonds are supported by the full faith and taxing power of the local government. RV bonds are issued to finance special projects such as road and bridge construction, construction of parking lot, hospital construction and other similar development projects. These projects generate revenue and repayment of RV bonds is from such revenues of the projects. So RV bonds are in a way secured by these special projects.

The interest rates on the GO and RV bonds should reflect the relative risk of the two types of debt. The purpose of this research is to compare the yields on GO and RV bonds and analyze the sources of their differences. GO bonds should have lower interest cost because they are supported by the full faith and taxing power of the local government. On the other hand, RV bonds are secured by the project they finance. If the issuing municipality files for bankruptcy, the automatic stay provision of Chapter 9 Bankruptcy Code prohibits GO bond holders "from bringing a mandamus action against an officer of a municipality on account of a prepetition debt. It also prohibits a creditor from bringing an action against an inhabitant of the debtor to enforce a lien on or arising out of taxes or assessments owed to the debtor"^[10]. GO bond holders settle their

Corresponding Author: Demissew Diro Ejara, Department of Economics and Finance, University of New Haven, West Haven, Connecticut 06516 Tel: 203 932-7150

claims under the recovery plan that the municipality has to prepare. In such recovery plan, the creditors may settle their claims for a lower amount. RV bond holders continue to receive debt service payments as long as the project they finance has cash flows in excess of its operating expenses. RV bond holders lose if the special project they finance fails. (Even though local governments have the power to impose tax, there are cases of municipal bankruptcies. These cases are very small, however. There are less than 500 cases of municipal bankruptcy filings since the bankruptcy law was enacted in 1934 compared to tens of thousand of business bankruptcy filings every year). The relative importance of the municipality's taxing power (in the case of GO bonds) and the special project's security (in the case of RV bonds) should be reflected in their credit ratings. GO bonds are more transparent than RV bonds as the latter depend on the performance of a special project. Such a difference in the degree of information asymmetry is another major reason for the difference in the yields of GO and RV bonds.

Few studies analyzed the determinants of municipal bond yields. For example Maese^[9] and Braswell *et al.*^[2] find that competitively bid municipal bonds have significantly lower interest costs than their negotiated counterparts^[5] and Liu and Thakor^[8] establish that credit rating is a significant determinant of municipal bond yields even after controlling for economic factors and issue features. Kidwell and Koch^[6] find significant explanatory power for the GO and RV bond yield spreads in the economic cycles and investor-borrower market segmentation. This research adds to the literature by analyzing the impact of information asymmetry on the yield differentials of GO and RV bonds. We measure information asymmetry by the transaction spread at the time of issue of each bond. If there is high degree of information asymmetry, dealers increase the transaction spread on the security to protect themselves from adverse consequences of dealing with informed traders. Thus the spread is positively correlated with the degree of information asymmetry. We control for external economic variables, issuer financial and demographic characteristics, issue features including credit rating, insurance, bid type, maturity and other factors.

We analyze the yield determinants by using a two-step regression model that minimizes the simultaneity effect of several variables being dependent on common factors. Based on a rich data set that combines Security's Data Company bond issue data with demographic data of local governments and other economic variables, we find that GO bonds have a higher average credit rating, lower issue (transaction)

costs and lower yields than RV bonds. The differences in the yields persist after controlling for credit rating and other variables. The gap in yield appears to widen as credit quality decreases. Consistent with previous studies, we also find that competitively bid issues and insured issues have significantly lower interest cost than negotiated and uninsured issues respectively.

MATERIALS AND METHODS

Model: We model the interest rate or yield on municipal bonds as a function of external economic factors at the time of issue, issuer financial conditions, specific issue features and the type and purpose of the bond issue (for variables that influence credit quality and yield^[2,7,9]). The external economic conditions include inflation rate, default risk premium, maturity risk premium or the slope of the yield curve and economic (production) activities. We measure the degree of information asymmetry by the security issuance costs (spread). Issuer financial conditions are factors that indicate the financial strength or weakness of the municipality. These include the size of the municipality, its revenue per capita, its existing debt burden, stability of its revenue base and its ability to cover its expenditures. The specific issue factors that are expected to influence debt yield are its default risk measured by credit rating, maturity choice, syndicate structure, security and seniority. Issue types such as refunding or new financing, insured or uninsured, callable or straight debt, rank of the underwriter and the type of bid are expected to have influence on bond yields.

The set of variables that influence interest rate also influence each other. Issue spread for example depends on the issuer's financial variables and its credit score. Both the credit score and spread affect debt maturity. Therefore, the estimation model should take into account such interdependencies^[8] for the methodology used here).

Therefore; we first estimate credit score as a function of issuer financial conditions and specific issue features:

$$\text{Credit score} = f(\text{issuer and issue characteristics}) + \epsilon_{cs} \quad (1)$$

where, ϵ_{cs} is White noise random error. The issuer features expected to affect the credit score are the size of the issuer measured by aggregate revenue, aggregate revenue per capita, expenditure coverage measured by the ratio of aggregate revenue to aggregate expenditure, level of existing debt measured by debt service ratio(or the ratio of interest expense to aggregate revenue),

production opportunity measured by index of state's economic activity at the time of issue and stability of the issuer's revenue base measured by Herfindahl-Hirschman Index (HHI) of revenue sources. These variables measure the financial strength of the issuer. Except the debt service ratio and index of economic activity, the other variables are expected to have positive relations with credit quality. Size of the issue, types of the issue such as whether the bond is GO or RV, refunding or new issue, insured or not and whether the bond is issued under competitive bid or negotiated bid are the issue features that are expected to affect credit score. We expect credit score to be positively related to size of issue and dummy variables identifying GO bonds, insured, refunding and competitive type issues. In addition, we include syndicate structure variables such as whether the issuer retained financial advisor or not, whether the issue is bank managed or not and whether the issue is underwritten by high ranked underwriters.

Gross spread (or issue cost) is also modeled as a function of the same set of variables as credit score plus a dummy variable that identifies callable bonds, a trend variable and residuals from the credit score regression.

$$\text{Gross spread} = g(\text{issuer and issue characteristics, syndicate structure, } \hat{\epsilon}_{cs}) + \epsilon_s \quad (2)$$

Where:

$\hat{\epsilon}_{cs}$ = Residual from the credit score regression

ϵ_s = Random error expected to be White noise

The residual from the credit score regression is expected to have negative coefficient because it should cost more to underwrite lower quality issues than higher quality issues. Stable and large size revenue, large issue size, competitive bidding, refunding type and GO bonds are expected to have lower issue costs. Large size is associated with lower information asymmetry. Competitive bidding also involves the release of more information than privately negotiated bids. Refunding type issues refinance already outstanding debt. Since the operations of the projects they finance are already known, they should cost less to issue than new debt issues.

Previous studies show that maturity of municipal bonds is influenced by the same set of variables described above. We add the residuals from the credit score and gross spread regressions and maturity risk premium or slope of the yield curve measured as the yield spread between ten-year Treasury bond and three-month Treasury bill. The credit score and spread residuals are expected to have positive relations with

maturity, but maturity risk premium will have negative relations. If the slope of the yield curve is positive, long-term debt would cost more than short-term debt and issuers will issue short-term debt and refinance as they mature to reduce their total financing cost.

$$\text{Maturity} = h(\text{economic variables, issuer and issue characteristics, syndicate structure, covenants, } \hat{\epsilon}_{cs}, \hat{\epsilon}_s) + \epsilon_m \quad (3)$$

Where:

$\hat{\epsilon}_s$ = Residual from the spread regression

ϵ_m = Error term expected to be white noise

Yield on municipal bond is modeled as a function of economic variables affecting the general level of interest rates, issuer and issue characteristics, covenants, syndicate structure and the residuals from the above three models.

$$\text{Yield} = \psi(\text{economic variables, issuer and issue characteristics, syndicate structure, covenants, } \hat{\epsilon}_{cs}, \hat{\epsilon}_s, \hat{\epsilon}_m) + \epsilon_i \quad (4)$$

Where:

$\hat{\epsilon}_m$ = Residual from the maturity regression

ϵ_i = Random error expected to be White noise

The residuals from the first three regressions are orthogonal to the economic factors, issue and issuer characteristics and covenants. This method reduces the multicollinearity effect and the residuals measure the impact of credit quality, spread and maturity on yield independently of the other factors.

We use two measures of yield. These are the True Interest Cost (TIC) and the Re-Offer Yield (ROY). TIC is the rate that equates the present value of future debt obligations to the net proceeds received by the issuer. This rate takes into account the time value of money concept. ROY is the rate at which the underwriter issues the debt to the public in the primary market. The difference between TIC and ROY is sometimes attributed to underpricing of the debt issue and sometimes as underwriter spread^[11]. It represents the re-pricing effect between the date of offer by the municipality and the date of offer to the public by the underwriter. The two measures of interest rate reflect similar economic fundamentals in spite of their differences and the analyses using each alternative are not expected to be qualitatively different.

Data and sample description: Our sample consists of tax-exempt city and county bonds issued during the period 1990-1999. The list of the municipal bond issues, their yields, classification as GO and RV, issue features such as size, covenants, ratings, insurance, spread and other data items are obtained from the Securities Data Company, Inc., (SDC) municipal database. Our initial data sample started with 9,493 bonds for the 1990-1999 time period and we excluded all bonds except cities and counties because census data can only be obtained for these municipal bond issues. Our final sample has 2,696 bonds after requiring that a complete set of data be available for all municipal issues used for our analyses. All census data such as aggregate revenue of the issuer, population, revenue components and financial figures are gathered from the Census Bureau's Annual Survey of Governments. Data for the OUTPUT measure relating to the state index of economic activity are obtained from the state coincident indexes produced by the Federal Reserve Bank of Philadelphia. Inflation rates are obtained from the Department of Labor, Bureau of Economic Statistics website^[3]. We use inflation rate based on the consumer price index series that excludes food and energy. The figures used here are annualized inflation rates from monthly data.

The sample is made up of 1550 (57%) GO bonds and 1146 (43%) RV bonds. Competitive bid types constitute 53% of the sample and the remaining 47%

are negotiated bid and private placement types. Competitive bid types also constitute 70% of the GO bonds and 31% of the RV bonds. Forty percent of the issues in our sample are bank qualified, but only 23% are bank managed. Bank qualified issues are smaller in size usually less than \$10 million. The average issue size of the sample is \$17.7 million. GO bonds' average issue size is \$15.92 million compared to \$20.10 million for RV bonds. The average issuer size by aggregate revenue is \$325 million, while the average issuer size for revenue bonds is slightly larger at \$334 million compared to \$319 million for GO bond issuers.

RESULTS AND DISCUSSION

Descriptive analyses: We convert the credit rating codes to credit score by assigning a value of zero to BBB rating and ± 1 for each step of the ratings including those with +/- signs. Thus BBB+ is assigned a score of 1 while BBB- is scored as -1. Our sample contains rating categories of AAA, AA, A, B and non-rated issues only that are respectively scored as 8, 6, 3, -6 and -15. This scoring assign highest value to AAA rated issues.

Table 1 shows average values of the sample variables by year of issue. The sample covers the years 1990-1999. The general economic variables such as inflation rate, default risk premium (measured as the spread between yields on BAA and AAA rated bonds),

Table 1: Means of municipal bond yields and other variables over the years

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total	
Sample size (N)	121.000	366.000	505.000	472.000	356.000	225.000	134.000	197.000	209.000	111.000	2696.000	
Inflation Rate (IR) %	***	5.525	3.401	3.118	2.958	3.004	2.713	3.209	1.617	1.973	2.383	2.963
Default Risk Premium (DRP) %	***	1.052	0.991	0.841	0.708	0.668	0.614	0.685	0.602	0.704	0.855	0.771
Maturity Risk Premium (MRP) %	***	0.819	2.442	3.497	2.820	2.722	0.875	1.316	1.145	0.373	0.819	2.161
Index of state's economic activity	***	99.463	97.955	99.880	104.135	108.866	114.461	118.964	127.496	133.955	142.537	110.113
Spread	***	1.218	1.168	1.134	0.955	0.949	1.001	0.920	0.908	0.813	0.825	1.011
Aggregate revenue in M\$		356.473	319.328	321.202	257.412	334.113	220.334	342.025	211.382	589.791	483.376	325.158
HH Index of revenues (HHI)	***	0.326	0.338	0.325	0.328	0.322	0.313	0.322	0.311	0.308	0.305	0.323
Debt service ratio	***	0.098	0.088	0.073	0.082	0.073	0.074	0.067	0.076	0.076	0.069	0.078
Aggregate revenue per capita	*	1.298	1.090	1.228	1.289	1.393	2.443	1.514	1.386	1.509	1.550	1.407
Expenditure coverage ratio	**	1.058	0.994	0.987	1.005	1.019	0.999	1.016	1.019	1.000	1.020	1.006
Years to maturity	***	19.067	17.702	16.527	16.053	16.806	16.680	17.531	16.415	15.546	15.401	16.687
Size of the issue in M\$	*	22.117	18.832	18.793	18.586	14.843	16.368	20.727	13.652	19.280	12.747	17.697
True Interest Cost (TIC)	***	7.206	6.585	5.949	5.088	5.545	5.477	5.312	5.122	4.598	4.758	5.603
Re-Offer Yield (ROY)	***	6.961	6.269	5.574	4.707	5.214	5.204	5.032	4.886	4.386	4.492	5.286
Syndicate size	***	3.165	3.066	3.257	2.818	3.076	2.787	3.493	2.426	2.368	3.108	2.963
Credit score	***	3.289	2.251	1.851	2.994	3.326	2.333	5.090	2.584	3.120	1.982	2.723
Proportion rated AAA	***	0.380	0.355	0.352	0.394	0.449	0.507	0.552	0.401	0.411	0.261	0.401
Proportion rated AA	***	0.207	0.208	0.164	0.167	0.169	0.187	0.269	0.228	0.273	0.414	0.204
Proportion rated A	***	0.264	0.235	0.257	0.282	0.230	0.084	0.090	0.188	0.153	0.126	0.214
Proportion rated B	***	0.050	0.055	0.073	0.038	0.034	0.027	0.015	0.020	0.019	0.000	0.040
Proportion not rated	**	0.099	0.148	0.152	0.119	0.118	0.196	0.075	0.162	0.144	0.198	0.141
Proportion issued by city	***	0.579	0.593	0.651	0.661	0.635	0.684	0.672	0.766	0.766	0.676	0.662
Proportion of competitive bid type	***	0.446	0.432	0.408	0.396	0.567	0.551	0.709	0.751	0.804	0.883	0.534
Proportion with financial advisor	***	0.694	0.661	0.687	0.722	0.739	0.764	0.806	0.858	0.876	0.937	0.747
Proportion bank managed	***	0.322	0.311	0.224	0.258	0.236	0.200	0.216	0.168	0.187	0.090	0.233
Proportion INSURED	***	0.364	0.342	0.333	0.381	0.430	0.480	0.545	0.365	0.383	0.225	0.381
Proportion CALLABLE		0.851	0.831	0.802	0.797	0.854	0.849	0.866	0.868	0.809	0.829	0.828
Proportion with top 25 underwriters	***	0.380	0.344	0.467	0.428	0.475	0.529	0.455	0.492	0.589	0.550	0.460
Proportion of refunding type issues	***	0.140	0.260	0.426	0.566	0.213	0.218	0.261	0.264	0.278	0.288	0.332
Proportion of GO bonds	***	0.455	0.522	0.511	0.578	0.593	0.551	0.664	0.624	0.699	0.721	0.575

***, ** and *: Indicate that cross-year variations are significant at 1, 5 and 10% levels respectively

maturity risk premium (measured as the slope of the Treasury yield curve, difference between the 10 year T-bond and 3-month T-bill rates) and index of the states' economic activities show significant variations over the years. But there is no systematic pattern in their variations. Spread, which represents the issue cost decreased steadily, if not monotonically, from 1.218% in 1990-0.825% in 1999. The maturity of the municipal bonds also decreased over the years. Average maturity for the sample was 19.1 years in 1990 and 15.4 years in 1999, while the average for the entire sample period is 16.7 years.

The average size of the bond issue in the sample is \$17.7 million. The average syndicate size for municipal debt issue is about three underwriters. Both the issue size and syndicate size vary over the years with no apparent pattern.

The True Interest Cost (TIC) and Re-Offer Yield (ROY) also declined over the sample period from an average of 7.206 and 6.961 in 1990-4.758 and 4.492% in 1999 respectively. Average TIC and ROY for the entire sample are 5.603 and 5.286% respectively. Municipalities issued more GO bonds than RV bonds during each of the years sampled except for 1990. GO bonds account for 57.5% for the entire sample but average proportions vary from 45.5% in 1990-72.1% in 1999.

Municipalities increased the proportion of issues under competitive bids over the years. In 1990, 44.6% of the issues were under competitive bid, in 1999 the proportion increased to 88.3%. Municipalities also increased the use of financial advisor as well as the service of top quality underwriters. However the proportion of bank managed issues decreased over the years.

Other variables considered in this study changed over the years but most of them seem to follow some cyclical pattern than trend. The average credit score of the bonds for example was 3.289 in 1990, it decreased to a low of 1.851 in 1992 and increased to a high of 5.090 in 1996 and then decreased to 1.982 in 1999. More than 80% of the municipal bonds in the sample are rated investment grade. About 83% of the munis in the sample were callable and the proportion of callable munis does not vary significantly over the sample period. City issued bonds account for 66.2%, while the rest of the sample (33.8%) is county issued bonds.

Table 2 compares the GO and RV bonds in terms of the various sample characteristics. There is no significant difference in the inflation rates at the time of issue of GO and RV bonds. Similarly, there is no significant difference between the two samples in terms

of aggregate revenue of the issuer, aggregate revenue per capita and expenditure coverage ratio. All the other variables show statistically significant differences between the GO and RV bond samples.

Higher default and maturity risk premiums are associated with RV bond issues than GO bond issues and the differences are statistically significant at 1% level. Underwriters charge an average of 1.172% for RV bond underwriting compared to 0.892% for GO bonds and the difference is significant at 1% level, implying higher level of information asymmetries for the RV bonds. GO bonds are associated with higher level of economic activity than RV bonds. GO bond issuers have average debt service to aggregate revenue ratio of 7.3% compared to 8.4% for RV bond issuers. Concentration of revenue measured by the HH index is 0.326 for GO bonds and 0.317 for RV bonds and the difference is significant at 5% level.

Table 2: Comparison of GO and RV bonds. This table presents average values of the variables in the study grouped into GO and RV bonds

	Sign.	GO	RV	Combined
Sample Size (N)		1550.000	1146.000	2696.000
Inflation Rate (IR%)		2.919	3.023	2.963
Default Risk Premium (DRP%)	***	0.762	0.782	0.771
Maturity Risk Premium (MRP%)	***	2.089	2.258	2.161
SPREAD	***	0.892	1.172	1.011
Index of state's economic activity (output)	***	111.361	108.424	110.113
Aggregate revenue in M\$		318.898	333.625	325.158
Aggregate revenue per capita		1.514	1.263	1.407
Expenditure coverage ratio		1.007	1.004	1.006
Debt service ratio	***	0.073	0.084	0.078
HH Index of revenues (HHI)	**	0.326	0.317	0.323
Size of the issue in M\$	***	15.922	20.096	17.697
Years to Maturity	***	14.912	19.087	16.687
Syndicate Size	***	3.303	2.503	2.963
Credit Score	***	3.520	1.646	2.723
Proportion with AAA rating	***	0.335	0.490	0.401
Proportion with AA rating	***	0.292	0.085	0.204
Proportion with A rating	***	0.246	0.171	0.214
Proportion with B rating	***	0.028	0.057	0.040
Proportion of non-rated issues	***	0.099	0.197	0.141
Proportion of bank managed issues	***	0.326	0.107	0.233
Proportion CALLABLE	***	0.794	0.873	0.828
Proportion with Competitive bid type	***	0.701	0.309	0.534
Proportion issued by city	**	0.646	0.683	0.662
Proportion that retain financial advisor	***	0.810	0.661	0.747
Proportion of Refunding type issues	***	0.305	0.370	0.332
Proportion of Insured Issues	***	0.297	0.496	0.381
Proportion with top 25 underwriters	**	0.440	0.487	0.460
Proportion issues in Far West	***	0.134	0.291	0.201
Proportion issued in Midwest	***	0.348	0.197	0.284
Proportion issued in Northeast	***	0.146	0.020	0.093
Proportion issued in Southeast	***	0.270	0.353	0.305
Re-Offer Yield (ROY) %	***	4.983	5.696	5.286
True Interest Cost (TIC) %	***	5.290	6.025	5.603

***, ** and *: Indicate that the mean difference between GO and RV bonds is statistically significant at 1, 5 and 10% levels respectively

Issue size for GO bonds average \$15.92 million compared to \$20.10 million for RV bonds and the difference is significant at 1% level. RV bonds have significantly longer maturities at 19.1 years than GO bonds at 14.9 years. Larger syndicates underwrote GO bonds than RV bonds despite the fact that RV bond issue sizes are larger on average. GO bonds average credit score is 3.52 compared to 1.646 for RV bonds and the difference is statistically significant at 1% level. However, RV bonds have greater proportion of AAA rated issues (49%) than GO bonds (33.5%).

Bank managed issues constitute 32.6% of the GO bonds and 10.7% of the RV bonds but a greater proportion of RV bonds used higher ranked underwriters than GO bonds. These relationships are consistent with the issue size comparison presented above. Bank managed issues are smaller in size. Callable bonds constitute 79.4% of GO bonds and 87.3% of RV bonds. A greater proportion of GO bonds (70.1%) are issued under competitive bid, while only 30.9% of RV bonds are issued under competitive bid. City issued bonds are more in both samples than county issued bonds and the relative proportion of city issue is more for RV bonds.

Financial advisors are used in 81% of the GO cases and in 66.1% of the RV cases. Refunding type issues

constitute 30.5% of GO bonds and 37% of RV bonds. The proportions of insured issues are nearly 30 and 50% for the GO and the RV bonds respectively. All these proportional differences between the RV and GO bonds are significant at 1% level.

Reflecting these characteristic differences, RV bonds have significantly higher interest costs than GO bonds when measured by both the true interest cost and re-offer yield. The true interest cost of RV bonds averages 6.025% compared to 5.29% for GO bonds. The difference of 0.735% is statistically significant at 1% level. Similarly RV bonds' re-offer yields exceed those of GO bonds by an average of 0.713%, which is significant at 1% level. Will these differences hold if we control for the variables that influence the level of interest rates? Next, we perform regression analyses of municipal bond yields on the set of economic variables, issue and issuer features and syndicate structure and test if the differences between GO and RV bond yields persist after controlling for the other variables.

Regression analyses: Table 3 shows heteroscedasticity consistent regression results of credit score, spread and maturity on external economic variables, issuer and issue features and other control variables.

Table 3: Regression of credit score, spread and maturity. This table presents regression results of credit score, spread and maturity regressions; models 1, 2 and 3 respectively

Independent variables	Dependent variables		
	Credit score	Spread	Maturity
Index of state economic activity	-0.0310***	0.0018**	-0.0148
HH Index of revenue sources	-1.4714	0.2297**	-1.4816
Log of aggregate revenue	0.4897***	-0.0194***	-0.2520***
Aggregate revenue per capita	-0.0076		0.0255**
Expenditure coverage ratio (aggregate rev./aggregate exp)	-0.4687	-0.0195	0.4683
Debt service ratio (interest exp. as a % of aggregate rev.)	-0.2868		4.8374***
Dummy for competitive bid type	3.1625***	-0.1653***	-0.2583
Dummy for financial advisor	0.9424***	-0.1419***	0.0176
Dummy for bank managed issues	-0.0397	-0.0538***	0.0510
Dummy for insured issues	8.5703***	0.0332*	1.5625***
Log of issue size	1.1625***	-0.1017***	1.6183***
Dummy for issues underwritten by top 25 underwriters	-0.3887*	-0.0127	-0.1210
Dummy for refunding type issues	1.4365***	-0.0726***	-1.9731***
Dummy for GO bonds	2.8115***	-0.1819***	-2.6397***
Dummy for callable bonds		0.2163***	7.7106***
TREND variable		-0.0401***	-0.0388
Syndicate size			-0.0002
Maturity risk premium			-0.1000
Dummy for city issued bonds			0.3847*
Regional dummy-Far West			1.9293***
Regional Dummy-Midwest			0.0557
Regional dummy-Northeast			2.9917***
Regional dummy- Southeast			1.6556***
Residual from credit score regression		-0.0185***	0.0478**
Residual from Spread regression			2.8845***
Constant term	-4.9438***	1.1930***	9.7793***
N	2694.0000	2694.0000	2694.0000
R-squared	0.4417	0.2726	0.5102
Adjusted R-squared	0.4388	0.2685	0.5056

***, ** and *: Signify statistical significance at 1, 5 and 10% levels

Credit score is negatively influenced by the index of local economic activity. High level of economic activity creates uncertainty and hence lowers credit score. The dummy identifying high ranked underwriters also has a negative coefficient, significant at 10% level. This may result from low credit quality issuers seeking the service of high ranked underwriters to obtain better terms. Aggregate revenue of the issuer and size of the issue have positive and significant (at 1% level) coefficients. Large size represents stability and hence high credit quality. Bonds issued under competitive bid, insured issues, refunding type issues and issues for which financial advisor is retained have higher credit scores than their respective counterparts. GO bonds have higher credit scores than RV bonds. This reflects the greater security resulting from the full faith and taxing power of the local government that supports GO bonds. The other variables do not have significant impact on credit score.

Spread is positively influenced by the index of local economic activity and the concentration of revenue measured by the HH index. Insured issues and callable issues also have higher spread. This is probably resulting from underwriters charging high fees for the additional work due to these clauses. The two size variables, aggregate revenue and issue size, have negative coefficients. Large size municipalities are stable and large issue size has scale advantage and hence lower percentage issue costs. Other issue features with significant negative coefficients include competitive bid, issues with financial advisor, bank managed issues and refunding type issues.

GO bonds have 0.1819% lower spread than RV bonds after controlling for the other variables. The lower spread for GO bonds reflects the lower degrees of information asymmetry since GO bonds are guaranteed by the taxing power of the municipality. RV bonds on the other hand are secured by the performance of the special project they finance, which may not be as transparent to all investors.

Consistent with the results in Table 1, the time trend variable has significant negative coefficient confirming the decreasing transaction cost over the years in the sample period. The residual from the credit score regression has significant negative coefficient. Higher quality issuers face lower transaction costs even after controlling for other economic factors and issuer and issue features.

The third column of Table 3 shows results of the maturity regression. These results are consistent with previous studies of municipal bond maturities^[4]. There is significant direct relation between maturity and credit score. High quality issuers issue long-term and this is consistent with results obtained for corporate bonds under reduced information asymmetry^[1]. Spread as a

measure of transaction costs also has significant positive relations with maturity. If transaction costs are high, issuing short-term bonds and refinancing as they mature could be expensive. Of the issuer features, aggregate revenue has negative effect on maturity but aggregate revenue per capita has positive influence. Index of local economic activity and concentration of issuer's revenue have no significant direct effect on bond maturity. The level of existing debt measured by debt service ratio has positive effect on maturity. If the issuer has high level of debt service expenditure, it may be overburdened to issue more short-term debt and prefers long-term debt instead.

Insurance, issue size and call features have significant positive effects on maturity. Insurance provides protection to the investors and reduces the need for the monitoring benefits of short-term debt. Large issue size provides the scale advantage to absorb issue costs associated with long-term debt. Call feature provides the flexibility to change maturity depending on future interest rate movements and it results in about 7.71 years longer maturity over the non-callable bonds. Refunding type issues have about 2 years shorter maturities than new issue bonds. GO bonds have about 2.6 years shorter maturities than RV bonds. The types of bid, retention of financial advisor, syndicate size and inclusion or exclusion of a bank from syndicate have no significant direct effect on municipal bond maturity. There are significant variations in maturity depending on the region of the municipality as measured by the coefficients of the regional dummies.

Municipal bond yield regression: Two alternative variables are used to measure the cost of municipal debt. These are the True Interest Cost (TIC) and the Re-Offer Yield (ROY). Results of the two regressions, corrected for heteroscedasticity, are shown in Table 4. External economic variables such as inflation rate, default risk premium and transaction cost (spread) have significant positive coefficients in both regressions. These are consistent with theory.

The coefficient of the residual from the spread regression is the focus of our attention in this study. Its coefficients are 0.547 and 0.473 in the TIC and ROY regressions respectively and both are statistically significant at 1% level. This effect after controlling for the credit score and other economic variables is attributed to differences in the degree of information asymmetry. Similar results are obtained in separate regressions for GO and RV bond sub-samples (not reported here). The coefficients for the residual from spread regression are approximately 0.5 for both sub-samples. A one unit increase in the spread residual increases yield by 0.5%.

Table 4: Regression Results of TIC and ROY. The table presents regression results of the TIC and ROY on various independent variables

Independent variables	Dependent variable	
	TIC	ROY
Inflation rate	0.0098**	0.0108**
Default risk premium	0.7403***	0.7521***
Maturity risk premium	-0.1393***	-0.1863***
Index of state economic activity	0.0025*	0.0018
Log of aggregate revenue	-0.0112	-0.0125
HH Index of revenue sources	0.1292	0.0279
Debt service ratio (interest exp. as a percentage of Aggregate revenue)	0.3217**	0.3514**
Aggregate revenue per capita	0.0002	0.0000
Expenditure coverage ratio (aggregate rev./aggregate exp.)	0.0792*	0.0641
Dummy for city issued bonds	0.0178	0.0085
Regional dummy-Far West	0.1125***	0.0892**
Regional Dummy-Midwest	-0.0395	-0.0151
Regional dummy-Northeast	0.0190	-0.0313
Regional dummy- Southeast	0.0905**	0.0710*
Syndicate size	0.0090**	0.0058
Dummy for competitive bid type	-0.2354***	-0.2006***
Dummy for financial advisor	-0.0013	-0.0217
Dummy for bank managed issues	-0.0780***	-0.0697***
Dummy for insured issues	-0.0403*	-0.0946***
Dummy for callable bonds	0.6073***	0.6249***
Log of issue size	0.0421***	0.0694***
Dummy for issues underwritten by top 25 underwriters	-0.0439**	-0.0227
Dummy for refunding type issues	-0.3095***	-0.3067***
Dummy for GO bonds	-0.4458***	-0.4433***
TREND variable	-0.2252***	-0.2222***
Residual from credit score regression	-0.0195***	-0.0184***
Residual from spread regression	0.5473***	0.4729***
Residual from maturity regression	0.0490***	0.0546***
Constant term	4.7523***	4.6086***
N	2694.0000	2694.0000
R-squared	0.7023	0.6842
Adjusted R-squared	0.6992	0.6808

***, ** and *: Signify statistical significance at 1, 5 and 10% levels

The maturity risk premium has significant (at 1% level) negative coefficient. This implies that when the yield curve is upward sloping, the interest rate on municipal debt is lower. This could be due to the effect of maturity. When the yield curve is upward sloping, municipalities issue short-term debt to reduce interest cost. Although it is not statistically significant, the coefficient of maturity risk premium is negative in the maturity regression above. Index of local economic activity has marginally significant (at 10% level) positive effect on the TIC.

Debt service ratio has significant positive coefficients in both regressions. Expenditure coverage ratio has marginally significant positive coefficient at 10% level in the TIC regression. Positive relations between debt service ratio and yield makes economic sense because if the issuer is heavily indebted, its new debt has high financial risk and the yield should reflect that. The other coefficients for the issuer feature variables are contrary to expectations.

The coefficient of competitive bid type is negative and statistically significant in both regressions. This

implies a 0.20-0.24% lower yield for bonds issued under competitive bid than those issued under negotiated bid. This is consistent with the findings of Maese^[9] and Braswell *et al.*^[2].

Consistent with our expectations, bank managed issues, insured issues, issues underwritten by high ranked underwriters and refunding type issues all have significant negative coefficients in both regressions. Callable bonds have about 0.6% higher yield than non-callable bonds. The time trend variable and residual from the credit score regression have negative and significant coefficients. The trend variable shows the general decline in interest rates over the sample period. The negative coefficient of credit score implies that high quality issues have lower yields. This is consistent with expectations and it indicates that credit rating has additional information beyond what is observed from the general economic conditions and issuer and issue features as argued in Liu and Thakor^[8]. Likewise the coefficients of the residuals from the spread and maturity regressions are positive and statistically significant at 1% level. Issues with high spread and longer maturities have higher yields.

Table 5: Regression results of yields by credit rating categories. This table presents the regression results of TIC and ROY on various variables by credit rating categories

Independent variables	Dependent variable TIC			Dependent variable ROY		
	AAA rated	AA rated	A rated	AAA rated	AA rated	A rated
Inflation rate	0.0076	-0.0047	0.0085	0.0073	-0.0071	0.0083
Default risk premium	0.6152***	0.4702***	1.1786***	0.6006***	0.4236***	1.2145***
Maturity risk premium	-0.1042***	-0.1181***	-0.1387***	-0.1479***	-0.1645***	-0.1902***
Index of state economic activity	-0.0008	0.0105***	-0.0006	-0.0010	0.0107***	-0.0002
Log of aggregate revenue	-0.0276***	0.0162	0.0127	-0.0358***	0.0190	0.0058
HH Index of Revenue sources	0.2278*	-0.5712**	-0.3513	0.1707	-0.5376*	-0.5263**
Debt service ratio (interest expense as percentage of aggregate rev)	0.2465	0.2478	0.0633	0.3963**	0.1518	0.0037
Aggregate Revenue per capita	0.0001	-0.0130	-0.0224	-0.0003	-0.0305	-0.0212
Expenditure coverage ratio (aggregate rev./aggregate exp)	0.0018	-0.0819	0.0029	0.0232	0.0003	-0.1128
Dummy for city issued bonds	-0.0033	-0.0789	0.0526	-0.0247	-0.0728	0.0459
Regional dummy-Far West	0.0061	-0.0509	0.1624*	-0.0115	-0.0952	0.1564
Regional dummy-Midwest	-0.0887*	-0.0064	-0.0205	-0.0869*	-0.0233	0.0416
Regional dummy-Northeast	-0.1241**	-0.1476*	-0.1254	-0.1604***	-0.2248***	-0.1495
Regional dummy-Southeast	-0.0327	0.1491**	0.0594	-0.0637	0.1307*	0.0773
Syndicate size	0.0086	0.0053	0.0089	0.0059	0.0045	0.0037
Dummy for competitive bid type	-0.1076***	-0.1426**	-0.1980***	-0.0687*	-0.1057*	-0.1860***
Dummy for financial advisor	0.0326	0.0539	-0.1084*	0.0357	0.0604	-0.1617**
Dummy for bank managed issues	-0.0892**	0.0012	-0.1040**	-0.0698*	0.0388	-0.0758
Dummy for insured issues	0.2639***	0.6215***	-0.1689	0.2051***	0.3641*	-0.1474
Dummy for callable bonds	0.3740***	0.4819***	0.6210***	0.4169***	0.5198***	0.6636***
Log of issue size	0.0899***	0.0253	0.0283	0.1195***	0.0392*	0.0513*
Dummy for issues underwritten by top 25 underwriters	-0.0479*	0.0237	-0.0674	-0.0276	0.0141	-0.0672
Dummy for refunding type issues	-0.3459***	-0.3017***	-0.3582***	-0.3532***	-0.2635***	-0.3059***
Dummy for GO bonds	-0.1554***	-0.3840***	-0.3987***	-0.1673***	-0.3942***	-0.4139***
TREND variable	-0.2173***	-0.2622***	-0.1846***	-0.2108***	-0.2631***	-0.1847***
Residual from spread regression	0.3028***	0.4177***	0.3406***	0.2382***	0.3695***	0.2960***
Residual from maturity regression	0.0346***	0.0436***	0.0495***	0.0403***	0.0481***	0.0535***
Constant term	4.9627***	4.2832***	4.8981***	4.7263***	3.9830***	4.7861***
R-squared	0.7108	0.7513	0.7414	0.6851	0.7292	0.7200
Adjusted R-squared	0.7034	0.7384	0.7287	0.6770	0.7152	0.7062
N	1082.0000	549.0000	576.0000	1082.0000	549.0000	576.0000

***, ** and *: Signify statistical significance at 1, 5 and 10% levels

GO bonds have lower yields than RV bonds even after controlling for the economic factors, issuer and issue features and syndicate characteristics. The yield difference as implied by the coefficient of GO dummy is about 0.44%. This indicates that the credit rating, maturity, external economic variables and issue features do not fully capture the differences in the GO and the RV bonds. The differences in the yields between the two indicate the superior quality of GO bonds because they are supported by the full faith and taxing power of the local government. This full faith and taxing power is more than what the credit ratings and other features reflect.

As a robustness test, we run the yield regressions within each credit rating category. Table 5 shows the results for AAA, AA and A rated categories for both the TIC and ROY. (Regression analysis for the B rated and Non-rated issues in the sample were not reliable due to reduced sample sizes and the many dummy

variables as explanatory variables that rendered the econometric analyses unstable. $X'X$ matrix was near singular and could not be inverted). The results are consistent with the ones obtained above. Some variables, such as insurance, bank management and use of financial advisor lost some explanatory power. In fact the coefficient of the insured dummy became positive in the regressions within credit rating categories. Bid type, call feature, refunding type, trend, spread and maturity continue to have significant effects with signs consistent with the previous analyses. The coefficient of the residual from spread regression decreases in magnitude to the range of 0.24 for AAA rated bonds in the ROY regressions to 0.42 for AA rated bonds in the TIC regressions. But still it is significant in all the regressions. The dummy identifying the use of financial advisor becomes significantly negative in the regressions for the A-rated category.

The dummy variable identifying the GO bonds has significant negative coefficient in all regressions. This confirms the previous results. Even within each credit rating category, GO bonds cost significantly lower than RV bonds. The magnitude of the difference increases as credit rating decreases. The implied difference is about 0.16% for the AAA rated issues, about 0.38% for the AA rated issues and about 0.40% for the A rated issues. These results are consistent and close in magnitude for both TIC and ROY. These results indicate that credit rating does not fully capture the yield differences between GO and RV bonds. The difference between security provided to GO bonds because of the full faith and taxing power of the local government is by far greater than the security provided to RV bonds by special projects. This difference persists even within the same credit rating category.

CONCLUSION

This study analyzes the yield differences between GO and RV bonds issued by city and county governments during 1990-1999. GO bonds finance general expenditures of the municipality and are supported by the full faith and taxing power of the municipality. RV bonds finance special revenue projects and repayment of debt service is from cash flows of these special projects. Reflecting these differences, the True Interest Cost (TIC) on RV bonds is greater than that on GO bonds by an average of 74 basis points. This difference shrinks to 44 basis points after controlling for external economic factors, issuer and issue characteristics, syndicate structure, credit rating and maturity. We tested the impact of information asymmetry on the municipal bond yields. We use the original issue spread as a proxy for information asymmetry. The average spread is 1.172% for RV bonds and 0.892% for GO bonds and the difference is statistically significant. This difference has significant explanatory power for the yield differences between GO and RV bonds. Credit rating also has significant explanatory power, but it does not fully capture the qualitative differences between the two categories of municipal bonds. The difference persists and remains statistically significant within each credit rating category. For AAA-rated issues, TIC of RV bonds is greater than that of GO bonds by an average of 16 basis points. This difference increases as credit rating decreases.

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