Customer Satisfaction, Productivity, and Profitability: Differences Between Goods and Services

Eugene W. Anderson • Claes Fornell • Roland T. Rust
School of Business Administration, The University of Michigan, Ann Arbor, Michigan 48109-1234, genea@umich.edu
School of Business Administration, The University of Michigan, Ann Arbor, Michigan 48109-1234
Owen Graduate School of Management, Vanderbilt University, Nashville, Tennessee 37203

Abstract

There is widespread belief that firms should pursue superiority in both customer satisfaction and productivity. However, there is reason to believe these two goals are not always compatible. If a firm improves productivity by "downsizing," it may achieve an increase in productivity in the short-term, but future profitability may be threatened if customer satisfaction is highly dependent on the efforts of personnel. If so, there are potential tradeoffs between customer satisfaction and productivity for industries as diverse as airlines, banking, education, hotels, and restaurants. Managers in these types of service industries, as well as goods industries in which the service component is increasing, need to understand whether or not this is the case. For example, if efforts to improve productivity can actually harm customer satisfaction—and vice-versa—the downsizing of U.S. and European companies should be viewed with concern. It follows that developing a better understanding of how customer satisfaction and productivity relate to one another is of substantial and growing importance, especially in light of expected continued growth in services throughout the world economy.

The objective of this paper is to investigate whether there are conditions under which there are tradeoffs between customer satisfaction and productivity. A review of the literature reveals two conflicting viewpoints. One school of thought argues that customer satisfaction and productivity are compatible, as improvements in customer satisfaction can decrease the time andeffort devoted to handling returns, rework, warranties, and complaint management, while at the same time lowering the cost of making future transactions. The second argues that increasing customer satisfaction should increase costs, as doing so often requires efforts to improve product attributes or overall product design.

A conceptual framework useful in resolving these contradictory viewpoints is developed. The framework serves, in turn, as a basis for developing a theoretical model relating customer satisfaction and productivity. The model predicts that customer satisfaction and productivity are less likely to be compatible when: 1) customer satisfaction is relatively more dependent on customization—the degree to which the firm's offering is customized to meet heterogeneous customers' needs—as opposed to standardization—the degree to which the firm's offering is reliable, standardized, and free from deficiencies; and 2) when it is difficult (costly) to provide high levels of both customization and standardization simultaneously.

To move forward from the model's propositions to the development of testable hypotheses, we argue that services are more likely than goods to have the preceding characteristics. Hence, tradeoffs between customer satisfaction and productivity should be more prevalent for services than for goods. Although this classification is not precise—many services are standardizable and many goods have a service component—it has the advantage of allowing an initial test of the propositions.

The empirical work employs a database matching customer-based measures of firm performance with traditional measures of business performance, such as productivity and Return on Investment (ROI). The central feature of this database is the set of customer satisfaction indices provided by the Swedish Customer Satisfaction Barometer (SCSB). The SCSB provides a uniform set of comparable customer-based firm performance measures and offers a unique opportunity to test the study's hypotheses.

The findings indicate that the association between changes in customer satisfaction and changes in productivity is positive for goods, but negative for services. In addition, while both customer satisfaction and productivity are positively associated with ROI for goods and services, the interaction between the two is positive for goods but significantly less so for services.

Taken together, the findings suggest support for the contention that tradeoffs are more likely for services. Hence, simultaneous attempts to increase both customer satisfaction and productivity are likely to be more challenging in such industries. Of course, this does not imply that such firms should not seek improvements in both productivity and customer satisfaction. For example, appropriate applications of information technology may improve both customer satisfaction and productivity simultaneously.

The findings should provide motivation for future research concerning the nature of customer satisfaction and productivity, as well as appropriate strategy and tactics for each one. It is worth emphasizing that this is an issue that is not only important today, but certainly will become even more important in the future. As the growth of services continues and world markets become increasingly competitive, the importance of customer satisfaction will also increase. To compete in such a world, firms must strike the right balance between their efforts to compete *efficiently* and their efforts to compete *effectively*.

(*Customer Satisfaction; Productivity; Services Versus Goods*)

0732-2399/97/1602/0129$01.25

1. Introduction

Is it always desirable to achieve superiority in *both* productivity and customer satisfaction? Although there is widespread belief that excelling at both should be a top priority, there is reason to believe the two are not always compatible. If a firm "downsizes," productivity (e.g., sales per employee) may increase in the short term, but future profitability will be threatened if customer satisfaction is dependent on customized service by personnel. Increasing volume—seats per plane, tables per waiter, children per care provider, students per class, classes per instructor—may also lower customer satisfaction. Conversely, single-minded pursuit of customer satisfaction can result in a myopic focus on current customers at the expense of attracting new ones.

In short, despite exhortations to pursue both productivity and customer satisfaction, there are likely to be fundamental tradeoffs between "quantity" and "quality," especially when service by personnel plays a central role in customizing a firm's market offering to better meet customer needs. If this is the case, tradeoffs of this type should be of major concern in developed economies where services are dominant. In general, a better understanding of how customer satisfaction and productivity relate to one another would seem to be of substantial and growing importance, in view of the expected continued growth in services.

The purpose of this study is to examine the links between customer satisfaction and productivity. The paper begins by discussing the nature of customer satisfaction and productivity. A review of the literature reveals sharp disagreement as to whether the two are compatible. We present a conceptual framework useful in resolving these contradictory viewpoints. The framework serves, in turn, as a basis for developing a theoretical model relating customer satisfaction and productivity. The model proves useful in helping us to understand why there is conflict concerning the nature of the relationship, as well as providing a basis for developing explicit propositions regarding when we should expect tradeoffs to exist.

In our empirical work, we build a database matching customer-based measures of firm performance with traditional measures of business performance, such as productivity and return on investment (ROI). The central feature of this database is the set of customer satisfaction indices provided by the Swedish Customer Satisfaction Barometer (SCSB) (Fornell 1992). The SCSB measures overall customer satisfaction *as experienced by customers*—rather than expert ratings (e.g., *Consumer Reports*) or managers' perceptions (e.g., PIMS). As such, it provides a uniform set of comparable customer-based firm performance measures that are matched with traditional accounting-based performance measures obtained from annual reports and business information services. Hence, the SCSB offers a unique opportunity to test the study's hypotheses.

If significant tradeoffs are found to exist, this would suggest a need for further effort to develop an understanding of how pursuing customer satisfaction can best be balanced with achieving goals related to other performance measures, such as market share and productivity (Anderson et al. 1994, Hauser et al. 1995, Kaplan and Norton 1992, Rust and Zahorik 1993).

2. Customer Satisfaction and Productivity

2.1. Customer Satisfaction

As the context of this study is the overall performance of the firm, it is natural to focus on customer satisfaction as an overall evaluation of a firm's product, rather than a particular individual's evaluation of a specific transaction (Boulding et al. 1993, Johnson and Fornell 1991, Fornell et al. 1996). Overall customer satisfaction should be a more fundamental indicator of the firm's performance due to its links to behavioral and economic consequences beneficial to the firm (Anderson et al. 1994).

A variety of studies find that higher levels of customer satisfaction lead to greater customer loyalty (Anderson and Sullivan 1993, Bearden and Teel 1983, Bolton and Drew 1991, Boulding et al. 1993, Fornell 1992, LaBarbera and Mazursky 1983, Oliver 1980, Oliver and Swan 1989, Yi 1991). Through increasing loyalty, it is argued, customer satisfaction helps to secure future revenues (Fornell 1992, Rust et al. 1994, 1995), reduce the costs of future transactions (Reichheld and Sasser 1990), decrease price elasticities

(Anderson 1996), and minimize the likelihood customers will defect if quality falters (Anderson and Sullivan 1993). Internally, improving quality and customer satisfaction reduces costs associated with defective goods and services, such as warranty costs, field service, reworking/replacing defective goods, and handling/managing complaints (Crosby 1979, Fornell and Wernerfelt 1988, Garvin 1988, Gilly and Gelb 1982, TARP 1979, 1981). Word-of-mouth from satisfied customers lowers the cost of attracting new customers and enhances the firm's overall reputation, while that of dissatisfied customers naturally has the opposite effect (Anderson 1994, Fornell 1992). Finally, empirical work suggests that firms providing superior quality enjoy higher economic returns (Aaker and Jacobson 1994, Anderson et al. 1994, Capon et al. 1990, Nelson et al. 1992).

2.2. Productivity

The purpose of measuring firm-level productivity is to evaluate the efficiency with which inputs are transformed into outputs (goods and services). The most common type of productivity measure is the simple, or single factor, ratio of output to a specific type of input, such as sales per employee. There is also a rich literature addressing the issue of how to measure productivity as a ratio of output to all types of inputs—labor, capital, materials—known as total factor productivity (Solow 1957, Griliches and Jorgenson 1967). As the present study is concerned with the type of performance measures used by managers, we focus on the most common "single factor ratio," labor productivity calculated as the firm's total sales divided by the number of employees.[1]

Classical economics discusses productivity improvements in terms of capital and labor (Smith 1776, Ricardo 1817), where increases in productivity are generally considered the major source of economic growth. Common types of investments that increase productivity include substituting capital for labor—automation of processes, improvements in existing technology—or developing new training programs for employees. Productivity may also depend on numerous factors, such as the quality of resource allocation (Stigler 1942). Rather than increasing current levels of investment in capital or labor, reallocation of resources can increase productivity via changes in strategy, processes, and/or organizational structure and values.

2.3. The Relationship Between Customer Satisfaction and Productivity

There is considerable disagreement concerning the nature of the relationship between customer satisfaction and productivity (Huff et al. 1996). In operations research and production management, it is common to argue that this relationship is positive. The firm that achieves superior levels of customer satisfaction needs to devote fewer resources to handling returns, rework, warranties, and complaint management, thus lowering costs and improving productivity (Crosby 1979, Deming 1982, Juran 1988). In a services context, Reichheld and Sasser (1990) argue that reducing defects leads to greater loyalty and increased loyalty leads, in turn, to greater productivity via lower costs of making future transactions, favorable word-of-mouth, and perhaps even a price premium.

However, there is equally compelling logic to suggest that the pursuit of customer satisfaction increases costs and thereby reduces productivity. In economics, for example, the relationship between productivity and customer satisfaction is generally viewed as negative. Customer satisfaction—utility—is modeled as a function of product attributes. Increasing the level of utility—improving raw materials, adding features or service personnel—requires increasing the level of product attributes and, therefore, costs (Griliches 1971, Lancaster 1979). Moreover, it is common to expect diminishing returns to such efforts.

Finally, empirical analysis based on the PIMS database fails to find support for either a positive or negative relationship between quality—as perceived by the firm's managers—and costs (Jacobson and Aaker 1987, Phillips et al. 1983). It may be, however, that the nature of this relationship depends on the type of quality under investigation.

2.4. Resolving Two Different Perspectives: Customization Versus Standardization

Juran (1988) suggests an approach to defining quality useful in resolving the apparent contradiction between

[1]The correlation between total factor and labor productivity is close to 0.90 (Kendrick and Grossman 1980).

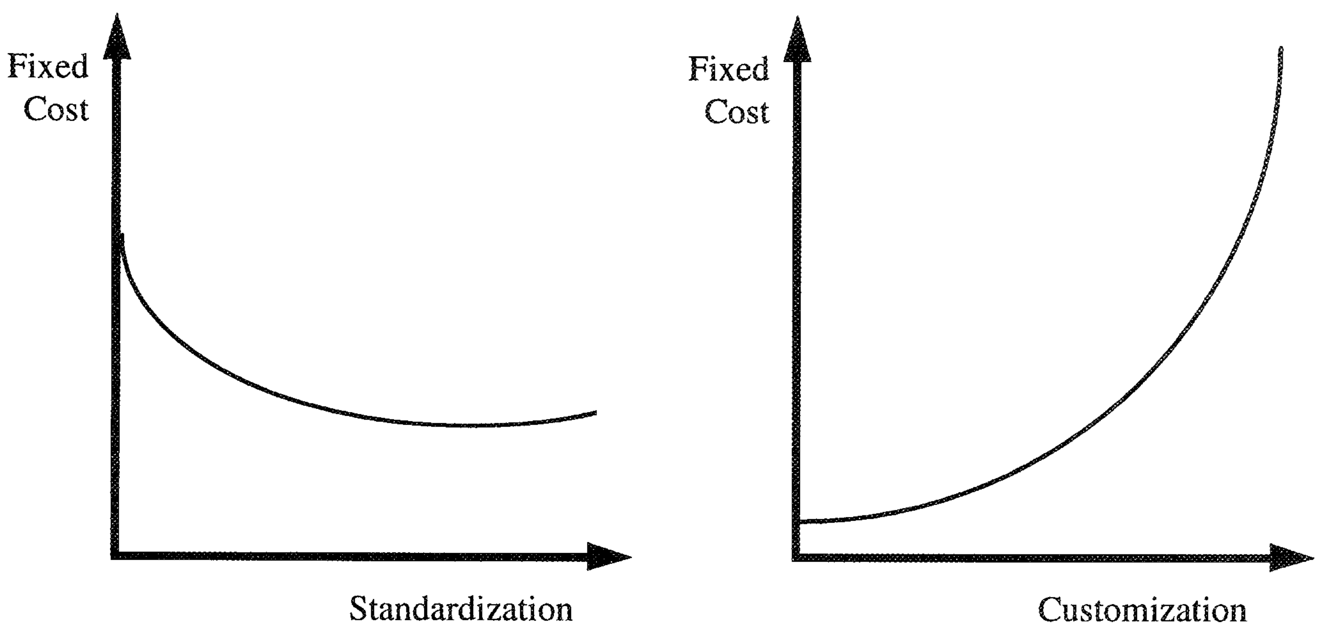
the two schools of thought on the relation between customer satisfaction and productivity. This approach suggests that although there are multiple dimensions of quality, the various dimensions can be classified as belonging to one of two distinct categories: 1) quality that *meets customer needs;* and 2) quality that consists of *freedom from deficiencies.*

Quality that meets customer needs refers to the design characteristics of a product—its attributes and features, as well as the way in which service is delivered (e.g., effort by personnel). For ease of exposition, we will refer to this type of quality as *customization* quality. Freedom from deficiencies refers to the degree to which the design is reliable with respect to the degree of variance customers experience in the set of features, feature levels, and service delivery. This type of quality we will denote as *standardization* quality.

Although it is possible to elaborate on these two dimensions to develop a finer taxonomy of component dimensions (e.g., Garvin 1988, Parasuraman et al. 1985), this two-dimensional categorization is well-suited to the goals of the current study. First, these labels are useful not only in capturing the two major types of quality as defined by Juran (1988), but also highlight the dual nature of quality. Customization and standardization are two mutually dependent, often conflicting, aspects of quality. Second, it is arguably more appropriate to use more abstract, inclusive dimensions for making cross-industry comparisons between relatively "noncomparable" goods and services (Johnson and Fornell 1991).

Figure 1a and b illustrate how "quality" can be both "free" and "not free" at the same time. In Figure 1a, costs decline with increased standardization quality per the arguments offered by operations management theorists such as Crosby (1979), Deming (1982), and Juran (1988). However, as there are likely to be diminishing returns to such efforts, costs eventually begin to increase. For example, technology providing further improvements in precision for manufactured components may be unavailable; increasing inspection on an assembly line may be impractical; customers may cease to notice further refinements in reliability; costs of hiring and training qualified service personnel may become prohibitive. Figure 1b shows how the cost of improving customization should increase everywhere at an increasing rate as increasing customization entails more and better features, available in a greater

Figure 1



variety of combinations, or more attention to customers by employees.

When Are There Tradeoffs Between Customer Satisfaction and Productivity? In general, when customer satisfaction is relatively more dependent on standardization quality, productivity and customer satisfaction are more likely to be compatible. Hence, achieving superiority in both productivity and customer satisfaction would seem most appropriate when standardization of quality for a homogeneous product is both possible for producers and desirable for customers. However, when customer satisfaction is relatively more dependent on customization quality—when customers desire different types and levels of features, more personal service, etc., then productivity and customer satisfaction are more likely to be in conflict.

3. A Model of Standardization and Customization

To develop an explicit understanding of when there might be tradeoffs between customer satisfaction and productivity, we formalize the preceding arguments. At minimum, the model must include the relative importance of standardization and customization to buyers, the impact of each type of quality on costs, and the allocation of effort devoted to each type of quality.

3.1. Customer Satisfaction as a Function of Standardization and Customization

To begin, we posit customer satisfaction as a function of the level of standardization quality, ϕ_s, the level of customization quality, ϕ_c, and the relative importance of standardization and customization quality, $(1 - \epsilon)$ and ϵ, such that:

$$s = (1 - \epsilon)\phi_s + \epsilon\phi_c \quad \text{where} \qquad (1)$$

s = level of customer satisfaction, $s > 0$,

ϕ_s = level of standardization quality, $\phi_s > 0$,

ϕ_c = level of customization quality, $\phi_c > 0$,

ϵ = relative importance of customization quality to customers $\in [0,1]$.

Equation (1) is consistent with Juran's (1988) intuitive notion that customer satisfaction is determined primarily by how well a good or service meets customer needs—customization quality—and how reliably it does so—standardization quality. The posited linear form is parsimonious, tractable, and can be expected to provide a reasonable approximation over a moderate range of effort levels for each type of quality. Although this may appear a strong assumption given that such quality efforts may exhibit diminishing returns in terms of the resulting level of customer satisfaction, the substantive implications of the model should be robust to this restriction given the nonlinear cost functions described below.

3.2. Cost as a Function of Standardization and Customization

The impact of the level of effort devoted to standardization and customization quality on costs is specified as follows:[2]

$$\text{FC} = -\delta_s\phi_s + \frac{\lambda_s\phi_s^2}{2} + \frac{\lambda_c\phi_c^2}{2} + \gamma\phi_s\phi_c \quad \text{where} \qquad (2)$$

FC = fixed costs, FC > 0,

δ_s = linear effect of standardization quality levels on costs, $\delta_s > 0$,

λ_s = rate of acceleration in costs for standardization quality, $\lambda_s > 0$,

λ_c = rate of acceleration of costs for customization quality, $\lambda_c > 0$,

γ = tradeoffs coefficient, $-\infty < \gamma < \infty$.

The form of the cost function is similar to that of other analytical models of investment in marketing instruments (e.g., advertising), with two key differences. First, pursuit of standardization quality can result in decreases in total costs (of quality), at least up to a point. The coefficient of the first term, the linear effect of standardization quality on costs, δ_s, represents the

[2]It is worth noting that the substantive implications of the model do not change if one models variable costs, rather than fixed costs, as a function of quality.

cost-reducing benefits of improving standardization quality. The quadratic terms of the cost function ensure that, as the level of either type of quality increases, costs increase at an increasing rate, λ_s or λ_c. Hence, for fixed costs to be reduced, initial investments in standardization must be more than offset by gains in decreased problems caused by defects. The combined effects of the linear and quadratic terms imply the effect of standardization quality on cost is U-shaped (Figure 1a), whereas the impact of customization quality is concave upwards (Figure 1b).

The second key difference between Equation (2) and other models of investment in marketing instruments is the fourth term, $\upsilon\phi_s\phi_c$, which captures the essence of our arguments concerning the compatibility of the two types of quality. For example, if it is difficult to simultaneously improve both customization and standardization, then we would expect the tradeoffs coefficient to be large and positive, $\gamma > 0$. If changes in one type of quality do not affect the other, then the coefficient would be zero. A negative value for this coefficient would imply that synergies actually exist between the two types of quality, $\gamma < 0$.

3.3. Allocation of Effort to Standardization and Customization

To model the firm's allocation decision, we specify the following as the profit function:

$$\begin{aligned}\text{Profit} &= D(s,p)[p - c] - \text{FC} \\ &= \alpha[(1 - \epsilon)\phi_s + \epsilon\phi_c]p^{-\beta}[p - c] \\ &\quad - \left[-\delta_s\phi_s + \frac{\lambda_s\phi_s^2}{2} + \frac{\lambda_c\phi_c^2}{2} + \gamma\phi_s\phi_c\right] \quad (3)\end{aligned}$$

where

D = demand as a function of satisfaction and price,

α = constant level of preference,

p = price,

β = impact of price on demand,

c = constant per unit.

The firm's demand is determined by price, p, and customer satisfaction, s, given the constant level of preference for the firm's output, α. The choice of the demand function is made, as before, for the purpose of achieving a suitable degree of tractability. The functional form is analogous to that used by Shugan (1989) in his study of the impact of (customization) quality on assortment. Hence, the firm chooses price, p, and the level of each type of quality, ϕ_s and ϕ_c. The level and relative importance of the two types of quality determines, in turn, the level of customer satisfaction experienced by customers.

Solving for the equilibrium expressions of optimal standardization quality, optimal customization quality, and optimal price yields the following (see appendix for derivations):

$$\phi_s^* = \frac{\alpha p^{*-\beta}(p^* - c)[(\lambda_c - \gamma)(1 - \epsilon) + \gamma(1 - 2\epsilon)] + \lambda_s\lambda_c}{\lambda_c\lambda_s - \gamma^2}, \quad (4)$$

$$\phi_c^* = \frac{\alpha p^{*-\beta}(p^* - c)[(\lambda_s - \gamma)\epsilon - \gamma(1 - 2\epsilon)] - \gamma\delta_s}{\lambda_c\lambda_s - \gamma^2}, \quad (5)$$

$$p^* = \frac{\beta c}{\beta - 1}. \quad (6)$$

The expressions for optimal standardization quality and customization quality have an intuitive appeal. For example, in equilibrium, a firm with positive tradeoffs ($\gamma > 0$) will offer greater standardization quality, and less customization quality, when the cost benefits from standardization quality are greater ($\delta_s\uparrow$). Alternatively, the firm will offer lower standardization quality and greater customization quality when the importance of customization is higher ($\epsilon\uparrow$).

3.4. Customer Satisfaction and Productivity

Are there conditions under which a firm might provide lower customer satisfaction, yet exhibit a higher level of productivity? To answer this question, we require optimal expressions for satisfaction and productivity. The appropriate expression for satisfaction can be obtained by substituting the expressions for optimal standardization and customization quality given by Equations (4) and (5) into the equation for satisfaction (1). An expression for productivity as the ratio of output (total revenue) relative to input (total costs) can be written as follows:

$$E^* = \frac{D^*p^*}{D^*c + FC^*}. \quad (7)$$

Using these expressions, the following propositions can be made regarding the association between customer satisfaction and productivity (see the appendix for greater detail):

PROPOSITION 1. *There exist situations where conditions change for a profit-maximizing that lead it to allocate greater effort to standardization quality and provide greater customer satisfaction while exhibiting higher productivity and enjoying higher profit.*

PROOF. Proof is by example: As shown in the appendix, when the benefits of standardization increase, $\delta_s \uparrow$, profit and productivity are increasing everywhere ($d\pi^*/d\delta_s > 0$ and $dE^*/d\delta_s > 0$). Customer satisfaction only will be greater if: 1) the importance of customization, ϵ, *is small; 2) the difficulty of increasing customization quality*, λ_c, is relatively large; and 3) the coefficient for tradeoffs between customization and standardization quality, γ, is relatively small. □

PROPOSITION 2. *There exist situations where conditions change for a profit-maximizing that lead it to allocate greater effort to standardization quality and provide lower customer satisfaction while exhibiting higher productivity and enjoying higher profit.*

PROOF. Proof is by example: Again, note that as the benefits of standardization increase, $\delta_s \uparrow$, profit and productivity are increasing everywhere ($d\pi^*/d\delta_s > 0$ and $dE^*/d\delta_s > 0$). However, customer satisfaction will be lower if: 1) the importance of customization, ϵ, is large; 2) the difficulty of increasing customization quality, λ_c, is relatively small; and 3) the coefficient for tradeoffs between customization and standardization quality, γ, is relatively large. □

The major insight from Propositions 1 and 2 is that customer satisfaction and productivity can move in opposite directions for a profit-maximizing firm. Specifically, customer satisfaction, s^*, will decrease, and productivity, E^*, and profitability, π^*, will increase if the benefits of standardization, δ_s, increase, given the conditions described for Proposition 2. Such a shift in a firm's cost curve for standardization quality might occur if exogenous "technological" changes transpire (e.g., changes in information systems or employee education levels). When these conditions do not hold, increases in δ_s will result in increases in customer satisfaction as in Proposition 1. Hence, productivity and customer satisfaction should be compatible when standardization is relatively more important than customization (i.e., ϵ is small) and tradeoffs between the two are negligible (i.e., γ is small).

4. Development of Hypotheses

In the absence of direct measures of standardization and customization quality—and their relative importance in determining customer satisfaction—an appropriate test of the model's propositions is not obvious. As an alternative, we propose a surrogate approach classifying industries on the basis of whether customer satisfaction is primarily determined by standardization quality or customization quality, as well as whether substantial tradeoffs are expected between the two. This approach has the advantage of drawing on existing literature for support while allowing utilization of available data.

4.1. A Goods Versus Services Classification

It is less likely that there will be tradeoffs between customer satisfaction and productivity when standardization quality is relatively more important than customization quality in determining customer satisfaction, $\epsilon \approx 0$, and/or the tradeoffs between the two are negligible, $\gamma \approx 0$. We propose that manufactured goods are relatively more likely to possess these characteristics. Conversely, it is more likely that there will be tradeoffs for services. Many services are personnel intensive, customized to suit heterogeneous needs and preferences, jointly produced by both producer and customer(s), and intangible (Lovelock, Magi and Julander 1996, Shostack 1977, Gronroos 1990). These characteristics imply customization quality will be more important in determining customer satisfaction and that tradeoffs should be expected between customization and standardization.

The greater role of personnel in determining quality for many services implies that, in many cases, it will be difficult to substitute capital for labor. Thus, it may be relatively costly to standardize quality and capital investments designed to increase productivity may reduce the degree of customization quality the firm can offer.

It is often important to customize services to meet individual needs and preferences. The situational nature of many services means smaller lot sizes and greater flexibility on the part of personnel. As above, there will be fewer opportunities to improve productivity via traditional methods in labor intensive services and costs of improving both customization and standardization simultaneously will be high, $\gamma > 0$ (Baumol et al., 1989).

The inseparability of production and consumption, as well as intangibility, of services make standardization of quality more difficult and costly to improve while maintaining customization quality, $\gamma > 0$. Manufactured goods are generally more amenable to traditional methods of quality control and more likely to enjoy the cost-decreasing aspects of improved quality. The "quality is free" argument is largely based on assembly line methods for removing defects early in the production process and thereby reducing subsequent costs to the firm. When customers are involved in the process, as they are in many services, it is not as straightforward to apply these assembly line methods. Hence, as the service component of a firm's offering increases, we expect the difficulty of improving quality to increase.

4.2. Usefulness of the Goods-Services Classification in Testing Propositions 1 and 2

The proposed classification scheme has the benefit of utilizing available data, providing a first test of the model's propositions, and advancing debate as to whether a firm should emphasize both customer satisfaction and productivity. Of course, these benefits must be weighed against potential limitations. For example, many goods firms bundle a substantial service component with their offerings and services often have many characteristics that are amenable to standardization. Hence, the empirical work based on this scheme should be evaluated subject to the extent to which customer satisfaction with goods is relatively more dependent on standardization and satisfaction with services is dependent on customization.

The implications of the classification scheme are summarized in Table 1. For goods, productivity and customer satisfaction are more likely to be compatible. The association between customer satisfaction and productivity should be relatively more positive (less negative). As tradeoffs between customer satisfaction and productivity are expected for services, the observed association between the two should be relatively more negative (less positive).

In terms of profitability, customer satisfaction and productivity should both be associated with high economic returns. However, as tradeoffs between customer satisfaction and productivity are expected for services, the association between changes in customer satisfaction and productivity—the interaction—and profitability should be more negative (less positive) for services than for goods.

5. Data

To test the hypotheses, we require measures of customer satisfaction, productivity, and profits. For the first measure, we utilize annual indices of customer satisfaction made available by the Swedish Customer Satisfaction Barometer (SCSB) from 1989 to 1992. The SCSB is an ongoing project managed by the National Quality Research Center (NQRC) at the University of Michigan Business School and the Center for Studies of Quality and Productivity at the Stockholm School of Economics. The firms included in our study are all major competitors in the following industries: airlines, automobiles, banking, basic foods, charter travel, clothing retail, department stores, furniture stores, gas stations, insurance (life/auto/business), mainframe computers, PCs, newspapers, shipping, and supermarkets. The companies surveyed in each industry are

Table 1 Summary of Empirical Hypotheses

Tradeoffs Hypothesis:	The association between changes in customer satisfaction and changes in productivity should be more negative (less positive) for services than goods
Profit Hypothesis.	The association between simultaneous changes in both customer satisfaction and productivity—the interaction—and profitability should be more negative (less positive) for services than for goods

the largest share firms such that cumulative share is approximately 70%.

The SCSB begins with a computer-aided telephone survey designed to obtain a representative sample of customers for each firm. Potential respondents are selected on the basis of having recently bought or used a company's product. To participate, each respondent must pass a battery of screening questions. The questionnaire employs 10-point scales to collect multiple measures for each construct. This approach results in over 25,000 observations per variable from which annual indices are constructed. Approximately 200 observations are used to estimate each index. Fornell (1992) describes the latent variable estimation of the indices.

The SCSB measures are matched with economic returns data for publicly held firms—specifically, return on investment (ROI) and labor productivity (sales per employee) for each firm.[3]

6. Model Specification Issues

6.1. Approach to Testing the Tradeoffs Hypothesis

The hypothesis states that we should expect a positive association between customer satisfaction and productivity for goods, while the association between the two should be negative for services. To test the hypothesis, the following model will be estimated:

$$\ln \mathrm{PROD}_{it} = \alpha_{\mathrm{GOODS}} + \alpha_{\mathrm{SERVICES}} + \beta_{\mathrm{GOODS}}(1 - \mathrm{SERVICE}_i) \ln \mathrm{SAT}_{it} + \beta_{\mathrm{SERVICES}}(\mathrm{SERVICE}_i) \ln \mathrm{SAT}_{it} + \epsilon_{it} \quad (8)$$

where[4]

SAT_{it} = customer satisfaction for firm i at time t,

PROD_{it} = productivity for firm i at time t,

$\mathrm{SERVICE}_i$ = binary variable (0 = good, 1 = service),

α = constant,

β = slope coefficient,

ϵ_{it} = error term = $\eta_i + \rho\epsilon_{it-1} + u_{it}$ such that $\eta_i \sim N(\eta, \sigma_\eta^2)$.

For the tradeoffs hypothesis to be accepted, the difference between the association of satisfaction with productivity for goods and that for services should be negative and significant, $\beta_{\mathrm{GOODS}} - \beta_{\mathrm{SERVICES}} < 0$.

However, in estimating specifications such as (8) with cross-sectional, time-series data, it is necessary to control for factors that can lead to violations of the assumptions of Ordinary Least Squares (OLS). First, omitted factors correlated with both the dependent and independent variables may lead to biased estimates. In particular, η_i captures several unobserved parameters of the model (e.g., γ, λ_s, λ_c), with the exception of ϵ and δ_s. The former, ϵ, is captured by whether the firm is a service or goods firm and δ_s is part of the random error term. Serial correlation of the errors is a second potential source of bias. Finally, measurement error and random environmental shocks may create correlation between the residuals and the independent variables.

A series of methodological approaches for addressing potential sources of bias have gained wide acceptance in marketing (Jacobson 1990a, 1990b; Boulding 1990; Boulding and Staelin 1993; Erickson and Jacobson 1992). A cogent summary of these methods is provided by Boulding and Staelin (1995). Accordingly, to control for unobserved fixed effects we considered the efficacy of transforming the specification given by Equation (8) via first differences. To investigate the possibility of serial correlation, we considered quasi-first-differencing or ρ-differencing. Finally, to control for potential measurement error and random effects (e.g., contemporaneous shocks) we applied an instrumental variables approach (Reirsol 1941). Following Boulding and Staelin (1993) and Erickson and Jacobson (1992), we chose as instruments lagged values of all right-hand-side variables from periods *t-2* or *t-3* as appropriate. However, Hausman's specification test indicates that violations of OLS due to measurement errors in the variables are not a significant concern ($H = 0.449$). Hence, the findings presented below control for fixed effects via first-differencing and serial correlation via ρ-differencing. After following these

[3]The financial data for the firms were collected with the aid of a grant from the Marketing Science Institute.

[4]Given the large dispersion in productivity numbers, natural logarithms are taken of the variables.

the largest share firms such that cumulative share is approximately 70%.

The SCSB begins with a computer-aided telephone survey designed to obtain a representative sample of customers for each firm. Potential respondents are selected on the basis of having recently bought or used a company's product. To participate, each respondent must pass a battery of screening questions. The questionnaire employs 10-point scales to collect multiple measures for each construct. This approach results in over 25,000 observations per variable from which annual indices are constructed. Approximately 200 observations are used to estimate each index. Fornell (1992) describes the latent variable estimation of the indices.

The SCSB measures are matched with economic returns data for publicly held firms—specifically, return on investment (ROI) and labor productivity (sales per employee) for each firm.[3]

6. Model Specification Issues

6.1. Approach to Testing the Tradeoffs Hypothesis

The hypothesis states that we should expect a positive association between customer satisfaction and productivity for goods, while the association between the two should be negative for services. To test the hypothesis, the following model will be estimated:

$$\ln \text{PROD}_{it} = \alpha_{\text{GOODS}} + \alpha_{\text{SERVICES}} + \beta_{\text{GOODS}}(1 - \text{SERVICE}_i) \ln \text{SAT}_{it} + \beta_{\text{SERVICES}}(\text{SERVICE}_i) \ln \text{SAT}_{it} + \epsilon_{it} \quad (8)$$

where[4]

SAT_{it} = customer satisfaction for firm i at time t,

PROD_{it} = productivity for firm i at time t,

SERVICE_i = binary variable (0 = good, 1 = service),

α = constant,

β = slope coefficient,

ϵ_{it} = error term = $\eta_i + \rho\epsilon_{it-1} + u_{it}$ such that $\eta_i \sim N(\eta, \sigma_\eta^2)$.

For the tradeoffs hypothesis to be accepted, the difference between the association of satisfaction with productivity for goods and that for services should be negative and significant, $\beta_{\text{GOODS}} - \beta_{\text{SERVICES}} < 0$.

However, in estimating specifications such as (8) with cross-sectional, time-series data, it is necessary to control for factors that can lead to violations of the assumptions of Ordinary Least Squares (OLS). First, omitted factors correlated with both the dependent and independent variables may lead to biased estimates. In particular, η_i captures several unobserved parameters of the model (e.g., γ, λ_s, λ_c), with the exception of ϵ and δ_s. The former, ϵ, is captured by whether the firm is a service or goods firm and δ_s is part of the random error term. Serial correlation of the errors is a second potential source of bias. Finally, measurement error and random environmental shocks may create correlation between the residuals and the independent variables.

A series of methodological approaches for addressing potential sources of bias have gained wide acceptance in marketing (Jacobson 1990a, 1990b; Boulding 1990; Boulding and Staelin 1993; Erickson and Jacobson 1992). A cogent summary of these methods is provided by Boulding and Staelin (1995). Accordingly, to control for unobserved fixed effects we considered the efficacy of transforming the specification given by Equation (8) via first differences. To investigate the possibility of serial correlation, we considered quasi-first-differencing or ρ-differencing. Finally, to control for potential measurement error and random effects (e.g., contemporaneous shocks) we applied an instrumental variables approach (Reirsol 1941). Following Boulding and Staelin (1993) and Erickson and Jacobson (1992), we chose as instruments lagged values of all right-hand-side variables from periods *t-2* or *t-3* as appropriate. However, Hausman's specification test indicates that violations of OLS due to measurement errors in the variables are not a significant concern ($H = 0.449$). Hence, the findings presented below control for fixed effects via first-differencing and serial correlation via ρ-differencing. After following these

[3]The financial data for the firms were collected with the aid of a grant from the Marketing Science Institute.

[4]Given the large dispersion in productivity numbers, natural logarithms are taken of the variables.

steps, the final number of usable observations for this analysis is 170.

6.2. Approach to Testing the Profitability Hypothesis

A useful approach to testing the second hypothesis, the profitability hypothesis, is to include an interaction effect between customer satisfaction and productivity, as well as their respective main effects, in a profitability equation. For all firms, the direct association of both variables with ROI is expected be positive. In the case of services, however, we expect the interaction between the two to be more negative (less positive) in its association with ROI.

The preceding discussion leads to the following translog specification for the base model, against which the appropriateness of allowing different parameters for goods and services will be tested:

$$\ln ROI_{it} = \beta_0 + \beta_{SAT} \ln SAT_{it} + \beta_{PROD} \ln PROD_{it} + \beta_{SAT \times PROD} \ln SAT_{it} \ln PROD_{it} + \epsilon_{it} \quad (9)$$

where

ROI_{it} = return on investment for firm i at time t,

SAT_{it} = customer satisfaction for firm i at time t,

$PROD_{it}$ = productivity for firm i at time t,

β_0 = constant,

$\beta_{variable\ name}$ = coefficient for variable,

ϵ_{it} = error term = $\eta_i + \rho\epsilon_{it-1} + u_{it}$ such that $\eta_i \sim N(\eta, \sigma_\eta^2)$.

As before, violations of the assumptions of OLS were considered. Once again, both first-differencing and ρ-differencing are employed. As in the case of Equation (8), Hausman's specification test indicates that violations of OLS due to measurement errors in the variables are not a significant concern in estimating Equation (9). The number of usable observations following these steps is 126.[5]

[5]Given the estimation procedure, deleting observations with missing values reduces the dataset by multiple observations for each missing value (e.g., if four rounds of data are required to estimate the model, four observations are lost for every missing value of ROI).

7. Findings

7.1. Testing the Tradeoffs Hypothesis

Estimation of Equation (8), after first-differencing and ρ-differencing for the reasons detailed above, yields the results summarized in Table 2. As shown, the association between satisfaction and productivity for goods is positive and significant at 0.94 (the standardized coefficient is 0.15). The association between satisfaction and productivity for services is negative and significant at -10.81 (the standardized coefficient is -0.30). The tradeoffs hypothesis, which states that the association for services should be significantly less positive, cannot be rejected as the difference in the slopes for goods versus services, -11.75 ($= 0.94 - 10.81$), is negative and significant ($t = -4.35, p < 0.01$). Hence, not only is the association between customer satisfaction and productivity less positive for services, but the association is actually significant and positive for goods, and significant and negative for services. This finding implies that services exhibit "tradeoffs," while goods do not, given that increases (decreases) in customer satisfaction are associated with decreases (increases) in productivity for services.

7.2. Testing the Profitability Hypothesis

Table 3 summarizes the estimation results pertaining to the profitability hypothesis.

The first column presents the "base" specification estimates, the second column allows for differential effects of goods and services, and the third column includes the hypothesized interaction term. In addition

Table 2 **Testing the Tradeoffs Hypothesis: Estimation of Equation (8)**

Independent Variable Coefficient	Estimate (Standard Error)
$\hat{\beta}_{GOODS}$	0.94*
	(0.43)
$\hat{\beta}_{SERVICES}$	−10.81*
	(2.42)
ρ	−0.09
R^2	0.22

Notes: i) Dependent variable is productivity; ii) $n = 170$; iii) indicates $p < 0.10$; iv) ρ is the first-order autocorrelation (estimated via Hildreth-Lu).

Table 3 Summary of Estimation Results for Profitability Hypothesis

Coefficient	(Specification 1) Base Specification—Equation (9) All	(Specification 2) Differential Slope Effects for Goods Versus Services: Goods	Services	(Specification 3) Differential Interaction Effects for Goods Versus Services: Goods	Services
$\hat{\beta}_{SAT}$	0.17*	0.13	0.24*	0.19*	
	(0.09)	(0.12)	(0.14)	(0.10)	
$\hat{\beta}_{PROD}$	0.08*	0.08*	0.10*	0.09*	
	(0.02)	(0.04)	(0.05)	(0.02)	
$\hat{\beta}_{PROD \times SAT}$	−0.49	−0.40		1.45*	−1.07
	(0.70)	(0.73)		(0.88)	(1.39)
ρ	−0.39	−0.45		−0.45	
R^2	0.12	0.13		0.15	
$F_{r,n-k}$		0.70		4.28*	

Notes: $n = 126$; *indicates $p < 0.10$; the standard deviations are in parentheses; ρ is the first-order autocorrelation (estimated via Hildreth-Lu); $F_{r,n-k}$ is the Chow test of an unrestricted (current column) versus the base specification (column 1) specification with r restrictions.

to the coefficients and their associated standard errors, the table provides an estimate of the first-order autocorrelation, ρ, the R^2, and a restricted-unrestricted F test (Chow test) to assess each specification against the base specification in the first column.

The specification allowing for differential effects for goods and services is not found to be a significant improvement over the base specification ($F = 0.70$). Hence, we do not show separate main effects for customer satisfaction and productivity in column 3 (estimation of the "full" or "saturated" model produces an identical substantive result). The specification with the hypothesized interaction term (Specification 3) is found, however, to be a significant improvement over the base specification (Specification 1), $F = 4.28$.

In the final specification, presented in column 3, the coefficient for the direct association between customer satisfaction and ROI is found to be positive and significant at 0.19. The coefficient for the direct association between productivity and ROI is also found to be positive and significant at 0.09. The interaction between customer satisfaction and productivity is found to be positive and significant for goods at 1.45, yet negative and insignificant for services at −1.07. The difference between the two coefficients is significant at the 0.01 level. Hence, simultaneous changes in both customer satisfaction and productivity are significant and positively associated with economic returns for goods, while the association is significantly less positive for services. In fact, the interaction for services is negative, albeit slightly insignificant (p value of 0.2), implying that the overall relationship is concave downwards. Taken together with the findings of the first test, this suggests support for the argument that tradeoffs are more likely for services than goods.

To see what this might mean for different types of firms, consider that the marginal impact or "average elasticity" of ROI with respect to satisfaction for goods is $\beta_{SAT} + \beta_{SAT \times PROD}$ (Average Productivity) $= 0.19 + 1.45(0.05) = 0.265$, yet only 0.14 ($= 0.19 - 1.07(0.05)$) for services. Similarly, the elasticity of ROI with respect to productivity for goods is $\beta_{SAT} + \beta_{SAT \times PROD}$ (Average Satisfaction) $= 0.09 + 1.45(0.007) = 0.10$ and 0.08 ($= 0.09 - 1.07(0.007)$) for services. Accordingly, a simultaneous 1% increase in both customer satisfaction and productivity should be associated with an increase of 0.365% in ROI for goods, but only a 0.22% increase for services.

8. Discussion

As a means of illustrating the importance of understanding the association between productivity and customer satisfaction, it is instructive to ask: In which industries do firms with the greatest economic returns also exhibit high productivity, high satisfaction, or both simultaneously? To gain insight into this question, we partition each industry into high/low satisfaction and high/low productivity firms based on a firm's relation to the industry median for each measure in a given year. We then calculate the average ROI for firms in each of the four resulting partitions. Figure 2 shows the strategy combination for which average ROI is highest.

The firms in the cell with high customer satisfaction and high productivity that exhibit higher than average (for their industry) ROI come from goods industries such as automobiles, basic foods, mainframe computers, and PCs. This quadrant also contains clothing

Figure 2 Strategy Combination That Earned the Greatest Average ROI for Firms in Different Industries

	High Productivity	Low Productivity
High Customer Satisfaction	*Automobiles, Basic Foods, Personal Computers, Mainframe Computers, Clothing Stores, Mail Order, Insurance*	*Airlines, Banks, Charter Travel, Furniture Stores, Shipping*
Low Customer Satisfaction	*Department Stores, Gas Stations, Newspapers*	*Supermarkets*

stores and mail order, both of which are a mixture of goods and service and both have gained from increased automation. Insurance is an interesting anomaly, until one realizes that productivity in insurance is measured by total assets relative to the number of employees rather than current sales. In light of this situation, it seems reasonable that the highest asset insurance companies would be those best at satisfying and, therefore, retaining their customers.

It is worth emphasizing that it is only for industries in this top-left quadrant that the firms with the highest returns are also found to exhibit the very highest levels of both productivity and customer satisfaction in their industry. In all other cases, the highest levels of productivity and customer satisfaction in a given industry are found in off-diagonal cells. This suggests further support for the notion that these "off-diagonal" industries are ones in which it is difficult—or undesirable—to achieve superiority in both satisfaction and productivity.

For the "purer" services—such as airlines, banks, charter travel, and shipping—the highest ROI firms exhibit relatively high customer satisfaction, but relatively low productivity. High relative productivity and low relative customer satisfaction are associated with high economic returns for firms competing in department stores, gas stations, and newspapers. It is interesting that two of these latter industries are retailers, and all share a common characteristic in that they each face limited competition due to the importance of location. Perhaps, for these services, customization provides fewer benefits to the firm relative to standardization.

The supermarket category is the only instance in which firms earning the highest returns actually have lower levels of productivity and customer satisfaction. We regard this particular case as an anomalous occurrence due to an artifact. In this highly concentrated industry, one particular firm has a strong location advantage mixed with substantial political appeal, giving it a degree of monopoly power that allows it to earn high profits. At the same time, one of the remaining two firms experienced financial difficulties in two of the four years spanned by the study. In the other two years, the high satisfaction, high productivity quadrant was associated with the highest returns for this industry.

Although it is fundamentally descriptive, Figure 2 also has a normative flavor that should be noted. The pattern of industries suggests that customer satisfaction and productivity may only be compatible for industries with a substantial goods component. In terms of the dual nature of quality, these would be industries in which customer satisfaction is highly dependent on standardization quality. In other industries, where customer satisfaction is more dependent on dimensions of quality that are more difficult to standardize, or must be customized, firms may be more successful by focusing on customer satisfaction. The theoretical framework suggests that, even if customization is relatively more important, profit-maximizing firms may choose to offer relatively low customer satisfaction—via offering low customization quality—and exhibit relatively high productivity, if the cost implications of allocating effort to standardization quality are relatively attractive.

In addition, the nature of the industries in the bottom half of the diagram suggests that pursuing productivity may possibly require some degree of monopoly protection. In the case of department stores and gas stations this may come from location. This is consistent with the notion that customer satisfaction is less important when there are significant switching barriers (Fornell 1992). When switching barriers are less significant, it becomes more important to defend current customers through customer satisfaction.

9. Summary and Conclusions

Although there is widespread belief that firms should be superior on both customer satisfaction and productivity, it may be more difficult to pursue both simultaneously when it is important to customize market offerings to better meet customers' needs. The findings presented here suggest that this may be particularly true for industries in which service by personnel plays an important role. As services have come to dominate the world's developed economies, such tradeoffs require greater understanding—especially as the trend toward services shows no signs of abating (Shugan 1993).

While the empirical work considers differences between goods and services, it is important to recognize the role of the dual nature of quality—standardization versus customization—in determining whether there will be tradeoffs in any given industry. The analytical portion of the study suggests that customer satisfaction and productivity are less likely to be compatible when: (1) customer satisfaction is relatively more dependent on customization as opposed to standardization; and (2) when it is difficult (costly) to provide high levels of both customization and standardization simultaneously. If such tradeoffs are driven by differences in the importance of customization and standardization, future research may wish to overcome the coarse categorization procedure of the current study and find more direct measures of standardization and customization quality to test the analytical framework's implications.

Of course, the preceding does not imply that firms should *never* seek opportunities that lead to improvements in both productivity and customer satisfaction. Rather, it is important to consider the risks and costs involved and the interrelationship between the two, particularly as the importance of services and customer relationships grows. Superiority in both will likely be achieved through the application of a single process to produce a broader variety of products meeting a wide variety of customer needs. For example, appropriate applications of information technology (Pine et al. 1993, Bessen 1993) may help a firm to become both more productive and more effective in satisfying its customers. Information technology may allow a firm to offer services for the bulk of its customers that are amenable to standardization, but provide a more customized approach to those who self-select into it (e.g., ATM banking versus working directly with the bank's employees, automated airline arrival/departure information versus use of an airline representative or agent). Accounting for the impact of technology on the ability to improve both customization and standardization quality appears to be an interesting direction for future research.

Future research may also wish to examine alternative measures of financial performance. A particularly promising approach is Tobin's q, the ratio of market value to the book value or replacement cost of the firm's tangible assets. Tobin's q has the advantage of imputing equilibrium returns based on all information available to the capital market. Although the capital market in Sweden is not large enough to pursue this approach, a study of this nature will be possible in the near future using U.S. capital market information and customer satisfaction measurements currently being collected. One question of particular interest that could be broached using Tobin's q is whether customer satisfaction is associated with persistent returns or Ricardian Rents. Persistent returns might accrue to the firm if it owns resources difficult to imitate—or resources for which imitation is uncertain (e.g., when firm's possess asymmetric information about the underlying relationships)—that are instrumental in providing customer satisfaction. Examples of such resources might include superior management, personnel processes, reputable brand names, attractively located land, proprietary knowledge or skills, and patent protection (Lippman and Rumelt 1982, Montgomery and Wernerfelt 1988, Simon and Sullivan 1993). As persistence of earnings has been observed in many industries (Lipe and Kormendi 1987), customer satisfaction measures may prove useful in tracing the source(s) of observed persistence back to such inimitable resources. Firms that are successful in increasing customer satisfaction may do so as a result of building distinctive advantages in resources.

Finally, it is worth emphasizing that while the issue of tradeoffs between customer satisfaction and productivity is important today, it is expected to become even more important in the future. The growth in services over the past few decades is expected to continue

(Shugan 1993). The implication is that more business transactions involve long-term relationships that depend on satisfying customers, often by customizing the firm's market offering, in order to retain them. A related reason is the increasing role of customer satisfaction as a corporate strategy (Fornell 1992). In most developed countries, firms face slowing growth, mature markets, and increasing foreign competition. This makes customers an increasingly scarce resource pursued by an increasingly large number of aggressive suppliers. As cost structures make price competition difficult for many firms, pursuing customer satisfaction—reducing price elasticities and retaining current customers—is becoming an increasingly attractive alternative. To survive, firms must offer greater customization through differentiating products and fine-tuning segmentation. And, as the importance of customer satisfaction continues to grow, situations in which there is conflict between customer satisfaction and productivity are likely to become increasingly common.[6]

Appendix

Profit Function

$$\pi = \alpha[(1 - \epsilon)\phi_s + \epsilon\phi_c]p^{-\beta}[p - c] - \left[-\delta\phi_s + \frac{\lambda_s\phi_s^2}{2} + \frac{\lambda_c\phi_c^2}{2} = \gamma\phi_s\phi_c\right],$$

α = constant,

ϵ = relative importance of customization quality, ϵ (0,1),

ϕ_s = level of standardization quality, $\phi_s > 0$,

ϕ_c = level of customization quality, $\phi_c > 0$,

β = price elasticity, $\beta > 1$,

[6]The authors gratefully acknowledge the data provided through the funding of the Swedish Post and the Marketing Science Institute, as well as the research support provided by the National Quality Research Center at the University of Michigan Business School, the International Center for Studies of Quality and Productivity at the Stockholm School of Economics, and the Center for Service Marketing and the Dean's Fund for Faculty Research at the Owen Graduate School at Vanderbilt University. This paper has benefited substantially from the helpful suggestions of the Editor, Area Editor, and two anonymous reviewers. The authors would also like to thank Jaesung Cha, Lenard Huff, and Jay Sinha for their help in assembling the dataset.

p = price,

c = constant variable costs, $c > 0$,

δ_s = linear effect of standardization quality levels on costs, $\delta_s > 0$,

λ_s = rate of acceleration in costs for standardization quality, $\lambda_s > 0$,

λ_c = rate of acceleration in costs for customization quality, $\lambda_c > 0$,

γ = tradeoffs coefficient, $-\infty < \gamma < \infty$.

First-Order Conditions

$$\frac{d\pi}{dp} = -\beta\alpha[(1 - \epsilon)\phi_s + \epsilon\phi_c]p^{\beta-1}[p - c] + \alpha[(1 - \epsilon)\phi_s + \epsilon\phi_c]p^{-\beta}[p - c] = 0,$$

$$\frac{d\pi}{d\phi_s} = (1 - \epsilon)\alpha p^{-\beta}[p - c] + \delta_s - \lambda_s\phi_s - \gamma\phi_c = 0,$$

$$\frac{d\pi}{d\phi_c} = \epsilon\alpha p^{-\beta}[p - c] - \lambda_c\phi_c - \gamma\phi_s = 0.$$

Solving the above for p^*, ϕ_s^* and ϕ_c^* yields expressions shown as Equations (4)–(6).

Second-Order Conditions

The determinant of the Hessian matrix is negative,

$$|H| = \begin{vmatrix} -(\beta - 1)\alpha[(1 - \epsilon)\phi_s^* + \epsilon\phi_c^*]p^{*\beta-1} & 0 & 0 \\ 0 & -\lambda_s & -\gamma \\ 0 & -\gamma & -\lambda_c \end{vmatrix}$$

$$= -(\lambda_s\lambda_c - \gamma^2)(\beta - 1)\alpha[(1 - \epsilon)\phi_s^* + \epsilon\phi_c^*]p^{*\beta-1} < 0$$

given $\lambda_s > 0$, $\lambda_c > 0$, $\lambda_s\lambda_c - \gamma^2 > 0$, and $\beta > 1$ Under these same conditions, the first principal minors are negative, the second principal minors are positive, and, consequently, the Hessian is negative definite.

Proof of Propositions

Proof is obtained through the construction of examples. The objective is to show that optimal levels of productivity, E^*, and profitability, π^*, are increasing everywhere as the benefits of standardization, δ_s, increase ($d\pi^*/d\delta_s > 0$ & $dE^*/d\delta_s > 0$), whereas changes in the optimal level of satisfaction depend on the relative size of the model parameters: ϵ, γ, and $\lambda_s\lambda_c/\gamma^2$.

To this end, we differentiate satisfaction with respect to the "benefits of standardization," δ_s, yielding:

$$\frac{\partial s^*}{\partial \delta_s} = \frac{\lambda_c(1 - \epsilon) - \gamma\epsilon}{\lambda_s\lambda_c - \gamma^2}.$$

Hence, as the cost benefits of standardization increase, $\delta_s\uparrow$, customer satisfaction decreases if the marginal impact of customization quality on customer satisfaction is large (e.g., $\varepsilon \to 1$), the "tradeoffs coefficient" is positive, $\gamma > 0$, and large relative to the cost or "difficulty" of increasing customization, λ_c. Conversely, if the relative importance of customization is low (e.g., $\varepsilon \to 0$), then customer satisfaction is increasing.

At the same time, productivity will be higher as the benefits of standardization increase:

$$\frac{\partial E^*}{\partial \delta_s} = \frac{1}{[D^*c + FC^*]^2}\left\{\frac{\alpha p^{*-\beta+1}[\lambda_c(1-\epsilon) - \lambda\epsilon]}{\lambda_s\lambda_c - \gamma^2}(D^*c + FC^*) - \left[\frac{\alpha p^{*-\beta}[\lambda_c(1-\epsilon) - \gamma\epsilon]c - \delta_s\lambda_c}{\lambda_s\lambda_c - \gamma^2}\right][D^*p]\right\}$$

$$= \frac{\alpha p^{*-\beta+1}}{[D^*c + FC^*]^2}\left\{\frac{\lambda_c(1-\epsilon) - \gamma\epsilon}{\lambda_s\lambda_c - \gamma^2}FC^* + \left[\frac{\delta_s\lambda_c}{\lambda_s\lambda_c - \gamma^2}\right][(1-\epsilon)\phi_s^* + \epsilon\phi_c^*]\right\}$$

$$= \frac{\alpha p^{*-\beta+1}}{2[D^*c + FC^*]^2}\left\{\phi_s^*\left(2FC^* + \delta_s\left[\frac{\delta_s\lambda_c}{\lambda_s\lambda_c - \gamma^2}\right]\right) + \left[\frac{\delta_s\lambda_c}{\lambda_s\lambda_c - \gamma^2}\right][(1-\epsilon)\phi_s^* + \epsilon\phi_c^*]\right\} > 0.$$

The above inequality will hold given all second-order conditions are met and both demand, D^*, and fixed costs, FC^*, are greater than zero

Finally, profitability increases everywhere as the benefits of standardization increase:

$$\frac{\partial \pi^*}{\partial \delta_s} = \frac{\alpha p^{*-\beta}(p^* - c)[\lambda_c(1-\epsilon) - \gamma\epsilon] + \delta_s\lambda_c}{\lambda_c\lambda_s - \gamma^2} = \phi_s^* > 0.$$

Derivation of Elasticities

The model is a translog function of the following form:

$$\ln y = \alpha + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3(\ln x_1)(\ln x_2),$$

which, applying the exponential function yields:

$$y = e^{\alpha + \beta_1\ln x_1 + \beta_2\ln x_2 + \beta_3(\ln x_1)(\ln x_2)} \quad \text{(or)}\ y = e^{\alpha}x_1^{\beta_1}x_2^{\beta_2}[x_1 + x_2]^{\beta_3}).$$

The elasticity of y with respect to x_1 is then:

$$\eta_{y\ x_1} = \frac{dy}{dx_1}\frac{x_1}{y} = \left[\left(\frac{\beta_1}{x_1} + \frac{\beta_3 \ln x_2}{x_1}\right)e^{\alpha + \beta_1\ln x_1 + \beta_2\ln x_2 + \beta_3(\ln x_1)(\ln x_2)}\right]\frac{x_1}{y}$$
$$= \beta_1 + \beta_3 \ln x_2.$$

Replacing y with ROI and the x's with satisfaction and productivity, we can use the same approach to determine the elasticity of ROI with respect to satisfaction (or productivity) yielding:

$$\eta_{\text{ROI SAT}} = \beta_{\text{SAT}} + \beta_{\text{SAT}\times\text{PROD}} \ln(\text{PROD}),$$

$$\eta_{\text{ROI PROD}} = \beta_{\text{PROD}} + \beta_{\text{SAT}\times\text{PROD}} \ln(\text{SAT}).$$

References

Aaker, David A. and Robert Jacobson (1994), "The Financial Information Content of Perceived Quality," *Journal of Marketing Research,* 31, August, 191–201.

Anderson, Eugene W. (1994), "Customer Satisfaction and Word-of-Mouth," Working Paper, National Quality Research Center, University of Michigan Business School, Ann Arbor, MI.

—— (1996), "Customer Satisfaction and Price Tolerance," *Marketing Letters,* 7, 3 (July), 19–30.

——, Claes Fornell, and Donald R. Lehmann (1994), "Customer Satisfaction, Market Share, and Profitability," *Journal of Marketing,* 56, July, 53–66.

—— and Mary Sullivan (1993), "The Antecedents and Consequences of Customer Satisfaction for Firms," *Marketing Science,* 12, 2, 125–143.

Baumol, William J., S. A. Batey Blackman, and E. W. Wolff (1989), *Productivity Growth and American Leadership: The Long View,* Cambridge, MA: MIT Press.

Bearden, William O. and Jesse E. Teel (1983), "Selected Determinants of Consumer Satisfaction and Complaint Reports," *Journal of Marketing Research,* 20, February, 21–28.

Bessen, Jim (1993), "Riding the Market Information Wave," *Harvard Business Review,* 71, 5, 151–160.

Bolton, Ruth N. and James H. Drew (1991), "A Multistage Model of Customers' Assessments of Service Quality and Value," *Journal of Consumer Research,* 17, March, 375–384.

Boulding, William (1990), "Commentary On 'Unobservable Effects and Business Performance: Do Fixed Effects Really Matter?'," *Marketing Science,* 9, Winter, 88–91.

——, Ajay Kalra, Richard Staelin, and Valarie Zeithaml (1993), "A Dynamic Process Model of Service Quality: From Expectations to Behavioral Intentions," *Journal of Marketing Research,* 30, February, 7–27.

—— and Richard Staelin (1993), "A Look on the Cost Side: Market Share and Competitive Environment," *Marketing Science,* 12, Spring, 144–166.

—— and —— (1995), "Identifying Generalizable Effects of Strategic Actions on Firm Performance: The Case of Demand-Side Returns to R&D Spending," *Marketing Science,* 14, 3, G222–G236.

Buzzell, Robert D. and Bradley T. Gale (1987), *The PIMS Principles,* New York: The Free Press.

Capon, Noel, John U. Farley, and Scott Hoenig (1990), "Determinants of Financial Performance: A Meta-Analysis," *Management Science,* 36, October, 1143–59.

Crosby, P. B. (1979), *Quality Is Free,* New York: McGraw-Hill.

Deming, W. E. (1982), *Quality, Productivity, and Competitive Position,* Cambridge, MA: MIT Center for Advanced Engineering Study.

Erickson, Gary and Robert Jacobson (1992), "Gaining Comparative Advantage Through Discretionary Expenditures: Returns to R&D and Advertising," *Management Science,* 38, 9, 1264–1279.

Fornell, Claes (1992), "A National Customer Satisfaction Barometer: The Swedish Experience," *Journal of Marketing,* January, 1–21.

—— and Birger Wernerfelt (1988), "A Model for Customer Complaint Management," *Marketing Science,* 7, Summer, 271–286.

——, Michael D. Johnson, Eugene W. Anderson, Jaesung Cha, and Barbara Bryant (1996), "The American Customer Satisfaction

Index: Description, Findings, and Implications," *Journal of Marketing*, 60, 4 October, 7–18.

Garvin, David A. (1988), *Managing Quality: The Strategic and Competitive Edge*, New York: The Free Press.

Gilly, Mary C. and Betsy D. Gelb (1982), "Post-Purchase Consumer Standardizations and the Complaining Consumer," *Journal of Consumer Research*, 9, December, 323–328.

Griliches, Zvi (1971), *Price Indices and Quality Change*, Cambridge, MA: Harvard University Press.

—— and D. W. Jorgenson (1967), "The Explanation of Productivity Change," *Review of Economic Studies*, 34, 249–283.

Gronroos, Christian (1990), *Service Management and Marketing: Managing the Moments of Truth in Service Competition*, Lexington, MA: Lexington Books.

Hauser, John R., Duncan I. Simester, and Birger Wernerfelt (1995), "Customer Satisfaction Based Incentive Systems," *Marketing Science*, 13, 4, 327–350.

Huff, Lenard, Claes Fornell, and Eugene W. Anderson (1996), "Quality and Productivity: Contradictory and Complementary," *Quality Management Journal*, 4, 1, 22–39.

Jacobson, Robert D. (1990a), "Unobservable Effects and Business Performance," *Marketing Science*, 9, Winter, 74–85.

—— (1990b), " 'Unobservable Effects and Business Performance,' Reply to Comments of Boulding and Buzzell," *Marketing Science*, 9, Winter, 92–95.

—— and David A. Aaker (1987), "The Strategic Role of Product Quality," *Journal of Marketing*, 51, October, 31–44.

Johnson, Michael D. and Claes Fornell (1991), "A Framework for Comparing Customer Satisfaction Across Individuals and Product Categories," *Journal of Economic Psychology*, 12, 2, 267–286.

Juran, J. M. (1988), *Juran's Quality Control Handbook*, 4th ed., New York: McGraw Hill.

Kaplan, Robert S. and David P. Norton (1992), "The Balanced Scorecard—Measures That Drive Performance," *Harvard Business Review*, 70, January-February, 71–79.

Kendrick, John W. and Elliot S. Grossman (1980), *Productivity in the United States. Trends and Cycles*, Baltimore, MD: The Johns Hopkins University Press.

LaBarbera, Priscilla A. and D. Mazursky (1983), "A Longitudinal Assessment of Consumer Satisfaction/Dissatisfaction: The Dynamic Aspect of the Cognitive Standardization," *Journal of Marketing Research*, 20, November, 393–404.

Lancaster, Kelvin (1979), *Variety, Equity, and Efficiency*, New York: Columbia University Press.

Lipe, Robert and Roger Kormendi (1987), "Earnings Innovations, Earnings Persistence, and Stock Returns," *Journal of Business*, 60, July, 323–345.

Lippman, S. A. and R. P. Rumelt (1982), "Uncertain Imitability: An Analysis of Interfirm Differences Under Competition," *Bell Journal of Economics*, 13, 418–438.

Lovelock, Christopher H. (1983), "Classifying Services to Gain Strategic Marketing Insights," *Journal of Marketing*, 47, Summer, 9–20.

Magi, Anne and Claes-Robert Julander (1996), "Perceived Service Quality and Customer Satisfaction in a Store Performance Framework: An Empirical Study of Swedish Grocery Retailers," *Journal of Retailing and Consumer Services*, 3, 1, 33–41.

Montgomery, Cynthia A. and Birger Wernerfelt (1988), "Diversification, Ricardian Rents, and Tobin's *q*," *RAND Journal of Economics*, 19, Winter, 623–632.

Nelson, Eugene, Roland T. Rust, Anthony J. Zahorik, Robin L. Rose, Paul Batalden, and Beth A. Siemanski (1992), "Do Patient Perceptions of Quality Relate to Hospital Financial Performance," *Journal of Health Care Marketing*, 13, December, 1–13.

Oliver, Richard L. (1980), "A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions," *Journal of Marketing Research*, 17, November, 460–469.

—— and John E. Swan (1989), "Consumer Perceptions of Interpersonal Equity and Satisfaction in Transactions: A Field Survey Approach," *Journal of Marketing*, 53, April, 21–35.

Parasuraman, A , Valarie Zeithaml, and Leonard Berry (1985), "A Conceptual Model of Service Quality and Its Implications for Future Research," *Journal of Marketing*, 49, Fall, 41–50.

Phillips, Lynn W., Dae Chang, and Robert D. Buzzell (1983), "Product Quality, Cost Position, and Business Performance: A Test of Some Key Hypotheses," *Journal of Marketing*, 47, Spring, 26–43.

Pine, B. Joseph, Bart Victor, and Andrew C. Boynton (1993), "Making Mass Customization Work," *Harvard Business Review*, 71, 5, 109–119.

Reichheld, Fredrick F., and W. Earl Sasser (1990), "Zero Defections: Quality Comes To Services," *Harvard Business Review*, 68, September-October, 105–111.

Reirsol, O. (1941), "Confluence Analysis by Means of Lag Moments and Other Methods of Confluence Analysis," *Econometricia*, 17, June, 1–24.

Ricardo, David (1817), *On the Principles of Political Economy and Taxation*, P. Sraffa (Ed.), Cambridge: University Press.

Rust, Roland T., and Anthony. J. Zahorik (1993), "Customer Satisfaction, Customer Retention, and Market Share," *Journal of Retailing*, 69, Summer, 145–156.

——, and Timothy L. Keiningham (1994), *Return on Quality: Measuring the Financial Impact of Your Company's Quest for Quality*, Chicago, IL: Probus.

—— (1995), "Return on Quality (ROQ): Making Service Quality Financially Accountable," *Journal of Marketing*, 59, April, 58–70.

Shostack, G. Lynn (1977), "Breaking Free from Product Marketing," *Journal of Marketing*, 41, April, 73–80.

Shugan, Steven M. (1989), "Product Assortment in a Triopoly," *Management Science*, 35, 3, 304–320.

—— (1993), "Explanations for the Growth of Services," in *Service Quality: New Directions in Theory and Practice*, Richard L. Oliver and Roland T. Rust (Eds.), Newbury Park, CA, Sage: 223–240

Simon, Carol J. and Mary W. Sullivan (1993), "The Measurement and Determinants of Brand Equity: A Financial Approach," *Marketing Science*, 12, 1, 28–52.

Solow, Robert M. (1957), "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics,* 39, 312–320.

Smith, Adam (1776), *The Wealth of Nations,* New York: Random House.

Stigler, George J. (1942), *The Theory of Price,* New York: Macmillan.

TARP/Technical Assistance Research Program (1979), *Consumer Complaint Handling in America: An Update Study,* Washington, DC: White House Office of Consumer Affairs.

—— (1981), *Measuring the Grapevine: Consumer Response and Word-of-Mouth,* Atlanta, GA: The Coca-Cola Co.

Yi, Youjac (1991), "A Critical Review of Customer Satisfaction," in *Review of Marketing 1989,* Valarie A. Zeithmal (Ed.), Chicago, IL: American Marketing Association.

This paper was received July 29, 1994, *and has been with the authors* 20 *months for* 3 *revisions; processed by Robert J. Meyer.*