DETERMINANTS OF THE CAPITAL STRUCTURE OF

MUNICIPAL WATER UTILITY SYSTEMS:

AN EMPIRICAL STUDY OF TEXAS PUBLIC WATER SYSTEMS

by

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ABSTRACT OF THE DISSERTATION

Determinants of the Capital Structure of Municipal Water Utility Systems:

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During the past several decades, increasing awareness of public infrastructure deterioration has elevated the importance of ensuring quality water systems. Though regulated by the Environmental Protection Agency (EPA), ensuring long-term sustainability of the nation's fragmented water infrastructure and funding-related costs are largely the responsibility of municipal governments. In 2013, the EPA reported that aging drinking water pipes may cost $384 billion to repair or replace and sustain through 2030. Various factors are considered before accessing capital, each with its own motivations and consequences to the system's risk profile. The purpose of this study was to understand the key financial and contextual determinants of municipal water systems' capital structure, expressed as leverage. Through the lens of capital structure theories, the quantitative study involved ordinary least squares regression to examine the extent of, and directional relationship between, leverage and seven firm-level determinants: profitability, growth, liquidity, size, risk, tangibility, and age. An ANOVA allowed for examination of differences in the context of the service area population size, and ancillary analysis measured differences in leverage before, during, and after the Great Recession of 2008–2009. The most significant relationships with leverage were between liquidity and age, which supports pecking order theory assertions that the use of retained earnings is preferable to debt. Qualitative assessment of management discussions and capital improvement plans identified key elements of funding decisions that affect leverage. Additionally, although leverage of the systems serving the largest populations surpasses that of mid-range systems, those serving the smallest populations are far more leveraged than their counterparts. Qualitative findings indicated that operating margins, financial flexibility, socioeconomic considerations, contingency reserves, and debt carry the most weight in influencing funding decisions because of their collective influence on their credit risk profile. The effects of climate-related events on infrastructure and water resources factor into policy implications. A need exists for scalable and replicable subnational and municipal efforts for modernization of the water sector, data availability for better capital budgeting, and expansion of pooled financial resources, particularly for systems that lack ready access to the debt market.

Preface

Acknowledgement

Thanks to the distinguished members of my committee for inspiring me to be a better researcher: Dr. Gregg Van Ryzin, for his proficiency at simplifying complex subject matter and Dr. Henry Coleman, for his patience and in-depth knowledge of governments. Special thanks to Dr. Norma Riccucci for endless motivation and leading by example, and Dr. Marilyn Rubin for listening and encouraging me for decades.

Dedication

To my parents for their eternal love and support, and to my family—those of blood and those of choice.

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CHAPTER 1: INTRODUCTION

The purpose of this study is to examine the determinants of the capital structure of municipal water systems and that factors that influence the decisions to finance operations and growth using different funding sources. The first chapter presents the importance of municipal water systems, trends in financial support, and current revenue sources that support these systems. The second chapter contains a review of relevant literature on capital structure theories, including a summary of these theories and their applications in corporate and public sectors, followed by an exploration of the gap in current research. The third chapter details existing capital structure theories as the framework for discussing the financial determinants of capital structure and the effect of capital funding decisions on leverage, which refers to the use of debt for the acquisition of assets. Within that context, in the fourth chapter, I examine data from municipal water systems and their underlying municipalities in the state of Texas. Finally, the fifth chapter includes a summary of the findings, followed by implications and paths for future research.

1.1 Importance of Municipal Water Systems

During the past several decades, increasing awareness of public infrastructure deterioration has elevated the importance of ensuring the quality of systems that collect, treat, and distribute drinkable water. Though regulated by the Environmental Protection Agency (EPA), maintaining the nation's fragmented water infrastructure is the responsibility of municipal governments that own roughly 85% of all water systems that are not owned by private entities (American Society of Civil Engineers [ASCE], 2017; Copeland, 2010; Environmental Protection Agency [EPA], 2013).

Because the water resources supplied by municipalities to their residents tend to be readily available, the costs of funding the infrastructure systems that facilitate its delivery are often overlooked by citizens until circumstances alter the safety or accessibility of water (ASCE, 2017; EPA, 2013). In 2013, the EPA reported approximately 700,000 miles of aging underground drinking water pipes may cost an estimated $384 billion to repair or replace and sustain through 2030 (ASCE, 2017). These projected costs highlight that funding municipal water systems is important for the long-term sustainability of municipalities.

Presented in this chapter is a discussion of the shifts in financial support and current revenue sources for public water systems. Following this information is the motivating influences that prompt capital financing considerations that ultimately affect each system's capital structure, which is operationalized as a financial leverage ratio defined in detail later. The research question is presented in the subsequent section and, finally, the last section of this chapter summarizes contributions of this research.

1.2 Financial Support and Revenue Sources for Public Water Systems

Financial support from the federal government for municipal water systems was stable until the mid-1960s when slower growth of the national economy resulted in steep declines in the federal budget devoted to infrastructure spending as a percent of gross national product (Hulten & Peterson, 1984). During the 1970s, the downward trend in federal and state support to municipalities continued. Specifically, the decline in funds granted to municipal water systems occurred concurrently with an important change: the government enacted federal standards for water quality and wastewater treatment with passage of the Safe Drinking Water Act of 1974 (Copeland, 2010). This act substantially increased costs of regulatory compliance and the need for municipally-sourced funds dedicated to infrastructure (Copeland, 2010). Additionally, the timing of the new and expanded health- and safety-related regulations coincided with economic slowdowns and taxpayer-driven spending limits. As such, since the 1980s, declines in federal funds to state governments has resulted in many municipalities opting to defer capital maintenance projects because fewer infrastructure projects were placed under consideration by municipal governments in the capital improvement programs (Musick & Petz, 2015).

As noted in the American Society of Civil Engineers (ASCE) 2017 Infrastructure Report Card, water infrastructure needs continue to outpace financial support. During the past four decades, unaddressed and deteriorating water infrastructure exacerbated financial pressures placed on municipalities that manage the nation's approximately 51,000 active community water systems (ASCE, 2017; EPA, 2013; Little, 2005; Loaiciga & Renehan, 1997). The projected cost to manage these problems is $1 trillion to upgrade existing waste and storm water systems that are between 50 to 150 years old (ASCE, 2017). Further, the EPA (2013) noted a disproportionate effect on costs across systems based on their size. The overall costs for the amount of physical capital assets for development and regulatory compliance for larger water systems tend to be lower, while systems that have a smaller physical plant tend to violate their standards for systemic monitoring at a higher rate (EPA, 2013). Additionally, both the ASCE and the EPA stated infrastructure resilience—as in the capacity to withstand and recover from wear and damage—is becoming more necessary as climate-related events become more frequent and intense in some regions, thus adding to existing financial pressures (ASCE, 2017;

EPA, 2013; Little, 2005; Loaiciga & Renehan, 1997). Practitioners and researchers have argued for more resilience planning as budgetary constraints will become more pronounced in response to costlier infrastructure retrofits, incorporation of technology, and building for future sustainability (Carter et al., 2015). This research is founded on data that show deteriorating infrastructure in the United States is becoming increasingly expensive for municipal governments (Carter et al., 2015).

Funding remains a challenge. Water systems owned solely by municipal governments are generally nonprofit public enterprises that depend on revenues derived predominantly from water rates (Howe, 2005; Loaiciga & Renehan, 1997). The rates are not a fee for water itself but, rather, a recovery charge to system users meant to reflect the economically efficient use of water resources. The rates include the cost of acquisition and reliable delivering of services during periods of varied water demand levels (Howe, 2005; Loaiciga & Renehan, 1997; Scott & Pidherny, 2018). These volumetric-based rates are user-based charges set by the system's governing board and monitored for their sustainability by each state's public commission (Howe, 2005; Loaiciga & Renehan, 1997). Development fees for water main connections to new construction projects, such as housing or industrial complexes, provide a secondary revenue source that is a significantly smaller component of total revenues (Mead, 2018; Scott & Pidherny, 2018). Because it is tied to economic growth, such fees fluctuate with the underlying municipality's economy, rendering them an unreliable component of the overall budget in more mature and space-constrained municipalities. Therefore, municipal systems are less likely to generate significant funds from new development fees than revenues generated from water sales to end users (Scott & Pidherny, 2018). In some cases, transfers from the

General Fund or Capital Projects Fund of the underlying municipalities, or those that encompass the system's service area, provide additional financial support, most often to cover shared labor and equipment costs (Klase, 1995; Mead, 2018; Scott & Pidherny, 2018). Further, in the event of emergencies, such as those caused by extreme climate-related events, municipalities can apply for federal and state grants dedicated to disaster relief (Mead, 2018; Scott & Pidherny, 2018). In addition to own-source revenues, host municipality funds, and grant monies, water systems may obtain state funds from pooled loans, banks, and private lenders for capital equipment leases, as well as obtain funds from municipal bond market investors for infrastructure development.

1.3 Considerations That Influence Municipal Water System Financing

Decades-long declines in federal and subnational government support for infrastructure maintenance have resulted in a financial load carried by the systems, with larger projects generally funded by tax-exempt municipal bonds that are debt obligations supported by a legally enforced revenue pledge (Copeland, 2010; Music & Petz, 2015; Scott & Pidherny, 2018). The importance of debt in funding infrastructure is underscored by Thomson Reuters'[1] report that municipal governments issued $4.1 billion for water and sewer systems in the first quarter of 2018 alone.

Prior to accessing capital, businesses consider various factors regarding current operating needs and projected future requirements, including managing cash flows, tax consequences, and how the costs associated with issuing debt or equity to investors affect long-term financial viability. Classified as business-type entities, municipal water

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[1] *SIFMA Municipal Bond Credit Report, First Quarter 2018. Located at https://www.sifma.org/wp-content/uploads/2018/05/US-Municipal-Report-2018-05-01-SIFMA.pdf*

enterprises are often restricted in their access to a broad revenue stream, such as the various taxes and numerous fees charged by the municipality in which the system is located to finance their own general operations (Ittelson, 2009; Mead, 2018). When long-term projects warrant capital funds, water systems may opt to use internally or externally sourced funds—each with its own motivating influences and consequences to the system's long-term financial viability and its capital structure.

Capital structure refers to how companies fund their assets to maintain business operations and fuel growth. Defined as the ratio of debt-to-equity or debt-to-total assets, the term is used synonymously with financing mix or financial leverage (Chen & Shimerda, 1981; Ittelson, 2009; Mead, 2018). Distinct differences exist between the way these ratios provide information about an enterprise, and the selection of one measure instead of the other depends on the type of enterprise and its overall financial composition (Ittelson, 2009; Mead, 2018). The significance of capital structure is its influence on the entity's risk profile—the perception investors have of the enterprise's viability—and the effect it has on the ability to obtain funding and the price it will pay for that funding. In other words, as a measure of debt owed against the overall value of a business entity, capital structure indicates how risky prospective investors and creditors will deem an enterprise. Perceived level of risk determines the price an enterprise will pay to acquire funds, whether those funds are in the form of equity or debt.

1.4 Research Question

Municipal water systems participate in the capital markets by issuing debt, for which interested parties (including potential investors) examine the risks to creditors based on the financial resilience of the enterprise. Because a key objective of many firms is to maximize the wealth built from accumulated profits and minimize the cost of capital, the capital structure decision is an important one that company officials make. Capital structure reflects financial leverage, which is the debt that businesses use to purchase more assets that bring value to their enterprise. Therefore, the question this researcher sought to answer is, what are the key financial determinants of the capital structure of municipal water systems? In answering this question, this study incorporates the potential effects of the size of the system's service area population as an external contextual determinant. That is, the study suggests that the size of the population served by the water system may influence the decisions that affect the municipal water system's capital structure.

Exploration of the research question was empirically guided by several competing approaches to capital structure. The theories, which emerged as a response to Modigliani and Miller's (1958) theories, explain the connection between different types of financing and the value of the enterprises that use them. The trade-off theory assumes that enterprises have an optimal capital structure depending on the ratio of debt-to-equity, while the pecking order theory suggests that no well-defined optimal debt ratio or specific capital structure target exists because it changes based on interest tax shields and financial distress (Myers, 1984; Myers & Majluf, 1984; Titman & Wessels, 1988). The pecking order theory also posits that information asymmetrically increases the cost of accessing funds from creditors, which tends to affect companies with fewer financial resources. Chapter 2 presents the evolution of capital structure theories and their applicability to this study.

1.5 Contribution of the Study

This study contributes to public finance and infrastructure funding and development literature in several ways. Though substantial scholarly research exists on capital structure, determinants of the capital structure of municipal water systems is an underexplored topic given that these systems are largely financed by public debt obligations. With increasingly substantial amounts of outstanding municipal bonded debt backed by the revenues of the systems, understanding the determinants of capital structure is an important aspect of ensuring continued access to the debt market. Capital structure, operationalized as a leverage ratio, is also important to financial intermediaries that require the same information about a firm that is available to its officers because access to this information facilitates the long-term stability of a sector facing sizable future spending needs. Further, because the ASCE (2017) noted some sizable infrastructure needs are the result of climate-related events, this study was the first extensive exploration of capital structure determinants of municipal water systems in a geographic location severely affected by environmental conditions that influence the service and water supply provided by enterprises. Ranking second by land mass, and with nearly one-tenth of the nation’s population, studying water systems in Texas allows for replicability of the study’s findings to other states given the similarity of services provided and their financial reporting (Arapis & Grady, 2015; Mead, 2018). Additionally, the use of accounting measures and ratios that apply to all enterprises allows for comparisons across municipalities within Texas and other states, and across industries. Findings in existing research are primarily dependent on quantitative study of the financial determinants while few researchers have examined qualitative aspects of capital structure decisions. Therefore, of equal importance to the regression analysis in the quantitative component of this study, an extensive qualitative review of the firm-specific decisions of all water systems in the sample frame augments the financial component of this research. Another contribution of this study is that prior researchers have directed comparatively limited attention towards the factors external to the financial aspects that influence the capital structure determinants of municipal water systems. Therefore, the study includes discussion of systems based on the size of the population served as smaller municipal entities may not fit within standard finance theories.

This research has several policy implications. Governments face constant financial pressures but the means of funding for infrastructure development are limited. Moreover, national political priorities can alter federal funding, as can changes in the underlying local economy that affect local tax revenues and user fees. Given the reliance of water systems on taxpayer-supported municipal bonds, and the influence of current and prospective regulatory compliance costs on financial resource-constrained water systems, policies that seek alternatives to existing approaches beyond merely facilitating access to the bond markets warrant exploration. Nonetheless, while determinants of the capital structure may explain the bulk of funding decisions across myriad types of enterprises, costs and the ability to issue bonds cannot be the sole considerations. This reasoning relates to the fact that access to the capital markets is often bound by various facets of the enterprise. Likewise, economic and environmental realities of the underlying municipalities affect ratepayers and water usage.

CHAPTER 2: LITERATURE REVIEW

Various theories relating to capital structure note that its importance rests with the fact that any financing decision affects the enterprise's ability to maintain short- and long-term financial viability (Frank & Goyal, 2003; Harris & Raviv, 1991; Myers & Majluf, 1984). Though these theories originated in corporate finance, researchers in the literature connected their concepts and applied them to public finance in general, and municipal water systems in particular. The review of the literature presented in this chapter creates a framework for this research by identifying salient capital structure issues and the relevant theories.

The chapter opens with the definition of capital structure. The second section details capital structure in the public and nonprofit sectors. The third section presents the relevant capital structure theories, followed by firm-level theoretical determinants of the capital structure of municipal water systems in the fourth section. In the fifth section, I discuss empirical findings on the determinants of capital structure. Considerations that influence the use of debt to finance municipal entities appear in the sixth section, and public water systems in the state of Texas appear in the seventh section. The final section of the chapter includes the significance of the research.

2.1 Capital Structure Defined

How a company maximizes its value by financing its growth and operations is as old a concept as the existence of corporations themselves. Prevailing consensus in corporate finance and accounting literature is that capital structure is the ratio of debt to equity that comprises the finances of a business entity (Chen & Chen, 2011; Frank &

Goyal, 2003; Harris & Raviv, 1991). As such, capital structure is the result of all funding decisions (Chen & Chen, 2011; Frank & Goyal, 2003; Harris & Raviv, 1991).

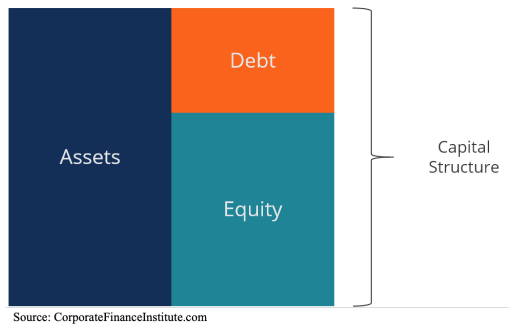


Figure 2.1. Capital structure components.

Derived from balance sheet components, researchers have defined capital structure (see Figure 2.1) in various ways. Capital structure reflects the resources that give a company its value and ability to provide future benefits (Harris & Raviv, 1991). It is typically calculated as either debt-to-equity or debt-to-total assets, where debt is the sum of borrowed money due to be repaid in the short- and long-term, and equity is classified as stock representing an ownership stake, or retained earnings (Chen & Shimerda, 1981; Mead, 2018).

The debt-to-equity ratio can be complex because of discrepancies between the book value, which is calculated from the balance sheet, and the market value of equity, which is determined by stock market valuation based on adjustments made for assets, goodwill, and impairment (Ittelson, 2009). In contrast, the debt-to-assets ratio is calculated by dividing total liabilities by total assets, including nonmonetary intangible assets, such as patents, reputation, trademarks, and copyrights that generate economic returns. Leverage is operationalized as debt-to-equity, which indicates the ratio of borrowed funds to retained earnings based solely on operational (tangible) assets that were purchased using debt and equity reserves (internal funds). By comparison, the ratio of debt to total assets includes both tangible and intangible assets and indicates the percent of total assets financed by creditors (Mead, 2018).

The composition of the leverage ratio indicates financial risk by conveying whether a claim on assets is on debt or on equity, thus revealing how much of the company is owned by creditors and investors (Frank & Goyal, 2003; Ittelson, 2009; Klein & Belt, 1994). This important difference between the capital structure ratio calculations provides rationale as to why the debt-to-equity ratio is the more appropriate measure for various types of business enterprises. First, debt is a cheaper funding source than the cost of equity—the net amount of a firm's total assets and total liabilities—which may affect the overall valuation of a firm (Frank & Goyal, 2003; Ittelson, 2009; Mead, 2018). Second, the debt-to-equity ratio is a more suitable indicator of debt position in businesses that have large fixed tangible assets and high debt levels because equity is often financed by borrowing (Frank & Goyal, 2003; Ittelson, 2009; Mead, 2018). Municipal water systems fall into the large fixed tangible assets and high debt category because their balance sheet consists of sizable property and physical plant assets composed of pipes, storage tanks, and filtration equipment that generate income but are not expected to be converted into cash within a year.

Debt-to-equity is important for making an assessment as to long-term solvency expectations for the enterprise because it is a key indicator regarding whether profits will be paid to creditors and shareholders, and whether access to further debt to fund operations and capital projects will be hindered (Chen & Shimerda, 1981; Ittelson, 2009; Mead, 2018). Cyclical industries, such as construction and travel, that are more likely to have unpredictable cash flows have limited certainty about their ability to repay debt obligations; these industries are more prone to insolvency and are often not suitable for evaluation of the financial components based on an assessment of their debt profiles (Ittelson, 2009). By contrast, financial service enterprises, such as banking institutions and insurance companies, have business models that require large amounts of borrowed capital to finance their assets (Ittelson, 2009). Justification for the use of debt-to-equity as the measure of capital structure in municipal water systems is because of relative levels of debt and equity that affect risk and cash flows. This, in turn, affects what investors and creditors perceive as the value they pay to lend to or invest in an enterprise (Arapis & Grady, 2015; Ittelson, 2009; Mead, 2018).

Use of debt-to-equity as the measure of capital structure is also particularly important when generalizing comparisons about different companies across different sectors because accounting principles for government enterprises recognize monetary assets (Arapis & Grady, 2015; Mead, 2018; Scott & Pidherny, 2018). Such recognition reveals more similarities exist between the capital structure of government business-type entities, regardless of their sector, than the similarities between corporate and municipal enterprises when evaluating based on the differences in the nonoperational assets and the equity component of their capital structure (Arapis & Grady, 2015; Chen & Shimerda, 1981; Mead, 2018; Scott & Pidherny, 2018).

2.2 Capital Structure in the Public and Nonprofit Sector: Public Sector Debt Financing

Understanding capital structure of municipalities begins with understanding borrowed capital. Public budgets cannot sustain operating expenses and fund all of their long-term infrastructure projects during short-term lengths (Mead, 2018; Scott & Pidherny, 2018). Because of this, according to the Center on Budget and Policy Priorities (2018), aside from maintaining projects that serve the public, governments use borrowing as a way to boost the state and local economy. Opponents of increasing government debt believe that pay-as-you-acquire is a financially pragmatic approach to financing projects because it does not burden future generations with debt, although the effect on the entity's capital structure is a substantial sudden increase in the debt load that simultaneously causes a shift in the debt-to-equity ratio. Conversely, public finance literature reveals proponents of pay-as-you-go financing argue that debt is not always a negative and, as such, capital projects should be paid during their lifetime to spread the costs across the generations that benefit from their use (Little, 2005; Scott & Pidherny, 2018). With significant costs for the capital-intensive segments of municipal infrastructure, such as public water, sewer, transportation, and power, researchers view placing the burden solely on those who acquire the infrastructure versus sharing among all beneficiaries as not operating in the public good (Hulten & Peterson, 1984; Musick & Petz, 2015).

Governments do not engage in corporate-type equity financing in which investors purchase an ownership stake; even government business-type enterprises (e.g., water and sewer, municipal ports and airports) serve the public good, and the equity portion of their capital structure is composed of retained earnings that are considered a source of internal funding (Mead, 2018; Scott, et al., 2013). These entities either self-fund through a combination of public funds and user charges or, when federal funds and state-supported revolving loan funds are unavailable or insufficient, through finance capital projects from external sources in the form of bonds—all of which alter perceived risk to creditors as debt changes leverage (Ittelson, 2009; Mead, 2018; Scott, et al., 2013). As entities that lack a profit motive, municipal water systems operate in the tax-free world such that the distinguishing factor between nonprofits and their profit-driven counterparts is that the former operate in restricted capital markets with neither private ownership nor stock trading, and they are exempt from corporate taxes on profits (Hansmann, 1980; Modigliani & Miller, 1958).

2.3 Relevant Capital Structure Theories

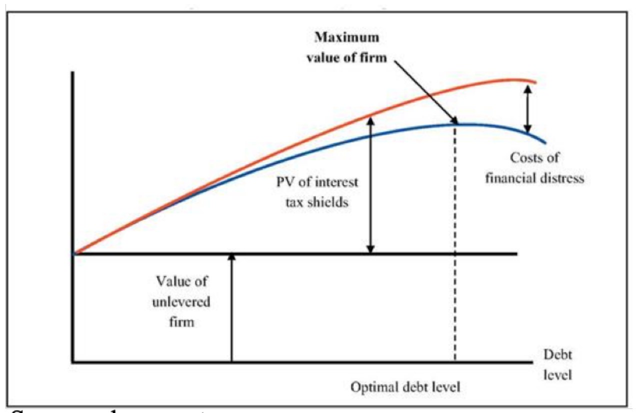
The primary point of capital structure theories is to best determine how businesses should finance growth and the fixed assets that return value to their companies. Numerous theorists, discussed in detail below, have attempted to explain the determinants of capital structure and the decisions that influence it (Frank & Goyal, 2003; Halov & Heider, 2011; Modigliani & Miller, 1958; Myers & Majluf, 1984). However, despite the best efforts of myriad scholars, the findings remain open to interpretation.

2.3.1 Modigliani-Miller theory of capital structure irrelevance. Current thinking on capital structure choice began with Modigliani and Miller's (1958) seminal theory of capital structure irrelevance, which asserted that with perfect markets there are neither taxes nor financial transaction costs so the cost of capital is unaffected by changes in capital structure because value would be determined by real assets (Modigliani & Miller, 1958). In addressing the most fundamental questions regarding how corporations should finance and what is the best capital structure composition, Modigliani and Miller's Proposition I distinguished between business risk, which focuses on a company's future operating income while ignoring the effects of methods of financing, and financial risk, which focuses on instability and loss of value when borrowed capital is used and leads to higher business risk. Modigliani and Miller's assertion that capital structure is irrelevant hinges on company valuation that does not depend on whether the firm opts to raise funds by issuing ownership shares or whether the firm becomes highly levered with debt. The researchers surmise this is because no material consequence exists to the weighted average cost of capital that signals risks associated with every financing decision and operational change.

Modigliani and Miller's Proposition I theory omitted the presence of taxes when examining capital structure (Modigliani & Miller, 1958). However, because taxes exist in the real world, as do transaction costs between companies and investors to whom risks are transferred but must be compensated for by their lack of equal access to company information, skeptical theorists challenged the rigid assumptions of the theory of capital structure irrelevance (Harris & Raviv, 1991). Objections to Proposition I brought about Modigliani and Miller's Proposition II, which recognized the existence of corporate taxes and asserted an optimal capital structure may be achieved for enterprises that fund completely with debt, thus optimizing wealth though the tax shield benefit (Modigliani & Miller, 1963). The importance of this to capital structure is that with an increase to the debt component, equity holders perceive higher risk. However, the crucial difference that debt holders benefit from the increase in equity commensurate with higher risks that simultaneously decrease costs of debt because debt holders have a claim on earnings that equity holders do not (Modigliani & Miller, 1963). Given that municipal water systems cannot issue equity shares, capital structure is likely reliant on debt and investors' wealth optimized through tax benefits.

2.3.2 Theories of capital structure relevance: Trade-off and pecking order. Critiques surrounding Modigliani and Miller's assumptions focused largely on valuation, the effects of financial distress on agency costs, and information asymmetry (Harris & Raviv, 1990; Myers & Majluf, 1984). The trade-off and pecking order theories emerged as competing (but complementary) theories. Contrary to Modigliani and Miller's (1958) early assertions, the trade-off and pecking order theories suggest that capital structure matters because it influences a company's risk profile to investors which, in turn, affects how much businesses pay to compensate creditors for assuming the risks of all their prior funding decisions (Harris & Raviv, 1991; Titman & Wessels, 1988). A critical review of public finance literature revealed enterprises, such as utility systems with sizeable and ongoing funding needs, are most in need of symmetrical information to reduce creditors' risks and the associated compensation to investors (Harris & Raviv, 1990; Halov & Heider, 2011; Guerrini, Romano, & Campedelli, 2011; Scott & Pidherny, 2018).

2.3.2.1 Trade-off theory. The trade-off theory broadened capital structure theories by introducing concepts pertaining to balancing the costs and benefits of debt and equity (Myers, 1984). This theory asserted the costs of financial distress, realized as debt, may be offset with shields that reduce tax liabilities (Myers, 1984). Myers (1984) argued when businesses opt to use debt financing for operations or growth, their decisions are arrived at by trading off on the costs of bankruptcy, or financial distress. The optimal capital structure is the difference between the enterprise's value and its debt levels, and the subsequent outlays related to raising capital, versus benefits of reduced liabilities and of debt monitoring (Myers, 1984). In Figure 2.2, the straight horizontal line indicates firm value using 100% equity funding. Debt has benefits in that, although it requires repayment of interest, those payments tend to be tax deductible, which is known as the interest tax shield. Tax deductible interest payments increase firm value until the enterprise borrows more and passes its optimal debt level, at which point firm value declines when the enterprise must pay higher levels of interest.

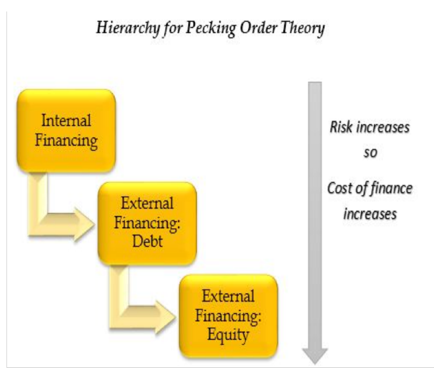


Source: ebrary.net

Figure 2.2. Trade-off theory and optimal capital structure.

Reducing the costs of debt with offsets that lower the total amount of debt owed is important because fewer debt obligations leave more available for capital investment. The trade-off entails considering the costs and benefits of raising funds through equity or borrowed capital, but it indicates an advantage to debt financing that decreases as marginal costs of financing increases and debt increases (Myers, 1984). Therefore, to minimize costs, firms optimize their value by balancing when its best to use debt or equity. In practice, several limitations of the trade-off theory exist, such as company management may deem it pragmatic to use a hierarchical financing approach in which funding is obtained from retained earnings first, followed by debt, rather than target a specific capital structure (Myers, 1984; Myers & Majluf, 1984). Further, some industries and firms go against that which the theory predicts. This renders the theory unable to explain why most profitable firms often have the lowest debt ratios and highest shareholder returns, characteristics that are more likely to occur with companies that increase their debt. This, in turn, bolsters the belief that financing is not dependent on achieving a targeted capital structure (Megginson, 1997; Pinegar & Wilbricht, 1989).

2.3.2.2 Pecking order theory. By comparison, the pecking order theory posits that financing decisions are backed by a hierarchy of least-to-most risk, with external funding, such as bonds and equity shares, as the latter and internal cash funds as the former (Myers & Majluf, 1984). The pecking order theory meshes with less stringent interpretations of Modigliani and Miller's theory in that, although employing debt is more risky and costlier than internal funds, it has benefits in cases where it can offset financial distress. Financial distress is addressed in the assertion that informed capital investment decisions are less likely to result in underinvestment and unnecessary assumption of risk (Myers & Majluf, 1984; Titman & Wessels, 1988).



Source: EfinanceManagement.com

Figure 2.3. Hierarchy for pecking order theory.

The financing hierarchy in Figure 2.3 is a result of the relative costs associated with each type of funding, the degree of risk, and the level of information asymmetry. Corporate finance literature insinuates that even the least risky financing source has capital structure consequences (Chen & Chen, 2011). Despite the absence of borrowing costs associated with cash drawdowns, the conundrum of cash is that its use reduces financial flexibility and forgoes opportunities to invest or pay down debt (Chen & Chen, 2011). High cash balances tend to lower the weighted average cost of capital because of its relatively low yield, which matters because cash reserves are likely to be drawn on first if financial performance becomes unsteady. Using the least risky source, as with other sources of funding to improve financial stability, warrants monitoring because companies must determine if the lost benefits outweigh the costs of their funding decisions. If not, then companies must consider whether other sources are more suitable for the particular circumstance.

Pecking order theory also asserts that a company's funding decisions vary contingent on information imbalances in transactions between that which is known by the company's management and that which is understood by investors (Myers & Majluf, 1984). Such information then leads investors to determine the level of risk the debt or equity investments pose. Although a positive facet of applying pecking order concepts is the consideration of the qualitative aspects of management's actions as a determinant of capital structure, an unrealistic assumption is that officials always behave in the best interests of equity holders to maximize company value.

Though superior to the trade-off theory in its allowance of the unique tendencies of each enterprise to dictate optimal capital structure, the pecking order theory has limitations in practice. One limitation is that the theory does not explain the influence of taxes, financial distress, issuance costs for securities, agency costs, or available investment opportunities. Another general limitation is that the theory ignores the problems that can arise when such high levels of liquid assets and unused debt capacity are accumulated such that management become immune to market discipline (Copeland, Weston, & Shastri, 1988). Nonetheless, limitations in one area do not necessarily apply under all circumstances; tax consequences and foregoing investment opportunities are not a consideration for nonprofits. For this reason, the pecking order theory is a complement to, rather than a substitution for, the traditional trade-off model. This complementary relationship is because the traditional trade-off model is useful for explaining corporate debt levels, while the pecking order theory explains changes to leverage. Neither theory can fully explain all of the reasons underlying management’s considerations regarding their preference for debt instead of equity. Therefore, the circumstances under which the enterprise operates dictate the selection of financing choice, and the chosen financing option may change as circumstances warrant.

2.4 Firm-Level Theoretical Determinants of Capital Structure

Findings from numerous empirical studies on the theoretical determinants of capital structure indicate it is influenced by external and internal factors. Those factors categorized as internal include the calculable variety that measures financial flexibility and financing costs. Conversely, external determinants include legal and regulatory requirements, economic environment, and industry competition (Frank & Goyal, 2003; Rajan & Zingales, 1995; Titman & Wessels, 1988). External factors are not specific to any company nor does the company possess any control of said factors. Combined with management decisions, external factors contribute to the firm’s overall financial health and must be considered in financing decisions, but internal determinants are firm-specific and reveal the financial health of the enterprise as a result of those decisions (Alipour, Mohammadi, & Derakhshan, 2015; Frank & Goyal, 2003; Handoo & Sharma, 2012).

Wide-ranging groupings emerged as a result of these studies. Although researchers have indicated their support of the complementary trade-off and pecking order theories, disagreement exists in two areas: the number and reliability of the determinants, and the magnitude and direction of the coefficients (Frank & Goyal, 2003; Rajan & Zingales, 1995; Titman & Wessels, 1988). Researchers have broadly identified common determinants to include liquidity, profitability, growth, size, tangibility of assets (value of fixed assets and inventory), risk lowering tax shields for nondebt, earnings volatility, industry classification, macroeconomic conditions, risk, stock return and value of the enterprise, availability of internal funds, agency cost of equity, operating leverage, financial constraints, age, default probability, regulation and ownership, and uniqueness of the firm (Chen, 2004; Handoo & Sharma, 2012; Harris & Raviv, 1990; Hittle, Haddad, & Gitman, 1992; Huang & Song, 2006). However, given the lengthy number of influencing factors, relative importance of each remained a question.

Titman and Wessels' (1988) study on domestic corporations extended empirical work by expanding the number of theoretical determinants through examining short- and long-term debt and arbitrage pricing to determine returns on assets. Effectively, the researchers stated selection of best applicable variables may be a point of contention because these explanatory variables may not fit all enterprise types (Titman & Wessels, 1988). More applicable to this study on municipal water systems is Khodjamirian's (2008) study on the capital structure of nonprofit organizations. The researcher observed nonprofits do not borrow using formal financial instruments. This finding is comparable to municipal water systems that issue tax-exempt debt and those systems that lack access to the capital market and must resort to financial intermediaries (Denison & Hur, 2001; Khodjamirian, 2008; Scott & Pidherny, 2018; Wedig, Hassan, & Morrisey, 1996). To resolve this, using Bayesian information criteria, Frank and Goyal (2009) studied the set of variables to reduce the possibility of using too many overlapping, unreliable, and insignificant determinants.

Because disagreements exist among the theories pertaining to the many varied determinants of capital structure, suitable variables must be determined based on the context of the business sector in which the firms operate (Harris & Raviv, 1991; Titman & Wessels, 1988). For this study, this researcher identified seven firm-specific variables in the literature that apply to the financial assessment of municipal water system leverage. The literature identified these variables as capital structure determinants based on their proven ability to convey financial position and predict future financial stability (Chen & Shimerda, 1981; Mead, 2018; Scott & Pidherny, 2018). Additionally, because empirical studies indicate a lack of agreement among the capital structure theories regarding the influence on some elements of an entity's capital structure, the following section presents the relevant capital structure theories and the influence of each determinant on leverage.

2.4.1 Profitability. Profitability is the degree to which financial gain is achieved because of enterprise activities. This measure shows the ability to produce earnings that exceed expenses incurred when conducting business operations. The pecking order theory claims a negative association occurs between profitability and leverage because enterprises will use available resources derived from retained profits before resorting to borrowed funds. Therefore, systems that are able to draw on reserves are less inclined to opt for the use of debt (Myers & Majluf, 1984).

In various empirical studies, researchers have established an inverse association between leverage and profitability because higher profitability reduces dependence on external funds (Rajan & Zingales, 1995). Frank and Goyal (2003) observed, however, that although many researchers agree with the inverse relationship, other reasons may exist as to why pecking order is not the sole interpretation to inform why profitability could decrease with debt. Through a study on the trade-off theory, Frank and Goyal asserted high profitability allows for increased borrowing capacity, and net profits decline as a result of paying off debt. When segregating companies based on size, other research shows that in some industries, such as manufacturing, profitability may influence the way smaller firms make financing decisions because of information asymmetry that results in not having the same level of access to external capital as their larger counterparts (Halov & Heider, 2011). Moreover, when the firms are able to access debt, it may adversely affect profitability (Halov & Heider, 2011; Obert & Olawale, 2010).

Should financial performance decline, reserves are likely to decline as well, which results in declining profit margins raised by water rates. Insufficient water rates spur a need to increase charges to cover operations and maintain stability. Continued distress would warrant borrowing; additional research suggests that more profitable and larger businesses face less risk caused by lack of access to capital than their smaller counterparts because of increased revenue streams and better information symmetry that lowers the costs of accessing external funds (Louiselle & Heilman, 1982; Obert & Olawale, 2010). However, leverage and profitability share a positive association because of the preferences of profitable systems to borrow external funds rather than increasing costs to customers and to keep cash available. Despite higher costs associated with issuing bonds versus cash drawdowns, bonds provide the enterprise with a way to spread costs for a period of time during the life of those bonds while maintaining higher profit margins that would be reduced from the effects of this indicator on cash flows. Nonetheless, for public water systems, ratepayers may view it unfavorably to have sizable reserves when there are outstanding capital projects and when water rates are perceived as too high.

2.4.2 Growth. Growth indicators show the income-generating abilities of a firm's existing assets are limited by underinvestment and leverage. Growth opportunities are determined by the ability of an enterprise to produce earnings from its assets, funds that allow additional investment in capital projects. The trade-off theory suggests that enterprises that have more opportunities for growth tend to have less debt (Frank & Goyal, 2003). Myers and Majluf (1984), however, argued that enterprises with more growth opportunities tend to be less leveraged. The researchers reasoned this is because realized growth pushes businesses towards assuming more risk and debt to facilitate that growth, whereas those with fewer growth prospects tend to use self-funding (Myers & Majluf, 1984). The pecking order theory suggests the association between growth and debt is positive. This association occurs because capital funding constrains cash, and though growing enterprises may have more access to cash, smaller firms may have less access to the debt market (Klein & Belt, 1994). Additionally, because the potential to increase assets and revenues is constrained by the size of the customer base, this may result in fewer resources, which limits the ability of smaller businesses to access debt.

This finding lends support to assertions that growth shares a positive relationship with debt. A potential caveat is that mature, low-growth enterprises that have virtually no competition are more often highly leveraged if they are fixed capital stock-intensive companies. Government accounting literature notes that as near-monopolistic enterprises, public water systems' growth is not based solely on increased income driven by changes in revenues or expenditures. Systems' growth also results from other factors, such as the effects of changes that drive the service area population where the system is dependent (Klase, 1995; Klein & Belt, 1994; Mead, 2018; Scott & Pidherny, 2018).

Another assertion of the pecking order of financing is that high growth firms tend to be more informationally asymmetrical when they are small (Myers & Majluf, 1984). However, researchers have performed the majority of tests on larger firms because of the lack of available information from smaller businesses (Graham, Leary, & Roberts, 2015; Guerrini et al., 2011; Halov & Heider, 2011; Obert & Olawale, 2010; Rajan & Zingales, 1995). The suggestion is that businesses with growth potential may be less leveraged as a direct result of their inability to provide information to creditors. That is, smaller companies often do not have the resources necessary to provide the information about their organization that investors and creditors seek. Inability to provide requisite information limits access to the debt market—something that low-growth monopolistic enterprises, such as utility companies, are able to avoid.

2.4.3 Liquidity. The financial strength of water utilities places particular emphasis on the liquidity ratio because it indicates inputs and outputs of annual cash flows to fund operations and maintenance, and a better ability to manage debt obligations. Although finance literature supports the assertion that liquidity (as indicated by the ability to generate cash from daily operations) is the most important measure of financial health, conflicting findings reveal differences in its influence on leverage because of prospective effects of enterprise size by assets and industry-specific characteristics (Chen & Chen, 2011; Frank & Goyal, 2003). This finding confirms the need for analysis of both.

Although the trade-off theory predicts a positive association between leverage and liquidity, the pecking order theory upholds that low liquidity businesses are not as likely to access the debt market (Frank & Goyal, 2003). This discrepancy is because the trade-off theory expects firms to trade off the costs of debt to achieve the benefits of optimal liquidity, while the pecking order theory proposes firms with higher liquidity levels will be more likely to draw on retained earnings rather than borrow. Therefore, a negative relationship exists.

Pecking order theory suggests drawdowns of reserves may indicate distress. In addition, because repeated draws on fund balances leave fewer funds for capital investment, either water rate increases or borrowing will be required (Myers & Majluf, 1984). Enterprises with high retained earnings to total assets tend to finance their operations from profits rather than relying on borrowed funds, while weak or young enterprises tend to have smaller retained earnings and are more prone to failure because of a limited ability to access needed capital (Altman, 1968; Chang, Chen, & Liao, 2014; Chen & Chen, 2011; Harris & Raviv, 1991; Myers, 1984). As the theory indicates regarding financial distress, if liquidity is reduced to the point that the system cannot handle the pressures of forces that affect financial operations, means of funding beyond available cash must be considered. An inverse relationship thus exists between leverage and liquidity. Researchers have argued that opting to use available cash reserves in the event of financial distress may be the most efficient choice in short-term scenarios, but not realistic for large capital expenses and long-term funding needs (Frank & Goyal, 2003; Mead, 2018; Scott & Pidherny, 2018). Cash drawdowns have consequences in terms of the perceived value and financial stability of the system when systems attempt to access capital from the debt market (Frank & Goyal, 2003; Mead, 2018; Scott & Pidherny, 2018).

2.4.4 Firm Size. Total asset size is a consequential determinant of capital structure owing to empirical observations that fewer assets are a feature of enterprises that are not as efficient and project lesser long-term sustainability indicators than their better-capitalized counterparts (Harris & Raviv, 1990). In studies pertaining to bankruptcy and liquidation costs, the trade-off theory provides rationale for a positive association between capital structure and firm size. This theory is ideal because larger enterprises tend to be less likely to descend to bankruptcy than smaller firms.

Demonstrated pecking order observations indicate companies with larger asset classes are not as likely to experience fiscal distress and a bankruptcy outcome relative to their total value. Some scholars have argued that smaller enterprises have higher information asymmetry-related costs, leading to a negative association between size and leverage (Halov & Heider, 2011). However, when applied to larger enterprises, researchers find conflicting negative and positive relationships between size and leverage. This finding is because larger firms have increased access to debt but, conversely, less need for borrowed funds because of their ability to generate revenues and retained earnings (Rajan & Zingales, 1995). The pecking order theory negatively associates firm size with leverage in firms that have higher amounts of assets. Larger firms tend to have fewer information asymmetry problems and better access to the capital markets, making the use of equity more likely than debt. Smaller firms pay larger penalties arising from information asymmetry, such that the smaller the asset size, the greater the tendency to use debt (Rajan & Zingales, 1995). This information predicts a negative association between leverage and firm size. However, literature reveals conflicting results arise when researchers specifically target utility systems, which are high in fixed assets because of the large infrastructure assets that comprise their balance sheets (Ittelson, 2009; Klase, 1995; Scott & Pidherny, 2018; Mead, 2018). In examining the effects of size on the leverage of specifically-defined clusters of utility systems, Guerrini et al. (2011) used a parametric statistics method. The researchers found smaller systems tend to have the highest turnover of capital, and larger systems tend to have higher debt ratios partly related to their ability to access more credit. Asset size in water systems is dependent on the size of the customer base and geographic area served, and those with fewer customers are more likely to resort to borrowing than using internal funds (Guerrini et al., 2011; Howe, 2005; Loaiciga & Renehan, 1997).

2.4.5 Risk. Conflicting views of risk continue despite consensus in the literature that risk is a crucial determining factor of enterprise debt (Alipour et al., 2015; Halov & Heider, 2011; Kale, Noe, & Ramirez, 1991). Although empirical results of some studies reveal a negative correlation between leverage and risk, others established a positive association when firm size is considered in concert with its overall efficiency (Halov & Heider, 2011; Titman & Wessels, 1988).

The trade-off theory suggests enterprises with higher business risk should have lower levels of debt because the cost of raising debt is lower than that of raising equity, and because interest on debt has tax-deductible advantages (Myers & Majluf, 1984, Frank & Goyal, 2003. However, the pecking order theory asserts when funding from internally derived sources is not an option, increased risk in leveraging the enterprise occurs, creating volatility and reducing efficiency in asset usage that measures management's effectiveness in revenue utilization (Myers & Majluf, 1984).

The unconventionality of the pecking order theory rests with its incorporation of information asymmetry, because managers have preferential access to information that investors lack pertaining to the financial health of the enterprise. As discussed earlier, increased risk creates vulnerability that larger firms are less susceptible to than smaller firms. This vulnerability is because of the lower proportional costs of an adverse funding selection that affects their capital structure (Halov & Heider, 2011). Investors in water systems do not know the actual value of infrastructure assets so they are unable to accurately evaluate all risks involved with purchasing the enterprise debt issued for system upgrades. The theory argues retained earnings are preferable to external funds but, in the event that drawing from external funds becomes necessary, the appropriate financing method will be chosen based on the perceived level of risk. Further, operating inefficiency increases risk, consequences of which include the need to increase revenues in emergency situations. When inefficiency is sustained through a long period, it influences the order of seeking external funds for projects or operations. The higher the levels of risk, the more positive the association with leverage indicates an increased likelihood of borrowing than drawing from internal funds.

2.4.6 Tangibility. The presence of tangible physical assets that have significant financial value means less dependence on debt and a preference towards using equity. Therefore, an inverse association occurs between tangibility and the leverage of larger enterprises that tend to have fewer borrowing needs as a result of their access to larger internal capital reserves (Harris & Raviv, 1991). Conversely, Rajan and Zingales (1995) are consistent with the trade-off theory in their assertion that leverage and the value of tangible assets do not share an inverse relationship because companies with sizeable tangible assets are perceived as a lower credit risk to investors. It is this perception of lower credit risk that allows enterprises more access to debt (Scott & Pidherny, 2018).

The pecking order theory posits that enterprises with higher tangible assets will have fewer financial challenges stemming from information asymmetry, resulting in less reliance on debt. Utility systems fall into this category given the sizeable fixed assets (e.g., property, plant, and equipment) present on their balance sheet. Additionally, the theory affirms that higher asset tangibility results in more access to borrowed funds that can be supported by the larger reserve of assets as collateral, indicating a positive relationship (Frank & Goyal, 2003).

2.4.7 Firm age. Firm age is an efficiency measure of tangible fixed assets (Mead, 2018). The distinction between the firm age and the measure of tangible fixed assets is that the firm age considers depreciation and deterioration of physical assets while asset tangibility considers their monetary value (Ittelson, 2009; Mead, 2018; Scott & Pidherny, 2018). The trade-off theory suggests a positive relationship between the age of the firm and leverage, while the pecking order theory supports the alternative assumption that the age of a firm affects leverage because mature enterprises are likely to use less debt over time. Some researchers in the literature assert the capital structure of older enterprises tends to have increased retained earnings despite that rapid growth no longer drives their sustainability, while younger firms tend to resort to external markets (Frank & Goyal, 2003; Harris & Raviv, 1991). However, regardless of the age of the assets, there is not always a need to add more leverage, thereby leading to an inverse association between leverage and age (Frank & Goyal, 2003; Harris & Raviv, 1991).

The average age of assets is included as a proxy for the age of the firm variable because the aggregate age of a municipal water system is of little significance unless the efficiency of assets is known. That is, age is a value commensurate with the useful life of assets (Mead, 2018; Scott & Pidherny, 2018). To calculate average age of the system's assets, depreciation of fixed assets is crucial to its valuation and establishing reserves through annual recorded depreciation expenses. In accrual accounting, depreciation is an asset replacement operating cost integrated into capital improvement programs. With newer capital stock, the average age of assets declines and efficiency of assets increases; older systems have higher anticipated capital needs contingent on the maintenance of assets that is critical to long-term viability (Hulten & Peterson, 1984; Musick & Petz, 2015). As the pecking order theory indicates, the inefficiency of assets denotes system viability is being compromised. This result exists when inadequate turnover of capital stock occurs and when insufficient funds are set aside for fixed asset replacement reserves. Higher average age of the enterprise's capital stock is related to a lower level of debt, signifying less borrowing (relative to the use of internal funds) has occurred.

2.5 Empirical Findings on the Determinants of Capital Structure

Modigliani and Miller's (1958) theory of capital structure irrelevance provided the foundation for determining the key characteristics of capital structure. Much of the early empirical research was geared towards publicly traded enterprises located in the United States. Titman and Wessels (1988) combined themes within the theories and, as a result, named growth, uniqueness, firm size, industry classification, asset structure, nondebt tax shields, earnings volatility, and profitability as key theoretical determinants. Attributes of these determinants were then tested to assess their effects on the debt-to-equity choice of the enterprises. Their results revealed conformity to capital structure theories (Titman & Wessels, 1988). Although their research did not provide strong empirical support of volatility, future growth, and nondebt tax shields, it revealed a solid negative association between leverage and profitability.

Since Titman and Wessels' (1988) study, researchers have tested theoretical determinants of capital structure using data collected from enterprises outside the United States. Rajan and Zingales (1995) examined firms in countries that are members of the Group of Seven (G7). However, because of regulatory constraints, financial service firms were eliminated from the study (Rajan & Zingales, 1995). This link encouraged the examination of municipal water systems in the United States because of the common ground of operating under government guidelines, and justified inclusion of the four variables—profitability, growth, firm size, and asset tangibility—to determine any effects on capital structure. Rajan and Zingales revealed a generally positive association between tangibility of assets and leverage in all but one (Japan) of the G7 nations, while the size of the enterprise was positively associated.

Regarding the research contradictions on the magnitude and direction of the determinants' predicted association to leverage, findings from various studies revealed a lack of reliability and consistency among coefficient signs among models. In direct contrast to Titman and Wessels' (1988) findings, Harris and Raviv's (1991, p. 334) research supported prior studies that agreed "fixed assets, non-debt tax shields, growth opportunities, and firm size and decreases with volatility, advertising expenditures, research and development expenditures, bankruptcy probability, profitability and uniqueness of the product" tend to increase leverage. Harris and Raviv found nondebt tax shields, volatility, valuation of collateral, and future opportunities for growth did not affect the capital structure ratio. Although profitability and firm size defined by assets were reliable indicators, these contradictions show that tangibility, growth, and firm risk diverged. Huang and Song (2006) also evidenced this finding and confirmed growth is inversely associated with leverage, but Chen (2004) found a positive association when using historical sales figures. In another study evidencing contractions, Yang, Lee, Gu, and Lee (2010) found a positive association between asset tangibility and leverage while Ahmed Sheikh and Wang (2011) found the reverse. Further inconsistencies exist in Friend and Lang's (1988) study in which a positive association was found between risk and leverage, while Myers (1984) concluded that operating risk has a negative effect when considering firm size.

The variability across findings pertaining to various determinants of capital structure indicated further study was warranted. The ample research on the capital structure of private sector enterprises shows that in earlier years, considerable research pertained to large, nonfinancial manufacturing enterprises that had the most access to funding and the widest array of financing options. Within the United States, during the past century of economic expansion, several changes occurred that prompted study of corporate leverage. Upon development of the financial sector and capital markets, extensive borrowing increased across industries and by firms of all sizes (Graham et al., 2015).

A significant amount of research indicates that prospective determinants of leverage differ in degrees of importance, depending on contextual factors, such as the operating environment, ownership structure, and maturity of the firm's industry or within its sector. US-centric studies were unclear as to how these determinants (that are generally agreed upon domestically) applied to companies internationally, during different economic periods, and with different industry or regulatory oversight (Alipour et al., 2015; Chen, 2004; Handoo & Sharma, 2012; Huang & Song, 2006). Further, because researchers have devoted a majority of attention to larger companies, a lack of clarity exists regarding whether something was unique about U.S. accounting rules and measurements, or whether legal and institutional distinctions produced the varied results (Arapis & Grady, 2015; Ittelson, 2009; Mead, 2018). Various international studies closed that gap of whether leverage models derived from the United States were able to explain capital structure decisions outside of western economies and regulations. In approaching capital structure from different angles, researchers found the determinants used in western countries extended to international firms, but several distinguishing factors made the models applicable outside of western constructs. Huang and Song (2006) stated the importance of institutional environment in emerging Chinese markets increased with fixed assets and firm size, but decreased with profitability and nondebt tax shields.

Alipour et al. (2015) studied nonfinancial Iranian enterprises and found that state ownership made the difference for firms achieving an optimal structure, one in which the maximum value is achieved through the lowest risk. In another study on India's emerging market, Handoo and Sharma (2012) compared private and public sector organizations and combined the firm-specific variables with corporate governance. The researchers found that firms adjust somewhat over time to an optimum capital structure. In another international example, Chen (2004) advised in a Chinese study that certain firm-level factors are relevant to explaining capital structure in mature economies, but capital choices of Chinese firms do not follow the same pecking order of retained earnings. Rather, the firms opt for a different financing order that places long-term debt after equity because of institutional differences and financial limitations, to which western companies are not subjected (Chen, 2004).

What connects these studies is the indication that capital structure issues in emerging and transitioning markets differ from those in developed markets, but they indicate agreement that differences may arise out of the economic, institutional, cultural, and corporate governance-related differences between countries. These findings are important to western countries because they stress a common theme for each region; the studies revealed debt has an advantage over equity financing. The results showed these themed are largely because of the tax-deductible interest payments on debt, unlike payments on retained earnings and dividends. Additionally, the findings indicate that whether the entity, regardless of its industry or corporate sector, is in an emerging market or in a developed nation with a sophisticated capital market, several firm-specific financial determinants remain consistent. Those determinants are liquidity, profitability, risk, size, age, asset tangibility, and growth. Variances tend to be among determinants considered key nonfinancial influences. Such determinants include managerial self-interest and ownership and country-specific elements, such as effects of inflation (Alipour et al., 2015; Frank & Goyal, 2003; Friend & Lang, 1988).

Although the pecking order theory implies firm-level determinants of capital structure appear independent of one another, accounting rules dictate otherwise. Each financial determinant is a ratio derived from financial statements and, as such, the underlying components are inextricably linked. Of significance, balance sheet items are interrelated to cash flow statements by way of the inflows and outflows of cash that is ultimately reported on the balance sheet as cash-on-hand, while the operating or income statement describes the use of assets and liabilities during the reporting period (Ittelson, 2009; Mead, 2018). Additionally, a linear relationship exists between the assets side of the balance sheet and the side composed of liabilities and equity, which includes retained earnings (Arapis & Grady, 2015; Ittelson, 2009; Mead, 2018). As such, because of these connections, a variable may affect leverage independently but also affect the other firm-specific determinants.

2.6 Capital Structure Considerations for Municipal Entities

2.6.1 Debt limits and borrowing restrictions. Capital structure is influenced by statutorily defined borrowing restrictions (Arapis & Grady, 2015; Farnham, 1985; Scott & Pidherny, 2018). Governments use several methods to limit their indebtedness and ensure payment of debt service—usually by legal restrictions that set a cap on total debt as a share of revenues or by establishing a maximum annual debt service limit in addition to ordinances that require payment of debt service before covering any other type of expense (Mead, 2018; Scott & Pidherny, 2018). Most debt is not issued for operations, but rather for capital improvement projects. Self-supporting water systems often issue revenue bonds secured by a pledge of the income generated by the business type entity, which typically fall outside of the cap and are not counted as part of the debt capacity margin of the underlying municipality (Mead, 2018; Scott & Pidherny, 2018). The effect of this is twofold. First, their repayment does not place a direct strain on the financial operations of the issuing municipality, though they are counted as part of the overall debt burden. Second, specific types of infrastructure debt can be repaid in equal installments that match the useful life of the project, thereby facilitating affordability by preventing spikes in payments that affect liquidity (Mead, 2018; Scott & Pidherny, 2018).

Public finance literature maintains that even when municipalities have the legal capacity to issue debt, when their debt capacity is narrowed, it signals diminished financial flexibility to investors and creditors (Farnham, 1985; Mead, 2018; Scott & Pidherny, 2018). Because lower debt capacity indicates an enterprise is getting closer to their borrowing limit, this move is deemed as placing the entity closer to insolvency (Haugen & Senbet, 1978). Further, satisfying capital demands, relative to increasing direct and overlapping debt, places an additional burden on taxpayers that, in turn, affects overall credit quality because of the perception of increased risk (Scott & Pidherny, 2018). With the support of their underlying host municipalities, and generally sound performance of the water sector in the municipal bond market, indications strongly suggest that these systems are not in immediate danger of defaulting on debt obligations. Nonetheless, every decision to utilize externally-sourced funding or to alter water rates is paid for by system users or taxpayers whose ability to support the system is affected by changes in the local economy (Howe, 2005; Loaiciga & Renehan, 1997; Scott & Pidherny, 2018). That burden has increased to municipalities because of previously mentioned trends of diminished financial intervention from federal sources (Louiselle & Heilman, 1982; Mead, 2018; Scott & Pidherny, 2018).

Although the trade-off theory indicates businesses balance tax shield benefits against costs of financial distress, to government systems that do not pay taxes, having more available cash and less debt means more resources to develop infrastructure and cover operations and maintenance needs. As the pecking order theory posits, the penalty for reduced credit quality is higher interest payments for investors and creditors to compensate for the increased risk (Myers & Majluf, 1984; Walter, 1989). Governments have limited funding choices, but officials may be less likely to consider raising funds from investors through bond offerings if taking such action will place their credit rating in jeopardy (Walter, 1989). When a substantial portion of operating income is used to service debt, it diminishes the enterprise's capacity to reinvest its net income in the infrastructure that increases the entity's value. In addition to higher average cost of capital, high levels of debt-to-equity presents a riskier capital structure. Additionally, the manner in which debt is positioned also affects whether the capital structure is considered risky. For example, if debt service payments are substantially allocated to high-interest rates or short-term securities with maturities that do not match the extended life of the infrastructure investment, it harms long-term capital structure prospects because it disallows optimization of the cost of capital that would improve profitability (Frank & Goyal, 2003; Rajan & Zingales, 1995).

2.6.2 Optimal capital structure for municipal water systems. As nonprofit enterprises, municipal water systems may seek increased income to fund projects, but not for the purpose of shielding income from taxes. Although some aspects of capital structure theories can explain differences between industries, they cannot explain some phenomena within the same industry that occur based on management preferences for carrying little to no debt (Friend & Lang, 1988; Hittle, et al., 1992; Obert & Olawale, 2010). Therefore, the assertions of the pecking order theory are more suitable for explaining the effects of various determinants on the capital structure of municipal water systems. Further, a key assumption of the pecking order theory is asymmetric information, which indicates investors do not know more than key officials about the enterprise (Halov & Heider, 2011; Hittle et al., 1992). Therefore, management actions reveal to investors their beliefs about the viability and future prospects of the enterprise. By incorporating the service area population as the customer base, the theory allows for the dynamics of the firm to dictate an optimal capital structure (Copeland et al., 1988). Given this information, this researcher confirms that key officials make funding decisions based not only on the effects on their capital structure, but also on needs that apply specifically to their varied service areas.

Local governments have restrictions on borrowing and debt capacity (Haugen & Senbet, 1978; Mead, 2018; Scott & Pidherny, 2018). Further, as previously noted, smaller cities are likelier to be out of regulatory compliance, which may lead to disproportionately suffering effects of decreased federal and state grants while exacerbating any challenges because of borrowing restrictions (EPA, 2013; Klase, 1995). Researchers analyzing structural and nonstructural causes of debt considers that growing cities make public investments at a faster pace, which influences debt levels and the debt capacity margin (Farnham, 1985; Scott & Pidherny, 2018). This result affects the overall mix of debt-to-equity in the capital structure because of changes in the debt component (Farnham, 1985). More sparsely populated cities do not tend to have the economic clout of their larger, more densely settled counterparts (Simonsen, Robbins, & Helgerson, 2001). However, small systems that are experiencing growth will need access to borrowed funds to secure the working capital that funds the growth (Brewer & Moomaw, 1985). The pecking order theory asserts that larger entities enjoy higher and more frequent access to the debt markets partly because they tend to be better providers of information (Myers & Majluf, 1984). Conversely, because of their lesser ability to provide information, smaller entities have higher information asymmetry, which leads investors and creditors not viewing their credit risk as favorably as their larger counterparts (Myers & Majluf, 1984). This finding suggests that although the decisions made by smaller cities are grounded in financial reasons, they are not made solely because of a prospective effect to the leverage ratio. Considerations, such as the size of the population, may serve as an influence because smaller jurisdictions tend to pay an interest cost penalty in the municipal bond market (Simonsen et al., 2001; Zhao & Guo, 2011).

Although a key principle of the pecking order theory indicates no specific target capital structure, each entity chooses a debt-to-equity mix based on its own needs and circumstances (Hittle et al., 1992; Pinegar & Wilbricht, 1989). For a municipal water system, this key principle means that an appropriate balance is a matter of management’s discretion once risks, costs payable in returns to investors, and the reasonableness of rates charged to customers are considered (Louiselle & Heilman, 1982). Just as seeking an optimal capital structure has advantages for governments, benefits increase for investors and creditors. The primary advantage of government bonds for investors is a comparatively lower level of risk than their corporate counterparts, but that means returns tend to be lower for assuming that risk of nonpayment. Additionally, given the stability of the government sector as a whole, Haugen and Senbet (1978) contended cost considerations factor into financing decisions, but bankruptcy costs should not be a consideration. This claim is because capital structure has no relevance when dominated by debt, rendering irrelevant the trade-off between bankruptcy and tax considerations (Myers & Majluf, 1984).

Legal and financial scholars determined an optimal capital structure is achieved when goals are met at a cost below what it takes to produce them, and the best funding decisions are made when information asymmetry is resolved (Altman, 1968; Louiselle & Heilman, 1982; Myers & Majluf, 1984). Key firm-specific determinants were identified with a caveat that the pecking order of financing decisions tends to describe the actions in larger firms.

2.7 Public Water Systems in Texas

According to the Texas Commission on Environmental Quality, state and federal regulations define public water systems (30 TAC §290.38[71], Fed Ref) as any system that provides potable water for the public's use and has a minimum of 15 service connections (or serves 25 or more individuals for at least 60 days per year). Among other factors, water infrastructure needs in Texas are shaped by its climate. The Texas Water

Development Board reported in its 2017 State Water Plan[2] that the 2010–2014 drought lasted 51 months (from August 2010 to October 2014). The plan also states that this drought was recorded as the second-worst and second-longest statewide drought based on the Palmer Drought Severity Index. The 2011 drought is ranked as the worst 1-year drought in recorded history, prompting the state to create a water plan after 2011. During the course of 1 year, Texas transitioned from virtually drought free to exceptional statewide drought. Water accessibility concerns informed statewide conservation efforts, water-related emergency responses, and infrastructure development—all of which affect water system capital funding decisions, especially when combined with regional population growth. The state scored a D+ ASCE 2017 rating for its drinking water infrastructure, and requires approximately $46 billion to address water infrastructure issues during the next 2 decades, much of which must be funded from a combination of own-source revenues, municipal bonds, state loans, and banking intermediaries. Through the longer term, $218.5 billion will be added to existing local debt.

Although substantial contributions have been made to the study of capital structure, much of the prior research focused on manufacturing firms and entities in mature capital markets and, more recently, government and nonprofit organizations. Limited attention has been directed to municipal water systems (a component of government), particularly those that, similar to companies operating in emerging markets, do not have the same level of access to capital as larger and more mature businesses. By virtue of their size in terms of assets and population served, smaller systems with less developed market access may be less likely to focus on capital structure when

[2] *Texas Water Development Board's Water for Texas 2017 State Water Plan: Drought and drought response in Texas http://www.twdb.texas.gov/waterplanning/swp/2017/chapters/03-SWP17-DROUGHT.pdf*

considering financing decisions. Given the unique challenges faced by Texas and the environment in which its water systems operate, a strong basis supported the study of capital structure determinants of municipal water systems in this state.

2.8 Significance of Research

This study involves existing capital structure theories to examine associations between the determinants of capital structure and extent of leverage of municipal water systems and to analyze those associations in the context of the size of the service area population. This researcher found a gap in prior research regarding the size of the population served; therefore, the study included size as a contextual determinant of the capital structure of municipal water systems. Although population is an external element of which the enterprise has no control, it contributes to the identification of leverage preferences across municipalities. Additionally, year is considered a constant control variable and, as with population, the year and events that take place during that time are factors of which a water system has no control. As such, this study entailed examination of the determinants of capital structure on leverage in different economic periods because changes in a municipality's economic base that affect system users may affect their ability to pay water utility rates (Howe, 2005; Loaiciga & Renehan, 1997; Scott & Pidherny, 2018).

Although this study does not extend the breadth of firm-level capital structure determinants, it involved examination of capital structure in the context of service area population size to assess whether the determinants and decisions on whether to source funds from internal versus external sources vary contingent on population size influences (Brewer & Moomaw, 1985). That is, what remains to be determined is if the size of a population influences capital planning decisions, and whether stratification by size leads to a distinct difference in the magnitude and direction of determinants of leverage. The number of people within a service area is naturally expected to be an important factor affecting infrastructure needs, as demands tend to increase as a population grows. However, increased need does not always translate to increased debt financing, particularly as many of the costs of maintaining a large capital-intensive system are fixed, with increases to the fixed portion of the system occurring through system expansion, and not replacement.

A more comprehensive answer to the question regarding which factors influence capital structure may be found in examination of external determinants, which includes assessment of factors that management incorporates into water infrastructure planning prior to deciding a funding option. This process is especially important for a municipal water system because, in conformity with pecking order concepts, when funds are needed to cover expenses and emergencies, after cash-on-hand, the least risky and costly source is adjusting water rates. However, regulatory requirements do not allow for immediate enactment of rate increases in the same way that a corporation may enact price changes for their goods or services. Water systems fundamentally have two options for funding projects: use internal funds or borrow. Financing projects is not predicated on achieving a targeted capital structure but rather is a reaction to their unique circumstances (Hittle et al., 1992; Megginson, 1997; Pinegar & Wilbricht, 1989). However, although the reasons for needing access to funds for infrastructure development and maintenance, such as aging pipes and filtration mechanisms, are consistent across systems, fewer options and larger constraints may exist for smaller cities.

What is missing from prior studies is a substantial qualitative component to the research built on the aspect of pecking order theory and that is integral to making financing decisions. Knowledge of management's considerations that ultimately result in changes to the capital structure may help address information asymmetry issues. A key facet of this theory is its suggestion that shared data can correct informational imbalances, but sharing data with investors does not inform them regarding the elements and circumstances that led to management's decisions. With utility system users responsible for paying the water rates and the overlapping property taxes and fees that support the host municipality, strong motivation exists for taxpayers, investors, and officials alike to receive a balanced assessment of the ability of the water system to meet future challenges. This assessment is dependent on the management's considerations of how the system should choose to fund infrastructure. The lack of focus on the decisions, versus that revealed by financial ratio determinants, has created a gap in existing studies that this researcher sought to address with qualitative analysis. Such analysis reveals what key water system officials say are their reasons for the funding choices that affect their capital structure. In contrast to prior research, in addition to examining the direction and extent of the effect that firm-specific determinants have on leverage, this study included a focus on the factors that influence the capital planning and funding decisions.

CHAPTER 3: METHODOLOGY

This chapter presents the methodology for examination of capital structure determinants of municipal water systems. Research design is in the first section, followed by the empirical model specification in the second section. Variables and their respective measurements are in the third section, followed by sources of data and collection and data sampling in the fourth section. The method of analysis and methodology limitations appear in the fifth and sixth sections, respectively.

3.1 Research Design

This empirical study entails exploration of the key financial and contextual determinants of the capital structure—operationalized as the debt-to-equity (leverage) ratio—of municipal water systems in the State of Texas. I used mixed methods to determine how each determinant affects leverage based on various financial components and key financial and capital planning officials' statements regarding factors that influence their capital funding decisions.

3.2 Hypotheses and Model Specification

Seven testable hypotheses were in this study. The first pertains to profitability; it states that greater profitability is associated with lower debt levels in water systems. Although trade-off theory concepts address borrowing capacity and debt limits, the hierarchical financing concepts of the pecking order theory address the available funds and the order of their use to achieve the lowest costs and least risk (Frank & Goyal, 2003; Myers, 1984; Myers & Majluf, 1984). Referring to assertions of the latter, municipal water utility systems that have built their financial reserves from operating profits are less likely to issue debt (Myers & Majluf, 1984; Rajan & Zingales, 1995). Additionally, as government enterprises that lack a profit motive, municipal water systems may not have the luxury of building sizeable financial reserves because of considerations given to end-user rate increases and extensive capital project needs. Therefore, this researcher hypothesized that the greater the profitability, the more likely the water system is to opt to use internal funds and raise rates than borrow. Hypothesis 1 is,

H1: Profitability and leverage are negatively associated.

Pecking order funding concepts suggest that less leverage is indicative of an enterprise taking advantage of opportunities to grow operations (Myers, 1984; Myers & Majluf, 1984; Scott & Pidherny, 2018). However, despite trade-off concepts that suggest businesses select from funding options based on weighing costs of financial distress against debt, the reverse may be true in businesses, such as water utility systems, that have exclusive control of a service or are driven by external factors that influence the system's financial operations (Klase, 1995; Klein & Belt, 1994; Myers & Majluf, 1984; Scott & Pidherny, 2018). The surrounding area in which the enterprise is located may further exacerbate this contradiction in that systems located in areas with a small customer base have fewer growth opportunities and are more likely to resort to borrowing debt than raising water rates. The second hypothesis indicates that growth opportunities are positively related to leverage:

H2: Growth and leverage are positively associated.

Use of retained earnings may be caused by financial distress but, conversely, liquidity may be reduced to defer water rate increases to pay for capital projects with cash-on-hand rather than resorting to the debt market (Altman, 1968; Chen & Chen, 2011; Frank & Goyal, 2003). Additionally, enterprises in areas populated with fewer users may be more likely to resort to accessing external funds than raising water rates to lessen the direct effect that would adversely influence fewer people who share costs, rather than extending costs to future users. For a municipal water system, the effects of liquidity on the capital structure may be influenced by the size of the customer base. If a large customer base exists from which the system can draw fees, then expansion is facilitated by more customers to share in the costs, revealing a negative relationship as leverage decreases over time. Additionally, liquidity may be inversely related to leverage in enterprises when circumstances are such that borrowing yields higher funds to either resolve more capital needs or to prevent the system users from carrying too much sudden and burdensome debt than would raising water rates. Following pecking order concepts, because an increase in liquidity from raising water rates is expected to result in a decrease in leverage, the third hypothesis is,

H3: Liquidity and leverage are negatively associated.

Although trade-off theory arguments are predicated on financial distress, an essential pecking order theory assertion pertains to information asymmetry (Halov & Heider, 2011; Rajan & Zingales, 1995). The opposing effects are from two distinct aspects of the key capital structure theories: the latter theory suggests that water systems that possess more assets—that is, the larger the entity—are capable of providing more information to prospective investors and creditors, which reduces lack of information symmetry-related costs of funding. The former theory suggests that a water system's value, when compared to its debt, is influenced by its size in that stockpiled debt obligations are offset by tax shield benefits. Therefore, the trade-off theory indicates asset size is negatively related to leverage in smaller firms and positively associated in larger enterprises. However, given that the benefits of tax shields are not applicable to municipal water systems, they may be expected to follow pecking order financing concepts, indicating that as size increases, leverage may decrease when the end-user population withstands water rate increases rather than solely spreading costs to future users. Therefore, the fourth hypothesis is,

H4: Size of assets and leverage are negatively associated.

The fifth hypothesis pertains to the levels of operational risk and its relationship to leverage factors that influence that risk. The trade-off theory suggests that higher business risk means lower debt levels. This assertion is because the cost of raising debt is lower than that of raising equity, and because interest on debt has tax-deductible advantages. Pecking order theory assertions regarding operational ineffectiveness insinuate that the inability to financially manage emergencies, and the lack of access to resources that could stabilize and sustain financial operations for the long term, contribute to increased risk. The more substantial the risks the more likely that the enterprise will resort to issuing debt obligations to cover existing operations and to improve the enterprise rather than raising water rates and drawing from existing reserves (Halov & Heider, 2011; Titman & Wessels, 1988). As such, Hypothesis 5 is,

H5: Risk and leverage are positively associated.

For a water system, higher amounts of tangible assets indicate these enterprises are more likely to resort to borrowing rather than raising water rates. This assumption is because larger pools of tangible assets from which to draw resources provide collateral, thereby enabling the enterprise to borrow against itself rather than draw on internal funds and following pecking order funding predictions (Frank & Goyal, 2003). The sixth hypothesis associates greater amounts of physical tangible assets with more debt. Additionally, water systems in areas populated with fewer end-users are more likely to resort to borrowing than raising water rates to spread costs across future users. Therefore, Hypothesis 6 states,

H6: Asset tangibility and leverage are positively associated.

The seventh hypothesis pertains to the relationship between the enterprise's age and capital structure. The average age of a water system's capital stock is inversely related to the level of debt. The addition of new capital stock reduces the combined average age of all physical assets, which, in turn, improves the overall efficiency of assets (Hulten & Peterson, 1984; Musick & Petz, 2015). Higher average age of the system's capital stock is related to a lower level of debt, suggesting less borrowing for maintenance requirements has occurred and that the system used internal funds, aligning with the predictions of the pecking order theory. Further, water enterprises in areas populated with more system users are more likely to have a greater need to borrow than raise water rates; borrowing would bring the average age down. Therefore, Hypothesis 7 is,

H7: Average age of assets and leverage are negatively associated.

Much of the literature indicates linear regression is used to explain the effects of the capital structure determinants on leverage (Huang & Song, 2006; Obert & Olawale, 2010; Rajan & Zingales, 1995). The following general equation estimates the determinants of capital structure, measurements discussed later in this section. The equation is in alignment with capital structure theories and its linear structure is in accordance with financial accounting norms:

$$CS = f\,(PR, GR, L, S, R, T, A, POP, Year)$$

CS = Capital Structure, defined as the ratio of debt-to-equity
1: PR = Profitability
2: GR = Growth
3: L = Liquidity
4: S = Size by Assets
5: R = Risk
6: T = Tangibility of Assets
7: A = Age of Assets
POP = Service Area Population

Therefore, the specified model is:

$$CS = \beta_0 + \beta_1 (PR) + \beta_2 (GR) + \beta_3 (L) + \beta_4 (S) + \beta_5 (R) + \beta_6 (T) + \beta_7 (A) + POP + \varepsilon$$

Where the numbers 1 through 7 correspond to the respective capital structure determinant noted, and β is the coefficient, β_0 is the constant (intercept). The error term is represented by ε.

3.3 Variables and Assumptions

The following variables test the hypotheses related to the capital structure:

3.3.1 Dependent variable: Capital structure (leverage). The measure of leverage for municipal water utility systems is ratio of debt to equity, because large fixed asset systems tend to be heavily laden with fixed capital stock such that consideration must be given to how much of the system is owned by its users versus its creditors (Frank & Goyal, 2003; Rajan & Zingales, 1995). The importance of the leverage variable is because of the ability of debt levels to indicate the potential for long-term growth and financial sustainability. The debt-to-equity ratio assesses the ability to use internal resources rather than external sources for funding needs, thus a higher ratio is associated with higher risks and lower reserves. A lower ratio is favorable because it represents the least risk for creditors (Mead, 2018). Leverage tends to decline when enterprises borrow less and, because leverage is debt, it increases when capital investment occurs. This result alludes to financial operating conditions, as borrowing may imply insufficient availability of funds to cover all capital needs. Researchers have found larger enterprises to experience increased access to borrowed funds (Harris & Raviv, 1990; Klein & Belt, 1994). This increased access is because of their greater ability to resolve information asymmetry and because of proportionally lower costs of issuing debt based on asset size as compared to smaller systems that seek access to the debt market (Klein & Belt, 1994; Obert & Olawale, 2010). The pecking order reaction to fiscal distress suggests that as financial distress increases, the actual capital structure will change as a result of declining reserves that require debt to pay for capital requirements (Gombola & Ketz, 1983; Obert & Olawale, 2010).

3.3.2 Independent variables: Firm-specific financial determinants. The following definitions relate to the capital structure determinant ratios.

Profitability (X_1). Measured by the gross margin, which is net income to total operating revenues, profitability is an indicator of water rate adequacy. This ratio reveals the flexibility to cover operating expenses, such as salaries. Because it measures the profits from selling water service, it also measures the percentage of revenues available to fund other aspects of water system maintenance (Chen & Shimerda, 1981; Gombola & Ketz, 1983; Mead, 2018).

Growth (X_2). Measured by percent change in net revenues to total assets, a low total asset ratio can indicate myriad problems, such as a long collection period for accounts receivables or under-utilized fixed assets. Both problems present significant challenges for utility systems with narrow revenue streams and sizeable fixed infrastructure stock (Altman, 1968; Chen & Shimerda, 1981).

Liquidity (X_3). Liquidity is measured by the current ratio which, at current assets to liabilities, indicates the difference between available cash resources and debt obligations that are due for repayment within one year (Chen & Shimerda, 1981; Klase, 1995; Mead, 2018; Scott & Pidherny, 2018). The greater the value of cash assets, the more favorable the conditions for meeting operating needs and repaying debt obligations. When using this measure, researchers should place emphasis on understanding that a negative value is not invariably a financial stress indicator, nor are high values always positive because it may indicate excess cash is not being invested in capital projects (Chen & Shimerda, 1981; Gombola & Ketz, 1983; Myers & Majluf, 1984).

Size of Assets (X_4). Firm size is indicated by total assets to total liabilities, and those assets must be sufficient to cover inventory and prevent cash from declining below levels that would render the enterprise unable to meeting cash needs for accounts payable (Mead, 2018; Scott & Pidherny, 2018). Size is used as a proxy for information asymmetry between the enterprise and prospective creditors because greater total assets are viewed as an indication of the availability of resources to provide prospective investors with the data required to make informed decisions (Altman, 1968; Chen & Shimerda, 1981; Gombola & Ketz, 1983).

Risk(X_5). As a measure of operating expenditures to total operating revenues, risk is an indicator of financial efficiency in that it reveals ability to manage financial volatility (Altman, 1968; Chen & Shimerda, 1981). Risk pertains to uncertainty in operations and income that jeopardizes the ability to withstand systemic disruptions because income unpredictability is a credit risk to investors (Scott & Pidherny, 2018).

Tangibility (X_6). Tangibility is a measure of fixed-to-total assets. Fixed assets include property, plant, and equipment that cannot be easily converted to cash, whereas total assets include cash and easily liquid convertible cash equivalents (Altman, 1968; Chen & Shimerda, 1981; Gombola & Ketz, 1983).

Average age of assets (X_7). Calculated as accumulated depreciation to depreciation expense, this figure is crucial to overall valuation. Older systems have higher anticipated capital needs, thus declines in average age indicate newer capital stock that, in turn, increases the efficiency critical to long-term viability (Hulten & Peterson, 1984; Little, 2005; Musick & Petz, 2015).

3.3.3 Contextual variable: Service area size or population. The area population variable refers to the number of permanent residents who access the resource provided by the utility system and place demands on services within the legal boundaries covered by the municipal water system. In addition to paying for the costs of maintaining infrastructure investments, the service area population contributes to changes in the use of physical assets as growth affects demands on the system (Scott & Pidherny, 2018). The number of people in the service area is a proxy for the size of the firm, which Chen and Chen (2011) found to interact with profitability because of the ability of large enterprises to take on more debt yet remain less susceptible to bankruptcy. Further, Klase (1995) found smaller communities are most likely to suffer the consequences of inadequate means to raise infrastructure improvements funds, especially without assistance from federal and state sources. The size and scope of water system infrastructure is commensurate with the monetary valuation of its property, plant, and equipment. However, a system that covers a physically vast region can serve a densely or sparsely populated area. Therefore, evaluation of the effects of population size differs from the assessment of the effect of asset size on capital structure.

3.3.4 Control variable: year. This variable represents the unit of time meant to accommodate any number of historical and institutional factors that are not readily observable during the course of time in the municipal systems. It is included as a control in the regressions for all factors that are constant across the utility systems within a particular period. Additionally, for ancillary analysis, the years included in the study were grouped together by economic cycle.

According to the National Bureau of Economic Research (NBER)[3], an economic recession is defined as a contraction in the gross domestic product (GDP) for 6 months, or two consecutive quarters, that generally do not last longer than 1 year. The pre-Recession period in this study includes 2004–2007 data. This date range is followed by a period that encompasses the Great Recession of 2008–2009, and 2010–2011, delineated as the early recovery "economic malaise" period when GDP remained flat and the economy suffered the lingering effects of the recessionary period's downturn. The latter part of this frame is characterized by lingering economic stagnancy and the beginning of slow growth that began after the Great Recession. The post-Recession period is from 2012–2017.

[3] *NBER is a private, nonprofit, nonpartisan organization dedicated to conducting economic research and to disseminating research findings among academics, public policy makers, and business professionals. NBER research lists US business cycle expansions and contractions.*

Table 3.1

Variables, Description, and Predicted Sign

Variable	Description / Ratio Calculation	Predicted Sign
X1: Profitability	Net income to total operating revenues.	-
X2: Growth	Net revenues to total assets.	+
X3: Liquidity	Current assets to current liabilities.	-
X4: Size	Total assets to total liabilities.	-
X5: Risk	Operating expenditures to total operating revenue.	+
X6: Tangibility	Fixed assets to total assets.	+
X7: Average age	Accumulated depreciation divided by annual depreciation expense.	-

3.4 Data Sources and Sampling

3.4.1 Data sources. Financial data are from publicly available and audited Comprehensive Annual Financial Reports (CAFR)—the set of financial statements that include a balance sheet, operating statement, cash flow reconciliations, and statistical data. Validity and reliability stem from audits that comply with generally accepted accounting principles and requirements established by the Governmental Accounting Standards Board[4] (Arapis & Grady, 2015; Mead, 2018). This researcher calculated and documented ratios for the firm-specific capital structure determinants in an electronic spreadsheet. The process involved uploading each municipality and values into statistical software.

[4] *The Governmental Accounting Standards Board (GASB) is the independent, private-sector organization based in Norwalk, Connecticut, that establishes accounting and financial reporting standards for U.S. state and local governments that follow Generally Accepted Accounting Principles (GAAP). https://www.gasb.org/jsp/GASB/Page/GASBLandingPage&cid=1175804799024*

This research also included qualitative data gathered from the Capital Improvement Programs and the nonfinancial sections of each entity's CAFR. Per Governmental Accounting Standards Board standards[5], a CAFR is a disclosure and accountability document geared towards financial transparency that is designed to promote public and investor trust. Each of the 98 municipalities' annual CAFR, for all 14 years of the study, comprise the 1,372 management interviews that were used for the qualitative elements of this study. Nonfinancial data were derived from the independent auditor's notes, notes to the financial statements, and the Management Discussion & Analysis (MD&A). The independent auditor's notes provide an assessment as to whether the reporting of the entity's financial transactions, accounting practices, and internal controls comply with generally accepted accounting principles. The notes to the financial statement divulge during- and postaccounting period information. The Appendix includes an example of a CAFR and the previously noted sections.

Key financial government personnel and other officials who compile data for the CAFR and are documented in the MD&A section of the audited report provided detailed insights regarding how well management performed their duties. The MD&A is one of the most crucial portions of the annual report; for researchers, analysts, and practitioners, it is the primary source of detailed qualitative information. This section relies on management interviews in which addressing operational and financial performance is a result of qualitative and quantitative measures. Combined with the auditor's notes and the

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[5] *The Governmental Accounting Standards Board states that its standards are recognized as authoritative by state and local governments, state Boards of Accountancy, and the American Institute of CPAs (AICPA). The GASB develops and issues accounting standards through a transparent and inclusive process intended to promote financial reporting that provides useful information to taxpayers, public officials, investors, and others who use financial reports.*

notes to the financial statement that divulge during- and post-accounting period information, the MD&A comprehensively details financial controls, regulatory compliance, and actions either planned or taken to address challenges that affect performance. Analysts (primarily rating agencies, underwriters, and investment banks) learn about these challenges when they conduct interviews to gather information about current and prospective operations (Arapis & Grady, 2015; Mead, 2018). The MD&A also contains information pertaining to (a) the multiyear capital improvement program and more immediate projects; (b) their projected effects on spending goals and entity-wide objectives capital funding plans, prospective bond offerings, and trends in available federal and state grants and loans; and (c) the effects of exogenous factors on finances. This researcher organized the data and categorized it into key themes to document management considerations in developing and funding capital needs and the influences that ultimately affect their decision to use leverage.

3.4.2 Population and Sampling. This study included a dataset composed of municipally-owned water systems that serve approximately two-thirds of the population that use public water in Texas. The state is the nation's second-largest by combined land and water area, and it is home to six of the nation's 25 largest cities and approximately 29.1 million residents according to 2018 census estimates. Given its population and landmass, the state has substantial water infrastructure that serves the public.

I selected Texas for this study, first, because of my interest in the state's ongoing issues with drought and water access, and their potential for altering the financial stability of systems that provide a vital resource. Additionally, the state provides a diverse source of cases based on the size and composition of municipalities, which enhances generalizability of the results to other states and to other generally monopolistic utilities, such as electric and gas systems that share sizeable and costly fixed asset infrastructure composition similarities with water systems (Little, 2005; Mead, 2018). Second, issues of data consistency and availability limited previous studies of water systems. Thus, the Texas Municipal League's annual survey of its municipalities about their water systems provided information for trend analysis regarding water rates as the primary revenue source.

Third is the focus one state allows for identical regulatory compliance requirements at the subnational level, as both federal and state agencies regulate public utilities. However, the third point carries some limitations; although calculation of each financial variable is identical across public water systems in any state, researchers must exercise caution in the interpretation of the significance of ratios. This is because variances in state and local health and safety regulatory requirements, as well as variances in operating conditions caused by exogenous factors, such as climate-related events, mean that the inputs that affect revenues, expenditures, assets, and liabilities ultimately affect the ratios that are determinants of capital structure (Arapis & Grady, 2015). As an example, the ratio of current assets to current liabilities is a measure of liquidity, whether the balance sheet is from a water system in Texas or any other state. However, current assets may be affected by unique circumstances within each state, such as revenue-raising ability or labor expenditures affected by costs associated with regulatory compliance. For this reason, comparisons of debt and equity financings across sectors warrant examination of unique industry-specific factors. This comparison applies not only to municipal water systems, which are functionally hybrid business enterprises operating under municipal government control, but also applies when comparing water systems to other large-fixed asset public enterprises, such as electric and gas utilities and transit systems (Ittelson, 2009; Mead, 2018; Scott & Pidherny, 2018).

The sample frame includes 98 systems spanning fiscal years 2004 through 2017, a period of unprecedented drought, several major superstorms, and hurricanes that affected infrastructure and water availability. Within this timeframe are economic cycles that include the Great Recession (officially December 2007 through June 2009, followed by a 2-year period of economic malaise[6]), thus capturing changes that may have affected system revenues and capital investments in the periods before, during, and post-recovery.

3.5 Method of Analysis

3.5.1 Quantitative analysis. Quantitative research involves mathematical computations in addition to regression analysis. The determinant variables and their interaction with leverage are primary areas of interest, with the size of the service area population providing context. The year controls for conditions that may affect capital structure, separate and distinct from financial determinants.

3.5.1.1 Ratio calculations. The first portion of quantitative analysis consists of calculations for all ratios. Ratios are examined in terms of flows to determine how much their respective levels changed during a period of time. Ratios that span several years are generally more reliable tools than examining 1 year in isolation (Klase, 1995; Mead, 2018).

3.5.1.2 Regression analysis. Regression analysis (ordinary least squares) determined the effect of each determinant on leverage (capital structure). An analysis of

[6] Appelbaum, Binyamin (April 24, 2011). "Stimulus by Fed Is Disappointing, Economists Say". *The New York Times.*

variance (ANOVA) revealed differences in leverage based on the size of the service area population (see Wilson, Keating, & Beal, 2015).

3.5.2 Qualitative analysis. Given that a key aspect of the pecking order theory is information asymmetry, which posits that financing costs are lower when investors receive more information, this study includes qualitative information that contributes to capital structure choices and resolves the informational imbalances between management and creditors or investors. Enterprises determine their own optimal leverage, and each financial ratio (determinant) is the result of decisions that influence financial health, affecting future financing decisions. A qualitative assessment of those decisions allows for a more comprehensive understanding of how the entity's capital structure was realized.

This portion of the study includes all cases in the sample, 46% of which are categorized by the Texas Municipal League's survey as small- and medium-size and the remaining are large based on service area population. Rationale for attention to small and medium systems is two-fold: (a) the pecking order theory indicates smaller systems face more funding limitations, and (b) the EPA (2013) noted small systems are more likely to be out of compliance with monitoring standards. I identified and categorized emergent themes to determine the qualitative influences on leverage. These influences affect their funding decisions and, ultimately, their ability to borrow funds, set rates, and collect fees to re-coup revenues lost during economic crises or systemic failures.

3.6 Limitations

Experiential perspectives exhibit differences among municipalities that have voting control of various aspects of capital spending and water rate increases. Therefore, differences posed by governance and political distinctions may result in degrees of dissimilarity in influence regarding financing decisions and what is considered an optimal capital structure. Additionally, a potential exists for endogeneity with the regression models; there are unmeasured, confounding variables that may affect the relationships established between the variables of interest (see Zohoori & Savitz, 1997). It is not possible to account for the influence of every covariate relationship. Therefore, I applied caution to the interpretation of the findings and did not automatically make generalizations to the larger population.

CHAPTER 4: RESULTS

The purpose of this study was to examine the determinants of capital structure of municipal water systems. The study also examined what influences the decisions to finance using different funding sources. This chapter includes empirical inferences and the findings of the data analysis.

4.1 Quantitative Analysis and Interpretation of Results

4.1.1 Descriptive statistics. Data analysis involved the calculation of ratios for the firm-specific capital structure determinants and the documentation of the ratios in an electronic spreadsheet for each of the 98 municipalities and for every year of the series. I uploaded the values into SPSS Version 25.0 for Windows. Examination of descriptive statistics for the determinants and leverage values followed. For each municipality, there were 14 years of data were collected (2004–2017). Table 4.1 presents the descriptive statistics for all 14 years.

Table 4.1

Descriptive Statistics for Determinants and Leverage (2004–2017)

Variable	*Min*	*Max*	*M*	*SD*
X1: Profitability	-0.53	0.97	0.21	0.16
X2: Growth	-0.04	0.16	0.03	0.02
X3: Liquidity	0.34	83.05	5.68	6.39
X4: Size	0.92	86.82	3.69	5.52
X5: Risk	0.26	1.53	0.79	0.16
X6: Tangibility	0.17	1.12	0.84	0.11
X7: Average age	0.15	50.12	13.97	5.58
Leverage	-50.07	169.46	1.54	6.29
Population	100.00	2396076	241493.06	450575.03

Note. Sample size (*n*) = 1372 cases.

4.1.2 Inferential analysis. I first conducted an ANOVA to further examine for differences in leverage by population. The results of the ANOVA were significant, *F*(6,

1364) = 4.48, $p < .001$, indicating significant differences existed in leverage among the levels of municipal population.

Post hoc-tests allowed for further examination of the differences through the use of pairwise comparison. Leverage for each population size was compared to the other population sizes. Leverage for population 5,001–15,000 was significantly larger than leverage for populations 25,001–75,000 and 75,001–200,000. Leverage for population 500,001+ was significantly larger than leverage for populations 25,001–75,000 and 75,001-200,000. The findings of the ANOVA justified the inclusion of population as a control variable in the regression analyses. Table 4.2 presents the results of the ANOVA. Table 4.3 presents the means and standard deviations.

Table 4.2

Analysis of Variance Table for Leverage by Population

Term	*SS*	*df*	*F*	*p*	η_p^2
Population group	1048.26	6	4.48	< .001	0.02
Residuals	53207.06	1364			

Table 4.3

Mean, Standard Deviation, and Sample Size for Leverage by Population

Combination	Leverage		
	M	*SD*	*n*
1–5000	2.57	0.93	28
5,001–15,000	3.55	13.24	83
15,001–25,000	1.30	2.90	154
25,001–75,000	1.23	3.57	414
75,001–200,000	0.80	1.13	382
200,001–500,000	1.20	1.21	110
500,001+	2.98	12.60	200

To address the research questions, I conducted a multivariate linear regression to examine the predictive relationship between the determinants and leverage. The determinants included profitability, growth, liquidity, size of assets, risk, asset tangibility, and average age of assets. The continuous dependent variable in the model was leverage. Year and population were included as control variables. Part of the regression analysis involved testing the following hypotheses.

H1: Profitability and leverage are negatively associated.

H2: Growth and leverage are positively associated.

H3: Liquidity and leverage are negatively associated.

H4: Size of assets and leverage are negatively associated.

H5: Risk and leverage are positively associated.

H6: Asset tangibility and leverage are positively associated.

H7: Average age of assets and leverage are negatively associated.

Prior to the analysis, testing of the assumptions of normality and homoscedasticity occurred. I visually test the assumption of normality through a normal P-P plot (see Figure 4.1). For the normality assumption to be met, the data in the P-P scatterplot should closely follow the diagonal trend line. The data seemed to deviate from the normality trend line, suggesting the assumption was not met. Stevens (2009) indicated the violations of the assumption of normality are not problematic when the sample size exceeds 50 cases, such as the 1,372 cases in this study. I visually tested the assumption of homoscedasticity through a residuals plot. For the assumption to be met, there should be a random spread in the scatterplot. A random scatter existed in the residuals scatterplot;

however, this cluster of data also resembles a line. This can be attributed to the repeat use of municipalities for different years (see Figure 4.2).

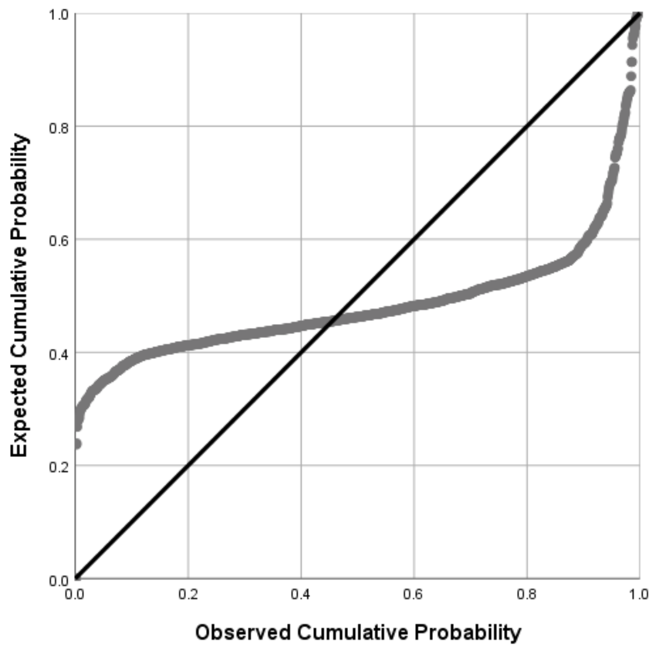

Figure 4.1. Normal P-P plot for regression with determinants predicting leverage (2004–2017).

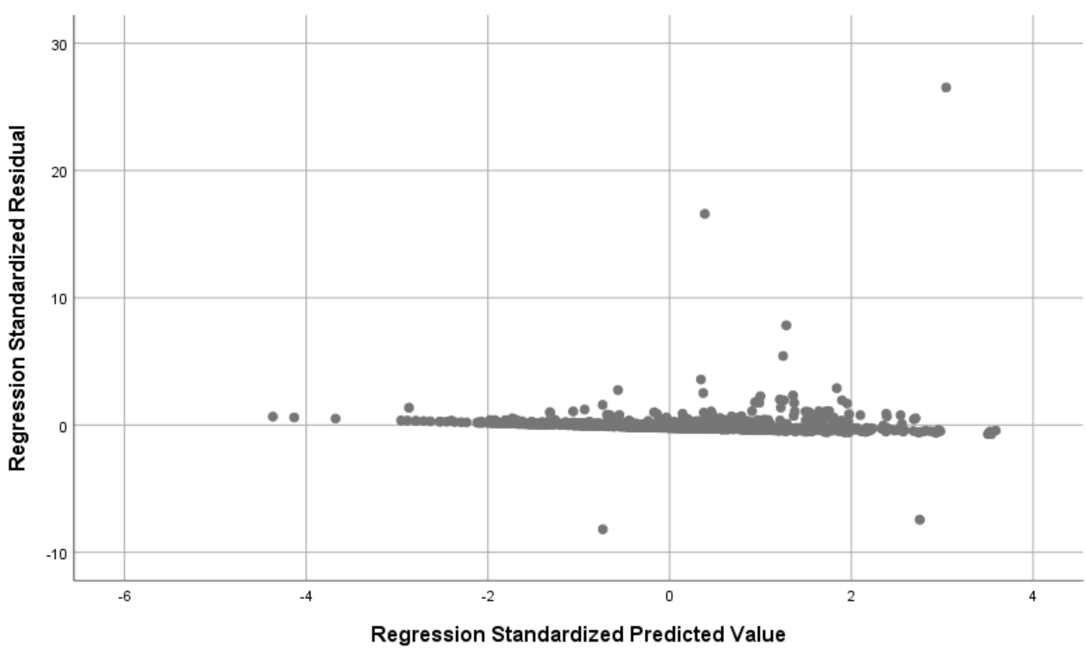

Figure 4.2. Residuals scatterplot for regression with determinants predicting leverage (2004–2017).

Results of the first step of the multiple linear regression were statistically significant, $F(2, 1368) = 11.71$, $p < .001$, $R^2 = .017$, suggesting a significant relationship existed between year, population, and leverage. Results of the second step of the multiple linear regression were statistically significant, $F(9, 1361) = 6.42$, $p < .001$, $R^2 = .041$, suggesting a significant relationship existed between year, population, profitability, growth, liquidity, size of assets, risk, asset tangibility, average age of assets, and leverage. The R^2 value only increased by 2.4% between the two steps. The predictors explained 4.1% of the variance in leverage.

Liquidity ($t = -2.35$, $p = .019$) was a significant predictor in the model, suggesting that with every 1-unit increase in liquidity, leverage decreased by approximately 0.06 units. Average age ($t = -3.37$, $p = .001$) was a significant predictor in the model, suggesting that with every 1-unit increase in average age, leverage decreased by approximately 0.11 units. Because of evidence of a statistically significant relationship between liquidity, average age, and leverage, H_3 and H_7 were supported. No sufficient evidence supported H1, H2, H4, H5, and H6. Table 4.4 presents the results of the multiple linear regression.

Table 4.4

Results for Hierarchical Linear Regression With Determinants Predicting Leverage, While Controlling for Year and Population

Predictor	*B*	SE	β	*t*	*p*
Step 1					
Year	0.04	0.04	0.03	1.04	.298
Population	1.75×10^{-6}	0.00	0.13	4.68	<.001
Step 2					
Year	0.07	0.04	0.04	1.57	.116
Population	1.64×10^{-6}	0.00	0.12	4.06	<.001
X1: Profitability	-0.34	5.18	-0.01	-0.07	.948
X2: Growth	-4.62	11.72	-0.02	-0.39	.694
X3: Liquidity	-0.06	0.03	-0.07	-2.35	.019
X4: Size	-0.05	0.03	-0.05	-1.68	.093
X5: Risk	-3.57	5.15	-0.09	-0.69	.489
X6: Tangibility	0.63	1.64	0.01	0.38	.702
X7: Average age	-0.11	0.03	-0.10	-3.37	.001

Note. For Step 1 model, $F(2, 1368) = 11.71$, $p < .001$, $R^2 = .017$; for the Step 2 model, $F(9, 1361) = 6.42$, $p < .001$, $R^2 = .041$.

4.1.3 Ancillary analyses. To further explore the relationships, data analysis entailed examining three periods around the Great Recession:

- Before: 2004–2007
- During: 2008–2011
- After: 2012–2017

I examined the periods separately to assess whether the financial ratios revealed susceptibility to changes in the underlying municipal economy that may affect revenues. The profitability ratio is derived from revenues and expenditures—stability of which are key drivers of financial sustainability. Despite that the revenue stream generated from water sales is narrower than revenues generated from general municipal operations, water utilities face somewhat different pressures than those faced by general governments. This difference in economic pressures is largely because of (a) waters' value as a life-sustaining resource, (b) lien-enforceable billing by household that boosts revenue collections, and (c) the financial support provided by transfers from the host municipality to make up budgetary shortfalls (Klase, 1995; Mead, 2018; Scott & Pidherny, 2018). The dataset was transposed by year so each of the 98 municipalities was treated as a separate unit of interest. I conducted a series of multiple linear regressions to individually examine these time periods. Profitability was highly correlated to the other determinants and was left out of the regression model for the period during the Recession as a predictor variable.

4.1.3.1 2004–2007: PreRecession. Descriptive statistics allowed for examination of the determinants and leverage values during the preRecession period (2004–2007). Table 4.5 presents the descriptive statistics for 2004–2007. Prior to the analysis, testing of the assumptions of normality and homoscedasticity occurred. The data slightly deviated from the normality trend line (see Figure 4.3). The assumption of homoscedasticity was met because of a nonrecurring pattern appearing in the plot (see Figure 4.4).

Table 4.5

Descriptive Statistics for Determinants and Leverage (2004–2007)

Variable	*Min*	*Max*	*M*	*SD*
X1: Profitability	-0.51	0.57	0.21	0.15
X2: Growth	-0.02	0.10	0.04	0.02
X3: Liquidity	0.88	48.76	6.32	6.72
X4: Size	1.07	68.30	3.94	7.25
X5: Risk	0.43	1.51	0.79	0.15
X6: Tangibility	0.29	0.99	0.83	0.13
X7: Average age	1.42	27.58	12.57	5.25
Leverage	-7.54	14.56	1.35	2.34
Population	148.00	2116618.50	220003.40	416553.38

Note. Sample size (n) = 98 cases.

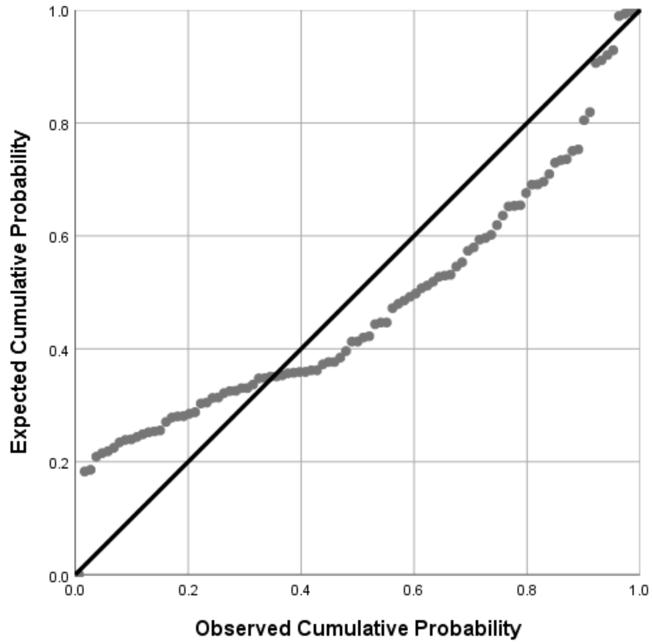

Figure 4.3. Normal P-P plot for regression with determinants predicting leverage (2004–2007).

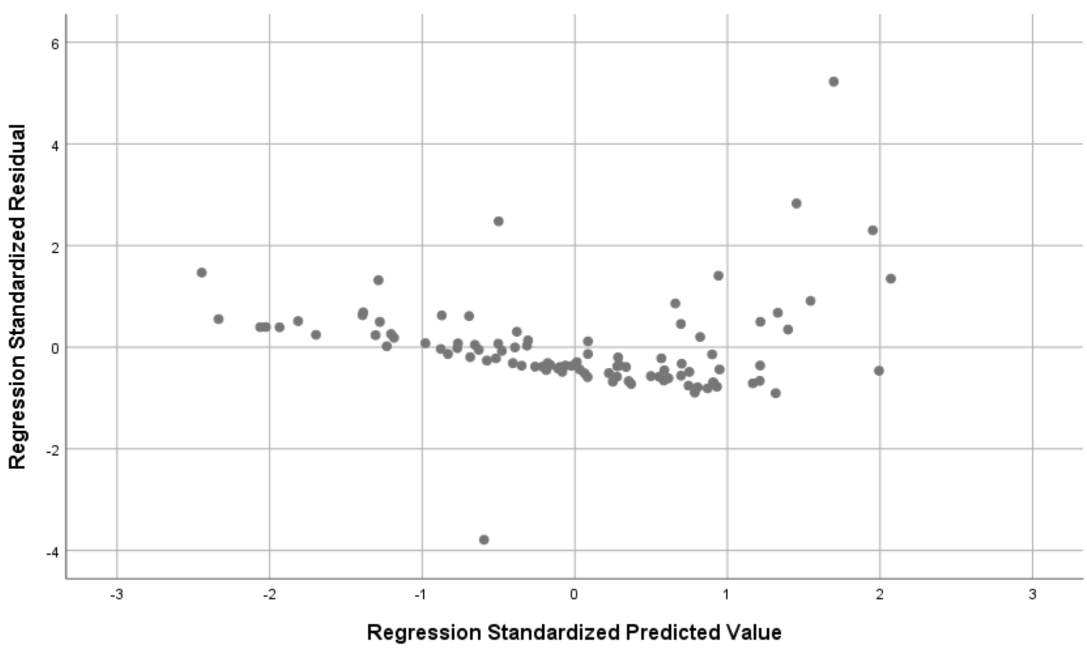

Figure 4.4. Residuals scatterplot for regression with determinants predicting leverage (2004–2007).

Results of the first step of the multiple linear regression were not statistically significant, $F(1, 95) = 3.08$, $p = .083$, $R^2 = .031$, suggesting no significant relationship existed between population and leverage. Results of the second step of the multiple linear regression were statistically significant, $F(7, 89) = 3.34$, $p = .003$, $R^2 = .208$, suggesting a significant relationship existed between population, growth, liquidity, size of assets, risk, asset tangibility, average age of assets, and leverage. The R^2 value increased by 17.7% between the two steps. The predictors explained 20.8% of the variance in leverage.

Average age ($t = 1.90$, $p = .001$) was a significant predictor in the model, suggesting that with every 1-unit increase in average age, leverage decreased by approximately 0.17 units. Evidence of a significant relationship between average age and leverage supports H7. No sufficient evidence supported H1, H2, H3, H4, H5, and H6. Table 4.6 presents the results of the multiple linear regression.

Table 4.6

Results for Hierarchical Linear Regression with Determinants Predicting Leverage, While Controlling for Population (2004–2007)

Predictor	*B*	SE	β	*t*	*p*
Step 1					
Population	9.99×10^{-7}	0.00	.18	1.76	.083
Step 2					
Population	1.11×10^{-6}	0.00	.20	1.90	.061
X2: Growth	-2.97	18.21	-.03	-0.16	.871
X3: Liquidity	-0.03	0.04	-.10	-0.97	.336
X4: Size	-0.04	0.03	-.12	-1.27	.208
X5: Risk	-2.00	2.51	-.13	-0.80	.428
X6: Tangibility	0.12	1.86	.01	0.06	.949
X7: Average age	-0.17	0.05	-.37	-3.39	.001

Note. For the Step 1 model, $F(1, 95) = 3.08$, $p = .083$, $R^2 = .031$; for the Step 2 model, $F(7, 89) = 3.34$, $p = .003$, $R^2 = .208$.

4.1.3.2 2008–2011: Great Recession and Recovery Period. Descriptive statistics allowed for examination of the determinants and leverage values during the Great Recession and subsequent Recovery period (2008–2011). Table 4.7 presents the descriptive statistics for 2008–2011.

Table 4.7

Descriptive Statistics for Determinants and Leverage (2008–2011)

Variable	*Min*	*Max*	*M*	*SD*
X1: Profitability	-0.30	0.70	0.21	0.14
X2: Growth	-0.02	0.10	0.03	0.02
X3: Liquidity	0.82	31.67	5.50	4.79
X4: Size	1.07	33.45	3.53	4.36
X5: Risk	0.31	1.30	0.80	0.14
X6: Tangibility	0.58	0.99	0.84	0.10
X7: Average age	3.95	24.22	13.56	5.11
Leverage	0.02	14.29	1.42	2.37
Population	116.00	2197786.25	236465.93	441007.15

Note. Sample size (*n*) = 98 cases.

Prior to the analysis, testing of the assumptions of normality and homoscedasticity occurred. The data slightly deviated from the normality trend line (see Figure 4.5). The assumption of homoscedasticity was confirmed because of a nonrecurring pattern appearing in the plot (see Figure 4.6).

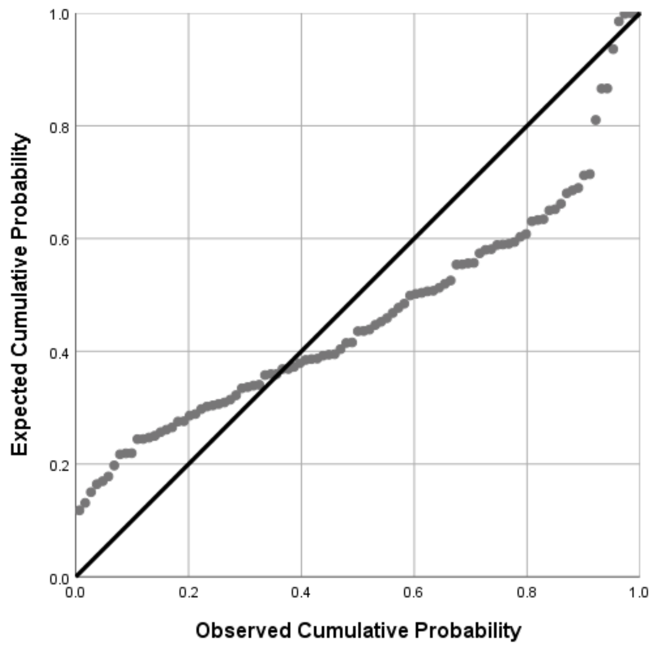

Figure 4.5. Normal P-P plot for regression with determinants predicting leverage (2008–2011).

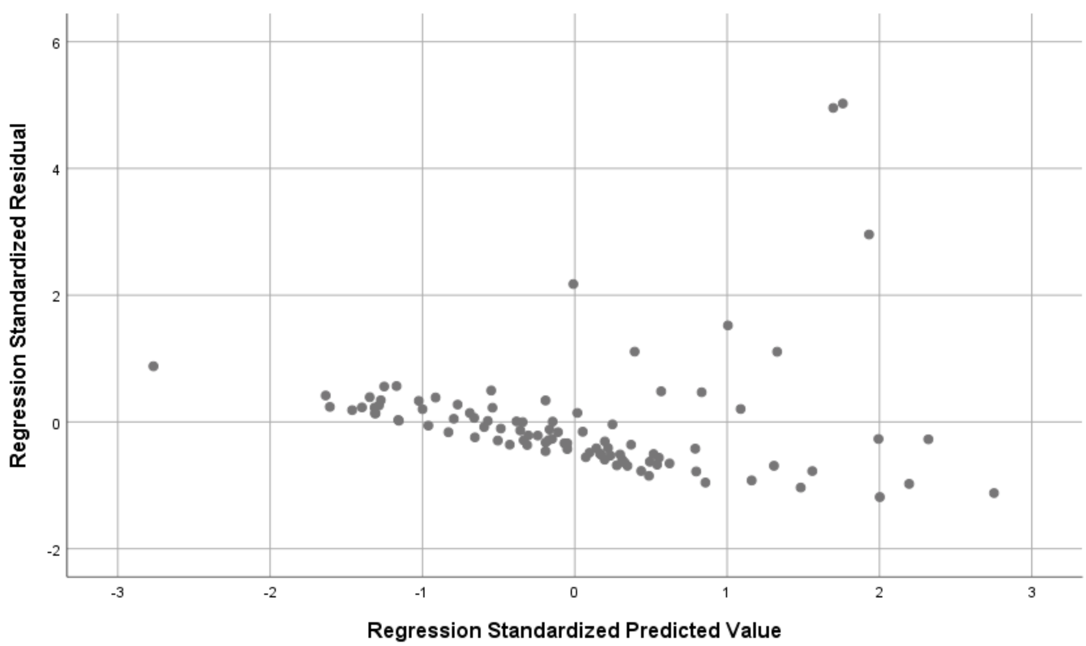

Figure 4.6. Residuals scatterplot for regression with determinants predicting leverage (2008–2011).

Results of the first step of the multiple linear regression were statistically significant, $F(1, 95) = 8.47$, $p = .004$, $R^2 = .082$, suggesting a significant relationship existed between population and leverage. Results of the second step of the multiple linear regression were statistically significant, $F(7, 89) = 4.23$, $p < .001$, $R^2 = .250$, suggesting a collectively significant relationship existed between population, growth, liquidity, size of assets, risk, asset tangibility, average age of assets, and leverage. The R^2 value increased by 16.8% between the two steps. The predictors explained 25.0% of the variance in leverage.

Liquidity ($t = -2.01$, $p = .047$) was a significant predictor in the model, suggesting that with every 1-unit increase in liquidity, leverage decreased by approximately 0.10 units. Average age ($t = -2.27$, $p = .026$) was a significant predictor in the model, suggesting that with every 1-unit increase in average age, leverage decreased by approximately 0.11 units. Because of evidence of a significant relationship between liquidity, average age, and leverage, H3 and H7 were supported. No sufficient evidence supported H1, H2, H4, H5, and H6. Table 4.8 presents the results of the multiple linear regression.

Table 4.8

Results for Hierarchical Linear Regression with Determinants Predicting Leverage, While Controlling for Population (2008–2011)

Predictor	*B*	SE	β	*t*	*p*
Step 1					
Population	1.54×10^{-6}	0.00	.29	2.91	.004
Step 2					
Population	1.36×10^{-6}	0.00	.25	2.51	.014
X2: Growth	-0.08	21.97	-.00	-.00	.997

X3: Liquidity	-0.10	0.05	-.20	-2.01	.047
X4: Size	-0.04	0.06	-.07	-0.68	.498
X5: Risk	3.51	2.93	-.20	-1.20	.235
X6: Tangibility	1.61	2.72	.06	0.59	.557
X7: Average age	-0.11	0.05	-.24	-2.27	.026

Note. Step 1) $F(1, 95) = 8.47$, $p = .004$, $R^2 = .082$, Step 2) $F(7, 89) = 4.23$, $p < .001$, $R^2 = .250$.

4.1.3.3 2012–2017: PostRecession. Descriptive statistics allowed for examination of the determinants and leverage values during the postRecession period (2012–2017). Table 4.9 presents the descriptive statistics for 2012–2017. Prior to the analysis, testing of the assumptions of normality and homoscedasticity occurred. The data slightly deviated from the normality trend line (see Figure 4.7). The assumption of homoscedasticity was confirmed because of a nonrecurring pattern appearing in the plot (see Figure 4.8).

Table 4.9

Descriptive Statistics for Determinants and Leverage (2012–2017)

Variable	*Min*	*Max*	*M*	*SD*
X1: Profitability	-0.10	0.59	0.22	0.14
X2: Growth	0.00	0.09	0.03	0.02
X3: Liquidity	0.49	27.62	5.37	4.74
X4: Size	1.05	25.05	3.63	4.20
X5: Risk	0.42	1.10	0.79	0.14
X6: Tangibility	0.54	0.99	0.84	0.08
X7: Average age	6.05	28.91	15.17	4.67
Leverage	0.00	28.15	1.75	4.36
Population	103.67	2354199.33	259170.93	481283.11

Note. Sample size (n) = 98 cases.

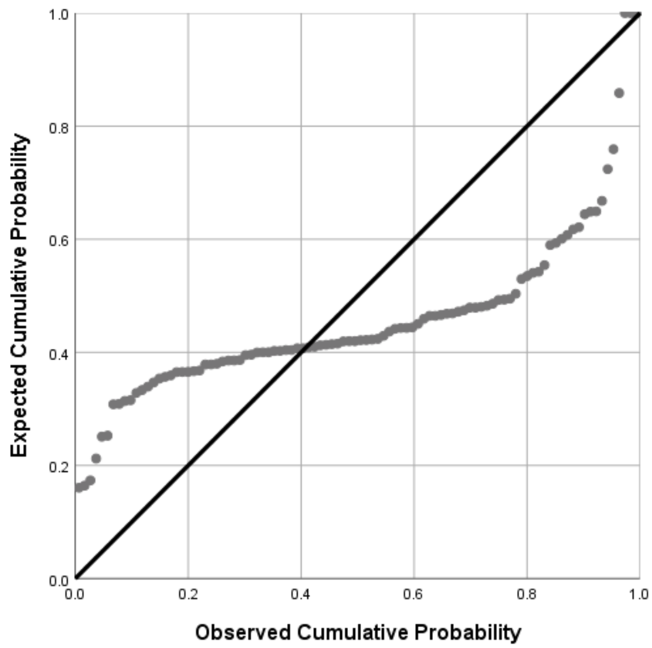

Figure 4.7. Normal P-P plot for regression with determinants predicting leverage (2012–2017).

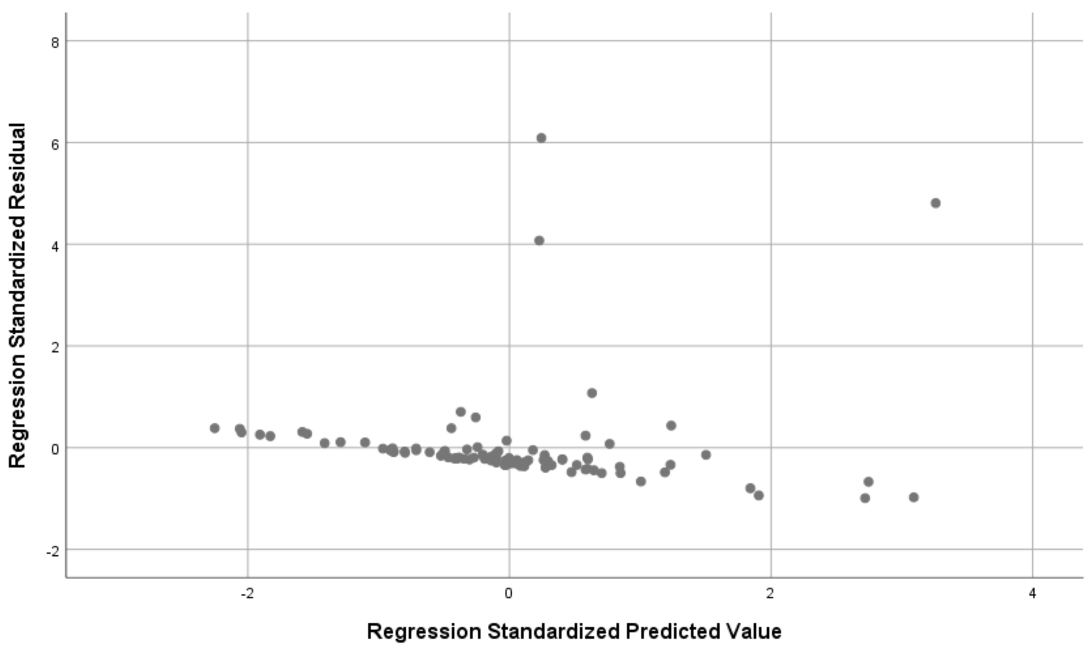

Figure 4.8. Residuals scatterplot for regression with determinants predicting leverage (2012–2017).

Results of the first step of the multiple linear regression were statistically significant, $F(1, 96) = 6.19$, $p = .015$, $R^2 = .061$, suggesting a significant relationship existed between population and leverage. Results of the second step of the multiple linear regression were not statistically significant, $F(8, 89) = 1.45$, $p = .186$, $R^2 = .115$, suggesting no collectively significant relationship existed between population, profitability, growth, liquidity, size of assets, risk, asset tangibility, average age of assets, and leverage. The R^2 value increased by 5.4% between the two steps. The predictors explained 11.5% of the variance in leverage. However, none of the determinants was a significant predictor individually of leverage. No sufficient evidence supported H1, H2, H3, H4, H5, H6, and H7. Table 4.10 presents the results of the multiple linear regression.

Table 4.10

Results for Hierarchical Linear Regression with Determinants Predicting Leverage, While Controlling for Population (2012–2017)

Predictor	*B*	SE	β	*t*	*p*
Step 1					
Population	2.22×10^{-6}	0.00	.25	2.49	.015
Step 2					
Population	2.38×10^{-6}	0.00	.26	2.25	.027
X1: Profitability	-5.77	13.97	-.18	-0.41	.681
X2: Growth	13.85	39.53	.06	0.35	.727
X3: Liquidity	-0.13	0.10	-.14	-1.29	.202
X4: Size	-0.11	0.12	-.11	-0.93	.355
X5: Risk	-6.39	13.71	-.21	-0.47	.642
X6: Tangibility	-3.09	6.07	-.06	-0.51	.612
X7: Average age	-0.09	0.11	-.10	-0.89	.374

Note. Step 1) $F(1, 96) = 6.19$, $p = .015$, $R^2 = .061$, Step 2) $F(8, 89) = 1.45$, $p = .186$, $R^2 = .115$.

4.2. Qualitative Findings

Although this study involved assessment of seven quantitative ratios identified as potentially significant capital structure determinants, the decisions that lead each entity to its own optimal capital structure indicates that not all aspects of financial sustainability can be quantified. Qualitative data cannot be gleaned from quantitative methods and are helpful for examining factors considered by key officials within their decision-making setting, thereby filling in missing unquantifiable elements (Hsieh & Shannon, 2005). The qualitative portion of this study stems from the elements that key financial officials document as the most important elements in the process of making financing decisions. To understand management's decisions that ultimately affect capital structure, data analysis entailed thematic analysis to detect patterns in their strategic planning, infrastructure improvement, and budgeting data relating to frequency. Documents from which information was gathered included the nonfinancial sections of each entity's CAFR and the multiyear Capital Improvement Programs, both of which are accountability and financial transparency documents that provide details pertaining to officials' performance of their duties. The MD&A was the primary source of exhaustive qualitative information on financial controls and regulatory compliance measures, as well as planned and actual actions taken to address challenges to financial performance. This portion of the study relied on 1,372 management interviews, compiled from each of the 98 municipalities and all 14 years of the study. Using this operational and financial performance data, qualitative and quantitative measures were applied to all years to examine trends and differences in the key factors that comprised management's decisions. I coded content by frequency, followed by the aggregation of results. Findings are in the context of the size of the service area population where applicable.

Several broad themes emerged from the unstructured qualitative data concerning operating margins based on revenues and management of expenditures, socioeconomic and taxpayer considerations, and debt management. Drawing on theoretical fundamentals, the categories align with the primary pecking order financing objective of seeking least-to-most costly sources of funding. Key officials provided a clear indication that what is deemed an optimal capital structure is specific to each enterprise and the unique circumstances surrounding its funding decisions. The following section provides a discussion of the overarching categories considered by finance directors and budget officers as determining factors that affect capital structure.

4.2.1 Operating margins. The ability to generate financial resources with enough flexibility for current operations and maintenance, while providing for future needs, is at the core of management's responsibilities. The operating margin is indicative of profitability, or the funds that remain after the revenues generated by water sales cover the costs of providing the service. Officials at every system in the study cited flexibility as management's first financial priority. Higher operating margins create the financial flexibility considered in budgeting practices, planning for contingencies, and in terms of perceptions of prospective investors. Examples of circumstances that warrant sound operating margins are unexpected flooding, such as that which occurred in the Brazos River Basin, and San Angelo's need to simultaneously increase pipe capacity and replace aging pipe infrastructure. Each of these events adversely affected expenses, thus lowering the operating margin. Given its crucial role as a financial performance indicator, officials from the Sherman water system noted that operating margins are monitored to ensure their unrestricted water fund balances are kept at all times at 60 days of expenses.

4.2.2 Financial flexibility and budgeting. Data revealed the most significant increases in expenses tend to be in three areas: costs related to water purchases, labor costs and contributions related to pensions and benefits, and replacement or expansion projects, such as water purification plants. All officials in the sample of 98 entities noted financial sustainability relies on setting clear financial performance targets determined by regular analysis of revenue and expenditure forecasts compared to recent historical trend figures. For example, the municipal water systems of Burleson, Carrollton, Cedar Park, and Corinth all attribute their unrestricted reserves and the ability to keep water rate increases moderate to their conservative budgeting practices, which facilitates financial flexibility. Management at each system stated establishing financial performance metrics leads to realistic resource management plans that facilitate the ability to manage financial volatility.

Officials further indicated conservative budgeting practices are necessary to reduce the likelihood of shortfalls and minimize deferral of systemic enhancement projects. For example, the cities of Austin, Belton, Waco, Watauga, and Wichita Falls had projects that included drainage and water reuse, some of which was paid for from funds made available because of conscious efforts to not financially overextend in prior fiscal years. A key reason cited for consistent assessment of whether current fiscal year resources can generate margins that provide for current needs and contingencies is to determine the adequacy of water rates. The lack of sufficient flexibility for the next budget cycle, because of inadequate water rates, informs potential creditors. Tight margins indicate a constrained ability to meet ongoing obligations, consequently increasing costs to obtain external funding. No discernible difference between large versus small or medium-size systems existed, as defined by service area population and regarding the importance of maintaining financial flexibility and budgeting for contingencies. As with other large systems, the municipalities of Plano and Amarillo diligently set aside resources on a pay-as-you-go basis in a Capital Reserve Fund. This was similar to practices implemented by smaller systems, such as Pampa, Red Oak, Rockford, and Stephenville in that all their financial flexibility is tied not only to maintaining operations, but also to build reserves for climate-related exogenous events or economic downturns. Officials across asset size indicated that adequate rate-setting allows for larger operating margins, but such rate setting must be balanced with ratepayer considerations and long-term capital requirements.

4.2.3 Reserves and contingency planning. As business-type entities, municipal water systems generally operate apart from the host government's general operations. However, the underlying municipality's fund balances can be an important factor in the enterprise's policy decisions because of their shared economy and any exogenous conditions that affect the system's finances. For example, Hurricane Harvey affected Corpus Christi's Packery Channel and Conroe's dam, resulting in flooding conditions, whereas Lewisville, Lubbock, and San Marcos experienced unseasonably hot and dry weather. Climate-related events affect revenues; when the weather results in more water use, revenues are boosted. Conversely, expenses are affected when, for example, insufficient water is available and must be sourced outside of the primary source, such as from neighboring treatment facilities. Systems, such as Victoria, have aggressive contingency policies to ensure that adequate water supplies are available, which helps avoid sharp rate increases that may result from having to pay for water drawn from other sources.

A review of the CAFRs revealed that many of the state's cities have financial governance policies requiring that they maintain unrestricted and unassigned general fund balances to be used for unanticipated emergencies. These reserves are based on a percentage of actual general fund expenditures and officials often establish targeted reserve levels to reach the 15–20% range since the Great Recession. Similarly, water officials stated the importance of maintaining financial reserves, thus many have adopted similar policies. However, targeted reserve levels may often be considerably higher than their host municipalities because water systems have sizeable capital needs given the nature of their costly capital requirements as high-fixed asset systems. The water systems included in this study proved it was common to see their underlying municipalities establish and achieve targets of 15–20% of budgeted expenditures as General Fund reserves. Additionally, the water rate reserves tended to be 20–30% for expenses even when no formally documented policy indicates a targeted reserve level.

Divergence among systems' contingency reserves tends to arise from management's view of public perceptions. Officials' CAFRs and their capital improvement plans reveal that there is concern with maintaining reserves that are deemed too high, particularly when projects that have been deferred too long can cost more in the long run. Further, management appears ineffective when they hold sizeable reserves while requesting increases from ratepayers to maintain the system. Conversely, financial audit notes, citizen-focused performance audits, and capital improvement programs reveal that insufficient reserves can reflect poor budgetary planning and can lead to insufficient cash flows when emergencies arise. For example, Denton mentioned rate reserve levels at a range of 25–42% of expenses were established for the water fund. This determination occurs in accordance with the unique operational aspects of the utility that include its revenue stability, expenses and demand volatility, infrastructure age, debt levels, and management plans for the use of these reserves. Systems, such as Beaumont that serve medium-size populations and have an economy dominated by the petrochemical and service industries, also institute cash reserves and management policies to balance out reserves, manage contingencies, and prevent sudden rate increases.

Water systems that serve smaller populations did not appear to report more vocal user participation with requests for rate stabilization or contingency reserves. Rather, stabilization was a function of (a) upcoming infrastructure projects, (b) the systems' history of rate increases, and (c) the effects of weather- and climate-related events in the geographic area. Officials across service area population sizes stated that contingency planning includes projecting prices for costs related to water purchases, which can be unpredictable in areas prone to weather extremes. Each system's budgeting and reserve planning indicates strong awareness that the essential nature of water resources does not remove or exempt systems from conditions that affect the business enterprise's ability to generate revenues that facilitate its financial stability. The systems' capital improvement plans increasingly reveal weather conditions and the effects of climate-related events in Texas have led to increased monitoring of water availability and consumption patterns. This monitoring is a result of drought conditions or excessive rains and subsequent flooding, which are precursors to revenue declines. Additionally, the weather extremes that are particularly damaging to water transportation pipeline infrastructure add to overall expenses. Officials reported that traditional asset management planning does not directly include management of climate-related risks. Therefore, systems must incorporate innovations, such as the use of novel technologies that detect environmental stressors, in the future to mitigate adverse effects of unexpected events. Historical events have required management to alter its outlook and financial commitment to mitigating the effects of climate-related events on water supplies and infrastructure. Little Elm, Rockwall, Rowlett, and Wichita Falls provide examples of systems that enacted water consumption restrictions that were subsequently lifted once water levels returned to predrought levels. Additionally, representatives in Colleyville, Mesquite, and McAllen noted the presence of water reuse technologies and conservation efforts to smooth peaks and valleys in water supplies during drought conditions.

4.2.4 Taxpayer and socioeconomic considerations. Although the systems are government-protected monopolies that can cease water service and impose property liens in the event of user nonpayment, officials declared they strive to keep inevitable rate increases moderate. Officials stated the strength of the underlying municipality can adversely affect the utility system; management monitors changes in the local economy for signs of increased unemployment levels, housing needs, and an influx of new businesses. As an example, Huntsville, Pearland, Pasadena and other municipalities that have experienced increases in economic activity, particularly postRecession, saw such activity translated into increased demand for public utilities. Unfavorable unemployment levels may lead to declines in current collection rates, while growth in the job market and housing signals an increased need for water system connections. Representatives from larger systems mentioned multiyear water rate projected increases as much as small and medium counterparts.

Additionally, a substantial portion of new projects is to address population growth, which is a key driver of capital spending needs. Systems of various sizes, such as those that serve Houston, Round Rock, Copperas Cove, and Eagle Pass adjust their infrastructure development plans by the need to accommodate demographic shifts. In evaluating changes to the economy, officials agreed that underinvestment in water infrastructure can adversely affect long-term economic growth throughout the state because they believe that faster investment in water will produce faster overall economic growth. Further, in addition to normal wear and environmental abatement projects, these socioeconomic developments influence demands for city services overall and new connections to the water system. The influence of socioeconomic shifts, in turn, affects water usage levels and drives demand for water and wastewater capacities, ultimately altering the amount of revenues collected and financial sustainability.

4.2.5 Debt management, capital projects, and credit strength. Debt management depends on monitoring current and future capital needs and, from this, influences decisions about the projects that can be financed from existing resources (funding on a pay-as-you-go basis) or from external sources. Acquisition of financing is dependent on the system's credit risk profile, which informs creditors of the water system's ability to repay debt obligations. The cost of access to the bond market is established according to that profile. Officials noted a sign of financial health is the ability to fully cover debt service payments from net operating revenues, but the ability to generate funds that exceed requisite debt payment covenants is an indication of credit strength that exceeds the strength sought by the rating agencies. Credit scores are important because the lower the score, the higher the interest cost to the debt issuer, which is carried by taxpayers and stresses the importance of sound debt management practices.

The use of internal funds poses less risk and cost than those externally sourced; however, for enterprises with extensive infrastructure needs that must be stretched for decades, drawing down cash reserves is not always pragmatic. Each of the systems prepares a 5-year Capital Improvement Program that considers prospective capacity and demands on the system, and criticality and cost determine annual projects. Multiyear financial strategies and capital improvement plans allow for better long-range forecasting to incorporate into the proposed annual operating budget. Because no system, regardless of size, is capable of funding all of its long-term infrastructure development needs within the course of one fiscal year, the plans are divided into incremental 1-year capital plans. Shorter-term plans maximize opportunities, establish priorities, and develop funding sources to ensure organizational sustainability while minimizing the effects of growth on the tax rate and user charges.

Each system recognized overall credit position as an important factor because it influences ease of access in the debt market, whether borrowing from bond investors, the state government, or banks for long-term capital lease obligations. The financial aspects of credit strength reflect the combined factors of a system's operating margins, along with considerations of costs to the taxpayers and the debt of the enterprise. The discussion that follows pertains to the two latter considerations. Strong financial aspects allow for the systems to offer stronger legal protections to bondholders and other creditors by pledging higher coverage of debt service by the revenues generated by the enterprise.

Systems in less populated areas appear to be concerned about not just access to the municipal bond market, but also that of banks. Additionally, the smallest systems often mention reliance on state funding and use of nonformal financial instruments, such as capital leases for equipment. Small- and medium-size systems use private lenders as often as larger cities for capital leases, so their credit score is important for bondholders as well as smaller lenders because systems with fewer resources typically cannot afford to buy outright the equipment they require.

Repayment of public infrastructure funding is spread across numerous fiscal years, such that current and future taxpayers who benefit from use of the physical plant share in the financing costs. Another common characteristic in debt management is structuring of debt service payments. Given that water utilities are capital stock-intensive enterprises with components that do not age at the same pace, monitoring the infrastructure is an integral part of maintaining long-term viability, which means taking on new debt to maintain the system throughout the useful life of the enterprise. After examination, I found the overwhelming majority of the systems had generally level or declining debt service payments each year. Officials noted that in managing their debt schedule, establishing a repayment plan in which debt service is paid in decreasing amounts each year means that new bond issues or loans are planned for years in which the largest declines occur. Escalating debt service payments affect the capital structure because they increase the debt-to-asset ratio in the later years of repayments.

Officials noted long-term capital planning, with contingencies for emergencies, is particularly important in zones located in regions prone to climate-related incidents. Deferred replacement of capital stock increases the need to replace outdated infrastructure and has the potential to make water unaffordable if systems charge based on current liquidity and working capital needs. However, no discernible difference existed in deferral of maintenance needs. Prioritization of needs is based largely on shifts in the service area that occurs with population growth and the influx of new businesses. Nonetheless, newness of the system is a greater consideration for systems across all asset classes than the size of population served. Specifically, all officials stated newer systems provide greater resilience and access to redundancies like various sources of supply, additional treatment facilities, and back-up generators that make systems more resilient and lower overall operating costs.

The receipt of federal funds has reduced various costs that may potentially be carried by municipalities in the form of long-term debt. As an example, regions affected by Hurricane Ike during September 2008 and Hurricane Harvey during August 2017 received Community Development Block Grant and disaster funding for recovery projects. These federal grants offset billions of dollars in damage, infrastructure improvement, and resiliency upgrades, such as to water treatment plants and through the expansion of various utility system facilities. Though federal and state grants help with recovery efforts, they are generally event specific. As a result, they tend to be insufficient towards covering expenses for debt incurred for anything other than the incident or climate occurrence for which the funds are collected. This further confirms sound financial management practices should limit the enterprise’s exposure to excessive debt, and debt should be structured such that the system has neither poor credit quality nor unmanageable repayment schedules. Audited financial data and capital improvement plans show that accommodating future obligations is a costly endeavor. Municipalities will suffer financially destabilizing effects as long as conditions, such as those that exacerbate physical wear on systems or alter water availability, exist.

4.3 Conclusions

The quantitative portion of this study involved exploration of whether differences by size of service area population influenced capital structure. The findings indicated leverage of the systems serving the largest populations surpasses that of systems in the mid-range. However, the water systems serving the smallest populations are far more leveraged than their counterparts across population groupings. Given that the systems across sizes have comparable fixed infrastructure assets but spread among a small population, debt expenses will be larger. Additionally, the analysis revealed a collectively significant relationship between population and the combined determinants on leverage. Although the size of the service area population on its own did not affect leverage, the effects of population when combined with growth opportunities, liquidity, size of assets, risk, asset tangibility, and the average age of assets had a significant effect on leverage. This finding supports pecking order theory concepts in that larger populations from which to draw resources affect the availability of retained earnings from water rates. This effect influenced liquidity, tangible assets, and the ability to grow the enterprise rather than using debt (Brewer & Moomaw, 1985). The statistical findings of the regression analysis indicated the most significant relationships with leverage are between liquidity and the average age of assets, respectively.

Changes in financial performance and municipal debt levels are known to occur gradually, with the full effects of shifts in the local economy not necessarily reflected during 1 fiscal year (Arapis & Grady, 2015; Farnham, 1985; Mead, 2018; Scott & Pidherny, 2018). As such, I conducted analysis to determine whether the determinants of capital structure experienced different effects during various economic periods. During the preRecession period, the average age of assets revealed as significant relationship to leverage, whereas during the Great Recession and the recovery period immediately thereafter, liquidity and the average age of assets revealed a significant relationship to leverage. As large fixed asset systems, it stands to reason that for municipal water enterprises available liquid assets and the age of capital stock were most prominently featured. Age determines physical sustainability of the system because of its indication of systemic inefficiency and resulting inability to withstand the pressures of more demands on the systems and to keep pace with damaging environmental changes. During a time of more economic stability, the postRecession period, none of the individual financial determinants were a significant predictor of leverage. However, all the determinants collectively were associated with leverage for all the time periods.

I examined qualitative elements to determine unquantifiable decisions by key officials and the effects of these elements on the composition of capital structure. The findings revealed the largest overarching influences on tax- and rate-payer-supported leverage are financial flexibility, systemic resilience, and contingency planning. To achieve this, municipal water enterprises generally follow conservative debt management practices, particularly when mandated limits on debt capital spending force the prioritization of projects. Financing projects from available retained earnings when it is fiscally responsible to do so further reinforces pecking order theory assertions.

CHAPTER 5: IMPLICATIONS AND CONTRIBUTION

The design of this research facilitated an examination of the effects of the determinants of capital structure on municipal water utility systems. The study involved analysis of 98 municipal water systems in Texas. Corporate finance capital structure theories, specifically the trade-off and pecking order theories, and literature specific to public finance accounting and business-type entities guided the analysis. Through a review of existing literature, seven quantifiable variables proved to be representative financial determinants of capital structure. The determinants best suited for analysis of municipal water systems are profitability, growth, liquidity, firm size (based on assets), risk, asset tangibility, and the average age of fixed assets. An ordinary least squares regression analysis and an ANOVA revealed how those determinants reacted with the size of the service area population size during various economic periods to affect leverage. Additionally, through analysis of management interviews, this researcher identified key nonquantifiable elements, such as the need to achieve flexible operating margins, establish contingency reserves, and practice debt management. These elements ultimately contribute to capital structure. This chapter includes discussion of the findings and implications of the results. The first section provides a discussion of the results in light of the study's research questions and supporting literature within the framework of capital structure theories. The second section contains research implications and recommendations. The following section includes discussion of the limitations of the study and recommendations for further research.

5.1 Capital Structure of Municipal Water Utility Systems

The research question that guided this study asked, what are the key financial and contextual determinants of the capital structure of municipal water systems? Each hypothesis reflected the presumed relationship of leverage in municipal water systems to the explanatory variables. I hypothesized the relationship between leverage and profitability, liquidity, size of assets, and the average age of assets to be negative; however, I expected a positive association between growth, risk, and tangibility of assets.

This section pertains to testing of the hypotheses and interpretation of the regression analysis in the framework of the capital structure theories discussed in the literature review. Statistical analysis of the municipal water systems in this study leads to a conclusion that collective significance exists between the financial determinants and leverage while controlling for year and population. The combined significance of the variables is a result of the links between each component of a balance sheet and income statement, and the effect of management's decisions on components that comprise each financial determinant ratio. Although no sufficient evidence supported the hypotheses for profitability, growth, size of assets, risk, and tangibility of assets individually as determinants of leverage, the beta coefficient for each determinant revealed all variables, except tangibility of assets, have a negative relationship with leverage. This finding contrasts with pecking order theory predictions that profitability, liquidity, size of assets, and the average age of assets would be negatively associated, and that asset tangibility would be positively associated, along with growth and risk factors (Myers & Majluf, 1984).

Individually, the most significant determinants of leverage are liquidity and the average age of assets. Consistent with the predictions of the pecking order theory, which indicates financing decisions are based on a least-to-most risk hierarchy that favors the use of internal funds (Arapis & Grady, 2015; Farnham, 1985; Myers & Majluf, 1984; Scott & Pidherny, 2018), I anticipated the liquidity variable to be negatively associated with a municipal water system's leverage. The level of significance supports the third hypothesis, which anticipated a negative association, and therefore implies the utilities achieve low debt-to-equity when they have more liquid assets. Changes in liquid assets are connected to profitability in that when profitability increases, the availability of cash and other current assets also increases. Sizeable cash reserves increase the ability to finance water infrastructure projects on a pay-as-you-go basis, while reducing the need to borrow funds and their related costs. Larger reserves also mitigate water rate increases; with greater liquidity, the water systems tend to rely on retained earnings rather than opting to use borrowed capital. Additionally, as cash resources increase, funding projects lower the overall age of existing infrastructure, which tends to increase systemic operational efficiency. This finding also follows pecking order theory constructs of assuming least to most risk in their financing choices (Arapis & Grady, 2015; Farnham, 1985; Myers & Majluf, 1984; Scott & Pidherny, 2018).

The systems show, in keeping with the less rigid connotations of the Modigliani and Miller theory of capital structure irrelevance (1958), that despite the more risky and costly implications of borrowing funds—such as those in which the system either has decreased profitability and liquidity or has experienced financial decline caused by exogenous circumstances (e.g., environmental or a softened economy)—it is still more advantageous to borrow than raise rates or draw from reserves (Frank & Goyal, 2003). Findings are also consistent with a key assumption of the pecking order theory and its contention that information asymmetry is a factor that increases risks to prospective creditors that can only be mitigated by management's actions to share their decision-making influences. The study revealed that sharing capital improvement plans and infrastructure prioritization methods reduced perceived risks to investors while providing water ratepayers with the rationale for the charges they incur for water service.

I hypothesized that the average age of assets was to be negatively associated with a public water system's leverage ratio in line with concepts suggested by the pecking order theory (Guerrini & Campedelli, 2011; Harris & Raviv, 1991; Klein & Belt, 1994). The negative relationship is at a statistically significant level supporting the contention of the seventh hypothesis that municipal water systems with higher average age of assets will have lower debt levels. Further, across the full range of sizes of their service area populations and throughout the course of a business cycle, this level of significance suggests that the use of debt to add to capital stock and improve the overall efficiency of assets reduced the combined average age of all physical assets.

Decisions made by key officials significantly influence the capital structure of municipal water systems. The study revealed systems' focus on operating margins, financial flexibility and contingency planning, the underlying economic conditions of the municipality, and debt management were the most instrumental aspects of navigating the influences of forces that affect leverage. Qualitative determinants of capital structure supported several assertions of the pecking order theory. First, by charging rates that ensure profitability and liquid assets, and by establishing targeted reserve levels, the systems follow pecking order funding hierarchies by ensuring they have retained earnings from which to draw prior to seeking funds from external sources. Second, by preparing multiyear capital improvement plans and sharing them with prospective creditors, the systems reduce information asymmetry by informing the debt markets about actions taken to sustain operations.

5.2 Implications and Recommendations

This study entailed an analysis of the determinants of the capital structure of public water enterprises in Texas and factors that influence leverage. These various elements lead to officials' decisions regarding water rate setting and debt issuance to cover infrastructure maintenance and development. The combined effect of the determinants on capital structure, as a result of financial performance outcomes, influences an enterprise's ability to withstand external shocks, such as those caused by (a) climate-related events, (b) economic shifts that affect rate payers' ability to pay in the fiscal year when charges are billed, and (c) population changes in the system's underlying municipalities that affect volumetric usage. As with the pecking order theory itself, this researcher did not argue a case for what should be the optimal capital structure of any individual municipal water system, nor did I attempt to determine reasonableness and adequacy of water rates as the primary source of revenues upon which the financial determinant ratios are formed. Examination of water rates is, in and of itself, a multifaceted issue with political and socioeconomic complexities, such as affordability, for ratepayers and includes financial considerations of the systems themselves.

The quantitative data and testing method identified some of the financial indicator determinants of capital structure are more influential than others. Combined with qualitative data, the study also revealed management's decision-making discretion is an integral contributor to leverage largely because officials must make their capital planning decisions based on the needs of a growing population and the changes that population brings. The qualitative data further indicated management's assessment of the interplay between financial flexibility, capital needs, and socioeconomic considerations is important to achieving what each system deems to be its optimal capital structure.

When development of the water sector is a national priority, and because municipalities cannot fund these systems solely by leveraging rates and charges or tax revenues at current levels, the federal government should have a mechanism to support infrastructure projects through targeted subsidies. Such projects should include clear directions regarding procedures for securing long-term credit funds. Given that the federal government incurs some costs of municipally-issued debt by effectively subsidizing tax exemption on bonds and other infrastructure credit programs, it behooves the federal government to augment and mend existing water and sewer infrastructure data. Complete and readily accessible data should be used to facilitate utility system innovation and more informed infrastructure development policy decisions. Strategies and policies should be determined by detailed financial metrics and practices grounded in conservative budgeting practices, establishing reserves, and anticipating climate-related emergencies that may influence the trajectory of water investment and asset management.

Because financing options should keep pace with system needs, any policies implemented must address needs in a variety of ways that are suitable for the size and scope of the demands presented by the infrastructure and its service area. Given that numerous municipalities cited in this study have suffered climate-related damage and extensive droughts, recommended options may include investment in technology and more support for state-level grants, loans, and emergency lines of credit. The federal government can play a part in encouraging alternative funding mechanisms through legislation, as long-term viability of these indispensable systems requires continuous investment. In other words, some part of preparing a financial solution should begin at the federal level to help reduce current debt levels and move infrastructure away from obsolescence. Conceivably, legislators should consider the possibility of shielding investment in critical public water infrastructure from changes in federal-level political agendas by determining a starting point of funds withdrawal from a direct-funding national pool. These funds should also include loan guarantees to subnational governments created to combat the lag in replacements of deteriorating infrastructure. Additionally, funds can be segregated by type of fixed asset to allocate resources specifically toward technological advances that would improve the efficiency of assets. Until such time, financing large-scale infrastructure projects that depend on continued access to the capital markets is the best option for utility systems across all asset classes to maintain financial quality and keep credit risks low for prospective investors.

This research has practical and political implications. Although much of the financial stress that resulted in the need for debt began with cutbacks from the federal level, given the downward trend in grants during the past 4 decades combined with the current political climate that appears to lack an appetite for focus on federal infrastructure spending, there is little reason to expect a surge in support on a national level. This, however, gives rise to making scalable and replicable subnational and municipal collaborative efforts. Therefore, a possible use of this study is to inform a direction in financial auditing practices to facilitate examination of this specific public finance sector. Financial analysis based on ratios is an equalizer across firm size and various business types in that it helps to monitor financial performance and identify areas that pose challenges against management's efforts at achieving long-term sustainability. This direction should build on existing financial monitoring tools that have been accepted for their effectiveness in corporate finance and their focus on revenue-generating business entities. Additionally, I recommend sustained efforts that facilitate improved data and legislation to enhance the ability of public water systems to meet the challenges of infrastructure funding.

There is no simple and inexpensive solution to facilitate water system infrastructure that is financially sustainable and reasonably leveraged. Using the findings of this study, systems managers and policymakers should build on public policies that encourage modernization and stability in the water sector and that require financial instruments and comprehensive assessment tools that support exhaustive forecasting, capital improvement plans, and budgets across systems, timeframes, and municipalities. Additionally, governing strategies that expand state-controlled grants and low-interest loans that target specific aspects of infrastructure development, such as climate-related resilience design or enhanced toxin testing systems, may complement important policy objectives of environmental scientists. Further, policies that push for increasing and coordinating pools of financial resources can assist smaller communities in jointly securing funds, or the responsibility could be transferred to a higher level of government. Another strategy is support for educational policies to facilitate understanding for the tax-paying public about an entity's debt capacity and other factors that affect the ability to borrow. Supporting research that encourages the provision of more information available to officials, water rate-payers and taxpayers, and prospective creditors about the determinants of leverage and capital planning may have positive implications for funding public water nationwide. Integrating funding decisions with policy can bring more visibility to current national and subnational government funding levels.

5.3 Research Limitations and Directions for Future Study

A benefit of this study is its generalizability, as the framework and use of financial ratio analysis is translatable to capital structure assessments well beyond the water utility sector to similarly-structured public utility systems across other states. However, the limitations from the lack of readily available financial data—coupled with the highly splintered and idiosyncratic nature of each state's water infrastructure and the localized nature of challenges that constrain the ability to raise capital—make it impossible to develop an approach to the study of and recommendations for an optimal level of financial leverage that fits every system.

Financial analysis presents a further limitation. Though used for forecasting purposes, it hinges on historical data, despite that past performance is not necessarily indicative of future viability. Predictive characteristics become further limited once external factors that affect operating margins and capital adequacy take hold (Mead, 2018). Consideration of external factors is particularly important in regions where the service area is subject to significant shifts in demographics or changes in the physical characteristics of the service area territory itself. Those extraneous variables may affect future funding needs that influence the ability to increase available reserves and the effect of this on financial sustainability. Moreover, adherence at the subnational level to regulatory differences and unique dissimilarities in the size and scope of each system's responsibilities may lead to differences in performance metrics outcomes. Nonetheless, given that this study demonstrates changes in capital structure may indicate changes to the underpinnings of the region that supports system revenues, thus reinforcing assertions that financial ratios reveal only a portion of the final capital structure, the vulnerability of user charges and connection fees that fluctuate with economic development activity is an area for future research consideration. Future researchers should consider studies of rate equity among the customer base. Within this area, researchers should also examine the benefits of tiered pricing to customers according to their environmental impact. Additionally, research that incorporates the extent and financial costs of climate events on water system revenues and expenditures is warranted.

Although little doubt exists among local-level government officials, engineers, and many taxpayers that upgraded infrastructure should be a nationwide priority, charges for system services affects those paying for the service (ASCE, 2017; Howe, 2005; Klase, 1995; Musick & Petz, 2015). In terms of the prospective effect on system users, this may further exacerbate any negative effects caused by economic downturns (Musick & Petz, 2015; Scott & Pidherny, 2018). Therefore, given that a key consideration of utility systems officials is the burden placed on property taxpayers and system users, future research focusing on the ability of the system to impose equitable rate increases among residential and commercial users may be valuable. Further, study dedicated to deferred replacement of capital stock is warranted. Prospective unaffordability of water, if systems charge based on current liquidity and working capital needs, indicates that attention to the economic effects of deferred capital investment on municipalities must be considered.

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APPENDIX

An example of an Independent Auditor's Report (pp. 1–2), the Management Discussion & Analysis (MD&A; pp. 3–12), and Notes to the Audit Statement (pp. 32–46) can be found on the City of Dallas' website. The following link is to the fiscal year 2017 Comprehensive Annual Financial Report.

https://dallascityhall.com/departments/budget/financialtransparency/AuditedFinancials/CAFR_FY2017.pdf