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EVALUATING WATER UTILITY FINANCIAL CAPACITY WITH RATIO ANALYSIS AND DISCOUNTED CASH FLOWS

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EXECUTIVE SUMMARY

The requirement that state water utility regulators focus on the financial problems attending water utilities has been reinforced by the combination of the need for water utilities to comply with regulatory provisions of the Safe Drinking Water Act (SDWA), their need to replace and upgrade an aging infrastructure, their need to meet water demand growth, and the requirements levied on state regulators by recent SDWA amendments. Financial capacity problems of certain water utilities can be divided into the lack of operating funds and the lack of access to capital funds.

With regard to the lack of operating funds, bankruptcy in a financial sense (i.e., the inability of the utility to pay its debts) is of most concern. Though water regulators have some abilities to prevent service termination, water utilities that cannot pay their debts may fail (over time) to maintain assets, provide necessary chemical treatments, hire competent managers, and, ultimately, may terminate water service. In addition, those water utilities that cannot generate operating funds cannot be aided by access to subsidized sources of capital and may not be able to attract buyers in the event of system bankruptcy.

Capital funds are, in theory, available to water utilities from ratepayers, retained earnings, subsidized loans such as the Pennvest program and the Drinking Water State Revolving Fund (DWSRF), and capital markets. To the extent that water utilities do not have the ability to generate the data necessary to sustain a loan request and lack sound economic fundamentals and an operating margin, they may be closed out of some or all of these sources. As water regulators evaluate water utility capital investments, the key is to determine (1) if the required level of capital investment will change the economic fundamentals of the utility so that it is no longer financially viable and (2) if the investment can be sustained at subsidized interest rates if it cannot be sustained at market rates. With regard to financing necessary water utility capital

investments, three possibilities exist: (1) the utility can sustain the investment at market levels of interest, (2) the utility can sustain the investment only at subsidized rates, or (3) the utility cannot sustain the new investment at any available interest rate.

Ratio analysis is one tool that has been used to evaluate water utility financial capacity, and ratio analysis has been used to construct models that attempt to predict business failures. The NRRI constructed such a model in 1992 for application to water utilities.[1] While ratio analysis is a well-known tool for financial evaluation, it has certain limits in its application to water utilities, particularly small water utilities. Its limitations include its need for accurate, historical data, its need to accommodate oddities in the data available, the difficulty involved in scaling ratios, and the relative sensitivity of the data used--all of which may be exaggerated in the case of small water utilities.

As alternatives to multi-variate failure models, for the evaluation of the appropriateness of disbursements from subsidized loan sources regulators may consider the use of ratios that specifically measure the ability of the utility to fund debt (e.g., the debt to assets ratio, the capitalization ratio, and the burden coverage ratio). In addition, water regulators might also consider the use of two nonstandard ratios for identifying water utility financial capacity--the ratio of capital investment to numbers of customers and a comparison of the utility's rates over time to the average rates for same-size utilities.

Much as water flows are central to water system engineering, cash flows are central to water system financial management. Discounted cash flow (DCF) models

[1] Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Models for Small Water Utilities* (Columbus, OH: The National Regulatory Research Institute, 1992), 154-167.

have been widely used by regulatory commissions and are particulary appropriate for investment decisions, such as disbursements from funds like the DWSRF; are forward-looking; and can be extended to create models for evaluation of existing water utility financial capacity. The simple lessons that can be derived from DCF models in general are that (1) cash flow is the most important variable effecting corporate worth and financial performance, and (2) cash flows must be discounted if they occur in an uncertain future. If water utilities cannot generate cash flows that, after appropriate discounting, exceed the cost of capital investments, it is unlikely that the water utility will be financially healthy. The two principal challenges of DCF analysis are the projection of future cash flows and the choice of the appropriate discount rate. Techniques for addressing both challenges are discussed in this report.

> *Much as water flows are central to water system engineering, cash flows are central to water system financial management.*

This report also posits a DCF model for water utility financial evaluation, a model that treats the entire utility as a capital investment problem--a treatment that is appropriate because of the capital intensive nature of water utilities. The variables that drive the model are the number of water utility customers, the average rate paid by customers, operating costs, the capital investment, and a discount rate. Not surprisingly, the model indicates that cash flows are key to utility financial health, and given the operating characteristics of water utilities, rate relief appears to be the most effective tool for increasing water utility financial capacity. The model can also be applied by state regulators to determine the minimum number of customers required for financially viable systems given certain capital investment requirements and implicit rate limitations. Because of the realities of water system operations, the financial capacity of water systems might be furthered most readily by state regulators by educating the public about the costs of safe water supply and, thereby, raising the acceptable level of rates and easing the psychological impact of rate shock.

For the evaluation of disbursements from the DWSRF or from other subsidized sources of funding, DCF analysis should identify those utilities that can be aided by access to subsidized capital and distinguish them from those that do not need subsidized capital. Additionally, it should help identify those utilities for whom the infusion of scarce subsidized capital will only prolong the inevitable.

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FOREWORD

Recent Safe Drinking Water Act Amendments have reinforced the long-standing need for water regulators to evaluate the financial capacity of water utilities under their jurisdiction. This study considers two techniques of financial evaluation--ratio analysis and discounted cash flow (DCF) analysis--that have been used by regulators. The study suggests that ratio analysis may be limited in its applicability to small water utilities and suggests two non-traditional ratios that may be of use. It also presents a DCF model that can be used for the evaluation of water utility capital investments and for the overall assessment of water utility financial capacity.

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CHAPTER 1

FINANCIAL ASPECTS OF WATER UTILITY REGULATION

As compared to traditional electric, telecommunications, and gas utilities, small water utilities are often financially fragile. Though some water utilities are well-funded and financially secure, many others operate on a wing and a prayer, and today even some water utilities that may have operated successfully in the past are being stressed by the current economic realities of the water supply industry, realities that are likely to cause financial stress for the industry as a whole for some time.

The economics of water supply are dominated by three external factors. These factors--the need to comply with regulatory provisions of the Safe Drinking Water Act (SDWA), the need to replace and upgrade an aging infrastructure, and the need to meet water demand associated with population growth and economic development [1]--are operating in concert to exacerbate the capital needs and financial exigency of some water utilities. According to a 1993 NRRI report:

> The capital needs of the water supply industry *over the next few decades* (emphasis added) will be substantial enough to cause utilities and the governments that own or regulate them to explore alternative financing approaches.[2]

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[1] Janice A. Beecher, Patrick C. Mann, and John D. Stanford, *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives* (Columbus, Ohio: The National Regulatory Research Institute, 1993), iii.

[2] Ibid.

And

> The concurrent and mutually reinforcing impact of these forces on many utilities presents a substantial pressure on both capital and operating costs, a pressure not previously experienced by the water supply industry.[3]

Indications are that these pressures may have even increased since 1993. Because state public service commissions have the responsibility to ensure safe and affordable water service, water regulators have had to take an active interest in the financial condition of water utilities under their jurisdiction.[4] Were the current pressures on state water regulators to identify and assist financially troubled water utilities not adequate enough to inspire concern, the 1996 Amendments to the SDWA, which placed particular emphasis on assisting smaller drinking water systems,[5] levied two additional requirements on states to identify systems that lack financial capacity.[6]

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[3] Ibid., 1.

[4] One indicator of the continuing interest by state regulators in the financial condition of water utilities is the steady stream of NRRI research reports on related topics. Those topics have included regionalization (1996), revenue effects of conservation (1994), financing and ratemaking alternatives for meeting water utility revenue requirements (1993), commission ratemaking practices (1992), viability policies and assessment methods for small water companies (1992), cost allocation and rate design (1990), cost impacts of the Safe Drinking Water Act and its Amendments (1989 and 1987), and issues related to the regulation of small water companies (1986, 1984, and 1983).

[5] John D. Borrows and Todd Simpson, *The Drinking Water State Revolving Loan Fund: A Guide for Regulatory Commissions* (Columbus, Ohio: National Regulatory Research Institute, 1997), 8.

[6] "Capacity" has replaced "viability" as the term of art. At this point, capacity has not been fully defined. It does, however, have three components under the SDWA Amendments--technical, managerial, and financial. A 1992 NRRI report on water system viability suggested that financial viability addressed the three questions--(1) does the system have or can it acquire necessary capital? (2) do the rates accurately, adequately, and equitably reflect the full cost of water service? and (3) are the system's customers willing and able to pay the necessary rates? See Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Methods for Small Water Utilities* (Columbus, Ohio: The National Regulatory Research Institute, 1992), 19.

First, the Amendments do not allow funds from the Drinking Water State Revolving Fund (DWSRF), which provides substantial funding for water system improvements and is available to investor-owned utilities, to be disbursed to systems that lack the financial capability to maintain SDWA compliance.[7] Second, states are required by the Amendments to establish a program to assist existing water systems in achieving financial capacity (and managerial and technical capacity as well) and to establish a means to prohibit the formation of new water systems that cannot demonstrate capacity.[8] Failure to accomplish either objective can result in the withholding of a portion of the federal funds otherwise due to the state (ten percent in 2001, fifteen percent in 2002, and twenty percent thereafter).[9]

The combination of the difficult financial environment for water companies and the new federal requirements has reinforced the need for water regulators to focus on the financial problems attending water utilities, problems that are divisible into two separable components. First, water utilities may lack operating (i.e., short term) funds and, thus, may be in danger of terminating their status as a service provider or losing the ability to maintain the quality service required. Second, water utilities may not have access to capital (i.e., long term) funds for system growth, replacement of aging infrastructure, or system improvements such as those required by the SDWA. These two problems, though often related, cause different dilemmas for regulators and to some extent require different solutions.

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[7] John D. Borrows and Todd Simpson, *The Drinking Water State Revolving Fund; A Guide for Regulatory Commissions*, 74.

[8] Ibid., 32-33.

[9] Ibid.

The Lack of Operating Funds

In an accounting sense, a firm is bankrupt when the fair value of its liabilities exceeds the fair value of its assets.[10] This definition, however, may not be wholly relevant for water utilities and water regulators. First, the definition uses the fair value of assets and liabilities rather than book values. While liabilities can usually be valued rather easily (e.g., accounts payable and debt), the fair value of water utility fixed assets, which are not frequently traded but which make up a large proportion of utility assets, may be difficult to measure. Second, many successful entrepreneurs have become adept at operating businesses that have negative net worth, and water companies may operate for some time in that condition. Small water companies with little initial capital investment in productive assets, or those which have undervalued their asset base, are particularly likely to experience negative net worth.

Bankruptcy in a financial sense is probably of more concern to regulators. Bankruptcy in a financial sense is simply defined as the inability to pay debts.[11] When firms are bankrupt in the accounting sense (i.e., liabilities exceed assets), they often delay payments to creditors, thus using the funds of creditors to sustain the firm. When they reach the point of financial bankruptcy, those creditors essentially refuse to continue to provide operating capital. Bankruptcy proceedings can then be initiated by either the firm or by its creditors.

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[10] Joel G. Siegel and Jae K. Shim, *Dictionary of Accounting Terms* (Hauppauge, NY: Barron's, 1987), 40. See also Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Methods for Small Water Utilities*, 27.

[11] John Downes and Jordan Elliot Goodman, *Dictionary of Finance and Investment Terms* (Woodbury, NY: Barron's, 1985), 29.

Bankruptcy is a common feature of the business landscape and does not necessarily imply the termination of business operations. In the case of the potential for electric utility bankruptcy, analysts are quick to point out that if an electric utility declares bankruptcy, the lights will not go out (as was demonstrated in the case of the Public Service Company of New Hampshire). That argument implies either the ability of the utility to work out satisfactory arrangements with creditors (usually under Chapter 11 Reorganization) or the availability of a third party willing to purchase the fixed utility assets at a bargain price in a liquidation. In either event, utility service will continue during the bankruptcy process and after.

In the case of distressed water utilities, however, neither condition may hold. If the fundamentals of a successful business entity (e.g., an adequate number of customers willing to pay the full cost of service) are not present, debt restructuring and negotiation of payment schedules acceptable to the creditors are not likely to be successful. No creditor will accept a new payment schedule for existing debt if it is likely that future debt will be defaulted on as well. Similarly, if the water utility fixed assets are in substantial need of improvement to meet new water supply standards, there may be no buyer willing to purchase those assets at any price. Therefore, in the case of water utilities, bankruptcy could, in theory, terminate water service. As a result, water regulators have attempted to identify distressed companies and intervene before they are forced to intervene to prevent the termination of service.

In addition to being concerned with water utility bankruptcy, water regulators are also concerned with water utilities that lack operating funds even though bankruptcy may be some time away. Utilities that are strapped for funds may fail to adequately maintain assets, fail to provide necessary chemical treatments, or may not be able to hire competent managers, thus creating a spiral that leads toward bankruptcy.

Though there is a link between a shortage of operating funds and a shortage of capital funds that will be explored later in this chapter, in general, water utilities that lack operating funds cannot be aided by access to capital funds unless the shortage of operating funds is the result of high interest charges that can be reduced by payment of lower interest rates. This probably represents a small percentage of troubled water companies. All other operating fund shortages must be addressed by increases in utility operating revenues or reductions in utility costs. The potential to generate adequate operating funds must be a prerequisite for access to subsidized sources of capital.

. . ., in general, water utilities that lack operating funds cannot be aided by access to capital funds unless the shortage of operating funds is the result of high interest charges that can be reduced by payment of lower interest rates.

Growth has been posited as a partial solution to financially strapped companies.[12] For water companies, if the capital investment cannot be supported by the current customer base, adding additional customers might be a solution since the fixed cost of water supply could be divided across more customers. However, given that per-capita water demand is stable[13] and that most water systems are geographically bounded and sometimes incapable of adding more customers, water system revenue growth is largely limited to increasing prices charged to customers, an untenable option if customers already bear high water prices.

[12]Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Methods for Small Water Utilities* (Columbus, OH: The National Regulatory Research Institute, 1992), 26.

[13] Janice A. Beecher and Patrick C. Mann with John D. Stanford, *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives*, 17.

The Lack of Capital Funds

The other side of the water utility financial dilemma is the supposed inability of water utilities to generate or access long-term funds. Because of factors alluded to earlier, many water utilities are in need of significant amounts of additional capital. Unfortunately, some sources of capital are regarded as closed to some water companies. Sources that are regarded as available to water companies include ratepayer funds, retained earnings (to the extent that they exist), and subsidized government loans.

Ratepayer funds are accessed by utilities through ratemaking alternatives specifically designed to address utility needs for long-term funding. They include accelerated depreciation, construction work-in-progress (CWIP), automatic pass-throughs, surcharges, expedited proceedings, use of future test years, preapproval of expenditures, and incentive regulation.[14] These ratemaking alternatives are thoroughly explained in the 1993 NRRI report *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives*[15] and need no further explanation here except to note that they shift risk from the utilities to ratepayers and provide capital to utilities at a cost of capital that approximates the rate of inflation with no risk premium.

Retained earnings are another source of capital. They represent prior period accumulated earnings. The decision to use accumulated earnings instead of other sources is dependent on (1) the availability of retained earnings and (2) the cost of other sources of capital as compared to the firm's own weighted average cost-of-capital. In the case of small water companies, accumulated earnings may be in short

[14] Janice A. Beecher and Patrick C. Mann with John D. Stanford, *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives* (Columbus, OH: The National Regulatory Research Institute, 1993), 113.

[15] Ibid., 113-146.

supply or nonexistent if the utility is distressed or marginal.

A third source of capital for water utilities is subsidized, below market government loans. According to an Environmental Protection Agency (EPA) survey, at least thirty-three states have loan, revolving-fund, or bond-bank programs to finance drinking water capital projects.[16] Many of these state funding programs give preference to public systems. An NAWC survey recently determined that fifteen of forty-one states surveyed have state restrictions on providing these funds to investor-owned water utilities.[17]

In addition, the DWSRF authorized by the 1996 SDWA Amendments is available to investor-owned utilities only if they can identify a dedicated source of revenue to repay the loan and demonstrate financial security, which may include a pledge of collateral.[18] To some extent, therefore, these funds are only available to water utilities that are likely to have access to other forms of capital, though the interest rates on loans from the fund will be less than rates available from other sources. As an additional limitation, investor-owned utilities attempting to access DWSRF funds will likely find stiff competition from municipal utilities, and there are some indications that some state implementation efforts may initially (or permanently) exclude investor-owned utilities.

[16] U.S. Environmental Protection Agency, *Alternative Financing Mechanisms for Environmental Programs* (Washington, D.C.: U.S. Environmental Protection Agency, 1992), 17 as cited in Janice A. Beecher and Patrick C. Mann with John D. Stanford, *Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives*, 99.

[17] USOA Task Force of the NARUC Staff Subcommittee on Accounts, “Report on the Appropriate Accounting Treatment for State Revolving Fund Loans Resulting from the Safe Drinking Water Act Amendments of 1996,” May 1997, 1.

[18] John D. Borrows and Todd Simpson, *The Drinking Water State Revolving Loan Fund: A Guide for Regulatory Commissions*, 55.

> *. . .to the extent that the funds are not available to private water utilities, they create a barrier to competition between those private systems and municipal systems. . .*

If funds can be accessed, these programs provide funds to water utilities at below-market interest rates, in some cases, as low as one percent per year. They are a subsidy from taxpayers to water customers through their water system, and to the extent that the funds are not available to private water utilities, they create a barrier to competition between those private systems and municipal systems (i.e., subsidized loans serve as an impediment to privatization if they are not available to investor-owned utilities as well as municipal utilities).

Though the vast majority of businesses obtain capital through financial markets and financial intermediaries, it is generally held that many water utilities, particularly small ones, are closed out of those markets. To the extent that they lack sound economic fundamentals and an operating margin, this is true.

The simple objective of every business is to generate a return on funds that is higher than the cost to the firm of those funds (i.e, the weighted average cost of capital--the combination of the cost of debt, preferred stock, and common equity). Securing capital at low rates lowers the cost-of-capital, thereby "lowering the bar" for the required financial performance of the firm and reduces operating costs to the extent that interest charges are reduced.

As a result, every competent financial manager attempts to secure capital at the lowest possible cost, and for water utilities an incentive exists for managers to convince regulators that capital is not available from standard sources. In theory, however, any firm has access to capital sources if it can demonstrate that the return on invested funds will be higher than their cost. If the firm is too small to publicly issue bonds or stock, it can still gain access to bank loans and additional capital from local investors. In practice, some water utilities apparently are so small and unsophisticated that they cannot generate the financial data to sustain a loan application.[19] The issue for most water utilities, however, is not whether they can access capital; it is a question of at what cost can capital be obtained.

In theory, however, any firm has access to capital sources if it can demonstrate that the return on invested funds will be higher than their cost.

For regulators, two interrelated sets of questions arise with regard to capital investment by water utilities:

1. Will the required level of capital investment change the economic fundamentals of the utility to the extent that it is no longer viable? In other words, can the fixed costs of the new investment be spread among the utility's customers without creating exorbitant rates?

2. If the investment cannot be sustained by the utility at market interest rates, can it be sustained at subsidized rates? Later in this report, we will examine the sensitivity of return on investment to a change in the interest rate.

Three potentials exist for water utility capital investment:

(1) The utility can sustain the capital investment at market levels of interest on invested capital,

(2) The utility can sustain the investment only at subsidized interest rates, and

(3) The utility cannot sustain the new investment at any available interest rate--subsidized or market.

In the first case, the utility should be provided access to subsidized capital only on the grounds of equity (i.e., if "weak" water utilities can generate subsidized capital, why shouldn't "strong" utilities have the same advantage?). In the second case, subsidized

[19] For some water utilities, the adage that "some entities cannot gain access to capital markets because they should not gain access to them" may hold true.

loan programs are, in fact, the answer to the utility's capital funding dilemmas. These water utilities are the ones that should be identified as the best candidates for loans from the DWSRF, assuming that the capacity objective is met. In the third case, subsidized loan programs are not the solution to the utility's problems and, if provided, will only postpone the inevitable financial day of reckoning.

Assessment of Water Utility Economic Condition

Based on this analysis, we have come full circle--both the water utility's need for operating funds and its access to capital are dependent on its basic economic condition. Assessing that condition is difficult and, to some extent, a matter of art rather than science. In the remainder of this report, we will examine two familiar methods of examining the financial condition of water utilities--ratio analysis and discounted cash flow (DCF) analysis--and investigate their suitability for use by water regulators. In the course of the examination of DCF analysis, we will attempt to posit a simple financial capacity model and examine with that model the key variables that determine water utility financial capacity.

> *. . .both the water utility's need for operating funds and its access to capital are dependent on its basic economic condition*.

Some might argue that meeting the financial needs of water utilities is not an issue of concern, in that the ratesetting process virtually guarantees the water utility an adequate return on its investment. Ultimately, however, there are limits, though rarely explicitly declared, on what the commissions are likely to do in regard to rates, and there are limits on what customers will pay. The commission typically has considerable latitude in what it will consider reasonable in regard to rates or rate increases. Limitations that a commission may impose on rate increases include:

1. Rate shock avoidance (i.e., limiting rate increases to some specified percentage).

2. Imposition of an upper limit on “reasonable rates” (e.g., some percentage above typical rates for similar services provided by other utilities, some percentage of average household income in the service territory, or some percentage of individual household income for typical household usage).

3. More “aggressive” prudence reviews, used and useful tests and other rate disallowance policies for companies seeking what are deemed to be “excessive” rates.

In some cases, customers may not behave in accord with commission or utility expectations, also leading to revenue shortfalls. Some customer responses that can cause water utility distress are:

1. Conservation resulting in reduced sales volumes and failure to meet revenue requirements.

2. Self-supply or alternative supply, such as well drilling or formation of a coalition of customers to obtain water elsewhere (i.e., inducing another existing supplier to enter the market or establishing a co-op or coalition to self supply.

3. Customer refusal or inability to pay bills.

These limitations on the water utility’s ability to earn adequate revenue can diminish its ability to service its capital and impair its ability to obtain capital. Dealing realistically within the limits of what can be accomplished in the way of rate relief and the limits on what customers will actually pay is a necessary component of water utility regulation. Techniques of financial analysis, such as the DCF model described later in this report, should help regulators identify the impact of those limits.

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CHAPTER 2

THE USE OF RATIO ANALYSIS FOR EVALUATION OF WATER UTILITY FINANCIAL CAPACITY

Financial ratio analysis is one tool that water utility regulators might consider for the identification of which of the three conditions described in the last chapter holds for a particular water utility, i.e.:

1. Can the utility sustain new levels of capital investment at **market levels of interest on invested capital** (i.e., can it generate adequate operating revenue to finance debt and allow a return on equity if that debt and equity is secured at prevailing market rates for firms that match the debt profile of the utility)?

2. Can the utility sustain new levels of **capital investment only at subsidized interest rates** (i.e., can it sustain new investment only if the capital is provided from a subsidized source like the DWSRF or a Pennvest-type program)?

3. Will the water utility be **unable to support any level of additional debt or equity no matter what the rate paid** (i.e., is the utility so strapped that any new investment will force it into financial danger or is it in danger already)?

Ratio analysis simply attempts to provide insight into a firm's financial condition by comparison of a variety of financial relationships over time and to other similarly situated firms. Though literally any financial measure can be compared to any other, financial analysts have come to agree on a standard series of ratios that measure:

- Liquidity--the ability of a firm to pay its current liabilities when they are due.

- Financial leverage--the extent to which a firm is relying on the use of debt.
- Efficiency--how well the firm is managing and controlling its assets.
- Profitability--management's ability to control expenses and earn a return on resources committed to the business.[1]

Each of these aspects of operations is critical in forming the total financial picture of the firm though, for some purposes, some measures are more important than others. In bankruptcy prediction models, for example, efficiency is regarded as less important than the other aspects of financial operations.[2] As we will see later, for the purposes of examining water utilities, and in specific for examining their capability to service debt at subsidized or market rates, ratios that measure financial leverage may be more important than the others.

The NRRI Distress Classification Model

Several fairly well-known ratio analysis models have been used to predict general business failures (e.g, the Altman *Z-Score Model* and *Zeta Model* and the Platt and Platt model).[3] Because none of these models had been developed for the specific conditions that apply to water utilities and because the models performed poorly in

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[1] Jerry A. Viscione, *Financial Analysis: Tools and Concepts* (New York, NY: National Association of Credit Management, 1984), 60.

[2] Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Methods for Small Water Utilities* (Columbus, OH: The National Regulatory Research Institute, 1992), 153.

[3] For a description of the development of these models, see Ibid., 143-152.

terms of measuring the financial distress of water utilities,[4] in 1992 the NRRI attempted to create a financial distress classification model that would be more appropriate to water utility companies. The model created by NRRI attempted to allow regulators to consistently identify water utilities that were distressed and in need of regulatory attention.[5]

The NRRI model used financial ratios to measure profitability (two separate measures), liquidity, leverage, and profit trend, and compared growth and efficiency and efficiency and profitability. The variables selected were all inversely related to financial distress (i.e., the lower the score the more likely was financial distress), and the variables were added together to determine the total score. Table 2.1, taken from the 1992 NRRI report, compares the results of the application of the model to a “viable” system and a “distressed” system. Based on the application of the model to a sample of water companies, a generalized scoring system was created. According to the scale, if companies scored 4.0 or more, they were regarded as “Good to Excellent.” Those scoring 3.0 to 3.9 were classified as “Weak to Marginal.” Those scoring 3.0 or less, were regarded as “Distressed.”[6]

The model performed well in tests against water utility data. When compared to fifteen weak and fifteen strong water companies using data supplied by the National Association of Water Companies (NAWC), two thirds of the NAWC strong firms were classified as “good” by the NRRI model, and 87 percent of the NAWC weak firms were classified as “marginal” or “distressed.”[7] In another test, the model was applied to six water utilities from three states. Prior to the test, in the judgement of staff members from the states five of the six water utilities were regarded as distressed; the other was

[4] Ibid., 154.

[5] Ibid., 161.

[6] Ibid., 158.

[7] Ibid., 160.

regarded as viable. The scores created by the NRRI model for each of the distressed utilities were lower than 2.0 (in some cases, demonstrably lower) placing them in the model's distressed range. The model scored the viable utility at 5.49, well within the model's "good to excellent" range.[8]

Table 2.1: Distress Classification Model with Illustrative Data		
	Viable System*	Distressed System*
Ratio X1: Profitability Net income + depreciation Annual operating revenues	$3.3 + 1.3 = .200 22.9	$.240 + 1.6 = .129 14.3
Ratio X2: Liquidity Current assets Current liabilities	5.8 = 1.570 3.7	3.1 = .607 5.1
Ratio X3: Leverage Common stock equity Total assets	16.9 = .326 51.8	11.1 = .170 65.3
Ratio X4: Profit Trend Retained earnings Common stock equity	11.1 = .657 16.9	5.0 = .450 11.1
Ratio X5: Growth and Efficiency Annual operating revenues Total assets	22.9 = .442 51.8	14.3 = .219 65.3
Ratio X6: Efficiency and Profitability Annual operating revenues Annual operating expenses	22.9 = 1.220 18.7	14.3 = 1.190 12.0
Ratio X7: Profitability Net income Annual operating revenues	3.3 = .144 22.9	.240 = .017 14.3
Distress Score (sum of the ratios)	4.56	2.78
* Dollar values are in millions. Reprinted from the NRRI report cited in footnote 2.		

Limitations of Ratio Analysis for Water Utility Financial Evaluation

[8] Ibid., 161-162.

Despite the strength of the NRRI distress classification model, it helps illustrate the limits of ratio analysis as a tool for the identification of water utilities that lack financial capacity. The water-utility specific limitations of ratio analysis include (1) the need for accurate historical data, (2) the need to accommodate oddities in data, (3) the difficulty involved in scaling ratios, (4) and the relative sensitivity of data. They are discussed in turn.

Ratio analysis requires the collection of historic financial data that is comparable across companies and across time. Despite the efforts of the Financial Accounting Standards Board (FASB) and the professional accounting community to standardize financial data, some opportunity exists for interpretation by accountants and, as a result, variability in the data can occur. In addition, the creation of good financial data is costly and requires substantial sophistication. Particularly for small water companies, collection of reliable financial data can be a problem. Indeed, according to one knowledgeable state staff member, if the water utility has the ability to generate accurate financial data, it probably is adequately managed and financed. The worst financial viability problems may be associated with those companies that cannot generate accurate financial information upon which ratio analysis can be applied.

. . .according to one knowledgeable state staff member, if the water utility has the ability to generate accurate financial data, it probably is adequately managed and financed.

The limits of historical data are also particularly acute in the evaluation of water utilities because of ratebase/rate-of-return (RBROR) regulation. Rate increases mark a significant financial event in the life of a regulated utility. Any financial ratio involving sales or revenue is likely to fluctuate significantly based on the granting of a rate increase. Following rate increases authorized by regulators, financial ratios that use sales or revenues are likely to indicate substantially better financial health than they might have just before the rate increase and vice versa. As a result, accurate comparison of utilities would require some adjustment related to the proximity of each water utility to its last rate increase. Fortunately, statistical means are available to smooth the associated data.

In addition, the adjustment of asset values by depreciation can obscure their true values. The substantial capital investment made by water utilities is included in ratebase at its original cost, and depreciation reduces the ratebase across the assigned useful life of the assets. If the estimated depreciable life equals the useful life, the asset would have zero value at the point at which its cost had been fully allocated. It is probable, however, that the useful life of the asset will not exactly match the depreciation schedule for the asset. If the asset outlives its depreciation, though it remains a productive asset, it disappears from the balance sheet, and under RBROR it earns the utility no revenue. If it becomes obsolete before it is fully depreciated, it must be "written down" to its real value.[9] Because projection of the fair value of the asset involves projection of the future cash flows expected to result from holding the asset, the process of estimating the value of an impaired asset is difficult and may not produce a new carrying value that matches the true economic value of the asset. Though the matching of depreciable lives and useful lives of assets is a problem for both regulated and unregulated firms, it creates a particular problem for highly capital intensive water utilities, and financial ratios may not capture the true worth of the utility and its ability to render service in the future.

. . .financial ratios may not capture the true worth of the utility and its ability to render service in the future.

Finally, depreciation is a technique for allocating historical costs, not a technique for accumulating cash for replacement of assets. No commonly used financial ratio

[9] FASB Statement No. 121, "Accounting for the Impairment of Long-Lived Assets and for Long-Lived Assets to Be Disposed Of," contains provision for the treatment of impaired assets. It requires that assets be reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of the asset is no longer accurate. Asset worth is determined by assessing the future cash flows expected to result from the use of the asset.

addresses the replacement cost of assets, which in the case of water utilities may be so large as to represent an unbooked liability that can render the utility no longer economically viable. That may be particularly true if assets must be significantly improved to meet new water standards.

Second, the results of ratio analysis sometimes require interpretation and sometimes cannot be taken at face value. Even under the best conditions, ratios do not enable us to make firm conclusions about companies. Put another way, ratios provide clues and hints but few definite answers.[10] We need to be particularly careful if oddities in the data occur. For example, in one test of the NRRI distress classification model, two otherwise weak companies received relatively high scores, indicating a reasonable degree of viability. In both cases, the high rating was caused by unusually high liquidity ratios (i.e, the ratio of current assets to current liabilities).[11] In most cases, high liquidity is regarded as a good indicator of the ability to pay current obligations. In these two water utilities, however, the high liquidity ratios were caused by inordinately high levels of accounts receivable or notes receivable. If these accounts receivable were old and uncollectible or if the notes represented uncollectible loans from owners, the supposed good level of liquidity could, in reality, represent a problem.[12] In any event, without careful evaluation, application of ratio analysis could lead regulators to make judgements that are not appropriate given the reality of the utilities' financial condition.

. . .ratios provide clues and hints but few definite answers.

Third, it is difficult to scale financial ratios and to create a single measure of

[10] Jerry A. Viscione, *Financial Analysis: Tools and Concepts* (New York, NY: National Association of Credit Management, 1984), 80.

[11] Janice A. Beecher, G. Richard Dreese, and James R. Landers, *Viability Policies and Assessment Methods for Small Water Utilities*, 160.

[12] Ibid.

enterprise financial health because of differences in the values created by the ratios. For example, in the application of the NRRI distress classification model to illustrative data, the liquidity measure (using the "current ratio" of current assets to current liabilities) for viable systems was 1.57. The profitability ratio (net income to annual operating revenues) was .144.[13] Given the differences in the values of the ratios, a ten percent change in liquidity has nearly eleven times the impact of a ten percent change in profitability since the values are summed in the model to determine the total score.[14] Though the NRRI model offsets this particular problem by using some aspect of profitability in four of the seven measures, an attempt to sum ratios into a single, useable measure can suffer from these types of statistical anomalies.

Fourth, ratio analysis may work best to identify differences in well-managed and well-financed corporations for whom at least several years of fairly consistent and comparable financial data are available. It can identify trends in the finances of a single firm, or it can identify subtle but important differences between same-size corporations. It is also usually employed to detect small gradations in the financial operations of otherwise viable enterprises. In water utility regulation, however, the differences between viable and nonviable utilities are often not subtle, and a comparison of a small,

[13] Ibid., 157.

[14] A ten percent increase in the current ratio (1.57) produces an increase in the total score of .157. A ten percent increase in the profitability ratio (.144) produces an increase in the total score of only .0144.

troubled water company with 500 customers to a financially healthy company with 10,000 customers may be invalid. For application of failure models based on ratio analysis, it might be appropriate to create subcategories of water utilities by size or age and to create scales appropriate to each subcategory.

In the final analysis, financial failure models based on ratio analysis may be most useful for quantifying judgements that commission staff have already made. Indeed, to reverse the comparisons made earlier in this chapter, if the results of the NRRI distress classification model were taken as a benchmark, it might be said that commission staff and the NAWC were very accurate in their determination of weak and strong utilities. Having passed the NRRI “test,” they may not need to use sophisticated, quantitative models to assess water utilities and can rely on judgement alone. It seems that making the distinction between weak water utilities and strong ones is a straight-forward task for water utility experts. What may be more difficult is the identification of accurate, credible, and quantifiable standards for water utility financial capacity that allow action to be taken by regulators if those standards are not met.

Alternatives to Multi-Variate Ratio Models

If, as mentioned, application of a fairly sophisticated model like the NRRI 1992 distress classification model presents some problems (chiefly those problems embedded in ratio analysis in general), how might regulators meet their requirements to identify water utilities lacking financial capability? Several traditional ratios might provide some insight, and two non-traditional ratios may also help.

If the objective of water regulators is to identify the capacity of the utility to bear additional debt to finance system upgrades and compliance with water standards, ratios that measure financial leverage can be highlighted. Though they are attendant with all the limitations that effect all financial ratios, they might provide some insight into how much debt is being employed relative to equity, help identify the ability of the firm to raise debt, and help assess a firm's ability to pay its debt when due.[15] While a snapshot, single-year look at any of these ratios will not provide compelling evidence of problems, changes in these ratios over time and comparison with similar ratios for same-size utilities might provide indication of difficulties. If a forecast of these ratios could be added to the analysis through well-constructed business planning, their value to regulators would substantially increase. The financial ratios that regulators might focus on are listed in Table 2.2.

If the objective of water regulators is to identify the capacity of the utility to bear additional debt to finance system upgrades and compliance with water standards, ratios that measure financial leverage can be highlighted.

Table 2.2: Ratios that Assess the Ability of a Firm to Fund Debt

Ratio	Calculation	Use
Debt-to-Assets Ratio	Total Liabilities divided by Total Assets	Measures the relationship of asset values to claims against those assets
Capitalization Ratio	Long-Term Debt divided by Long-Term Debt and Owners' Equity	Measures long-term debt relative to other sources of capital
Burden Coverage Ratio	Earnings before Interest and Taxes divided by Interest plus Principal, which is divided by 1 minus the tax rate	Measures the relative ability of the firm to meet required interest and principal payments

Source: Author's construct.

[15] Jerry A. Viscione, *Financial Analysis: Tools and Concepts*, 66.

In addition to using these simple financial leverage ratios to guide analysis, water regulators might also consider the use of two non-standard ratios for which data may be fairly readily available. First, because system size is often linked to system financial viability, the number of customers in a system is key. Similarly, the level of capital investment is critical.[16] Therefore, the ratio of investment to customers (capital investment at original cost divided by the average number of customers in a period) may provide an interesting indication of financial viability when compared to other utilities. Growth in the number of customers would decrease the ratio; erosion of the customer base or increases in the amount of required capital investment would increase it. Identifying the impact of planned capital investment on the ratio might also prove worthwhile.

Figure 2.1 illustrates the application of a capital investment to customers ratio. In this example, which is not based on real data, the utility has historically experienced a ratio below the average for other water utilities. Based on hypothetical, projected data, when it makes new capital investment in 1998, its ratio will climb to a level above the average and then moderate as projected additional customers come onto the system. In this hypothetical example, the utility's future financial health is highly dependent on this growth in customers. The likelihood of that growth is an issue that regulators may need to investigate. Comparing water utilities to the average is, of course, problematic if the average utility is financially distressed and if the average utility requires unacceptably high rates to maintain its financial capacity.

[16] For example, if an operator can provide service to a small group of customers without much capital investment (e.g., a well and minimal filtration), the utility may be financially viable. However, if the capital requirements are high and the potential customer base remains low, there is a high likelihood that the utility cannot be viable.

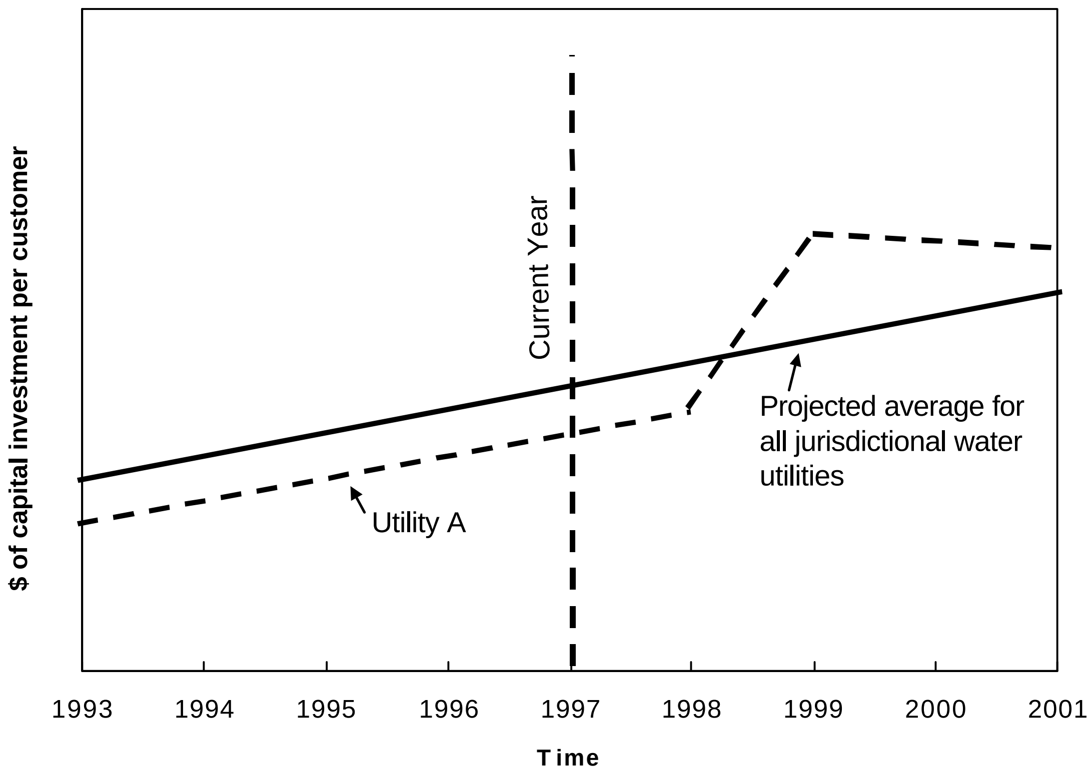

Figure 2-1. Illustration of the application of the investment to customers ratio (Source: Author's construct).

Similarly, the rates paid by customers present an upper constraint on the ability of a water utility to generate revenue. Rates cannot float upward to support any level of capital investment; as regulators are painfully aware, there is a political limit on the monthly rates paid for water. For example, in the State of Washington small water systems must demonstrate that budgets and reserves can be funded at rates that do not exceed 1.5 percent of the median household income for its county.[17]

. . .the rates paid by customers present an upper constraint on the ability of a water utility to generate revenue.

If a water utility can provide service and meet debt obligations on capital investment without violating explicit or subjective rate ceilings, the utility has a good chance of remaining financially viable. Therefore, a comparison of a water utility's rates over time to the average rate for same-size utilities in the state may provide another interesting indicator of financial viability. Those utilities whose rates-to-average ratio is less than 1.0 may have additional room for financing additional capital investments by increasing rates. Those whose ratio is substantially higher than 1.0 may not be able to raise rates and finance investment. Complex tariffs would, of course, make this measure more difficult, though not impossible, to apply, and again, supplementation of historical rate information with projected rate information would make this measure even more useful.

Though ratio analysis can provide useful insights into the financial condition of water utilities and early warning of potential problems, it may fall short of providing clear and compelling indication of financial capacity or the lack of it. That is, it may help inform the judgement of regulators but cannot replace it.

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[17] U.S. Environmental Protection Agency, *Initial Summary of Current State Capacity Development Activities,* EPA 816-S-97-001 (Washington, D.C.: U.S. EPA, January 1997), 19.

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CHAPTER 3

THE APPLICATION OF DCF MODELS TO THE EVALUATION OF WATER UTILITY FINANCIAL CAPACITY

Discounted cash flow (DCF) models have been used for financial analysis for some time by state public utility commissions. When commissions analyze the deferral of utility costs, choose among amortization schedules for utility assets, perform cost-benefit analyses, choose among cost recovery methods, or attempt to identify the cost of utility equity for determination of the weighted-average cost-of-capital, they apply DCF methods.

Though DCF analysis is an old commission tool, the requirements that state commissions both identify the financial capacity of water utilities and identify which water utilities would be good candidates for disbursements from the DWSRF may trigger a reevaluation of its attributes and potential. DCF models are particularly appropriate for the evaluation of investment decisions, being commonly used by private corporations for make-versus-buy decisions and capital investment decisions. The private investment analogy easily extends to the question of disbursement of funds from the DWSRF or similar funds to water utilities, and DCF analyses can allow commissions to evaluate the cost-effectiveness of proposed projects in comparison with other alternatives, as is required, for example, by the Pennvest program.[1] With some embellishment, DCF models can be extended to create a model for the evaluation of water utility financial capacity.

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[1] Pennsylvania Infrastructure Investment Authority Act, P.S., Section 751.10 (a)(3).

DCF analysis also is forward-looking, which may make it more appropriate to water utility financial evaluation than ratio analysis, which is inherently based on historical performance and which requires comparable financial data. Regulators are primarily concerned, after all, with how the utility will perform in the future and whether it will continue to provide utility service. DCF analysis is also complementary to business planning, a current focus of water utility regulation.

Lastly, as regulators examine the merits of DCF analysis, they may wish to consider two recent enhancements to DCF analysis, the Federal Energy Regulatory Commission's (FERC) two-step model and adjusted present value (APV) analysis, to determine what insights they hold for water utility regulation.

General Application of DCF Analysis to Water Utilities

Much as water flows are central to water system engineering, cash flows are central to water system financial management. DCF models are characterized by two components: (1) the primacy of net cash flows as a measure of value and (2) the discounting of those flows to account for the time value of money. Though there are many ways to structure the DCF analysis, both of these components are illustrated by the Gordon growth model, which is typically used to identify the rate of return required on corporate equity.[2] In its simplest form, the model states that:

$$\mathbf{r = D_1/P_0 + g}$$

Where:

r = the rate of return required on the investment

D_1 = the dividend on the equity in period 1

[2] The model was first developed by J. B. Williams in 1938 and then rediscovered and publicized by M. J. Gordon and E. Shapiro in 1956.

P_0 = the current stock price
g = the expected growth rate on the dividend

By rearranging terms, we can determine the value of the investment (the value of corporate common stock) as follows:

$$\mathbf{P_0 = D_1 / r - g}$$

This DCF model presumes that the only thing of value to corporate equity holders is the flow of cash. It does not attempt to incorporate the value of corporate assets except to the extent that they contribute to the creation of dividends. Further, the value of equity is totally dependent on dividend payouts because, in the final analysis, the only thing of value to shareholders is the ability of the corporation to put cash in their hands. Therefore, the potential appreciation in the value of corporate equity is only created by market expectations that dividends will increase.[3]

The use of cash flow to value assets simplifies the analysis of water utilities. Under this model, the value of a utility asset is solely derived from its contribution to the ability of the utility to generate positive cash flows. This is true for individual assets and for the assets of the utility taken as a whole. The cost of utility assets is relevant only because it partially represents (along with working capital) the financial investment against which the net cash flows are to be compared.

Under this model, the value of a utility asset is solely derived from its contribution to the ability of the utility to generate positive cash flows.

If positive cash flows can be generated (i.e., if the return on cash flows, when discounted appropriately, exceeds the cost of capital investments),

[3] Sometimes the "growth" term in the Gordon model is presumed to imply appreciation of the value of the stock in equity markets. However, because dividends are the only mechanism available to corporations to provide wealth to shareholders, that appreciation must, at its core, reflect the expectation that the corporation will share profits with shareholders through dividends.

it is likely that the water utility will be financial healthy. Stated in the negative, if water utilities cannot generate positive cash flows, it is unlikely that any type of financial or managerial legerdemain will make them viable for any extended period of time. By focusing on cash flows, water regulators can, therefore, shift from consideration of financial ratios and past performance to the projection and analysis of those future cash flows.

The simple model presented above also presumes constant dividend growth in perpetuity. That assumption is applied to the valuation of corporate equities, in part, because of the ongoing enterprise assumption used for accounting purposes.[4] The extended model, which assumes an end-date for the cash flows and is more appropriate for the evaluation of water utility investments, is stated as:

$$\mathbf{NPV = -I + \frac{A_1}{(l+r)} + \frac{A_2}{(l+r)^2} + \frac{A_3}{(l+r)^3} + \frac{A_4}{(l+r)^4} + \frac{A_5}{(l+r)^5}}$$

Where:

NPV = the net present value of the investment
I = the investment's up front cost
A = the net cash flow in year x
r = the required rate of return

In this model, five years of cash flows are assumed (longer periods may be more appropriate in actual applications), and each year's cash flow is discounted separately thus allowing for the realistic potential of uneven cash flows which can be separately valued and discounted.

[4] In actuality, corporations have a shorter life span than most might believe. In a study of Japanese and European firms, the average life expectancy was determined to be 12.5 years; the life expectancy of U.S. firms is expected to be about the same. Arie de Geus, *The Living Company* (Boston, MA: Harvard Business School Press, 1997), 2.

The simple lessons to be derived from this model are that (1) positive cash flow is the most important variable affecting corporate worth and performance, and (2) cash flows must be discounted if they occur in an uncertain future. For the evaluation of water utilities, DCF models, like the Gordon model, can be simply adapted to evaluate the likely outcome of individual investments in capital assets by replacing the dividend and current equity price terms with the net annual cash flow related to the investment and the cost of the new asset, respectively.

Table 3.1 illustrates the application of DCF techniques to a water utility investment decision. In this hypothetical model, the utility makes capital improvements costing $4,000,000; generates new revenue of $1,200,000 per year related to the investment; incurs $600,000 per year of new costs related to the investment. The investment is estimated to have useful life of twenty years; and the utility cost of equity (13 percent) is used as the discount rate. The role of subsidized interest rates in DCF analysis is discussed later. In this case, the net present value of the cash flows ($4,215,00) exceeds the investment’s cost ($4,000,000), the investment passes the DCF test and should be made.

The same techniques used to evaluate investment decisions are also appropriate for the evaluation of water utility mergers, particularly if a merger of a healthy company with a marginal one is being considered.

The Challenges of DCF Analysis

Though theoretically sound and adaptable to an array of financial circumstances and decisions, DCF analysis is not without its own problems, the two most significant of which are dealt with here. First, a strength of DCF analysis is its focus on the future rather than the past; similarly, one of its weaknesses is its reliance on projected, and therefore uncertain, flows. Second, a significant variable in determining the worthiness

Table 3.1: DCF Evaluation of a Water Utility Capital Investment	
Where:	
New capital investment	$4,000,000
New revenue	$1,200,000 / year
Operating costs related to the investment	$600,000 / year
Utility cost of equity	13 %
Life of the Investment	20 years
And:	
$NPV = -I + \sum_{t=1}^{n} \frac{(\text{Annual revenue} - \text{operating costs})}{(1 + \text{Cost of equity})^{\text{Life in Years}}}$	
$NPV = -\$4,000,000 + \sum_{t=1}^{20} \frac{(\$1,200,000 - \$600,000)}{(1 + .13)^{+}}$	
NPV = -$4,000,000 + $4,215,000	
NPV = $215,000	

Source: Author's construct.

of investments is the discount rate applied to future cash flows, a task sometimes requiring considerable judgement. These two issues--the projection of financial flows and the choice of the discount rate--are considered in turn.

The Projection of Cash Flows

The accurate projection of cash flows is key to DCF analysis, Unfortunately, few standards exist for the projection of water utility cash flows, and incentives will exist for water utilities seeking funds from subsidized sources to demonstrate the worthiness of investments by overestimating the magnitude of inflows and underestimating the magnitude of outflows. There may also be some difficulty for state public utility regulators in estimating cash flows for investor-owned water utilities, who are now eligible for the types of subsidized funding formerly only available to government-owned providers and who must compete with those government-owned utilities for funds. Thus, in forecasting cash flows, the principal analytic challenge presented to water utility regulators is to prevent the overestimation of net cash flows. There are several techniques available.

One technique used to adjust for uncertainty in cash flows is to employ a higher discount rate than might otherwise be expected. For example, if a water utility were considering an investment that could likely be paid for by existing customers, the utility's existing weighted average cost-of-capital might be used as the discount rate. If the utility were considering an investment that required customer growth, a premium might be added to the cost-of-capital to reflect the additional risk of the customer growth not occurring. The higher the risk of the project, the higher the discount rate that would be applied.

Using a higher discount rate automatically reduces the magnitude of cash flows, and it requires the discount rate to perform double duty;[5] it adjusts the flow of funds for time preferences and risk preferences. Though employing higher discount rates for projects with less certain cash flows is easy to understand and implement, it lacks precision and requires the use of considerable judgement in choosing the rate.

To mitigate against a single utility's overestimation of future cash flows, regulators might also limit growth factors to industry-wide or economy-wide norms instead of company-specific forecasts. For example, instead of allowing a utility to project earnings growth from a stable core of customers based on their own estimates,

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[5] Richard J. Briston and Jack Liversidge, *A Practical Approach to Business Investment Decisions* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981), 121.

commissions could limit growth to national estimates of inflation or other norms of industry growth.

The FERC uses national projections to estimate long-term forecasts of revenue for gas pipelines. For short-term revenues (five years), the FERC applies company-specific earnings projections. For the long term, FERC has applied estimates of industry-wide revenue growth to specific firms.[6] For large, publicly traded gas utilities, the accuracy of these industry-wide estimates as compared to the ability of independent analysts to predict future revenue for a specific firm is debatable.[7] But for water utilities, where in-depth and independent analysis of revenues is not normally performed, the use of industry-wide norms may be an improvement over the growth claims of individual utilities.

Application of these two methods--the use of higher discount rates for risky projects and the application of industry-wide norms--and the use of other more sophisticated techniques[8] for incorporating uncertainty may be poor proxies for the application of judgement by regulators. Water regulators have a sense of reasonableness developed over time that should allow them to judge the cash flow claims of utilities. Their judgement can be supplemented by evaluating the suitability of the investment under several different assumptions of revenue or customer growth. In this way, regulators can determine how dependent the success of the investment is on growth and what magnitude of growth is necessary to make the investment worthwhile.

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[6] Christopher Garbacz, "Now Showing, FERC's "Ozarkian Fantasy", Starring DRI on DCF's Stage Two," *Proceedings of the Tenth NARUC Biennial Regulatory Information Conference* (Columbus, Ohio: National Regulatory Research Institute, 1996), 19-23.

[7] Ibid., 19-31.

[8] See Richard J. Briston and Jack Liversedge, *A Practical Approach to Business Investment Decisions* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981), 120-141.

Given the ease of use of commercially available spreadsheet software, these types of "what if," or sensitivity, analyses are relatively simple to construct and compute.

> *. . .scenario analyses, coupled with the experience of regulators, will facilitate the identification of those combinations of circumstances which are necessary for the success of a utility.*

These scenario analyses, coupled with the experience of regulators, will facilitate the identification of those combinations of circumstances which are necessary for the success of a utility. Multiple evaluations with incremental changes in inputs substantially improves the analysts appreciation of the ability of the utility to succeed.

Estimating the Discount Rate

The second problem inherent in DCF analysis is the determination of the interest rate (or rates) with which to discount future cash flows. As indicated earlier, the discount rate should reflect the riskiness of the investment. The higher the risks, the higher the discount rate. The higher the discount rate, the lower the value of future cash flows as compared to up-front capital investments. Put another way, the discount rate used to value an investment should be the rate of return that must be earned in order to leave the overall value of the firm unchanged.[9] If the firm earns a higher rate than the discount rate, the value of the firm will increase. If it earns less, its value will decrease.

> *. . .the discount rate used to value an investment should be the rate of return that must be earned in order to leave the overall value of the firm unchanged*.

[9] Jerry A. Viscione, *Financial Analysis: Tools and Concepts* (New York, NY: National Association of Credit Management, 1984), 331.

So what discount rate should be applied to water utility infrastructure investments? If no risk were involved, the discount rate would be the risk-free rate of return, generally regarded as the rate earned on short-term U.S. government securities. But even if an adequate return on investment were built into commission-approved water rates, some risk still attends water utility investments.

The discount rate commonly applied to the evaluation of corporate investments is the weighted average cost-of-capital for the firm as a whole. This discount rate takes into account the differential costs of various forms of capital used by the firm and their relative weights in the composition of the firm's total capital. The weighted average cost-of-capital is the appropriate discount rate to apply to evaluation of a water utility investment if two conditions are met. It is appropriate only if:[10]

1. The level of risk of a specific water utility investment is identical to the risk of other investments by the same utility, and

2. The level of investment does not alter the firm's optimal capital structure (e.g., an investment structured entirely with debt might introduce enough debt to change the entire firm's level of risk).

To some extent, it could be argued that the same risks will attend new water utility investments as attend the utility as a whole. Managers, customers, and regulators will remain the same after the investment, and the utility will continue to operate a familiar line of business. But for water utilities, it also could be argued that the weighted average cost-of-capital should represent a floor rate to be applied. When water utilities are required to make large capital investments to meet new standards or replace old infrastructure, it is unlikely that their overall level of risk will decrease. Unlike most corporations, they are not likely to be out "shopping" for opportunities for business expansion. They are, of necessity, increasing the costs of the existing line of business.

[10] Ibid., 346.

As a result, it is more likely that water utility financial risk will increase given the additional financial burden to be covered by ratepayers and the increasing risk that individual customers will be unable to pay the higher rates. The investment might also violate the second condition listed above if it is large enough to significantly impact the composition of the utility's total financing portfolio.

In recent years, the use of the weighted average cost-of-capital has fallen into some disfavor. Critics argue that the weighted average cost-of-capital "bundles" such items as the effects of interest tax shields and subsidies into one calculation without giving explicit recognition to each. A newer method, the APV method, unbundles these various effects by using the cost of equity as the discount rate and calculating the other effects separately. The result is a determination of the value of an investment with clear identification of all of the individual sources of value, including those contributed by financial maneuvers or subsidies.[11] Descriptions of the application of the APV method are available in finance texts and various articles.

For water utilities, the APV method may be more appropriate than use of the weighted average cost-of-capital in order to isolate the impact of subsidized sources of capital like the DWSRF. Indeed, if subsidized financing has been made available to water utilities through programs like Pennvest or the DWSRF, the weighted average cost-of-capital for those utilities will not reflect the true risk level for the utility as it does for firms without subsidized capital. The result is that the weighted average cost-of-capital for water utilities may significantly understate the risk level of water utility investments. Employing the APV method may, in fact, begin to

For water utilities, the APV method may be more appropriate than use of the weighted average cost-of-capital in order to isolate the impact of subsidized sources of capital like the DWSRF.

[11] Timothy A. Luehrman, "Using APV: A Better Tool for Valuing Operations," *Harvard Business Review*, May-June 1997, 145-154.

clarify some of the hidden subsidies made available to public water systems over their investor-owned counterparts.

Investments in a municipal water system are typically composed of debt and contributed capital with no explicit equity element. The overall risk of the investment is not, therefore, discernable because the contributed element is not subject to either an investment test or an evaluation of its expected return. Even though debt is rated, it does not reflect the total degree of utility risk because the debt element is diluted by any contributed capital. Financial arrangements available to a utility do not change the overall riskiness of it. Rather, risks are assumed by the contributor of capital and borne by the customers of the municipal system. As a result, using embedded capital costs to estimate comparative risk between municipal and investor-owned utilities is misleading.

Though the choice of a discount rate to apply to the evaluation of water utility capital investments may involve more art than science, one thing is certain; the discount rate applied should not be the subsidized rate of interest charged on loans from public sources. Those rates of interest are in many cases nominal, and applying those rates to future streams of revenue would nearly obviate the time value of money and the risk implicit in DCF analysis. The discount rate applied to future streams is intended to adjust for risk; risk is not reduced merely because the interest paid is low. The utility benefits from low interest payments in DCF analysis by virtue of the fact that cash outflows are reduced by the lower interest payments on subsidized loans. The discount rate, however, must reflect the risk of the investment not the interest rate paid to finance it.[12]

[12] In efficient financial markets with a free flow of information and no subsidized sources of capital, there would, in fact, be no difference between the risk of an investment and the rate the firm would have to pay to finance it.

A DCF Model of Water Utility Operations

Much of the previous discussion of the use of DCF methods for water utilities has focused on the evaluation of capital investments by water utilities. DCF can also be used by regulators to evaluate the total financial health of an entire water utility. Fortunately, DCF models are not dependent on the existence of historical financial data and, therefore, can be applied to water utilities of any size. In addition, by "solving for" one of the variables in the model, regulators can determine the necessary change in the variable (e.g., the number of customers or the average rates) that would make the utility financially viable; by employing a range of values for each variable, regulators can identify the ranges within which the utility can remain viable.

A simple DCF model of water utility financial operations can be stated as:

$$\mathbf{NPV} = -\mathbf{I} + \sum_{t=1}^{n} \left[\frac{(C \times R) - E}{(I + r)^{t}} \right]$$

Where:

I = the total financial investment in the utility
C = the average number of customers for the year
R = the average annual rate paid by customers
E = the annual expenses of the utility including interest and taxes
r = the required rate of return

This model treats the entire water utility like a capital investment problem, a treatment that is appropriate given the capital-intensive nature of water utilities. In it, the value of the capital investment in the utility is compared to the present value of the net income of the utility after taxes. The net income stream, of course, must be discounted by an appropriate rate to account for the uncertainty of cash flows. If the

NPV of the utility is a positive number, the utility is generally viable; if it is a negative number, financial capacity is in question. (Later in this chapter, more will be said about care that should be taken in the interpretation of DCF results.)

For small utilities, the capital investment can be determined by adding working capital requirements to facility costs. For larger utilities with financial documentation, the capital investment can be derived from the utility balance sheet. For utilities requiring substantial new investment, the analysis can be conducted pre-investment and post-investment to identify the net effect of the investment on the utility's financial capacity. The model does not explicitly address the issue of the availability of capital. However, as was indicated in Chapter 1, it is our hypothesis that the overwhelming majority of firms can gain access to capital as long as they have the skills to demonstrate the existence of those flows. The real issue is not the availability of capital; the real issue is the availability of capital *at rates that are affordable to the utility and to its ratepayers*.

Past income may provide a guide for estimating future net income streams. Utility revenue is largely the result of two factors, both of which are separately identified in the model--the number of customers and the average rates paid by customers. For added sophistication, separate income streams could be identified for industrial/business and residential customers. The revenue streams then could be summed to identify the total revenue flow to the utility. Costs, which need to be netted against revenue to determine net income, include such items as salaries, maintenance costs, interest on debt, and taxes. Depreciation, except to the extent that it impacts taxes paid, should not be included as an operating cost. The total capital investment includes investments in physical assets (original cost less accumulated depreciation) and working capital.

The number of years of net income to project is an question of some importance. The longer the period forecast, the better chance the utility has to generate a positive present value, but forecasts become less accurate the farther into the future they occur.

On the other hand, forecasts far in the future are not critical to the analysis because they lose importance due to the discounting of flows. For example, a dollar of net income received twenty-five years from now, at a discount rate of 13 percent, is worth slightly less than a nickel today. Net income should probably not be forecast for periods longer than the useful life of capital equipment used in the production of utility service.

Table 3.2 illustrates the application of this model to a fairly small water utility with 1600 customers, $24 average monthly revenue per customer, $350,000 of operating expenses, capital investment of $600,000, and a cost of equity/discount rate of 13 percent. In this example, the discounted value of twenty years of cash flow (the estimated average remaining life of capital investments) is $780,000 as compared to the capital investment of $600,000. Under this model, the utility has the financial capacity to provide service. The difference between the present value of the cash flows and the total capital investment ($180,000) can also be regarded as the maximum amount of additional capital investment that the water utility can make without additional revenue. The model, of course, is not that sensitive, and we are not suggesting that a water utility in this circumstance be required to invest at that level without relief.

If this model were to be applied in the next year, a combination of factors would increase the net present value of the utility unless rates were simultaneously decreased. The utility's total investment would decrease due to depreciation of the physical assets, and the remaining useful life of those assets would also decrease (i.e., the evaluation period would decrease to nineteen years). The net effect would be an increase in the present value.[13] Indeed, as capital assets are depreciated and their

[13] Net present value would increase even if straight-line depreciation were applied. The net present value would increase even faster if accelerated methods of depreciation were applied. The depreciation method applied should be the one that most clearly matches the flow of time with the remaining investment in the asset.

Table 3.2: DCF Evaluation of a Small Water Utility	
Where:	
# of customers	1600
Average monthly customer bill	$24
Operating expenses	$350,000 / year
Total capital investment	$600,000
Cost of equity	13 %
Evaluation period	20 years
And:	
$NPV = -\text{Total investment} + \sum_{t=1}^{n} \left(\frac{[\#\text{ of customers} \times \text{Annual cost}] - \text{Operating expenses}}{(1 + \text{Cost of equity})^{\text{Year}}} \right)$	
$NPV = -\$600{,}000 + \sum_{t=1}^{20} \left(\frac{[1600 \times 24 \times 12] - 350{,}000}{(1 + .13)^{+}} \right)$	
NPV = -$600,000 + $780,000	
NPV = $180,000	

Source: Author’s construct.

value approaches zero (which would never, in fact, be the case because of the investment in working capital), the value of the utility would be the value of cash flows without an offset for investment. Presumably, however, water rates charged would also decrease, creating a simultaneous decrease in cash flows to the utility (and a corresponding decrease in net present value) even if no new investment were required or made.

As is apparent from the preceding discussion of the re-application of the model in successive years, not all variables in the model effect net present value equally. Table 3.3 adjusts three of the variables by ten percent to identify the change in the total net present value. A change in the number of customers or in the average rate paid by customers is interchangeable since they are multiplied together in the model. In Scenario A, a ten percent increase in either customers or the average monthly rate paid creates a sizable increase in net present value (from $180,000 to $503,000).

Table 3.3: Adjustment of DCF Variables (from Table 3.2)
Scenario A: 10% Increase in # of customers or average rate paid
$NPV = -\$600{,}000 + \sum_{t=1}^{20} \left[\frac{\$507{,}000 - \$350{,}000}{(1.13)^{+}}\right]$
NPV = -$600,000 + $1,103,000
NPV = $503,000
Scenario B: 10% Decrease in Operating expenses
$NPV = -\$600{,}000 + \sum_{t=1}^{20} \left[\frac{(1600 \times 24 \times 12) - \$315{,}000}{(1.13)^{+}}\right]$
NPV = -$600,000 + $1,026,000
NPV = $426,000
Scenario C: 10% Reduction in the Discount Rate
$NPV = -\$600{,}000 + \sum_{t=1}^{20} \left[\frac{(1600 \times 24 \times 12) - \$350{,}000}{(1.11)^{+}}\right]$
NPV = -$600,000 + $884,000
NPV = $284,000

Source: Author's construct.

A decrease in operating costs has less impact in this example. In Scenario B, a ten percent decrease in operating costs increases the net present value to $426,000 from $180,000. Recall the prior argument that subsidized interest rates do not decrease the discount rate but only result in decreases in operating costs (because less interest is paid). The total effect of subsidized interest rates is, therefore, determined by the size of the subsidy and the proportion of operating costs made up of subsidized interest charges.

Finally, a decrease in the discount rate of ten percent (rounded up to the nearest whole percent--down from 13 percent to 11 percent) has the least impact in this example. The net present value of the utility increases in Scenario C from $180,000 to $284,000, a sizable increase but less than the effect created by changing revenues or operating costs. The fact that the discount rate seems to have less impact than the other variables should be encouraging to those attempting to apply the model since the discount rate is the variable most subject to interpretation.

Implications and Conclusions

The treatment of water utilities as capital investment problems that can be analyzed by DCF models is a deceptively simple concept attended by a host of fairly complex considerations. As a result, it should be applied cautiously, and the results of the application of the model should be moderated by other judgements and cross-company comparisons. Fortunately, existing computer programs can allow successive iterations of the model to identify the effect of changes in the variable values on individual utilities. Like the results of ratio analysis, DCF analysis also may be most useful when data allows comparison across utilities and across time.

Despite the fact that some experience with the model may be necessary before it can be applied to the evaluation of individual water utilities, the model makes clear the impact of the model's variables on overall water utility financial capacity and points regulators toward matters of most importance in maintaining water system viability. If positive discounted cash flow is the preeminent variable affecting water utility financial capacity, the adequacy of rates assumes a very central role. Water systems are often limited in their ability to add new customers, and substantial reductions in operating costs, while important, are limited by the realities of water service delivery. Capital investment requirements may fall outside the control of system operators, and the rate paid on financial capital may not impact the model as directly as increases in revenue since interest payments are only one component of operating costs.

If rates are capped by implicit political limits, the DCF model makes it apparent that systems below a certain size and given minimum capital investment requirements cannot be viable. Fortunately, it would be fairly simple for state regulators to identify the minimum customer base necessary to support a water utility given the upper limit on rates and various levels of capital investment by "freezing" variables in successive iterations of the model. Ultimately, given the realities of water systems, the financial capacity of water utilities might be furthered most readily by state regulators by educating the public about the costs of safe water supply and, thereby, raising the acceptable level of rates and easing the psychological impact of rate shock.

If rates are capped by implicit political limits, the DCF model makes it apparent that systems below a certain size and given minimum capital investment requirements cannot be viable.

For the evaluation of disbursements from the DWSRF or from other subsidized sources of funding, DCF analysis should identify those utilities that can be aided by access to subsidized capital and distinguish them from those that do not need subsidized capital. Additionally, it should help identify those utilities for whom the infusion of scarce subsidized capital will only prolong the inevitable.