MUNICIPAL BOND RATINGS: A PRE-INVESTMENT FINANCIAL MARKET PERSPECTIVE

by

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ABSTRACT

The recent interest in the Geography of Finance and Investment has introduced a number of studies on credit availability from the lenders' perspective. The focus of this dissertation is on the factors of credit analysis from the borrowers' perspective. This dissertation employs a new modeling technique to the area of financial geography to develop a rating model which may be employed by municipal planning officials to help improve their bond rating over time - thereby improving the community's ability to afford development.

Municipal bonds are used by local governments to fund large scale municipal projects to build infrastructure. The financial community employs municipal bond ratings to summarize the creditworthiness of a community and its ability to repay the loan for infrastructure development. Placing the development of community infrastructure in an urban growth framework, the thesis explores a variety of growth theories, ultimately drawing from Disequilibrium Dynamic Adjustment Theory to best understand the myriad of socio-economic linkages within a community.

The dissertation develops a multi-level linear regression model to better understand the relative importance each of the socio-economic variables plays in the rating process. The model is developed and tested using Hierarchical Linear Modeling on a data set of 3,648 rated communities between 1977 and 1991. The critical factors to the model are noted for the municipal administrators who may employ such models, and placed within the framework of the Disequilibrium Dynamic Adjustment Theory. The model's validity is tested against a hold-out data set of 200 communities.

A summary of findings, observations, and some concluding remarks serve to complete the dissertation before introducing areas for continued research into the Geography of Finance which may be prompted by this work.

Keywords: Municipal Bond, Hierarchical Linear Model, Agglomeration, Urban Growth, Disequilibrium Dynamic Adjustment Theory

Dedicated to Dakota and Kiani:

Now, daddy can come out and play.

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PRELUDE

This thesis approaches one of the perennial questions of urban-economic geography - how do agglomeration economies form - from a different perspective. Rather than attempting to address growth by looking back and trying to determine how it happened, the perspective taken herein is more precursory, asking "how do places finance growth to develop agglomerative economies in the first place?"

Employing a new modeling tool to address the question above, the focus of this thesis is aimed at the financial administrators in metropolitan areas who define and design the growth of their urban places.

To aid readers in their understanding of the terminology used among the financial community, a glossary is provided. Throughout this study, italicized words reflect inclusion in the glossary, unless otherwise noted. Chapter 2 is tailored for all readers to develop a shared syntax for an understanding of the financial marketplace and the content of the thesis.

I seek here to employ new analytic tools heretofore untested within geography to develop a more robust model within the geography of finance. Linkages are made from the model to theoretic and contextual supports in an attempt to arm financial administrators with better tools in their battle to finance affordable growth. I make no claim that this work is exhaustive in any way within the geography of finance or among bond rating literature. Rather, it is my intention that this work be used as a starting point, with a different perspective and a new tool, to address the myriad of questions, both unanswered and those yet to be asked, within the geography of finance.

CHAPTER 1
INTRODUCTION

Preamble

December 1994, Orange County, California - $1.7 Billion; Cuyahoga County, Ohio - $130 Million; March 1995, Wisconsin State Fund - $95 Million (Economist, 1995). The three cases above are all debts in default. How is it that some of the wealthiest counties and funds in the US (Economist, 1995) can go into default on their loans? Are there no means of determining the viability of a loan before the entity has been given the money? No matter how prestigious the list, if a community does not want membership on a default roster for their development loans, are there measures that may be taken to see that the loans are as affordable to finance as possible? This thesis sets out to answer these questions, first by establishing the context of the study within the extant literature, and secondly by modeling the socio-economic characteristics of a community that may affect the community's ability to make loan re-payments.

This thesis makes a contribution to the study of the geography of finance. The literature is replete with analyses and locational decisions for bank location models and credit availability. The common filament within all those discourses is an implicit (and sometimes explicit) expression of the behaviour of the investment community - the investors have already deposited funds into banks and lending institutions for given local development needs, and the banks redistribute those funds as they see fit. This thesis provides an integral supplement to that literature, looking not at the bank's perspective on the development loan, but the community's perspective, or pre-investment perspective, whereby the community must define and defend its position for the request for development funds. To adequately answer the above questions for this work, a new analytical technique is employed, improving upon existing methodologies in the literature of the geography of finance, and having application to the broader discipline.

There has long been an interest in the geography of finance at the international level. Studies of international capital flows, offshore holdings, and international banking top the list (Leyshon, 1995). The focus of this dissertation, however, is not international,

but rather urban based, with particular attention to the United States. The literature addresses the flow of funds between countries and the frictions impeding the flow, such as taxes, currency transfer, or trade barriers, but frictions also exist at finer resolutions, such as the urban environment, resulting in differential availability to capital (Gertler, 1984).

Capital availability is important to city financial administrators since they use capital drawn from the investment community to support development initiatives such as roads, sewers, and communications infrastructure. The more affordable the development loans to communities, the more readily the community can develop infrastructure, re-pay the loan, and allocate financial resources not to debt repayment, but to other services such as education, health care, and protective services. The investment community that supports the development of urban infrastructure provides loans to the community with interest charged based on the community's ability and willingness to re-pay the loan. Those loans take the form of municipal bonds. *Municipal bonds* are a form of promissory note that pays the investor a set payment (based on the interest rate) on a specific date, until the bond reaches *maturity*, whereby, the *principal* is due to the investor. Because infrastructure development is so costly, and communities do not have the funds to pay for such developments from cash in the community treasury, they look to investors to finance their growth plans.

The investment community uses *municipal bond ratings* as a shorthand financial notation defining the community's ability to re-pay the loan. The bond rating is related to the cost of servicing the debt of the bond - higher ratings reflect less credit risk, and therefore, more affordable interest rates on the loan. *Municipal bond ratings* are provided by *rating agencies* who take into consideration a plethora of financial data to assess the credit risk-level of the development project under consideration. Arguably, the financial data are but reflections of the deeper social and economic characteristics of the community that requires the development project. If such characteristics may be defined, could they then be modeled (managed) to provide communities with the best possible rating, and therefore, the most affordable growth, leaving scarce monetary resources for other social programs and services? It is this general question that forms the motivation for the current research.

The linkage between development and the financial system can be traced back at the very least to Myrdal (1957). His 'backwash' effects hinder the periphery from developing as funds are drawn from it to support the growth of the core, further entrenching the core's dominant position over its periphery. While no direct evidence supported his claim, the theory has received popular acclaim. Dreese (1974) looked at lending and development from a more empirical stance than Myrdal, but the findings were based on a limited sample, and had a particularly bank-oriented focus.

The bond rating literature has made an attempt to model the socio-economic and financial variables that comprise ratings, with varying degrees of success, as detailed in Chapter 3. This literature moves away from the traditional bank-oriented approach in favour of a community, or community's administration, perspective. More empirical than the development and growth literature, the ratings studies have sought quantifiable and germane indices that financial administrators may manage to improve their ratings position. The empirical results from those studies have not attempted to directly link the ratings to the development and growth such ratings are used to support. This oversight has kept the literature on ratings rather academic, resulting in limited application by those practitioners the studies target.

Seeking to bridge the theoretic/applied gap, this work endeavors to model a myriad of socio-economic urban characteristics to gain a better reflection of the municipal bond rating position of an urban centre, and ground that model in development literature that has import for a community's financial administrators.

Summary of the Chapters

This introductory chapter has set the broader context from which the current work receives its impetus. Outlining the general trend within the geography of finance, and identifying an opportunity to advance our understanding of this sub-field within our discipline, sets the stage for the text that follows in subsequent chapters.

Chapter 2 serves to acquaint the reader with the terminology of the financial community as it relates to municipal bonds. Very much a stand-alone chapter, its purpose is to develop a shared syntax among readers from various disciplines unfamiliar

with the lexicon of financial markets, providing a standard point of reference. For those familiar with the language of the bond market, the chapter reinforces the context of the terms used in this work, and for those new to the bond market, it is vital to understanding following chapters.

Chapter 3 covers the extant literature on urban growth and development, and the literature of the municipal bond market as it relates to ratings. The chapter sets the theoretic and contextual framework from which the research questions are developed, and then those questions are set into the context of the ratings literature to identify the contribution of this study.

Chapters 4 and 5 provide the methodology employed to answer the research questions. In Chapter 4, a review of existing techniques employed by past ratings researchers is made, noting points of strength and weakness among the various analyses. Raising more questions than it answers, the chapter is highly critical of past techniques. The chapter has been deliberately given a fluid structure, allowing the data and each run of analysis to define the next logical step in the development of a ratings model. The result is a rather exploratory chapter, tailoring the analysis and techniques to the nature of the data, rather than forcing the data to prescribed structures. Chapter 5 maintains the fluid structure of methodological development, addressing more complex forms of analysis as the data show particular patterns leading to the development of the ratings model. Employing Hierarchical Linear Modeling, the data reveal a system of urban characteristics with local, State, and combined effects nested in a series of relationships that may be understood within the context of the development literature.

Chapter 6 covers the outcomes of the Hierarchical Linear Modeling, detailing some of the relationships, their import on urban finances, and thus, on municipal bond ratings.

The final chapter, Chapter 7, concludes the findings of this work, stating some of the observations from the analysis, addressing the application of this work to the Canadian condition, and outlining areas for continued research in the geography of finance with particular attention to the nature of municipal bonds.

CHAPTER 2
TOWARDS DEVELOPING A SHARED UNDERSTANDING

Introduction

When the boundaries between disciplines become blurred, as issues of current interest find import in various academic realms, it is paramount to develop a shared syntax, so that information may be exchanged, shared, and understood by all parties involved. It is to that end the current chapter receives its motivation. In the case of this work, geography and finance become interwoven. Few geographers, however, regularly incorporate the breadth of financial terminology into their daily research, and, therefore, may find some of the terms used herein foreign. The following provides a basic understanding of financial terminology as it applies to the municipal bond market. This chapter is deliberately structured as a stand-alone piece, so that those readers who possess a strong financial background may continue to Chapter 3 without loss of context; and for those whose primary research focus is not financial in nature, they will become exposed to the terminology employed in subsequent chapters, so that a shared syntax is developed by all. As noted in the Prelude, italicized words indicate their inclusion in the Glossary. While brief descriptions and summary definitions are provided in this chapter, for more detailed accounts of italicized words, please refer to the Glossary.

Bonds

From the introductory chapter we have gained an understanding of what a *municipal bond* is and why they are used. To recap, a *municipal bond* is a *security* that obligates the *issuer* to pay back the *bondholder* the borrowed money at a specified date or under specific conditions, as well as any interest accumulated on the loan *principal*. The *general obligation* bond, the focus of this study, is typically a *debenture* backed by the '*full faith and credit*' of the *issuer*, but not by any specific *collateral*.

To finance projects with large capital needs, local governments have used three sources to generate funds: 1) internal revenues, 2) government grants, and 3) the

municipal bond market. Points one and two are self-defining, but point three requires some explanation. The bond market is employed to generate funds for capital projects whereby the *issuer*, in the context of this work means the local government, requests funds from the populace at large to supply these funds. Rather than approaching each potential investor in turn, the *issuer* uses '*financial intermediaries*' to solicit the populace on behalf of the *issuer*. These intermediaries, typically investment banks, (see Appendix I) fund the project and control the payment of interest and *principal*, directly with the investors, leaving the *issuer* to create the project and generate the funds for payment.

Before the *issuer* receives funds from the marketplace, that *issuer* must answer a variety of questions concerning the debt it wishes to incur; questions such as:

1) What is the purpose of borrowing?
2) Is it essential or non-essential?
3) Is there the legal ability to borrow?
4) What are the legal constraints on borrowing?
5) How will the debt be secured?
6) What is the best way to structure the debt?
7) Should the debt be short or long-term?
8) Will it be a broad or narrow revenue pledge?
9) What expertise is needed to structure and market the debt? , and
10) What is needed to rate the *issue*?

Questions 1 and 2 are answered by the requirement for the bond and the ability of the issuer to sell its case for funding requirements. Points 3 and 4 are answered by the issuer's constitution. The form of the bond answers question 5. In the case of this thesis, the bond type is the *general obligation bond* (or GO), implying the debt will be secured by the *full faith and credit* of the *issuer*. Questions 6 through 9 become the purview of the intermediaries and their expertise in handling the issuance of such debt. The tenth point, the rating, is the focus of this dissertation. The rating provides investors with a shorthand notation of the creditworthiness of the issuer. The rating indicates to investors how much risk is associated with this investment; and to the investment banks, the rating helps with the marketing of the *security*, for in one phrase the entire *credit analysis* of the *issuer* is summarized.

Rating Agencies

Ratings are provided by rating agencies such as *Moody's Investor Services, Standard and Poor's Ratings*, or *Fitch Investor Services*, to name the largest players. The ratings are meant to provide an objective assessment of the risk associated with the *issue*. Ratings act as differentiators between the vast number of issues presented to the market each week, providing a base form of "discipline in an otherwise largely unregulated market" (Johnson, 1993, 233). Johnson's comments may seem harsh, labeling the process as undisciplined and unregulated. Harsh as it may be, it is an accurate portrayal of the rating process. While the agencies do employ rigorous models to define a rating for each *issue*, the models are a guarded secret, and have only been regularly utilized since 1977 when the industry standardized. Until that time, ratings were based on transportation (rail) links running through the community (Rabinowitz, 1969) – three lines equated to the highest rating, two lines the second highest rating, and so on. The rail line 'guide' may be interpreted as a form of discipline, but it was regularly superceded by information gathered by the regional manager. The regional manager could over-ride a rating because he knew the local official, went to school with him/her, or was familiar with the nature of the project being funded. This purely subjective and highly contextual information made the industry seem undisciplined and arbitrary in its rating process, leading to the 1977 standards (Rabinowitz, 1969; Kreps, 1993)

Unlike mergers and acquisitions and foreign direct investment, the rating process is unregulated – as it must be. The government should not be permitted to regulate or have a hand in the rating process, since it is most often a government body looking for a rating. By having the ratings unregulated, there is an arms-length transaction between *issuer* and rater without the issuer's superior (higher levels of government) becoming involved either directly or indirectly. The unregulated nature of the industry means anyone with an opinion about the creditworthiness of the *issue* may provide such an opinion. Whether that opinion is regarded as important is based on market perception and reputation with rating success. The reputation of a *rating agency* is based on its

ability to accurately measure the credit risk of an *issue*, while providing such measures based on quantifiable analyses.

The agencies prescribe an alpha-numeric rating to an *issue* based on the analysis of the socio-economic and financial data related to the *issue*, the project, and the debtor (Rabinowitz, 1969; Cohen, 1993; Lamb et al., 1993). (A listing of the ratings and their definitions is provided in Appendix II). The largest *rating agencies* typically rate an *issue* exactly the same, or they differ only by a single degree. The consistency of the ratings from agency to agency provides a degree of confidence to the investor that the rating is indeed accurate, and the credit risk has been diligently assessed. *Debtors* often approach all rating agencies to ensure that they are rated by all so that the *security* is perceived by the market as a solid investment – rated AA by one agency is good, but rated AA by all agencies is impressive, and shows a sign of confidence by the *debtor* and the agencies that the investment is sound.

Credit Analysis

The *credit analysis* that ultimately supports the rating can be summarized in two points: the credit risk of the *issuer* is based on ability and willingness to repay the debt. The ability to repay the debt is grounded in the variables of the economic model used to derive the rating, and can be deconstructed to identify the specific variables underlying the rating such as debt load, tax base, incomes, employment structure, and so on (more on this in Chapters 3 and 4). The quantification of these variables provides a measure to the *rating agency* of the degree of control the *debtor* has in managing all the resources necessary for loan repayment.

The willingness to repay is not as readily quantifiable as the ability to repay. The willingness to repay the debt typically comes down to two factors – has the *debtor* made timely payments historically (on previous debt issues), and is the *debtor* willing to take tax measures, although publicly unfavored, necessary to see the obligation is fulfilled. The tax measures are intrinsically linked to points 3 and 4 (see the list above) and also related to the constitution of the *issuer*. The analysis weighs not only the willingness to repay, but also the legal limits to that willingness. It is the balance between legal

limitations, willingness to repay debt, and ability to repay debt that is summarized in the rating.

From the above, it would appear that the process is model driven, judicious in its use of reproducible facts, and based on objective data. Reality, however, notes a great deal of subjectivity in the *credit analysis* of the *debtor*. While the financial figures may not be disputed, other measures of creditworthiness come to bear on the final decision about the rating. The measures of socio-economic state for the community can be interpreted in a number of ways; forecasts for demographic change may be liberal or conservative; urban characteristics may be underplayed; and all may be viewed within the context of the financial data which may lend support for any number of positions. Most importantly, however, is the role of the regional credit manager. The regional managers are used by the rating agencies to place the information presented by the *debtor* in the context of the project, the people administrating the project, and the place of the project. Regional managers provide case-sensitive information back to the agencies' headquarters in New York so that the office located there may understand the nature of the project that may be thousands of miles away. While the project may be fully described in the project prospectus, and the vitas of the administrators provided, the regional manager can argue to New York for an improved rating given the relationship he/she has with the people administrating the debt. The regional manager may have some insight into the people or the nature of the project that may be beyond the ability of New York to interpret solely from the provided documentation. The regional manager will also have an understanding of the nature of the local/regional market for the *issue* under consideration. The regional manager is able to advise New York about the level of acceptance for a particular *issue* given the location of the project and the general perception about that location as an investment site among the investment community. Rightly or wrongly, this subjective aspect of the rating process occurs, and may represent up to 50% of the final *credit analysis* that goes into the rating decision (Rabinowitz, 1969; Scott, 1992).

Frequently Asked Questions about Municipal Bonds: The FAQs

Now that there is a general understanding about municipal bonds, the agencies that rate them, and the process of how ratings are determined, the following section provides greater details about the nature of municipal bonds, their market, the investor, and the typical questions that arise about these topics. This section will follow a question and answer format to address many of the most frequently asked questions about municipal bonds, to help further develop the shared syntax and understanding about the subject matter described at the beginning of this chapter.

Why invest in municipal bonds as opposed to other financial vehicles?

From the investors' standpoint, municipal bonds are a very secure investment. Historically, municipal bonds have had a good track record of paying interest and *principal* to the investors in a timely manner, and in full. In fact, many investors regard municipal bonds as on par with US Government bonds. While some bonds are rated lower than others, subjecting the investor to more risk, those bonds also have higher rates of return for those investors with a lower level of *risk aversion*. On the whole, however, municipal bonds are a safe investment.

One of the most attractive features of municipal bonds is their tax-free status. Most, but not all, municipal bonds are free from federal, and in some cases also State, taxes. The tax free status of the bond allows investors to deposit large sums of money into the market to reduce their tax rate, and when interest is paid it is paid tax free. While the interest rate of tax-exempt bonds is not as high as a corporate bond, the *marginal tax rate* of the investor makes their payback more attractive in the long term.

How does the *marginal tax rate* affect the investment in bonds?

The calculations are quite straightforward. For investors who might consider using other investment vehicles, such as a *certificate of deposit*, or CD, they need to consider the actual after-tax return on their investment. Consider the following example: if an investor had the option to invest $10,000 in a five year CD with a 9% annual *yield* or $10,000 in a *municipal bond* with a 7% annual *yield*, the investor should take the *municipal bond* even though the *yield* is lower. The investor would use his/*her marginal tax rate* to determine the actual *ROI (return on investment)*. Let us assume a marginal

personal tax rate of 28% for the investor. With the $10,000 invested in the CD the return is $900, but the tax rate on that $900 is 28%, or $252. Thus, the investor only realizes an actual ($900-252=$648) 6.48% return on the initial $10,000. If the investment is also subject to State level taxes of (for example) 5%, the return is actually ($900-252-45=$603) 6.03%. The *municipal bond*, however, will return $700 on the $10,000, making it a better investment than the CD. If the investor's *marginal tax rate* is higher than the 28% in this example, then *municipal bond* investment becomes even more attractive based on its *ROI*.

Can the interest payments fluctuate on municipal bonds as market interest rates change?

No. Once the *coupon* has been set, the *debtor* is obligated through the intermediary to make payments based on the defined payment schedule at the established rate, both of which are defined at the outset of the bond issue and are known by the investor at the time of purchase. Market conditions, however, do play a role in the attractiveness of a bond after its issue. If interest rates begin to fall for the economy as a whole, then the interest rate on bonds that have higher rates of return relative to other investments become attractive to investors seeking higher returns. The result is an increase in the *face value* of the bond (the price one is willing to pay to own the bond) relative to the change in the interest rate and the price the market is willing to bear for ownership of the higher return bond. The converse is true when interest rates rise – the bond becomes less attractive to investors because other investments are better at that time, and therefore, the municipal bond would have to be sold at a *discount* to attract investors.

Where does all this buying and selling of bonds take place?

There are two markets for bonds. In the *primary market*, the initial offering of the bond is made for investors to place their money into the *municipal bond*. The initial offering is facilitated by the *financial intermediaries* discussed above, and summarized in Appendix I, and made to the pool of known and new investors active in the municipal bond market. These bonds are sold at *par* given that the offer is current and the *coupon* reflects the existing market conditions available on other like investments.

There also exists a *secondary market*. For any number of reasons, investors trade municipal bonds in the marketplace in like fashion to the stock market. *This secondary market* is the place where bonds are bought and sold at a *discount* or a *premium* based on the relative *ROI* of those bonds compared to current market conditions (interest rates and the *coupon* available on similar investments.) The *secondary market* is also handled by the *financial intermediaries*.

If I own bonds, must I be active in the *secondary market*?

Not at all. The *secondary market* is the place for active investors to try to capitalize on minor changes in the economy. On occasion, however, the *debtor* may also place provisions into the *issue* so that the *debtor* can capitalize on changes in the interest rate. Such provisions are termed "Calls." *Calls* permit the *debtor* to recall the *issue* at a certain date and pay the investor in full at that date. The *debtor* can then pay off all the outstanding debt and re-issue at a lower interest rate. If the *call date* arrives, and it is not advantageous for the *debtor* to *call* the debt, then the *call* option is not exercised.

Call provisions are very important for the *bearer* to understand because the *call* can radically change the investment income stream realized from municipal bonds for the investor. Using the $10,000 dollar example again, let us assume there is a 12% *coupon* on the bond. The investor will realize a $1200 annual income from that bond. If the bond has a *call* provision, and it is exercised because the current market rate is 7%, the investor will have an income loss of $500 ($1200-700=$500) as he/she seeks new investments at the current market rates for his/her *principal* of $10,000.

Similarly, provisions may be placed into the *security* for the *bearer* of the bond to exercise. Such provisions are called "Puts." A *put* is a provision placed on the bond that permits the *bearer* to request full payment of the debt at a predetermined price at some date before the bond matures. Puts are almost never used in the *municipal bond* market.

Calls and *puts* can be found under the purview of the *secondary market*.

Yield is a term that is used a lot in *municipal bond* circles. What is it?

The *yield* of a bond is the *coupon* or interest paid on that bond. Other terms that are frequently used are *current yield* and *yield to maturity*. *Current yield* is the actual

payment made to the investor calculated by dividing the annual interest payment by the bond's current price in the *secondary market*. Using our $10,000 bond again, let us set a 10% *coupon* with 10 years to *maturity* and a *secondary market* price of 90, or $9,000 (it is discounted since you would only pay $9,000 for a $10,000 bond). The *current yield* is $1,000 interest payment (10% of $10,000) divided by the $9,000 paid for the *security*, or 11.11%. When the bond trades at a *premium*, the short-term gains in higher yields are offset at *maturity* by loss of market value as the *security* reaches *par* at *maturity* (e.g., a bond at 110 in the *secondary market* is priced at $11,000, but at *maturity* it can only be cashed in for $10,000, thus the loss is $1000 over the term).

The other term often used is *yield to maturity*. The calculation in this case is based on a discounted bond held to *maturity*. The *coupon* rate is added to the differential in the price/face ratio to determine the actual *yield*. For example, using the trusty $10,000, if the *security* was purchased at $8,400 with a ten-year *maturity* and a *yield* of 10%, then the *yield to maturity* is $1,000 interest payment plus the (($10,000-8,400)/10 yrs)=$160) $160 dollars in annual appreciation, makes for a *yield to maturity* of $1,160 or 11.6%.

Yield to call is used on occasion, and is of importance for the serious investor looking to capitalize on interest rate fluctuations and stability of income stream. Calculated in exactly the same manner, the summary definition of *yield to call* is based on the differential between current *coupon* and estimated interest rate at *call*, less depreciation of the security. This feature of municipal bonds is not often discussed among typical investors, since it affects only the select few institutional and large private players.

Municipal bonds sound like a good investment. Why isn't everyone investing in them?

Municipal bonds are used to generate large sums of working capital for large-scale municipal projects. As such, the investment community is not looking to secure a few dollars from every investor, but rather large sums of money from every investor to make the offering as quick as possible and secure the funds for development. A single unit of a *municipal bond* is $5,000 for private investors, $100,000 for institutional investors. While single units can be sold to the public, the typical trading block of

securities to private investors is in blocks of 10 units, with the larger players securing 1000 unit blocks.

Given these large sums due at initial investment, and the length to *maturity* (some bonds have *maturity* after 50 years, and century bonds – 100 year *maturity*, have come into use) municipal bonds are not for the casual investor. While they are very secure, it is a financial vehicle that requires an understanding of the market, and a great deal of money to be able to run in the municipal circle.

Assuming I invest in municipal bonds, what is the down-side?

Municipal bonds are very secure, payments are regularly made providing a tax-free income stream, and the investment is paid in full at *maturity*. Municipal bonds, however, *default* on occasion. For circumstances particular to the investment, the project, and the people administrating the project, the issue may *default*. For example, the case of Orange County, California, where the financial administrator for Orange County used crystology and psychic readings to manage the bonded funds, went into *default*. The administrator was touted as a financial genius when all was well with the finances, but when the County went into a rapid debt spiral, and it was discovered that the administrator was not using financial principals to manage the County funds, the *issue* went into immediate *default*. In such cases, the investor may or may not be paid in full depending on whether the investment was insured.

For municipal bonds, the adage of "caveat emptor" holds true. The investor must do the necessary research into the investment to satisfy his/her level of *risk aversion* before investing in municipal bonds, or rely on the advise of the *broker* whom one trusts to have performed *due diligence* on the *security* before promoting it to his/her clients.

Is insurance for securities a consideration before investing?

The *municipal bond* market has dramatically changed since 1991. Pre-1991, most of the issues were not guaranteed against failure of payment by some form of insurance. When issues defaulted, the investors lost their money. Post-1991, based on some of the major defaults and default scares such as the New York City *default* of 1975, the $2.25 billion *default* of the Washington Public Power Supply System of 1983, the *default* of

Bridgeport, CT., in 1991, and the scare given to the investment community when Philadelphia, PA., almost defaulted in the late 1980s, most issues are now insured. The insurance secures the payment of debt in the event of *default*, and most importantly to the municipality issuing the debt, the insurance guarantees a Aaa rating because the *issue* is secured by the *full faith and credit* of the *issuer* as well as the insurance firm backing the municipality. This lowers the interest payment on the debt service. From the investor's perspective, the only advantage to insured debt is the added security it offers for payment. If, however, the investor is less *risk averse*, then uninsured non-Aaa rating issues offer a greater return because the risk is higher.

(A list of municipal bond insurance companies is listed in Appendix III).

Summary

This chapter has provided an outline of the municipal bond market, its terminology, and the general conditions of investing in such bonds. As stated at the outset of this chapter, the intention herein is to develop among non-financial researchers a basic shared syntax of financial terminology so the subject matter of this dissertation may be discussed with a shared understanding of the subject matter and its nature. This chapter has been kept deliberately brief, highlighting only those areas of the municipal bond market and bond related issues that typically come to the fore among individuals without a background in finance.

The Glossary and the Appendices related to the material of this chapter are resources for the rest of the dissertation. Please refer to them as necessary as the rest of the dissertation assumes a shared level of familiarity with financial terms as outlined here.

CHAPTER 3
THE EXTANT LITERATURE ON GROWTH AND BONDS

Introduction

One of the central themes of urban-economic geography is the relationship cores have with their hinterland regions, and how the growth of core areas affects that relationship. Beginning in the 1950s, the US saw an era of suburbanization that moved people into the belts surrounding the existing metropolitan centres. People wished to have amenities where they lived rather than having to venture downtown for basic services, so the marketplaces moved into suburbia in the 1960s and 1970s in the process known as the 'malling of America' (Garreau, 1988). More recently, our means of generating wealth - our jobs - have moved into the spaces surrounding the areas officially defined as cities (USBC, 1990) in what can be termed the 'flight of firms'.

Given the geographic expansion of our cities over the last fifty years, a body of literature has developed in an attempt to understand the processes and motivations for metropolitan growth (see next section). In that attempt, theory has focused on agglomeration economies; also commonly referred to as economic and social infrastructure. It is that infrastructure which has given the core a dominant position relative to its periphery.

Not since the industrialist era have major infrastructure developments been self financed. The question thus arises: "How do metropolitan areas finance the creation of infrastructure necessary for growth?" Municipal bonds have been employed to finance such undertakings since the beginning of the century. Given the recent changes with respect to suburbia's ability to generate wealth relative to the traditional urban core, is a 'geography of finance' developing among municipal bonds which reflects the new spatial patterns of metropolitan growth, and are such patterns able to be modelled through urban-socio-economic variables to better manage such growth? It is to this general question the current research is directed.

The following outlines the extant theories of metropolitan growth and how they relate to the spatial patterns of pre-investment financial market behaviour relative to

municipal bonds, and questions are generated relating to the strengths and weaknesses of those theories. The limited literature on municipal bonds is introduced to establish the framework from which to develop a methodology to answer the questions arising herein.

Theories of Metropolitan Growth

Numerous theories have been espoused to describe the rationale for the movement of population and employment to the suburbs. This movement out of traditional urban cores into the immediately adjacent lands has been one of the central foci of urban economics and the growth of metropolitan areas (Norton, 1979).

Export Base Theory is often cited as the leading explanation for metropolitan growth. The general tenet of the theory states "exports to purchasers outside the metropolitan area drive the local economy" (Mills and McDonald, 1992). The theory is, by this traditional Keynesian definition, purely demand driven. The assumptions made here are that the metropolitan area has excess productive capacity that is underutilized, and that it is an external region's excess demand for goods that generates growth because of its demand for products made in the core. Similar to Friedmann's (1966) regional development thesis, discussed later in this chapter, metropolitan growth is always created externally. While Friedmann's arguments are convincing, they follow in the tradition of demand-side economics - ignoring the fact that growth generated by demand must also have an accompanying supply-side to fulfil that demand.

Addressing the supply-side of metropolitan growth is the Neo-Classical Growth Theory. Introduced by Solow (1957), growth is believed to occur, and the amount of growth controlled by labour, capital, and technical knowledge. Highlighting the three issues in turn, labour-induced growth concentrates on the importance migration has on urban economics. For example, if a firm moves to a peripheral locale outside of the traditional urban core, this shifts the local demand for labour to that peripheral area. Such a shift induces migration as labour moves to the new location. The migration of labour to the new location may be sufficient to generate employment growth (Borts and Stein, 1964), and therefore more metropolitan growth. Key to the movement of labour supply is the initial shock to the economic system which created the migration - the (re)location of

capital (firms). The movement of firms has long been associated with the development and growth of urban/metropolitan systems (see Pred, 1966, 1967, 1969, 1974; Meyer, 1980; Semple, 1973, 1985; Simmie, 1983).

Neo-Classical Growth Theory's last point - technical knowledge - has been treated as a residual of the metropolitan growth process (Richardson, 1979). Technical knowledge has been considered both a precursor to, and a result of, capital/human migration. Siebert (1969) and Borts and Stein (1964) have both tried to address the issue of technical knowledge and the importance it plays in regional development. Both postulate that regional development can occur when either an innovation is introduced into the economic system such that it generates a change in the market dynamic, or the market grows to a point where it begins to create innovations to improve its own state. The result of their theories is that either technical knowledge (and the firms that employ it) attracts people to a region to spur growth, or as people migrate to a region they bring with them technical know-how that causes growth. This 'chicken and egg' problem about the sequence of technical knowledge in metropolitan growth is evident in the oversimplifications of Siebert's (1969) determinants and Borts and Stein's (1964) economic assumptions. Typical of economic studies, the oversimplifications and economic assumptions assume too much away from reality, making the system in which their concepts are applied far too vacuous to reflect reality. Suffice it to note, whether knowledge is a precursor or an outcome of the first two factors, the spatial result is indistinguishable: the metropolitan area grows.[1]

The relationship(s) among labour, capital, and information have been central to the development of neo-classical metropolitan growth theory, and have fallen under the broad title of 'Agglomeration Economies'. These economies may be considered as the relationship among the growth factors of labour, capital, and information as they relate to their mutual interaction due to spatial proximity (Böventer, 1970). Kaldor (1970, as cited in Beeson, 1992) defines agglomeration economies as "not just the economies of large scale production commonly considered, but the cumulative advantages accruing from the growth of industry itself - the development of skill and knowledge; the opportunities for

[1] Technical knowledge may also be viewed as the number of innovations developed within a metropolitan area. For seminal works on the impacts innovations have on the growth of urban economies, see Hägerstrand (1967) and Morrill (1968, 1970).

easy communication of ideas and experience; the ever increasing differentiation of processes of specialization in human activities" (p.340). The engines of economic activity - firms - are attracted to areas where they may best exploit these agglomerative forces - metropolitan areas. Metropolitan areas possess localization economies "which are industry specific and result from the expansion of a particular industry in a certain place" or urbanization economies which are the benefits "arising from the greater array of services and opportunities available in larger places" (both citations from Mills and McDonald, 1992, p.xvi). The agglomerative forces of metropolitan areas allow firms to capitalize on higher levels of productivity. If firms cannot (re)locate to urban core areas because of the costs of wages and rent, they tend to cluster in suburban areas just outside traditional cores so that they may minimize the distance, and therefore increase the spatial proximity, to the sources of agglomeration.

If the growth of metropolitan areas is related to industrial (re)location, then the expansion/contraction of industrial sectors must also play a role in that growth. Product Life-Cycle Theory is typically employed to describe the effects firms have on metropolitan growth. While originally inferred by Schumpeter in 1942, Vernon (1966) popularized the concept within the business and economics literature. Firms in mature sectors of the economy tend to focus on achieving scale economies and cutting costs. The focus of the mature firm, while still profit, is driven by organizational efficiency, not innovation (Schumpeter, 1942). Mature firms face obsolescence as market demands change and they have no innovations to replace out-dated products. New, innovation-driven, firms are characterized by a rapid growth phase which attracts the neo-classical factors of production - labour, capital, and information. If the firm/industry can sustain a slower, but steady, rate of growth in the future, so too will the economy. When there are a number of firms/industries at various stages of the product life-cycle, the metropolitan area may see an extended period of growth.

The product life-cycle, while sound in theory, is weak in empirical support. Product life-cycle theory is often cited in the recent growth of high-tech firms in the US. Unfortunately, the theory is insufficient to explain the success of areas in the South and West, while the Route 128 complex failed to live up to the expectations of its proponents. The theory must rely on exogenous factors such as political influence, federal spending

programs, and intangible human assets to begin to address industry specific growth. Given the inherent weakness of the theory, its contribution as a major theoretical framework from which to address metropolitan growth is limited. However, it does raise the issue that mature industries may hinder metropolitan growth when market demands change. As such, metropolitan employment profiles are an extension of the theory that may be used to observe sectoral changes that are reflective of growth.

Cumulative Causation Models, first introduced by Myrdal (1957), have been applied to regional growth in the context of developing countries. While Mills and McDonald (1992) suggest that cumulative causation has not been identified in any region of the US, their perspective is overly narrow: the tenets of cumulative causation can be observed in urban systems. In a competitive economy, market forces lead to a clustering of economic activity in certain places to take advantage of higher levels of productivity (localization and urbanization agglomerative economies), and these places tend to be metropolitan areas. The build-up of economic activity becomes self-sustaining because of internal and external forces creating agglomeration economies (Richardson, 1979). For example, control of administrative and financial functions concentrate in these areas, and firms which require access to the information such functions create are drawn to the centre, creating more information causing greater drawing power. Externally, people migrate to these places to seek higher wage employment and a diversity of employment opportunities not offered in peripheral regions. The original advantages held by peripheral areas such as lower wages, lower taxes, and lower capital costs, cannot be outweighed by the agglomerative benefits realized with proximity to metropolitan places. The result is a cascade effect whereby growth begets growth at the expense of areas not positively influenced by the agglomerative forces of the metropolitan area.

Following directly from cumulative causation, Friedmann's Core-Periphery Model (Friedmann, 1966, 1972/1973, 1973) is a broader extension of the last approach. Looking not solely at economic variables, but rather attempting to provide an alternative to neo-classical approaches to metropolitan growth, Friedmann introduces a political component with his 'autonomy-dependency' relationship. The relationship is reminiscent of a colonial system where the periphery supplies the core in a non-reciprocal exchange structure furthering the core's economic, political, and social interests at the expense of the

periphery. The core is "an organized subsystem of society which has a high capacity for generating and absorbing innovative change; peripheral regions are subsystems whose development path is determined chiefly by core region institutions with respect to which they stand in a relation of substantial dependency" (Friedmann, 1973, p.67).

Growth Pole Theory, while developed independently, is an amalgam of the previous theories. Boudeville (1966), based on the works of Perroux (1964), defines growth poles as "a set of industries capable of generating dynamic growth in the economy, and strongly interrelated to each other via input-output linkages around a leading industry" (Richardson, 1979, p.164). The premise is that growth can occur in lesser developed regions (or in lesser developed metropolitan areas) by transplanting the conditions for growth in that area. A set of leading industries is necessary to begin the process. These industries generate agglomerative forces that attract supply firms to the area. These firms generate forward and backward linkages with the immediately adjacent area in a core-periphery relationship favouring the growth of the pole (cumulative causation). The theory has had its proponents (Hansen, 1972; Paelinck, 1972) yet it has failed to achieve the results espoused in theory. One of the greatest short-comings of Growth Pole Theory is that for agglomeration economies and spillover effects to occur, the area must have a highly developed infrastructure, both physical and informational, to generate any cumulative effects. There must be a large social system in place (*e.g.*, schools, hospitals, police) to support the new employees attracted to the area by agglomerative forces - that is, of course, assuming there is a labour supply available in the pole's hinterland. With such assumptions, and the time period necessary to meet the conditions for sustained growth, the scant examples of regional policy focused on growth poles have proven unsuccessful. The conditions for success, especially the infrastructure requirements, can only be met in existing metropolitan centres. The theory attempts to create a policy approach to rural/peripheral centre development while in practice urban centres already have the necessary conditions for growth, further enhancing their relative position over peripheral areas.

Enhancing one's relative position over others, within the context of the individuals responsible for municipal growth versus those who receive directives from such power brokers, has been the focus of much of the sociological work on urban growth. Ultimately

an expression of power (Molotch, 1976), sociological approaches focus on the concentration of decision-making power and the scale of local interest groups, and how they work within the context of other power circles operating at regional or national scales (Mizruchi, 1982).

Community power circles are often approached from a structuralist perspective in sociology, attempting to define the community structure in terms of the relative importance of various formal organizations such as interest groups, elite clubs, and interlocking hierarchies. The structuralist perspective on community power circles develops the notion that power is a "wholly systemic, rather than personal or interpersonal property. Social change is envisioned as a largely unguided process determined by the distribution of population, organizations, and technology" (Liebert and Imershein, 1977). The power and control held within interlocking corporate hierarchies has been a focus of works by Kono *et al.* (1998) and Green (1981a,b). Attempting to prove that decision-making power is shared by a corporate elite that has the power to direct and influence production and investment decisions across the entire economic system of a nation or region, their works have had limited success in proving such a power elite exists and is effective in directing public policy. While the type of systemic power discussed by Green or Kono may have held import during the 'smokestack chasing' era in the earlier part of this century when the economy was far more domestic in focus, with heightened globalization, the influence of such alliances and elites controlling local growth machines that traditionally helped shape local municipal development has eroded (Dicken, 1994).

More recent work within a social framework on municipal growth has approached the issue from the perspective of defining the necessary factors for growth within a community. The work by Clarke and Gaile (1998) exemplifies this movement (Barnes, 1998). Clarke and Gaile make a critical examination of the existing focus within community growth initiatives, and espouse a new focus for community growth. With a strong emphasis on the development of human capital as opposed to physical capital such as roads and waterways, Clarke and Gaile call for more investment into human resources such as education, training, and professional skills development. They argue that globalization has broadened the context in which local officials must consider the competitive and growth forces affecting their communities. Their argument draws heavily

from the work of Scott (1992) who called for a reduction of transaction and innovation costs for communities to grow, and from Reich (1991) who holds that communities looking for growth into the future must concentrate on developing high value-added production processes, not just high volume production. Much of the Clarke and Gaile discussion is supported with examples from the US where small initiatives in the development of human capital have been implemented, but their argument is weakened by the fact they never define for local administrators how such initiatives are developed, exercised, or linked to existing policy variables. The commentary by Clarke and Gaile is a discussion of what they believe the direction for future growth should be, however, they never define that direction for growth with meaningful road-signs.

The last theory I wish to address is an eclectic approach not based on the neo-classical Keynesian equilibrium found in the above theories. Clark, Gertler, and Whiteman (1986) have developed a Disequilibrium Dynamic Adjustment Theory to address the conditions of the post-Fordist economy of flexible production for foot-loose and locationally diversified industries.

The general tenor of the theory states that firms have the ability to locate the various factors of production and administration at different locations to take advantage of local endowments (e.g., wages, labour, market prices, and capital) to support specific firm functions (e.g., finance in New York, or production in the American South). The strength of the theory is it allows for the spatial division of labour and the observed effects this has had on urban economics not only among the developed economic areas of a nation, but those of the developing economic regions as well. The authors observe the four following economic adjustments which cannot be readily reconciled under economic equilibrium: 1) the allocation of variable demand to peripheral firms, 2) the division of technical, control, and management functions to centres with respective supporting facilities, 3) the increasing degree of labour specialization, and 4) the development of peripheral economic markets outside of existing traditional core markets (the economic growth of the newly industrializing countries, regions, and greenfield sites).

The theory recognizes the limitations of neo-classical equilibrium - that all economic agents have perfect knowledge, that they are optimizers, and that all economic adjustments are made instantaneously so that the system remains in equilibrium. Clark *et*

al. level a critique at neo-classical equilibrium theories that becomes the crux of their argument for a disequilibrium theory. They hold steadfast to the belief that existing theory fails to incorporate any consideration of temporal adjustments to the economy, and if any changes are made based on those rare adjustments that modify the state of the economic future, those adjustments must be considered away in typical neo-classical fashion. By assuming away change to the system, neo-classical theories collapse the future into the present, not recognizing that changes to the economy do not always manifest themselves immediately, but may have implications at some future time. Clark *et al.* (1986) acknowledge that economic adjustments are not made in a vacuum, which means that the system will be in a constant state of disequilibrium, always seeking to adjust to the conditions which allow economic agents to exploit known opportunities to their fullest.

This growth theory holds import geographically, for it recognizes that these adjustments occur in place and over time. The theory calls for the recognition that any changes in a local economy have impacts on the surrounding region(s), since the local economy is but part of a larger national or global economic system. The forces that cause change and growth must not be looked at in the aggregate, for the local context is thus lost in the analysis. Clark *et al.* (1986) caution that when considering adjustments and economic changes, the distinction between local and macro-regional issues becomes important. At the local level, the theory has to explain how individuals and local institutions will respond to signals in the economy that signify change, while simultaneously recognizing that a broader system (e.g., a regional or national system) exists which may have initiated the very change affecting the local environment. Understanding full well that individual positions in the economy are greatly influenced by the context of higher economic forces (State or national policies), the theory delivers one final blow to neo-classical theories - scale of inquiry. Neo-classical theories, through their rational calculations (over-simplifications and assumptions) of the economy, fail to address the concept of scale. The individual and the nation state are treated as equal, responding to economic changes similarly and predictably. The Disequilibrium Dynamic Adjustment Theory addresses the community from the local scale, but recognises that the structure and performance of the local economy is subject to directives and variables beyond the purview of the community. As such, the theory addresses the changing patterns of wages,

migration, employment profiles, and capital not only within the community of study, but in the context of the economic system in which it is embedded (cf. Storper and Walker, 1989). The theory rises above the limits of static neo-classical equilibrium, and embraces the dynamic conditions of a continuously adjusting and evolving economy.

The Clark *et al.* work holds appeal not only for its position on the limitations of neo-classical equilibrium based theories, but in its recognition that the variables that impact the economic conditions of a community arise not only from the choices of the community, but from the conditions of the economic system as well. The theory holds as a conceptual cornerstone that to understand the conditions of the micro-scale, variables from the meta- and macro-scale systems must also be addressed to place the micro system in context. From the applied perspective, such a statement seems pedestrian; yet neo-classical theories have failed to observe such a linkage. As it is argued in subsequent chapters, addressing the variables of municipal growth cannot be restricted to the local arena - they must be considered contextually (at numerous scales). While it may be contended that the theory is itself contradictory (it rejects neo-classical approaches, yet it relies heavily on neo-classical variables), the strength of the theory rests in its consideration of the scalar effects of economic adjustments, heretofore unaddressed or assumed away.

Yet another positive feature of the Clark *et al.* theory, is the highly applied nature of the work. The theory is quickly introduced and developed in their treatise, and as more detail is provided about the intricacies of each of the sub-components of the theory in subsequent chapters, Clark *et al.* provide insights into the impacts various adjustments have to the economy. Not only is their work a theoretical advancement because of its non-neo-classical approach, but given the details provided throughout the work on the myriad of impacts adjustments have to the local economy, the text reads as a guide book for municipal administrators, outlining the course(s) of action to realize a given adjustment.

The Clark *et al.* study abounds with empirical evidence to try to support their disequilibrium theory. Their theoretical framework, however, only tangentially addresses the forces driving metropolitan growth, and still relies heavily on the importance of neo-classical factors such as migration and population growth. The most restricting constraint of their theory is its application to a limited number of firms and industries in the economy. The theory works best when applied to higher technology firms and those firms engaged in

flexible production; but must rely more heavily on traditional growth variables when addressing more mature industries. While the theory is limited in this respect, it holds the most promise among existing theory for explaining metropolitan growth in future years. Given that most of the US economy has not yet moved to address all the social and human capital considerations espoused by Beck (1993) and Clarke and Gaile (1998), the Disequilibrium Dynamic Adjustment Theory is a quantum step forward in our understanding of the conditions and effects of municipal growth. The theory has shown success with firms of the "new economy" (Beck, 1993), and as more industries move towards higher technologies and more flexible production techniques, this theory may prove even more useful in describing the process of metropolitan growth.

Other theories have been developed to describe the rationale for metropolitan growth such as Pottier's (1963) development axes (a variation of the growth pole theory centred on transportation networks); Warntz's (1965) income potential model; Hägerstrand's (1967) innovation diffusion theory (strongly related to the effects noted in capital (re)location and agglomeration economies); Lave's (1970) variation on Pottier's transportation linkages; Harvey's (1973) social class struggles and political economies; and the Bergsman *et al.*(1972) focus on industrial clustering. The above theories espouse similar concepts to the aforementioned theories, and therefore, their tenets need not be reiterated, simply summarized in Table 3.1.

Towards a Synthesis - Asking the Right Questions

Table 3.1 is a brief outline and summary of the major metropolitan growth theories, providing a quick reference guide to the theories of metropolitan growth.

The theories, except for disequilibrium dynamic adjustment theory, all rely on the assumption of economic equilibrium. As such, they are only partially successful in describing the process of metropolitan growth; for growth itself runs contrary to the concept of equilibrium - especially when that growth is positive in the aggregate. Exports usually lead the discussion of metropolitan growth as metropolitan areas are, in their

Table 3.1:

Theories of Metropolitan Growth

Author	Theory	Tenets	Variables Affected
Smith, A. (1776)	Export Base Theory	migration, push/pull factors	population, income, ethnicity
Solow (1957) Borts Stein (1964) Siebert (1969)	Neo-Classical Growth	supply side growth migration transportation, knowledge	population, income, labour, sectoral employment, income potential
Kaldor (1970) Böventer (1970)	Agglomeration (urbanization and localization)	sustained growth, city size, distance, market structure	economic diversity, population, distance, income
Schumpeter (1942) Vernon (1966)	Product Life-Cycle	innovation business cycles, innovation	economic diversity, income, market attraction
Myrdal (1957)	Cumulative Causation	growth	population, income, market attraction
Friedmann (1966, 1972, 1973)	Core-Periphery Models	population growth, infrastructure, transportation	population, distance, rural/urban relationships
Perroux (1964) Boudeville (1966)	Growth Pole Theory	infrastructure, firms	population, employment, income, ethnicity, property value
Clark et al. (1986)	Disequilibrium Dynamic Adjustment	spatial division of labour, firms, capital investment	population, ethnicity, income, employment
Warntz (1965)	Income Potential	income, city size, distance, market attraction	income, distance, population, income potential
Pottier (1963)	Development Axes	transportation, distance, urban distribution	distance, income, population, income potential
Hägerstrand (1967)	Innovation Diffusion	knowledge, communications, hierarchy	sectoral employment, income, population
Lave (1970)	Transportation	infrastructure	property value, income, population
Bergsman et al. (1972)	Industrial Clustering	localization agglomerations	sectoral employment, income, population, market attraction
Harvey (1973)	Social/Political Economies	class, race, social distance	ethnicity, population, property value, income

classical geographic sense, designed to supply the needs of the hinterland (and vice versa). The hinterland, and the metropolitan area itself, supply labour, capital, and knowledge in order to develop economies of scale (agglomeration economies) to supply more products to a larger area at lower costs. This development, if scale economies can be achieved, can become self-sustaining whereby growth begets more growth since more economic actors (firms and employees) are drawn to the metropolitan area to supply and exploit the agglomerative forces. When this growth exists among firms with innovative skills, the process can become well entrenched, and long-term sustained growth can be achieved. Capital investment is attracted to the nexus of growth, providing more fuel for the growth engine. At some stage, the centralizing tendencies of the core (high wages and high productivity) become decentralizing forces (overly high wages and high rents compared to peripheral areas). The growth moves from the traditional core into immediately adjacent areas, ultimately creating an economic structure based on a spatial division of labour and a resultant hierarchy of urban and economic places. Such a process has been the theme of urban-economic geography since Weber and Christaller.

To provide a complete synthesis of metropolitan growth theories is an ambitious undertaking which is beyond the focus of this dissertation. Whatever drives metropolitan growth - be it simple migration, export economies, product innovations, agglomerative forces, or disequilibrium adjustments - the spatial outcomes are the same: the metropolitan areas, as well as their immediately adjacent areas, grow.

The theories of metropolitan growth raise a number of questions. How does the growth begin? From an equilibrium framework, a shock must enter the economic system: a new firm, a new product, or changing levels of supply and demand. These factors have been the focus of theory to date. Dealing with firms (since most other shocks to metropolitan areas can be attributed to the (re)location of economic engines) they are said to be attracted to metropolitan areas because of localization and urbanization economies that, if economies of scale are to be achieved, result in a cumulative and circular process generating further growth. The question thus arises: what are the effects of agglomeration economies on metropolitan growth? Typically, the question asked is "how do agglomeration economies form?" This is an intractable question to which regional economists have attempted to seek answers. The number of theories espoused, and their

lack of comprehensive applicability, leads me to believe that the real focus should not be to seek an *a priori* explanation, but rather an *a posteriori* description. The largest impact agglomeration economies have on metropolitan growth is they "affect the efficiency of intra-regional spatial structures" (Richardson, 1979, p.156). In other words, agglomerative economies produce positive externalities that firms can exploit for competitive advantage - those externalities being communications and transportation networks, distribution infrastructure such as water and sewer lines, a large *in situ* market, and security (in the form of police and fire prevention) - and for employees, amenities such as schools, playgrounds, parks, shopping centres, and social infrastructure.

If firms are the engines of growth, and firms seek out areas that have agglomerative economies, and those economies are expressed in urban and social infrastructure not paid for by the firms, how then do metropolitan areas afford the infrastructure necessary for growth? A corollary to that question is: do certain places have a greater ability to pay for infrastructure development, giving such places a competitive advantage in attracting future growth?

These questions have not been asked within the context of urban growth theory. Research has focused on an examination of 'how do agglomerative economies form' without asking the necessary precursory question 'how do metropolitan areas finance such growth to develop agglomerative economies in the first place?'

Over the last decade, a body of literature on the 'geography of finance' has begun to emerge which addresses the issue of credit availability and its implications for the location of economic and infrastructure development (Chick and Dow, 1988; Dow, 1992; and Porteous, 1995). This work has concentrated on developing the theoretical economic basis of financial activity and its consequences for the development of regions. The focus of the literature has been exclusively directed at the role of banks and lending institutions as the actors responsible for raising the funds to finance economic development within regions. The historical focus on banks within the literature has made contributions to understanding bank location behaviour, financial centre development, and the effect of distance on access to credit (Code, 1971; Neufeld, 1972; Chick and Dow, 1988). The literature has focused on access to credit and the role of banking from a post-investment perspective - it is assumed that metropolitan growth occurs and infrastructure is already in place to support such

growth. Such assumptions are market driven in their perspective - investors have already been identified and their investments into capital projects established. Unfortunately, the short list of literature on the 'geography of finance' (see Porteous, 1995 and Leyshon, 1995) has not addressed the questions: what attracts investors to a given regional development project? with the number of potential investment opportunities, do investors have some form of shorthand method for investment decisions? and if so, does this pre-investment information exhibit any spatial patterns? These issues are of vital concern to understanding the spatial patterns of financial activity, for they address the forces that tie economic agglomeration and regional development to the lending patterns of banks and financial intermediaries.

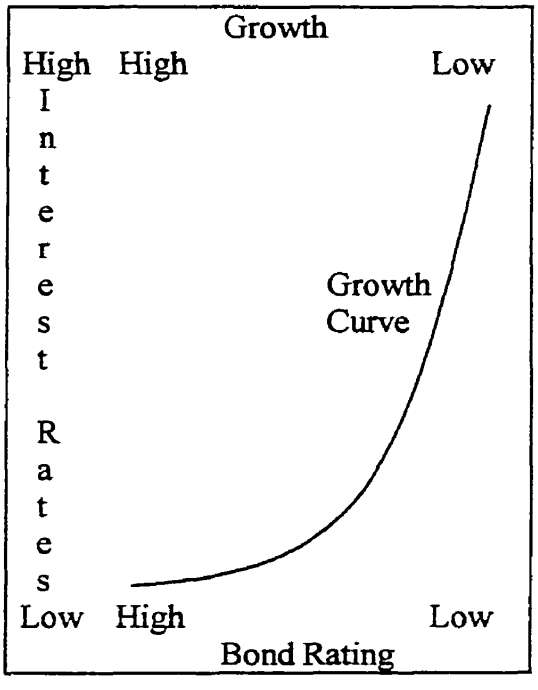
Although not explicitly stated within the existing literature, the aforementioned tie is grounded in the creditworthiness of the region. For the financial sector, the underlying theme in assessing creditworthiness is the flow of information between the parties concerned. Information flows of specialized financial information rely on 'relational proximity' (Porteous, 1995) - areas which have greater flows (such as metropolitan centres) have more information about each other. However, information has value "only when it can be placed in context, against a background in which it can be correctly interpreted" (Porteous, 1995, 8). Placing the creditworthiness of regional development in context for its "correct" financial assessment is reflected in municipal bond ratings.

The Relationship Between Bond Rating and Regional Development

A region's administration employs capital to build infrastructure (e.g., transportation, communication, services) to maintain a comparative regional advantage relative to other regions. Often, however, the economic requirements to maintain such primacy, or to secure new infrastructure to enhance regional comparative advantage, exceed the region's financial ability to independently finance such ventures. Regional/local governments are thus forced to raise funds for economic and infrastructure development with the assistance of the financial community. The funds are secured by investment banks, and conditions are placed on the region for the long-term repayment of the loan. Funds are raised through the issue of bonds.

Bonds are a form of promissory note which provide the issuer with required funds, and return a fixed income stream (*yield* or interest payment) to the investor over the life of the bond. The issuance of a bond is designed to raise large amounts of capital (typically hundreds of millions of dollars) for regional development. Before an investment bank, and the investors who eventually buy these bonds through the banks, actually invest, they require some estimate of the likelihood that a loan of such magnitude will be repaid in full and that the payments will be made in a timely manner. The financial community looks to bond rating agencies, such as Moody's or Standard and Poor's, to assess the issuer's ability to meet the conditions of repayment set forth in the bond. The rating agencies work in close consultation with the entity issuing the bond to ensure that the proposed infrastructure development is viable, and that there exists a sufficient degree of financial responsibility to make interest and principal payments. The agencies provide a categorical rating that indicates to investors the likelihood of default on the bond's conditions of repayment.

Figure 3.1: Ratings, Interest Rates, and Growth.



High ratings (see Appendix II) indicate a low level of risk to the investor, but more importantly, a high rating provides the region with favourable interest payments on the development loan. The relationship between ratings, interest rates, and growth, as hypothesized in the literature, is shown in Figure 3.1. The favourable terms permit the region to allocate scarce funding resources to attract new industry with tax incentives, provide infrastructure which allows existing firms to remain competitive, secure future employment through these firms, maintain low corporate and residential taxes, and, thus, create agglomerative economic effects which in turn secures favourable bond ratings for future infrastructure loans.

The process of economic development can, therefore, potentially exhibit cumulative and circular causation (Myrdal, 1957). Development requires infrastructure, which brings

to a region firms which capitalize on that infrastructure. These firms provide income to their employees, who in turn pay taxes to the region. These taxes go to fund more development, which may attract more firms. The result is the development of a self-sustaining process as in Figure 3.2. Peripheral regions quickly begin to lag behind the growth of the agglomeration, and can offer no incentives to maintain their economic base. Peripheral regions may begin to suffer from economic outflow, reducing their ability to secure future infrastructure development loans.

Figure 3.2:
Cumulative and Circular Causation Relationship Between Municipal Bonds and Economic Development

The rating of bonds is based on highly specialized financial information. As Hepworth (1990) has pointed out, such unstandardized information is subject to extreme distance decay effects. Given that the rating agencies and most of the investment banks who invest in bonds have located in the financial core of New York, (see Appendix I) the potential exists for information asymmetries to become exaggerated over the distance from

the region requiring development funds to the region supplying the funds. While the agencies have regional offices to handle smaller issues of debt, the regional offices are invaluable in relaying to the New York head office the local context of the information provided for a rating. The regional managers act as either ameliorating or impeding effects (depending on the extent of communication and contact between the parties) in information asymmetries between small centres and the head office where the final rating decision is made.

Information asymmetries tend to favour those areas that are repositories of information, areas that are 'thick' in information, such as urban-economic agglomerations (Wheeler, 1986; Porteous, 1995). These cores produce a wealth of information that reduces uncertainty about fiscal response to changes in the economy, effectively maintaining favourable bond ratings (the result of which becomes cumulative and circular causation as in Figure 3.2). Proximity to these cores of information has been observed to create 'spillover' effects (Ohlin, 1933; Holland, 1976) into immediately adjacent regions; which, when applied to bond ratings, may provide suburban areas with higher than normally expected ratings. This issue has been articulated by Cohen (1993), however, it has never been examined.

Research Question and Significance

Given the dearth of information specifically addressing the issue of the spatial characteristics of bond market behaviour, it raises the question: "As a reflection of financial market behaviour, are the ratings based on measurable, quantifiable, variables which can be modelled, and managed, for the benefit of locations seeking development?"

In the context of core-periphery relationships, the existing literature on metropolitan growth, and Cohen's (1993) query about spatially adjacent ratings, a second question arises: "Do the suburban communities which are experiencing the greatest growth have disproportionately higher (or lower) ratings than the urban centres which they surround?" Has the phenomenon of the suburbanization of America not only changed the relationship of urban areas with rural areas, but also of the city's core with its suburban communities? The seminal work of Blumenfeld (1954), and of Newling (1969) and Boyce (1971), show

how the population in urban areas has expanded outward from the traditional city core in favour of the suburban fringe, analogous to the movement of a tidal wave in the ocean. Has the wave also brought with it the bond ratings that finance such growth; and has this wave left in its wake an urban core unable to financially support the existing infrastructure?

Within the literature of finance and economics, research has tended to focus on the region as an autonomous unit, atomistically self-determining its future direction, from an orthodox neo-classical economic perspective. Unfortunately, the bond-rating process is somewhat subjective - a feature orthodox economic theory does not address, and thus fails to account for any spatial variation in the outcome. The geographic literature on the role of banks as financial intermediaries and the linkages they create between investors and borrowers has never attempted to address the issue of municipal bonds as a pre-investment spatial reflection of financial market behaviour. Financial geography must be concerned with understanding the various factors that reflect financial market behaviour, their impact on economic activity in space, and the effects those impacts have on core-periphery relationships for cities and their hinterlands. A necessary step to further developing the theories and models of the geography of finance is an investigation of municipal bond-ratings as a reflection of pre-investment financial market behaviour on a national scale.

The goal of this research is to contribute to the study of the geography of finance, by presenting empirical research expressing the spatial patterns of municipal bond ratings. The research will focus on addressing the spatial manifestations of financial market behaviour in what is perceived to be an aspatial financial market reflection according to neo-classical economic theory and the rating agencies themselves (Lamb *et al.*, 1993; Lamb and Rappaport, 1987).

From the above general research statement and question stems a number of related issues which will aid in developing the methodology of Chapter 4 to determine the spatial patterns of municipal bond ratings.

Scope and Scale

Given that there are various scales at which bonds may be studied, an issue to be addressed is the scope and scale of the study. States have sovereign powers (they can levy

income taxes), and therefore have the ability to better manage their fiscal responsibilities than those levels of government (counties and municipalities) which only have taxing abilities as granted by the State. Because of their sovereign powers, States have typically been given the highest bond ratings; and they have held these ratings steadily over the years (Johnson, 1993). Studies of bond ratings at the State level would show very little variability from State to State, and virtually no changes over time. Metropolitan areas, however, also issue debt to service development projects and maintain their existing infrastructure, but their ratings are far more variable since the entity is limited by the powers granted to it by the State. Cities collect the detailed financial information required by the rating agencies, but how they employ that information to manage their development projects and growth is self-determined and subject to variability between cities.

Previous studies have examined ratings at various levels (Carleton and Lerner, 1969; Michel, 1977; Aronson and Marsden, 1980; Raman, 1982; Loviscek and Crowley, 1988). These studies have been based on small samples (from 12-691 cases) to describe alternative measures to financial variables for determining a municipal rating. The spatial coverage of these studies has focused on the US MSA (metropolitan statistical area), resulting in studies with a particularly urban coverage. While somewhat limited, the scope has been appropriate given most infrastructure development and maintenance occurs at the city level. Given that the data are available for the entire US, and the data analysis technique detailed in the following chapter has no upper limits on sample size, an analysis of the entire US metropolitan bond rating pattern is appropriate. Previous works have shown a range of success in predicting ratings (53-83%), but their focus has never been extended to the national level. To fill that void, this research attempts a study of bond ratings at the national scale.

While the MSA may provide some interesting spatially aggregated results, previous research has failed to recognize that the MSA itself is not a debt-issuing entity. The MSA is comprised of a number of smaller urban units that issue debt. The oversight to identify the MSA as a non-issuing entity casts a spurious shadow over previous results that have been MSA-based. The cities and towns (urban and suburban), not the MSA, are the focus of this study. This finer resolution of analysis provides details of local/State socio-economic relationships as reflected in bond ratings that have been lost at the MSA level.

There are a great number of bond types which can be studied in metropolitan growth (general obligations, tax anticipation notes, bond anticipation notes, revenue bonds, sewer bonds, water and utility bonds). For the purposes of this dissertation, only the general obligation bond will be considered. All other bonds have a repayment mechanism factored into their payment structure based on revenues collected from the development project. Only the general obligation (G.O.) bond is supported by the tax base of the entity issuing the bond. As such, the G.O. bond is the most susceptible to the conditions in the urban environment which modify the tax base.

The Need for a Model

The previous works listed above are noted for their use of alternative measures to financial variables for determining a bond rating. One of the major challenges facing the study of municipal bonds is the fact that the rating agencies do not publish the model they use to determine ratings. Therefore, in lieu of such information, surrogate measures of fiscal responsibility are employed to reproduce bond ratings. Reproduction of ratings is seen as a valuable asset to regional governments seeking future development funds, for if they can identify surrogate elements of the rating model, they may be able to control/manage them in order to secure a higher rating in the future. A model is required for this proposed research to identify the socio-economic and spatial attributes of municipal bond ratings, and to test the significance of those variables for their influence on a rating.

The rating agencies argue that a bond rating is based solely on financial responsibility. To that end, the agencies deem variables such as per capita debt, per capita revenue, and debt service payments as the most important considerations in the rating process. These factors have also been identified as significant by Carleton and Lerner (1969), Aronson and Marsden (1980), and Raman (1982). If these were the only factors of importance, municipalities could readily obtain the highest rating by managing the variables accordingly over an extended period of time. The Aronson and Marsden study uses a sample of 25 major urban places in the US and employs multiple discriminant analysis on nine discriminating variables to generate ratings reflective of the Moody's ratings. Their selection of variables is dominated by financial characteristics of urban

places, and is based on information declared by Moody's in its Analytic Overview. These financial measures are the reflection, or outcome, of the deeper social characteristics of the community. By only addressing the symptoms (finance), Aronson and Marsden have failed to look at the cause of the ratings (the social structure). They accept that their study is limited in the number of variables and cases to which those variables are applied. While open to continuing investigation of the subject matter with more detailed data, their current study is cast into a spurious light given the limited sample size.

Raman's (1982) study suffers from the same limitations as the Aronson and Marsden study. Raman employs a discriminant analysis on five variables for twelve cities in the US. Even more limited in scope than the study above, it claims the same degree of replication success - 83.3%. Again, spurious due to its sample and variable sizes, there were other more fundamental shortcomings to the study. The rationale for such a small sample was questionable, and smacked of a lack of data collection effort on the part of Raman. The selection of variables considered had typographic errors, casting two of the five variables into non-sensibles, and placing the validity of the remainder of the study into doubt. While fundamentally flawed, the Raman study is one of the few studies on bond ratings, and is included in Table 3.2 on page 44 for reference purposes only.

With the very small sample sizes of the above two works, their ability to reproduce Moody's ratings with such a high degree of success should be questioned.

Aronson and Marsden also identify the importance ethnic mix plays on a region's rating. They find this variable highly significant in their study, and can predict ratings based solely on this variable alone. While no other research refers to ethnicity as a variable in the rating process, it may be argued that ethnic mix represents a good surrogate measure for the socio-economic factors in the urban landscape considered by the rating agencies. (Note: The terms ethnic and Ethnicity are applied herein as artefacts from the terminology of previous research. Others have used the terms inappropriately to identify the 'race' of a group, specifically the black population. Not wishing to enter a debate about racial research, which can be a politically charged issue, the terms ethnic and ethnicity will be employed throughout as a more politically sensitive (although misnamed) term. The inclusion of the Ethnicity variable, and its related discussions, in no way implies bias,

prejudice, or racism on the part of the researcher, and its inclusion in this work is grounded in the considerations afforded it by others.)

Similarly, Hausker (1991) employs surrogate variables such as the strength of public administration and how it deals with local issues with the State and with local employers. Hausker identifies this variable as one that is highly subjective, of little value beyond the context of the case in which it is presented (along the lines of Porteous' (1995) locational context), and not readily quantifiable. As such, it is open to interpretation. Hausker's text covers a great many non-financial variables, such as transportation networks, demographics, and location, but their treatment is cursory, never fully explaining how such variables interact with the rating system, nor providing any justification for their coverage in his treatise. Hausker describes an idyllic ratings system - one that covers all aspects of the entity being rated, so that there is no bit of information left unconsidered that would adversely affect the rating. Never does his description provide any form of analysis, nor does it state at what level (local, State, national) should his considerations be applied. Very much a statement of what "should be" in the ratings world, Hausker's text provides little concrete support for his arguments. His discussion, however, does identify a number of salient social and economic characteristics of urban places that may be supported by US census data, and may be tested within the context of a ratings model - such as location and public administration. The seminal work of Lamb and Rappaport (1987) states the degree of unionization and tenure of political parties may be significant in assessing administrative success in a bond rating, and as such should be considered among the modelled variables.

Two other texts, one by Rabinowitz (1969) and the other by Smith (1974), may have laid the groundwork for Hausker. Both these texts provide no form of analysis to support their statements about the nature of the bond rating process. Rabinowitz focuses primarily on financial measures of urban places to support ratings. His text has no ratings replication study, as the purpose of his text is more informative than applied. Rabinowitz employs numerous case studies of bonds that have been successful, and those that have defaulted, to lend support to his statements. While the text is not directly related to the replication of bond ratings, it does provide a valuable reference to many issues that could be considered by the rating agencies in their assignment of ratings. Dated as the text is, it is

an excellent springboard from which to begin developing an understanding of the financial considerations that become part of the rating process.

The Smith text is less staid than Rabinowitz, but it raises a few interesting points. Smith states that there are a number of considerations that go into a bond rating - everything from debt to demographics. While most of the considerations of Smith are similar to other works on bond ratings, that fact that Smith was a vice-president of Moody's writing this text with the support of Moody's, lends a degree of credibility, and insider understanding about ratings, to his arguments. One point of Smith's stands out - that the economic geography of the place being rated is considered. Unfortunately, he never describes nor defines what he means by economic geography, nor does he apply his considerations to any cases, stating only that ratings are "situation specific." Filled with platitudes about ratings, and the importance the rating agencies (especially Moody's) have to the investment community, the work appears more as a marketing piece than a scholarly text. Notwithstanding the self-serving perspective taken within the text, for a vice-president of Moody's to state that economic geography is important to a rating, any subsequent model of ratings should incorporate variables economic geographers have identified as important to urban growth.

The Pinches and Mingo (1973) study of 180 corporate bonds steps beyond the scope of considering only GO bonds, but their study provides some insights into model considerations. Pinches and Mingo follow the tradition of considering financial variables above all else, but their study produced the highest degree of replication of ratings (other than the spurious results of Raman and Aronson and Marsden). Employing both factor and multiple discriminant analyses, their study is significant not only for the replication level attained, but in stating that their model indicates that the rating agencies consider not only the credit quality of the entity being rated, but also the marketability of the *issue*. While beyond the scope of this study (the marketability of an *issue* is an industry perspective, and not a municipal pre-investment perspective), the Pinches and Mingo study provides an avenue of exploration for future research.

The largest study to date (691 cases) was conducted by Carleton and Learner (1969). Their work employed discriminant analysis on six variables at the municipal level. They admit that the study produced mixed results, and with only a 54% replication rate of

ratings, they are critical of their efforts. Their study covered the financial characteristics of the municipality (debt, tax ratios, property values), and they gleaned from their results some interesting conclusions. More a "suggestion" within the data, they believed that the rating agency could not fully disaggregate the data underlying a rating (*i.e.*, the rating could be replicated to a certain extent, but there were further layers of information that composed the variables considered). Limited by the number of variables they addressed, Carleton and Learner suggested that the variables considered in their study were reflective of other variables of a more subjective nature. They imply that by looking into the socio-economic characteristics of a community, and addressing those variables alongside the financial variables, one may be able to "improve our predictions" (Carleton and Learner, 1969, 762).

Others, such as Michel (1977) and Loviscek and Crowley (1988), however, add to the list of variables noting that economic indices such as economic diversification, municipal wealth, and the tax collection ratio, also appear to be statistically significant. If economic variables can be identified as parameters in the bond rating process, then those areas which possess the greatest concentrations of economic activity (urban-economic agglomerations such as metropolitan areas) should exhibit better ratings than those areas located at a greater distance from the core of activity. To support and test such a claim, the rating model should account for, first, the effects of information transfer between the region requesting funds and the region supplying funds; and secondly, the proximity of a region to the regional/national rating office to measure the effect of contextual information transfer over space. Smith (1974) and Hausker (1991) have both identified the importance of geography in the rating process. Both, however, provide only a cursory reference to its significance without addressing which variables are considered in a rating analysis.

The variables considered in the previous research on bond ratings have followed a mind-set consistent with that of the rating agencies. Researchers have adopted such variables as debt ratios, fiscal responsibility, employment profiles, and population growth. While these variables may be highly significant in the actual rating process, they may only be economic reflections of the social phenomena actually causing or supporting metropolitan growth. As such, a model of bond ratings should not only include measures of financial accountability, but should also measure social factors such as the crime rate,

the per cent of the population on welfare, and/or the number of illegal immigrants employed in the community.

Bond rating should not be treated as a static process. To do so would not recognize that metropolitan growth has a temporal component, as called for by Clark *et al.* Infrastructure development funds, and their associated bond ratings, may be allocated based on the existing degree of infrastructure currently in place. Those places that have proven their ability to finance developments may be more apt to receive beneficial ratings than those places that have no history of development or the financing thereof. A model must address this issue by considering the extent of infrastructure currently in the system. This may be addressed from two perspectives: on an industrial level to identify the economic strength of the region through the per capita kilowatt usage; and on a social level by identifying the extent of service provision within the metropolitan area, such as the per capita level of post-secondary institutions, and/or the number of hospital beds.

A model of municipal bond ratings serves not only an academic purpose, but also a pragmatic purpose as well. In an industry which represents $1.3-$2 trillion (*The Economist*, 03/26/1996 and Moody's, 1996) with a default rate of 5%, the annual losses in municipal bonds can represent $100 billion to the US economy. The municipalities that do not default indirectly pay for such losses through their interest rates on their loans and through the costs of providing information to the agencies to first receive a rating, and then maintain a rating. If there are fewer defaults, rates may be lowered which provides municipal governments with a greater ability to finance existing growth and secure new investments in infrastructure because of a lower capital outlay in the form of payments. The result is more affordable growth for new projects with more revenues available for existing services such as education, health care, security, and general infrastructure.

Previous studies have relied almost exclusively on discriminant analysis to develop probabilities for accurately determining bond ratings. Loviscek and Crowley (1988), however, employ a linear probability model to determine regression coefficients that are far less cryptic and more readily interpreted than the discriminant scores of univariate and multivariate discriminant analysis. The details of the actual methodology employed herein are detailed in Chapter 4. Note, however, that the methodologies employed by past studies into the nature of bond modeling provide a valuable reference

point from which to begin data analysis, even if the results of those analyses have been misrepresented by the framework under which they were applied (*e.g.*, the Metropolitan Statistical Area).

A summary of previous research on bond ratings is provided in Table 2 at the end of this chapter.

Concluding Synopsis

Municipal bond ratings provide the financial markets with investment information about the viability of a development project. These projects are the result of metropolitan growth, and in turn create the conditions necessary for further metropolitan growth. Numerous theories have been postulated to identify the sources of metropolitan growth, but most have been limited by neo-classical equilibrium constraints that do not allow for the spatial and temporal elements of metropolitan growth. A newer theory, Dynamic Disequilibrium Adjustment Theory, recognizes the non-static nature of metropolitan growth and attempts to identify a broader spectrum of social and economic variables that may account for metropolitan growth. It is to that broader base of socio-economic variables that bond ratings may actually be applied. As such, the proposed model of municipal bond ratings attempts to cover a similarly broad spectrum of variables, and identify measures heretofore untested among the bond rating literature to establish their effects on metropolitan growth.

If a rating model shows that there is a spatial component to municipal bond ratings, and/or that there exists a degree of manageable socio-economic factors among ratings, it will advance our understanding of the geography of finance and be of value to those practitioners who employ such ratings. And, specifically for municipal bond ratings, it will establish the spatial characteristics of a process that is touted as aspatial in theory. However, if the model identifies no urban-economic factors, no geographic factors, no social factors, no information asymmetries, and only financial variables as significant to the rating process, then this study will have identified an area of economic-geographic research which requires much further investigation to uncover how the rating agencies manage to eliminate the friction of distance, and information asymmetries

between peripheries and cores, for unstandardized financial information which has been shown (Hepworth, 1990) to exhibit extreme distance decay effects.

Table 3.2:

Sample of Previous Studies on Bond Ratings

Author	Factors	Analysis	# of Vars	% Rep.	Scale	Sample
Carleton, W.T. Lerner, E.M. (1969)	Debt, Assessed property values, Population, Tax collection	Discriminant Analysis	6	54	Muni.	691
Rabinowitz, A. (1969)	Debt, Assessed property values, Population, Economy, Taxes, Accuracy of accounting practices.	Undefined				
Pinches, G.E. Mingo, K.A. (1973)	Assets, Dividends, Income, Debt, Issue Size.	Factor and Multiple Discriminant	6	65	Corp.	180
Smith, W.S. (1974)	Debt, Debt service, Operating funds, Reliance on loans, Economy, Demographics, Local management, Housing ownership, Economic Geography.	Situation Specific			Muni.	
Michel, A.J. (1977)	Debt, Revenue, State Aid, Assessed property values, Taxes, Debt service, Welfare payments.	Discriminant Analysis	12	59.6	City	50
Aronson, J.R. Marsden, J.R. (1980)	Debt, Debt service, State aid, Taxes, Housing ownership, Ethnicity.	Linear Discriminant Analysis	9	83.3	City	25
Raman, K.K. (1982)	Debt, Revenue, Working capital, Operating cash.	Stepwise Discriminant	5	83.3	City	12
Loviscek, A.L. Crowley, F.D. (1988)	Employment, Population growth, Market attraction, Energy surplus.	Linear Probability Model	4		SMSA	50
Hausker, A.J. (1991)	Location, Transportation network, Demographics, Tax, Employment, Retail Sales, Income, Accounting Debt, Public Administration.	Undefined				

CHAPTER 4
METHODOLOGY I

Introduction

The previous chapter has set forth the questions that need to be addressed within the context of municipal bonds, and the socio-economic conditions within a community that define the rating structure of those bonds. While there has been a small literature base on municipal bonds and the constituent variables that define the bond's rating, a vast array of techniques have been applied to the data in an attempt to recreate those ratings. Much of the past literature has used techniques that follow along the same themes - logit analyses, regressions, or data reduction techniques such as discriminant and factor analyses as the final techniques in the analysis of ratings. It, also, has been noted in Chapter 3 that some previous works have misapplied their data to a spatial scale not reflective of the level of bond application. It is possible, therefore, that a more comprehensive methodology is required to address these shortcomings from previous works and answer the questions that have been raised in previous chapters. This chapter defines the methodological approach employed to advance our understanding of the geography of finance as it applies to bond ratings.

The Variables

The previous two tables have identified two very distinct variable sets. Table 3.1 provides all of the variables from the development literature, looking at regional growth primarily from the socio-economic perspective. Table 3.2 is a summary of past bond rating literature, and there is a dominant financial bias in the variables considered within that literature set. What is of interest within these two bodies of literature originating from different disciplines are the similarities that may be found if one applies the variables from one set to the tenets of the other. The variables of the bond rating literature have concentrated on using financial measures of community characteristics to identify creditworthiness. Such measures have included debt loads, tax base, revenues,

employment profiles, property values, and other like measures noted in Table 3.2 to define ratings. Applying the tenets of the development literature to bond rating produces a vast number of similarities in the issues under consideration. The development literature focuses on topics like growth poles (with variables such as population, employment, incomes, and property values), product life-cycles (with variables such as economic diversity, income, and market attraction), and the others listed in Table 3.1. As stated previously, the variables of the bond literature are simply the financial reflections of the deeper socio-economic conditions within the community. The financial variables are useful summary measures for the vast array of social issues within communities. The use of financial variables to reflect social characteristics helps lend credibility and a sense of objectivity to the bond rating process and the agencies themselves. Therefore, to improve upon the success of other models identified in Chapter 2, the variables to be considered in a new ratings model should not only employ the variables from past financial works, but must include the socio-economic characteristics that create the financial reflection of those issues, as well as the other previously unconsidered variables as identified from the growth/development literature cited in Table 3.1.

To that end, the variables considered for the model of bond rating activity will include the financial variables of per capita debt, debt to assessed property values, per capita revenues, debt to revenue ratios, old debt charges, and uncollected taxes ratios. The second set of variables will address the socio-economic characteristics of the municipality by considering the employment diversity, income ratios, population, population growth, ethnicity, unionization, municipal political structure, crime rates, welfare, number of illegal immigrants, education of the workforce, social infrastructure, and industrial infrastructure. The final group of variables addresses those issues raised in the bond literature, but never elaborated upon to assess their importance to the rating process - including the distance to the regional rating office, and the distance to the rating office headquarters (New York).

The variables listed above have been chosen for this study for a number of reasons. First, and most importantly, these variables have been shown to have success in reproducing bond ratings from a financial perspective; secondly, the social variables are the underlying characteristics of the municipal environment that give the financial variables their *raison d'être;* and finally, the distance variables address the geographic implications

of location on the ratings received by municipalities. The variables and the initial model are provided in Figure 4.3.

Figure 4.3: The Initial Model

$MBR\ f\ \alpha \pm (\beta_1 D/P, \beta_2 D{:}APV, \beta_3 R/P, \beta_4 D[1+i]^2{:}R, \beta_5[OD/a^i_n]n{:}Rn, \beta_6 UT/T, \beta_7\{\Sigma\,|((e_{ic}/E_c - e_{ni}/E_n)/2)|\}, \beta_8 Y_c{:}Y_n, \beta_9 \Delta P_c/\Delta P_n, \beta_{10} P, \beta_{11} A, \beta_{12} UN, \beta_{13} Pt, \beta_{14} CR, \beta_{15} W, \beta_{16} \Pi, \beta_{17} PS/P, \beta_{18} HB/P, \beta_{19} KW/P, \beta_{20} d_c\Omega_{sbr}, \beta_{21} d_c\delta_{sbr}, \beta_{22} d_c RRO, \beta_{23} e_{fc}E_{fh}/d_{ch}{}^b, \beta_{24} e_{mfg}/E_c, \beta_{25} P_s/P, \beta_{26} e_{srv}/E_c)$

where:

MBR=municipal bond rating
ß=coefficient of probability
P=population
R=municipal revenues
OD=old debt (existing long term debt previous years)
n=number of interest payments
T=taxes levied
E_c=employment in municipality c
E_n=national employment
Y_n=real average personal income in the nation
ΔP_n=population growth rate of the nation
P_r=rural population
UN=percent of the workforce Unionized
CR=crime rate
Π=number of illegal immigrants in the municipality
HB=number of hospital beds in the municipality
e_{mfg}=local employment in manufacturing
e_{srv}=local employment in the service sector
$d_{c\delta SBR}$=distance from municipality to lowest Bond Rating in State
e_{fc}=employment in financial services within the municipality
E_{fh}=employment in financial services in agency headoffice municipality
α=equation error term
D=municipal debt
APV=assessed municipal property value
i=interest rate
a=amortization payment
UT=uncollected taxes
e_{ic}=employment in industry i in municipality c
e_{ni}=employment in industry i in the nation
Y_c=real average personal income in the municipality
ΔP_c=population growth rate of the municipality
P_u=urban population
A=ethnicity index
Pt=political structure of the municipal administration
W=welfare ratio
PS=number of post-secondary educated
KW=kilowatts
P_s=local population of senior citizens
$d_{c\Omega SBR}$=distance from municipality to highest Bond Rating in State
d_cRRO=distance from municipality to Regional Rating Office
d_{ch}=distance from municipality to agency headoffice location.
b=friction of distance for financial information (empirically derived)

While at first the initial equation may seem complex to account for the myriad of socio-economic characteristics of the community, the above equation is to be read as:

"Municipal Bond Ratings may be a function of: per capita debt, the debt to assessed property value ratio, municipal revenue per capita, short-term debt to revenue ratio, long-

term debt service to revenue ratio, uncollected taxes as a percentage of taxes levied, municipal economic diversification index, municipal income index, municipal population growth index, the urban to rural population ratio, ethnic (racial) mix, the degree of unionization in the municipality, the political structure of the municipal administration, the crime rate, the welfare ratio, the number of illegal immigrants, the level of post-secondary education provision, the level of medical services, the degree of energy consumption, the distance from the municipality to the highest bond rating in State, the distance from the municipality to lowest bond rating in State, the distance from the municipality to the regional rating office, the interaction between the financial sectors of the municipality and the rating agency's location as it is affected by the friction of transferring non-standardized financial information across space, and the effects of the specific industrial composition of the community."

Figure 3 is referred to as the "initial" equation due to the exploratory nature of this study. While many of the variables included in the model have been identified as significant in previous works, the combination of the financial variables with their socio-economic underpinnings, along with heretofore untested geographic variables, may cause some of the variables to "fall out" through insignificance after analysis using data reduction techniques (more on this later). Therefore, the final model that will represent the ratings may or may not contain all of the above variables, and will need to be expressed in a format that is appropriate for the technique used herein rather than a simple relational expression.

The Data Sources and Limitations

Variables

Data acquisition and the sources of data posed few challenges in the research. The variables identified in Figure 3 are all readily acquired from four currently published sources. The fiscal variables concerning debt, revenue, income and taxes (parameters 1 through 6 in the relational model) are collected by the rating agencies and published in their annual rating manuals. Data for parameters 7 through 13 are collected in part by the agencies, and in part by the US Bureau of Economic Analysis, Department of Commerce (published in their Survey of Current Business). The variables of parameters 14 through

19, and variables 24 to 26 are readily obtained from the Survey of Current Business, and the US Census Bureau in the State statistical abstracts. The data for the geographic variables (parameters 20 through 22) are readily determined from traditional print maps or more expeditiously from the vast array of electronic distance calculators available on the world wide web. The electronic option has been exercised for this dissertation, and the reference for the site is noted in the bibliography. Variable 23, the financial information decay variable, is a modified version of a simple gravity model. The employment figures within the financial sector for the municipality and for the head-office location are available in Ward's Business Directory of Services.

Rating Agency

As mentioned previously, there is more than one bond rating agency. The selection of agency (Moody's, Standard and Poor's, Fitch Investor Services) is important to the study, for not all agencies are perceived to be equals within the financial community, nor among the municipalities seeking ratings. The accepted 'rule-of-thumb' is to use the Moody's rating whenever possible, since this rating is the most respected in the marketplace (Lamb, 1993). Moody's, being the industry leader, rates more bonds than the other agencies, and therefore, has a greater geographic representation among its ratings. Given the extent of the Moody's coverage, it is the data source for the ratings and the variables employed in the initial model.

Time Line

The time-line for the data used in the dissertation is the twenty-year period from 1977 to 1996. This period is chosen for a number of reasons. First, many of the national infrastructure projects of the post-war era were completed by the 1970s, so the level of federal support for regional development was dramatically reduced, forcing regional governments to seek development loans without the backing of the federal government. Secondly, in the later years of the time frame, those development projects completed in the 1950s and 1960s required maintenance and/or replacement. Finally, in 1977 all the rating agencies standardized their reporting, data collection, and rating fee structures, so that the

industry would be perceived as an objective observer of capital projects for regional development.

Given that a time period of twenty years is covered since rating standardization, one cannot assume that the municipal areas are standardized over time - as municipal growth occurs, the boundaries of the urban area will extend into adjacent land. To account for the addition of newly annexed areas over the study period, the municipal area is treated as the area defined by the 1986 boundaries.

Limitations

The variables of the relational model present one of the limitations of this study. The variables are surrogate measures of the variables the rating agency may use. Given the proprietary nature of the information the actual Moody's model contains, it remains a guarded secret. All other studies have used surrogate variables, and given that this study employs all of those variables and more, this study should have at least the same, if not better, level of reproduction of ratings.

Other limitations are even more fundamental. The rating agencies themselves contend "they consider subjective factors [when producing a rating] that cannot be quantified, they consider more variables than a statistical model can incorporate, and the rating process is far too complicated to be reduced to a few equations" (Ederington, 1985, 237). The attempt of social science to measure and quantify subjective interpretations of the human environment has been one of the most challenging issues faced by social researchers - 1) can such measures of the social environment be created; and 2) are they meaningful? It is not the intent of this dissertation to resolve this intractable question. It is, however, the purpose herein to provide a model that contains variables that can be managed by municipal authorities in order to enhance their likelihood of improved ratings and thereby lower the costs of infrastructure development.

Another fundamental consideration to be noted for the data is the issue of self-selection. This study hinges on the fact that a municipal entity has had a development project within the study time frame and that project sought external funding that required a bond rating. The issue of selectivity arises because the data set contains only those projects for which a rating was received. All projects that were not rated have not been identified.

It is inappropriate to consider this model all encompassing and applicable to all municipal entities if there is some systematic rationale that the municipalities that have not been rated have chosen not to do so. The consequence for application of the model is that it should only be applied to municipalities that have been rated since 1977, and when employed by other municipal units previously not rated, it should be considered strictly as a rough estimator.

The Available Techniques

The literature is replete with techniques employed to reproduce bond ratings. As noted in the introduction to this chapter, and in Table 2, typical approaches to the analysis of bond ratings have employed logit analyses, regressions, discriminant analyses and/or data reduction techniques such as factor analysis. The techniques have met with varying degrees of success, but all of them have limitations to their applicability and appropriateness given the nature of the data.

Regression Analyses

Used extensively in the study of both municipal and corporate bonds (see Kaplan and Urwitz, 1979; Ederington, 1986; Altman *et al*, 1981), regression analysis provides for a simple linear relationship between the independent and dependent variable that is readily recognized and accepted given its wide-spread use in other applications and in other disciplines. Taking the form $Y_i = \alpha + \beta X_i + u_i$ where X is the characteristic under consideration, β its coefficient, and Y the rating being modelled. While many studies have used OLS regressions, and claim some success in reproducing the rating (see Figure 2), there is a problem applying such a technique to data represented by the independent variable. Typical with regression analyses used in bond ratings, the ratings are assigned a numerical value (*e.g.*, Aaa=9 Aa=8 A=7 *etc.*). The analysis assumes the independent variable is an interval scale datum, and assigns to the variable divisions/intervals that are not reflective of the datum. The problem arises from the fact the analysis assumes the risk between a "Aaa" and a "Aa" rating is the same as the risk differential between "Baa" and

"Ba." This may not be so. If one looks at the *ratings* and *interest rates* of bonds issued at various ratings on the same date, the intervals are not equal (see Appendix IV).

Given this noted shortcoming in the technique as applied to interval level data, all studies employing the OLS method are cast in a spurious light. As such, the typical regression method should not be employed in ratings analyses as a final technique, and is only employed herein for comparative and descriptive purposes.

Ordered Probit and Logit Analyses

To overcome the interval class data limitation of the OLS method, ordered probit and logit models treat the variables within the standard regression equation differently. Rather than fixing the divisions between the dependent variable, and thereby arbitrarily defining it as interval, it is assumed that the ratings are simply divisions - a higher rating is simply higher, not higher by the same degree in all cases. The relationship, therefore, becomes $Z_i \in R_k$ if $\gamma_{k-1} < Y_i > \gamma_k$, such that the group of like ratings (Z_i) is a set of ratings (from k=1 to 9 {Aaa to C in the above example}), where the cut-off points between ratings (Y_i) is between k and k-1.

To determine the probability that a group of like ratings is indeed a set of the rating being considered, the γs and βs are to be determined. Established through $Pr(Z_i \in R_k) = F(\gamma_k - \alpha - \beta X_i) - F(\gamma_{k-1} - \alpha - \beta X_i)$, where F is the probability distribution, the model takes form. If the distribution of data is normal, the model is ordered probit; if it is cumulative logistic, the model is ordered logit. Given that the two probability distributions are quite similar, the models, too, are alike (Ederington, 1985).

The theoretical advantage of these models comes from the intervals in the dependent variable. Unlike the fixed intervals of the OLS method, the $\gamma_k - \gamma_{k-1}$ intervals vary from rating to rating, such that the difference between a Aaa and a Aa rating need not be the same as the difference between a Baa and a Ba rating.

The treatment of the dependent variable gives the ordered probit and logit techniques a clear advantage over the OLS method. The advantage of a "floating" division between dependent data points is mitigated by the fact the technique can only produce discrete models for each set of ratings. In the case of 9 dependent variables, there would be nine equations - one for each rating. For the applicability to municipal administrators using

information to manage ratings, the sheer number of equations and the possible number of outcomes makes the use of such models impractical as a general management tool. Specifically, the local administrator would need to know the rating outcome in advance of the need for a rating in order to maximize the utility of the information to manage the rating and therefore the cost of development.

Discriminant Analyses

Discriminant analyses are the most often used techniques in bond rating studies (Table 2, Ederington, 1985, Kaplan & Urwitz, 1979). Linear discriminant analyses are a minute advancement over the logit and probit (L&P) models (Amemiya and Altman, Avery, Eisenbeis & Sinkey, 1981), because the L&P models consider ratings to be a function of the local characteristics, whereas the discriminant models view the parameters of the model as dependent on the rating itself.

The linear models have the well-known problem of unequal variance-covariance matrices, which may be corrected by applying quadratic or multiple discriminant analysis as done by Pinches and Mingo (1975) or Altman and Katz (1974). The success of their models in reproducing ratings is similar to other techniques, overcoming the limitations of OLS, but not addressing two key issues. First, the technique assumes the data are normally distributed or have been corrected through transformations to become normalized. In the case of financial variables, it is widely recognized that the data are rarely normal (Altman, Avery, Eisenbeis & Sinkey, 1981). Without normally distributed data, discriminant analysis produces inconsistent estimators. Secondly, the analysis creates discrete models just like those of the logit technique, producing an unwieldy number of possible rating models for administrators to manage.

Given the limitations of the technique, the number of models which could be derived from analysis, and a lack of improvement in ratings reproduction over other similar techniques, the use of the variety of discriminant analyses as the methodological approach to resolving the questions set forth herein would not advance our understanding of bond ratings.

Data Reduction Techniques

The use of factor analysis has been limited to Pinches and Mingo (1973), and it was used in conjunction with other techniques, notably discriminant analysis. Data reduction techniques, such as factor analysis, may prove useful in the context of this study. The general tenor of the technique is to identify variables that behave in a like manner to produce the outcome of the dependent variable, but do not exhibit any form of co-linearity. For application to this study, data reduction may prove useful to determine if, indeed, the financial variables are reflections of the underlying socio-economic characteristics of the municipality.

Not to be considered as a stand-alone technique, factor analysis is a useful tool to simplify the data to uncover some of the underlying structure and relationships within the municipality. The factors identify essentially independent dimensions in the data that between factors are distinguishable, but within the factor are similar in nature. The advantage to employing a data reduction technique to the initial model of Figure 3 permits for fewer parameters to be modelled if a number of the initial variables impact the bond rating in a like fashion.

While factor analysis is employed in this study, it, too, has some limitations. The most common limitation of the technique is the somewhat arbitrary assigning of factor names. While a typical factor analysis provides information about the impact each independent variable has on the dependent variable, how one assigns a title to the factor is usually left to the creative interpretation of the researcher. For purposes of clarity and understanding, factor analysis titles employed in this study are based on the most dominant variable(s) and named for the characteristics those variables most aptly identify.

The Mining

Given the exploratory nature of the study, the first step to uncovering some of the patterns within the data is to conduct simple descriptive analyses using the existing techniques of past studies. Not to be interpreted as an exercise in redundancy, using some of the past techniques, flawed as they are, provides useful benchmarks for the analysis, and a means of comparison for this study to past works. Also, this study represents a combination of

variables previously considered. Their aggregation into a single model may uncover avenues of analysis previously abandoned, unconsidered, or otherwise (although unlikely) support existing techniques.

To begin, the data are observed for obvious errors, either through original data collection or from file transfer. (Since all the data, except those collected from the Moody's and Ward's directories, were available in digital format, the data are as reliable as can possibly be expected, since it comes directly from the source of the data - usually the US government.) The data are ordered so that obvious errors become apparent. For example, if there is a datum in the Illegal Immigrants variable that represents 1100% percent of the population, the case will be cut from the analysis.

Secondly, some data require transformation. Given that the data arrive from the US government in a number of forms/scales to reflect the publications into which they will ultimately be printed, the data needs to be transformed to eliminate scalar/magnitude effects with some of the variables, and to normalize the data in cases that do not reflect a normal distribution (paramount to the analyses previously described). Variables 11, and 18 of the initial model required log transformation, and variables 1, 5, and 8 required root transforms, to normalize their distributions.

The collection of Moody's data provided 15,730 cases of general obligation municipal bonds rated between 1977 and 1996. Only those bonds that are uninsured (true general obligation bonds), and have complete records are included in the study, thus reducing the number of cases to 11,211. Of those cases, information is required to satisfy the variables of Figure 4.3. The information provided by the US Census, the Survey of Current Business, financial directories, and distance calculators needs to be complete in all respects so that every variable has representation for every one of the 11,211 cases. Given these constraints, and trimming all obvious errors, reduces the data set to 3,648 ratings cases.

The data are first applied to a regression analysis to determine the benchmark from past studies. The regression analysis identifies those variables that have import on the bond rating. Reapplying descriptive techniques to the results of the analysis establishes the direction of subsequent analyses.

The methods employed herein are evolutionary as more is uncovered in the data as various techniques are applied to the data. The following chapter details the preliminary results of the first run of the analysis, and further explores methodologies available, and subsequently employed, to answer the research questions.

CHAPTER 5
METHODOLOGY II AND THE DEVELOPMENT OF RESULTS

Introduction

The previous chapter provides a thumbnail sketch of the techniques that have been applied to the study of bond ratings. Weaknesses have been identified in those techniques, but there are still merits to those techniques from an exploratory perspective. This chapter details the exploratory results of the first run of analyses and the methodological evolution employed to advance our understanding of the geography of finance as it applies to bond ratings.

The First Results

Applying a simple linear regression to the 3,648 cases produces a number of interesting results noted in Table 5.3. Note that the States of Delaware, Idaho, Montana, Vermont, and Wyoming do not have representation in the table. Given the few number of ratings cases for these States, and the number of variables to which those cases would need to be applied, the tenets of regression analysis would be violated, and thus the cases for those States are removed from the analysis. (Their elimination from analysis was unknown prior to analysis, and therefore alters the number of cases - it becomes 3,610.)

The regression technique is a step-wise additive method, progressively adding more variables to the model each iteration until there is no more improvement in the correlation coefficient. Since the goal of modelling is to improve our understanding of a certain phenomenon by reducing the variables that affect the outcome to as few as is possible, a 5% correlation coefficient improvement is used as the cut-off point, else the regression model would become unwieldy in its number of parameters. For example, taking the entire US and letting the model run unrestricted to final iteration produces a model with all 26 variables from the initial model plus an error term. The improvement from the first to the last additive parameter is a meagre 3%, the last four variables to enter the model having no

effect at all. It is, therefore, in the consideration of a most parsimonious model that the 5% improvement criterion is applied.

Table 5.3: Linear Regression Results - 5% R^2 improvement cut-off. (Stepwise additive)

State	R^2	N	State	R^2	N	State	R^2	N	State	R^2	N
AL	0.708	53	IN	0.835	38	NC	0.888	135	RI	0.520	43
AR	0.982	11	KS	0.903	64	ND	0.907	32	SC	0.752	32
AZ	0.868	76	KY	0.901	25	NE	1.000	28	SD	0.933	17
CA	0.621	306	LA	0.782	57	NH	0.994	24	TN	0.786	64
CO	0.597	92	MA	0.662	211	NJ	0.889	100	TX	0.675	364
CT	0.912	107	MD	0.784	49	NM	1.000	18	UT	1.000	14
DE	-	8	ME	0.993	34	NV	0.892	30	VA	0.790	114
FL	0.701	122	MI	0.709	129	NY	0.441	162	VT	-	3
GA	0.954	50	MN	0.836	90	OH	0.755	193	WA	0.901	80
IA	0.552	132	MO	0.983	63	OK	0.938	44	WI	0.881	119
ID	-	8	MS	0.961	31	OR	0.936	53	WV	1.000	16
IL	0.745	127	MT	-	12	PA	0.608	61	WY	-	7
									All Cases	0.454	3610

One must note some points in the results above. First, and most obviously, the data has been aggregated to the State level from the municipal level. The first cut of the data produced results quite similar to each other for the municipalities with ratings within each State, yet different between the various States. Attempting to produce a manageable number of results from the analysis rather than thousands of municipal case studies, an analysis of variance was applied to the first results to assess the extent to which the data may be aggregated. The Anova results are in Table 5.4.

Table 5.4: Data Aggregation ANOVA Results

Source of Variation	df	Sum of Squares	Mean Square	F-Statistic
Between States	47	1.9436	0.0414	221.39
Within States	3600	0.6745	0.000187	

With an F ratio so large, it is clear that the variance comes from the State level, with much less variation within a given State.

The Anova suggests that the data may be aptly interpreted at the State level, but with the understanding that there are variations within the States that do not make

application of the results an absolute. Each rating should be considered within the context of the State, but based on its own merits. For example, Cleveland, Ohio, has the lowest rating in the entire data set at C grade. While all of the other cases within the State of Ohio are of a like rating (A1 ± one rating grade), Cleveland stands out. The reason for this odd rating is quite expected. Cleveland, unlike other major cities in Ohio, is spatially constrained. The city is bound to the north by Lake Erie, and to all its other borders by 21 neighbouring communities. When Cleveland applies to the marketplace for monies to develop its infrastructure to support growth, the rating agency recognizes that the community cannot grow outwards. Without the ability to grow spatially, and annex new land for industrial and residential growth, the community is faced with a paradox. Cleveland must build infrastructure to attract and retain businesses and residences that support the tax base to pay for the infrastructure. Development, however, cannot occur because there is no new territory for growth within the confines of the city. Industries, and the people who work in those firms, are moving into the suburban ring around the city (the flight of firms discussed in Chapter 3). The community, however, must maintain and service the existing infrastructure for those people and businesses not yet attracted to the suburban fringe. The result is a community that must fund development with a decreasing tax base to support its development. The bond market recognizes such a dire financial situation, and when Cleveland applies for development dollars, the risk is quite high that the monies will not be repaid, since the means of raising the repayment dollars is weakening, and this is reflected in their low (very high-risk) rating.

The second point to note from the regression analysis is the overall correlation coefficient for all cases considered simultaneously. At only a 45% likelihood that the model derived would be able to reproduce the ratings, this figure falls short of the success rates of those previous studies that employed the technique (see Table 3.2).

Thirdly, there are R^2 values of 1.000. While theoretically possible, the value must be viewed cautiously. Given the small number of cases, these figures are spurious, and should be treated as statistical anomalies.

The points one and two raise is an issue previously unconsidered in bond rating studies. If the ratings cannot be reproduced with any level of certainty, yet the model incorporates all of the variables from past studies, has something been overlooked? The

initial run at the data suggests that ratings within a State are similar, yet different between the States. It is likely, therefore, that local conditions (social, economic, demographic, taxation) are influenced to some extent by those conditions at the State level. Heretofore untested, it is prudent to re-evaluate the original data considerations and incorporate State level data to establish their impact on the ratings for the local municipalities.

To facilitate data re-collection at the State level, only those variables that entered into the original regressions will be pursued. The following variables, originally thought to have import into the ratings relationship, had no significance in the original regressions and are not further considered: population, unionization, illegal immigrants, the distance to high/low ratings, seniors population, and employment in the financial services sector.

The Second Results

Data for the second run of analysis is available from the same sources as in the first run. Applying the newly collected data along with the relevant existing data to a linear regression model provided a rather dramatic improvement in the correlation coefficients for all but 5 of the States: Georgia, Mississippi, Oklahoma, Virginia and West Virginia, as noted in Table 5.5.

Table 5.5: Regression Results State Data included - 5% R^2 improvement cut-off. (Stepwise additive)

State	R^2 1	R^2 2	N	State	R^2 1	R^2 2	N	State	R^2 1	R^2 2	N
AL	0.708	0.820	53	MA	0.662	0.735	211	OH	0.755	0.755	193
AR	0.982	1.000	11	MD	0.784	0.820	49	OK	0.938	0.911	44
AZ	0.868	0.902	76	ME	0.993	0.994	34	OR	0.936	0.976	53
CA	0.621	0.669	306	MI	0.709	0.839	129	PA	0.608	0.633	61
CO	0.597	0.892	92	MN	0.836	0.985	90	RI	0.520	0.781	43
CT	0.912	0.931	107	MO	0.983	0.990	63	SC	0.752	0.922	32
DE	-	-	8	MS	0.961	0.915	31	SD	0.933	1.000	17
FL	0.701	0.800	122	MT	-	-	12	TN	0.786	0.786	64
GA	0.954	0.931	50	NC	0.888	0.927	135	TX	0.675	0.681	364
IA	0.552	0.796	132	ND	0.907	0.935	32	UT	1.000	1.000	14
ID	-	-	8	NE	1.000	1.000	28	VA	0.790	0.743	114
IL	0.745	0.771	127	NH	0.994	0.994	24	VT	-	-	3
IN	0.835	0.835	38	NJ	0.889	0.889	100	WA	0.901	0.968	80
KS	0.903	0.918	64	NM	1.000	1.000	18	WI	0.881	0.905	119
KY	0.901	0.962	25	NV	0.892	0.948	30	WV	1.000	0.998	16
LA	0.782	0.883	57	NY	0.441	0.774	162	WY	-	-	7
								All Cases	0.454	0.590	3610

Improvements in the correlation coefficients indicate that the newly applied State level data does enhance our ability to reproduce the bond rating of the communities within the States. The addition of State level data, however, creates a new data issue. The regression analysis used to produce the outcomes of Table 5.5 also indicates that there exists colinearity between some (and in a few cases, many) variables. Rather than listing the litany of colinearities, suffice it to note that the colinearities existed between variables such as poverty, education, and crime rate; income, ethnicity, and employment; and debt load, manufacturing concentration, and service sector employment, to name just a few. To mitigate the statistical problem of colinearity among the variables, a data reduction technique may be applied to the data to 'group' those variables that have like properties and influence the outcome of the analysis in a similar manner. Factor analysis is applied to the ratings cases to establish the number of groups, or factors, that have variables that act in a consistent manner with other variables within the group, yet are substantially different from other variables that comprise the other internally consistent groups (other factors).

Before describing the methodology of the factor analysis, for it leads the analysis away from the other techniques described in the previous chapter, the rationale for abandoning the use of those other techniques (discriminant, logit, and probit analyses), must be reiterated. The aforementioned techniques all suffer from the same folly - they produce a unique function for every dependent case in the data. With the potential for up to 18 different dependent cases (18 classes of bond ratings between Aaa and D), the combinations and permutations of 34 variables (local and, now, State), and each function will differ between the 48 States, leaves an intractable number of solutions for those administrators looking to manage their development expenditures and the inputs into calculating the cost of servicing those debts. When applied to cases with a single or bivariate outcome, and involving only a limited number of variables (as in the previous studies on ratings listed in Table 3.2), such techniques may be employed. In the context of this study, however, their use is inappropriate.

The Factors

The tenets of factor analysis have been described in the previous chapter, and are well known to most researchers; thus the following only touches on the highlights of the methodology.

To establish the factors, the data is submitted to a Principal Components Analysis (PCA) to extract the factors, identifying those variables that impact on the outcome in a like fashion. The factors under consideration for analysis are restricted to those with Eigenvalues greater than 1 (see Appendix VII). The resulting matrix is rotated to normailze the data to a standard X,Y co-ordinate system (using Varimax rotation and Kaiser Normalization) for ease of interpretation of matrix values.

A rotated component matrix from Principal Components Analysis produces a value for all variables in the data set. Some variables within the factor have greater import than others, with a range between -1 and 1. Whether the value is positive or negative is not important - it is the absolute value of the matrix cell that needs to be considered. Ideally, a matrix should contain a number of cells with large absolute values (nearing 1) and a number of cells with values nearing 0. The cells with large values identify the Principal Components of the factor, those with small values have little effect on the outcome of that group of variables, but are important to other groups. The commonplace rule of thumb is to use a 0.500 cut-off for inclusion into a factor. The 'rule', however, gets circumvented when a variable does not have the 0.500 cut-off, and is not included within any of the factors. Since all variables must be accounted for, the variable is allocated to the factor to which it has the greatest impact, irrespective of the cut-off value.

One of the criticisms of factor analysis is the somewhat arbitrary way variables are assigned to factors. While a steadfast rule of 0.500 as a cut-off may hedge such criticism, the need to include all the variables often contradicts such guides. Often, it is the case where a variable has import into a number of factors (it has nearly equal PCA scores in a number of factor columns, but is less than the cut-off value). It becomes the researcher's prerogative to which factor the variable is assigned. Assignment is typically based on an understanding by the researcher of the general nature of the study and the structure of the system in which the analysis is being applied. That understanding also carries with it the

natural biases of that researcher and how he/she comes to his/her 'understanding' of the system. While every attempt has been made to eliminate bias from this study, the author acknowledges that personal bias may have entered into the selection of variables for each factor, or the naming of the factors. The inclusion of variables into factors is based on the support of the matrix, but the naming of the factors remained the purview of the author. Being blind to one's own biases, the titles of the factors are an interpretation of the author's 'understanding of the system' and have no grounding other than that 'understanding.'

The results of the factor analysis are presented in Table 5.6. The highlighted cells are those variables that are included in the factor.

Table 5.6: Rotated Component Matrix *(0.500 inclusion)*

Variables	Components									
	1	2	3	4	5	6	7	8	9	10
D:APV	.047	.063	.031	.032	.017	.014	.032	.023	.048	.485
D:REV	.044	-.660	0.087	.106	.119	-.101	.161	.019	.234	.147
EmpIndex	.004	.183	.031	.003	.032	.006	-.001	.115	.631	-.194
PopGrowth	.061	-.095	.043	-.060	-.597	.264	.212	.051	.082	.146
Gov't	.086	-.058	-.054	.075	-.062	-.052	.040	-.009	-.038	-.758
Crime	.075	.221	.183	-.101	-.280	.357	-.034	.330	.378	-.032
Poverty	.055	.108	.604	.056	-.515	.223	.265	-.239	.089	.005
HS	.075	-.702	-.367	-.081	.171	.080	-.271	.188	.116	.048
KWUse	.096	.871	.080	.103	.114	-.090	.025	.123	.028	.044
Distance	.059	-.067	-.276	-.445	.326	.703	.117	.048	.039	.020
MfgConc	.072	.022	-.033	-.157	.128	-.597	.081	-.001	.054	-.039
OD:REV	.090	-.205	0.022	-.109	.080	-.021	.116	-.221	.768	.176
IncomeIndex	.092	-.078	-.308	-.148	.433	.083	-.506	.407	.178	-.001
BlackPop	.071	.127	.783	-.071	-.278	-.001	.055	.069	.126	.004
HospBeds	.024	.008	.224	-.012	-.628	-.037	-.080	-.135	.050	-.014
D/CAP	.062	.822	-.037	-.044	.012	-.021	.020	-.094	.407	.180
ServiceSect	.046	-.013	.009	-.156	.807	.014	-.037	-.123	.040	-.069
R/CAP	.020	.861	-.007	.117	-.090	-.046	.003	.067	.060	.186
St D/CAP	.166	.045	-.154	.924	-.092	.035	-.002	-.001	-.040	-.004
St D/CAP	.882	-.027	-.111	-.098	.130	.236	.082	.097	-.061	.053
St R/CAP	.462	.042	-.512	.319	-.125	.227	.031	-.110	.027	-.028

St D:REV	.050	.042	-.062	.928	-.076	-.026	-.048	.043	-.066	-.004
St OD:REV	.896	-.007	-.028	.301	-.045	-.007	.104	.037	-.021	.038
St IncomeIndex	.373	-.002	-.336	.079	.020	.046	.139	.670	-.090	.106
St PopGrowth	-.256	-.040	.175	-.335	.426	.611	.215	.182	.034	-.009
St BlackPop	.120	-.022	.839	-.058	.088	-.071	-.103	-.174	.020	.002
St Crime	.421	.003	-.001	.060	.238	.436	.110	.617	-.030	-.003
St Poverty	-.257	-.010	.448	.047	-.137	-.171	.582	-.073	.086	-.035
St HS	-.257	-.055	-.065	-.430	.108	-.088	.583	.240	-.028	.189
St HospBeds	.730	.042	.185	-.023	-.204	-.159	-.173	.174	-.012	-.112
St KWUse	.609	.064	.125	.446	.009	-.281	.103	.242	-.060	-.004
St Distance	.392	-.122	-.021	-.350	.269	.534	-.005	-.042	-.023	.156
St MfgCon	-.275	.025	.395	-.211	-.162	.601	-.110	-.121	-.099	.017
St Service	.101	.038	.077	.035	.058	.002	.697	.001	.169	-.203
FACTOR ABBRV.	SW	LW	ET	BF	SS	Mfg	IE	IC	Emp	Gov

Extraction Method: Principal Components Analysis
Rotation Method: Varimax with Kaiser Normalization
Rotation converged in 13 iterations.

Where: SW: Social Wealth
LW: Local Wealth
ET: Ethnicity
BF: Base Finances
SS: Social Services
Mfg: Manufacturing sector
IE: Income & Education Level
IC: State Income & Crime
Emp: Employment
Gov: Government

The factor names are based on the socio-economic characteristics of the urban system. Since these names are author assigned, and have embedded within them the natural biases of the author, the factors require some explanation.

Social Wealth consists of the State level variables debt to assessed property value, old debt to revenues, the number of hospital beds, and kilowatt usage. The debt load of the State indicates the State's spending on infrastructure (private and corporate, measured in the number of hospital beds provided and the degree of industry served with electrical power, respectively). This "wealth" of infrastructure provides jobs for the able and firm, and medical support for those in the State who are infirm. Local Wealth follows along the same lines as Social Wealth, but is focused at the community level. Containing variables such as high school completion ratios, debts and revenues per capita, their relative proportions, and kilowatt usage, indicates to the financial community the ability of the community to repay debts.

The Ethnicity factor crosses between State and local variables, linking the number of non-white residents to the extent of poverty in the area and the revenues those individuals generate in the State.

Base Finance is a grouping of State level variables indicating the ability of the State to load debt onto the population and compare that debt to the revenues available to repay those debts. From a financial perspective, debt is one of the most important issues in a bond rating. How the community shares the repayment of the debt load among the populace eases the individual debt burden. The lighter the debt burden, the greater the likelihood of repayment as all can afford their fair share.

Social Services is a factor identifying the links between income, poverty, population growth, the number of hospital beds, and service sector employment at the local level. The term "social services" has been applied to this factor recognizing the degree of State Aid that may have been used to cover the expenses of public housing, medicare, and welfare payments for the urban poor, in keeping with the studies of Michel (1977) and Aronson & Marsden (1980).

The remaining five factors are quite self-explanatory, identifying the dominant variables of each group and titling those factors accordingly. As is often the case in PCA, as one approaches the last few factors, fewer and fewer variables enter the group, since those variables are less interrelated than those variables that enter the analysis at earlier iterations.

The principal components analysis provides some interesting insights into the data. The most obvious fact is that the data may be grouped into 10 distinct categories (10 groups with Eigenvalues greater than 1). Among those groups, most have PCA scores above the 0.500 threshold, except for row 1, column 10, and row 6, column 9. These values are less than the 0.500 cut-off, but they are the only values for the variables of any consequence, and, therefore, have been highlighted.

The variable 'poverty' is shared between factors 3 and 5. In strict terms the variable should be assigned to a single factor. Given its inclusion in two factors, however, indicates its importance to variables such as debt, income, debt service, revenues, property values, and other like measures held in such high regard by the rating agencies in their determination of bond ratings (see Table 3.2).

Of particular importance from the PCA is the nature of how the factors align themselves along either State level, local level, or a combination of reflective State and local level variables. One may casually disregard this observation of the data as part of the inherent data structure, but from a geographic perspective it poses a problem for the assumptions of the bond rating process. The rating process assumes that all aspects of the community looking for a bond rating can be identified as atomistic, or self-contained to the community. Such an assumption does not take into consideration the role the State has in establishing some of those local conditions. The State provides guidelines for education standards, sets welfare policy, provides medical/social services dollars, and defines the rating ceiling for local debt (since no sub-unit of a State can have a rating higher than that of the State) - all of which have local repercussions.

The data suggest, therefore, that in the case of bond rating activity, one has data on three scales (State, local, and a combination of the two {hereafter called Dual level}). Rather than applying the traditional regression or linear probability models to multi-scalar or hierarchical data, it is appropriate to find a technique suited to handling such data.

The Hierarchical Linear Model (HLM)

Although there is a plethora of hierarchical structures in social research, past studies have not been able to address the richness of interpretation of results that is possible from multilevel data because of the limitations of conventional statistical techniques. Often criticized for aggregation bias or "unit of analysis" problems, traditional statistical techniques simply were not designed to model hierarchies. Recent developments in sociological and educational statistics have shown a technique that permits for the analysis of hierarchical data and allows for interpretation of results across levels to establish relationships between variables with nested characteristics. Hierarchical Linear Modelling is such a technique.

Hierarchical Linear Modelling, as mentioned, is a relatively recent development in statistical social research. While still in its infancy, the technique has found application not only in sociology and education, but in other fields under different banners. In sociology, HLM is sometimes referred to as multi-level linear models (Goldstein, 1987); in biometrics

as mixed-effects models (Laird & Ware, 1982); in statistics as covariance components models (Longford, 1987); and in econometrics as random-coefficient regression models (Rosenberg, 1973).

The tenets of Hierarchical Linear Modelling are described most eloquently in Bryk & Raudenbush (1992). For a complete description of the technique, and all of the nuances and rationales behind the technique's development, see the aforementioned text. For purposes of brevity and clarity, the following adequately summarizes the technique:

> "With hierarchical linear models, each of the levels in this structure is formally represented by its own sub-model. These sub-models express relationships among variables within a given level, and specify how variables at one level influence relations occurring at another" (Bryk & Raudenbush, 1992, p.4).

In other words, HLM uses a general regression equation and has as the parameters all of the first level variables. Those variables, however, are influenced by the nature of the next order of variables (the State influences the local variables), and are therefore regressed along with the first order variables, taking into account both error terms (first and second level errors).

The regression relationships take on the following form:

$$Y_i = \beta_0 + \beta_1 X_i + r_i \tag{5.1}$$

Where β_0 is the intercept, β_1 is the slope for variable X (a first level variable), and r_i is the error term unique to case i. The equation assumes that the error term is normally distributed with a mean of zero and a variance recorded as σ^2, such that $r_i \sim N(0, \sigma^2)$. The general form of the equation used to handle more than one variable is:

$$Y_{ij} = \beta_0 + \beta_{1j} X_{1ij} + \beta_{2j} X_{2ij} + \ldots . \beta_{qj} X_{qij} + r_{ij} \tag{5.2}$$

or

$$Y_{ij} = \beta_0 + {}_{q=1}\Sigma^{Q} \beta_{qj} X_{qij} + r_{ij} \quad \text{where } r_i \sim N(0, \sigma^2) \tag{5.3}$$

And

$$\beta_{qj} = \gamma_{q0} + \gamma_{q1} W_{1j} + \gamma_{q2} W_{2j} + \ldots . \gamma_{qSq} W_{Sqj} + \mu_{qj} \tag{5.4}$$

or

$$\beta_{qj} = \gamma_{q0} + {}_{q=1}\Sigma^{Q} \gamma_{qS} W_{Sj} + \mu_{qj} \quad \text{for each } q=0 \ldots Q \tag{5.5}$$

where i represents the local level, j the State level, X the local variables, W the State variables, q the number of cases, and μ the error term for each variable.

While the above equations denote the case for only two levels, it is theoretically possible to have an unlimited number of levels within the model. The challenge lies in the researcher's ability to define the linkages between the levels, and for current statistical software packages to handle the number of variables and levels (more on this later).

To relate the second level variables to the first level, equations 5.2 and 5.4 need to be combined. For purposes of clarity only a single variable will be used - the principles are the same for more variables:

$$Y_{ij} = \gamma_{00} + \gamma_{01}W_j + \gamma_{10}X_{ij} + \gamma_{11}W_jX_{ij} + \mu_{0j} + \mu_{1j}X_{ij} + r_{ij} \qquad (5.6)$$

Where γ now takes the place of the traditional β marker, γ_{00} is the intercept, $\gamma_{01}W_j$ is the State effect, $\gamma_{10}X_{ij}$ is the local effect, $\gamma_{11}W_jX_{ij}$ is the combined State and local effect, μ_{0j} is the State error term, $+\mu_{1j}X_{ij}$ is the combined State and local error term, and r_{ij} is the local error term. Note that higher level variables operate without the local constraint (the W's only have the j suffix, not the ij noted with the X variable). The local variables have the State level constraints since local conditions are governed by State level actions.

The above summarizes the tenets of the HLM technique. As with any statistical technique, there are limitations and laudables. Given the embedded use of regression within the technique, the typical regression rule applies, in that the data must be normally distributed, or at least transformed to normalcy, and all cases must be complete (no zero value entries). Unlike OLS regression, the dependent variable may take on discrete outcomes and need not be constrained to a continuum of possible values. The advantage of this characteristic of the technique is that within geographic research it permits analysis of discrete outcomes (places, points, areas, *etc.*) so often found within, especially, economic geography. As such, the technique opens avenues of empirical support and explanation not currently employed within the discipline to address our discrete units of study, that, given their very nature, are inherently hierarchical (cities are part of Counties, Counties part of States, States part of Countries, Countries part of the global economy). By accommodating the linkages within such hierarchies, the technique has the structure to show how variables at one level are influenced by the variables of the other levels. From a geographic perspective, the technique allows for generalization at larger spatial scales, with the

understanding of how small-scale and large-scale variables interact to create the broader spatial pattern(s).

The technique has been most often applied in education research, to establish the relationships between test scores in a given class, to the school's overall performance, to the school board's guidelines, across a number of different boards. Bryk and Raudenbush (1987, 1988, & 1992) and Raudenbush and Bryk (1985, 1986, 1987) have had the most prolific application of the technique, improving replication of outcomes over traditional statistical techniques by up to 28.6% (Bryk & Rauenbush, 1992). While others have employed the technique, and have met success in outcome prediction, the more hierarchically structured the data, the better the results (Bryk & Rauenbush, 1992). Thus, its application to inherently hierarchical geographic data is appropriate.

The disciplines that employ variations of the HLM technique have each developed a unique statistical software package to address the data peculiarities of their specific types of research. While numerous modelling packages exist, the major packages include GENMOD (Mason, Anderson & Hayat, 1988), HLM (Bryk, Raudenbush, Seltzer, & Congdon, 1988), ML2 (Rabash, Prosser & Goldstein, 1989), MLn (Rabash, Prosser & Goldstein, 1996), VARCAL (Longford, 1988) and PROC MIXED (SAS Institute, 1992, 1996), and most are critically reviewed in Kreft, de Leeuw and van der Leeden (1994). The packages typically allow analysis of up to 3 levels, with 15 variables. Some packages permit the researcher to write the analysis program using programming guidelines (SAS is one such package) whereby there is no limit on the number of levels one may analyze. Most of the commercial packages are quite expensive, and they are limited to 3 levels with a finite number of variables. Some packages such as MLn are available for downloading off the web, but as is typical with free packages, they are fraught with "bugs" and errors. For the purposes of this research, the SAS package will be used given its availability, and programming flexibility. SAS's PROC MIXED is constrained, however, to a maximum of 15 variables. Given that the PCA has identified 10 factors, the data fits within the parameters of the technique.

An important caveat must be noted at this point: the current statistical packages available for HLM analysis are limited by the number of variables that may be handled. The most appropriate level of data resolution for the HLM would be the original 34

variables entered into the PCA. Since no current package is available to handle such an array of variables, the factors must be used. The factor scores were applied to the original data to convert all cases to their respective scored values, and then the analysis was performed on the 10 composite variables defined from the factor analysis.

Naturally, this limitation of all the software packages creates data aggregation bias beyond the control of this study, and the results of the following chapter are to be considered with this in mind. As the HLM technique finds greater disciplinary application as it evolves out of its infancy, other statistical programmers may further develop software packages to handle a greater number of variables.

The initial model of Figure 4.3 is thus revised for Figure 5.4 to address the HLM technique. The model takes the following form, and is to be interpreted and understood in terms of the description of equation 5.6. It is to this model that the 3,648 rating cases are applied.

Figure 5.4: The Hierarchical Linear Model (HLM)

$$MBR = ([\gamma_{00} + \gamma_{01}(SW)_j + \gamma_{02}(BF)_j + \gamma_{03}(IC)_j + \gamma_{10}(LW)_{ij} + \gamma_{11}(SW)_j(LW)_{ij} + \gamma_{12}(BF)_j(LW)_{ij} + \gamma_{13}(IC)_j(LW)_{ij} + \gamma_{02}(ET)_{ij} + \gamma_{21}(SW)_j(ET)_{ij} + \gamma_{22}(BF)_j(ET)_{ij} + \gamma_{23}(IC)_j(ET)_{ij} + \gamma_{30}(SS)_{ij} + \gamma_{31}(SW)_j(SS)_{ij} + \gamma_{32}(BF)_j(SS)_{ij} + \gamma_{33}(IC)_j(SS)_{ij} + \gamma_{40}(Mfg)_{ij} + \gamma_{41}(SW)_j(Mfg)_{ij} + \gamma_{42}(BF)_j(Mfg)_{ij} + \gamma_{43}(IC)_j(Mfg)_{ij} + \gamma_{50}(IE)_{ij} + \gamma_{51}(SW)_j(IE)_{ij} + \gamma_{52}(BF)_j(IE)_{ij} + \gamma_{53}(IC)_j(IE)_{ij} + \gamma_{60}(Emp)_{ij} + \gamma_{61}(SW)_j(Emp)_{ij} + \gamma_{62}(BF)_j(Emp)_{ij} + \gamma_{63}(IC)_j(Emp)_{ij} + \gamma_{70}(Gov)_{ij} + \gamma_{71}(SW)_j(Gov)_{ij} + \gamma_{72}(BF)j(Gov)_{ij} + \gamma_{73}(IC)_j(Gov)_{ij}] + [\mu_{0j} + \mu_{1j}(LW)_{ij} + \mu_{2j}(ET)_{ij} + \mu_{3j}(SS)_{ij} + \mu_{4j}(Mfg)_{ij} + \mu_{5j}(IE)_{ij} + \mu_{6j}(Emp)_{ij} + \mu_{7j}(Gov)_{ij} + r_{ij}])$$

Where:
- SW: Social Wealth
- LW: Local Wealth
- ET: Ethnicity
- BF: Base Finances
- SS: Social Services
- Mfg: Manufacturing sector
- IE: Income & Education Level
- IC: State Income & Crime
- Emp: Employment
- Gov: Government

CHAPTER 6
ANALYSIS & DISCUSSION OF THE HLM RESULTS

Introduction

The previous chapter outlines the evolution of exploratory results that led to the identification and application of hierarchical linear modeling as an appropriate analytical tool in the study of bond ratings. This chapter details the findings of that analysis, presents the results in a comparative format against the other forms of analysis outlined in Chapters 4 and 5, and discusses some of the insights gained about the bond rating process from the analysis.

Options within the Analysis

Within the HLM technique, one may choose to center the data about the grand mean, or center the data for each variable around the mean for that variable. Uncentered data presents information in its natural metric and the means of each level reflect the data as originally intended, but has the potential to include data values of a theoretically obtuse nature (*e.g.*, negative income, or negative test scores). Grand mean centered data adjusts the β parameters of the first level to the error term of the first level less the level 2 means from the data points, reducing the system variance, and lowering error term values - or $\beta_{0j} = \mu_{ij} - \beta_{1j}(X_{ij} - X_{..})$. Variable mean centering (or group mean centering as it is typically known) makes the β parameters equal to the level 2 means (since the second level is the aggregate of all first level entries).

The analysis was attempted on the data, using all three forms of the data (natural metric, grand mean centered, and group mean centered) to determine the most parsimonious solution. The peculiarities of the original data, however, exposed numerous cases where the centered data contained cell values of 0, violating the general principles of regression. It just happened to be the instance of this data that there were numerous cases where data points were identical to either the grand mean or the group

means, forcing the use of the natural metric data. The following results are based on the analysis of the natural metric data, and are divided into two sections.

The Results of the HLM I: The "Bad" News First

The results of the hierarchical linear modeling analysis produce a number of results, not all of which are positive in their outcome. The HLM technique is designed for large data sets with thousands of cases. Within the data, the number of cases ranges anywhere from 3 to 364 cases per State. The HLM technique, because of its use of nested regression equations, relies on the tenets of regression analysis. With so few cases in a number of the States, the HLM analysis is unable to produce a viable solution that converges before the analysis terminates. The outcome is the exclusion of results for the 16 States of: Arkansas, Delaware, Idaho, Maine, Mississippi, Montana, Nebraska, New Hampshire, New Mexico, Nevada, South Carolina, South Dakota, Utah, Vermont, West Virginia, and Wyoming.

For the remaining 32 States, solutions are provided by the analysis and are presented in Appendix V.

A measure of the goodness of fit for hierarchical linear models is Akaike's Information Criterion (AIC) or Schwarz's Bayesian Criterion (SBC). Both perform the same function - to identify how well models fit the original data, but the SBC accommodates for the number of parameters estimated and may be considered more reflective of the model fit (Littell *et al.*, 1996). Ideally, the SBC should have values in the tens of thousands to indicate a good model fit. Since the SBC calculations produce negative numbers, the greater the absolute value of the SBC, the better the model fit. As one will note from the SBC values from the results of Appendix V, the models are a poor fit to the data. While the parameters have been estimated, the limited number of cases places the fit of particular models into doubt. In hindsight, it was acknowledged that the HLM technique does state that large data sets are typically required for analysis. Standard statistical techniques are designed to handle small sets of data - statistics are used to make generalizations about a larger population than that of the sample. The HLM technique, however, requires large data sets. The extant literature on hierarchical linear

modeling does not provide a minimum threshold for sample size required to perform the analysis. While most statistical techniques would perform well with sample sizes of 200-300 cases, it appears that such a number of cases does not meet the minimum threshold of the HLM technique, as noted in the SBC values.

The results of the HLM analysis for the 32 States presented in Appendix V require some explanation. The values presented in Appendix V for all of the γ's are well beyond the scope of the data. The SAS PROC MIXED package accepted the data and performed the requested analysis, but given the limited sample sizes, forced solutions upon the data that are nonsensical. In certain cases, such as Kentucky, Massachusetts, and Maryland, the procedure could not resolve the equation before reaching the maximum number of allowable iterations, and even created positive Schwarz Bayesian Criterion values - a theoretic impossibility.

Since the HLM technique relies upon the tenets of regression, the results of the analysis may best be interpreted within a regression framework. The spurious results shown here are akin to running a regression analysis on a matrix that has 21% of the cells with a value of zero. Any statistical software package will permit the user to run the analysis, but the results violate the principles of regression analysis (no analysis should be performed on a matrix with 20% or greater null values), and cast the results into doubt.

The Results of the HLM II: Now for the "Good" News

While the State-level results were not as supportive of original expectations as intended in their outcome, it is recognized that the problem stems from the small sample sizes of individual data runs. Given the consideration for the need for large data sets, the analysis was re-run not at the State level, but on the entire data set of 3,648 cases. The formerly excluded cases could now be re-introduced to the analysis since the case-number-constraint by State no longer applies (the number of cases exceeds the number of variables). The result is a national scale model with some interesting observations. The data were first applied to an unconditional means model, allowing the model to run with just an intercept and an error term as outcome parameters. The result is a poorly fitting

model with parameters of the intercept at 0.002, the error term at 28784.145, an SBC value of only -42.7 for an overall model fit of only 5.2 E-08.

The data was next re-run in the SAS PROC MIXED package using progressively finer resolutions of data. The State level variables were applied to the technique to improve on the model fit. The result:

$$MBR = 4.93 + 4.93(SW)_j + 7.68(BF)_j + 1.04(IC)_j + 21495.95\mu_j$$

$$\alpha=0.05, \text{ and } SBC=-505.54,$$

indicates an improvement over the original model, but that improvement is only to 1.97% probability in data replication. The State level information provides more insight into the bond rating process, indicating that more weight is placed on the State's base finances, (debt per capita and debt to revenues) than the other variables of Social Wealth or Crime. The model still has a poor fit to the original data, but it is an improvement over the unconditional means model. The γ values for the State level HLM produces results that are more in keeping with the structure of the data, except for the intercept value. The low intercept value indicates questionable results, reinforced by the error term, indicating most of the State level information about the bond rating process needs augmentation by some very large modifier. Applying the local variables to the technique in a further run of analysis indicates that the modifier to the State level information is the local variables and their interactions with the State level variables. The final HLM run with all variables included in the analysis indicates the model for municipal bond ratings is:

The HLM Bond Rating Model

$$MBR = 814.09 - 41.81(SW)_j - 46.00(BF)_j + 29.28(IC)_j - 8.51(LW)_i + 4.64(BF)_j(LW)_{ij} + 10.54(IC)_j(LW)_{ij} - 43.97(ET)_{ij} + 17.61(SW)_j(ET)_{ij} - 26.40(BF)_j(ET)_{ij} - 11.46(IC)_j(ET)_{ij} + 17.04(SS)_i + 13.23(SW)_j(SS)_{ij} - 8.42(IC)_j(SS)_{ij} + 30.88(SW)_j(Mfg)_{ij} - 9.54(IC)_j(Mfg)_{ij} - 14.73(IE)_{ij} + 23.27(SW)_j(IE)_{ij} + 26.26(BF)_j(IE)_{ij} + 31.44(Emp)_i + 11.93(SW)_j(Emp)_{ij} + 13.51(BF)_j(Emp)_{ij} + 8.69(Gov)_i + 6.93(SW)_j(Gov)_{ij} + 5.70(IC)_j(Gov)_{ij} + 2.81\mu_{ij}$$

$$\alpha= 0.05, \text{ and } SBC= -23910.1.$$

Where:
- SW: Social Wealth
- LW: Local Wealth
- ET: Ethnicity
- BF: Base Finances
- SS: Social Services
- Mfg: Manufacturing sector
- IE: Income & Education Level
- IC: State Income & Crime
- Emp: Employment
- Gov: Government

The dramatic improvement in the SBC value indicates a model with a good fit to the data. The parameter values are also more reflective of the original data than were the previous two HLM models that did not account for local, State, and dual effects combined. The model does not include 7 of the potential parameters, as they did not make the cut when alpha was set to 5%.

Of particular note in the above model are some of the weights of the parameters. The three most heavily weighted variables (those with γ values over 40) are Base Finance, Ethnicity, and Social Wealth. From the existing literature on bond ratings, one would expect to see finance and wealth as major players in the ratings process, since so much of the rating is based on the ability of the debtor to repay the loan in a timely manner. The Ethnicity factor's γ value is particularly noteworthy. Only Aronson and Marsden (1980) noted ethnicity ("race", in their study) as an issue in the rating process, and actually stated that 95% of all ratings could be attributed to this one variable (Loviscek and Crowley, 1988). While they presented no rationale for the inclusion of this variable, they simply stated that the ethnicity variable must be a surrogate for a number of other social variables. Ethnicity, in the case of this work, is a factor composed of the ethnic background (black population), revenues per capita, and poverty. The documentation on black poverty in urban settings is lengthy and need not be repeated here. Suffice it to note that the long-standing tradition of a poor urban black population impacts the State wide revenue level per capita - the more poor, the lower the personal revenues. While Aronson and Marsden claim a 95% replication rate based on the ethnicity of the community, no such claim is made here. Within the data, however, there were cases where the ethnic issue appeared to have an impact. For example, Memphis, Tennessee has a large black population, and a bond rating of A. A suburb of Memphis, Germantown, TN., is dominated by anglo-Americans and has a rating of Aaa. Germantown has no industry, virtually no tax base other than residential taxes, has only one shopping mall and a few small shops, and is essentially a dormitory community for Memphis commuters. The original data illustrate the point quite clearly:

Table 6.7: Ethnicity and Bond Ratings

Memphis, TN.		Germantown, TN.	
D:APV	183.81	D:APV	162.48
D/CAP	1.016	D/CAP	1.103
D:REV	0.000689	D:REV	0.000717
Crime	59965	Crime	6481
MfgConc	55.81	MfgConc	2.47
IncomeIndex	0.9546	IncomeIndex	1.3013
Poverty	0.211	Poverty	0.012
BlackPop	0.0356	BlackPop	0.0014
RATING	A	RATING	Aaa

Given that the data are the essentially the same until one addresses the last four rows of the table, those socio-economic variables correlated to the ethnic population appear to affect the bond rating. Whether the black population of a community is the sole affective variable, or it is as Aronson and Marsden believe - a factor that captures a greater underlying social condition considered by the rating agencies, will continue to be held in proprietary confidence by the agencies. The evidence of this work, however, lends support to the claims of Aronson and Marsden (1980).

Continuing the discussion of the most heavily weighted variables, local employment comes to the fore in the model. The local employment picture is important to the rating agencies for one simple reason - employed people contribute to the tax base rather than drawing welfare dollars from it. As long as the populace is employed across a diversified employment base, they have the means to repay debts. Note the discussion relates to a diversified employment base. Those communities that have concentrated employment pictures - single industry towns - have a more volatile repayment picture. In the event of industry downturn, the community with the majority of the employed involved in that one industry, means that community will not be generating tax revenues to repay its debts.

The Social Wealth/Manufacturing dual effect follows in importance. The State-level social wealth factor has embedded within the factor variables that relate to the infrastructure of the State. The manufacturing base is a major beneficiary of that infrastructure, and from a tax dollar perspective, is also a major contributor.

The State-level Income & Crime effect influences the ratings model most effectively as a single variable, although it does have minor combined effects with local variables such as ethnicity, social services, local wealth, and manufacturing concentration in the community. While the single term effect has more effect on the ratings model, the combined effects provide insights into the social characteristics that influence crime (such as wealth/poverty, ethnicity, and employment prospects) that are of interest to municipal administrators looking to improve their ratings through better managed socio-economic programs and their related variables.

The Base Finance dual effects are next in importance to the model. Base finance ties directly to local factors such as local wealth, ethnicity, income, and education. The linkages are rather intuitive given that the State-wide financial outlook is based on the amalgamated local conditions. The local conditions are highly correlated in the following manner: higher levels of education typically provide better paying and more diversified jobs (income), higher income communities have the capacity to handle more debt because they can generate more revenues per capita (tax base), and the ethnic mix of the community seems to reflect the broader socio-economic conditions of the community.

The remainder of the parameters of the ratings model have import into the rating, but their influences steadily diminish. The Government factor, as a whole, has the least impact on the ratings. Local governments and their structure are important to the rating process (Smith, 1974; Hausker, 1991) because it is the local administration's management of the socio-economic variables and their concomitant financial reflections that are paramount to the rating. While their influence is important, it is minor because the administration is a short-term personification of the long-standing local bylaws and constitutions that govern debt accumulation and debt servicing.

The Model's Performance: Some More "Good" News

A discussion of the variables that influence the rating and the interactions between those variables is important, but the performance of the model in application is of far greater value to the local administrators looking to improve their rating position. To that end, the model was applied to a separate data set - a holdout data set. The holdout data set

consisted of 200 ratings cases randomly drawn from the data before the initial data analyses were performed (in other words, the original data set consisted of 3,848 ratings cases, 200 of which were removed from analysis to create the holdout set, leaving 3,648 cases for analysis). The holdout data set met all of the criteria of the other cases so that sample size was the only difference. The data were entered into a spreadsheet and the equation written to solve for the bond rating.

The outcome of the HLM ratings model with the holdout data set produced from 200 cases, 158 successful solutions - solutions that matched the ratings received by the municipality -, 41 solutions within one rating grade, and one solution with a difference of two grades. The results are presented in Appendix VI, detailing the variations between the model's performance and actual data, and Figure 6.5 below presents a visualization of the models' performance. The 79% success rate of the rating model is in keeping with the performance of some of the more successful past models defined in Chapter 3 and summarized in Table 3.2. More importantly, the HLM technique provides a marked improvement in ratings replication over the techniques first employed in the methodology. The summary of the regression results is presented in Table 6.8.

Figure 6.5: The Model Rating-Replication Success

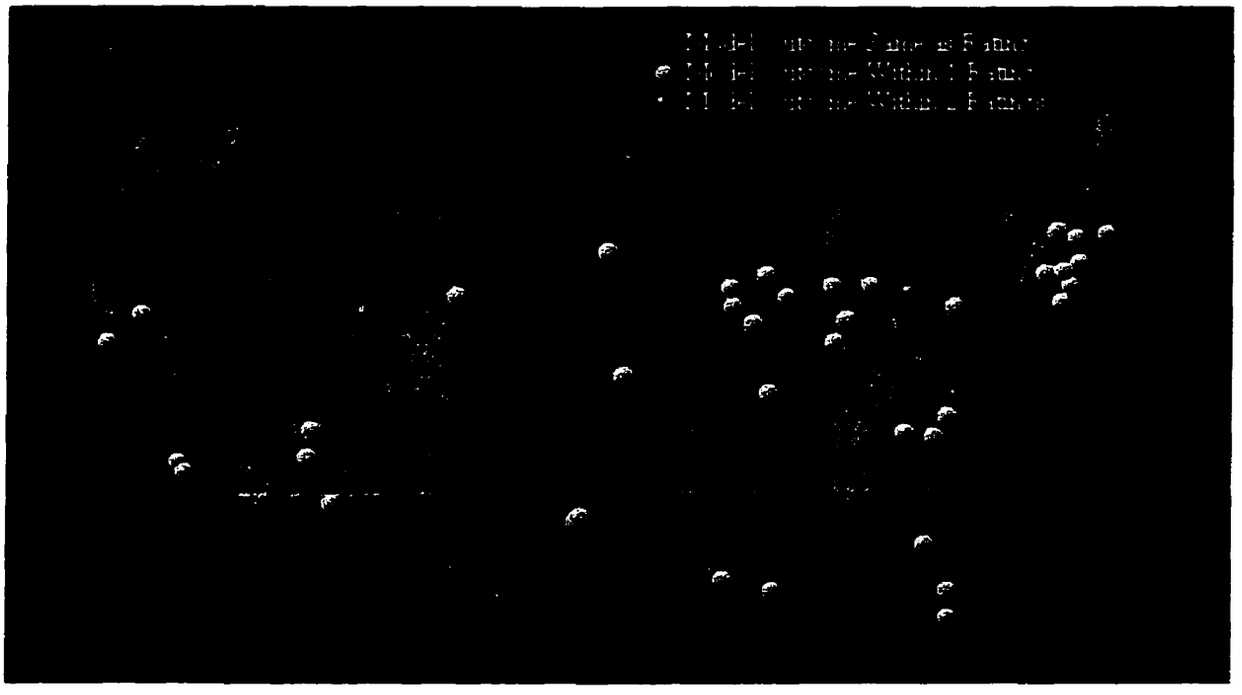


Table 6.8: Summary of Model Improvements

Model Technique & Data	Outcome Success Rate
OLS Regression with local variables only.	45.4%
OLS Regression with State and local variables.	59.0%
HLM with factored variables.	79.0%

Of note in Figure 6.5 is the pattern of the model's performance. The model replicates well the ratings from across the country, with most of the model errors occurring in the larger metropolitan clusters. Centers such as Los Angeles, San Francisco, New York, Boston, Detroit, Dallas, and Chicago were rated within one rating of the actual rating. Their suburban communities performed better with the model, reproducing the bond rating in virtually every case (see Appendix VI). Part of the explanation for this occurrence may be the variables of the model. With the model's focus on base finance and social wealth, areas with high education levels, income, revenue to debt ratios, residential energy usage, and low per capita debt - such as the dormitory communities surrounding the urban cores rather than the cores themselves - tended to perform better.

The ratings of the communities within one State were poorly predicted by the model. The cities in Arizona that were not accurately modeled, were under-predicted in every case. The rating agency may have placed more emphasis on the growth rates experienced in these communities over the time period of study than just the quantifiable urban metrics. The long-term sustained growth of these places between the period of 1977 and 1991 may have biased the ratings in favour of growth (and therefore a higher bond rating in support of that growth).

Finally, the one community for which the model was most errant was Cleveland, Ohio. Cleveland, as described elsewhere in this work, is a unique case in the sample. Cleveland has the lowest ratings among the major metropolitan centers, and it also has a wide range of ratings between Ba and Caa1, depending on the year. In the holdout sample, the random selection of Cleveland happened to be a year with a Caa1 rating. The model predicted a B1 rating, which, had another year been randomly selected, may have been a match between the predicted and actual values. The widely fluctuating ratings for Cleveland cannot be explained within the context of this study, but their variability from

year to year would be an interesting exploration into the ratings rationale - an area for future research.

The technique has presented a model with a range of variables that can now replicate 99.5% of the Moody's ratings within one ratings grade. Even with the limitations of the data, the theory behind the technique, and the software in support of the technique, such a replication rate is astounding.

With the limited number of cases used to produce the successes of the Aronson and Marsden, and Raman studies, the ability of the model to generate similarly positive results on a much larger sample, is encouraging for the technique, and lends support for its continued use along such applied lines.

The model permits the linkage of different layers of data that reflects the bond rating of the community. An amalgam of past variables, it was postulated that the current model may be able to achieve a similar ratings replication success rate; but never before have models been able to incorporate variables from different levels of data resolution, either due to statistical or computational limitations. The HLM technique permits for this barrier to be broken, and has produced exceptional results compared to past studies.

The Methodological-Theoretical Linkage

The hierarchical linear modeling technique has shown an improvement in ratings replication over other regression techniques, and the model addresses a number of linkages between variables at different scales creating the replication improvement. Those linkages can be established from the model, but the management of the component issues that are contained within each relationship and within each factor requires further grounding than what is available from inspection of the model.

The HLM technique embraces the nature of nested information - variables at one level impact on variables at another level. Theoretically, however, unless one fully understands the nature of the relationships between the variables, their management is futile. The Disequilibrium Dynamic Adjustment Theory (DDAT) postulated by Clark, Gertler and Whiteman (1986) permits for the better understanding of the relationships among the variables of the model. The DDAT recognizes the limitations of traditional

economic theories in that they assume a state of equilibrium- a state of stability that is fleeting if existent at all. Clark *et al.* state that the economy is in a constant state of flux, whereby one economic variable has an impact on other variables. And those variables may impact the system differently in different locations making the entire system prone to constant adjustments.

The DDAT was espoused by Clark *et al.* to address the nature of high technology foot-loose firms and their communities. The theory is only marginally successful in addressing the growth issues for such communities, and relies quite heavily on the traditional socio-economic variables commonly addressed in the growth literature identified in Chapter 3. While the limited application of the theory to higher technology locations, and its reliance on traditional variables for all other places was received as a weakness of the theory, it is, indeed, a strength when applied to bond rating management. The model employed in the HLM technique is composed of variables that are traditional measurements of urban growth - population growth, income indices, employment diversification, taxes, education, crime, and debt loads - all factors addressed in the DDAT. Given that most of the American urban landscape is not yet running on the technological horizon, and relies to a great extent on established industries, the DDAT provides a greater understanding of the linkages between the traditional growth variables.

For example, taking income as one variable, the DDAT recognizes that local incomes are but a reflection of a larger economic activity related to the patterns of migration, industrial location, education, intervening opportunities in other forms of employment, and how those reflections are developed at not only the local scale, but also at the regional (or State) scale through policies affecting these variables. For local administrators, the patterns become quite clear. As policies are created at the State level, the local level will be able to establish how the State level policy change(s) will create adjustments to the local economic picture. From the DDAT, related variables may be noted and then referenced back to the ratings model to determine the future impact on municipal bond ratings. By treating the urban system as one that is constantly in flux, the linkages established in the DDAT may be related to the linkages within the ratings model, and management of those linkages for positive outcomes may be applied to the municipality. If, for example, the local administration identifies within the community a

low income level relative to other like communities, the administration may opt to improve education, attempt to attract higher paying industries to the area, or modify the manufacturing/service sector ratio. Improvements in one area, according to the DDAT (and the rating model) have impacts felt beyond the immediate application in a cumulative and circular nature.

The linkage between theory and methodology may be addressed in summary as follows: the model employs socio-economic variables that have amongst them correlations and colinearities identified by the PCA. These variables have both local and State-level expressions that interact and intersect at points in the local community. Such variables are dynamic in that a change to one creates changes in many other variables, and those changes are constantly occurring in the urban system. These variables, traditional in their application to growth theories, are employed by rating agencies to justify the funds for future growth projects. The underlying fact that growth is sought demonstrates the system under consideration is in economic flux - a condition only addressed by the Disequilibrium Dynamic Adjustment Theory. While the model presents the impacts changes in the economic system will have on a municipal bond rating, the management of the underlying conditions in support of positive changes to the bond rating is best addressed by the interrelationships between the socio-economic variables identified in the DDAT.

Observations about the HLM Technique

The hierarchical linear modeling technique has some interesting characteristics that affect its effectiveness in application. One of the issues of the technique raised by Bryk and Raudenbush (1992) and reiterated by Singer (1999), is that the technique is designed for large data sets. For most statistical techniques, a large data set would have a few hundred cases. Given that statistical techniques are designed for the study of samples, not populations, the 3,648 cases in this study seemed at first consideration to be more than adequate. In the case of the Singer study where a "small" data set of N=7,185 cases was employed, the author cautions against using such small data sets, unless there is a clear hierarchy within the data. From a geographic standpoint, the technique is suited to

handling the discipline's naturally hierarchical data where, with the use of geo-coding and ever increasing amounts of data, the technique may find greater application.

The requirement that the data have some inherently hierarchical structure may be limiting for some disciplines, but the technique is ideally suited to geography and its hierarchically ordered (spatially scaled) data. The technique also permits for the nesting of an unlimited number of levels so one may address issues from local to global scales, all within one model. For some areas of the discipline, such scalar resolutions may not have import, but for economic, environmental, resources, or bio-geographies, the application of the technique is appropriate.

The theories supporting the HLM technique are still in their infancy. The technique is still rather new, and as such, has not been fully developed to express all of the subtleties of higher forms of HLM analyses (Bryk and Rauenbush, 1992), yet it has proven to be highly effective with the data of this study. The theory relies heavily on the tenets of Anova and regression analyses, which are, however, well understood. As the technique finds wider acceptance and application into the broader academic community, the theory that supports the technique will develop. In this first geographic application of the technique, it has shown success in dealing with hierarchical geographic data.

The technique is sound, the theory is in continuous development and re-expression, but the software that allows one to perform the analysis is wanting in almost all regards. There are a number of software packages available to conduct HLM analysis, most of which are commercial packages. These packages come in two forms: purchased or free. The purchased packages are costly, but provide a number of interesting options such as multiple levels, and a large number of variables. Free packages are available over the web and are fraught with errors, user unfriendliness, and limited depth of analysis (fewer levels and variables). It is for these reasons the SAS package was selected - cost, flexibility, and depth of analysis. The depth of the SAS package, however, is a restriction. There is no limit to the number of levels one may address, but one may only consider 15 variables. In the case of this research, the software presented one of the limitations to the study. Had the analysis been able to handle the 34 original variables rather than the 10 factors from the PCA, there would be even further data resolution for more detailed socio-economic linkages between the variables, possibly

leading to an even higher level of ratings replication. Until the software develops to a point where it can handle more parameters, improved ratings replication must remain speculative.

Even with the limitations of the software, the data, and the theory, the HLM technique managed a 79% replication rate, and 99.5% replication within one rating grade. Such results should be prominently featured, and the technique's potential application to other areas within geography underscored.

CHAPTER 7
CONCLUSIONS

Introduction

The preceding chapters have outlined the theories behind metropolitan growth, the methodologies developed and employed herein, and the results and observation that have been revealed from the application of those methodological techniques. This chapter covers four concluding topics: it summarizes the amalgam of findings by answering the questions posed throughout the dissertation, presents observations about the study and the potential for further application of the HLM technique within geography, discusses the issue of municipal bonds in the Canadian context, and introduces areas of future research within the study of municipal bonds and the geography of finance.
Note: The use of italics in this chapter implies emphasis and expression of past questions, not inclusion in the Glossary.

Answering the Questions

The third chapter on the extant literature on municipal bonds and growth theories raised a number of questions that became the rationale for the research conducted herein. While many of the questions were answered directly to develop the arguments of Chapter 3, some were left unanswered until the analysis could be completed. The following attempts to answer the research questions in turn.

The first question: "*do certain places have a greater ability to pay for infrastructure development giving such places a competitive advantage in attracting future growth*?" may now be answered. The ratings model has shown that among the variables there exist a number of socio-economic considerations that may be managed by the municipal administration to improve their ratings position relative to other communities. If a community is to attract future growth, capitalizing on aspects the community can manage, and manage well, will, over time, improve the ratings position of the community. For example, the model clearly identifies the Base Finances and socio-economic mix as

important to bond ratings. Controlling debt loads per capita and improving the overall revenue position for all members of the community, provides greater tax revenues and lower debt service costs, thus developing increased capacity for debt servicing when development dollars are requested. One may argue that the Base Finance factor is State-level, so local management of such variables is not warranted. The State-level variables have local reflections that can be managed by the communities. While they may not have the same impact on the model as the State Base Finance, they have the same effect on the development of localized wealth and debt servicing capacity as the State-level variable. Also, given that the Base Finance factor links to local employment, education, income, and local debt loading, as identified in the model, these local, community based variables, provide the municipal administration with areas for ratings improvement.

The socio-economic mix is far harder to manage than the base finances. Ethnicity, and the related variables from the PCA of Chapter 4 such as poverty, income, education, and service sector employment, can be a politically charged issue. But, just as in the argument about the financial picture of a community being a reflection of deeper social and economic forces, so too may an argument be made for the ethnic factor. Similar to the Aronson and Marsden study, ethnicity came to the fore. That is not to say that this factor is solely responsible for the bond rating, but rather this factor is a reflection of deeper social and economic characteristics in the community. The long recorded history of lower incomes, because of lower education levels, among the urban black population is well established (USBC, 1990). Tie to those income and education variables the financial considerations of the ratings community - higher per capita debt loads, lower revenue capacity, and/or unstable tax dollar streams - and the municipality may be perceived as a ratings risk. Therefore, from the perspective of the ratings agencies, and the communities that receive the agency's ratings, certain places *do* have a greater *ability* to pay for infrastructure development giving such places a competitive advantage in attracting future growth. That competitive advantage is based on the community's ability to *affordably* fund development through the local long-term management of variables considered by the rating agencies, and identified in the ratings model.

The next question to be answered comes from a volley of questions posed about the ratings process: "*What attracts investors to a given regional development project?*

with the number of potential investment opportunities, do investors have some form of short hand method for investment decisions? and if so, does this pre-investment information exhibit any spatial patterns?" To the first question in the series, the attraction of any given project is based on the individual investor's investment preferences, and is not part of the scope of this study. The second component (the shorthand notation) is the ratings themselves. The display of spatial patterns in the pre-investment information (the ratings) is of more interest. Figure 5, showing the success of the ratings model, serves as a graphic illustration of the success of the model developed herein. The explanation of the spatial patterns, however, is of far greater value to the local administrators who will attempt to manage their ratings through some of the patterns described within. The ratings vary widely from community to community based on the successful application of sound fiscal and social management/development practices. To those communities that strive to improve their employment base, enhance the per capita revenues and incomes of their constituents, minimize debt loads and crime rates, and develop programs to ensure high school completion and the provision of social services, go higher ratings. Therefore, mapping the ratings themselves (at this point in time) has little application for local administrators. However, displaying the component variables of the ratings model at the community level (and at finer resolutions within communities such as the census division or city block) will allow local administrators to identify specific areas within the municipality for targeted improvements. Such an exercise is best performed using detailed census data and geo-coded entries for display in a GIS - an avenue for future research.

The third question arising from the literature is: *"As a reflection of financial market behaviour, are the ratings based on measurable, quantifiable, variables which can be modelled, and managed, for the benefit of locations seeking development?"* While it would have been ideal to unequivocally state that the model derived from the methodology is the very model used by the rating agencies, the actual model is proprietary and will continue to remain a guarded secret. The model presented here, however, is a model of surrogate variables, that when applied to individual communities, has a 79% ratings replication success rate, and a 99.5% success rate within one rating grade. Given the replication success, the variables of the model may be used as good

estimators of a community bond rating. The variables, while readily modelled, may be more difficult to manage. Some variables such as the financial variables, can readily be managed through sound fiscal management; others that are more reflective of the social and demographic mix of the community require more tactful and longer-term management. With such variables, it is noted within the model that they interact with State-level variables. While local management of the variables is important, those municipal administrations working in close consultation with State-level policy developers and implementers will likely see greater development opportunities due to effective community improvements, and, therefore, capacity for development debt-load.

The last four questions are highly related, and deal with the suburbanization of America, whereby the population in urban areas has expanded outward from the traditional city core in favour of the suburban fringe. The four questions may be summarized as follows: "*Do the suburban communities that are experiencing the greatest growth have disproportionately higher (or lower) ratings than the urban centres which they surround?"; has the phenomenon of the suburbanization of America not only changed the relationship of urban areas with rural areas, but also of the city's core with its suburban communities?; has the suburbanization wave also brought with it the bond ratings that finance such growth?; and has this wave left in its wake an urban core unable to financially support the existing infrastructure?*" The urban-suburban relationships are best addressed on a case specific basis. Generally, however, the trend has been for downtown areas to suffer economic and population loss as the suburban fringe has become the recipient of the urban exodus. Urban cores have lost the means of economic production as firms have moved to the suburban fringe, those people employed by those firms lead the exodus by moving to suburbia, and the urban core has become the domain of the urban poor. The suburban fringe acts as a barrier to the core, preventing it from expanding outward in an attempt to retain its economic viability. The suburban ring becomes endowed with those attributes characteristic of favourable ratings - employment diversification, high incomes, educated workforce, and large debt capacity. Those attributes support the suburban need for continued outward expansion as more people are attracted to communities that have much to offer in the form of infrastructure - parks, services, schools, new roads, and the like. Thus, the wave of suburbanization has brought with it the conditions favourable to support

continued economic growth, while the core has lost its capacity to attract/retain economic dominance over its suburban periphery. The long term implications for urban cores suffering economic out-flow is a severely diminished capacity to support even their existing infrastructure, let alone attract new ventures to reverse the downward economic slide.

Observations about the Study

The goal of this research was to contribute to the study of the geography of finance, by presenting empirical research expressing the patterns of municipal bond ratings. The research focused on addressing the manifestations of financial market behaviour in what is perceived to be an aspatial financial market reflection according to neo-classical economic theory and the rating agencies themselves (Lamb *et al.*, 1993; Lamb and Rappaport, 1987). The findings of this study have shown that the variables presented in the ratings model developed herein are quantifiable, manageable socio-economic variables under the purview of local and State administrators. The variables of the model have been the subject of urban-economic geography for the last few decades. As such, this work continues to further develop our understanding of the urban environment, and specifically of the geography of finance.

The spatial variable of "distance" played only a minor role in the ratings model, but it did remain statistically significant. The inclusion of this variable adds a wrinkle to the financial/neo-classical economic perspective on ratings that believes the ratings process to be spatially unbiased. All of the urban-economic geography literature for the last few decades dealing with urban space and the variables one may consider in defining urban spaces or distances (race, gender, income, education, crime, growth rates, and now the ratings model) is in contradiction to the financial/neo-classical economic perspective, lending support to the importance location still plays in a capitalist economy's penultimate expression - the bond market.

The ratings model shows that there is a spatial component to municipal bond ratings. The model advances our understanding of the geography of finance and is of value to those practitioners who employ such ratings. And for geography, specifically

the study of municipal bond ratings, it lays the foundations for developing further the spatial characteristics (and their display) of a process that was touted as aspatial in theory.

While no other research explicitly refers to ethnicity as a variable in the rating process, it has been argued that ethnic mix represents a good surrogate measure for the socio-economic factors in the urban landscape considered by the rating agencies. Whether the black population of a community is the sole affective variable, or is a factor that captures a greater underlying social condition considered by the rating agencies, will continue to be held in proprietary confidence by the agencies. The evidence of this work, however, lends support to the claims of Aronson and Marsden (1980).

The model presented within this thesis has identified more than just financial variables as important to the bond rating of a municipality. The array of social and economic variables lend added depth to the rating's discussion, yet placing those variables into the specific context of the community under consideration raises a question. At the end of Chapter 3 it was noted that if no information asymmetries existed between the rating's core (New York) and the periphery (the rated locations), how does the industry manage to eliminate the friction of distance between peripheries and cores, for unstandardized contextual information, which has been shown (Hepworth, 1990) to exhibit extreme distance decay effects? The model developed herein cannot resolve that question, and must become the purview of future research.

The hierarchical linear modelling technique aided in the development of the ratings model. The technique is designed to handle nested information, or information that has a hierarchical structure. The more natural or explicit that hierarchy, the more effective the technique in identifying the relationships between variables of different levels in the hierarchy. While ideally suited to this study, and geography in general because of our study of discrete points and their relationships with other points, areas, or regions, the technique has its limitations. The single most limiting factor is the need for large data sets. Given that this study contained naturally hierarchical data, the analysis performed quite well on the limited 3,648 cases. With less hierarchical structure to the data, more cases are required.

The technique also suffers from what may be called the Lucas Syndrome. The technique is still in its infancy, and as such is not fully developed theoretically or

technically. The technical limitations of the software have forced the analysis to consider a restricted number of factors as opposed to the original variable data. These software constraints have undoubtedly cost this study some points in ratings replication and resolution of variable relationships. Similar to the constraints George Lucas had in developing his Star Wars movies, he was forced to produce the middle three movies first because "they were the easiest to do" (Time, 04/26/1999). Not until the computer and software technology existed could the technical limitations be overcome to produce what Lucas envisioned when the first three movies were conceptualized. When the HLM software is more fully developed to handle more variables, better ratings replication may follow.

Application to Canada and specifically Ontario

The Canadian bond market is rather limited. With the tradition of Federal and Provincial transfer payments, municipal governments have had the higher levels of government to support the growth efforts of the local community. The Provinces maintained the road transportation system, the education system, and greatly regulated companies providing provincial infrastructure, such as Ontario Hydro. Federally, the picture is quite similar. Because of such support, communities needed only to tend to local concerns. As of late, however, the Ontario government has cut-back on transfer payments to communities, and stated that the communities are now responsible for aspects of services provision formerly handled by the Province. This has meant that communities have for the first time a major revenue short-fall to cover the cost of local services. Not in a political position to simply raise taxes, local governments have had to reduce services, cut-back programs, and reduce overhead. Such cost cutting measures only last to a point until the fiscal shortfall is greater than the annual savings, and the community goes into debt.

With no support from government, and no support by the populace for higher taxes, the only alternative to raising the funds to support the community is the bond market. Canadian communities have not had to rely on the bond market for funds, and may not be fully prepared for the ratings process and to support the bond market. The case of Elgin County serves as an exemplar. After the Provincial government reduced

the transfer payments to the area, the county projected a shortfall in funds within a few years. The county entertained the idea of floating a municipal bond to cover the costs associated with running the county, relying on taxes to cover the costs of repayment of the debt incurred. Looking first to the Canadian rating agency, Dominion Bond Rating Service, the county was faced with providing the details of the county - the details similar to the variables of the ratings model. The agency provided a preliminary rating unsatisfactory to the county, so it approached Moody's. Moody's countered with some simple statements rather than a rating. The comments followed the following logic: for a newly rated entity, the documentation must fully support the request for funds. Not only must there be documentation to support the request, the entity must also have a track record of supporting a debt load of the magnitude requested. In the event that there is no rating history, the entity will be given a more speculative rating grade than what the entity may be capable of attaining. While the rating would be provided, the marketing of such an investment would be challenging. Within Canada, there is no substantial market for bonds, and therefore the issue would be sold primarily in the US. Without the local tax breaks for regional investment, the bonds would not be well received. Given these challenges, the Canadian entity requesting a rating to support debt will be faced with a poor rating, higher interest rates to support the speculative coupon rate, and therefore a costly debt to service (Innes,1998).

The Canadian market for bonds, however, is increasing. As more investors see the benefits of bonds within their portfolios, more communities are seeking to float municipal bonds. All of the major Canadian cities now have bonds, and given the fiscal conservatism of the provincial governments, it is likely that more communities will approach the bond market to support their growth efforts. For those smaller communities with bond needs, but without international recognition, applying the ratings model developed herein, and managing the socio-economic variables of the model with the linkages of the DDAT in mind, *may* provide those communities with the tools to approach the investment community and support their request not only for development funds, but for positive ratings in support of that development. A caveat must be made at this point: the model has been developed specifically from the American example between 1977 and 1991. To state that the model is universally applicable to Canada

would be grossly presumptuous. The model does reflect Moody's rating actions quite closely, and if Moody's is the rating agency selected by Canadian communities to rate their municipal bonds, then the model may prove to be a useful benchmark - but only a benchmark. While there may be some element of cross border applicability, a thorough Canadian case study would be most appropriate to develop a Canadian model.

Future Research

A number of possibilities exist for future research in the geography of finance. This study has noted within the limited literature a focus on banking and credit availability that is overly narrow. With the increasing importance of municipal bonds not only within Canada, but in the US as well, there needs to be further understanding of not only the post-investment side of finance, but the pre-investment side as well. A better understanding of the pre-investment landscape will provide to those places active in financial markets with a better post-investment position. Leyshon (1995) and Porteous (1995) have done well to develop our post-investment understanding of the geography of finance. Developing the literature and theoretical foundations of the pre-investment side of this sub-field within geography, in conjunction with their works, will advance our knowledge of the urban system and the role finance plays within it.

Moving from the theoretic to more methodological considerations, the hierarchical linear modeling technique holds great potential for application within geography. The naturally nested nature of our data, and the laurels of the technique in its ability to handle discrete outcomes, seems to be a sound match for geography. As the technique finds further practice in the discipline, it is hoped that those researchers gifted in statistical development and program creation employ their skills to counter the limitations of the HLM technique as they currently exist today. With greater depth of analytical capacity, the model may help urban-economic (and other geographers) better understand the system, and its concomitant linkages, under consideration.

Finally, from the applied perspective, those individuals who are the practitioners of urban/municipal development may benefit greatly from the information outlined here. The creation of like models for countries employing municipal bonds to finance

development is a natural extension from this work. Such national models, with policies directed through the linkages of the DDAT, linked down through the hierarchy of the political system (from national to State to local), may allow local administrators to identify specific areas within the municipality for targeted improvements to further enhance their community-wide bond rating and their development potential.

GLOSSARY

Bearer: The actual holder of the security. The individual who may claim ownership of the security at time of interest payment and/or payment of principal at maturity.

Bond Rating: Method of evaluating the possibility of default by a bond issuer. Standard & Poor's, Moody's Investor Service, and Fitch Investors Service analyze the financial strength of each bond's issuer, whether a corporation or a government body. Their ratings range from AAA (highly unlikely to default) to D (in default). Bonds rated BB or below are not investment grade – in other words, institutions that invest other people's money may not under most State laws buy them.

Bondholder: Synonym for bearer. The individual who may claim ownership of the security at time of interest payment and/or payment of principal at maturity.

Broker: Person who acts as an intermediary between a buyer and seller, usually charging a commission.

Call: The right to redeem outstanding bonds before their scheduled maturity. The first dates when an issuer may call bonds are specified in the prospectus of every issue that has a call feature in its indenture.

Call Date: The actual date on which the call option is exercised.

Certificate of Deposit (CD): Debt instrument used by a bank that usually pays interest. Maturities range from a few weeks to several years. Interest rates are set by competitive forces in the marketplace.

Collateral: Any asset pledged to a lender until a loan is repaid. If the borrower defaults, the lender has the right to seize the collateral and sell it to pay off the loan.

Coupon: The interest rate on a debt security the issuer promises to pay to the bearer until maturity, expressed as an annual percentage of the face value. For example, a bond with a 10% coupon will pay $10 for every $100 of the face amount per year, usually in installments paid every six months. The term is derived from the small detachable segment of a bond certificate which, when presented to the bond's issuer, entitles the bondholder to the interest due on that date.

Credit Analysis: The determination of the credit ratings of corporate and municipal bonds by studying the financial condition and trends of the issuers. The complete analysis of the record and financial affairs of an individual or body to ascertain its creditworthiness.

Current Yield: Annual interest on a bond divided by the market price. It is the actual income rate of return as opposed to the coupon rate (the two are equal if the bond is

purchased at par) or the yield to maturity. For example, a 10% coupon bond with a face value of $1000 is bought at a market price of $800. The annual income from the bond is $100, but since only $800 was paid for the bond, the current yield is $100/800, or 12.5%.

Debenture: General debt obligation backed only by the integrity of the borrower and documented by an agreement called an indenture. An unsecured bond is a debenture.

Debtor: Person or entity that owes money. The person or entity on the other side of the transaction is the creditor.

Default: Failure of the debtor to make timely payments of interest and principal as they come due or to meet some other provision of a bond indenture. In the event of default, bondholders may make claims against the assets of the issuer in order to recoup their principal.

Discount: The difference between a bond's current market price and the face value or redemption value of the bond.

Due Diligence: Meetings and analyses conducted by the underwriters of a new security whereby the brokers may probe into the financial, legal, managerial, and other affairs of the issuer's background to assess the reliable and proper use of the intended funds. Brokers who do not perform due diligence on offerings may face lawsuits if the investment should go sour later. While the final due diligence meeting is perfunctory in nature, informal meetings and analyses are typically held in neutral settings with top management representatives of the issuer to answer questions by the security analysts and institutional investors.

Face Value: The value of a note, bond, mortgage, or other security as given on the certificate or instrument. Municipal bonds have face values in $5,000 multiples.

Financial Intermediaries: Commercial bank, savings and loan, mutual savings bank, credit union, or other "middleman" that smoothes the flow of funds between investors and debtors. Financial intermediaries redistribute savings into productive uses, and in the process serve two functions: By making investors small shareholders in huge pools of capital which in turn are loaned out to a wide number and variety of borrowers, the intermediaries provide both diversification of risk and liquidity to the individual investor.

Fitch Investor Service: New York and Denver based rating firm, which rates corporate and municipal bonds, preferred stock, commercial paper, and obligations of health care and not-for-profit institutions.

Full Faith and Credit: Phrase meaning that the full taxing ability and borrowing power, plus revenue other than taxes, is pledged in payment of interest and repayment of principal of a bond issued by a government entity. US government securities and general obligation bonds of States and local governments are backed by this pledge.

General Obligation Bond (GO Bond): Municipal bond backed by the full faith and credit of a municipality. A GO bond is repaid with general revenue and borrowings, as opposed to the revenue from a specific facility built with the borrowed funds, such as a toll road or a sewer system.

Issue: The stock or bond of a corporation or government entity sold at a particular time.

Issuer: The legal entity that has the power to issue and distribute a security. Issuers include corporations, municipalities, governments and their agencies, and investment trusts. Issuers are responsible for reporting on developments to the investors and underwriters of the debt and making timely payments of interest and principal to the bondholders.

Marginal Tax Rate: Amount of tax imposed on an additional dollar of income.

Maturity: The date on which the principal amount of a note, draft, acceptance, bond, or other debt instrument becomes due and payable in full.

Moody's Investor Service: Headquartered in New York, the most recognized and widely accepted agency producing ratings for corporations and government entities. Moody's rates most of the publicly held corporate and municipal bonds and many Treasury and government agency issues, but does not usually rate privately place bonds.

Municipal Bond: A debt obligation of a State or local government entity. The funds may support general governmental needs or special projects. The Tax Reform Act of 1986 divided Municipal Bonds into two groups: 1) Public Purpose Bonds which are fully tax exempt and can be issued without limitation, and 2) Private Purpose Bonds which are taxable because the purpose of the final use serves an individual group or party more than 10% of the time the facility is in operation.

Par: Equal to the nominal or face value of the security. A bond selling at par is worth the same dollar amount it was issued for or at which it will be redeemed at maturity.

Premium: Amount by which a bond sells above its face value. Also, the amount by which the redemption price to the issuer exceeds the face value when the bond is called.

Primary Market: Market for new issues of securities, as distinguished from the secondary market, where previously issued securities are bought and sold. A market is primary if the proceeds of sales go to the issuer of the securities sold.

Principal: The face amount of a debt instrument or deposit on which interest is either owed or earned.

Put: Bondholder's right to redeem a bond before maturity.

Rating Agency / Rating: Entity which provides evaluation of securities investments and credit risk. The agencies provide alpha-numeric designations (ratings) to securities that summarize the entirety of the creditworthiness of the issue.

Return on Investment (ROI): Amount, expressed as a percentage, earned on a deposited sum of money calculated as annual payment made on the investment before taxes, interest payments and dividends owing.

Risk Averse: Term referring to the assumption that, given the same return and different risk alternatives, a rational investor will seek the security offering the least risk, or put another way, the higher the degree of risk, the greater the return that a rational investor will demand.

Secondary Market: Exchanges and over-the-counter markets where securities are bought and sold subsequent to original issuance.

Security: An instrument that signifies a creditor relationship (for bonds) with a corporate or government body.

Standard & Poor's Ratings: Agency that provides a broad range of investment services, including ratings for corporate and municipal bonds, common stocks, preferred stocks and commercial paper. Arguably a more robust agency than Moody's given the vast number of investor publications provided by Standard & Poor's, a division of McGraw-Hill.

Yield: Return on an investor's capital investment.

Yield to Call: Coupon rate of interest less the expected interest rate at time of call divided by the term until call.

Yield to Maturity: Rate of return on a bond, taking into account the total of annual interest payments, the purchase price, the redemption value, and the amount of time until maturity.

The above definitions are taken directly and/or adapted from Downes & Goodman's, the Dictionary of Finance and Investment Terms, 3rd edition, 1991. All credit for the definitions herein is to be given directly to the editors of the Dictionary.

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http://www.indo.com/distance/
Distance calculator. (Site has subsequently been relocated from the above address.)

http://odesa.missouri.edu/plue/geocorr/
Distance calculator and centroid estimator. Used in geographic variables of Figure 3.

http://www.ins.usdoj.gov/stats/illealalien/index/html
US Department of Justice, Immigration and Naturalization Services Site for publications and press releases on illegal immigration. Used for variable 16 of Figure 3.

Appendix I
Investment Banks Handling Municipal Bond Issues

Bank of America
San Francisco, CA.

George K. Baum & Company
Kansas City, MO.

Bear, Sterns & Co.
New York, NY.

Chase Securities Inc.
New York, NY.

Dean Whitter Reynolds, Inc.
New York, NY.

Dillon Read & Co. Inc.
New York, NY.

The First Boston Corporation
Boston, MA.

First Chicago Capital Markets, Inc.
Chicago, IL.

Goldman, Sachs & Company
New York, NY.

Kemper Securities Group Inc.
Chicago, IL.

Kidder, Peabody & Company, Inc.
New York, NY.

Merrill Lynch Capital Markets
New York, NY.

Shearson Lehman
New York, NY.

Morgan Stanley & Company, Inc.
New York, NY.

J.P. Morgan Securities, Inc.
New York, NY.

John Nuveen & Company, Inc.
Chicago, IL.

Paine Webber, Inc.
New York, NY.

Prudential-Bache Capital Funding
New York, NY.

Salomon Brothers, Inc.
New York, NY.

Donaldson, Lufkin & Jenrette Securities
New York, NY.

Smith Barney Harris Upham & Company, Inc.
New York, NY.

Appendix II
Municipal Bond Rating Definitions

Moody's Rating	S&P Rating	Definition
Aaa	AAA	Highest rating with extremely strong capacity to pay principal and interest.
Aa	AA	High grade by all standards, but with slightly lower margins of protection than AAA.
A	A	Medium grade with favorable investment attributes, but with some susceptibility to adverse economic changes.
Baa	BBB	Medium grade with adequate capacity to pay interest and principal, but possibly lacking certain protections against adverse economic conditions.
Ba	BB	Speculative grade with only moderate protection in principal and interest in an unstable economy.
B	B	Speculative and lacking desirable characteristics of investment bonds. Small assurance of repayment.
Caa	CCC	Issue with high risk of default.
Ca	CC	Highly speculative grade, potential for immediate default, and other market shortcomings.
C		Extremely poor investment quality.
	C	Income bonds paying no interest.
D		In Default with interest and/or principal in arrears.

All grades except the AAA, Aaa and D ratings can have a suffix of 1, indicating a higher level of bond quality.

Based on Appendix V
Scott, 1992

Appendix III
Municipal Bond Insurance Companies

American Municipal Bond Assurance Company (AMBAC)
1 State Street Plaza
New York, NY.

Capital Guaranty (CGIC)
Stewart Tower
1 Market Plaza
San Francisco, CA.

Financial Guaranty Insurance Company (FGIC)
175 Water Street
New York, NY.

Financial Security Assurance (FSA)
350 Park Avenue
New York, NY.

Municipal Bond Investors Assurance (MBIA)
445 Hamilton Avenue
White Plains, NY.

From Appendix Z
Scott, 1992

Appendix IV
Municipal Bond Ratings vs. Interest Rates Charged

Rating	Interest	Difference	Rating	Interest	Difference
Aaa	4.95%		Baa	7.15%	
		0.30			0.35
Aa	5.25%		Ba	7.50%	
		0.15			0.20
A1	5.40%		B1	7.70%	

Source: The Weekly Bond Buyer, activity report week of May 12-16, 1986

Appendix V
HLM Results for 32 States

State	Model	SBC
AL	-1606.1(IC)j(SS)ij + 685.09μij	-106.19
AZ	3017.44(SW)j(LW)ij + 1338.09(IC)j(LW)ij + 1151(IC)j(Mfg)ij +3123.05μij	-283.74
CA	468.48(SW)j(LW)ij + 459.17(BF)j(LW)ij + 149.83(IC)j(LW)ij - 468.92(SW)j(Emp)ij - 136.96(BF)j(Emp)ij - 708.68(IC)j(Emp)ij + 626.14(SW)j(Gov)ij + 667.28(BF)j(Gov)ij + 221.73(IC)j(Gov)ij + 1227.77μij	-1803.69
CO	-7691.58 - 6487.18(SW)j - 4716.24(BF)j - 1529.53(SW)j(LW)ij - 235.81(IC)j(LW)ij - 7467.18(ET)ij - 6926.44(SW)j(ET)ij - 4033.01(BF)j(ET)ij - 657.13(IC)j(ET)ij + 3109.01(SW)j(SS)ij + 610.87(BF)j(SS)ij + 490.56(IC)j(SS)ij + 7930.51(Mfg)ij + 6474.47(SW)j(Mfg)ij + 3580.94(BF)j(Mfg)ij + 8285.67(IE)ij + 9596.33(SW)j(IE)ij + 4348.95(BF)j(IE)ij + 1760.89(IC)j(IE)ij + 2119.04(SW)j(Emp)ij + 520.30(BF)j(Emp)ij + 623.27(IC)j(Emp)ij - 1209.09(SW)j(Gov)ij + 2434.65μij	-389.53
CT	-10998.91(SW)j - 7179.16(BF)j - 2986.34(IC)j + 1282.07(SW)j(LW)ij + 466.44(IC)j(LW)ij + 7715.81(BF)j(ET)ij + 1808.90(IC)j(ET)ij - 6194.00(SW)j(SS)ij - 2567.16(BF)j(SS)ij - 2106.15(IC)j(SS)ij - 10035.84(SW)j(Mfg)ij - 7528.24(BF)j(Mfg)ij - 2489.29(IC)j(Mfg)ij - 7228.13(SW)j(IE)ij - 8444.25(BF)j(IE)ij - 2824.78(IC)j(IE)ij - 1034.82(IC)j(Emp)ij - 459.79(IC)j(Gov)ij + 3484μij	-469.23
FL	2279.01(SW)j + 873.74(IC)j + 2738.36μij	-570.14
GA	-11480.23(BF)j(Mfg)ij + 373.94μij	-81.69
IA	-8172.93(SW)j + 859.89(IC)j(SS)ij - 1201.61(IC)j(IE)ij + 315.13(IC)j(Gov)ij + 11503.59μij	-686.52
IL	-1255.89(SW)j(LW)ij - 324.04(BF)j(LW)ij - 180.24(IC)j(LW)ij + 1659.13(SW)j(SS)ij + 694.06(BF)j(SS)ij + 288.72(IC)j(SS)ij + 4184.04(SW)j(IE)ij + 1526.32(BF)j(IE)ij - 486.16(BF)j(Emp)ij + 9088.83μij	-656.95
IN	No solution.	10.19
KS	26298.55 + 26709.12(SW)j + 12344.37(BF)j + 3446.28(IC)j + 10517.96(SW)j(LW)ij + 4835.50(BF)j(LW)ij - 1338.76(IC)j(LW)ij + 5759.88(SW)j(SS)ij + 2345.27(BF)j(SS)ij + 1541.51(IC)j(SS)ij - 2390.51(IC)j(Mfg)ij + 2732.05(IC)j(IE)ij - 3620.44(BF)j(Emp)ij + 1182.63(IC)j(Emp)ij + 23479.78(SW)j(Gov)ij + 8465.90(BF)j(Gov)ij + 184.43μij	-144.89
KY	No solution.	106.99
LA	1124.03(BF)j(Emp)ij + 1788.60(IC)j(Emp)ij + 1404.41μij	-144.31
MA	No solution to match alpha	-1230.08
MD	No solution to match alpha	-66.22
MI	867.67(IC)j - 454.77(IC)j(ET)ij - 2157.85(SW)j(SS)ij - 2935.44(SW)j(Mfg)ij - 1950.82(SW)j(IE)ij + 665.62(IC)j(IE)ij + 260.29(IC)j(Emp)ij - 1461.29(SW)j(Gov)ij + 14281.75μij	-689.49
MN	-5869.86 - 25839.08(SW)j - 4193.63(BF)j - 4074.62(IC)j - 1564.80(SW)j(LW)ij - 830.06(IC)j(LW)ij - 17955.03(SW)j(ET)ij - 5433.10(BF)j(ET)ij - 1744.11(IC)j(ET)ij + 3905.72(SW)j(Mfg)ij + 6225.26(SW)j(IE)ij + 3986.43(BF)j(IE)ij + 1881.48(SW)j((Emp)ij +	-351.77

	414.82(IC)j(Emp)ij + 2585.96(SW)j(Gov)ij + 1040.47(BF)j(Gov)ij + 1212.44(IC)j(Gov)ij + 1460.79μij	
MO	No solution to match alpha	-156.57
NC	-12441.06(SW)j - 4929.20(IC)j - 1364.34(BF)j(LW)ij + 525.81(IC)j(LW)ij + 4100.41(SW)j(ET)ij + 1518.92(IC)j(ET)ij - 2692.81(SW)j(SS)ij - 696.55(BF)j(SS)ij - 646.14(IC)j(SS)ij - 4104.94(SW)j(Mfg)ij - 2675.18(BF)j(Mfg)ij - 1556.31(IC)j(Mfg)ij - 4435.37(SW)j(IE)ij - 1219.62(SW)j(Emp)ij - 541.20(BF)j(Emp)ij - 496.94(IC)j(Emp)ij - 1183.15(BF)j(Gov)ij + 789.87(IC)j(Gov)ij + 5720.28μij	-666.18
ND	No solution.	119.09
NJ	-2763.42(SW)j - 389.26(IC)j + 2900.04(SW)j(ET)ij + 1846.55(BF)j(ET)ij + 502.39(IC)j(ET)ij - 3609.43(SW)j(IE)ij - 1445.82(BF)j(IE)ij - 732.61(IC)j(IE)ij - 243.30(IC)j(Emp)ij - 106.39(IC)j(Gov)ij + 2641.87μij	-436.93
NY	2004.24(SW)j + 716.43(IC)j + 1758.83(SW)j(ET)ij + 1523.75(BF)j(ET)ij - 369.11(IC)j(SS)ij + 2574.41(SW)j(Mfg)ij + 1174.58(BF)j(Mfg)ij - 576.80(IC)j(IE)ij - 240.97(IC)j(Emp)ij - 632.11(SW)j(Gov)ij - 561.48(BF)j(Gov)ij + 8439.41μij	-870.70
OH	-2551.57(BF)j + 943.30(IC)j - 140.94(IC)j(LW)ij - 588.63(IC)j(ET)ij - 1406.51(SW)j(Mfg)ij - 1353.03(BF)j(Mfg)ij + 823.12(IC)j(IE)ij - 511.04(SW)j(Gov)ij - 128.96(IC)j(Gov)ij + 7087.80μij	-1047.03
OK	No solution to match alpha	-43.61
OR	53438.67(SW)j(Emp)ij - 160271.28(SW)j(Gov)ij + 1908.77μij	-94.64
PA	-34847.38(SW)j - 12576.14(SW)j(SS)ij - 21523.00(SW)j(Mfg)ij - 30873.10(SW)j(IE)ij + 20347.01μij	-209.75
RI	548715.74 - 906907.99(SW)j - 476007.90(BF)j + 400355.06(IC)j - 579713.45(SW)j(ET)ij + 369682.16(IC)j(ET)ij + 133407.07(SW)j(SS)ij + 22048.85(BF)j(SS)ij + 303014.50(SW)j(Mfg)ij + 152344.51(BF)j(IE)ij - 243043.52(IC)j(IE)ij + 879.62μij	-9.41
TN	No solution to match alpha	-201.73
TX	479.64(IC)j + 841.34(BF)j(ET)ij - 388.69(SW)j(SS)ij - 354.08(BF)j(SS)ij - 110.28(IC)j(SS)ij - 458.30(BF)j(Mfg)ij - 145.32(IC)j(Mfg)ij - 568.34(BF)j(Emp)ij - 66.24(IC)j(Gov)ij + 16137.10μij	-2224.42
VA	-4551.03(SW)j - 2787.97(BF)j + 1240.05(SW)j(LW)ij + 628.02(BF)j(LW)ij + 1589.86(SW)j(ET)ij - 669.69(IC)j(ET)ij - 2513.49(SW)j(Mfg)ij - 2038.57(BF)j(Mfg)ij + 401.97(IC)j(IE)ij + 951.60(BF)j(Gov)ij + 4836.45μij	-540.28
WA	-6606.44(SW)j - 1859.81(IC)j - 405.94(BF)j(LW)ij + 1506.21(SW)j(SS)ij + 406.00(IC)j(SS)ij + 5811.91(SW)j(Mfg)ij + 3245.67(BF)j(Mfg)ij + 1785.31(IC)j(Mfg)ij - 3943.12(SW)j(IE)ij - 1599.55(BF)j(IE)ij - 936.93(IC)j(IE)ij + 726.13(SW)j(Emp)ij - 290.67(BF)j(Emp)ij + 2213.75μij	-311.89
WI	1072.46(IC)j + 849.29(BF)j(LW)ij - 419.37(IC)j(ET)ij + 639.91(IC)j(SS)ij + 1578.73(IC)j(Mfg)ij - 409.77(IC)j(IE)ij + 1370.91(SW)j(Emp)ij + 1090.37(BF)j(Emp)ij + 266.90(IC)j(Emp)ij - 765.00(SW)j(Gov)ij - 610.91(BF)j(Gov)ij + 7466.76μij	-589.52

Modeling Application: SAS PROC MIXED
SBC: Schwarz Bayesian Criterion (goodness of fit)
Iteration Termination: 25 iterations
Alpha: α=0.10
No Solution: Analysis terminated or no variables met the alpha cut-off point.

Appendix VI
Performance of the Model to the Holdout Data set.

State	City	Actual Rating	Model Rating	Difference
AL	Birmingham	A	A	
AL	Huntsville	A	A	
AL	Mobile	Baa1	Baa1	
AR	Little Rock	A	A	
AZ	Flagstaff	Baa1	Baa	x
AZ	Phoenix	A1	A1	
AZ	Scottsdale	Aa1	Aa	x
AZ	Tempe	A	A	
AZ	Tucson	A	Baa1	x
AZ	Yuma	Baa	Baa	
CA	Santa Clara	A	A	
CA	Anaheim	A1	A1	
CA	Bakersfield	A1	A1	
CA	Burbank	A	A	
CA	Chula Vista	Baa1	Baa1	
CA	Concord	A	A	
CA	Costa Mesa	A1	A1	
CA	Davis	A	A	
CA	Escondido	Baa1	Baa1	
CA	Fremont	Baa1	Baa1	
CA	Glendale	A	A	
CA	Hayward	Baa1	Baa1	
CA	Long Beach	A1	A1	
CA	Los Angeles	Aaa	Aa1	x
CA	Modesto	A1	A1	
CA	Napa	A	A	
CA	Palo Alto	A1	A1	
CA	Pomona	Baa1	Baa1	
CA	Sacramento	Aa1	Aa	x
CA	San Diego	Aa1	Aa	x
CA	San Francisco	Aa1	Aa	x
CA	San Jose	Aa1	Aa1	
CA	San Mateo	A1	A1	
CA	Santa Barbara	A1	A1	
CA	Santa Rosa	A	A	
CO	Boulder	A1	A1	
CO	Denver	A1	A1	
CO	Englewood	A	A	
CO	Fort Collins	A1	A1	
CO	Greeley	A1	A1	

State	City	Actual Rating	Model Rating	Difference
CT	Bridgeport	A	A	
CT	Bristol	Baa1	Baa1	
CT	Hartford	A	A	
CT	Milford	A1	A1	
CT	New Haven	Baa1	Baa	x
CT	Norwich	A1	A1	
CT	Stamford	Aaa	Aaa	
CT	Torrington	A	Baa1	x
DE	Wilmington	Baa1	Baa1	
FL	Boca Raton	A1	A1	
FL	Clearwater	A	A	
FL	Fort Lauderdale	A	A	
FL	Gainesville	A	Baa1	x
FL	Jacksonville	A	A	
FL	Miami	A	A	
FL	Pompano	Baa1	Baa1	
FL	Sarasota	A	A	
FL	St Petersburg	A	A1	x
GA	Albany	Baa1	Baa1	
GA	Atlanta	A1	A1	
GA	Augusta	A	A	
GA	Macon	A	A	
GA	Valdosta	Baa	Baa1	x
IA	Ames	Aa1	Aa1	
IA	Burlington	A	A	
IA	Cedar Falls	A	A	
IA	Cedar Rapids	Aaa	Aaa	
IA	Davenport	A1	A	x
IA	Des Moines	Aaa	Aaa	
IA	Dubuque	A1	A	x
IA	Iowa City	Aaa	Aaa	
IA	Ottumwa	A1	A1	
ID	Idaho Falls	A	A	
IL	Champaign	Aa1	Aa1	
IL	Chicago	Baa1	Baa	x
IL	De Kalb	Baa1	Baa1	
IL	Decatur	Baa1	Baa1	
IL	Elmhurst	A1	A1	
IL	Evanston	Aaa	Aaa	
IL	Highland	A1	Aa	x
IL	Peoria	A	Baa1	x
IL	Springfield	A1	A1	
IN	Fort Wayne	Aaa	Aa1	x

State	City	Actual Rating	Model Rating	Difference
IN	Gary	Baa1	Baa1	
IN	Indianapolis	A1	A	x
IN	South Bend	A1	A1	
KS	Kansas City	A	A	
KS	Leavenworth	A	A	
KS	Topeka	A1	A	x
KY	Covington	Baa1	Baa1	
KY	Louisville	A1	A1	
LA	Bossier	Baa1	Baa1	
LA	Lafayette	Baa1	A	x
LA	New Orleans	Baa1	A	x
MA	Boston	Ba1	Ba1	
MA	Cambridge	A1	A1	
MA	Fall River	Ba1	Ba1	
MA	Haverhill	Baa1	Baa1	
MA	Lawrence	Ba1	Ba1	
MA	Leominster	A1	A1	
MA	Lowell	Ba1	Ba1	
MA	New Bedford	Baa	Baa	
MA	Quincy	B1	Ba	x
MA	Worcester	Ba1	Ba	x
MD	Annapolis	A	A	
MD	Baltimore	A	A	
ME	Bangor	A1	A1	
ME	Lewiston	A	A	
ME	Portland	Aaa	Aaa	
MI	Ann Arbor	A	A	
MI	Dearborn	A	A	
MI	Detroit	B1	Ba	x
MI	Grand Rapids	A1	A1	
MI	Jackson	A	A	
MI	Kalamazoo	A1	A	x
MI	Saginaw	Baa1	Baa1	
MN	Minneapolis	Aaa	Aaa	
MN	Rochester	Aaa	Aaa	
MN	St Paul	A1	A1	
MO	Kansas City	A1	A1	
MO	St Louis	Baa	Baa	
MS	Jackson	A1	A1	
MT	Billings	Baa1	Baa1	
NC	Burlington	Baa1	Baa1	
NC	Charlotte	Aaa	Aaa	
NC	Gastonia	A	Baa1	x

State	City	Actual Rating	Model Rating	Difference
NC	Greensboro	Aa1	Aa1	
NC	Wilmington	A	A	
NC	Winston-Salem	A1	A	x
ND	Bismarck	A1	A1	
ND	Fargo	A1	A1	
NE	Lincoln	A1	A1	
NE	Omaha	Aaa	Aaa	
NH	Manchester	A1	A1	
NH	Nashua	A1	A1	
NJ	Bayonne	Baa1	Baa1	
NJ	Camden	Ba1	Ba1	
NJ	Hackensack	A1	A1	
NJ	Jersey City	Baa	Ba1	x
NJ	Newark	Ba1	Ba1	
NM	Albuquerque	A1	A1	
NV	Las Vegas	Baa1	Baa	x
NV	Reno	A	A	
NY	Albany	Ba1	Baa	x
NY	Buffalo	Ba1	Ba1	
NY	Ithaca	A1	A1	
NY	New Rochelle	A	A	
NY	Poughkeepsee	A	A	
NY	Rochester	A1	A1	
NY	Syracuse	A1	A1	
NY	White Plains	Aa1	Aa	x
OH	Akron	Baa1	Baa1	
OH	Canton	Baa1	Baa1	
OH	Cincinnati	A1	A1	
OH	Cleveland	Caa1	B1	xx
OH	Columbus	A1	A	x
OH	Cuyahoga	A	A	
OH	Dayton	A1	A1	
OH	Euclid	A1	A1	
OH	Garfield	Baa1	Baa1	
OH	Sandusky	Baa1	Baa1	
OH	Springfield	A	A	
OK	Oklahoma	A1	A1	
OR	Corvallis	A1	A1	
OR	Medford	A	A	
OR	Portland	Aaa	Aaa	
PA	Bethlehem	A	A	
PA	Philadelphia	Ba1	Baa	x
PA	Pittsburgh	Baa	Ba1	x

State	City	Actual Rating	Model Rating	Difference
RI	Cranston	Baa	Baa	
RI	Newport	Baa1	Baa1	
SC	Columbia	A	A	
SD	Rapid City	A	A	
SD	Sioux Falls	A1	A	x
TN	Knoxville	A	A1	x
TN	Memphis	A1	A1	
TX	Amarillo	A1	A1	
TX	Arlington	A1	A1	
TX	Austin	Aaa	Aaa	
TX	Brownsville	Baa	Baa	
TX	Dallas	Aaa	Aaa	
TX	Fort Worth	Aa1	Aaa	x
TX	Garland	A1	A1	
TX	Irving	Aa1	Aaa	x
TX	San Antonio	A1	A1	
TX	Temple	A	A	
TX	Waco	A	A	
TX	Wichita	Baa1	Baa1	
UT	Salt Lake City	Aaa	Aaa	
VA	Charlotte	Aaa	Aaa	
VA	Norfolk	A1	A1	
VA	Richmond	A1	A1	
WA	Bellingham	A	A	
WA	Seattle	Aa1	Aa1	
WA	Spokane	A1	A1	
WI	Beloit	A1	A	x
WI	Eau Claire	A1	A1	
WI	La Crosse	A1	A1	
WI	Milwaukee	A1	A1	
WY	Cheyenne	A1	A	x

where:

x = One rating grade difference
xx = Two rating grade difference

Appendix VII
Eigenvalues from the Principal Components Analysis

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	4.805	14.559	14.559
2	4.301	13.032	27.592
3	3.054	9.253	36.845
4	2.421	7.335	44.180
5	1.917	5.809	49.989
6	1.477	4.476	54.465
7	1.438	4.359	58.824
8	1.334	4.042	62.866
9	1.083	3.280	66.146
10	1.035	3.138	69.284
11	.985	2.985	72.269
12	.975	2.955	75.224
.	.	.	.
.	.	.	.
.	.	.	.
33	7.413E-02	.225	99.983
34	5.689E-03	1.724E-02	100.000