Go to Table of Contents

NRRI 96-18

OPTIONAL TWO-PART TARIFFS, PRICE-CAP REGULATION, AND STRANDED COSTS

Robert J. Graniere
Senior Institute Economist

THE NATIONAL REGULATORY RESEARCH INSTITUTE
The Ohio State University
1080 Carmack Road
Columbus, Ohio 43210
(614) 292-9404

October 1996

This report was prepared by The National Regulatory Research Institute (NRRI) with funding provided by participating member commissions of the National Association of Regulatory Utility Commissioners (NARUC). The views and opinions of the author do not necessarily state or reflect the views, opinions, or policies of the NRRI, the

NARUC, or NARUC member commissions.

TABLE OF CONTENTS

LIST OF TABLES

Page

TABLE

ACKNOWLEDGMENTS

I wish to express my thanks to Douglas Jones and Kenneth Costello for reviewing this paper. Their comments helped focus my efforts and clarify my exposition. However, I alone am responsible for any remaining errors.

I also would like to thank Francine Sevel for editing this report and Marilyn Reiss for typing and proofreading the report.

Go to Table of Contents

OPTIONAL TWO-PART TARIFFS, PRICE CAP REGULATION, AND STRANDED COSTS

Introduction

A tariff is more than a one-dimensional price list for a regulated service. A tariff is a multi-dimensional contract entered into by the utility on its own behalf and its regulators on behalf of large classes of consumers. The specific terms and conditions found in every tariff create the additional dimensions. For example, the second dimension of a tariff is its universal availability in a nondiscriminatory fashion to customers in the pertinent class of customers. The third dimension of a tariff is that its prices (rates) cannot be unduly discriminatory across customer classes. The fourth dimension is that the affected customers must agree to use the regulated service in the proper manner and pay the published rates.

Multiple dimensions establish a tariff as a communication to the rest of the world that describes the public policies of regulatory authorities and the market strategies of regulated utilities.[1] The dimensionality of a tariff sends aggressive or passive signals to the utility's customers and its competitors. Generally, the utility hopes that these signals will cause an increase in its profits. Meanwhile, its regulators hope that the signals enlarge the consumer surplus enjoyed by the utility's customers.[2]

The sum of the profits and the consumer surplus generated by the sale of a service is an accepted measure of economic welfare among economists. Absent externalities and government intervention, the market forces characterizing perfectly

[1] Tariffs also perform internal functions for the regulated utility. They allocate resources and assist in the implementation of strategies.

[2] Consumer surplus is the benefit that a utility's customer receives by paying a tariff that is lower than the tariff this customer would have been willing to pay. Clearly, consumer surplus cannot be directly observed for any particular customer. However, it is clear that a reduction of the tariffed rate serves to increase the consumer surplus realized by every customer currently consuming the regulated service in question.

competitive and perfectly contestable markets result in the maximization of economic welfare.[3] The welfare-maximizing aspect of a perfectly contestable market rests on a specific structure of entry and exit conditions that undeniably causes harm to monopolistic or oligopolistic incumbents who do not act *as if* they are competing in a perfectly competitive market.[4] In particular, the incumbent is required to employ its resources in their most productive and highest-valued uses and is limited to the level of profit earned in a perfectly competitive market by the dual threats of instantaneous entry and costless exit. In others words, the threat of a perfectly competitive market induces the optimal allocation of resources by the incumbent or incumbents in a perfectly contestable market.

Unfortunately, real-world markets are never perfectly contestable or perfectly competitive. Consequently, for a practitioner, the most productive use of these idealized markets is as a guide to the analysis of economic welfare. We are concerned with real-world regulated markets that are either monopolistic or oligopolistic. Consequently, perfect contestability is the idealized market most suited for our analysis of the gain in economic welfare achieved through the introduction of two-part tariffs.[5] As usual, our markets have the characteristic downward-sloping demand curves for regulated services. They also have the characteristic market power over consumers implied by this shape of the demand curves.

The model of perfect contestability alerts the regulated utility to the economic harm caused by inefficient tariffs for regulated services. Like prices in an unregulated market, tariffs cause entry and exit opportunities in regulated markets. Efficient tariffs

---

[3] William J. Baumol, John C. Panzar, and Robert D. Willig, *Contestable Markets and the Theory of Industry Structure*, with contributions by Elizabeth E. Bailey, Dietrich Fisher, and Herman C. Quimback, rev. ed. (San Diego, CA: Harcourt Brace Jovanovich, 1988).

[4] William J. Baumol and J. Gregory Sidak, *Toward Competition in Local Telephony*, AEI Studies in Telecommunications Deregulation (Cambridge, MA: The MIT Press and Washington DC: The American Enterprise Institute for Public Policy Research, 1994).

[5] A restrictive form of country club membership is the best analogy for a two-part tariff. A member pays a lump-sum (initiation) fee for the privilege of club membership. Subsequently, he pays an annual nonusage-sensitive fee for the right to pass through the country club gate. In addition, he pays usage-sensitive fees on a monthly basis in order to participate in any of the club's activities. The recurring annual and monthly fees are the components of a two-part tariff.

induce efficient entry and exit.[6] Efficient entry and exit opportunities induce the optimal allocation of resources in the sense of replicating the allocation of resources occurring when the market in question is unregulated and perfectly competitive. However, efficient tariffs are beyond our reach.[7] Consequently, we need to be content with almost efficient tariffs, which cause the approximations of the optimal allocation of resources and the maximization of economic welfare by a regulated utility.

A menu of single-part and two-part tariffs allowing multiple and voluntary choices for the utility's customer classes is more efficient than a menu that mandates a single-part tariff for each customer class. Voluntary self-selection of tariffs results in higher production levels of regulated services, lower average rates for regulated services, and higher profits for the utility.[8] However, these results are achieved only if the following initial conditions exist. First, marginal cost has to be lower than average cost. This condition ensures that average cost falls as production increases, thereby providing the basis for lower rates. Second, the existing average rate for the regulated service has to be higher than marginal cost. This condition establishes that profit and production increases will move in tandem. Third, customers with elastic demands have to be more likely to select the two-part tariffs than customers with inelastic demands. This condition ensures that higher production levels and lower average rates do not reduce profits.

---

[6] First-best efficient tariffs exist when the utility can profitably set its rates equal to the pertinent marginal costs. If the utility cannot profitably set its rates equal to marginal costs, second-best efficient tariffs exist when the utility minimizes economic-welfare-decreasing deviations from first-best efficient tariffs. The structure of second-best efficient tariffs is dependent on the interplay between the utility's revenue needs and its customers' demands for its regulated services. See Frank P. Ramsey, "A Contribution to the Theory of Taxation," *Economic Journal* 37 (1927): 47. William J. Baumol and David F. Bradford, "Optimal Departures from Marginal Cost Pricing," *American Economic Review* 67 (1977): 350.

[7] Information limitations on both sides of the regulator/utility divide prevent the replacement of inefficient tariffs by efficient tariffs. Therefore, the next best alternative is to employ replacement tariffs meeting the following criteria. The tariff must encourage the existing customers to consume more of the regulated service in question, and the additional consumption must be accompanied by a rise in the utility's profits. In other words, lower prices must be consistent with higher prices. See Robert J. Graniere, *Almost Second-Best Pricing for Regulated Markets Affected by Competition* (Columbus, OH: The National Regulatory Research Institute, 1996).

[8] Stephen J. Brown and David S. Sibley, *The Theory of Public Utility Pricing* (Cambridge, MA: Cambridge University Press, 1989).

As long as these initial conditions exist, Niagara Mohawk's proposal to replace its existing menu of tariffs with a menu of single-part and two-part tariffs improves the allocation of resources and raises the level of economic welfare.[9] This proposal is described in more detail in the following section. The basic philosophy and mechanics of the two-part tariffs contained in the proposal are discussed in the next section. The use of these two-part tariffs to recover and prevent stranded costs is analyzed in the following section. The welfare effects of these two-part tariffs are explained in the next-to-last section.

Niagara Mohawk's Proposal to Supplement Standard Tariffs

Niagara Mohawk proposes to supplement its standard tariffs for electricity services with optional, self-selecting two-part tariffs and specialized two-part tariffs. The addition of optional, self-selecting two-part tariffs is meant to stimulate the quantity of electricity services demanded by those existing customers who are not explicitly threatening to leave the utility.[10] The inclusion of specialized two-part tariffs in this utility's list of tariffs is meant to prevent the loss of large-volume customers who have credibly threatened to leave Niagara Mohawk's service territory or engage in self-

[9] David S. Sibley, Direct Testimony of David S. Sibley before the New York Public Service Commission on Behalf of Niagara Mohawk Power Corporation, 1994, Niagara Mohawk Power Corporation, PSC Case No. 94-E-0098. Bidwell presents the argument that the Niagara Mohawk proposal is a movement toward efficient tariffs. See Miles O. Bidwell, Testimony and Exhibit of Miles O. Bidwell before the New York Public Service Commission on Behalf of Multiple Intervenors, January 1996, Rochester Gas and Electric Corporation, PSC Case Nos. 95-E-0673 and 95-G-0674. Hemphill represents the proposal as a defense against the competitive attacks of market entrants with new technologies.
See Ross C. Hemphill, Rebuttal Testimony of Ross C. Hemphill before the New York Public Service Commission on Behalf of Niagara Mohawk Power Corporation, n.d., Niagara Mohawk Power Corporation, PSC Case Nos. 94-E-0098 and 94-E-0099.

[10] Over the years, federal and state regulators allowed a divested and regulated AT&T to supplement its standard tariffs with two-part tariffs such as Reach-Out American, ProAmerica, and their progeny that were meant to stimulate the quantity demanded of telecommunications services and prevent the loss of medium-volume residential and business customers to competitors such as MCI and Sprint.

generation.[11] Together, these two-part tariffs represent the foundation of Niagara Mohawk's competitive strategy to increase the size of its retail electricity market and to prevent the loss of market share to competitors and competing self-generation technologies.

Niagara Mohawk's standard tariffs for its different customer classes would fully recover this utility's revenue requirement under the assumptions that its existing customers would purchase all of their retail electricity services from the standard tariffs and that its customers would not respond favorably to the alternatives of self-generation or flight from Niagara Mohawk's service territory. In other words, Niagara Mohawk's continued economic survival would be assured if no form of competition existed in the retail electricity market. However, Niagara Mohawk is aware that self-generation and service territory flight do exist as competitive alternatives are available for some of its customers. This utility also is aware that other forms of retail competition are on the horizon. Therefore, it wants to use specialized two-part tariffs to prevent the loss of existing customers to any form of retail competition.

Fundamentally, a specialized two-part tariff is a contract between Niagara Mohawk and one of its customers. The contract process is initiated by the Niagara Mohawk customer. Specifically, the customer presents Niagara Mohawk with a petition that contains a request for a specialized two-part tariff that meets its needs. Contract negotiations do not begin until after Niagara Mohawk has investigated the petition. If Niagara Mohawk concludes that its customer possesses a credible threat of switching to a competitor, self-generation, or service territory flight, then it begins contract negotiations with the customer. If these negotiations are successful, Niagara Mohawk will grant its customer's petition for a specialized two-part tariff because this action is in Niagara Mohawk's financial interests. The negotiations will be unique to the customer.

---

[11] Specialized two-part tariffs appear similar in purpose to the Tariff 12 contracts that AT&T designed for specific, very large-volume business customers who credibly threatened to leave AT&T for a competitor. However, they appear more similar in design to the competitive response tariffs that AT&T created to retain medium- and large-volume business customers who were susceptible to increasingly aggressive marketing tactics by AT&T's competitors.

Therefore, the specialized tariff will provide the threatening customer with a targeted discount meant to keep that customer on Niagara Mohawk's system. The basis for the discount is the standard tariff for the customer in question. Because a specialized two-part tariff is a load-retention tariff, the targeted discount has to be sufficiently deep to lower the total bill of the customer that is threatening to leave the system. Consequently, this customer must pay less even if the same amount of electricity is consumed after the customer switches to the specialized two-part tariff.

Niagara Mohawk wants to supplement its standard tariffs with optional, self-selecting two-part tariffs for the primary purpose of stimulating the quantity of retail electricity demanded without causing a reduction in the total electricity bill of any retail customer that selects one of these optional tariffs.[12] In effect, optional, self-selecting two-part tariffs are targeted to appeal to retail electricity customers that currently are without competitive alternatives. However, it will be subsequently shown that optional, self-selecting two-part tariffs can prevent the loss of above-average-usage customers to competitors that are expected to invade the retail electricity market.

The Philosophy and Mechanics of Two-Part Tariffs

The beauty of two-part tariffs is that they can be designed to divide a given class of customers into low-, medium-, and high-volume users.[13] This feat is accomplished by proposing specific combinations of nonusage-sensitive lump-sum fees and usage-sensitive rates that are constructed to appeal to prespecified types of customers within the given customer class. This capability supports the philosophy and mechanics of specialized two-part tariffs and optional, self-selecting two-part tariffs.

---

[12] The main purpose of optional calling plans such as Reach-Out America, ProAmerica, and their progeny was to prevent the additional loss of AT&T's residential customers to facilities-based competitors. The secondary purpose was to stimulate the quantity of residential telecommunications services demanded to replace some of the residential losses that AT&T already had suffered.

[13] AT&T's full set of optional calling plans was designed to divide the residential and business classes into low-, medium-, and high-volume segments.

Specialized Two-Part Tariffs

The philosophy of specialized two-part tariffs is to prevent the loss of a specific customer and her load to the utility's competitors. This philosophy is supported by the belief that it is in the best interest of the utility and the utility's other customers to lower the total electricity bill of the affected customer in order to retain that customer. This support makes it clear that the indiscriminate use of specialized two-part tariffs is not appropriate.

The basic rules of effective discounting to retain a specific customer are well-established among economists. First, the maximum discount from the standard tariff, or alternatively the minimum customer-specific tariff for the consumption of retail electricity, should yield revenue equal to the variable cost of producing the electricity purchased under the specialized two-part tariff. Second, the optimal discount from the standard tariff should yield revenue that maximizes the affected customer's contribution toward the recovery of the utility's fixed costs. The first rule puts the utility in the same economic position it would be in if it lost the customer in question to a competitor. In either instance, the utility does not obtain any contribution toward the recovery of its fixed costs. The second rule strives for the best improvement in the utility's economic position as compared to its position if it lost the affected customer to a competitor. In particular, the utility obtains the maximum contribution towards the recovery of its fixed costs by using a discount to retain the customer.

These rules lead to the conclusion that it is not in the economic interest of a regulated utility to retain a customer that is threatening to leave when the utility cannot recover all of the variable costs that it incurs to serve this customer. Conversely, the rules establish that the utility should retain the customer for a short period of time when it can recover at least the variable costs of serving her. However, despite these rules, the utility may be too quick to use specialized two-part tariffs as its preferred response to competition when it is assured of the opportunity to recover approved costs. This possibility has been described as a "free-rider problem" by the Staff of the New York

Public Service Commission. This problem results when the utility is too eager to discount the applicable standard tariff.

Fortunately, there is a solution to this problem — namely, the utility compares the present value of the expected revenue stream under the specialized tariff to the present value of the expected revenue stream under the standard tariff. To make this comparison, the utility must possess measures of two probabilities.[14] First, it must know the probability that the utility's offer of a specialized two-part tariff will be accepted by the customer who petitioned for a specialized two-part tariff. Second, the utility must know with what probability the customer requesting a specialized two-part tariff will leave the utility, if the utility does not offer this type of tariff to her.

Assuming that measures of these probabilities can be obtained, two conditions need to be met before the utility can offer a specialized two-part tariff for the purpose of retaining a particular customer. These conditions ensure that the utility and its remaining customers will benefit from the retention of the customer being offered the deep discounts contained in specialized two-part tariffs.

Condition 1: The expected value of the revenue stream under the specialized two-part tariff must cover at least the variable costs the utility incurs to serve the affected customer under this tariff.

Condition 2: The present value of the expected revenue stream under the standard tariff must be smaller than the present value of the expected revenue stream under the specialized two-part tariff.

It is a misplaced belief that incentive regulation will guarantee that Conditions 1 and 2 always are met. The public policies embedded within this form of regulation will determine whether these two conditions are met. Subsequently, two forms of price-cap regulation are examined to make this point. The first is price-cap regulation without a Z-factor, and the second is price-cap regulation with a Z-factor.

[14] Without past histories of offers of specialized two-part tariffs and their acceptance rate by the affected customers, it is clear that it is not possible to calculate objective probabilities. Absent objective probabilities, it is certain that there will be disputes over the utility's offer of a specialized two-part tariff to any its customers.

Optional, Self-Selecting Two-Part Tariffs

The philosophy of an optional, self-selecting two-part tariff is embedded in the belief that a utility's customer should have an opportunity to be indifferent when choosing between the optional and standard tariffs. That is, the rate levels of the two tariffs should not force the customer to choose between them because he does better under one tariff than the other. Instead, the rate levels should be selected such that the utility and a particular type of customer can be equally well-off under either tariff. On the customer's side of the equation, he is equally well-off when the same amount of electricity is consumed under either tariff. On the utility's side of the equation, this company is equally well-off when the same amount of revenue is received under either tariff. Therefore, the following condition ensures indifference.

Condition 3: A utility's customer is indifferent between the optional and standard tariffs when the utility's production of electricity does not change and the customer's total electricity bill does not change under either tariff.

Condition 3 protects the interests of customers who do not know that optional tariffs are available, or do not have the time to make a reasoned choice between the optional and applicable standard tariffs. Consequently, the ability of a particular customer to be indifferent when it comes to tariff selection ensures that the availability of optional tariffs does not penalize the uninformed, unprepared, and harried customers of the utility. Therefore, the introduction of optional, self-selecting two-part tariffs is in a sense fair because a customer does not gain or lose because he has chosen to not substitute the optional two-part tariff for the applicable standard tariff.[15]

---

[15] When an optional, self-selecting two-part tariff with indifference is constructed for a customer class, the tariff-making basis is the average customer within the customer class. For example, the utility must construct three average customers when it divides its customer base into residential, commercial, and industrial customer classes. Obviously, there would be more than three average tariffs if the utility wants to further subdivide the residential, commercial, and industrial classes by energy usage level.

The rate level pattern of a two-part tariff helps to understand the underlying philosophy. Let the effective rate per kilowatthour (kWh) under the optional tariff be the customer's total electricity bill divided by his actual consumption level.

$$ER = TEB/q \tag{1}$$

where

ER is the customer's monthly effective electricity rate.

TEB is the customer's monthly total electricity bill.

q is the actual amount of electricity that is consumed per month by the customer under the optional tariff.

The optional tariff contains a nonusage-sensitive fee for the recovery of fixed costs and a usage-sensitive rate for the recovery of variable costs. Neither the nonusage-sensitive fee nor the usage-sensitive rate vary by month. As a result, the customer's responsibility, as it pertains to the recovery of fixed costs, is not affected by his actual monthly consumption level under the optional tariff. Let this responsibility be measured by the constant of K dollars per month. Also, let the usage-sensitive rate be k cents per kWh. Then the customer's monthly total electricity bill under the optional tariff is:

$$TEB = K + kq \tag{2}$$

Consequently, the customer's monthly effective rate is:

$$ER = K/q + k \tag{3}$$

Equation 3 shows that the monthly effective rate falls as the customer increases his consumption. This pattern arises because the customer's contribution to the recovery of fixed costs is constant under the optional tariff. We already have determined that indifference guarantees that the effective price under the two-part tariff equals the price under the applicable standard tariff for the customer does not change his consumption level. That is,

$$K/q + k = r \qquad (4)$$

where

q is the actual amount of electricity consumed per month by the customer under the standard tariff.

r is the usage-sensitive rate per kWh under the applicable standard tariff for the customer class.

Equations 3 and 4 imply that the applicable standard tariffs do more than serve as touchstones for indifference by customer. Their availability also ensures that the utility's customers are not penalized when they elect to stay with the standard tariff or select the two-part tariff. It is not difficult to extend the preceding arguments to optional, self-selecting two-part tariffs with parameters designed to establish indifference for the average customer within a customer class.[16] Let r be 5 cents per kWh; k be 3 cents per kWh; 1000 kWhs be the usage level for a below-average user in the customer class, q^{ba}; 4000 kWhs be the usage level for the above-average user in the customer class, q^{aa}; K be $40 per month. Then the effective rate for the below-average customer under the optional tariff is 7 cents per kWh. Meanwhile, the effective rate for the above-average customer under the optional tariff is 4 cents per kWh. When these effective rates are compared to the effective rate of 5 cents per kWh under the standard tariff, it is clear that the below-average customer is better off staying with the standard tariff. It also is clear that the above-average user is made better off by selecting the two-part tariff.

[16] Although it is possible that a customer class will not contain an actual customer with average usage characteristics, it is undeniable that a customer class will contain some customers with above-average-usage characteristics and some with below-average-usage characteristics.

The preceding discussion has established that the mechanics of optional, self-selecting two-part tariffs can be described in four segments. First, below-average-usage customers, by customer class, remain on the applicable standard tariffs. Second, some average-usage customers are indifferent with respect to remaining on the applicable standard tariffs or switching to the applicable optional tariffs. Third, the remaining average-usage customers switch to the applicable optional tariff. Fourth, above-average-usage customers, by customer class, abandon the applicable standard tariff and embrace the optional two-part tariff.

These mechanics imply the following four effects on the utility's production levels when optional tariffs are made available to customers. In total, these four effects indicate that the net effect on electricity output of optional two-part tariffs is to cause the utility to raise its production of electricity.

Effect 1: The consumption levels of the below-average-usage customers do not change as a result of the availability of optional tariffs. Therefore, the utility's production for consumption by below-average-usage customers does not change.

Effect 2: The indifferent average-usage customers have the same consumption attribute as the below-average-usage customers; that is, the existence of optional tariffs does not cause them to change their consumption levels. As a result, the utility's production for this type of average-usage customer does not change.

Effect 3: The average-usage customers that switch to the optional tariff are "on the cusp," which means that they are coaxed into increasing their consumption of electricity by the discounted price for an additional kilowatthour of electricity. Therefore, the utility has to increase its production for this type of average-usage customer.

Effect 4: The above-average usage customers increase their consumption of electricity after they switch to the optional tariff. Therefore, the utility increases its production of electricity.

Specialized Two-Part Tariffs Can Strand Costs

The intention that paves the way for specialized two-part tariffs is **minimization** of stranded costs. The basic thought is that it is better for the utility to keep an existing customer on the system rather than to permit that customer to self-generate or switch to a competitor of the utility. This thought is so well-established in utility regulation because any customer that is retained under a properly designed specialized tariff is guaranteed to prevent the stranding of some investment. To be more specific, the retained customer makes a reduced contribution to the recovery of the utility's fixed costs. This reduced contribution represents the amount of investment that the specialized tariff has prevented from becoming stranded.

However, it cannot be forgotten that a specialized two-part tariff strands investment. Interestingly, this result also is guaranteed by the retained customer's reduced contribution to the recovery of the utility's fixed costs. Although this customer continues to support some of the utility's fixed costs after it accepts a specialized two-part tariff, it is not contributing as much as it would under the standard tariff. The amount of revenue that this customer is no longer contributing to the recovery of the utility's fixed costs represents stranded investment. The cost of this stranded investment is the measure of the costs that are stranded by a specialized tariff.

In this section, we examine the incentives the utility faces to strand costs as it makes offers of specialized two-part tariffs to selected customers. This examination is conducted in two parts. First, a situation is investigated where the utility is subject to price-cap regulation without a Z-factor, and market forces place price ceilings on inelastically demanded services that are **higher** than the price ceilings placed on these services under this form of regulation. The absence of a Z-factor means that the utility is not allowed to increase its prices to compensate for cost increases beyond its control. Second, a situation is analyzed where the utility is subject to the same market force characteristics, but this time the regulatory format is price-cap regulation with a Z-factor.

Price-Cap Regulation Without a Z-Factor

Price-cap regulation without a Z-factor is the pure form for price-cap regulation. That is, the utility is not allowed to propose rate increases that can be traced to cost factors that are beyond its control. Instead, the utility is permitted to divide its services into market baskets that are supposed to contain closely substitutable services. Baseline rates are determined for each service in the basket. These rates are allowed to rise annually by no more than a percentage that is calculated by subtracting a productivity adjustment from the pertinent rate index.

When a utility is subject to price-cap regulation without a Z-factor, it must rely on the generally allowable rate increases and achievable cost reductions to provide the net revenue needed for the recovery of stranded costs. The stranded costs in question are created by: (1) offering a specialized tariff that is accepted by a customer threatening to leave the utility, (2) offering a specialized tariff that is not accepted by the customer threatening to leave the utility, and (3) not offering a specialized tariff to a customer threatening to leave the utility. Of course, the stranded costs created by the second and third means are identical because they are the lost contribution to the recovery of the utility's fixed costs after the customer actually leaves the utility.

Table 1 describes the utility's ability to recover stranded costs when it offers a specialized two-part tariff and when it does not offer this tariff. Five situations completely summarize this ability. The best situation for the utility is when it can recover its stranded costs regardless of its tariff offers. The worst situation for the utility is when it is certain that it cannot recover its stranded costs whatever its tariff offers. The situations in between refer to various expectations that can be held by the utility concerning the recovery of stranded costs.

The first situation describes a utility that can fully recover its stranded costs. It does not matter in this situation whether the stranded costs are created by offering a specialized tariff or by not offering a specialized tariff. That is, the utility is certain that it can recover 100 percent of either level of stranded costs. The second situation describes a utility that knows the limits of rate increases. The utility is certain of the

TABLE 1

DESCRIPTION OF THE UTILITY'S ABILITY
TO RECOVER STRANDED COSTS

Situation	Stranded Costs Created by Offering Tariff	Stranded Costs Created by Not Offering Tariff
1	Utility is certain that it can recover 100 percent of stranded costs.	Utility is certain that it can recover 100 percent of stranded costs.
2	Utility is certain that it can recover 100 percent of stranded costs.	Utility is certain that it cannot recover 100 percent of stranded costs.
3	Utility is certain that it cannot recover 100 percent of stranded costs.	Utility is certain that it cannot recover 100 percent of stranded costs.
4	Utility expects to recover 100 percent of stranded costs.	Utility is certain that it cannot recover 100 percent of stranded costs.
5	Utility expects to recover 100 percent of stranded costs.	Utility expects to recover 100 percent of stranded costs.

Source: Author's construct.

recovery of stranded costs that arise when it offers a specialized tariff, and it also is certain that it cannot recover stranded costs that are created when the customer leaves the utility. The third situation describes a utility that is in an unenviable position. It knows that it cannot recover the full amount of stranded costs when it offers specialized tariffs or when it does not offer these tariffs. The fourth situation describes a utility that has to choose between a certain outcome and an expected outcome. It knows that it cannot fully recover the stranded costs that are created as a result of not offering the specialized tariff, but it only expects that it can fully recover the stranded costs that arise when it offers a specialized tariff. The fifth situation also describes a utility that has to choose between two expected outcomes.

Table 2 summarizes the utility's tendency to overuse specialized two-part tariffs as a competitive response. As will be shown subsequently, this tendency arises because the utility prefers a smaller to a larger amount of stranded costs. Improperly so, this preference is not weakened by the condition that the utility should not offer a specialized two-part tariff to a customer that is threatening to leave its system when the present value of the expected revenue stream under the standard tariff is greater than the present value of the expected revenue stream under the specialized two-part tariff.

TABLE 2

TENDENCY TO OVERUSE SPECIALIZED TWO-PART TARIFFS

Situation	Tendency to Overuse	Reason for Overuse
1	Excessive	Utility is sure of recovery. Its preference for a smaller amount of stranded costs ensures overuse.
2	Extreme	Utility is sure of recovery only when a specialized tariff is offered and accepted, which ensures overuse.
3	Seldom	Utility is unsure of recovery. Preference for a smaller amount of stranded costs provides tendency toward overuse.
4	Significant	Utility expects to recover only when a specialized tariff is offered and accepted, which ensures some overuse.
5	Modest	Utility expects to recover whether tariff is offered or not. Its preference for a smaller amount of stranded costs ensures some overuse.

Source: Author’s construct.

The first situation places the utility in an enviable position. The generally allowable rate increases under price-cap regulation always permit the full recovery of stranded costs. Because the utility's stranded cost position is secure regardless of what it does with respect to specialized two-part tariffs, its behavior is controlled completely by its preference for smaller amounts of stranded costs. One way for the utility to reduce stranded costs is to stop its customers from leaving its system. As a result, the utility attempts to ensure the smallest amount of stranded costs by keeping the maximum number of customers on its system. Excessive offers of specialized tariffs implement this strategy. However, the strategy can backfire when the utility makes too many improper tariff offers.[17] If too many improper offers are made and accepted, then the utility incurs more stranded costs than it would have incurred by not making the improper offers. The reason is that the utility has placed customers on specialized tariffs that would not have left the system even if they were required to stay on the standard tariff.

The utility's use of specialized tariffs is extreme in the second situation. This utility is scared to not offer a specialized tariff to anyone that requests one. On the one hand, it does not want to take the risk of losing a customer because it is certain that it cannot fully recover the stranded costs that are created when the customer leaves its system. On the other hand, the utility wants to make an attractive tariff offer to a customer that is threatening to leave its system because it is sure it can fully recover any stranded costs created by the customer's acceptance of its offer.

The unenviable position in which the utility finds itself in the third situation suggests that the utility will be careful about the overuse of specialized two-part tariffs. This utility is faced with a dilemma. Its decision to offer or not offer a specialized two-part tariff to a customer does not alter the fact that the allowable rate increases under price-cap regulation do not permit the full recovery of whatever stranded costs are created by either decision. Consequently, the utility must make a careful determination of whether it is in its best interest to run the risk of losing a customer or to make an

[17] The utility should not offer a specialized two-part tariff when the present value of the revenue stream under the standard tariff is greater than the present value of the revenue stream under the specialized tariff. Instead, the utility should take the risk of losing this customer's contribution to fixed costs.

improper offer of a specialized tariff to this customer. The need to make such a determination causes a substantial decrease in the utility's willingness to overuse specialized two-part tariffs as its response to competition.

The utility is faced with another unenviable position in the fourth situation. It knows it does not have sufficient resources to cover the stranded costs that are created when it does not offer a specialized tariff and the customer leaves its system, but it only expects that it has sufficient resources to cover the stranded costs it creates when it offers a specialized two-part tariff that is accepted by the customer. These circumstances put the utility in a difficult position. It is hard for this utility to not offer a specialized tariff because this tariff represents its only chance for the full recovery of stranded costs. However, the customer may not leave the utility even if it is not offered a specialized tariff. Under these circumstances, the utility is confronted with the choice of either properly running the risk of losing this customer and not fully recovering its stranded costs or improperly offering a specialized tariff and raising its chances of recovering its stranded costs. Therefore, the utility must balance the expected value of the economic loss that arises when a specialized two-part tariff is not offered against the **net effect** of the expected value of the economic loss realized when a specialized tariff is accepted against the expected value of the strategic gain the utility realizes by continuing to serve a customer that should be served by someone else.[18] The specialized tariff is offered when the utility expects to lose less or actually win by making the offer.

The fifth situation represents a somewhat more pleasant set of circumstances for the utility. It expects to avoid an economic loss whether or not it offers a specialized two-part tariff. As a result, the utility is more careful about making improper offers of specialized tariffs. Although the utility continues to make an improper offer when the **net effect** of the expected value of the economic loss from offering the tariff and the expected value of the strategic gain from retaining the customer puts it in a better

[18] The expected value of the utility's loss when it does not offer the specialized tariff is the customer's contribution to the recovery of fixed costs times the probability that this customer will leave the utility if the utility does not offer it a specialized tariff. The expected value of the utility's loss when it offers a specialized tariff is the reduction in the customer's contribution to the recovery of fixed costs times the probability that this customer will accept the specialized tariff as a replacement for the applicable standard tariff.

position than the expected value of the recovery of stranded costs when the tariff is not offered, the utility is less inclined to make an improper offer because it is not facing a certain nonrecoverable economic loss when a customer leaves its system.

Price-Cap Regulation With the Z-Factor

The Z-factor and the "consumer dividend" are the most often used modifications of the pure form of price-cap regulation. The consumer dividend exists to ensure that retail customers realize some economic gains from price-cap regulation. As a result of the consumer dividend, the economic gain may be directly observable in the form of lowered rates, and the gain may be indirectly observable in the form of rates that are lower than they otherwise would be as a result of the consumer dividend. Consequently, the consumer dividend is operationally an add-on to the productivity adjustment that is an element of the pure form of price-cap regulation. Whereas the consumer dividend always helps to improve the lot of the retail customers, the Z-factor can improve the position of retail customers or the utility. However, the Z-factor cannot improve both of these positions within a given timeframe. Either the Z-factor lowers rates or it increases rates.

The Z-factor adjusts price ceilings for cost changes that are beyond the control of the utility. Originally, this adjustment factor captured the effect on prices of newly created additional costs or newly eliminated existing costs. Obviously, stranded costs do not fall into either of these classifications. Stranded costs are what is left over after existing variable costs have been eliminated by competition. Stranded costs are existing fixed costs that are no longer supported by any revenue stream. Furthermore, the stranded costs under discussion in this section are created by offers of specialized two-part tariffs in response to competition. Therefore, in a sense, these stranded costs are simultaneously within the control and beyond the control of the utility. Surely, offers of specialized two-part tariffs are under the control of the utility. However, it is clear that competition is beyond the utility’s control. It is likely that the utility will focus on the competitive necessity of offering its specialized tariffs to establish the legitimacy of the associated stranded costs as a component of the Z-factor.

Under price-cap regulation, the competitive necessity argument wins the day and the Z-factor gives the utility the latitude to recover tariff-related stranded costs. As a result, an expansively interpreted Z-factor makes the utility even more inclined to overuse specialized two-part tariffs as a tool for responding to competition. The utility knows that the Z-factor grants it the flexibility to raise the prices of its inelastically demanded services to recover the stranded costs it has created by offering specialized two-part tariffs. Pricing flexibility of this type most assuredly improves the odds that the utility will actually recover the stranded costs that it created. Consequently, the utility is eager to make improper offers of specialized tariffs to retain retail customers that should be served elsewhere.

The following discussion explains why the mechanics of specialized two-part tariffs, as affected by price-cap regulation with a Z-factor, support an incentive for the utility to make excessive improper offers of these tariffs. The Z-factor puts the utility in a better position to cover the stranded costs created by the offer and acceptance of these tariffs. Recall, it can exercise more flexibility in terms of rate increases for inelastically demanded services. If market forces do not place ceilings on these rates that are **lower** than the rate ceilings that are implied by any reasonable Z-factor, then the utility is able to implement the maximum rate increases for inelastically demanded services. Consequently, the utility has an incentive to overuse specialized two-part tariffs. This overuse is observed on two levels. First, the utility makes more attractive offers to customers that should be offered a specialized two-part tariff. Second, the utility makes more offers to customers that should not be offered a targeted discount. This behavior is supportable as the utility finds it easier to raise the rates of goods and services that are consumed by customers with inelastic demands.

Optional, Self-Selecting Two-Part Tariffs Can Strand Costs

One of the intriguing aspects of an optional, self-selecting two-part tariff is the opportunity that it provides for the recovery of stranded costs without having to increase the standard rates for customers with inelastic demands.[19] The basic assertion is that the profit received from the sale of additional units of electricity under the optional tariff can be used to offset the stranded costs created by the offer and acceptance of specialized tariffs. Although this claim is seductive, its validity is questionable when the availability of optional, self-selecting two-part tariffs creates stranded costs. If this condition exists, then the utility's offers of these tariffs must increase its profits. There must be new money available to offset the stranded costs that are created by two-part tariffs.

Unfortunately, an optional, self-selecting two-part tariff can also create stranded costs. This possibility arises when the construction of this tariff proceeds on the basis of customer classes. In this instance, the "indifference" characteristic is tied to the usage characteristics of the average customer in the pertinent customer class. Because all customers in the customer class are not apt to be average customers, there will be some below-average and some above-average users in the class. It is the above-average users that represent the potential for the creation of stranded costs.

The following system of equations shows precisely why the above-average user is in the position to create stranded costs. The key inequality in this system is equation 7. It indicates that the above-average user pays less to the utility, after selecting an optional two-part tariff, if the quantity of electricity demanded by this customer remains the same after he switches to an optional two-part tariff.[20] This condition ensures that an above-average customer can consume more electricity under the optional tariff than under the standard tariff for the same amount of money. Working backward from this

---

[19] Anna P. della Valle and Miles O. Bidwell Jr., "Restructuring Rates Creates Value and Reduces Stranded Costs," *The Electricity Journal* (December 1995): 19.

[20] This specification of post-selection payments to the utility differs from the Bidwell-della Valle (BdV) specification. The BdV specification requires that $rq^o = K + kq^o$ for every customer on the utility's network. If k is the same for every customer on the network, then the BdV specification implies that a customer's K is higher when her initial consumption level, q^o, is higher. This result is obtained from the condition that $K = q^o(r - k)$ for every customer under the BdV specification. A similar argument demonstrates that k varies for each customer on the utility's network when K is held constant for each customer. Of course, there is no particular reason why either K or k has to be held constant across customers and customer classes. Therefore, the BdV specification implies the existence of a huge set of optional, self-selecting two-part tariffs. Our specification requires only that $K = q^o(r - k)$ for the average customer in a rate class. Because there are fewer rate classes than utility customers, our specification implies a set of optional, self-selecting two-part tariffs that is a proper subset of the set of two-part tariffs implied by the BdV specification. Therefore, the utility would have to construct fewer optional two-part tariffs under our specification as compared to the BdV specification.

result, we can see that the "first effect" of this customer's switch to an optional tariff is a decline in her total electricity bill. This outcome is guaranteed because the effective rate for this customer under the two-part tariff is lower than the effective rate this customer faces under the standard tariff. Of course, this first effect may never be observed by a third party. The lowered energy rate of the two-part tariff may cause this customer to increase her consumption of electricity to a new level that negates the initial reduction in her electricity bill.

$$r > k \tag{5}$$

$$q^n > q^o \tag{6}$$

$$rq^o > \mathrm{K} + kq^o \tag{7}$$

$$rq^o = \mathrm{K} + kq^o + k(q^n - q^o) \tag{8}$$

$$q^n - q^o = (rq^o - \mathrm{K} - kq^o)/k \tag{9}$$

$$q^n = [(rq^o - \mathrm{K} - kq^o)/k] + q^o \tag{10}$$

where

r is the usage-sensitive rate per kWh under the applicable standard tariff for the customer class.

k is the usage-sensitive rate per kWh under the pertinent optional, self-selecting two-part tariff.

q^n is the new amount of electricity consumed per month by the above-average user under the pertinent optional, self-selecting two-part tariff.

q^o is the original amount of electricity consumed per month by the above-average user under the standard tariff.

K is the nonusage-sensitive lump-sum fee under the pertinent optional, self-selecting two-part tariff.

Equations 5 through 10 show that q^n is the break-even consumption level for the above-average user under her pertinent optional tariff. However, q^n is not the break-even consumption level for the utility. To produce the additional (q^n - q^o) units of electricity, the utility had to incur additional cost equal to:

$$c(q^n - q^o) \tag{11}$$

where

c is the constant marginal cost of producing the additional units of electricity.

Therefore, the utility is looking to add consumption above q^n in the amount of:

$$k(q^{n'} - q^n) = c(q^n - q^o) \tag{12}$$

$$k > c \tag{13}$$

where

$q^{n'}$ is the electricity consumption above q^n required to recover the utility's additional cost of producing q^n rather than q^o units of electricity.

Obviously, this not the end of the adjustment process because the utility had to incur additional costs of $c(q^{n'} - q^n)$ to get the revenue to cover the additional $c(q^n - q^o)$. Consequently, the above-average user needs to increase her consumption again. Fortunately, the process converges to q^f when k is greater than c. Therefore, q^f represents the utility's break-even point for the above-average user that switches from the standard tariff to the pertinent optional, self-selecting two-part tariff. Clearly, it is true that:

$$q^f > q^n \tag{14}$$

Equations 11 through 14 show that an already above-average user must consume in excess of q^f units of electricity after she switches to the two-part tariff, if the utility is to increase its profits as a result of offering the optional tariff to this customer. Conversely, these equations show that the utility suffers a reduction in its profits if this user consumes less than q^f units of electricity after switching to the optional two-part tariff. Therefore, regulators have to worry that these tariffs may create stranded costs.[21] The tariffs will create these costs when the already above-average users switch to optional tariffs for the dual purposes of increasing their usage and lowering their total electricity bills.

The utility has to worry about the recovery of stranded costs that are created by optional, self-selecting two-part tariffs. If the utility is subject to price-cap regulation without a Z-factor, it has less incentive to underuse these tariffs because the form of regulation, on average, makes it more difficult for the utility to recover the stranded costs created by the optional, self-selecting tariff. Conversely, the utility is more inclined to underuse these optional tariffs when it is subject to price-cap regulation with a Z-factor.

The Welfare Effects of Two-Part Tariffs

The fact that a specialized two-part tariff can be offered improperly should not overshadow the fact that if used properly it can improve economic welfare.[22] This theme is developed in this section. Similarly, the fact that an optional, self-selecting tariff can create stranded costs should not overshadow the fact that this tariff can improve economic welfare. This theme also is developed in this section.

---

[21] There is no such thing as the overuse of optional, self-selecting two-part tariffs. The number of below-average and above-average users decreases as the number of optional, self-selecting tariffs increases. Consequently, regulators have to worry about the underuse of these tariffs after they have approved them as alternatives to the standard tariffs.

[22] A specialized two-part tariff is offered properly when it generates revenue that covers the service's variable cost of production and results in a revenue stream whose present value exceeds the present value of the revenue stream under the standard tariff.

Specialized Two-Part Tariffs

The purpose of a specialized two-part tariff is to stop an existing customer from leaving the utility for a competitor or to self-generate. The *status quo* is encouraged by providing the threatening customer with a rate discount that is engineered to produce a reduction in his total electricity bill, if he continues to consume the same amount of electricity after he accepts the specialized tariff. The engineering of this outcome is done through the judicious choice of a lump-sum, nonusage-sensitive fee for the opportunity to consume energy and usage-sensitive rates for the actual consumption of energy.

The utility's stockholders are harmed when the threatening customer accepts a specialized two-part tariff and does not alter his consumption level. The utility receives less money from the customer. Less revenue from the sale of the same amount of electricity means that the utility has less revenue to assign to the recovery of its costs. The principles of rational behavior by the utility require that it first assign its revenue to the recovery of variable costs and then assign what is left over to the recovery of fixed costs. Obviously, the utility's variable production costs have not changed because the customer's electricity consumption has not changed. As a result, the utility has less revenue to assign to the recovery of fixed costs because of the reduction in revenue due to the offer and acceptance of a specialized two-part tariff. These newly unsupported fixed costs represent the stranded costs that are created by the specialized two-part tariff. However, the logic of a properly offered specialized tariff implies that the harm to the stockholder is not as great as it would be if the utility did not offer this tariff to the threatening customer.[23] Therefore, the customer's contribution to the recovery of the utility's fixed costs attributable to the offer and acceptance of the specialized tariff denotes the stranded costs that are prevented by this tariff.

---

[23] Regardless of whether this outcome occurs, it is undeniable that the utility has successfully protected its workers and the utilization of its facilities when its specialized two-part tariff is accepted by the threatening customer, and this customer continues to consume the same amount of electricity. Clearly, the utility continues to use the same amount of labor and nonlabor resources because the customer that requested the specialized tariff continues to consume the same amount of electricity.

In theory, the specialized two-part tariff helps to prevent stranded costs through the effects that a declining effective rate for electricity has on the consumption of the threatening customer.[24] To explain these effects, we define the effective rate for a specialized two-part tariff by:

$$EP_{sp} = [L + eq]/q = L/q + e \qquad (15)$$

where

EP_{sp} is the effective rate for the specialized two-part tariff.

L denotes a lump-sum fee in dollars for the opportunity to consume electricity under the specialized tariff.

e denotes the energy rate in cents per kWh for the specialized tariff.

q denotes the amount of electricity consumed by the customer that has requested a specialized tariff.

Equation 15 shows that the ever-changing effective rate for this tariff is found by adding an unchanging lump-sum fee to the product of the energy rate and the quantity of electricity that the customer consumes under the specialized tariff, and then dividing this sum by the quantity of electricity consumed. It also describes why the effective rate under a specialized two-part tariff declines as the customer requesting this tariff increases his consumption level. The energy rate, e, is the same number for any quantity, q, that is consumed under the specialized two-part tariff. Meanwhile, L/q decreases as q increases. Consequently, $L/q + e$ must decrease as q rises. Furthermore, this equation implies that the decline in the effective rate for electricity occurs rapidly at first, becoming slower and slower as the customer increases his consumption level. For example, the effective rate for the first unit of electricity consumption for a specific month is $L/\mathbf{1} + e$. The effective rate for the second unit of

[24] The construction of a specialized two-part tariff implies that the schedule for the declining effective rate for electricity is unique to the customer that is threatening to leave the utility.

consumption in that month is $L/\mathbf{2} + e$. The effective rate for the third unit is $L/\mathbf{3} + e$, and so on. Eventually, the customer that has accepted the specialized two-part tariff consumes his last unit of electricity, **n**, for the month at the effective rate of $L/\mathbf{n} + e$.

The phenomenon of rate declines occurring at a slower and slower pace presents the customer on a specialized tariff with an incentive to consume a minimum amount of monthly electricity. To find the minimum level of consumption, we need to know the effective rate for electricity under the standard tariff. If the standard tariff in question contains only one usage-sensitive rate, u, for any consumption level, q, then EP_{st}, the effective rate under the standard tariff, is simply u.

It would be irrational for a customer that has accepted a specialized two-part tariff to consume at a level q^0, where the effective rate under the specialized tariff is larger than the effective rate under the standard tariff. To show this, let the customer consume a level of electricity such that:

$$L/q^0 + e > u. \qquad (16)$$

Because this customer could do better under the standard tariff, it would be in his best interest to purchase electricity under the standard tariff. Therefore, any q^0 satisfying equation 16 is less than the minimum level of consumption for a rational customer that has accepted a specialized two-part tariff.

Equation 16 suggests that the minimum level of consumption for a rational customer under a specialized tariff satisfies the equality:

$$L/q^m + e = u \qquad (17)$$

where

q^m is the minimum level of consumption for a rational customer that has accepted a specialized two-part tariff.

At q^m, the customer is paying the same effective rate for electricity as he would under the standard tariff. For any $q^0 < q^m$, this customer is paying a higher effective rate for electricity under the specialized tariff as compared to the standard tariff. Therefore, q^m represents the minimum consumption by a rational customer under the specialized tariff.

The minimum consumption level, q^m, is a critical consumption level in the sense that any consumption beyond q^m implies an effective rate for electricity under the specialized tariff that is less than the effective price of electricity under the standard tariff. That is,

$$L/q^1 + e < u \tag{18}$$

where

q^1 is any consumption level beyond q^m.

Equation 18 implies that the effective rate for electricity under a specialized two-part tariff is less than the effective rate for electricity under the standard tariff at the threatening customer's consumption level under the standard tariff. To show this, we note that the construction of the specialized tariff guarantees that the utility receives revenue such that:

$$q^{st}[L/q^{st} + e] < uq^{st} \tag{19}$$

where

q^{st} is the threatening customer's level of consumption under the standard tariff.

As a result, it is true that:

$$L/q^{st} + e < u \tag{20}$$

It is easily shown using Equations 17 and 20 that the threatening customer's minimum level of consumption under the specialized tariff is smaller than that customer's level of consumption under the standard tariff. Meanwhile, equation 19 implies that the threatening customer will consume at least q^{st}. After all, this customer is paying less under the specialized tariff to consume this level of production.

If the threatening customer's demand for electricity is not perfectly inelastic, then the lower effective rate, EP_{sp}, at the consumption level, q^{st}, implies that this customer will increase his consumption beyond q^{st} to some level q^{1}. The additional consumption, $q^{1} - q^{st}$, definitely causes the utility to incur additional variable costs, $vc^{1} - vc^{st}$. If the additional consumption does not cause the utility to incur additional fixed costs, then a customer who has accepted a specialized two-part tariff provides an additional contribution to the recovery of the utility's fixed costs when the energy charge is larger than the average variable cost associated with the additional production of electricity. That is,

$$e > [vc^{1} - vc^{st}]/[q^{1} - q^{st}] \qquad (21)$$

where

$[vc^{1} - vc^{st}]/[q^{1} - q^{st}]$ is the average variable cost that is associated with the threatening customer's consumption under the specialized tariff that is above its break-even level.

Equation 21 implies that the utility earns a new revenue stream that exceeds the new variable cost stream. The excess of revenue over variable cost is the contribution to the recovery of fixed costs. Therefore, sufficient stimulation with proper cost characteristics helps to prevent stranded costs.

The driving force behind a specialized two-part tariff is that an existing customer of the utility is threatening to leave the system. If this customer leaves because he is not offered an acceptable specialized tariff, and if everything else is equal, it must be true that more of the utility's fixed costs are unsupported. Consequently, the utility's profits will decline. Presumably, profits will increase for the company that has "won" the utility's former customer. Also, the switching customer presumably will pay a lower price for electricity. Consequently, there definitely is a gain in consumer surplus after the switch. However, there may not be a gain in producer surplus because the utility may lose more profits than its competitor wins. Given this uncertainty, it is useful to know the conditions under which the offer and acceptance of a specialized two-part tariff always improves economic welfare.

Several simple conditions establish an improvement in economic welfare after the offer and acceptance of a specialized two-part tariff. The first condition is that the competitor's profits increase by more than the decrease in the utility's profits. This condition ensures an increase in producer surplus. The second condition is that the threatening customer is charged a lower effective rate under the specialized tariff. This condition ensures an increase in the threatening customer's consumer surplus. The third condition is that the utility does not increase any of its other rates to recover any lost profits. This condition establishes that no one else suffers a reduction in his consumer surplus because of the offer and acceptance of the specialized two-part tariff. These three conditions allow us to construct the following system of equations that represents a strict increase in economic welfare when the utility has two customers.

$$P^c_s - P^c_0 = 0 \tag{22}$$

$$P^u_s - P^u_0 < 0 \tag{23}$$

$$C^i_s - C^i_0 > 0 \tag{24}$$

$$C^j_s - C^j_0 = 0 \tag{25}$$

$$(P^u_s - P^u_0) + (C^i_s - C^i_0) > 0 \tag{26}$$

where

P^c_s is the competitor's producer surplus after the customer switches to the specialized two-part tariff.

P^c_0 is the competitor's producer surplus before the customer switches to the specialized two-part tariff.

P^u_s is the utility's producer surplus after the customer switches to the specialized two-part tariff.

P^u_0 is the utility's producer surplus before the customer switches to the specialized two-part tariff.

C^i_s is the threatening customer's consumer surplus after he switches to the specialized two-part tariff.

C^i_0 is the threatening customer's consumer surplus before he switches to the specialized two-part tariff.

C^j_s is the other customer's consumer surplus after the threatening customer switches to the specialized two-part tariff.

C^j_0 is the other customer's consumer surplus before the threatening customer switches to the specialized two-part tariff.

If the utility's other customer had an inelastic demand for its service, then there is not any reason why the utility would not attempt to raise the rate for this customer in an effort to recover the costs that have been stranded by the offer and acceptance of a specialized two-part tariff. If the utility was to act in this manner, then the next set of equations guarantees an improvement in economic welfare.

$$P^c_s - P^c_0 = 0 \tag{27}$$

$$P^u_s - P^u_0 < 0 \tag{28}$$

$$C^i_s - C^i_0 > 0 \tag{29}$$

$$C^j_s - C^j_0 < 0 \tag{30}$$

$$(C^i_s - C^i_0) + (C^j_s - C^j_0) + (P^u_s - P^u_0) > 0 \tag{31}$$

where

$(C^i_s - C^i_0)$ is the value of the increase in consumer surplus enjoyed by the customer that is threatening to leave the utility.

$(C^j_s - C^j_0)$ is the value of the decrease in consumer surplus suffered by the utility's other customer.

$(P^u_s - P^u_0)$ is the value of the decrease in the utility's profits after the offer and acceptance of a specialized two-part tariff and the imposition of rate increases on the customer with the inelastic demand for service.

Equations 27 through 31 demonstrate that the recovery of stranded costs from a customer with an inelastic demand complicates the dynamics of achieving an improvement in economic welfare. The utility recaptures some of the profits it lost as a result of the offer and acceptance of the specialized two-part tariff by charging a higher rate to the customer with the inelastic demand. Everything else equal, this outcome improves economic welfare. However, the higher rate to the consumer with an inelastic demand recaptures some of the gain in economic welfare. Specifically, only a portion of the gain in economic welfare is recaptured when the amount of recaptured profits exceeds the decrease in the consumer surplus that is realized by the customer with the inelastic demand. All of this gain is recaptured when the recaptured profits equal the aforementioned decrease in consumer surplus. Finally, it is harder for the offer and acceptance of a specialized two-part tariff to result in an improvement in economic welfare when the decrease in the consumer surplus that is realized by the customer with the inelastic demand exceeds the amount of recaptured profits.

The following system of equations describes the conditions for an improvement in economic welfare when the utility is able to recapture all of its lost profits from the customer with the inelastic demand. Simply, it is the condition that the gain in consumer surplus by the threatening customer exceeds the loss of consumer surplus experienced by the customer with the inelastic demand for service. It should be noted that this result often is mistaken for the condition that underlies the inverse-elasticity test for rate increases to recover costs that are unsupported under marginal-cost pricing.[25] The inverse-elasticity condition is that selected departures from marginal-cost pricing should minimize the loss of economic welfare.

$$P^c_s - P^c_0 = 0 \tag{32}$$

$$P^u_s - P^u_0 = 0 \tag{33}$$

$$C^i_s - C^i_0 > 0 \tag{34}$$

$$C^j_s - C^j_0 < 0 \tag{35}$$

[25] Baumol and Bradford, "Optimal Departures from Marginal Cost Pricing," 350.

$$(C^i_s - C^i_0) + (C^j_s - C^j_0) > 0 \quad (36)$$

The last system of equations shows what is necessary for an improvement in economic welfare when the utility is able to recapture more than its lost profits from the customer with the inelastic demand. Simply, it is the condition that the gain in consumer surplus by the threatening customer and the gain in the utility' profits exceeds the loss of consumer surplus experienced by the customer with the inelastic demand for service. Obviously, the utility finds it easier to offer specialized two-part tariffs to threatening customers and improve economic welfare when it can freely increase the rates for inelastically demanded services.

$$P^c_s - P^c_0 = 0 \quad (37)$$

$$P^u_s - P^u_0 > 0 \quad (38)$$

$$C^i_s - C^i_0 > 0 \quad (39)$$

$$C^j_s - C^j_0 < 0 \quad (40)$$

$$(P^u_s - P^u_0) + (C^i_s - C^i_0) + (C^j_s - C^j_0) > 0 \quad (41)$$

Optional, Self-Selecting Two-Part Tariffs

An optional, self-selecting two-part tariff is not designed to change the mind of a customer that already is threatening to leave the utility. Instead, this tariff is meant to stimulate the use of electricity by existing customers that expect to stay with the utility. However, as previously demonstrated, this does not mean that the utility does not have to worry about lost profits after it offers an optional, self-selecting two-part tariff to a specific class of customers. Consequently, the effect of this tariff on economic welfare is similar to the effect on economic welfare of the specialized two-part tariff. The prime difference is that the utility may have to worry less about lost profits when it offers the optional two-part tariffs.

An optional, self-selecting two-part tariff brings an additional complication to the study of economic welfare that is not present when a specialized two-part tariff is under consideration. Because an optional tariff causes the utility to increase the production of its services, it has to worry whether the additional revenue it receives as a result of offering this tariff exceeds the additional cost it incurs when it increases its production of services.

The preceding discussion of the philosophy and mechanics of this tariff established that it is irrational behavior on the part of an already below-average user to select the optional tariff when this user intends to remain a below-average user. The only thing that a below-average customer can expect under these circumstances is an increase in her electricity bill. However, it is rational behavior to switch the optional tariff for every other type of customer who is not threatening to leave the utility. These results indicate that four situations have to be examined to determine the conditions for an improvement in economic welfare under an optional, self-selecting two-part tariff.

It will be useful to recall some notations before we begin this examination.

- q is the actual amount of electricity consumed per month by the customer under the optional, self-selecting two-part tariff.
- q^{ba} is the actual amount of electricity consumed per month under the optional tariff by the below-average user in the customer class.
- q^a is the actual amount of electricity consumed per month by the average customer for the customer class in question.
- q^{aa} is the actual usage level for the above-average user in the customer class.
- K is a nonusage-sensitive fee for the recovery of fixed costs.
- K is measured in dollars.
- k is a usage-sensitive rate for the recovery of variable costs.
- k is measured in cents per kWh.
- The customer's monthly total electricity bill under the optional tariff is $K + kq$.
- The customer’s monthly effective rate is $K/q + k$.
- vc^{ba} is the variable costs that the utility incurs for the below-average-usage

customer.

- vc^a is the variable costs that the utility incurs for the average-usage customer.

- vc^{aa} is the variable costs that the utility incurs for the above-average-usage customer.

- r is the usage-sensitive rate per kWh under the applicable standard tariff for the customer class.

The first situation deals with a below-average-usage customer that becomes an above-average-usage customer as a result of the optional tariff. The indifference characteristic ensures that this customer pays an effective rate, $K/q + k$, equal to the standard rate, r, when he or she consumes the average amount of electricity, q^a. Therefore, this customer's total electric bill is the same under either tariff at q^a. Since k is selected to be greater than $(vc^{aa} - vc^{ba})/(q^{aa} - q^{ba})$, this customer's switch to an optional tariff represents an increase in the utility's profits. There is no change in the profits of the utility's competitors. Similarly, there is no change in the consumer surplus realized by the other customers of the utility. However, the customer on the optional tariff experiences an increase in her realized consumer surplus because r is greater than k.

The preceding results clearly indicate an unambiguous gain in economic welfare when a below-average user becomes an above-average user after selecting the optional two-part tariff. The following system of equations represents this welfare gain.

$$P^u_{aao} - P^u_{bas} > 0 \tag{42}$$

$$C^{aa}_o - C^{ba}_s > 0 \tag{43}$$

where

P^u_{aao} is the utility's profits after the below-average user becomes an above-average user as a result of the optional tariff.

P^u_{bas} is the utility's profits before the below-average user becomes an above-average user as a result of the optional tariff.

C^{aa}_o is the customer's consumer surplus after becoming an above-average user as a result of the optional tariff.

C^{ba}_{s} is the customer's consumer surplus before becoming an above-average user as a result of the optional tariff.

The second situation deals with an average-usage customer that becomes an above-average-usage customer as a result of the optional tariff. Exactly the same analysis applies to this situation as applied to the first situation. Therefore, the second situation also represents an unambiguous gain in economic welfare when a customer of this type selects the optional two-part tariff over the standard tariff.

The third situation deals with an above-average customer that increases her consumption of electricity and lowers her total electricity bill after selecting the optional two-part tariff. Once again, the customer experiences an increase in her realized consumer surplus because *r* is greater than *k*. Consequently, there is a gain in economic welfare under the optional two-part tariff when the increase in consumer surplus exceeds the decrease in the utility's profits. The following system of equations describes this situation.

$$P^{u}_{aao} - P^{u}_{aas} < 0 \qquad (44)$$

$$C^{aa}_{o} - C^{aa}_{s}) > 0 \qquad (45)$$

$$(P^{u}_{aao} - P^{u}_{aas}) + (C^{aa}_{o} - C^{aa}_{s}) > 0 \qquad (46)$$

where

P^{u}_{aao} is the utility's profits after the above-average user selects the optional tariff.

P^{u}_{aas} is the utility's profits before the above-average user selects the optional tariff.

C^{aa}_{o} is the above-average user's consumer surplus after she selects the optional tariff.

C^{aa}_{s} is the above-average user's consumer surplus before she selects the optional tariff.

The fourth situation deals with an above-average customer that increases her consumption of electricity and increases her total electricity bill after selecting the optional two-part tariff. As usual, the customer experiences an increase in her realized consumer surplus because *r* is greater than *k*. Also, the utility realizes an increase in its profits because *k* is selected such that it is greater than $(vc^{aa}_o - vc^{aa}_s)/(q^{aa}_o - q^{aa}_s)$. Therefore, there is the usual gain in economic welfare under the optional two-part tariff. The following system of equations describes this situation.

$$P^u_{aao} - P^u_{aas} > 0 \tag{47}$$

$$C^{aa}_o - C^{aa}_s > 0 \tag{48}$$

Three of these four situations imply that there are many configurations of an optional, self-selecting two-part tariff that represent improvements in economic welfare. However, the third situation considered above implies that there are some tariff configurations that represent degradations in economic welfare. Although it is uncertain which situations will emerge after an optional tariff is made available to a specific class of customers, it is certain that the keys to achieving an improvement in economic welfare are inducing already below-average users to become above-average users and inducing the already above-average users to substantially increase their consumption levels. This fact suggests that the optional tariffs will have to contain a usage-sensitive rate, *k*, that is discounted substantially from the usage-sensitive rate, *r*, found in the standard tariff.

Concluding Remarks

The utility does not have to prevent the loss of every customer that threatens to switch to a competitor. Instead, it should use specialized two-part tariffs to retain customers only when it is in its economic interests to do so. The utility should not attempt to stimulate the usage of all types of customers. Rather, it should attempt to stimulate the usage of those customers that are expected to increase its profits. However, it may be in the interests of society to stimulate the usage of all customer types and to offer a specialized tariff whenever the revenue received exceeds the variable costs of production. Economic welfare can be improved even when the utility is fully recovering (or more than fully recovering) the stranded costs that are created by specialized two-part tariffs.

Economic welfare is the sum of producer surplus and consumer surplus. Therefore, reductions in profits can be offset by increases in consumer surplus. Meanwhile, the recapture of lost producer surplus can be balanced by very large increases in consumer surplus attributable to these two types of two-part tariffs. However, there is a complication when an increase in economic welfare is used as the determinant of whether an activity is good or bad. Producer surplus is profit. Profit is a directly observable value. Consumer surplus is the benefit that a customer receives by paying a price for electricity that is lower than what this customer would have been willing to pay to consume electricity. Consumer surplus cannot be directly observed for any particular consumer, but a change in consumer surplus can be measured if we have a reliable geometry of the shape of that customer's demand schedule. However, reliable geometries of the shapes of individual demand schedules are hard to come by. Consequently, it is difficult to really know whether or not economic welfare has been improved by the introduction of specialized two-part tariffs and optional, self-selecting two-part tariffs.

Our inability to say that all switches from single-part tariffs to two-part tariffs improve economic welfare is a serious shortcoming because we have demonstrated that specialized and optional two-part tariffs can create stranded costs. In the case of specialized tariffs, stranded costs are created to retain the customer on the network. In the case of optional two-part tariffs, stranded costs are created when (a) this tariff is developed for the average-usage customer in the rate class, (b) an above-average-usage customer selects the optional two-part tariff, and the above-average-usage customer, after selecting the optional two-part tariff, does not significantly increase his consumption. Consequently, regulators must worry about two potential "free-rider problems." The first potential problem is that the majority of customers that self-select the optional two-part tariff may be above-average-usage customers that intend to use this decision to lower their total electricity bill **and** increase their consumption. This was the intention of those AT&T customers that selected the optional calling plans over the standard calling plans. The second potential problem is that the utility may offer too many specialized two-part tariffs to customers that should not be offered this alternative. That is, the utility might offer a specialized tariff even when the present value of the utility's expected revenue stream under the standard tariff is greater than the present value of the utility's expected revenue stream under the specialized tariff. The utility might make such a choice for reasons that are unrelated to the utility's revenue and profit. If the utility's management expects criticism from its regulators and Board of Directors after losing a large customer to a competitor, then the utility's management may be too quick to offer a specialized two-part tariff to a customer that is threatening to leave the utility. If the utility's management expects sharp drops in the utility's stock price after losing a large customer to a competitor, then these individuals will lose a large customer only when they are absolutely certain that the utility will be made better off by this event. In this case, the condition for allowing the loss of a large customer to a competitor is that the utility's management must be certain that the present value of the utility's revenue stream under the standard tariff is greater than the present value of the utility's revenue stream under the specialized tariff.

This second form of free-riding is easier for the utility's management to tolerate when it expects to recover all the stranded costs it has created by offering specialized two-part tariffs. Therefore, the second potential "free-rider problem" can be very real under price-cap regulation that allows the full recovery of stranded costs via the Z-factor. This possibility suggests that regulators have to be concerned about too lax a policy for offering specialized two-part tariffs when they permit these tariffs to exist along side of the Z-factor. Their concern arises because it is almost certain that the Z-factor will be the cause of additional upward pricing flexibility for the utility. More likely than not, this additional flexibility will be used to increase the prices of inelastically demanded services for the purpose of recovering stranded costs. Quite naturally then, the Z-factor provides the utility with an incentive and opportunity to overuse specialized two-part tariffs as its response to competition because it does not have to worry much about the recovery of stranded costs.

The only checks on the Z-factor are regulatory and market forces that prevent price increases for inelastically demanded services. Therefore, the utility discovers what is in its best interests with respect to offering two-part tariffs by using a three-stage process. In the first stage, the utility determines the magnitude of the stranded costs that it creates by offering these tariffs. In the second stage, it ascertains the amount of these stranded costs that it can recover through pricing flexibility under the Z-factor. If any stranded costs remain unrecovered, then the utility decides whether it can exercise some cost efficiencies to make up the cost-recovery shortfall. If the sum of cost declines and revenue growth under the Z-factor is sufficient to cover the utility's stranded costs created by the offers of specialized and optional two-part tariffs, then it is clear that the utility will have to choose between a slower increase in its profits versus the strategic gains from keeping its customers and stimulating its production. This choice is required since a decision to strand costs means that the utility's profits will rise less rapidly because fewer of its cost reductions are being converted to profits.