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Critical Determinants of Michigan Municipal Bond Ratings

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Abstract: In this study we examined Standard & Poors bond ratings for a sample of 36 cities and townships in Michigan in 2013. We were interested in determining the critical factors that play a role in these bond ratings. A secondary question was whether the longstanding financial difficulties and reputation for high crime levels City of Detroit might adversely affect the bond rating of neighboring municipalities. We were also interested in determining whether a large minority population could adversely affect bond ratings, holding other variables constant. We found that Revenue per Capita (RPC), and Median Household Income (MHI) were significant determinants of bond rating. Additionally we found that geographic proximity to Detroit and minority population also affect bond ratings for Michigan municipalities.

Introduction:

All Michigan residents know the extent to which Michigan cities have been negatively impacted by the problems of the automotive industry and the mortgage crisis. A good discussion can be found in Guzman & Moldogaziev (2012). The financial struggles of the City of Detroit are well known, and, for a period of time, Detroit was overseen by an Emergency Manager. Several other Michigan cities have also had an Emergency Manager. These include Allen Park, Benton Harbor, Ecorse, Flint, and Pontiac (municipalinsider.com). Accordingly,the General Obligation (GO) bonds of these cities have comparatively low bond ratings. A low bond rating indicates that the bond credit rating agencies have attached a relatively high risk of default to the bonds. As a result, the bond issuing entity must pay a higher interest rate to compensate risk-averse investors for the added risk. This means that if the bond issuing authority is a municipality, additional interest must be paid on the bonds, instead of paying teachers, police, and firefighters. So, a low bond rating places an additional burden on already struggling municipalities.

In this paper, we investigate the key variables which are determining current bond credit ratings for Michigan municipalities. We focus on General Obligation bonds issued by cities and townships in Michigan. Counties subsume cities and townships geographically, so county credit ratings were not included in the analyses. Cities and Townships also issue Revenue bonds, but these were also excluded, as this type of bond generally has a higher credit rating than GO bonds issued by the same issuing authority. With this type of bond, payments to bondholders are made from specific sources of revenue which can be budgeted and appropriated. There are also water and sewer and school district bonds which were excluded for similar reasons.

We address a number of fundamental research questions. First, given the geographical proximity of many municipalities to the City of Detroit, we were interested in determining the extent to which the bond ratings of these cities are being negatively impacted by this proximity. In other words, would these cities have higher bond ratings if they were not located geographically close to Detroit? Theoretically, the bond rating should reflect relevant financial and economic variables only. So, for example, average income levels, economic diversity, and average unemployment rates in a city should have the largest effect on bond credit ratings. Many studies have found that these variables play a key role in municipal bond credit ratings (Palumbo & Zaporowski, 2012). However, geographic variables have also been shown to affect credit ratings of municipal bonds. For example, Morse and Deely (1983) found that credit ratings of municipalities in southern states tended to have lower ratings than those in plains states for which financial and economic variables were comparable. So it is possible that many municipalities near Detroit have lower ratings than would be merited by their financial and economic circumstances, alone.

An obvious related question deals with the extent to which a city's credit rating is affected by the size of its minority population. The degree of racial segregation between Detroit and its suburbs is well documented (Sugrue, 2005). A number of researchers have found that there tends to be an inverse relationship between minority populations

and credit ratings. In other words, the higher the minority population in a given city, the lower the credit rating, all things equal (Aronson & Marsden, 1980). Other researchers have not found that variable to be statistically significant (Badu, Bawuah, & Daniels, 1996). Of course, the percentage of minorities in a city could be a proxy for other economic variables like income and education levels (Parry, 1983). With the high minority population in Detroit, and low minority population in surrounding suburbs, we believe that those cities would provide an excellent test for the significance of this variable.

One potentially relevant economic variable is the diversity of the economic base. Hildreth and Miller (2002) argue that diversity of the economic base is positively correlated with the city's credit rating. In other words, the greater the diversity of the economic base, the higher the rating. They cite the case of Highland Park, which lost almost half of its tax base when Chrysler moved its headquarters to Auburn Hills. Michigan cities are particularly vulnerable to the problem of overreliance on the auto industry for the tax base. This is a difficult variable to measure. Some researchers have calculated economic concentration ratios (Hildreth & Miller, 2002). We did not attempt to quantify this variable in the current paper. Another potentially significant variable is whether the bond is insured or not. Liu (2012) has found that insurance premium amounts can predict future downgrades of municipal bonds: the higher the premium, the greater the probability that a bond will be downgraded in the future. However, the mortgage crisis of 2008 also severely affected the municipal bond insurance industry. In 2006, approximately 60% of municipal bonds were insured. In 2013, only about 3% were insured (Krudy, 2013). Also, Allen & Dudney (2008) found that the credit rating for these bonds reflects to a large degree the rating of the insurance company, not the municipality. Accordingly, we did not include this variable in our analyses.

A related research question deals with the relationship between bond ratings and bond yields for Michigan cities and counties. Investors use bond ratings to determine the yield which they require and, therefore, the interest which must be paid by the municipality. If that relationship is strong statistically, then it would make non-economically relevant variables like proximity to Detroit and percentage of minority population more detrimental to the municipalities involved. Adelson (2007) has pointed out that bond ratings tend to be inconsistent in terms of their relationship to yields. Wang, Wu, and Zhang (2008) have found that some portion of a municipal bond's yield is explainable from the relatively low degree of liquidity (it is generally more difficult to sell a municipal bond than a corporate bond). This research question is not directly addressed in this paper. It is a topic for future research.

Data

We began with a list of the 100 largest cities and townships (by population) in Michigan, from the 2010 Federal Census. The largest was Detroit, with a population of 713,777, and the smallest was Genoa charter township with a population of 19,821. Since the dependent variable in our analyses would be the bond ratings, the next step was to identify those cities and townships on the list which had outstanding General Obligation (GO) bonds as of June, 2013. General obligation (GO) bonds are municipal bonds that are backed by the "full faith and credit" of the issuer. No specific projects (e.g. airport, power system, etc.) are identified as the source of funding for the bond, as they are with Revenue bonds. Any source of revenue may be used to make the interest and principal payments of the GO bonds. Therefore, the rating for GO bonds is more likely to reflect a broader range of demographic, economic, and financial variables than bonds for which a specific source of revenue is identified.

Municipal bonds must be registered with the Municipal Securities Rulemaking Board (MSRB), a quasi-governmental agency founded by Congress in 1975 to oversee the municipal bond markets in the U.S. Investment and legal information about municipal bonds can be found on their website (emma.msrb.org). Standard & Poors (S&P) has agreed to provide its current municipal bond ratings on this website at no cost to any users of the site. Of the other two main rating agencies, Moody's and Fitch, Fitch has provided only selected ratings to the site, and Moody's ratings require access to a subscription service. Accordingly, we have chosen to use the S&P ratings provided on the MSRB website.

Of the 100 largest municipalities in Michigan, we found 48 that had GO bonds which were outstanding as of June, 2013. Of these 48 data points, we decided to exclude 12 data points as outliers, as they caused significant deviations in the statistical results. This gave us an n=36 for all statistical tests conducted. In Michigan, there is a legal distinction between GO bonds that are "limited tax" versus "unlimited tax." We did not distinguish between these for the purposes of our investigation. We required only that the bonds be clearly marked "General Obligation" in the information provided on the MSRB site. We did screen out any bonds that were part of the Build America Bonds Program (BAB), a federal government program which provided interest subsidies to certain municipal bonds. The program expired on December 31st, 2010. Presumably, the interest subsidy feature of these bonds could positively affect the credit rating. We did not distinguish between bonds which were insured by a private insurance company, and those which were uninsured. After the mortgage and financial crises of 2008-2009, the market for private municipal bond insurance essentially collapsed, and very few municipal bonds are now privately insured.

We obtained audited financial statements for the 48 initial municipalities in our sample. These are referred to as Comprehensive Financial Reports (CAFRs). Typically, municipalities have a June 30th fiscal year-end, so most of these were for the fiscal year ended June 30th, 2012. Michigan has required its municipalities to adhere to Generally Accepted Accounting Principles (GAAP) since 1968 (Gore, 2004). This means that financial information provided by the municipalities should be relatively transparent, allowing valid comparisons to be made between different cities and townships. All of the financial ratios used in this project were calculated from data provided in the CAFRs. One ratio in particular is recommended by Joffe (2012). This is the interest expense to revenue ratio, which measures interest expense on bond debt as a percentage of tax revenues collected. The higher the interest expense relative to the revenue collected, the more difficult it will be for a municipality to make its bond interest payments on a timely basis.

Demographic and economic data was obtained primarily from the 2010 federal census. Some data was obtained from the Census Department's American Community Survey which was conducted between 2008 and 2012.

Methodology

The dependent variable of interest, bond rating, is a categorical variable with a number of different ordered classes (AAA, AA+, AA, AA-, …). For this type of dependent variable, we chose to employ binary logistic regression. Binary logistic regression is similar to discriminant analysis, but with a few possible advantages. One potential advantage is that logistic regression requires no assumptions about the distributions of the independent variables to be made by the researchers. The independent variables do not have to be normally distributed, linearly related, or have equal variances within each group. If, however, the distribution assumptions are met, discriminant analysis may be stronger. Table 1 summarizes the basic criteria for the highest categories of municipal bond ratings issued by S&P (from S&P published information). Within each letter category, S&P uses + and - to provide further delineations.

Table 1: Standard & Poors Municipal Bond Ratings Categories

AAA - An obligor rated 'AAA' has EXTREMELY STRONG capacity to meet its financial commitments. 'AAA' is the highest Issuer Credit Rating assigned by Standard & Poor's.
AA - An obligor rated 'AA' has VERY STRONG capacity to meet its financial commitments. It differs from the highest rated obligors only in small degree.
A - An obligor rated 'A' has STRONG capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.
BBB - An obligor rated 'BBB' has ADEQUATE capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.

For the purpose of the binary regression model, we organized the 36 data points into two groups by municipal bond rating (MBR) as follows:
MBR 1: AAA, AA+, and AA bond ratings
MBR 2: All ratings below AA

Based on this grouping, there were 19 data points in level 1 and 17 data points in level 2. The variables that were incorporated into the regression model are summarized in Table 2.

Table 2: Independent Variables by Category

Category	Variable	Description
Demographic	Minority population	Minority population from 2010 census.[1]
Economic	Median household income (MHI)	Median household income from the American Community Survey.
Financial	Debt per capita (DPC)	From the CAFRs and the 2010 census.
	Revenue per capita (RPC)	From the CAFRs and the 2010 census.
Geographic	Distance from Detroit	From Rand McNally online mileage calculator.

[1] Minority population was taken from the 2010 census, and represents all respondents who did not identify themselves as "white." This includes respondents who chose multiple racial identities.

Findings

A Binary logistic regression was performed to ascertain the effects of Debt per Capita (DPC), Revenue per Capita (RPC), and Median Household Income (MHI) on the likelihood of Municipal Bond Rating (MBR). The results were as follows: In testing the equal number of municipalities within the sample variability between MBR 1 and MBR 2, it was determined that there was a statistically significant inequality in variability with $P=0.00<0.05$). A possible reason for this is the categorical determination of the MBR variable. The variability may stem from the difference in the amount for those with high rating and high DPC. In generally observing the data collected, it can be

deduced that a higher bond rating did not necessarily equate to a higher DPC.

The Omnibus test indicated that the predictive power of the independent variables was also significant. However, based on the model summary, the explained variation in the dependent variable based on the Nagelkerke test was 34%. This means that the independent variables DPC, RPC, MHI, explained 34% of the variance in the dependent variable MBR. (See Table 3.)

Table 3: Model Summary

MBR	-2 Log Liklihood	Cox & Snell R Sqr	Nagelkerke R Sqr
	24.446	.202	.344

It is possible that other factors might significantly affect the bond rating yet were not tested. Furthermore, a higher sample size might have increased the predictive power of the independent variables measured. In determining the effectiveness of the predicted classification against the actual classification of cases in the summary, 91.9% of cases were correctly classified. (See Table 4.)

Table 4: Classification Table

Observed	Bond Rating 1 / 2	Percent Correct
Bond Rating 1	3 3	50
Bond Rating 2	0 31	100
Overall Percentage		91.9

In further observing the predictive power of each independent variable on MBR we discovered the following: DPC; p=.259 >0.05, RPC; p=.040<0.05, MHI; p =0.05. (See Table 5.)

Table 5: Significance of Variables

Step 1	B	Sig.	Exp (B)
DPC	.8630	.259**	2.369
RPC	1.930	.040**	.145
MHI	1.490	.050**	.225
Constant	4.712	.012**	111.286

This result implies that RPC and MHI added significantly to the model while DPC did not. Debt levels in general seemed to be independent of MBR. For example, East Lansing had a 3:1 debt to revenue ratio and had the same MBR as Novi, which had a 2:1 debt to revenue ratio. This implies that other factors not considered in this study may play a significant role in the predictability and actual classification of MBR. In observing the Beta analysis, it was discovered that a 1-unit increase in DPC would increase the likelihood of a higher MBR by .86 units, while increasing RPC and MHI by 1-unit would decrease the likelihood of a higher MBR. Finally, DPC has a 2% greater likelihood of a higher MBR controlling for the individual increase in MHI and RPC.

In looking at distance from Detroit and its effect on MBR, greater distance significantly increased the predictability of higher MBR. With a 1-unit increase in distance, MBR would increase by 14 units. This gives the impression that the farther away a city was from Detroit the greater and higher the bond rating. Conversely, the test for odds ratio determined that there was a 400% less likelihood of a higher MBR when data was classified solely by DPC, MHI and RPC.

In determining the effect of minority population on MBR, the variables where divided into high and low levels. High levels include those municipalities with n>=0.17, while the lower level where those with n<=0.17. (See Table 6). The finding revealed that there was a significant correlation between high levels of minority population and municipal bond rating, while the lower level minority population had no significant effect on municipal bond rating.

Table 6: Minority Population: n>=0.17

	B	Sig	Exp(B)
Constant	1.609	0.011	5.000

Conclusion

Our study supports the contention that Revenue per Capita (RPC) and Median Household Income (MHI) are significant variables in the determination of Municipal Bond Rating (MBR) for Michigan municipalities. The relationship would be positive: the higher the magnitude of the of these variables, the higher the bond rating, ceteris paribus. An argument could be made that there is a relationship between the two independent variables: all things equal, the higher the Median Household Income, the higher should be Revenue per Capita. However, we tested for multicollinearity, and these variables were not found to be multicollinear. Revenue per Capita is also a function of local tax rates and other variables. Taken together, this finding indicates that more affluent communities with a relatively high tax base have higher bond ratings.

In terms of distance from Detroit and minority population levels, there were some interesting findings. Distance from Detroit was, indeed, negatively correlated with bond ratings, as originally hypothesized. This implies that decision makers implicitly or explicitly factored this variable into their decision making processes. This would unduly penalize municipalities that are geographically close to Detroit. We also determined that municipalities with minority populations greater than 17% appear to have bond ratings lower than would be justified by other factors. The idea that a variable involving race could play a role in municipal bond ratiings is troubling, and calls for additional research.

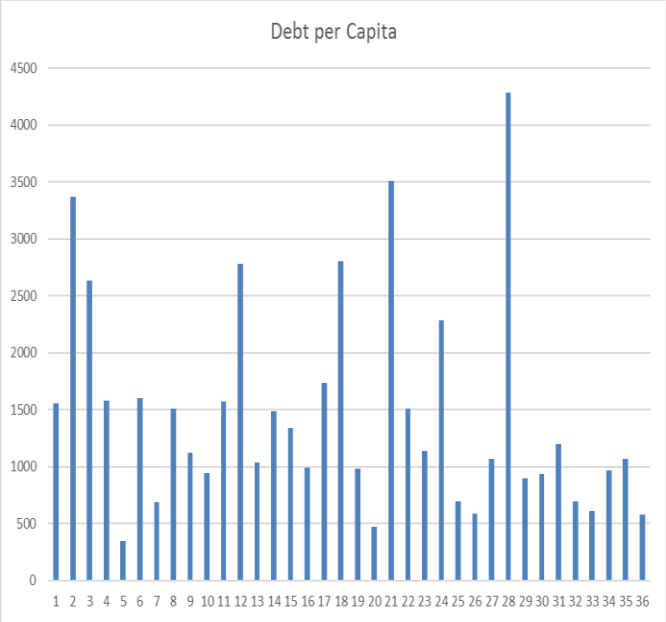
Limitations and Further Research:

Not every Michigan city has GO bonds. Out of the top 100

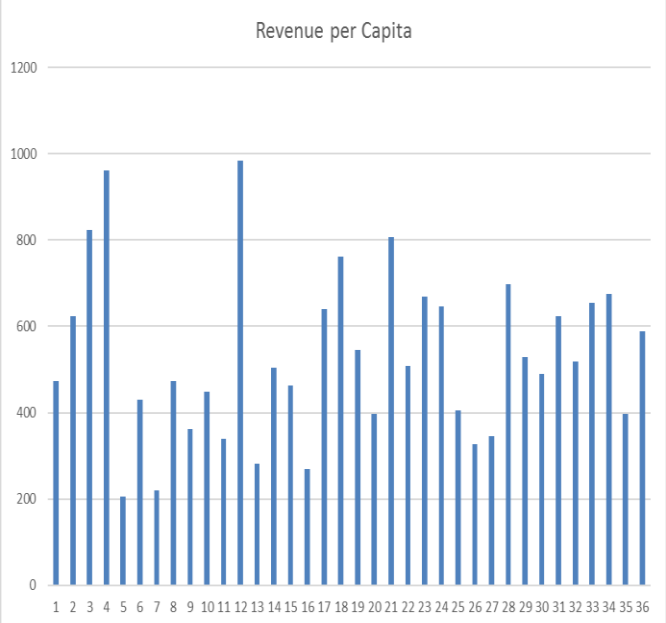
cities, only 48 had GO bonds. Smaller cities tend not to have rated GO bonds. Thus, a larger sample size of Michigan bonds cannot easily be obtained. GO bonds tend to be highly rated since the risk of default has been extremely low. This caused a clustering of the ratings in only a small number of categories. Other statistical methods may yield slightly different results. Also additional variables could be examined including using an Economic Diversity Index which would measure the degree to which the economic base of the municipality is concentrated in only a few industries. Other statistical techniques such as Discriminant Analysis might also be employed.

Appendix 1: Levels of the Dependent and Independent Variables

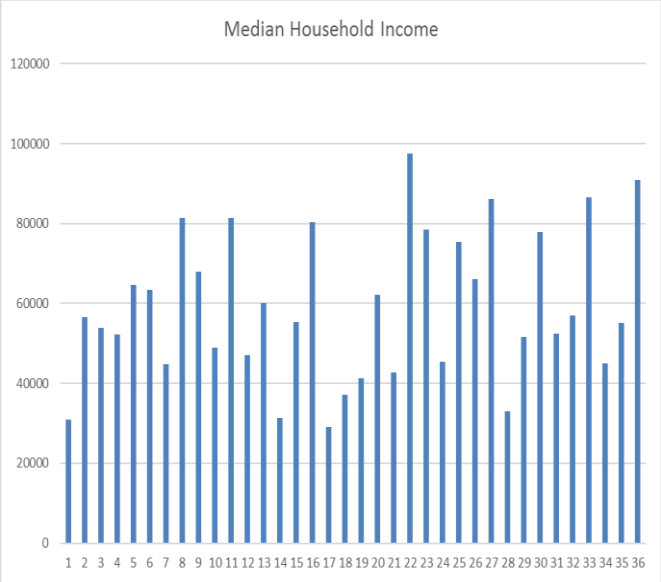
Debt per Capita



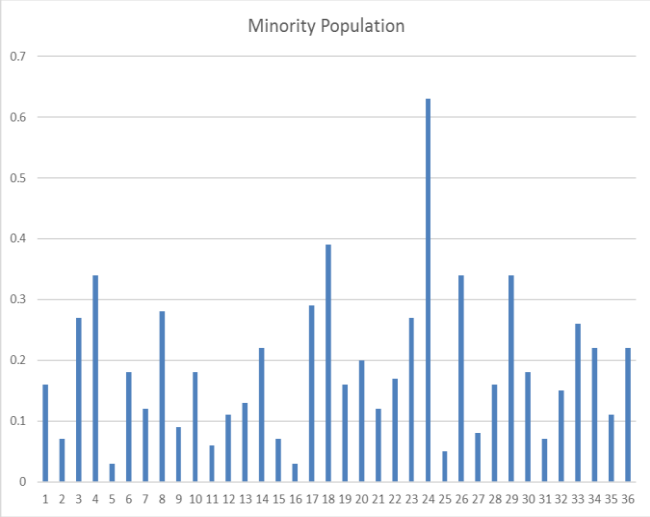
Revenue per Capita



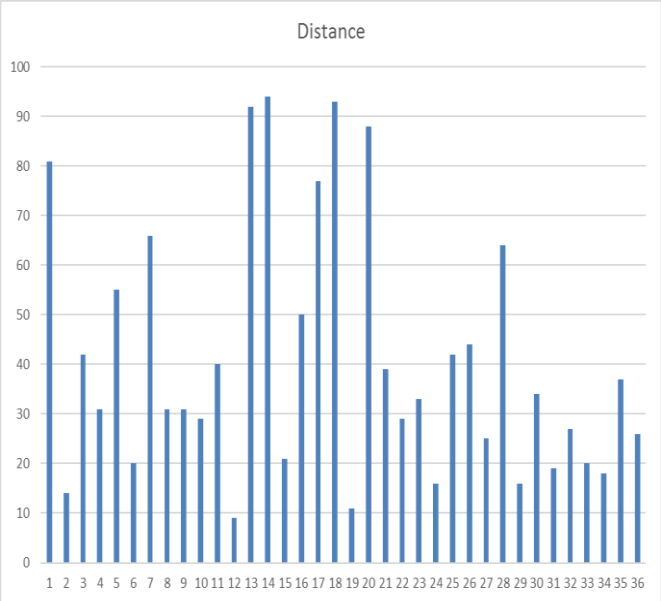
Median Household Income



Minority Population



Distance from Detroit



Appendix 2:

List of Cities and Townships by Graph Number

1	Adrian
2	Allen Park
3	Ann Arbor
4	Auburn Hills
5	Bedford charter
6	Brownstown charter
7	Burton
8	Canton charter
9	Chesterfield charter
10	Clinton charter
11	Commerce charter
12	Dearborn
13	Delhi charter
14	East Lansing
15	Garden City
16	Hamburg charter
17	Jackson
18	Lansing
19	Lincoln Park
20	Meridian charter
21	Monroe
22	Northville charter
23	Novi
24	Oak Park
25	Oxford charter
26	Pittsfield charter
27	Plymouth charter
28	Port Huron
29	Redford charter
30	Rochester Hills
31	St. Clair Shores
32	Sterling Heights
33	Troy
34	Warren
35	Waterford charter
36	West Bloomfield charter

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