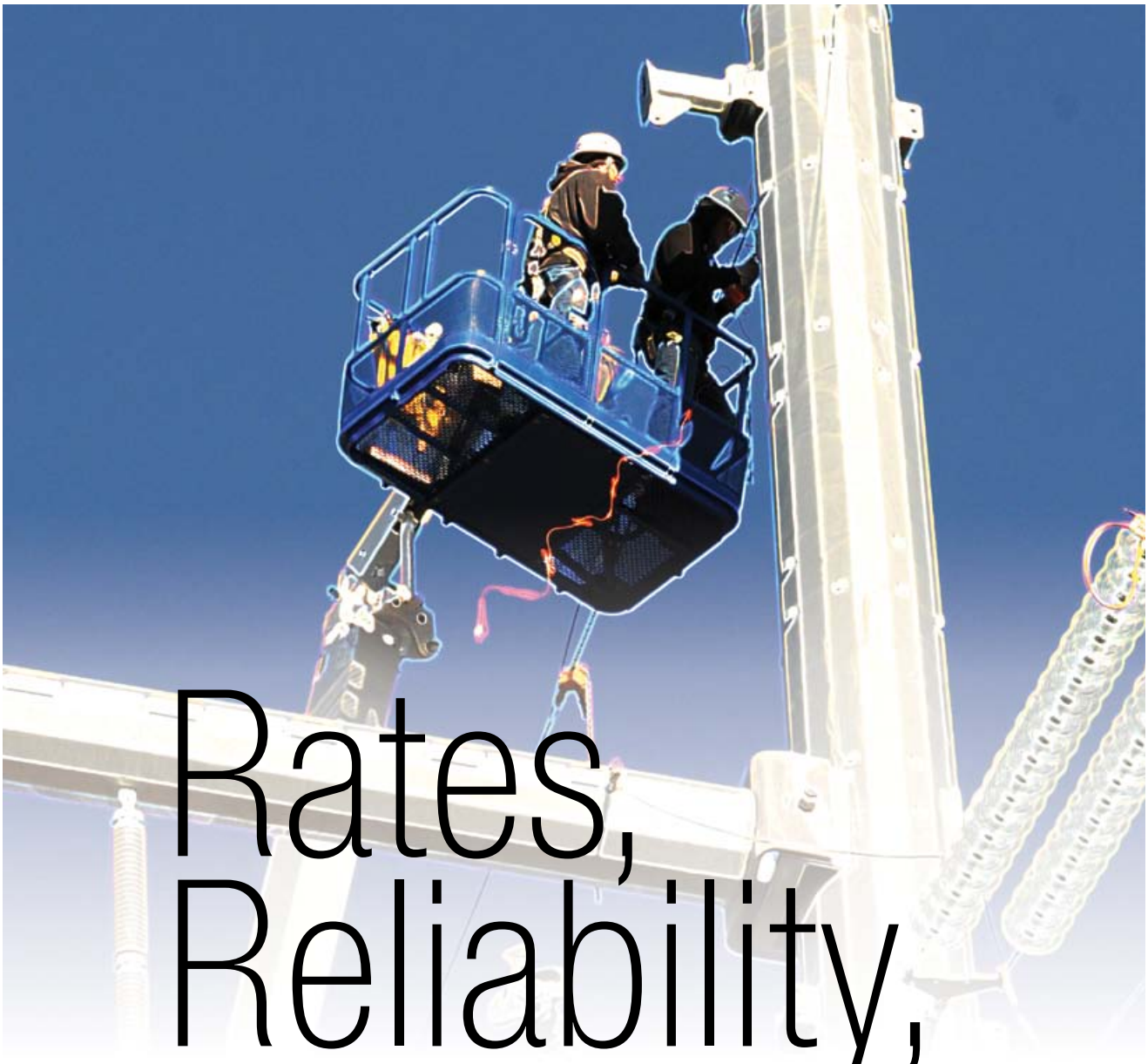

Rates, Reliability, and Region

Customer satisfaction and electric utilities.

By William P. Zarakas, Philip Q Hanser, and Kent Diep

It's no surprise that customer satisfaction is increasingly important to retail electric utilities. Satisfying customers was important during the old days of utility regulation, when utility customers had little if any choice concerning their electricity supplier. It's even more important today, when customers can invest in equipment to bypass the grid in whole or in part, and it will inevitably be more pronounced in the future, when distributed generation options become more widespread and affordable.

The Brattle Group's recent research on customer satisfaction, based largely on an empirical analysis, studied the relationships across a data set that included: measures of customer satisfaction, indicators of electric system reliability, and utility cost structures as well as system characteristic and demographic variables. This analysis confirmed some of the views that have been widely held by utility managers, but which were based more on a sense of conventional wisdom than backed up by the data. It provided a few surprises as well, which are important to take into account as utilities brace for mounting competition in retail markets and develop strategies to enhance satisfaction among their customers.

Defining Satisfaction

Customer satisfaction largely depends on whether a company's products or services fulfill a customer's expectations—*i.e.,* whether it meets, exceeds, or falls short. Quantifying customer satisfaction involves accumulating specific customer perceptions, measured through surveys—typically using a 5- or 10-point scale, ranging from "extremely dissatisfied" to "extremely satisfied"—that are presented at various levels of aggregation.[1]

It's fairly common practice for companies to survey customers in order to understand how customers perceive the service they receive; it's even more widespread in recent years with the evolution of Internet and app-based survey instruments. Surveys frequently pay significant attention to non-price dimensions, especially in price-competitive environments—such as airlines and retail banking—as companies look for ways to differentiate themselves against competitors.

Historically, electric utilities haven't been directly subject to price competition for electric products due to geographic franchise arrangements—although cross-fuel competition in many areas could be quite fierce. It could be argued that, with nowhere else to turn, customers had few alternatives to their local utility, thereby reducing the importance to utility management of satisfied customers. However, even the most short-sighted utility managers recognized that satisfying customers was important and that it needed to be included as an element of business strategy. For one reason, state regulatory commissions typically required utilities under their jurisdiction to conduct customer satisfaction surveys—which were taken into account in rate and other proceedings. For another, bond and equity analysts also looked at current and projected rates, as well as other customer issues when rating investments in electric utilities.

Customers might forgive their utility if rates go up, as long as they perceive service is improving or at least consistently reliable.

Currently, the threat of losing customers due to increased competition and potential bypass of the electric distribution system through distributed generation is driving electric utilities' interest in customer satisfaction. Investment in utility infrastructure is projected to increase as growth in sales is declining; at the same time, alternatives to the electric grid are becoming more widespread and cost competitive. Also, the rates for delivering electric power are almost always volume-based, which means that defections of customers can have a large impact on unit rates. As a result, attracting and retaining customers to keep prices affordable is more important than ever.

Another development that has brought utility customer satisfaction to the forefront is the use of benchmarking studies, which compare levels of customer satisfaction across utilities. High scores in benchmarking studies can show that utilities are recognized by their customers as being the best in class. This notion of comparing levels of customer satisfaction across utilities can be perplexing to many utility managers. Utilities typically serve all of the retail customers in a defined geographic area on an exclusive basis; some residential—as well as small commercial—customers reside in the same utility service area for all of their lives. This means that customers aren't necessarily in a position to directly compare their utility's performance against other utilities, as they would be able to rank their experiences with banks or gas stations. That is, they might not know how good or bad they have it. Nonetheless, utility customers certainly have views about the quality and value of electric services, which

1. The most common scales used to measure customer satisfaction are classical "Likert" scales, which describe the range of possible attitudes from "very dissatisfied" to "very satisfied" using numeric values.

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FIG. 1 SUMMARY OF VARIABLES INCLUDED IN EMPIRICAL ANALYSIS

SAIDI, SAIFI, and CAIDI are widely used measures of electric distribution system reliability. SAIDI = System Average Interruption Duration Index, which measures the average number of minutes that interruptions last each year (or period of review). SAIFI = System Average Interruption Frequency Index and measures the average number of times customers are interrupted in a year (or period of review). CAIDI = Customer Average Interruption Duration Index which measures the average outage duration experienced by any affected customer. CAIDI = SAIDI /SAIFI.

Variable	Form
Customer satisfaction	Annual J.D. Power score (residential customer survey)
Reliability (SAIDI, SAIFI, CAIDI)	SAIDI, SAIFI, and CAIDI, measured including and excluding major events.
Price	Annual average residential revenue per kWh
Capital investment in distribution system	Annual net capital additions
Distribution system O&M expenditures	Annual spending per kWh
Customer service O&M expenditures	Annual spending per kWh
Service area density	Population per square mile
Geographic location	Utilities assigned to NE, SE, Midwest, NW, or SW regions

are voiced, sometimes vociferously, and best-in-class comparisons have become an embedded part of grading companies.

As a result, utilities have expended considerable effort to understand the drivers of high customer satisfaction ratings, and have undertaken initiatives to improve their scores. They have enhanced their staffs, implemented new information systems, and retained experts to help them strengthen their relationships with customers. Many of their initiatives were borrowed from the best practices of customer-facing industries, including development of user-friendly web interfaces, investment in state of the art customer care centers, and training to make employees more empathetic to the plights of their customers. Other initiatives were more specific to electric utility operations, notably enhancing the electric distribution system in order to provide more reliable service. Finally, and certainly not least, numerous utilities have focused on reducing their cost structures in order to demonstrate to customers that they are delivering as much value per dollar as possible.

Most of the above referenced initiatives—except, of course, for the cost-reduction initiatives—can be expensive. Thus, utility managers and budgeters frequently seek to trade-off between costs and benefits; that is, to target the initiative that will provide the biggest bang—or increase in customer satisfaction—for the buck. In some cases, the answer might be obvious, but in most cases, it tends to be more elusive. This is because there are a number of factors at work. One utility might improve its standing among its customers by upgrading its distribution system, while another might do better by improving its customer interfaces or customizing marketing programs for a segment of particularly concerned customers. The conventional wisdom—*i.e.,* delivering highly reliable electric service at a low price—might provide good overall direction, but it doesn't provide an actionable plan for addressing customer satisfaction at any particular utility.

Industry Benchmarks

Perhaps the most widely-known benchmark of customer satisfaction comes from J.D. Power and Associates, which surveys customers in a variety of industries and develops scores for the participating companies. For the electric utility industry, customer satisfaction scores were developed for nearly 125 public utilities—*i.e.,* municipals and cooperatives—and investor owned electric utilities.[2] Many utilities also survey their customers on their own, the results of which are treated confidentially. The J.D. Power survey is one of the only instruments that compares utilities' customer satisfaction on a consistent basis and is publicly available.

J.D. Power produces an annual report that provides a ranking of the utilities included in the study,[3] summarizes the results, and provides insight into the trends in utility customer satisfaction scores. For example, a series of storms in 2011 appears to have had a significant effect on customer satisfaction, specifically with respect to power quality and reliability as well as communications related to outage restorations. In some cases, utilities might be able to act almost immediately on study findings. However, in many cases—such as improving levels of power quality and reliability, which might require construction, development, and implementation of new systems—addressing problem circumstances can take years to effectuate. Further, it can take some time—perhaps years—for customers to fully realize the effects of hard or soft system enhancements, especially since customers tend to notice the bumps in the road more than when their service is being provided smoothly.

Utilities have long puzzled about the levers of customer satisfaction. Specifically, they face the classic balancing act between cost and quality. They can engineer a bullet-proof distribution

2. The most recent J.D. Power survey included a panel of 124 electric utilities, 85 of which were investor-owned and 39 were non-investor-owned utilities. The panel was smaller in 2006 and 2007, with roughly 80 public and investor owned electric utilities. Residential customer satisfaction is developed on a 1,000-point scale. In 2012, the average score among the electric utilities included in the study was 625.
3. J.D. Power also provides awards to the top performers in several categories, including those based on size and geographic region.

Fig. 2 SAIDI vs. Customer Satisfaction

SAIDI including major events vs. J.D. Power residential customer satisfaction score.

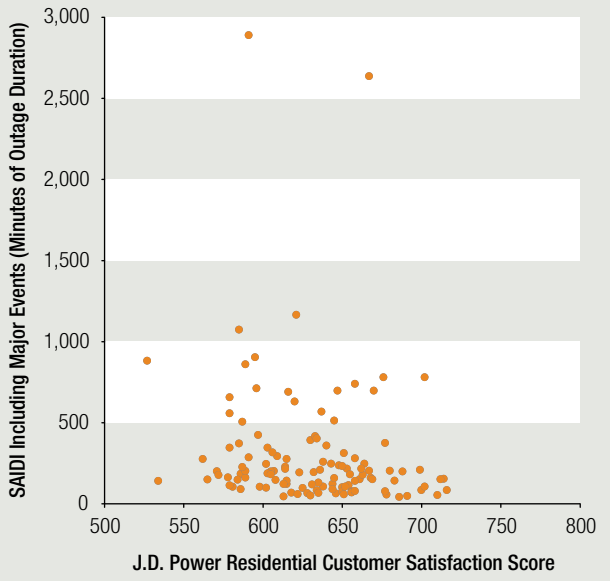
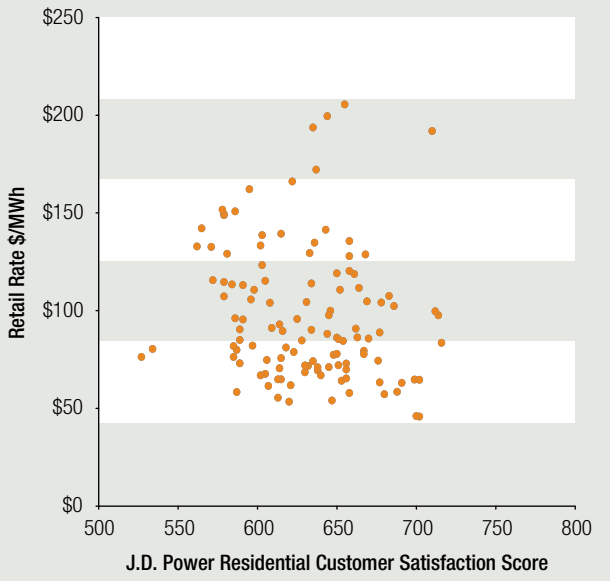


Fig. 3 Rates vs. Customer Satisfaction

Retail rate ($/MWh) vs. J.D. Power residential customer satisfaction score.



system that would deliver very high levels of reliability regardless of the many perils it faces—including ice storms, hurricanes, errant drivers, and even the potential damages of squirrels and birds—but it would likely come at a very high cost, especially if such hardening included undergrounding a significant percentage of their distribution systems. Thus, utilities have long sought an algorithm that illuminates the customer trade-off of price versus quality of service. Further, they're interested in whether other levers, such as investment in customer service systems and customized product offerings, might better fulfill their customers' expectations.

The Brattle Group's analysis seeks to confirm or refute the views widely held by utility managers concerning the key factors that determine customer satisfaction. It compiled a data set that covers utility performance (*e.g.,* financial, system operations and customer satisfaction scores), levels of investment, operations and maintenance expenditures, and demographic characteristics (primarily concerning geography and customer density) for a panel of roughly 30 investor-owned electric utilities located throughout the United States, covering a period of six years.[4] The primary factors considered in the analysis are summarized in Figure 1.

Based on common utility wisdom, a quick look at these data might be expected to show directly observable relationships between customer satisfaction and the various explanatory variables summarized above. For example, an electric utility that consistently invested in and maintained its distribution systems—as evidenced by above average levels of spending—might be expected to realize high levels of reliability. And if that same utility also had invested and maintained customer service systems and had low rates, it would achieve high customer satisfaction results. Finally, those relationships could be stretched into a matrix or algorithm, through which utility managers could manage their way to strong customer satisfaction. For example, perhaps they could spend a little less on, say, distribution infrastructure per year, in order to keep rates down without triggering noticeable levels of system degradation, with the overall result of happier customers.

All of this seems to make sense. However, as shown in Figures 1 and 2, scatter plots of any two variables don't present any clear pictures. Part of the explanation for this might lie in the complexity among relationships. Few if any utilities simultaneously achieve the combinations of spending, reliability, and rates to clearly make the case.

Figures 2 and 3 depict the relationships between customer satisfaction scores with reliability and price, respectively—both hypothesized to be important explanatory variables of customer satisfaction. These scatter plots indicate that the majority of observations fall within a fairly tight range. However, fitting a trend line within the scatter would be challenging at best. Furthermore, scatter plots of two variables at a time—*i.e.,* customer satisfaction scores versus a single independent variable—don't begin to explain the relative significance of a single explanatory

4. In addition to the customer satisfaction scores from J.D. Power, data included in this analysis come from several sources, primarily Form 1 reports filed by electric utilities to the Federal Energy Regulatory Commission (FERC) and from reliability reports made public by state regulatory commissions or from electric utilities themselves. Not all utilities have publicly available information concerning customer satisfaction scores or consistent reliability indicators. Thus, the size of the data set is limited by the public availability of consistent data.

Fig. 4 Residential Customer Satisfaction

Distribution of electric utility residential customer satisfaction for panel of electric utilities (2006 through 2011).

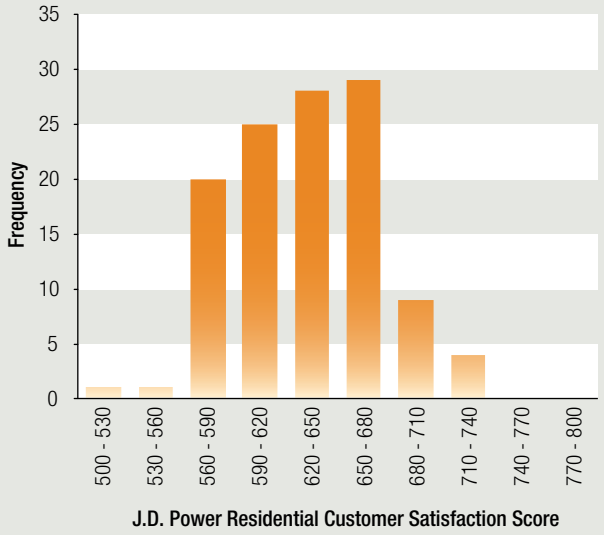
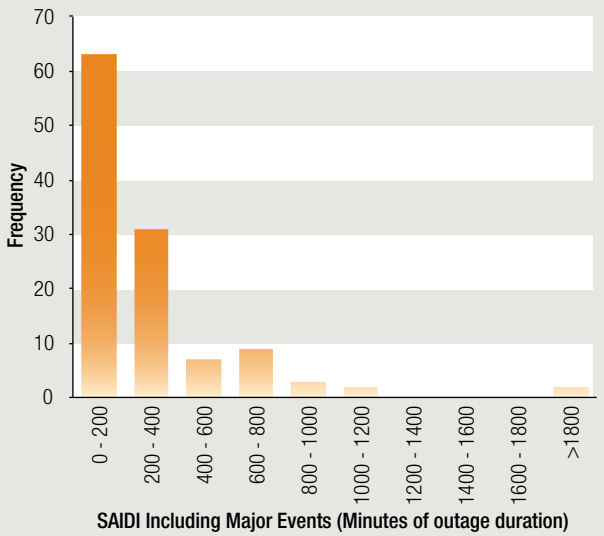


Fig. 5 Outage Duration

Distribution of duration of power outages for panel of electric utilities (2006 through 2011).



variable compared to other such variables.

Interpreting Empirical Analysis

A review of the data included in the set confirmed definite differences across utilities concerning customer satisfaction scores as well as some of the key variables that might explain it—such as the extent of power outages. Figures 4 and 5 illustrate the distribution of J.D. Power customer satisfaction scores (based on surveys of residential electric customers) and the duration of power outages (SAIDI measured including major events) for the utilities included in the panel.

The figures indicate that these data tend to be fairly tightly distributed, which means that differences across utilities might not be directly observable through a graphic or visual inspection. They also indicate that explaining the determinants of customer satisfaction might require expressing some of the dependent variables in natural log form.[5]

A regression analysis confirmed much of the conventional wisdom concerning customer satisfaction and also provided a few additional insights as to causation.[6] This analysis used utility customer satisfaction score as the dependent variable, with independent variables including: price, reliability, spending on distribution systems, spending on customer service, the density of population in the utility's service area, and the U.S. geographic region where the utility is located.

A summary of results is included in Figure 6. The key findings fall into four areas. First, the analysis indicated that, indeed, system reliability—as measured by the duration of service interruptions, their frequency, or both—significantly explains customer satisfaction scores. Furthermore, a separate but related regression showed that spending by utilities on their distribution systems was significantly correlated with achieved levels of reliability. This confirms general understanding of the cycle and effect of utility investment and operations and maintenance spending: achieving high levels of reliability requires consistent investment and spending.

Second, the analysis showed that rates—as measured by average residential revenue per kWh—play a significant role in explaining why customers rank utilities at a high or low level with respect to customer satisfaction. However, rate levels are less of a determinant than system reliability. In order to make the customer satisfaction scores more meaningful, the analysis standardized the customer satisfaction variable,[7] which allowed more directly comparing the effect that independent variables have upon the dependent variable. As indicated in Figure 6, improvements in reliability could increase customer satisfac-

5. It is clear that SAIDI scores are asymmetrically distributed, and appear to be approximate a log normal distribution. This means that we can change the form of SAIDI to log normal—or ln (SAIDI)—to better express its distribution in a regression analysis.

6. Regression analyses—assuming that the results are statistically significant—provide an indication of the importance of an independent variable in explaining changes in the dependent variable. As a general practice, the results of a regression are summarized by displaying the coefficient of the independent variables considered, as well as indicating the degree to which those variables are statistically significant (as measured by t-scores).

7. Standardizing a variable involves centering it about the sample's mean value and dividing it by the sample's standard deviation. This yields a customer satisfaction variable that is measured relative to the panel of observations (*i.e.*, not in absolute terms).

tion scores by roughly 0.23 standard deviations from the mean, while a slight decrease in rates would improve scores by less than 0.01 standard deviations. This suggests that, for the panel overall, customers might forgive their utility if rates go up, as long as they perceive that the service they receive is improving or at least consistently reliable.

Third, geography and locations provide statistically significant explanations of customer satisfaction scores. In fact, the regression analysis indicated that the single biggest impact on overall customer satisfaction scores comes from geographic variables—which was a somewhat unexpected finding.[8] Specifically, utilities in the Northeastern U.S. are statistically at a disadvantage compared to utilities located elsewhere in the U.S. when customers rate their levels of satisfaction. The coefficient for utilities in the Northeast is statistically insignificant—*i.e.,* it's essentially zero—while the coefficients for all other regions are positive and statistically significant. That suggests an unfortunate locational distinction for Northeastern utilities. Comparatively, they're starting at ground zero and need to work their way up from there, whereas utilities in the other parts of the country begin above the mean. It's possible that this geographic effect reflects cultural pre-dispositions; it also might be the result of cross-correlations with storm-related service interruptions.

FIG. 6 SUMMARY OF REGRESSION RESULTS

Source: The Brattle Group

In regression analysis, variables are tested to find how they explain the data considered. For each variable, the results provide a coefficient that reflects the strength of the relationship. For example, a large negative coefficient value for an independent variable (*e.g.*, reliability) would mean the variable has a large negative effect on the dependent variable (*e.g.*, J.D. Power Customer Satisfaction Score). That is, poor reliability leads to a low J.D. Power score. Looking at this alone, though, doesn't indicate how significant the dependent variable is in explaining the independent variable. To indicate the level of statistical significance, several statistical tests can be performed. The "t-score" is one such test, showing departure from the norm. Figure 6 summarizes the statistical significance of the variables by placing * for different levels of significance; t-scores higher or lower than the indicated level are either more or less statistically significant.

Variable	Coefficient	t-score
J.D. Power residential customer satisfaction score		
Customer service expenses	0.0920	1.25
Distribution expenses	0.0794	1.38
SAIDI including major events	-0.2265	-2.17**
Population and area	0.0001	1.99**
Retail rate	-0.0087	-2.02**
Net investment in distribution	-0.0017	-1.36
Regions		
Northwest	2.5830	4.25***
Southwest	2.1967	3.73***
Northeast	0.6918	1.12
Southeast	2.5193	3.96***
Midwest	1.8697	2.85***

*** Statistically significant at 1 percent.
** Statistically significant at 5 percent.
* Statistically significant at 10 percent.

Somewhat related to geography, the analysis showed that population density of a utility's service area—*i.e.,* a proxy for how many customers are served per mile of utility distribution system—is another statistically significant explanatory factor and positively associated with customer satisfaction. However the effect of the density of the distribution system upon customer satisfaction scores is less than the impact stemming from geographic location.

Finally, electric utility spending on their customer service functions is statistically significant, but explains little. This came as a surprise in light of recent findings associated with reviews of utility performance in response to last year's storms in the Mid-Atlantic and Northeast. Those studies found that customer frustration was tied to poor communications by utilities, frequently more so than to physical restoration efforts and results. Thus, those utilities that spent more on their customer service functions—in the form of system upgrades and other resources—would be expected to have happier customers.

This part of the regression results likely reflect data and measurement issues more than it supports a finding that spending on customer service doesn't matter. The variable included in the regression simply captures dollars spent per customer and per kWh of sales. It might be fair to infer that higher levels of spending on customer service can be associated with more sophisticated systems. However, it doesn't necessarily mean that those utilities have better communications with their customers—especially during crucial events.[9]

8. The analysis used "dummy" variables through which the electric utilities included in the panel were assigned to the Northeast, Southeast, Midwest, Southwest or Northwest.

9. The analysis also considered lagging the customer service variable—*e.g.*, t-1, t-2, etc.—which captured the impact of past spending have on current levels of customer satisfaction. Results for the lagged variable were similar to the results for the contemporaneous variable.

Analysis in Practice

At its highest level, this analysis confirms the primary suppositions underlying why some utilities succeed in achieving high customer satisfaction ratings. It supports the logical hypothesis that good service—*i.e.,* high levels of reliability, or low SAIDI—combined with low prices are key to satisfying customers.

Clearly there's merit in developing empirical support for what common sense tells us must be so. However, the finding above is a prescription that can be applied to virtually any business; by itself, it provides little actionable direction to improve a utility's customer satisfaction rating. In practice, recommending that utilities keep service levels up and prices down is about as useful as advising a stock broker to buy low and sell high.

The primary goal in conducting this research and analysis is to use it to develop actionable recommendations for electric utility managers.[10] The analysis provides three key insights that can be used by utilities to improve customer satisfaction scores.

First, all customers expect reliable electric service at the lowest prices possible. Meeting this expectation requires system-wide investments and initiatives. Comparatively reliable service and reasonably priced delivery services, then, become the common denominators that electric utilities must provide in order to satisfy customers and regulators overall. This will satisfy a segment of customers; however, going above and beyond this foundation level of service must be addressed on an incremental basis.

Second, location matters. This means that customer needs and expectations vary across geographies, even among utilities with similar levels of reliability and rates. It also suggests that best practices—aimed at improving customer satisfaction scores—aren't always portable. On first blush, the analysis might appear to indicate that some drivers of customer satisfaction are beyond the control of the utility. However, that doesn't mean utilities in the Northeast should succumb to despair. Instead, it suggests that utilities have to proactively address these disconnects with their customers through additional customer research and analysis and more effective communications and interactions.

Third, recognizing variances might be more important than understanding averages. The regression analysis estimated variances and standard deviations across the panel of utilities. Likewise, customer preferences vary within utilities. While it's possible to find the mix of cost and service that will generally satisfy customers at a common denominator level, there's probably room to meet the expectations of a sub-segment of customers that are looking for higher levels of service. For example, a sub-set of the overall residential customer segment is interested in realizing greater energy efficiency or receiving higher quality power, and is willing to pay extra for it.[11] These customers will be more satisfied with their utility because it enabled them to realize their goals, even though it came at a cost. By addressing the expectations of these customers separately—or incrementally—the utility also can dodge a bullet; it won't upset its foundation customers by applying a system-wide upgrade, thereby increasing rates.

Utilities can realize such incremental improvements in customer satisfaction through market segmentation and other approaches. Utility marketing programs that address energy efficiency and power quality are considered to be successes because they show the utility understands the needs of a segment of its customers, and it applies tools necessary to help.[12] Plus they're developed in an iterative fashion; that is, the programs are neither pushed by product developers nor pulled by segment managers, but instead are developed in response to customer demand.

Customer segmentation is hardly new to the electric utility industry. Utilities track a range of data in order to provide service and to bill customers, notably locations and energy consumption. Most utilities segment their customers based on these two criteria, in part because it's useful when developing load forecasts, and in part because it's the primary data that's readily collected and available. From a customer satisfaction standpoint, segmenting customers along these lines doesn't necessarily assist the utility in gaining insight into what it takes to satisfy those customers, nor does it lead to actionable strategies. This is primarily because customers who share common levels of electricity consumption and those who live in common locations have other characteristics that more fully define their expectations from their electric utility.

More sophisticated systems don't necessarily mean better communications with customers—especially during crucial events.

Customer segmentation by itself, however, is only meaningful if the utility can act to improve satisfaction in those segments—that is, if it has tools in place, or under development, to reach

10. More so than incorporating our research into the academic literature. In order to be seriously considered among academic economists, the analysis will need to be fortified further—requiring elaboration upon the statistical dimensions of the analysis to better estimate the regression coefficients, the extent of their explanatory power, and the covariance across independent variables.

11. More accurately, these customers are willing to make an initial investment—either directly or through their electric utility—with the expectation of realizing benefits in the form of lower overall costs in the future or higher levels of power quality.

12. Energy efficiency programs involve saving customers money by improving the efficiency of electricity consumption, ranging from caulking leaky windows in older homes to the mass replacement of light bulbs with LEDs in large warehouses. Programs that address power quality and voltage fluctuations also require an investment, frequently in an uninterruptible power supply that automatically switches the customer off the grid if it detects a transient condition on the line.

customer needs and expectations. Segmentation can be enhanced, refined, or even outright changed, if utilities develop new tangible tools to address other unmet customer needs. For example, new programs enabled by smart meters, the smart grid, and services related to plug-in hybrid electric vehicles will require that utilities apply more sophisticated segmentation tactics to tailor programs to meet customer expectations.

Without this connection between segments and programs, however, segmentation is an academic exercise; utilities might be able to develop more nuanced, and perhaps more interesting segmentations of their customers, but they will lack the ability to improve their customers' satisfaction.

Best practices aimed at improving customer satisfaction scores aren't always portable.

Beyond Conventional Wisdom

Analysis provides an empirical basis for some of the conventional wisdom concerning the drivers of customer satisfaction assumed by utility managers. It also places these drivers in context. Most of the electric utilities in the panel have achieved relatively consistent and acceptable levels of reliability—in terms of the frequency and duration of service interruptions—which led to these factors being statistically significant. However, the tight cluster of these observations led to low coefficient values, suggesting that improvements in reliability wouldn't move customer satisfaction scores that much. The same is true for rate reductions. This doesn't mean that reliability and rates aren't important to customers; quite the contrary is true. Customers have come to expect that utilities provide electric service within a certain band of reliability and rates. Low rates—or rates that are as low as possible—plus reliable service then becomes the common denominator of a utility's customer satisfaction strategy.

The geographic region of a utility's service territory plays a strong role in customer satisfaction, the highest of all of the independent variables considered. This could be interpreted to suggest that achieving high levels of customer satisfaction is out of the control of the utility in question. However, such an interpretation would be overly simplistic. Instead, this part of the regression results indicate that customer satisfaction is largely driven by utility attention to the specific issues facing its unique customer base.

Is it possible to improve upon low customer satisfaction scores? Of course, but it might take time to overcome embedded customer biases. This will be particularly true for electric utilities in the Northeastern U.S., which are starting out with lower customer satisfaction scores than is the case for utilities located elsewhere in the country. Regulators and other observers need to keep this point in mind when gauging progress going forward.

In addition to meeting the common denominator of reliable electric service at low rates (or at least without notable increases in rates), electric utilities can improve upon their customer satisfaction scores by improving observed deficiencies (such as communications and customer interactions) and tailoring marketing programs to meet the expectations of specific customer segments, with marketing programs tangible enough to address specific customer needs. Otherwise, generalized programs might make good sound bites, but aren't actionable enough to improve the satisfaction levels for any particular group of customers.