Chapter 6
Issues in Computing Customer Lifetime Value

Abstract This chapter addresses the challenging details in computing LTV that are all-too-easy to ignore. We focus particularly on the appropriate discount rate and appropriate costs. We draw from standard corporate finance and the CAPM model to derive the appropriate discount rate. We discuss the application of activity based costing (ABC) in computing costs. We advocate that the only costs appropriate for LTV calculations are those that change as a function of the number of customers within the particular application at hand (i.e., variable costs). We conclude with a discussion of incorporating marketing response and customer externalities in LTV calculations.

6.1 Introduction

This chapter discusses some of the major issues in computing LTV. Many of them have received little attention in the marketing literature. Yet, each is essential. Specifically, Sect. 6.2 addresses how to determine the appropriate discount rate for calculating LTV. Section 6.3 discusses customer portfolio management. We show that the firm reduces risk by constructing a portfolio of customers, but this comes at the cost of lower returns. We also discuss whether the firm should adjust the discount rate for the risk associated with individual customers or segments. Section 6.4 examines the relevant costs to include in LTV computations. Many firms allocate fixed costs when calculating LTV. We propose that for most database marketing decisions, such as targeting mailings to a specific set of customers, LTV should be calculated using just variable costs. Section 6.5 discusses incorporating response to marketing into LTV calculations. This is especially useful if the marketing environment is expected to change, or if the firm wants to determine long-term marketing policy using LTV. The chapter ends with a brief discussion of externalities (e.g., customer referrals) in the computation of LTV.

6.2 Discount Rate and Time Horizon

In the basic formula for LTV, LTV $= \sum_{t=1}^{\infty} \frac{E(\tilde{R}_t - C_t)}{(1+d)^{t-1}}$ where $\tilde{R}_t$ = revenue in period t, C_t = the cost in period t and d is the discount rate. We assume revenues are a random variable but costs are known.[1] A key parameter is the discount rate. A higher discount rate means that future profit streams $(\tilde{R}_t - C_t)$ are less valuable. Many firms solve the problem of setting the discount rate by limiting the length of the period over which LTV is computed. However, depending upon retention rates and the size of the revenue stream, revenue streams that accrue after the cutoff period may be significant.

We discuss two approaches for determining d – opportunity cost of capital (Sect. 6.2.1), and source-of-risk (Sect. 6.2.2). Our goal in providing alternative methods is to spur further research in this area.

6.2.1 Opportunity Cost of Capital Approach

6.2.1.1 Basic Concepts

Capital budgeting theory in corporate finance tells us that the appropriate discount rate for evaluating the financial value of a proposed project equals the *opportunity cost of capital* for the firm's *investors*. By opportunity cost, we mean the rate of return investors can achieve on another investment of similar risk. In calculating LTV, we think of customers as investments or "projects" and hence use a discount rate equal to the rate of return investors could make on similar-risk investments, i.e., their opportunity cost of capital.

There are three key concepts: (1) the link between the appropriate *discount rate* for LTV and *rate of return* investors could make on other investments, (2) what investors could expect to make on investments of similar *risk* as the customer projects undertaken by the firm, and (3) the definition of *investors*.[2]

Rate of return and the discount rate are linked in that both represent the time value of money. If the investor can make a 10% return on investments, then the investor is indifferent between receiving $100,000 today and $110,000 tomorrow. So promising the investor $110,000 tomorrow is equivalent to giving the investor $100,000 today ($110,000/(1.10)). The rate of return (10%) and discount multiplier (1/1.10) are thus two sides of the same coin. If the investor can make 10% on alternative investments and the returns generated by a customer are not profitable when discounted by 10% per period, the investor would not want to invest in that customer. Hence if we want to use LTV to decide whether to undertake a marketing activity, the activity has to

[1] We implicitly are assuming costs are more predictable than revenues.

[2] See Hansen (2006) for a discussion of the cost-of-capital associated with LTV models. His discussion is somewhat different than ours but his work was helpful in framing the issues for us.

be profitable using a discount rate equal to what the investor could make on other projects.

The situation is amplified by the second key concept – risk. No investment is a sure bet, and so in calculating LTV, we need to use as a discount rate the rate of return the investor could make on a project *of similar risk* to the customer management project. For example, if the investor's opportunity cost of capital at a certain risk level is d, and the LTV of a customer is positive at that value for d, the investor still might not want to invest in that customer if the customer is considered more risky than other projects on which the investor can generate a return of d. A good portion of this section will be spent on how to determine the opportunity cost of capital (hence d) incorporating risk.

The third concept is the definition of "investor." For publicly owned companies, the investor is the shareholder. We say the manager makes the decision of whether to invest in the customer, but really the shareholder is making the decision because the manager represents the shareholder. For privately held companies, investor might be the owner who is funding the company from personal funds but has alternative uses of those funds.

6.2.1.2 Calculating the Opportunity Cost of Capital

With these concepts in mind, the first step is to calculate the opportunity cost of capital incorporating risk. A theory has been developed to do this for publicly owned companies. Brealey et al. (2004) state, "The cost of capital for corporate investment is set by the rates of return on investment opportunities in financial markets."[3] Hence, in its general form, the cost of capital represents the alternative investment a shareholder can make in financial markets that provides the same return and risk. It is computed as the weighted average cost of capital (WACC),[4]

$$WACC = \frac{D}{V} r_{debt} + \frac{E}{V} \cdot r_{equity} \tag{6.1}$$

where:

D = amount of debt the firm has
E = amount of equity the firm has
$V = D + E$
r_{debt} = rate of return on the firm's debt
r_{equity} = rate of return on the firm's equity

To compute $WACC$ we need four key quantities: D, E, r_{debt} and r_{equity}. D and E are readily available from the firm's balance sheet. Usually, r_{debt} is

[3] Brealey et al. (2004), p. 40.

[4] Ibid, p. 325. Note Equation 6.1 is not adjusted for tax rates.

easy to compute because it is simply the marginal borrowing cost of the firm. The reason for using the marginal borrowing cost is that if debt is added to the firm, the cost of debt might increase because the risk increases.

Computing r_{equity} requires using another model. The formula for r_{equity} is:

$$r_{equity} = r_f + \beta(r_m - r_f) \tag{6.2}$$

where:

r_f = the risk free rate
r_m = the market rate of return

r_f is usually the T-bill rate (treasury bills) for a long-bond (10- or 30-year treasury bond). The current rate of return for long-term treasury bonds is between 4% and 5%.[5] $r_m - r_f$ is the "risk premium" for stocks. Currently this is in the range of 4–5%.

The other unknown quantity is β ("beta"), which adjusts the risk premium based on how risky the firm (or investment) is. A market portfolio (e.g., an investment comprised of all the stocks in the S&P 500 or FTSE 100) will have a beta of one. Firms whose variability is greater than the market will have a beta higher than one and those with low variability relative to the market will have a beta of less than one. Beta is very important because the higher beta, the more the market wants to be compensated for the risk it is taking and hence the higher the weighted cost of capital.

Brealey et al. (2004) provide examples of betas from the period May 1997 to April 2002.[6] For example, Amazon.com had a beta of 3.3 and Pfizer had a beta of 0.57. We will use these and assume a specific corporate debt and equity structure and show how the weighted average cost of capital is computed. Assume Pfizer has 20% debt and 80% equity and Amazon has 30% debt and 70% equity. Also assume that Pfizer's borrowing rate is 6% and Amazon's is 7% because it is riskier. The market premium $(r_m - r_f)$ will be assumed to be 5% and risk free rate will be 4%.

The first step is to compute r_{equity} using Equation 6.2. For Pfizer it is $r_{equity}^{Pfizer} = 0.04 + 0.57(0.05) = 0.0685$ or 6.85% and for Amazon it is $r_{equity}^{Amazon} = 0.04 + 3.3(0.05) = 0.205$ or 20.5%. Thus, required expected return for Amazon is much higher than for Pfizer because it is much riskier. We can now compute WACC for each.

For Pfizer, $WACC^{Pfizer} = 0.2 \times 0.06 + 0.8 \times 0.0685 = 0.0688$ or 6.88% and for Amazon $WACC^{Amazon} = 0.3 \times 0.07 + 0.7 \times 0.205 = 0.1645$ or 16.45%. Clearly, Amazon has a much higher cost of capital than does Pfizer.

[5] www.Bloomberg.com for March 9, 2007 indicates the 10-year treasury bond yield is 4.59%.

[6] Brealey, et al. p. 296. Also see http://finance.yahoo.com/ to look up betas for specific stocks. Simply enter a stock's ticker symbol and then click on "Key Statistics" on the left-hand side of the page.

This will manifest itself in the types of projects for which Amazon can make investments to guarantee the rate of return its shareholders expect. Pfizer has much lower WACC and can invest in many more potential projects because it does not require as high a rate of return. In terms of LTV, Amazon should use a discount rate of 16.45%, whereas Pfizer needs only use 6.88%. Amazon will require higher returns and retention rates from its customers in order to generate positive LTV.

It is time to stop and digest the information just provided. The two critical elements in computing WACC are: (1) beta, reflecting the riskiness of the firm, and (2) the capital structure, namely, the amount of debt and equity.

The question now is whether weighted cost of capital is the appropriate measure for calculating LTV. The answer depends upon whether the LTV project the firm is undertaking is within the normal scope of business and similar to its normal investment strategy in terms of risk or it is not in the normal course of business. If it is, investors have assumed an appropriate cost of equity. The market has adjusted for this risk through r_{equity} and r_{debt}. Then WACC is the appropriate measure. If not, then a project-specific cost of capital should be used, which is discussed in the next section.

6.2.1.3 Project Weighted Average Cost of Capital

If the projects the firm is investing in are similar to those it has historically invested in, WACC is the appropriate discount rate. However, if a proposed project is significantly different, then there should be a project WACC because the risk is different than the market expects from the firm. Brealey et al. (2004) observe[7]:

> The project cost of capital depends on the use to which that capital is put. Therefore, it depends on the risk of the project and not on the risk of the company. If a firm invests in a low-risk project, it should discount the cash flows at a correspondingly low cost of capital. If it invests in a high-risk project, those cash flows should be discounted at a high cost of capital.

Of course, every project has a different risk. However, only those projects with a substantially different risk level should have a project-specific cost of capital. For example, suppose Capital One is making an investment decision to solicit a segment of customers who are similar to those it targets for its typical credit cards. Then the firm's WACC is the appropriate discount rate. Now suppose Capital One decides to target the sub-prime market (poor credit quality customers), which we will assume it does not do currently. Is the risk the same as it is for its typical projects? Clearly it is much higher. Capital One should use a higher discount rate than its WACC for this project.

The major problem is determining an appropriate project-specific discount rate. The earnings for Capital One's sub-prime project are likely to have a

[7] Brealey et al. p. 309.

high beta because sub-prime customers are more vulnerable to downturns in the economy. The profit flows from sub-prime customers are more volatile than normal profit flows from investments Capital One usually makes. With a higher beta, the firm must use a higher cost of capital and hence a higher discount rate. To help understand how to determine the appropriate beta to use, it is helpful to understand what beta is and how it is computed.

6.2.1.4 Computing Beta and Project-Specific Discount Rates

Beta is computed several ways but we will concentrate on its definition:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \tag{6.3}$$

where σ_{im} is the covariance between stock i's return and the market return and σ_m^2 is the variance of the market return. Thus, the more the stock co-varies with the market, the higher beta. In the case of no co-variation, beta is zero. Analysts typically obtain rates of return for a stock and the market, calculate the covariance and variance, and compute β.

Assume the firm determines there is a correlation of 0.5 between the profit flow from its customers and the overall stock market. Further, it finds that its variation in returns among its customers has a standard deviation of 0.1, which is the normal variability it sees in its annual returns. An analysis of the stock market shows that it has a 0.04 standard deviation in its returns. Noting that $\sigma_{im} = \rho_{im}\sigma_i\sigma_m$, we calculate $\beta_i = (0.5 \times 0.1 \times 0.04/0.04^2) = 1.25$. Obviously, the difficult part of the above computation is the linking of the returns from the market to returns from customers. Little has been published in marketing showing how to conduct these analyses and it would be useful to see real-world examples.

For a new project it is far more difficult to determine β because there are no data on cash flows for this project. Some firms develop general guidelines based on the type of project. Risky projects will have a significantly higher cost of capital than do standard projects. Some projects such as replacing a machine where the return is based on savings might have a very low discount rate because it is almost a guaranteed return (low σ_i).

While the notion of project-specific discount rates for calculating LTV is not particularly satisfying because it requires setting WACC subjectively, it is based on sound theory. It is important to understand the basic principles of how WACC is set and when to deviate. If the analyst is uncertain about the risk, he or she can always revert to using the firm's WACC.

6.2.1.5 Empirical Research on Calculating Customer-Specific Discount Rates

Wangenheim and Lentz (2004) applied the notion of project-specific discount rates to specific customers. The idea is that each customer is in a sense a different project, and hence has his or her own β. One deviation from theory in their application is that they calculated β relative to the returns from all customers, instead of relative to the returns from a financial market. Denote by "C" the returns from their entire customer base and "a" the firm's income stream customer a. They calculated:

$$\beta_a = \frac{Cov_{aC}}{\sigma_C^2} \tag{6.4}$$

Finance scholars would argue that one should use the market of all securities, not the firm's customer base, as the "market" from which to calculate the crucial covariance. The reason is that in a publicly owned company, managers supposedly are operating in the interest of investors who can invest in the entire securities market. Even in a privately held company, the owners of that company are investors who should be interested in the market as a whole.

Wangenheim and Lentz (2004) as well as Dhar and Glazer (2003) recommend ignoring the risk-free rate and just using $\beta_a \times R_m$ for the discount rate. This implicitly assumes the risk-free rate is zero for all customers and is a departure from finance theory. So theoretically this weakens the ties to the CAPM. However, pragmatically, customers with higher β's are assigned higher discount factors for the LTV calculation and those β's represent a measure of volatility relative to the portfolio of customers as a whole.

Wangenheim and Lentz (2004) calculate β_a for each customer in a European airline's customer base. They used revenue as the measure of returns, and used the revenues generated by all the company's customers as the market return. The sample included 26,776 customers over a 4-year period. The authors calculated an alternative measure of risk, the number of periods with no purchases (NIP) for each customer. These calculations were made for two separate periods, period 1-quarters 1–8, and period 2-quarters 9–16. The correlation matrix among the measures is shown in Table 6.1.

The results are quite clear: β_a is an unstable measure of customer risk. It is virtually uncorrelated between two separate time periods. On the other hand, the number of inactive periods, an *ad hoc* measure of risk but easier to calculate, is very stable over time. One could question whether NIP is a measure of risk or simply a measure of purchase frequency, but in any case, the

Table 6.1 Correlations between various measures of risk (From Wangenheim and Lentz 2004)

	β^{a}	β^{b}	NIP^{a}	NIP^{b}
$\boldsymbol{\beta}^{a}$	1	–	–	–
$\boldsymbol{\beta}^{b}$	0.087	1	–	–
$\boldsymbol{NIP}^{a}$	−0.133	−0.157	1	–
$\boldsymbol{NIP}^{c}$	−0.187	−0.067	0.613	1

[a] "1" and "2" refer to the data period.
[b] Is calculated by Wangenheim and Lenz using Equation 6.4.
[c] *NIP* stands for number of periods with no purchase.

instability of β is somewhat disappointing. It might be that there were not enough observations given that β was estimated with only eight observations, but this did not seem to hurt the stability of NIP. One alternative would have been to segment customers into groups based on demographics or some other variable. They could then create a β for each segment and determine its stability. It might have led to a higher correlation. In any case, this is an interesting but speculative investigation of β as a measure of customer-specific risk.

6.2.2 Discount Rate Based on the Source-of-Risk Approach

Many times the risk in a database marketing project may be attributable to a specific component. For example, in deciding whether to undertake an acquisition campaign, the acquisition rate may be very uncertain but the long-term customer income stream matches historical risk levels. One approach for handling this is to use a high discount rate for the component of lifetime value that is most risky (the acquisition rate), while using the firm's ordinary $WACC$ for discounting long-term income.

Consider the case of evaluating a customer acquisition program that requires an investment of \$2,500,000 for a mailing of 1,000,000 pieces with an expected response rate of 2%. Once a customer responds to the mailing, he or she fits the traditional response patterns. Acquired customers generate \$35 per year in net income and have a retention rate of 90%. However, the firm believes this is a very risky project because it is not certain about the acquisition rate. The firm therefore plans to use a 20% discount rate versus its normal rate of 10%.

Assume that the \$2,500,000 acquisition investment is made at time $t = 0$, and revenues begin at time $t = 1$. We therefore begin discounting revenues at $t = 1$. In that case, the net present value of the investment is[8]:

$$NPV = N\alpha LTV - I = N\alpha m\left(\frac{1}{1+d-r}\right) - 2{,}500{,}000 \tag{6.5a}$$

where N = number of customer's mailed, m = margin per customer, α = response rate, r = retention rate, I = investment, and d = discount rate. For the example, $N = 1{,}000{,}000$, $m = \$35, \alpha = 0.02, r = 0.9, I = \$2{,}500{,}000$, and $d = 0.2$. Substituting into Equation 6.5a, the project has a net loss of $-\$167{,}667$. So using conventional NPV methods the firm should not invest in the acquisition project.

However, the abnormal risk is attributable only to the first-period returns. To account for this specific source of risk, one could find an appropriate

[8] Note LTV $= m/(1+d-r)$ rather than $m(1+d)/(1+d-r)$, which is the usual formula we use for a simple retention model LTV. The difference is because we assume the discounting begins in period 1.

discount rate for first-period revenues, then discount the ensuing revenues at the regular discount rate. We can arrive at an appropriate first-period discount rate by asking the manager to specify a certainty equivalent; that is, what amount of money would leave the manager indifferent between that amount and the expected first-period earnings. Then we could solve for the discount rate implied by the certainty equivalent, apply that discount rate to the first-period returns, and discount subsequent period returns by the company's *WACC*, which we assume to be 10%. The NPV of the project can be represented as follows:

$$\text{NPV} = \frac{Npm}{1+d_1} + \frac{Npmr}{(1+d_2)(1+d_2-r)} - I \tag{6.5b}$$

The first term represents first-period returns, discounted by an amount d_1. The second term represents the discounted value of future returns beginning in period 2. These will be discounted by d_2, the firm's *WACC* (10%). Given the parameters, $Npm = 1{,}000{,}000 \times 0.02 \times \$35 = \$700{,}000$. We then ask the manager, "What amount of money would leave you indifferent between that amount for sure and the $700,000 you expect to receive in period 1, given your uncertainty about the 2% response rate?" Say the manager answers, "$550,000". Then the manager has told us:

$$\$550,000 = \frac{\$700,000}{1+d_1}$$

or (6.5c)

$$d_1 = 27.3\%$$

Now we can substitute $d_1 = 0.273$ into Equation 6.5b, and use $d_2 = 0.10$. The NPV is now $606,818 and the project is profitable. Applying a 20% discount factor to the entire calculation over-penalized the lifetime value, making the investment appear unprofitable. When applying a high discount rate to the part of the calculation that was really uncertain (first-period revenues), the results changed and the project is profitable.

The "source-of-risk" approach appears to be a useful method when the project under consideration is abnormally risky. The approach has two benefits: (1) it requires the manager to think through why the project is abnormally risky, and (2) it computes a more realistic net present value, highly discounting the components of the project that are truly risky, while not penalizing the components that have normal risk. As we illustrated, the technique can change the decision. It relies on the manager stating a certainty equivalent, which would probably not be too difficult in the example we used. There may be other situations where it would be more difficult. Nevertheless, source-of-risk discounting appears worthy of consideration when a project and a customer's lifetime value is abnormally risky due to an attributable source.

6.3 Customer Portfolio Management

Finance theory has developed methods for dealing with risk. The CAPM model applies to the discount rate d and was discussed in Sect. 6.2. Modern portfolio theory (Sharpe 2000) applies to managing customers with different risks (variances) as well as expected returns (means). Marketers have barely scratched the surface in applying portfolio theory, which will be discussed in this section. Modern portfolio theory is concerned with what percentage of a firm's total investment should be allocated to the various investment opportunities available to it. The specification of these percentages creates the investment portfolio.

Consider two investments A and B. Each is characterized by an expected return, μ_{A} and μ_{B}, a standard deviation around that return, σ_{A} and σ_{B} and a correlation between these returns, ρ_{AB}. Let w_{i} be the fraction of investment placed in investment $i(i = \text{A}, \text{B}; \sum_i w_i = 1)$. The expected return and variance of that return for any set of w's are:

$$E[return] = \mu_p = w_1\mu_A + w_2\mu_B \tag{6.6}$$

$$Variance[return] = \sigma_p^2 = w_1^2\sigma_A^2 + w_2^2\sigma_B^2 + 2w_1w_2\sigma_A\sigma_B\rho_{AB} \tag{6.7}$$

The subscript p refers to the portfolio. A given specification of w's constitutes a portfolio with a specific expected return and risk (measured by the variance) calculated using Equations 6.6–6.7.

To see why a firm should invest in a portfolio rather than an individual security, suppose there are two stocks, both of which have the annual same rate of return, 10%. Each has a standard deviation of 2% and their returns have a correlation of 0.5. Consider the decision of whether to purchase 100 shares of stock 1 or purchasing 50 shares of each stock. If 100 shares of stock 1 is purchased, the expected return is 10% $(1 \times 10\%)$ and the variance is $1^2 \times 2^2 = 4$. If 50 shares of each stock are purchased, then the expected return is still $0.5 \times 10\% + 0.5 \times 10\% = 10\%$ but the variance is $0.5^2 \times 2^2 + 0.5^2 \times 2^2 + 2 \times 0.5 \times 0.5 \times 2 \times 2 \times 0.5 = 3$. This demonstrates a key principle – the lower the correlation between two securities, the greater the advantage is to creating a portfolio because for the same return, the portfolio will have lower variance. If the correlation between two securities is 1, then there is no diversification advantage in buying a weighted average of two securities.

For customer management, the same principle can apply. If a portfolio of two customers segments can be created, then it may have the same rate of return but lower variance than marketing to only one customer segment.

What does a portfolio of customers mean? It is the same concept as stocks except the factor determining the commonality between customers' rates of return may be related to economic factors (e.g., income level), or lifestyle differences.

Suppose a firm has two potential target segments – high and low income customers – and needs to decide whether to invest in both segments or one.

Table 6.2 Alternative customer portfolios

	Data	
	Segment 1 (high income)	**Segment 2 (low income)**
Mean return	10%	20%
Standard deviation	2%	10%
Correlation	0.75	

	Alternative portfolios		
	Portfolio 1	**Portfolio 2**	**Portfolio 3**
Weight for segment 1	0.9	0.7	0.5
Weight for segment 2	0.1	0.3	0.5
Expected portfolio return	11.00%	13.00%	15.00%
Standard deviation	2.06%	3.31%	5.10%

Assume the firm acquires 100,000 credit card customers per year from high-income prospects. The expected annual rate of return from these customers is 10% and the standard deviation is 2%.[9] The low-income customers have a higher expected rate of return, 20%, because they are charged a higher credit card interest rate, but they have a standard deviation of 10% because they are riskier. In some years, the rate of return from low-income customers is negative because of a higher default rate.[10]

The difference in the rates of return between the two segments are driven by two factors: the amount they borrow (called "revolving") and the degree to which they pay off their debt ("solvency" risk). The firm finds that the correlation between the returns of the two groups is 0.75.

The firm constructs three alternative portfolios. One contains 10% low-income and 90% high-income, the second has 30% low-income and 70% high-income and the third has 50% of each. The expected return and variance of each portfolio is computed using Equations 6.6 and 6.7. Table 6.2 shows the results.

The expected return for portfolio 1 is 11% with a standard deviation of 2.06%. For portfolio 2 it is 13% with a standard deviation of 3.31% and for portfolio 3 it is 15% with a standard deviation of 5.10%. The firm feels that portfolio 1 is far superior to its current strategy of targeting only high income customers (10% return with a standard deviation of 2%) because, for very little increase in risk (0.05%), it can increase its return to 11% versus 10%. However, portfolios 2 and 3 increase the risk beyond what it views as tolerable.

The concept of customer portfolios clearly has some benefits. The critical inputs the firm must determine are the relative rates of returns, the variability

[9] Note we are setting up this example in terms of expected annual returns, to follow finance theory as close as possible. However, we could also set up the problem in terms of LTV per customer segment, in which case we would want to use segment-specific discount rates.

[10] For example, homeowners from the lower income households are facing penalties and tougher credit causing default problems in the "subprime" market (see, Simon 2007).

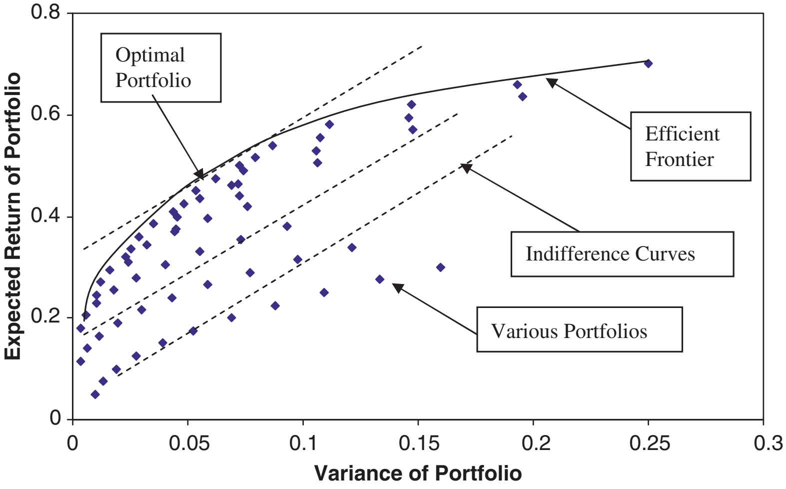

Fig. 6.1 Modern portfolio theory applied to managing a customer portfolio Assumptions: 3 customer segments (A, B, and C)
$\mu_A = 0.30(30\%)$
$\mu_B = 0.05$
$\mu_C = 0.70$
$\sigma_A = 0.4$
$\sigma_B = 0.1$
$\sigma_C = 0.5$
$Cov_{AB} = 0.02$
$Cov_{AC} = -0.06$
$Cov_{BC} = -0.04$

in returns and the correlation in returns. If these can be estimate adequately by the firm, it can construct a portfolio of different segments of customers.

Figure 6.1 illustrates how these calculations could be used to find the "optimal" portfolio, the set of w's that is best for the investor. There are three important steps:

1. Calculate and graph all the possible portfolios by considering all possible w's. (Note: Fig. 6.1 was constructed assuming three potential investments with characteristics shown in the notes to the figure.)
2. Identify the "efficient frontier" set of portfolios. This consists of the set of portfolios such that one cannot improve both the expected return and the risk by varying the w's. Figure 6.1 shows the efficient frontier as an upper envelope. Any portfolio within the envelope is not efficient because one can either increase return for the same risk or decrease risk and obtain the same return.
3. Place the investor's "indifference curves" on the graph and find the highest indifference curve that has a tangency to the efficient frontier. The portfolio at that tangency is the optimal portfolio. The indifference curves in Fig. 6.1 are based on a utility function of the form $U = b \times$ Expected

Return − c × Variance. This means that an indifference curve would be of the form Expected Return = $U/b + (c/b) \times$ Variance. The investor would be indifferent among any set of portfolios whose expected returns and variances satisfy this equation, since they all yield the same utility U. As one increases U, one gets higher indifference curves. So the point of tangency in Fig. 6.1 shows the portfolio that yields the highest utility.[11]

The above procedure can be used to decide how many customers of each risk/return profile to acquire in order achieve the firm's goal, which might be to create a portfolio of customers that generate high return at acceptable risk. The trade-offs between risk and return would be captured by the utility function. The w's would be the fractions of each type of customer to acquire.

In summary, the concept of customer segment portfolios is very important. Many firms use some variant of the concept but do it intuitively rather than systematically. In finance, a major breakthrough was creating stock portfolios to be on the efficient frontier. The opportunity exists for database marketers to apply the same concepts. Little work in database marketing has focused on customer portfolio management. However, it is a promising area of research.

6.4 Cost Accounting Issues

Whether in the context of LTV or any cost-related calculations of customer value, quantifying costs can be a severe challenge. Seppanen and Lyly-Yrjanainen (2002) make the useful distinction between product and customer costs. Product costs pertain to the cost of producing the product sold to the customer. Customer costs refer to the marketing and service costs incurred by the customer. Customer costs are particularly relevant for LTV calculations so we focus on them.

6.4.1 Activity-Based Costing (ABC)

Costs may vary significantly among customers, depending on variation in customer-specific marketing efforts, customer orders, and customer after-service calls. The challenge is to quantify these costs on a per customer basis. Searcy (2004) suggests activity-based costing (ABC) as a method for doing so. ABC attempts to link customer activities such as placing orders to the costs of executing those activities (Kaplan and Cooper 1998). Searcy suggests five steps to implement an ABC analysis:

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[11] Sharpe(2000, part 1, chapter 4) shows how to formulate the identification of the efficient frontier and the selection of the optimal portfolio as a mathematical program.

1. List the “activities” which a customer might undertake (e.g., fulfilling an order).
2. Determine how much the organization spends on each activity in total.
3. Identify the organization’s products, services, and customers.
4. Select “drivers” for each activity. A driver is the customer action that causes the activity to take place (e.g., placing an order).
5. Calculate the activity rates, i.e., the cost to fulfill one order.

Table 6.3 shows an example of an activity-based costing scheme for a hypothetical catalog company. The company identified five customer-related activities: catalog mailing, filling web orders, filling telephone orders, data maintenance, and after-sales support. It then listed the costs directly incurred in executing these activities – salaries, printing, shipping, and hardware/software. Then it listed the drivers of these costs, e.g., catalog mailing costs are incurred when catalogs are mailed, and the company mailed 1,000,000 catalogs in the year of consideration. The number of web orders drives the filling web orders activity. Next the company allocated these costs to each activity, using the cost drivers when possible. For example, the company spent $2,825,000 on salaries in the year under consideration. $1,875,000 was allocated to filling telephone orders. This is determined from telephone operators costing $22.50/h including benefits, time per order is 10 min per order and there are 500,000 orders totaling to $1,875,000. Other allocations such as printing and shipping costs can also be made accurately, whereas others were less scientific, e.g., salaries related to filling web orders.

Note that costs that could not be allocated directly to activities, but were considered part of customer-related costs, were classified as overhead. For example, there was $1,000,000 in hardware/software overhead, and $100,000 in salaries that were related to customers but not classifiable in any of the activities. The overhead was allocated to each activity proportionally to the subtotals of the direct costs for that activity. Allocating overhead is controversial and is discussed later.

An important and final step is then the calculation of cost per activity. The most expensive activity is after-sales support, because it absorbs typically as much as 30 min in service personnel time. Note the much lower cost of filling a web order compared to filling a telephone order. This comes about because of the salaries that must be paid to fill telephone orders, whereas the web requires almost no salaries.

Table 6.4 shows an application of the ABC-based costing scheme to evaluate the profitability of three customers. Customer A places only four orders, but they are all on the web and therefore do not cost much. This customer also only placed one after-sales call. The customer generated a profit of $58.91. Customer B places twice as many orders, but is actually less profitable. This is because the orders are placed on the telephone, and the customer demands significantly more after-sales support. Customer C is perhaps what management would like to do with Customer B. Customer C also places eight orders,

Table 6.3 Activity-based costing example for a hypothetical catalog company

Expense	**Activity**						
	Catalog mailing	**Filling Web orders**	**Filling telephone orders**	**Data maintenance**	**After-sales**	**Overhead**	**Total**
Salaries	$100,000	$50,000	$1,875,000	$200,000	$500,000	$100,000	$2,825,000
Printing	$500,000	–	–	–	–	$50,000	$550,000
Shipping	$400,000	$100,000	$500,000	–	–	$50,000	$1,050,000
Hardware/software	–	$50,000	–	$200,000	–	$1,000,000	$1,250,000
Total	$1,000,000	$200,000	$2,375,000	$400,000	$500,000	$1,200,000	$5,675,000
Overhead allocation	$268,156	$53,631	$636,872	$107,263	$134,078	$1,200,000	
Drivers	**Catalogs mailed**	**Web orders**	**Telephone orders**	**Total orders**	**After-sales calls**		
Number	1,000,000	100,000	500,000	600,000	50,000		
Cost per activity	$1.27	$2.54	$6.02	$0.85	$12.68		

Table 6.4 Customer profitability based on activity-based costing

	Catalogs mailed	**Web orders**	**Telephone orders**	**Total orders**	**After-sales calls**
Customer A					
Drivers	12	4	0	4	1
Costs	\$15.22	\$10.15	\$0.00	\$3.38	\$12.68
Revenues	\$200.00	(4 orders × \$50/order)			
COGS	\$100.00	(Revenues × 0.50)			
Customer costs	\$41.43				
Total profit	\$58.57				
Customer B					
Drivers	35	2	6	8	5
Costs	\$44.39	\$5.07	\$36.14	\$6.76	\$63.41
Revenues	\$400.00	(8 orders × \$50/order)			
COGS	\$200.00	(Revenues × 0.50)			
Customer costs	\$155.77				
Total profit	\$44.23				
Customer C					
Drivers	35	8	0	8	2
Costs	\$44.39	\$20.29	\$0.00	\$6.76	\$25.36
Revenues	\$400.00	(8 orders × \$50/order)			
COGS	\$200.00	(Revenues × 0.50)			
Customer costs	\$96.80				
Total profit	\$103.20				

but places them on the Web, and only makes two after-service calls. This customer's profit is more than double that of Customer B (\$101.84 vs. \$42.88).

Table 6.4 illustrates the value of the ABC approach. The analysis also raises important marketing issues. For example, it is clear that Customer B would be more profitable if the customer could be migrated to the Web and encouraged to use the Web for after-sales support. This makes sense from a cost perspective. However, the lack of human contact could weaken the customer's loyalty to the firm in the long run (Ansari et al. 2008). In any case, the analysis is valuable because it identifies potential cost savings, highlights differences among customers, and raises the broader issues of what happens to the customer when we cut costs.

6.4.2 Variable Costs and Allocating Fixed Overhead

An important issue in activity-based costing as well as in all cost calculations for LTV analysis is the allocation of fixed overhead. There are two schools of thought – full costing versus marginal costing. Full costing says that all fixed costs must be allocated. Table 6.4 shows that this "overhead" can be significant and its allocation a bit arbitrary. For example, why was so much hardware/software overhead allocated to telephone fulfillment? The arithmetic reason is that the allocations were proportional to the costs of that

Table 6.5 Firm profit statement before customer acquisition

Number of current customers	100,000
Sales per customer per year	$150
Gross margin percentage	40%
Administrative overhead costs	$3,000,000
Variable costs per customer	$10
Overhead per customer	$30
Sales	$15,000,000
Gross profit	$6,000,000
Variable customer costs	$1,000,000
Profit before overhead	$5,000,000
Administrative overhead costs	$3,000,000
Net profit after overhead costs	$2,000,000
Profitability per customer (excluding overhead)	$50
Profitability per customer (including overhead)	$20

activity. However, that may inflate the cost of filling orders via telephone, making telephone customers look more expensive and less profitable, and causing the company to migrate customers to the Web, which might not be good for loyalty.

Overhead allocations can saddle customers with huge costs that actually yield negative lifetime values. Consider a telecom firm that has just made a huge investment in infrastructure. If these costs are allocated per customer, it is easy for many customers to have negative LTV's, even though these customers contribute to profits and "firing" them would decrease profits.

The alternative is marginal (variable) costing where the only costs allocated to the customer are those that vary with the number of customers and are directly attributed to servicing or marketing to the customer. The view of the "marginal costers" is that the goal is to ascertain how much each customer contributes to fixed overhead and therefore to profit. To saddle the customer with arbitrarily allocated overhead costs hides the true value of the customer, and may convince the firm to "fire" a customer, leaving the firm with less profit, or not acquiring a customer and losing an opportunity to increase profit.

To understand why fixed overhead should *not* be included in LTV, suppose a firm has 100,000 customers who on average spend $150 per year with a gross margin of 40%. The firm has a fixed overhead cost of $3,000,000 which includes the office complex, top management's compensation and other fixed costs. Variable costs per customer (e.g., catalog mailings) are $10. Table 6.5 provides the income statement for the base case. The profitability of the customer is $50 without allocating overhead and $20 with overhead.

Suppose the firm is considering adding 10,000 new customers. Since we assume overhead is fixed, it does not increase when the 10,000 new customers are added. We can now construct an income statement with the new customers added. This is shown in Table 6.6. We see that profit increases by $500,000. This is $50 per customer, so the value of these new customers is $50 per customer, not $20.

Table 6.6 Firm profit statement after acquiring 10,000 customers

Number of current customers	100,000
Number of acquired customers	10,000
Sales per customer per year	\$150
Gross margin percentage	40%
Administrative overhead costs	\$3,000,000
Variable costs per customer	\$10
Overhead per customer	\$30
Sales	\$16,500,000
Gross profit	\$6,600,000
Variable customer costs	\$1,100,000
Profit before overhead	\$5,500,000
Administrative overhead costs	\$3,000,000
Net profit after overhead costs	\$2,500,000
Increase in net profits (cf. Table 6.5)	\$500,000
Value added per acquired customer	\$50

One might argue that the firm must allocate overhead because these costs must be "covered". True, for the firm to stay in business it must cover its overhead costs. But this is not relevant for making business decisions such as whether to add new customers. The firm can improve profits by adding customers that contribute *at the margin*. If the firm adds fixed overhead to the computation of the value of a customer, it will under-invest in adding new customers and will not maximize profits.

Many associate "overhead" with "fixed," but it is quite possible that overhead does vary with an increase in the number of customers. It is then a variable cost. Suppose that one could model these costs using an equation to capture how they change as the number of customers change. Assume the equation is $\text{OH}(N) = 2{,}500{,}000 + 5 \times N$ where N is the number of customers and $\text{OH}(N)$ is the overhead associated with N customers. To continue our example, $N = 100{,}000$ and $\text{OH}(100{,}000) = \$2{,}500{,}000 + \$5 \times N = \$3{,}000{,}000$. When the firm adds 10,000 customers, overhead increases by \$50,000. Specifically, the marginal overhead cost for adding a new customer is \$5 which is the coefficient in front of N. This cost should be subtracted from the profitability of a new customer and for our example the incremental profit would be lowered to \$45.

How does the firm determine the coefficients for the equation above? One method is to run a regression in which the number of customers is the independent variable and the overhead expenses of the firm is the dependent variable. It is important to adjust these numbers for inflation because otherwise there is spurious correlation between the number of customers (usually increasing) and costs (also usually increasing).

Another important concept is that of "semi-variable" costs. Semi-variable costs vary with the number of customers according to a step-function. The complication this adds to the computation of LTV is that it makes costs a non-linear function of the number of customers.

To understand semi-variable costs, we begin with a firm that has 1,000,000 customers with average sales per year of \$50, variable costs of \$35 and a margin of \$15. The firm incurs fixed costs of \$2,000,000 per year including the costs of its call center. The average customer has a yearly retention rate of 85%. The acquisition cost per new customer is \$50. The firm uses a discount rate of 15%. The LTV, given these assumptions and a simple retention lifetime value model, is \$57.50.[12]

Assume that starting from its current situation, the next additional 200,000 customers require the firm to build another building, incurring a one-time cost of \$500,000. The next 200,000 customers add \$300,000 more, and each additional 200,000 customers after that adds \$150,000. This traces out a step function. We call these *semi-variable* costs. More generally, customer center costs are nonlinear in the number of customers. The question is: "How does this affect the cost side of the LTV calculation?"

The answer depends upon the decision being made. Assume the decision is whether the firm should add 200,000 customers. Also assume for the first, simplest example, that the \$500,000 is a one-time cost. The computation for the decision is then very straightforward. We have the acquisition cost of \$50 per customer. The LTV calculated earlier is \$57.50. The decision is to add 200,000 new customers comes with a one-time incremental cost of \$500,000. The incremental profit from adding the customers is 200,000 × (\$57.50 − \$50) − \$500,000 = \$1,000,000. In this example the semi-variable cost is a one-time cost and so it is subtracted from the net profit at the time the decision is being made to add new customers. Table 6.7 shows the company's current year profit statement and the net gain in LTV. Note that current year profits decrease because of the investment in customer acquisition, but add \$1,000,000 in the long term.

For our second example, suppose the same assumptions as above are used except instead of adding a building, the firm realizes if it adds 200,000 customers, the additional \$500,000 will be *per year* due to adding supervisors and layers of management. It will have an incremental cost (above its current variable costs) of \$2.50 per new customer (\$500,000/200,000). How does the firm compute the LTV?

Thinking of lifetime value as the incremental benefits and costs associated with a customer, the solution is also straightforward. We add \$2.50 to the variable costs for the new 200,000 customers. The total variable costs per new customer are now \$35.00 + \$2.50 = \$37.50, and profit contribution is now \$12.50 per customer. LTV is now \$47.92 rather than \$57.50. The net impact of the acquisition is now 200,000 × (\$47.92 − \$50) = −\$416,667 (Table 6.8). It is now unprofitable to add the new 200,000 customers.

The tricky part of this problem is that we are now assuming variable costs per the *new* customers are \$37.50, different than \$35.00 for existing customers. This is despite the fact that the new customers will use the call

[12] The formula for computing LTV for this example is $LTV = \frac{m}{1-k}$ where $k = r/(1+d)$, m is the margin, r is the retention rate, and d is the discount rate.

Table 6.7 Treatment of semi-variable costs: One-time expenditure

	Current year base	**Current year proposed**
Fixed costs	\$2,000,000	\$2,000,000
Semi-variable costs	\$0	\$500,000
Number of customers	1,000,000	1,200,000
Sales per customer	\$50	\$50
Variable costs per customer	\$35	\$35
Gross profit per customer	\$15	\$15
Acquisition cost per customer	\$50	\$50
Total acquisition costs	\$0	\$10,000,000
Total sales	\$50,000,000	\$60,000,000
Total variable costs	\$35,000,000	\$42,000,000
Gross profits	\$15,000,000	\$18,000,000
Profits after fixed and semi-variable costs	\$13,000,000	\$15,500,000
Profits after acquisition costs	\$13,000,000	\$5,500,000
Gross profit contribution per customer	\$15	\$15
Retention rate	0.85	0.85
Discount rate	0.15	0.15
LTV multiplier	3.83	3.83
Customer LTV	\$57.50	\$57.50
Total customer LTV	\$57,500,000	\$69,000,000
Total customer LTV after fixed, semi-variable, and acquisition costs	\$55,500,000	\$56,500,000
Net change in total LTV	–	\$1,000,000

center no more or no less than current customers. However, this goes back to (1) linking the treatment of semi-variable costs to the decision at hand, and (2) thinking of LTV as incremental costs and benefits generated by customers. The decision is whether to add 200,000 more customers, and these customers force us to spend an additional \$500,000 per year on the call center.

If we were to amortize the \$500,000 among the 1,200,000 customers we would have after the acquisition of the 200,000 customers, it would amount to only \$0.42 per customer. This would result in a profit contribution of \$14.58 per customer, an LTV for the new customers of \$55.89, and we would calculate the profits to be 200,000 × (\$55.89 – \$50) = \$1,178,000, although Table 6.8 clearly shows the net result is lower profits.

For this example, the key point is that costs are non-linear, in this case a step function. The costs could also be concave or convex in the number of customers. The shape of the cost function is critical. Most articles about LTV assume a constant variable cost function, i.e., variable costs per customer are constant in the number of customers.

Our final example will cover a different decision. Suppose the firm wants to compute LTV after it has added the 200,000 new customers. However, we will change the parameters of the decision slightly to make the incremental customer profitable. We will use all of the same assumptions used earlier in this section except we will assume the 200,000 new customers add \$0.50 (not \$2.50) per customer due to supervisors and management personnel required

Table 6.8 Treatment of semi-variable costs: Yearly expenditure

	Current year base	**Current year proposed**
Fixed costs	\$2,000,000	\$2,000,000
Semi-variable costs	\$0	\$500,000
Number of customers	1,000,000	1,200,000
Sales per customer	\$50	\$50
Variable costs per current customer	\$35	\$35
Variable costs per acquired customer		\$37.5
Gross profit per current customer	\$15	\$15
Grow profit per acquired customer		\$12.5
Acquisition cost per customer	\$50	\$50
Total acquisition costs	\$0	\$10,000,000
Total sales	\$50,000,000	\$60,000,000
Total variable costs	\$35,000,000	\$42,500,000
Gross profits	\$15,000,000	\$17,500,000
Profits after fixed and semi-variable costs	\$13,000,000	\$15,500,000
Profits after acquisition costs	\$13,000,000	\$5,500,000
Gross profit contribution per current customer	\$15	\$15
Gross profit contribution per acquired customer	–	\$12.5
Retention rate	0.85	0.85
Discount rate	0.15	0.15
LTV multiplier	3.83	3.83
Current customer LTV	\$57.50	\$57.50
Acquired customer LTV		\$47.92
Total LTV among current customers	\$57,500,000	\$57,500,000
Total LTV among acquired customers	–	\$9,583,333
Total customer LTV after fixed, semi-variable, and acquisition costs	\$55,500,000	\$55,083,333
Net change in total LTV	–	−\$416, 667

to manage the additional customers. The profit contribution per customer is now \$14.50 and the LTV for this segment of customers is \$55.58 and Table 6.9 shows the acquisition is profitable.

Now suppose the 200,000 customers have been acquired and the firm wants to calculate LTV for planning purposes, e.g., to target certain customers for a loyalty program. If we know how much of each resource a customer uses, then customer-specific *variable* costs could be calculated using ABC costing. If the usage level is not known, we would simply use the average variable cost per customer. Total variable costs are now $\$35 \times 1{,}200{,}000 + \$100{,}000 =$ \$42,100,000, or \$42,000,000/1,200,000 = \$35.083 per customer. Thus, the profit contribution per customer across their entire customer base is now $\$50 - \$35.083 = \$14.927$ and the average LTV per customer is now \$57.18.

In summary, determining the costs to use in an LTV calculation can be the most difficult part of the calculation. The single most challenging issue is whether to include fixed or only variable (marginal) costs. Researchers can be found who advocate full costing (e.g., Searcy 2004; Foster et al. 1996, p. 11) as well as marginal costing (Mulhern 1999, p. 29; also see Gurau and

Table 6.9 Treatment of semi-variable costs: lower yearly expenditure

	Current year base	**Current year proposed**
Fixed costs	$2,000,000	$2,000,000
Semi-variable costs	$0	$100,000
Number of customers	1,000,000	1,200,000
Sales per customer	$50	$50
Variable costs per current customer	$35	$35
Variable costs per acquired customer	–	$35.5
Gross profit per current customer	$15	$15
Grow profit per acquired customer	–	$14.5
Acquisition cost per customer	$50	$50
Total acquisition costs	$0	$10,000,000
Total sales	$50,000,000	$60,000,000
Total variable costs	$35,000,000	$42,100,000
Gross profits	$15,000,000	$17,900,000
Profits after fixed and semi-variable costs	$13,000,000	$15,900,000
Profits after acquisition costs	$13,000,000	$5,900,000
Gross profit contribution per current customer	$15	$15
Gross profit contribution per acquired customer	–	$14.5
Retention rate	0.85	0.85
Discount rate	0.15	0.15
LTV multiplier	3.83	3.83
Current customer LTV	$57.50	$57.50
Acquired customer LTV	–	$55.58
Total LTV among current customers	$57,500,000	$57,500,000
Total LTV among acquired customers	–	$11,116,667
Total customer LTV after fixed, semi-variable, and acquisition costs	$55,500,000	$56,616,667
Net change in LTV	–	$1,116,667
Post-acquisition variable cost per customer	–	$35.08
Post-acquisition gross profit contribution per customer	–	$14.92
Post-acquisition LTV per customer	–	$57.18
Post-acquisition total LTV among current customers	–	$68,616,667
Post-acquisition total customer LTV	–	$56,616,667

Ranchhod 2002). Our recommendation is to link the determination of costs to the decision being made and recall that LTV is the net present value of *incremental* profits and costs. If the decision is to add customers, their LTV should be calculated using the costs they *add* to the company. Marketers are likely to skip over these elements of the calculation, but as the above discussion illustrates, they can be crucial in actual applications.

6.5 Incorporating Marketing Response

The LTV models reviewed so far do not take into account how customers respond to marketing efforts. These models view lifetime value as a *ceteris* *paribus* calculation: given the environment stays the same, what is the value of the customer? These calculations can be useful but including marketing response in the calculation of LTV can be very valuable (Berger et al. 2002; Calciu and Salerno 2002) for at least two reasons:

- Marketing efforts may in fact change so calculations that assume a constant marketing effort are erroneous;
- Incorporating market response allows firms to examine the impact of policy on customer value.

Note, however, that LTV is essentially a prediction of future customer value, discounted to the present. As a result, if incorporating marketing efforts requires the firm to predict future marketing efforts and these are difficult to predict, incorporating future marketing efforts might in fact diminish the accuracy of LTV.

Rust et al. (1995) were among the first to relate marketing expenditures to customer value. They model the following process:

Marketing => Objective => Perceived => Customer => Market => Profit
Expense Quality Quality Retention Share

The authors do not measure LTV at the customer level, but rather aggregate up to market share and profit. Their market share and profit models are:

$$MS_t = \frac{rMS_{t-1}N_{t-1} + (1 - r' - c)(1 - MS_{t-1})N_{t-1} + A(cN_{t-1} + N_t - N_{t-1})}{N_t} \tag{6.8a}$$

$$\mathit{Profit}_t = Y \times MS_t \times N_t - X_t \tag{6.8b}$$

where:

r = retention rate
MS_t = market share in period t
N_t = number of customers in market, i.e., market size, in period t
r' = retention rate for competitors
c = rate at which customers leave the market
A = % of new customers who choose the brand, i.e., acquisition rate
Y = profit margin
X_t = Expenditure on quality improvement in period t

To complete the model, the authors assume that the retention rate r is a function of perceived quality, which in turn is a function of objective quality, which is a function of marketing expense, so essentially:

$$r = f(X_t) \tag{6.9}$$

In addition to the explicit link between marketing expense and retention rate in Equation 6.9, the authors include in Equation 6.8a the number of customers who switch to the firm, and the acquisition of new customers among the pool who either has left the market in the previous period (cN_{t-1}) or joined the market this period (N_t–N_{t-1}). Note that the authors focus on marketing's impact on retention rate, not on acquisition rate or the percentage of customers who leave the market. These would be obvious extensions to the model.

The challenge of course is to estimate Equation 6.8a. The authors suggest using market testing and discuss an application we review in Chapter 7. The authors also calculate the net present value of the profit stream as follows:

$$NPV = \sum_{k=1}^{P} \frac{Y \cdot MS_{t+k}(1+G)^k N_t - X_{t+k}}{(1+\delta)^{k-1}} \tag{6.10}$$

where

G = annual growth rate in the total number of customers in the market
δ = annual discount factor
NPV is the aggregate analog of LTV

Blattberg et al. (2001) and Blattberg and Thomas (2000) develop a "customer equity" model in which they model acquisition rate, retention rate, and future "add-on selling," as functions of marketing actions. Their customer equity model is at the customer segment level and is as follows:

$$CE_t = \sum_{i=1}^{I} \left[N_{it}\alpha_{it}(S_{it} - c_{it}) - N_{it}B_{iat} + \sum_{k=1}^{\infty} \frac{N_{it}\alpha_{it}\left(\prod_{k=1}^{\infty} \rho_{j,t+k}\right)(S_{i,t+k} - c_{i,t+k} - B_{ir,t+k} - B_{i,AO,t+k})}{(1+\delta)^k} \right] \tag{6.11}$$

where:

N_{it} = Market "potential" in period t, i.e., the number of customers in segment i available to be acquired.
α_{it} = Acquisition rate for segment i in period t
S_{it} = Sales per customer in segment i in period t
c_{it} = Cost of goods sold for segment i in period t
B_{iat} = Acquisition expenditures per customer in segment i in period t
ρ_{it} = Retention rate for segment i in period t
$B_{ir,t}$ = Retention expenditures per customer in segment i in period t

$B_{i,AO,t}$ = Add-on sales expenditures per customer in segment i in period t
δ = Discount factor

Equation 6.11 traces the lifetime value of a firm's customer franchise starting from acquisition and proceeding over the customers' lifetimes. The analysis is at the segment level, which is practical in real-world applications. The model identifies three drivers of customer equity: acquisition, retention, and add-on sales. Add-on sales include cross-selling and up-selling sales. Blattberg et al. discuss strategies for increasing these quantities. Blattberg and Thomas suggest models that would link marketing expenditures to these three quantities, i.e.:

$$\alpha_{it} = k_a \left[1 - e^{-\sum_{j=1}^{J} \lambda_j B_{iatj}} \right] \tag{6.12a}$$

$$\rho_{it} = k_r \left[1 - e^{-\gamma B_{irt}} \right] \tag{6.12b}$$

$$S_{it} = \sum_{j=1}^{J_{it}} O_{ijt} r_{ijt} \tag{6.12c}$$

$$B_{i,AO,t} = \sum_{j=1}^{J_{it}} O_{ijt} C_{ijt} \tag{6.12d}$$

where:

B_{iatj} = Expenditures for acquisition activity j targeted at segment i in period t
O_{ijt} = Number of offers of type j made to segment i in period t
C_{ijt} = Unit cost of type j offers made to segment i in period t
r_{ijt} = Response rate and contribution from type j offers made to segment i in period t

Equations 6.12a–d are crucial for driving customer value over time and would have to be estimated through market testing.

Comparing the Rust et al. (1995) (RZK) and Blattberg et al. (2001) (BGT) models, both consider customer acquisition as well as retention. RZK is at the aggregate customer level whereas BGT is at the segment level, although RZK could easily formulate their model at the segment level (see Rust et al. 2000) in addition to Rust et al. (1995). RZK focus on retention rates and model the process from expenditure to objective quality to perceived quality/satisfaction to retention, whereas BGT model just the relationship between expenditures and behavior. BGT include acquisition and add-on selling impact as well as the impact on retention.

Both models could be used evaluate current versus alternative marketing efforts. The key relationships are between marketing effort and retention, and in BGT's case, acquisition and add-on selling as well. These relationships could be estimated using historical data, managerial judgment (see also

Blattberg and Deighton 1996), or market tests. For example, a firm could test an offer by extending it to each of its market segments and measuring the response rate r_{ijt}. Similar tests could be used to gauge the effectiveness of acquisition as well as retention efforts. With BGT's model, the firm would only have to measure customer behavior (i.e., how many customers were acquired, how many were retained, etc.) whereas the RZK model would require surveys to measure perceived quality/satisfaction. This would take more effort but provide rich diagnostics. Both models also require knowledge of the size of the market; i.e., how many potential customers are available in each time period. RZK model this explicitly through customers leaving the market (c) and customers defecting from competitors to the focal company (r'). RZK also explicitly model the growth of the market through the parameter G.

The next step is for these models to be estimated empirically and the links between marketing and LTV quantified. Another step would be to optimize marketing efforts over time. See Chapters 26, 28 and 29 for discussion along these lines.

6.6 Incorporating Externalities

Another measure of customer value is the externality generated by the customer. Externalities include word-of-mouth, which could be positive or negative, or the number of referrals generated by the customer.

A challenging circularity occurs in trying to incorporate customer referrals in lifetime value calculations. One could imagine including the expected revenue generated through referrals but that revenue is the lifetime value of the referred customer. In order to calculate that lifetime value, however, one must take into account that the new customers might refer customers, and these new customers have lifetime values. So one faces an infinite recursion and it is not clear how to incorporate it into lifetime value.

Another complication would be, if one wanted to value the entire customer database one customer at a time, one would have to be careful not to double-count. For example, customer i might have referred customer j, so customer i's LTV would include customer j's. So should customer j be treated as not having a separate LTV? In short, incorporating referral value of a customer in LTV calculations is a challenging area that needs to be addressed.

Hogan et al. (2003) conduct an analysis of word-of-mouth externalities in which they merge a lifetime value model and a Bass diffusion model to calculate the impact of a customer "disadopting" the category. An example of disadoption, analyzed by Hogan et al., is the decision not to continue with online banking after an initial trial. Note we do not mean that the customer is moving to another company's online banking service but that the customer has decided no longer to use online banking. This can produce a harmful effect to the entire industry due to a smaller customer base in the industry. For example, the Bass model can be stated as:

$$n(t) = \left(p + q \times \frac{N(t)}{m}\right) \times (m - N(t)) \tag{6.13}$$

where:

$n(t)$ = number of new adopters in period t
$N(t)$ = total adopters as of period t
m = marketing potential parameter
p = innovation parameter
q = imitation parameter

When customers leave the market, N(t) and m both decrease. Since N(t) > m, the impact of losing one customer is to decrease the ratio $\frac{N(t)}{m}$ and hence a smaller number gets multiplied by the imitation parameter. This slows the growth of the market and hence generates fewer sales for all firms.

In an empirical application to the online banking industry, Hogan et al. find that this indirect effect (on imitation) due to disadoption can be larger than the direct loss in revenues (in the case of online banking, cost savings), to the extent that the disadoption occurs earlier. Hogan et al. make two additional points. First is that a disadoption by a competitor also carries the indirect effect, so competitive disadoptions can hurt the firm. Second is that a disadoptor may in fact spread negative word of mouth and have a further negative impact on the firm. This is not explicitly incorporated in the Bass model ($m > 0$) but Hogan et al. use a simple assumption (one disadoptor causes another would-be adoptor to delay purchase by 5 years due to negative word-of-mouth) and show that the financial impact can be substantial.

In summary, customers can be valued by externalities in terms of word-of-mouth and in terms of the number of referrals. The referral issue needs empirical work to demonstrate its magnitude, and also conceptual work on how to incorporate it into lifetime value calculations. Word-of-mouth has been initially investigated by Hogan et al. (2003) but needs further work especially in estimating negative word-of-mouth from disadoption of the category.