SOLID WASTE RATE SETTING METHODOLOGY

Report Submitted by

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1.0 PROJECT INTRODUCTION

1.1 RATIONALE FOR STUDY

The Washington Utilities and Transportation Commission (WUTC) currently uses the Lurito Gallagher (L-G) methodology for determining revenue requirements for the solid waste collection companies that it regulates. The current L-G model is based on an analysis conducted in the late 1980s of the empirically observed relationship between profit margins and capital turnover ratios among a set of comparable companies.

The model is considered by many to be a black box because the regression formulas utilize data that is not clearly documented. During the model's development, the information used to derive the formulas was based on research of comparable companies from 1968 to 1977. The current model was updated in the early 1990s and has been in use for over 25 years. Limited supporting data used by Mr. Richard Lurito and Kenneth Gallagher during the model development and subsequent update was retained by the WUTC.

The WUTC wishes to reexamine this statistical relationship to validate the current use of the L-G model, modify its use, or replace the model with a more appropriate methodology. The motivation for examining the validity of the L-G model is based, in part, on recent studies purporting to show that the return on equity (ROE) produced by the methodology are high relative to ROEs in comparable industries.[1]

1.2 STUDY OBJECTIVES AND REPORT OUTLINE

The objective of this report is to provide the WUTC with the necessary information and analyses to assist them in assessing whether the L-G methodology and resulting model is still an appropriate methodology for calculating hauler revenue requirements. Towards achieving these goals, this report is structured as follows.

Section 2 discusses the L-G methodology and the current L-G model. The L-G methodology is briefly outlined in Section 2.1, and then critiqued in Section 2.2. We find that the current L-G methodology is relatively sound, though the previously stated rationale underlying the methodology is not entirely accurate. Section 2.3 examines the implementation of that methodology, in the form of the Excel-based L-G model. The model has what we believe are two material errors that cause revenue requirements to be lower than intended, and these errors are discussed in Section 2.3. A more extensive explanation of how the Excel model works is contained in the Appendix.

Section 2.4 provides a comparison of model outputs from the currently used L-G model and a model that corrects the errors discussed in Section 2.3.

[1] See Blumenthal, A., and T. Hulet. 2010. An Evaluation of the Return on Equity in the Waste Management Industry in Washington State, Evans School of Public Affairs, University of Washington; and Sheehan, M.F. 1996. Rate Regulation in the Solid Waste Industry: A Review of Standards and Performance, Osterberg & Sheehan, Public Utility Economists.

Attention is then turned towards updating the equations that drive the L-G model. This is done in Section 3. Data sources and methodology are discussed in Section 3.1, followed by econometric results in Section 3.2. A comparison of regression results from the updated model with both the current model, as well as the corrected L-G model discussed in Section 2.3 are presented in Section 3.3. The largest difference derives not from the update of the model, but from the corrections discussed in Section 2.3.

Many jurisdictions use the operating ratio methodology to set rates. While the L-G methodology utilizes an operating ratio, that ratio is not fixed and depends on the capital turnover ratio. The operating ratio methodology tends to be criticized for not having a good basis for setting the operating ratio. Section 4 constructs a model that explicitly recognizes the distinction between economic and accounting profits. The resulting model is subsequently estimated using the same data used to update the L-G model. The results of the econometric estimation indicates a return on expenses, as in the operating ratio methodology, combined with a return on net property, plant, and equipment, does a good job of matching revenue requirements to haulers' actual economic costs.

Section 5 presents some brief observations on the use of a CAPM model and why such a model would be difficult to apply to the regulated solid waste carriers. Section 6 provides some conclusions and recommendations.

This report presents four sets of empirical results that utilize data from six recent WUTC rate cases. The four sets differ by the rate model used. These are (1) the current L-G model; (2) a corrected L-G model that uses the original L-G 'curves'; (3) a revised L-G model that takes the corrected L-G model and updates the curves using more current data; and (4) an economic cost model estimated using the same data underlying the third model.

A word on terminology is in order. In conducting the research underlying this report, we found two terms being used in a manner that deviated from their standard meaning. One example is 'return on equity,' or ROE. While typically taken to mean a company's net income as a percent of shareholder equity, Lurito and Gallagher used the term to mean net income as a percent of a prorated portion of property, plant and equipment, where the equity ratio was used for prorating. In a similar manner, 'rate of return' (ROR) uses property, plant and equipment in the denominator, rather than a broader definition of assets. Neither of these deviations from standard usage affects the workings of the L-G model and the calculated revenue requirements. Still, the 'ROE' and 'ROR' generated from the model are biased upwards and cannot be directly compared to ROE and ROR calculated using the standard definition.

2.0 CRITIQUE OF THE L-G METHODOLOGY AND MODEL

This section first discusses the logic behind the L-G methodology. The Appendix contains a step-by-step description of the Excel-based L-G model currently in use by the WUTC to regulate solid waste carriers. The model contains two substantive errors, which are summarized in section 2.3.

2.1 THE L-G METHODOLOGY

The L-G methodology uses the DuPont Formula to estimate a hauler's required return on equity.

In brief, a company's return on capital can be derived from the following identity:

(1) Return on Capital = Profit / Revenue x Revenue / Capital = Profit Margin x Capital Turnover Ratio

To put this concept into practice, Lurito and Gallagher noted that for a given return on capital, and holding the equity ratio constant, there should be an inverse relationship between the profit margin and the asset turnover ratio. If that inverse relationship can be established for representative companies in market equilibrium, it can be used to obtain the required return on capital. Lurito and Gallagher also note that such an econometric estimation should also pick up any differences in risk due to having a higher or lower capital turnover ratio. Given an estimated 'L-G curve' that relates a company's capital turnover ratio to their expected profit margin, and using the company's debt/equity structure and the cost of debt, it should be possible to algebraically derive the company's required return on equity.

2.2 CRITIQUE OF THE L-G METHODOLOGY

We believe Lurito and Gallagher's methodology is sound, though the ROE generated can be mistakenly interpreted as being 'too high' relative to other comparable industries. To see why, multiply Equation (1) through by Capital/Equity to give:

(2) Return on Equity = Profit / Revenue x Revenue / Capital x Capital / Equity

= Profit Margin x Capital Turnover Ratio x Equity Ratio

Instead of using capital, Lurito and Gallagher used net property, plant and equipment (PP&E). To keep the proper identity for ROE, (2) becomes:

(3) ROE = Profit / Revenue x Revenue / PP&E x PP&E / Capital x Capital / Equity

The PP&E / Capital ratio is ignored by Lurito and Gallagher. Multiplying through by the inverse of this ratio gives the following equation:

(4) ROE x Capital / PP&E = Profit / Revenue x Revenue / PP&E x Capital / Equity

However, the left-hand side is still treated as equaling ROE by Lurito and Gallagher.

To obtain the correct ROE, the L-G model's ROE must be multiplied by PP&E / Capital or PP&E / Total Assets. For Waste Management, Inc. this ratio has been relatively constant at 0.55. For Waste Connections the ratio has been 0.484 for the past two years. For Republic Services, Inc. the ratio has been 0.35 for the past three years. Other publicly traded waste management companies have even lower ratios, down to 0.12. Purely from a standpoint of comparing the L-G model's ROEs to other studies that use the standard definition of ROE, the reported 'ROEs' of 24%-42% should be adjusted by these multiples, bringing the true return on shareholder equity down to the teens or lower. It is important to note, however, that the difference in how ROE is defined does not affect the accuracy of the L-G model's revenue requirements.

A brief comment regarding the impact of inflation is warranted. For the ten-year period (1968-1977) used to estimate the L-G curve, inflation, based on the CPI for urban consumers (all items), averaged 6.4%. In contrast, inflation for the 2011, 2012, and 2013 averaged just 2.2%. Holding other factors constant, this should produce lower nominal returns on equity. At a minimum, the L-G curve(s) should be updated when inflation rates change appreciably.

2.3 ANALYSIS OF THE L-G RATE MODEL

The L-G rate (or revenue requirement) model is less-than-transparent. Many formulas contain hard-coding where the parameters are not documented within the model. The Appendix provides a description and critique of this model and also serves as sort of a user guide as to how the model currently works. Two material errors are identified in the Appendix and are worth noting here.

The first error pertains to going from a pre-tax to an after-tax ROE. Lurito and Gallagher had adjusted their data prior to their econometric estimation. The tax rate during the time frame for their data had been 46%, but had been reduced to 34% at the time they were developing their model. The adjustments they made indicate they thought the after-tax ROE should be independent of the prevailing tax rate. We agree. The current L-G model should be using 34% in converting from the pre-tax ROE to the after-tax ROE, not the hauler's tax rate. While we usually dislike hard-coding in Excel formulas, this is a case where the 34% tax rate should be hard-coded into the model, with appropriate documentation explaining the hard-coding. The consequence of this error is zero for a hauler with a 34% tax rate. However, if the hauler has a lower tax rate, the model generates revenue requirements that are too high. A hauler with a 50:50 debt to equity ratio, and a tax rate of 10%, the model produces revenue requirements that are 2.5% higher than in a model without this error.

The second error in the Excel model pertains to the final calculation of the Revenue Deficiency, which is then added to Reported Revenue to obtain the Revenue Requirement. The Revenue Requirement should be independent of the Reported Revenue. That is, if the model's user changed the Reported Revenue by the hauler, there should be no change in the calculated Revenue Requirements, though the Revenue Deficiency would change. The error lies in not properly adjusting Reported Revenues for the conversion factor. An easy fix to this error is to calculate the Revenue Requirements directly from the expenses and the conversion factor (which adjusts for revenue-based taxes and fees). The calculation is:

(5) Revenue Requirement = Expenses / (1 – Conversion Factor)

The Revenue Deficiency is then simply Revenue Requirement minus Reported Revenue. This error causes the Revenue Requirement to fall as the Reported Revenue increases. The smaller the revenue increase required, the larger the error.

The next section presents data on the magnitude of these two errors for the six rate cases examined.

2.4 CORRECTED L-G MODEL RESULTS

This section provides empirical examples of the magnitude of the errors from the combination of the errors discussed in Section 2.3. Data from six rate submissions are used.

The Project Team requested six recent rate submissions to understand the nature of the information required to file a rate increase, to evaluate allowable costs and the data sources that were input into the rate model, and to test and compare changes to the current L-G model and any proposed rate models. Two of the rate submissions were from the densely populated areas of King and Snohomish County, two were from the moderately dense areas in Yakima and Pacific County, and the remaining two were from the sparsely populated counties of Wahkiakum and Okanogan.

Company data from the six rate cases were applied to both the original L-G model and the corrected L-G model. The results, in terms of revenue requirements, are shown in Table 1. Keep in mind that the revenue requirement from the original L-G model are sensitive to the revenues entered in cell E5. To the extent that WUTC staff entered different values than utilized in this analysis, the magnitude of the error can vary.

Table 1. Comparison of revenue requirements: Original L-G model vs. Corrected L-G model.

Revenue Requirement			
Company	**Corrected L-G**	**Original L-G**	**Error %**
WM	$60,937,322	$59,251,578	-2.8%
Rabanco	$9,958,837	$9,811,845	-1.5%
Yakima	$9,210,479	$8,946,502	-2.9%
Peninsula	$2,929,078	$2,866,270	-2.1%
Stanleys	$466,057	$461,494	-1.0%
Methow	$682,463	$670,618	-1.7%

The magnitude of the errors are highly dependent on the revenue-sensitive taxes and fees, indicating that the model is not properly adding those fees and taxes to revenue requirements. In other words, haulers would be paying these taxes and fees from their profit margin.

3.0 UPDATED L-G MODEL

This section updates the L-G model using recent data from a subset of companies included in the S&P 500 Index.

3.1 METHODOLOGY

Our methodology deviates from Lurito and Gallagher in four distinct ways. First, Lurito and Gallagher used averaged company data spanning a ten-year period, for 198 representative companies. This data was subsequently split into ten groups based on a company's ten-year average capital turnover ratio, and the group averages were used, giving just ten observations. We instead utilize each annual observation for each company over a three-year period. We did not split the data into groups and take the average of the groups. Lurito and Gallagher's methodology hides important information on variability across and within companies, which obscures important information that might be used to determine if a particular revenue-requirement methodology is reasonable. In addition, any confidence intervals generated under Lurito and Gallagher's data averaging method cannot be interpreted in the usual fashion.

Second, Lurito and Gallagher selected a time period with stable inflation and for which they considered the ten-year average to approximate market equilibriums. This raises the question of whether the use of a shorter time span creates a potential bias. Since the comparable companies selected by Lurito and Gallagher were regulated, whether the companies were in equilibrium in the goods market is a moot point. Based on the application of their econometric results to their model, it is more reasonable that the focus was on equilibrium in the financial market, particularly for equity capital. The nominal return on equity capital, however, should vary with inflation, and even the real return on equity capital can vary from one time period to another. One could argue that providing a real return on equity consistent with current market returns would be reasonable, and allowing higher returns is not fair to consumers. This is a policy question for the WUTC.

Third, Lurito and Gallagher excluded solid waste companies from their data, reasoning that including regulated solid waste companies to determine revenue requirements would be circular. While this would be true if the WUTC were to be setting revenue requirements for a substantial portion of these companies' operations, that isn't the case. If it is circular because other jurisdictions might be looking at the same type of analysis to set their own revenue requirements, the same argument could be made for excluding any regulated utilities where the revenue requirements are based on analyses including representative companies. Our view is that the returns earned by companies in other jurisdictions impact their opportunity cost of serving WUTC-regulated areas.

Fourth, Lurito and Gallagher, in their early 1990s revision, used four separate curves, depending on the capital turnover ratio. Given that they only had ten data points, we find this somewhat curious. Unless there is evidence of a bias due to data transformations or model misspecification, the simpler one-curve equation seems more appropriate.

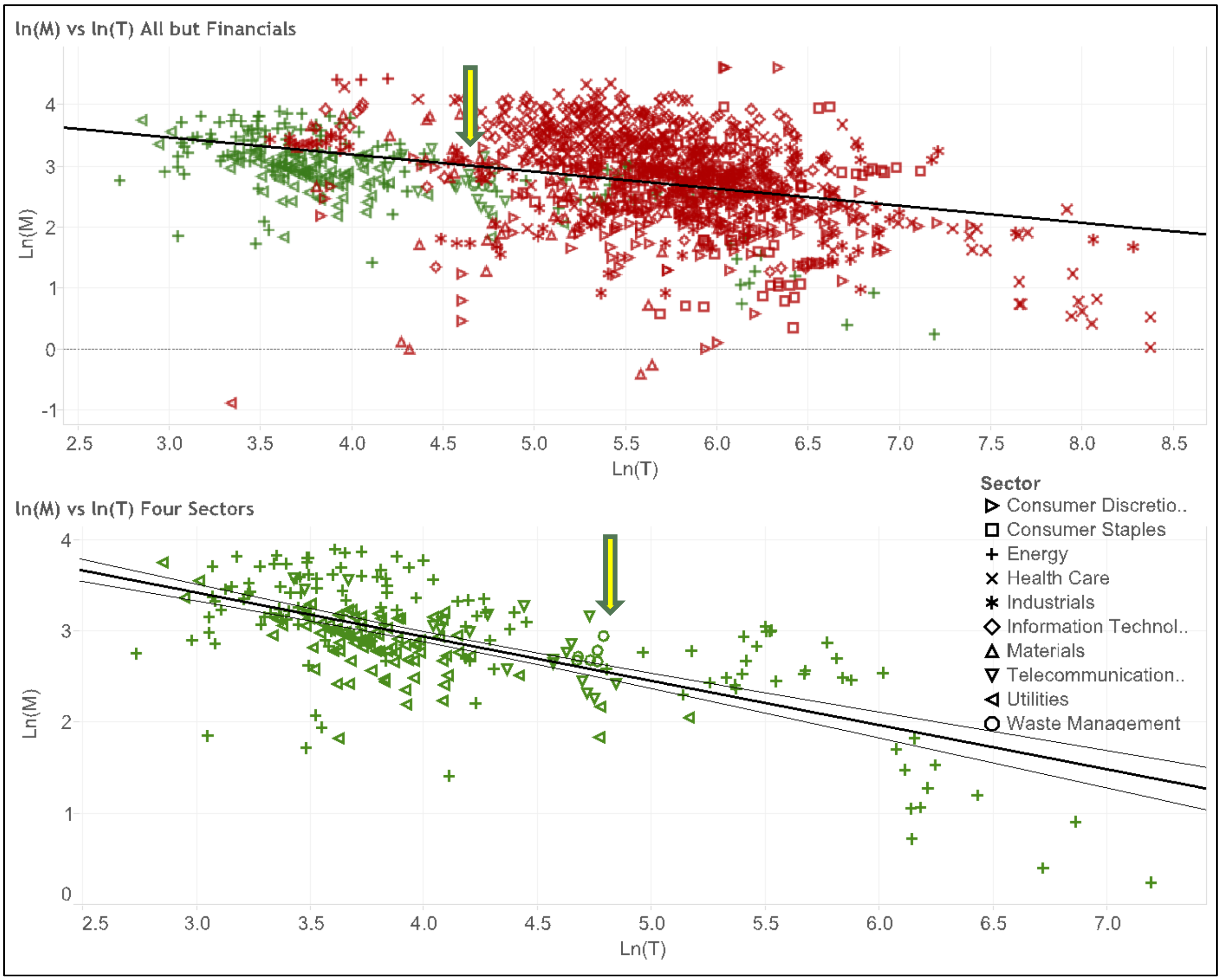
3.2 S&P 500 DATA

The data consists of three years' worth of annual income statement and balance sheet data for 414 companies in the S&P 500. Eighty-three companies in the financial sector were excluded from our data gathering. One utility (Integrys Energy Group Inc.) was excluded due to lack of needed data. Income statement and/or balance sheet data was missing for one year for three additional companies. The resulting 1,239 observations encompassed nine sectors: consumer discretionary, consumer staples, energy, health care, industrials, information technology, materials, telecommunications services, and utilities. Two waste management companies, Waste Management, Inc., and Republic Services, Inc., were reclassified from the industrials sector to a separate waste management sector. Subsequent regressions only utilized data from the energy, telecommunications services, utilities and waste management sectors. Two companies in this subgroup, Diamond Offshore Drilling and Stericycle, Inc., were deemed to be extreme outliers and were dropped, giving 242 observations.

The top panel of Figure 1 shows a scatterplot of the natural log of (100 x profit margin) (i.e., 100 x EBIT/Revenue) vs. the natural log of T [the PP&E turnover ratio (100 x Revenue/PP&E)]. The black data points are those observations included in subsequent regressions using the four included sectors, while the gray data points are excluded observations. As can be seen, the data used for the regressions tends to have lower profit margins, for a given turnover ratio, than the excluded data. The bottom panel of Figure 1 shows the scatterplot for the same variables for the sample companies only. The six observations for the waste management sector (three each for Waste Management, Inc., and Republic Services, Inc.) are represented by circles (yellow arrow). As can be seen in the bottom panel of Figures 1, these observations lie just above the regression line, approximately at the upper bound of a 95% confidence interval for the mean ln(M), conditional on the turnover ratio.

The data also included industry risk premia, from Duff and Phelps (2014) and each company's stock beta, obtained from Yahoo! Finance in late October, 2014. These variables serve as industry-level and company-specific measures of risk.

Figure 1. Natural log of profit margin vs. natural log of PP&E turnover ratio.



3.3 ECONOMETRIC RESULTS

Three equations were estimated. The first is the standard L-G curve, with one independent variable:

(6) $\ln(M) = 4.6764 - 0.4291 \ln(T)$

Adjusted $R^2 = 0.4177$; Standard error of the regression = 0.4615

Average residual for waste management sector = 0.115

	Coefficients	*Standard Error*	*t Stat*	*p-value*
Intercept	4.67637	0.13829	33.81581	0.00E+00
LN(T)	-0.42914	0.03255	-13.18586	0.00E+00

For comparison purposes, the original L-G curve is:

(7) $\ln(M) = 5.67537 – 0.68367 \ln(T)$; $R^2 = 0.95$

The new fitted line has a smaller intercept and flatter slope than the original regression line. Given the lower inflation rate that prevailed during our sample period compared to 1968-77, this was expected. Lower inflation should reduce the nominal return on equity, so that the impact on the profit margin from higher capital levels is smaller.

The standard error of the regression is useful in describing the variability in observed values from the regression line. As a rough rule of thumb, approximately 95% of the observations should lie within 2 standard errors of the regression line.

We also report the average residual (observed value – fitted value) for the six data points from the solid waste sector. As expected from Figure 1, the solid waste sector has a positive residual, indicating that their profit margin is higher than would be expected from the fitted model.

To explore the impact of risk on profit margins, each company's risk premia (a measure of risk at the industry level) and beta (a measure of individual company riskiness) were added to the basic L-G model:

(8) $\ln(M) = 4.9570 - 0.4170 \ln(T) + 12.8370 \text{ Risk Premia} - 0.2180 \text{ Beta}$

Adjusted $R^2 = 0.5129$; Standard error of the regression = 0.4221

Average residual for waste management sector = 0.2252

	Coefficients	*Standard Error*	*t Stat*	*p-value*
Intercept	4.95704	0.13359	37.10641	0.00E+00
LN(T)	-0.41703	0.0312	-13.3648	0.00E+00
Risk Premia	12.83703	1.88018	6.82756	7.13E-11
Beta	-0.21796	0.05666	-3.84678	1.54E-04

While this specification improves the adjusted R^2, and reduces the standard error of the regression, the average residual for the waste management sector increases. While both Risk Premia and Beta were statistically significant, the coefficient on Beta is perhaps of the wrong sign. This is most likely due to the collinearity between Beta and the Risk Premia (r = 0.718; p-value = 6.1E-107), with Beta's negative coefficient indicating that Risk Premia might not be entered in the correct functional form.

Equation (8) is primarily presented for informative reasons only. Actually applying a model based on equation (8) to private solid waste companies would be problematic due to the lack of betas for those companies.

A third specification adds the ratio of a company's equity to their liabilities:

(9) $\ln(M) = 4.7530 - 0.4291 \ln(T) + 8.4733 \text{ Risk Premia} - 0.2735 \text{ Beta} + 0.4085 \text{ Equity / Liabilities}$

Adjusted R^2 = 0.5630; Standard error of the regression = 0.3998

Average residual for waste management sector = 0.2077

	Coefficients	*Standard Error*	*t Stat*	*p-value*
Intercept	4.753	0.13221	35.94905	0.00E+00
LN(T)	-0.42907	0.02964	-14.47561	0.00E+00
Risk Premia	8.4733	1.96063	4.32172	2.28E-05
Beta	-0.27352	0.05467	-5.00291	1.10E-06
Equity/Liabilities	0.40845	0.07678	5.32003	2.40E-07

The coefficient on Equity/Liabilities is positive and indicates higher levels of equity are associated with higher profit margins. It is highly likely, however, that the causal relationship may be in the reverse direction: higher profit margins allow a company to build greater shareholder equity. Allowing a company a higher profit margin purely because they have greater shareholder equity seems to involve circular reasoning.

3.4 COMPARISON TO EXISTING AND CORRECTED L-G MODELS

Table 2 gives the revenue requirement comparisons to the current (original L-G) model, the corrected L-G model, and the revised (updated with new data and corrected) L-G model. As can be seen, there is little change from the corrected L-G model from Section 2.4, so that the change from the original L-G model is largely reflecting these corrections.

Table 2. Comparison of revenue requirements: Original L-G model vs. Corrected L-G model.

	Revenue Requirement			% Change from	
Company	Original L-G	Corrected L-G	Revised L-G	Corrected L-G	Original L-G
WM	$59,251,578	$60,937,322	$60,631,671	-0.5%	2.3%
Rabanco	$9,811,845	$9,958,837	$9,985,306	0.3%	1.8%
Yakima	$8,946,502	$9,210,479	$9,183,621	-0.3%	2.7%
Peninsula	$2,866,270	$2,929,078	$2,902,505	-0.9%	1.3%
Stanleys	$461,494	$466,057	$458,866	-1.5%	-0.6%
Methow	$670,618	$682,463	$677,674	-0.7%	1.1%
Aggregate	$82,008,308	$84,184,237	$83,839,644	-0.4%	2.2%

4.0 ECONOMIC COST MODEL

A weakness of the L-G and pure operating ratio methodologies is that the economic cost of invested capital is poorly recognized. Ideally, if a company invests in new capital equipment, such as a $350,000 truck, the rate review process will produce an increase in revenue requirements sufficient to cover the economic costs of that purchase. That is not the case with a fixed operating ratio approach. As operations become more capital intensive, revenues do not adequately increase to match increased economic costs. The Lurito-Gallagher model partially corrects for this by tying the operating ratio to the capital turnover ratio, but the L-G curve is not sufficient to generate what might be considered a reasonable internal rate of return (IRR) on new capital purchases.

This section lays out an argument for a rate model based on the combination of a fixed operating ratio combined with a reasonable return on property, plant, and equipment. The model is subsequently estimated using the same dataset as used in Section 3 to revise the L-G model. The model is then applied to the six rate cases, and the results are compared to the results from the current L-G model, the corrected L-G model, and the revised L-G model.

4.1 METHODOLOGY

The economic costs of a solid waste company include their operating and general and administrative expenses, an opportunity cost for net tangible capital investment, and an opportunity cost for intangible assets. This latter category includes structural capital. The goal of this section is to develop a model that relies on data available to the WUTC. Intangible assets are not easily observable, but must still be allowed for in the model specification.

Economic profit is given as

(10) Economic profit = Revenue – (return on net capital tangible investment + expenses + return on structural capital).

Accounting profits, as used in this analysis, are earnings before interest and federal taxes. Expenses are essentially the same as currently used by the WUTC. Property, plant and equipment (PP&E) is a relatively easily measured tangible asset. The WUTC currently uses average investment. In practice, the WUTC would need to utilize a standardized depreciation schedule to calculate a proper return on PP&E.

(11) Accounting profits = Economic profits + rate of return on PP&E * PP&E + return on other tangible assets + return on intangible assets.

Dividing through by revenues gives

(12) Accounting profit margin = ((Economic profits + return on other tangible assets + return on intangible assets) / Revenue) + rate of return on PP&E * PP&E / Revenue.

The first component in parentheses is collapsed into a constant and is essentially an operating margin. The second component is the return on PP&E.

Using the variables from the L-G model estimation, gives:

(13) M = Operating margin exclusive of capital costs + rate of return on PP&E * (1/T) = $\beta_o + \beta_1$ (1/T)

Variations on this specification can allow for different slopes or intercepts based on risk factors, such as the following:

(14) M = $\beta_o + \beta_1$ (1/T) + β_2 Risk Premia + β_3 (Risk Premia / T)

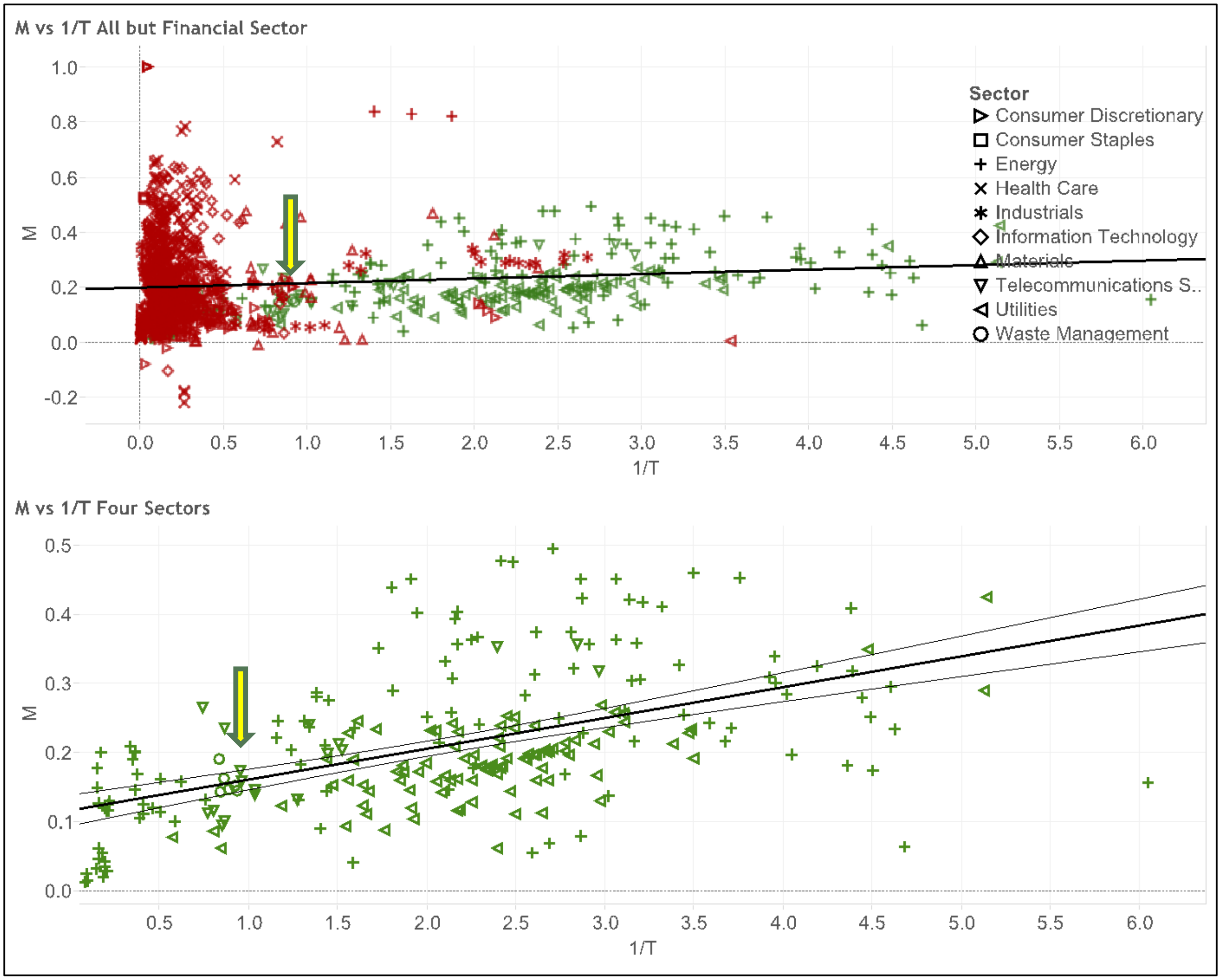
Revenue requirements under this model are given as

(15) Revenue requirement = (Expenses * Operating Margin / (1 – Operating Margin) + Rate of Return on PP&E * PP&E) * (1 + Revenue-Sensitive Taxes / (1 – Revenue-Sensitive Taxes))

4.2 DATA

The same data used in Section 3 is used to estimate equation (12) and (13). The top panel of Figure 2 shows a scatterplot of the profit margin (EBIT/Revenue) vs. 100 / T (i.e., PP&E / Revenue) for the full sample, while the bottom panel shows a similar scatterplot for the four included sectors. The six observations for the waste management sector (three each for Waste Management, Inc., and Republic Services, Inc.) are represented by circles. As can be seen in the bottom panels of Figure 2, these observations lie close to the regression line.

Figure 2. Accounting profit margin vs. PP&E/Revenue ratio.



4.3 ECONOMETRIC RESULTS

Equation (13) was estimated as

(16) M = 0.1164 + 0.0446 * (1/T)

Adjusted R^2 = 0.2677; Standard error of the regression = 0.08664

Average residual for waste management sector = 0.0300

	Coefficients	*Standard Error*	*t Stat*	*p-level*
Intercept	0.11635	0.01129	10.30172	0.E+0
1/T	0.04455	0.00472	9.43858	0.E+0

Equation (14) produced the following fitted model:

(17) M = 0.1243 + 0.0460 * (1/T) - 0.5849 * (Risk Premia / T) + 2.5545 * Risk Premia

Adjusted R^2 = 0.3490; Standard error of the regression = 0.08168

Average residual for waste management sector = 0.04372

	Coefficients	*Standard Error*	*t Stat*	*p-level*
Intercept	0.12426	0.01105	11.24403	0.00E+00
1/T	0.04598	0.00458	10.03918	0.00E+00
Risk Premia/T	-0.5849	0.25385	-2.30413	2.21E-02
Risk Premia	2.55447	0.59976	4.25916	2.96E-05

The risk premia for the solid waste sector is -0.0244. This gives the following equation for the solid waste sector:

(18) M = 0.06193 + 0.060247 * (1/T)

The interpretation of these results is relatively straightforward. Based on equation (18), the operating margin, exclusive of a return on capital, is 6.2%, and the return on PP&E is 6.02%. Allowing for the positive average residual of 0.044 (i.e., 4.4 percentage points) for the waste management sector, slightly higher operating margins or returns on PP&E would be reasonable. Comparing (16) and (18), the tradeoff is between a higher operating margin and lower return on PP&E. Equation (18) seems more in line with the current cost of debt. Consequently, (18) is used to estimate the revenue requirements for the six rate cases.

4.4 COMPARISONS TO L-G MODEL RESULTS

Table 3 gives the revenue requirements for the six rate cases, summarizing the results from the previous models.

Table 3. Comparison of revenue requirements from the Economic Cost Model to the L-G models

	Revenue Requirement				% Change of Economic Cost Model relative to		
Company	Original LG	Corrected LG	Revised LG	**Economic Cost Model**	Original LG	Corrected LG	Revised LG
WM	$59,251,578	$60,937,322	$60,631,671	**$61,459,393**	3.7%	0.9%	1.4%
Rabanco	$9,811,845	$9,958,837	$9,985,306	**$10,033,480**	2.3%	0.7%	0.5%
Yakima	$8,946,502	$9,210,479	$9,183,621	**$9,325,402**	4.2%	1.2%	1.5%
Peninsula	$2,866,270	$2,929,078	$2,902,505	**$2,869,314**	0.1%	-2.0%	-1.1%
Stanleys	$461,494	$466,057	$458,866	**$462,585**	0.2%	-0.7%	0.8%
Methow	$670,618	$682,463	$677,674	**$675,526**	0.7%	-1.0%	-0.3%
Aggregate	$82,008,308	$84,184,237	$83,839,644	**$84,825,701**	3.4%	0.8%	1.2%

The economic cost model generates, in aggregate, slightly higher revenue requirements than the corrected and revised L-G models. For Peninsula, Stanleys, and Methow, the small difference compared to the original L-G model is largely attributed to the lower revenue-sensitive taxes and fees applied to their revenues. Overall, however, the corrected L-G model, the revised L-G model, and the economic cost model produce very similar results.

4.5 COMPARISON TO OPERATING RATIOS IN OTHER JURISDICTIONS

It is instructive to compare the operating margins obtained from the models in Section 4.3 to the operating margins used in other jurisdictions.

Within the State of Washington, incorporated towns and cities

> *..may by ordinance provide for the establishment of a system or systems of solid waste handling for the entire city or town or for portions thereof. A city or town may provide for solid waste handling by or under the direction of officials and employees of the city or town or may award contracts for any service related to solid waste handling including contracts entered into under RCW 35.21.152.* [2]

The primary method of establishing collection rates within the boundaries of the State's incorporated jurisdictions is through an open procurement process where the service provider is selected by city or town's legislative authority. Rates and rate adjustments are negotiated between the jurisdiction and the selected

[2] RCW 35.21.120 Solid waste handling system - Contracts

service provider(s) and addressed within the contract. Most contracts do not address a specific rate of return or operating margin.

The primary method utilized within the State of Oregon to manage the collection of solid waste and recycling is the issuance of a franchise by cities and counties to provide service within a specific geographical area.[3] Oregon Revised Statues prescribes cities and counties the authority to establish rates to be just and reasonable and adequate to provide necessary collection service.[4] The Statute is silent on how the rates are established and maintained.

Setting the fees based on allowable expenses with annual financial and operational reviews is the primary means to set solid waste collection fees among the largest cities and counties in Oregon. Table 4 below summarizes the process Oregon's largest cities and counties complete in order to set fees.

Table 4. Rate Setting Approach for Oregon Jurisdictions

Jurisdiction	Population	Rate Method	Margin	Rate Method
City of Portland	582,130	Annual Review	9.50%	Residential Franchise
Washington County *	192,310	Annual Review	8 to 10%	Franchised Area
City of Eugene	157,100	Annual Review	11% **	Open Mkt. w/ License
City of Salem	156,955	Annual Review	10%	Franchised Areas
City of Gresham	101,015	Annual Review	10%	Franchised Areas
City of Hillsboro	90,380	Annual Review	8%	Franchised Areas
Clackamas County *	88,725	Annual Review	10%	Franchised Areas
City of Beaverton	86,860	Annual Review	9%	Franchised Areas
Marion County *	86,609	Annual Review	10%	Franchised Areas
City of Bend	82,280	Annual Review	10%	Franchised Area
City of Medford	77,240	CPI / Rate Request	8 to 10%	Franchised Area
City of Springfield	58,085	Rate Request	8 to 11%	Franchised Area
City of Corvallis	55,125	Annual Review	8 to 10%	Franchised Area

* Unincorporated areas of the county

** Margin is not calculated on disposal expenses.

Several jurisdictions adjust collection rates at the high end of the allowable margin range with the expectation of keeping the rates stable over a two to four year period.

[3] Oregon Revised Statues 459.015 (2)(b)
[4] Oregon Revised Statues 459A.085 (1)(a)

5.0 COMMENTS ON THE CAPM APPROACH

A methodology based on the capital asset price model (CAPM) is problematic when applied to a solid waste company serving a specified area. Four concerns are:

First, using a CAPM model to set rates or revenue requirements seems inappropriate when the regulators themselves have control over the riskiness of the business venture. If rates are set such that they are highly correlated with realized economic costs, then the company's risks are low and the return on capital, as dictated by a rational market, should also be lower. On the other hand, if rates are poorly set, or the rate-setting process is poorly structured to reflect changes in costs, risks are increased, and the return on capital, and revenue requirements, should be higher.

Second, a company's risk, as reflected in the stock's beta, doesn't necessarily mean that all of the company's operations have the same level of risk. Just as a conglomerate business may form to reduce risks, a solid waste company may be able to reduce risks by selecting certain service areas or by vertically integrating their operations. But this can depend critically on the size of the company. While a large company may find that the risks of serving a rural area in Washington State may be mitigated through diversification of their operations, a small company that only serves that one rural area may face a considerably higher risk. Any application of the CAPM should recognize the 'portfolio' nature of a company's operations.

Third, using costs of capital derived from a CAPM model doesn't address how to compensate companies for intangible assets, which are inherently difficult to measure. This is less problematic if a company's assets are dominated by tangible assets and operating expenses are low relative to such assets.

Finally, it should go without saying that the CAPM model is most applicable to a publicly traded company, particularly when that company's entire operations are regulated. While it might be possible to transfer costs of capital from publicly traded companies to privately held companies, doing so would require a subjective translation for each rate case.

6.0 PROJECT CONCLUSIONS AND RECOMMENDATIONS

The study resulted in the following conclusions and recommendations for the WUTC.

6.1 CURRENT RETURNS ON EQUITY

One of the impetuses for this study was the perception that ROEs were unreasonably high amongst regulated haulers. That is not the case. The return on the equity portion of PP&E, which is what is used in the L-G model, is not the same as the return on shareholder equity or even the return on total assets.

6.2 CORRECT THE L-G MODEL

In the near term, the WUTC should correct the deficiencies in the L-G rate model. This should include a correction of the errors identified in Section 2.3. Given the relatively small difference between the output from a corrected L-G model and an updated (and corrected L-G) model, whether the model is also updated with a new 'curve' using the S&P 500 company data employed in this study, is of less importance.

6.3 MOVE TOWARDS A MORE TRANSPARENT SW RATE MODEL

As demonstrated in Section 4.4, there is not a large difference between the operating ratios produced by the corrected L-G model, the updated L-G model, and the economic cost model. Of the three, we believe the economic cost model is the most transparent. It also explicitly gives haulers the proper economic incentive to invest in new capital.

6.4 DEVELOP A STANDARDIZED REPORTING PROTOCOL

The WUTC needs to develop and utilize a standardized financial and operational report that would be submitted by all regulated haulers when requesting a rate adjustment. While there are specific documents and information requirements that need to be included for a rate filing, each document varies from company to company. The WUTC is one of the few solid waste regulating agencies that doesn't require the completion of a standard form / report.

The standardized format would be segregated into three areas: financial results / allocated costs, operational data, and collection assets.

Financial results would include a standardized solid waste industry profit and loss statement as well as a beginning balance sheet and ending balance sheet. Costs would allocated between regulated and non-regulated areas.

Operational Data includes customer counts by service type, labor and truck hours, collected material amounts and cost allocation data. The operational data is the basis for any cost allocations.

Asset Schedule would include all assets utilized for waste collection activities in a standard Excel table.

The substantial amount of time spent seeking the relevant data for the rate filing would be reduced and spent completing the analysis of the costs and operations. From the standardized report, an audit program would be developed by the agency to provide a reasonable level of insurance that the revenue and expenses are fairly stated given the collection operation and service territory. Predictive tests of revenues and expenses would be developed and costs would be comparable from previous rate filings. Follow up questions to the regulated company would be based on the predictive tests.

APPENDIX A L-G MODEL LOGIC AND OUTPUT

The L-G model has only 11 inputs necessary to calculate the revenue requirement. Figure A1 below is the input and output section of the model. The model inputs are in red font; whereas the figures in black font are calculated within the model.

Figure A1: L-G Model Input

	C	D	E	F	G	H
2						
3	Revenue Requirement		$13,371,773	!!!<–		
4	Revenue Deficiency		$371,773	!!!<–		
5	Revenue	input>	$13,000,000	* p/ f before rates		
6	Expenses	input>	$12,000,000	* p/ f before rates		
7	Avg. Investment -	input>	$6,000,000	* p/ f before rates		
8	curve turnover		250.00	(calculated)		
9	final turnover		222.68	(calculated)		
10	curve No. used		3	(calculated)		
11						
12	Company actual					
13	capital structure:		!!!	OPERATING RATIO ->		89.81
14	______________	__________				==============
15	Actual Debt Ratio	input>	40.0%	Conversion factor data:		
16	Actual Equity Ratio	input>	60.0%	B & O Tax	input>	0.015
17	Actual Cost of Debt	input>	4.5%	WUTC Fee	input>	0.004
18				City Tax	input>	0.000
19	Tax Rate	input>	35.0%	Bad Debts	input>	0.007
20						____________
21				Revenue Sensitive		2.60%
22						
23				Conversion Factor		0.8721

The first three inputs, Revenue, Expenses, and Average Investment in cells E5, E6, and E7 respectively, are the allowable and/or adjusted test year amounts derived from the rate package submitted by the regulated hauler. The second set of inputs is the debt to equity inputs that are calculated or derived from the hauler's submitted balance sheet. The third set of inputs is the current rates for State and local taxes as well as the percentage of bad debt.

The Revenue Requirement is the sum of the input Revenue and the Revenue Deficiency (cells E4 + E5 in the model). The formula to calculate the Revenue Deficiency is (Expense – ((Operating Ratio / 100) * Revenue) / Conversion Factor (cells E6 – ((H13 / 100)*E5)) / H23).

The Operating Ratio is derived from a series of iterations to solve the polynomial functional form relationship between capital turnover and the revenue requirement. Each iteration set has four curve variables that are calculated on the ratio of average investment to revenue.

Figure A2: LG Model Calculations

	U	V	W	X	Y
2	1st Revenue	1st Turnover	M	ROR	ROE
3	15,000,000	250.00	7.0128	17.5321	24.57
4	15,000,000	250.00	6.9131	17.2827	24.10
5	15,000,000	250.00	6.8459	17.1146	23.79
6	15,000,000	250.00	6.8029	17.0071	23.58

The formulas in the above section are as follows:

Column U is the 1st Revenue which is the allowable expense multiplied by 1.25. This just gives a starting point for the iteration and doesn't impact the calculated ratio.

Column V gives **T** (100 * (1st Revenue / Avg. Investment)), based on the revenue level from column U. The formula in Cell V3 is (100 x (cell U3 / E7).

Column W uses the estimated equation to obtain the profit margin (M, or 100 * Profit / Revenue). The formula in cell W3 is =EXP (5.7226 – (0.68367 * LN(+V3))). Cells W4, W5, and W6 have slightly different intercept terms, based on the range that T falls within. This difference is explained below.

The original LG curve[5] was given as:

(5) $\ln(M) = 5.67537 - 0.68367 \ln(T); R^2 = 0.95$

The relatively high value for R^2 is due to their use of grouped data. While they started with 198 companies, with annual data from the 1968-1977 period, they averaged each company's values, then split the companies into ten groups, and used the average M and T values for each group. From that, they took the natural logs of the averages and estimated the above equation. The revised LG model from the early 1990s has the same slope term (-0.68367) as the above equation, but different intercepts depending on which of four curves is being used. The intercepts in all four equations are greater than in the original model. No rationale for the use of four curves, or the higher intercept values could be found. The range for T for each of the curves doesn't match up with the range of T used to group the 1968-77 data. The higher intercept values may be an adjustment to correct for a bias arising either from an adjustment to run the fitted curves through the average for M and T, rather than through the average for ln(M) and ln(T). It could also be due to a correction arising from the use of averaged data.

[5] See Lurito and Gallagher's 1987 testimony to the WUTC, page 32, line 7 (Cause No: TG-2016, Exhibit RJL (KFG) -1, October 1987

The resulting four equations are used to calculate the profit margin for a firm with a given capital turnover (T). Since the companies used in their econometric estimation could have different equity (and debt) ratios compared to a regulated Washington company, L-G made an adjustment in the rate model. This is done via column X and Y in the rate model.[6]

Column X multiplies column V by column W, and divides by 100. This gives 100 * Profit / Avg. Investment, or the return on PP&E. This has been labeled as ROR, though the denominator in the calculation is a narrower definition than typically used.[7] The formula in Cell X3 is = (W3 * V3) / 100.

The adjustment made in Column Y can be explained by referring to Table A1 below.

Table A1: ROE Calculation from the L-G Model

	Percent	Cost	Weighted (Percent x Cost)
Debt	56.20%	6.36%	3.574%
Pfd.	9.40%	6.59%	0.619%
Equity	34.40%	ROE	=0.344 x ROE
SUM	100%		SUM = ROC

ROC is the total of the right-hand column. We need ROE. Pre-tax ROC is converted to post-tax ROC by subtracting the taxes on (EBIT – Interest):

Post-tax ROC = (ROC-0.03574) * tax rate

The remainder of the equation derives from algebraic manipulations to get post-tax ROE.

Post-tax ROE = ((Post-tax ROC) - 0.03574 - 0.00619) / 0.344

Two issues of concern arise from this process. First, the adjustment to go from the ROC from the equation to ROC for the company assumes that the proportion of equity vs. debt financing matters to the pre-tax and interest profit margin. That question is addressed later. Second, the model currently used by the UTC uses the tax rate specified in cell E19. Given Lurito and Gallagher's 1987 testimony, where they indicate that the original 1968-77 data was adjusted to reflect what revenues would have been if the tax rate during that period had been 34% (it had been 46%), it is clear that they thought the after tax ROE should be fixed, independent of the prevailing tax rate. Thus, the tax rate in column Y shouldn't refer to cell E19, but should be the 34% rate that their data was adjusted to reflect. This correction is presented in Section 2.4.

[6] Due to the polynomial functional form for the solution for the revenue requirement, the L-G model takes an iterative approach. While the process is iterative, it suffices to understand one round of the estimation.

[7] See the discussion in Section 2.2. The difference in how ROR is defined or used does not affect the accuracy of the model.

The post-tax ROE is then used, along with information on the regulated company's cost of debt, equity and debt proportions, and the tax rate to get back to the company's pre-tax ROC. From there, the model reverses the step taken earlier in column X to get to the profit margin and, finally, the required operating ratio.

Figure A3: LG Model Calculations – Second Section

	Z	AA	AB	AC	AD	AE	AF
2		Adj ROE	Pre Tax ROE	Adj M	Revenues	Decision	OP/RATIO
3	0	24.57	24.48	0.0979	13,302,856	not yet	90.21
4	0	24.10	24.05	0.0962	13,277,241	not yet	90.38
5	0	23.79	23.76	0.0950	13,260,042	not yet	90.50
6	0	23.58	23.57	0.0943	13,249,064	not yet	90.57

If the company is a publicly traded company, column Z gives the added cost of raising equity capital (assumed at 0.25%) by issuing new shares; otherwise, this cell has a value of zero.

Column AA is the Adjusted ROR, which is the sum of ROE and the value in column Z. The formula is Cell Y3 + Z3.

Column AB is the calculation of the pre-tax ROE. The calculation is (100 * (Debt Ratio * Cost of Debt + (Equity Ratio * (Adj. ROE / 100)) / (1 – tax rate). The formula in the cell is as follows: =100 * (E15 * E17 + (E16 * (AA3 / 100)) / (1-E19)).

Cell E19 refers to the tax rate applicable to the hauler, not the 34% rate from the underlying regression data.

The column Y error, where it references the hauler's tax rate, does affect the calculations, particularly when the user-input tax rate differs from the tax rate that should have been used. For a 50:50 debt to equity ratio, if the user-input tax rate is 10%, when the tax rate should be 34% in Y3, the model generates revenue requirements that are approximately 2.5% higher than without this error. This conclusion, however, is from a model that contains one additional error in the calculation of the Revenue Deficiency in cell E4, explained later in this section.

Column AC is the calculation of the Adjusted Margin which is calculated by the Pre Tax ROE (column AB) and dividing by the 1st Turnover in column V. The formula in the cell is = AB / V3

Revenues in column AD is calculated by dividing the Allowable Expenses by (1- Adjusted Margin). The formula in the cell is = E6 / (1 – AC3).

The Decision column is an IF statement that compares the Revenues calculated in Column AD to the 1st Revenue (column U). If the amounts are within a dollar, the revenue requirement is complete and the formula will report "yes". If the amount is not within a dollar of the 1st Revenue, which it never will be because the 1st Revenue Formula is the starting point, then the second set of iterations recalculates the Revenues and compares that amount to the revenues generated in cells AD3 to AD6. This sequence of calculations keeps occurring until the revenue requirement are within $1 in two of the iteration sets.

The OP/Ratio is the calculation of the operating ratio and is simply the 100 * (1 – Adjusted Margin). The formula in the cell is = 100 * (1 – AC3).

The operating ratio from the iterative steps is adjusted by subtracting any revenue-based local taxes and fees, such as B&O taxes, and the WUTC fee. This is appropriate if these fees are levied on gross revenues. The resulting ratio is referred to as the conversion factor in the rate model. The revenue requirement should then be calculated as Expenses / (1- conversion factor). Instead, the model calculates a revenue deficiency, in Cell E4, which has the following formula:

= (+E6 - ((H13 / 100) * E5)) / H23

This error causes the total revenue requirement to fall as the reported revenue (cell E5) increases. Revenue requirements should be invariant to changes in prior reported revenue, and they are not. Iterating the initial revenues until the total revenue requirement is stable doesn't fix the problem and can potentially exacerbate the error. The smaller the revenue increase required, the larger the error.

The corrected formula in E4 should be Expenses – (Conversion Factor * Revenue) / Conversion Factor. The formula in the cell needs to be = (+E6 - (H23 * E5)) / H23. Alternatively, the revenue requirement can be directly calculated as Expenses / (1 – Conversion Factor), with the revenue deficiency calculated as Revenue Requirement – Revenue.

When the cell E4 correction is made, the magnitude of the Column Y error is typically reduced. In the example where the debt to equity ratio is 50:50, and the tax rate is set at 10%, the model generates revenue requirements that are 0.3% lower than when those two errors are corrected. While this particular example shows a negligible impact, when the user-specified tax rate is set to 34%, the model generates revenue requirements that are 2.7% too low due to the cell E4 error.

APPENDIX B CIRRUCULUM VITAE

Chris Bell, CPA is a Certified Public Accountant (Oregon license #10,451) practicing in the field of integrated solid waste management with an emphasis in the financial analysis and operational evaluation of solid waste and recycling collection systems and facilities. He is the principal Bell & Associates, Inc. a consulting firm located in Camas, Washington specializing in financial and operational analysis of integrated solid waste management. Mr. Bell has assisted numerous public and private entities with setting solid waste and recycling collection rates, service procurement, program implementation, financial and performance audits, planning, and facility and systems analysis.

Prior to solid waste consulting, Mr. Bell served as Assistant Divisional Controller for Waste Management of Oregon. His responsibilities were the monthly financial close, budgeting, reconciliation, reporting, operational performance analysis, audit preparation, and annual franchise reporting for three separate collection companies and two transfer stations. In addition, Mr. Bell was in charge of fixed assets and accounts payable for all six Oregon and Southwest Washington collection companies.

Neal Johnson, PhD, has a Ph.D. in Economics and has either taught or practiced applied economic analysis for over twenty years. He is the principal of the economic consulting firm, Sound Resource Economics, located in Tacoma, Washington. Dr. Johnson is currently a Resident Assistant Professor of economics at Pacific Lutheran University in Tacoma, where he teaches statistics and economics courses to undergraduate students. Prior to moving to Tacoma in 2004, Dr. Johnson was a senior economist for six years with the City of Portland, Bureau of Environmental Services.

As a senior economist with the City of Portland, he provided economic analysis services to both the Bureau of Environmental Services (BES) and the Solid Waste and Recycling Division (SW&R) of the Office of Sustainable Development. For BES, he was responsible for calculating numerous rates and fees, including sanitary and stormwater rates, system development charges, Industrial Waste Permit fees, development and land use review fees, and internal fees for the allocation of BES laboratory, sampling, and modeling services. For SW&R, he was responsible for calculating cost-of-service rates for the franchised residential solid waste and recycling system and the write-up of the annual rate study, as well as economic analyses of proposed system changes.