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THREE ESSAYS ON MERGER POLICY AND REGULATORY POLICY

A dissertation presented

by

Evgenia Shumilkina

to The Department of Economics

In partial fulfillment of the requirements for the degree of Doctor of Philosophy

in the field of

Economics

Northeastern University Boston, Massachusetts September, 2010 Dedicated to my parents, Elena and Anatoly

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by

Evgenia Shumilkina

ABSTRACT OF DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Graduate School of Arts and Sciences of Northeastern University, September, 2010

The first chapter of my dissertation focuses on the mergers that eliminate potential competition. The effects of mergers, including mergers in the airline industry, have been examined in a number of papers, but none has directly estimated the effect of a merger that eliminates a potential competitor. The first chapter of my dissertation examines this type of mergers by analyzing the 1987 merger of USAir and Piedmont. We focus on routes served by one carrier where the other served one or both endpoints and hence was advantageously position to enter service. Comparing several quarters of operation before and after the merger, we find that elimination of a potential competitor permits a 5.0 to 6.0 percent price increase – less than the 9.0 to 10.2 percent increase where they were direct competitors, but important nonetheless. This result has important policy implications for antitrust policy in the U.S. and other jurisdictions. Current policy treats the elimination of potential competition quite differently and rather cautiously relative to actual competition effects. Indeed, in the U.S. no mergers have been challenged specifically on potential competition grounds for some time. This approach has been prompted in part the lack of direct evidence of the effect of potential competitors and of their elimination. The results of this chapter present the first direct empirical evidence of anticompetitive effects from elimination of potential competition through mergers. This research should help inform the policy debate on potential competition.

The other two chapters of my dissertation focus on the events in the electric industry that took place in the last 10-15 years.

The second chapter examines the state of reliability of electric service, and how it was

affected by the introduction of incentive regulation. Incentive regulation mechanisms are expected to lower utility costs. However, these mechanisms can have an adverse side effect on quality of service. This chapter examines the effects of incentive regulation plans on frequency and duration of electric outages in the period from 1994 to 2006. The study finds that incentive regulation is associated with deterioration of electric service both in terms of duration of outages and their frequency. Implementation of incentive regulation results in an increase in duration of outages by about 17 minutes (given the average number of outages, this corresponds to an increase of about 13 percent) as well as in an increase in the average number of interruptions by about .08 times (approximately 7 percent increase). The other question that the study asks is whether these adverse effects can be mitigated with the help of quality provisions that bear financial consequences for utilities. The results indicate that quality provisions help to restore the level of reliability in terms of duration of outages. These provisions, however, are not capable of mitigating negative impact of incentive regulation on frequency of outages. By extending the knowledge about the effects of incentive regulation on quality of electric service the results of the research send a note of caution to regulators that consider introduction of incentive regulation.

The third chapter of my dissertation examines the effects of mergers with claims of cost savings on utilities' operating costs. Merging utilities often promise significant cost savings in the documents they present to the state public utilities commissions in order to secure a merger approval. They usually name the following sources of merger benefits: administrative savings, corporate savings, purchasing economics, labor-related savings, fuel savings, business optimization, and strategic benefits. The main task of the research was to examine whether mergers with claims of cost savings have effect on utilities' operating costs. The results indicate that mergers that were expected to result in cost savings did not perform any better in terms of the level of operating costs than mergers that did not claim any savings. The question of whether there are any scale-related effects of mergers is outside the scope of this study. The implication for the public policy from the results of the study is that claims of merger savings should be viewed carefully. Regulators might consider requiring merging utilities to provide more evidence on the forecasted cost savings.

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CHAPTER 1

The Price Effect of Eliminating Potential Competition: Evidence from an Airline Merger

(together with John Kwoka of Northeastern University)

1. Introduction

Analysis of the competitive effects of horizontal mergers has undergone profound change in economics and policy over the past twenty-five years. Theoretical and empirical reconsideration of the roles played by concentration, market shares, entry barriers, and other factors have narrowed the focus of antitrust on the U.S. economy. One of the areas affected by this reconsideration has been mergers involving an incumbent firm and a non-incumbent that is positioned to enter the market - a so-called potential entrant. Once a common policy concern, the elimination of potential competition is now much less often an important consideration in merger proceedings. One reason for this diminished attention is the paucity of evidence on the effect of potential competition in general and certainly on the effect of elimination of such competition as a result of merger.

This lack of direct evidence about potential competition contrasts with a growing body of literature demonstrating that at least some mergers of actual competitors can lead to price increases.¹ But if eliminating an actual competitor can relax a competitive constraint and allow price to increase, the analogous scenario involving a merger between an incumbent firm and a potential entrant would seem to raise similar, though not identical, concerns. Certainly, to the extent that a non-incumbent firm can enter relatively quickly, cheaply, and effectively, it may represent a competitive constraint on incumbent firms analogous to that posed by an actual

¹ This literature includes cross-sectional, industry-specific, and individual merger studies. See Gugler et al (2003), Pesendorfer (2003), and Borenstein (1990) as examples of each. Here and throughout the term "merger" should be interpreted as encompassing acquisition as well, the difference not being relevant for present purposes.

competitor. In that case, its elimination by merger might also be expected to permit an increase in price.

This paper provides the first direct evidence of the effect on incumbent pricing from the elimination of potential competition. Our evidence derives from a merger in the airline industry, a setting chosen for familiar reasons: there are a great many city-pairs or routes that may be taken as markets. These exhibit a wide range of firm pairings, market shares, concentration, and other characteristics. And detailed data on prices, route characteristics, and identity of carriers are available. Indeed, it is for these reasons that the airline industry is often the setting for examination of the price effect of market concentration, of potential competition, and of mergers between incumbents. In contrast to previous studies, we shift attention to the price effect where one of the merging parties is an incumbent and the other a potential entrant. In these markets the merger does not alter concentration or shares among incumbents. Its sole effect - if any - derives from eliminating a possible entrant and relaxing the competitive constraint it may impose on incumbent pricing behavior. Our question is a simple one: What is that effect?

This study examines the 1987 merger between USAir (now US Airways) and Piedmont Airlines. We examine all routes in the country, categorizing each route by the relationship between USAir and Piedmont on that route at the time of the merger. The possibilities include, of course, routes where they were both incumbents as well as others where neither was present. Most important for present purposes are the routes served by one carrier with the other a potential entrant. We follow past practice in defining a potential competitor as a carrier serving either or both endpoint cities on the route, but obviously not the route itself. The expectation, also based on previous studies, is that endpoint presence identifies carriers that can most readily enter, are therefore most likely to affect incumbent behavior, and whose elimination is consequently most likely to permit an increase in price by incumbents.

Our data are largely taken from the Department of Transportation's ten percent ticket sample. We have more than 23,000 observations on individual carrier prices by routes throughout the U.S. in each of four quarters prior to the USAir-Piedmont merger and in each of four quarters after integration of their operations. The use of multiple quarters before and after the merger is designed to minimize data anomalies that inevitably arise in any single quarter. In principle, there should be about 180,000 possible observations, but gaps in quarterly data reduce the total to approximately 132,000. We estimate a difference in differences model, comparing fares before and after the merger on routes where a potential competitor was eliminated with before-and-after prices on other routes. We use both pooled OLS and also fixed and random effects, obtain essentially equivalent results.

As noted, our key question is: What is the effect on price when an incumbent firm merges with a potential entrant into the same market? Our analysis indicates that where one of the carriers was a potential entrant into a route served by the other merger partner, the USAir-Piedmont merger allowed the incumbent to raise price by an amount between 5.0 and 6.0 percent. This increase is statistically significant in all model specifications and establishes that the elimination of a potential competitor can have a very considerable impact on market price. This result should be compared to the price change on routes where both carriers had previously operated. There the merger eliminated an actual competitor, and prices increased between 11.1 and 12.1 percent, more than twice the increase from eliminating a potential competitor.

Further analysis investigates variations on this basic finding. These variations include possible differences in the effect in cases involving large vs. small incumbents, large vs. small potential competitors, different degrees of market concentration, one-endpoint vs. two-endpoint potential entrants, large vs. small rivals, and USAir vs. Piedmont as the incumbent. We find some interesting and important nuances from these further inquiries, although the price effects from eliminating a potential competitor are robust to all variations in specification.

The next section of this paper provides background on the potential competition and airline mergers, including USAir-Piedmont. Section III sets out the data, model, and results of the empirical analysis. Section IV concludes.

2. Potential Competition and Airlines

The present study draws on theory and evidence concerning potential competition, together with experience with mergers in the airline industry. This section provides some background with respect to each of these issues, concluding with discussion of the USAir-Piedmont merger.

2.1. Theory of Potential Competition

Models of price determination in oligopoly markets generally focus on the interaction among incumbent firms, but simple extension of the standard formulation illustrates the closely parallel role of a non-incumbent. To see this, consider a single incumbent firm *i*, with profits defined as $\pi_i = x_i p(X) - C(x_i)$. Here x_i denotes its output, and $C(x_i)$ its total costs. The term p(X)is market demand, where $X = \sum x_i$. This firm's first order condition is then given by $p(X) + q_i$ $[\delta p(X)/\delta x_i] = \delta C/\delta x_i$, where $\delta C/\delta x_i$ denotes marginal cost and $\delta p(X)/\delta x_i$ measures the effect on market price of firm i's own output change. This latter term can be rewritten as follows:

$$\delta p(X) / \delta x_i = \left[\delta p(X) / \delta X \right] \left[\delta X / \delta x_i \right] \tag{1}$$

where $\delta p(X)/\delta X$ is now simply the slope of the demand function and $\delta X/\delta x_i$ measures the total market quantity change resulting from firm i's output initiative. As is well-known, $\delta X/\delta x_i$ can be written as $[1 + \delta X_{ii}/\delta x_i]$ where $\delta X_{ii}/\delta x_i$ is the conventional conjectural variation.²

One method of characterizing oligopoly theories is to assume different values of the conjectural variation. Each corresponds to a different expectation about the response behavior of the firm's rivals, and thus the different degrees to which they represent competitive constraints on firm *i*'s output choice. By extension, we can also characterize possible responses by firms not presently producing in the market - that is, firms for which $x_j = 0$. To the extent that these might initiate production in response to the incumbent action, the incumbent's conjectural variation with respect to those potential entrants will be non-zero and hence will matter.

This can be made explicit by decomposing the conjectural variation as follows:

 $^{^{2}}$ The conceptual limitations of the conjectural variation are well-known. It is perhaps best interpreted simply as a summary statistic for the output responses of rivals and is used here for its expository value.

$$\delta X_{i}/\delta x_{i} = \delta x_{I}/\delta x_{i} + \delta x_{N}/\delta x_{i}$$
⁽²⁾

The first right-hand side term measures the usual expected output response from other incumbents I, while the second term is the expected output response from non-incumbents N, that is, from potential competitors. To the extent that the latter is non-zero, those firms' likely output responses are as relevant to firm *i*'s profit-maximization problem as are the responses of other incumbents. At a first approximation, it therefore follows that the elimination of a non-incumbent that affects incumbent price setting will result in a relaxation of that constraint and a rise in price.³

Two observations are relevant here. First, the prediction that potential competition constrains incumbent behavior is shared by a wide variety of oligopoly models. The Cournot, Bertrand, and Stackelberg models, models of strategic entry deterrence, and others all predict that under a wide variety of circumstances the elimination of a constraining competitor will alter competition among incumbents and hence alter market prices (Kwoka, 2008). One obvious exception is that when the market is itself quite competitive, any further constraint from a potential competitor may be redundant and hence its elimination will not have market consequences.

Second, the impact of a potential competitor on pricing need not be, and indeed is not

³ The constraining potential competitor described here differs from the non-incumbent that is *not* perceived as a likely entrant but, absent the merger, would in fact have entered. The elimination of the latter type of firm does not alter current pricing, because it is not recognized as a likely entrant, but its elimination nonetheless has competitive consequences by preventing future deconcentration of the market. We will not consider this latter case - sometimes called an "actual potential competitor" or a "prospective competitor" - further.

likely to be, quantitatively identical to that of an incumbent. The non-incumbent firm has alternative markets in which to operate, has no costs that are sunk in the market in question, and hence is in no sense committed to operation in it. Knowing that, the incumbent firm is less likely to be constrained in its pricing by a potential entrant than by an actual competitor, cet. par. This implies that the elimination of such a potential competitor through merger is likely to have a smaller effect on pricing than the effect from merging with a direct and actual competitor. We shall cast light on this issue, among others, in this study.

2.2. Evidence Concerning Potential Competition

We have found no studies directly measuring the price effect of eliminating a potential entrant by merger. That potential competition matters is usually inferred from the empirical literature examining the effect of the existence of one or more potential entrants into a market. The most relevant studies concern the airline industry. The reason is that the identification of potential competitors is more straightforward and objective in airlines than in virtually any other industry. A potential competitor on a route is conventionally defined as a carrier that, while not serving the route, operates at either or both endpoint cities. Such a carrier is viewed as positioned for relatively quick and easy entry since it has (a) feed or connecting traffic for the route in question, (b) ground infrastructure, such as gates, terminal space, and baggage handling, and (c) first-hand information about and perhaps marketing investment in the route endpoint. For all these reasons, such a carrier is advantageously positioned to extend its operations to the route in question. Studies typically include some measure or count of potential entrants in regression models of pricing. An illustrative formulation is that of Morrison and Winston (1987), who examine 769 city-pair airline markets in 1983. The average quality-adjusted price on each route is related to the number of incumbent carriers of nontrivial size, the number of potential entrants (as defined above), and several variables specifying whether or not the route involved a hub. Each additional actual competitor is found to reduce price by 0.44 percent, whereas each additional potential competitor also reduces price, but only by about one-third that amount. Both effects are statistically significant.

At least a dozen other studies examine the effect of potential competition in airlines.⁴ These differ in some respects, including some minor variations in the definition of a potential competitor⁵, but their basic findings are quite consistent. Virtually all find statistically significant price effects from the presence of potential competitors, as well from concentration among actual incumbents. The magnitude of the effect of potential competition is in almost all cases substantial, although without exception it is smaller than the effect of an actual competitor. Where comparisons are possible, it appears that each potential competitor causes a price reduction from about one-eighth to one-third that of an actual additional carrier.

⁴ For a review, see Kwoka (2001). Outside the airline industry, it is considerably more difficult to identify potential competitors reliably and to estimate their constraining effect on incumbent pricing. A smattering of corroborative evidence nonetheless exists (Bergman, 2002).

⁵ Hurdle, et al (1989), for example, require adequate feed as well as endpoint operation. Reiss and Spiller (1989) consider indirect service to be an alternative. Strassman (1990) limits potential competitors to carriers with a major hub at one endpoint. Bruekner, Dyer, and Spiller (1992) and Bruekner and Spiller (1994) require that a carrier serve both endpoints of a route.

The most dramatic effects from potential competition arise in the case of Southwest Airlines, which has long been the dominant low-cost carrier. Two notable studies of Southwest are those by Morrison (2001), and by Goolsbee and Syverson (2004). Morrison estimates fares to be 11-13 percent lower when Southwest serves one end-point of a route and fully 33 percent lower when it serves both endpoints (but not the route itself). Goolsbee and Syverson look at the nature of incumbent response to threatened entry by Southwest, reporting that fares drop in anticipation of its entry and fall further upon actual entry by that carrier, for a total decline of 26-33 percent.

This evidence demonstrates the presence of a potential entrant indeed does affect market pricing. The obvious limitation of these studies for present purposes is that they compare markets with and without potential entrants, or with varying numbers of such entrants. While one might infer a comparable - or even larger⁶-effect from elimination of a potential competitor by merger with an incumbent, none of these studies in fact examines such an event. This study provides a direct test of that scenario and effect.

2.3. Mergers in the Airline Industry

Since deregulation of the U.S. airline industry in 1978, there have been more than forty mergers. These fall roughly into two periods delimited by the year 1989 when merger review authority transferred from the Department of Transportation to the Antitrust Division of the

⁶ One might reasonable expect the merger-related effect to be larger insofar as the merger is motivated by a reduction in competition, both direct and potential. That is, the parties to the merger chose each other in order to eliminate a particularly constraining rival, rather than an "average" one whose effect is captured by a simple count of potential competitors.

Justice Department. During the period 1978-1988, approximately thirty mergers occurred, fully twenty-five in the years 1985 to 1988. While most of these did not raise competitive concerns, DOT approved all of them, including a small number which were actively opposed by the Justice Department. In the nearly twenty years since transfer of oversight to DOJ, the number of mergers has declined sharply and most that have been consummated involve bankrupt carriers.

A few airline mergers have been studied for their effects on route concentration and on prices.⁷ While most focus on the reduction of direct competition on routes, some have also examined the effect of the number of potential entrants. Their standard approach is illustrated in Figure 1, where points A and B denote hypothetical cities between which carriers 1 and 2 operate. The effect of a merger between these carriers is then determined by comparing the prices on the A-B route before and after the merger, holding other relevant factors constant. Those past studies accounting for "potential competition" include a count of the number of carriers designated in Figure 1 as 3 and 4. Such carriers serve either point A or point B (or both) but do not fly the A-B route itself, are thus positioned to enter, and arguably therefore constrain incumbent pricing. A cross-sectional comparison across many routes then isolates the effect of varying numbers of potential entrants, as well as varying degrees of concentration among incumbents on the route. Previously cited studies find that both existing and potential competition matters.

⁷ See for example Hurdle et al (1989), Werden and Johnson (1991), Borenstein (1990), and Morrison (1996). A very few studies have examined the effects on carrier costs or service quality, issues beyond the scope of the present study.

The primary focus of this study is not with existing competition or with the count of potential entrants, but with a merger eliminating a particular potential entrant. That is, we are not primarily concerned with routes where a merger combines carriers numbered 1 and 2, but rather with routes where carrier 1 in Figure 1 merges with carrier 3 or with carrier 4, that is, where an incumbent eliminates a potential competitor serving either one or both endpoints on the route. In this case market concentration on the route is unchanged, but the number of non-incumbent constraining competitors decreases by one - and that one has been absorbed by the incumbent.⁸ Whatever competitive threat was posed by carrier 3 or carrier 4 would be eliminated, so that carrier 1 now has more discretion to exercise any market power that it may possess, either by itself or together with carrier 2. It is this case that we now identify and investigate.

2.4. The USAir-Piedmont Merger

As noted, there has been a substantial number of mergers in the airline industry since 1978. Most recent mergers have involved bankrupt carriers, mergers whose effects almost certainly are not typical of mergers in general.⁹ Among non-bankrupt carrier mergers, that between USAir and Piedmont offers perhaps the best case for examination.¹⁰

⁸ As noted before, a merger should not be presumed to be between a random pairing of firms, and hence the effect of elimination of a potential entrant by an incumbent is likely to be quantitatively different.

⁹ The absorption of a bankrupt carrier is likely to result in a substantial price increase, one that overstates, perhaps substantially, the price effect from ordinary merger. See, for example, Kim and Singal (1993).

¹⁰ The case study by Kole and Lehn (1990) is particularly helpful in establishing relevant facts about this merger. This section relies on that source.

Prior to the merger, both USAir and Piedmont were large regionally-based carriers. While USAir's operations concentrated in the Northeastern U.S. and Piedmont in the Southeast, each had extensive route networks with considerable overlap. The carriers were of roughly equal size, each serving more than one hundred cities with about 9 billion revenue passenger miles annually. They also had similar operating revenues, in the range of \$1.6-1.8 billion, and similar work force sizes, each employing 13-16,000 workers (Kole and Lehn (2000)). Each had also been involved in another, smaller acquisition around the same time as their own merger. In 1985 Piedmont acquired Syracuse-based Empire Air, a deal that increased its overlap with USAir. In early 1987, USAir acquired West Coast based PSA, but this had no overlap with or implications for the USAir-Piedmont merger.

In January 1987, USAir and Piedmont announced their intention to merge. Financial aspects of the merger were completed in November of that year, but both regulatory and labor issues delayed integration of their operations until August 1989. Indeed, problems with labor relations, customer service, and flight operations plagued the surviving carrier, USAir, for some time. Two studies in the literature have previously examined the price effects of this merger. Morrison (1996) finds that prices on the merged carrier's routes relative to comparable routes rose immediately by 4.4 percent, and in the longer run by 22.8 percent. He remarks on the fact that this merger attracted less policy scrutiny than TWA-Ozark or Republic-Northwest, despite apparently larger price effects. Peters (2006) calculates actual fare increases on USAir-Piedmont's routes of 20.3-31.8 percent, baseline numbers that he uses for purposes of

comparison with a merger simulation that he undertakes.¹¹ Both of these studies find relatively large fare effects on routes where this merger eliminated one actual competitor.

While these studies focus on the effects of reductions in actual competition, the USAir-Piedmont merger has several characteristics making it suitable for an examination of the price effects of eliminating a potential competitor. The route structures of the two carriers were neither fully overlapping nor completely disjoint, but rather characterized by considerable potential to enter into each other's markets. The merger appears to have resulted in increased prices where direct competition was eliminated, thus setting an upper bound on what might result from elimination of a potential competitor. And the merger was both large and significant, indeed, by some measures the largest to have occurred in the industry. We now turn to an examination of its effects in markets where one merging party was an incumbent and the other a potential competitor.

3. Data, Modeling, and Results

This section begins with a description of the data, followed by a discussion of the specification of the empirical model. The results follow immediately.

3.1. Data and Model

The data employed in this study come from the Department of Transportation's Origin-Destination Survey of Airline Passenger Traffic. Generally referred to as Data Bank 1A, this is a 10 percent sample of all tickets written. We employ several conventions and make certain

¹¹ Peters also decomposes actual fare change into that due to various factors, and concludes that cost increases were responsible for at most one-third of the observed fare increase on USAir-Piedmont's routes.

exclusions standard in the literature: All foreign and non-continental U.S. travel is excluded. We use only round-trip tickets. Routes are assumed non-directional, so that tickets from A to B and those from B to A are treated as identical. We do not distinguish nonstop vs. one-stop tickets, although all tickets involving more than one stop each way are excluded. Distance is calculated as the nonstop distance for all tickets involving the same origin and destination, even those with a stop. In addition, any route with fewer than 30 recorded passengers in a quarter (implying 1200 passengers per year, after adjustment for the 10 percent sample) is excluded. ¹²

Fare is calculated as the log of weighted average fare charged by each carrier for all economy class tickets written on a route.¹³ The calculation of ticket prices by route and carrier, rather than the average for all carriers on a route, is designed to permit analysis of the effect on the incumbent carrier's pricing from the elimination of the other carrier as a potential entrant. Stated differently, we are essentially estimating the realization of the term $\delta x_N / \delta x_i$ from equation (2), expressed in terms of price as the strategic variable. Conventional fare screens are employed to eliminate unusually low or high fares: We exclude tickets with fares less than ten dollars or more than 2000 dollars, and also tickets with fares per mile less than 0.013 dollars or more than three dollars.¹⁴

¹² This follows Kim and Singal, among other studies.

¹³ This excludes first class and business class travel, which are rather different products and therefore typically treated separately in airline studies. Note also that given how the data are structured in the data base, routes are from airport to airport.

¹⁴ These exclusions follow standard practice in the airline literature: Borenstein excludes tickets with fares less than ten dollars. Hurdle et al exclude tickets with fares over 1000 dollars and with fares per mile less than 0.013 dollars. Kim and Singal exclude tickets with fares per mile in excess of three dollars.

For this merger we take as the baseline those fares in the four quarters prior to the merger, specifically, the fourth quarter of 1986 and the first three quarters of 1987. These are compared to the fares for the fourth quarter of 1989 and the first three quarters of 1990. The separation of these dates is due to the lengthy period between the consummation of the merger and what has been identified as the point of full integration of the carriers' operations (Kole and Lein). Use of the same calendar quarters in both periods minimizes seasonality effects. Use of multiple quarters minimizes distortions due to data anomalies that inevitably arise in any single quarter.¹⁵

There are three major categories of routes involving USAir and Piedmont, based on their relationship on the route prior to their merger. The label for each refers to whether one or both are actual competitors (*ONE* or *TWO*) followed whether neither or one is a potential entrant (*ZERO* or *ONE*). These categories are as follows:

TWO-ZERO	A route served by both USAir and Piedmont. ¹⁶
ONE-ONE	A route served by either USAir or Piedmont, with the other operating as a
	potential entrant, i.e., serving one or both endpoints of the route.
ONE-ZERO	A route served by either USAir or Piedmont, with the other carrier not
	present as a potential or an actual competitor.

¹⁵ Fares and other data are identified by quarter. The data base can therefore be viewed as allowing for four before-and-after comparisons on each route, resulting in an averaged effect across quarters. Individual quarter comparisons were estimated and, as expected found to be more variable but not inconsistent.

¹⁶ Since in this case the other carrier cannot be a potential competitor in this case, the suffix "*ZERO*" is actually redundant.

The remaining category of interest consists of non-merging carriers that might be affected by the merger. These are rivals to USAir and/or Piedmont on *TWO-ZERO* and on *ONE-ONE* routes, that is, on routes where USAir and Piedmont directly competed, or where either carrier was present and the other represented a potential competitor. To the extent that the merger affected incumbent pricing in these cases, it also very possibly altered pricing by non-merging rivals. These observations are labeled *RIVALS*. The control group consists of observations on tickets of *non*-merging carriers on routes *not* affected by the merger. Most of these are geographically separated from USAir's and Piedmont's operations, so that neither actual nor potential competition on these routes was altered by the merger.

Table 1 summarizes these categories of route configurations and gives the sample size for each in the data set. As reported, 807 routes involve direct competition between USAir and Piedmont, with another 1443 characterized by potential competition. There are nearly 6400 observations on rivals to USAir and/or Piedmont on these routes. The remaining observations derive from routes where the two carriers do not interact - either one incumbent without potential entry by the other, or routes entirely unrelated to service by either USAir or Piedmont. The total number of route-carrier observations in each quarter is 23,673. The average number of actual competitors across all of these routes is 3.5, with a median number of 3. With respect to potential competitors, the mean number of such carriers is 4.9, the median 5.

In the actual estimation, the variables *TWO-ZERO*, *ONE-ONE*, and *ONE-ZERO* are included by themselves in order to control for any systematic differences in these routes relative

to the control group throughout the sample periods. Tests for effects of this merger require defining each of these variables in a form interacted with a dummy variable *POST* indicating the period after the merger (i.e., the fourth quarter of 1989 and the first three quarters of 1990). The latter terms - *POST:TWO-ZERO*, *POST:ONE-ONE*, and *POST:ONE-ZERO* as well as *POST:RIVALS* - therefore measure the effect of the merger on fares for each specific type of route.

We expect *POST:ONE-ZERO* to be essentially zero, since those routes involve only one of the merging parties and hence no change in the competitive environment. In contrast, *POST:TWO-ZERO* involves a reduction in actual competition and, based on past studies, is expected to be positive. *POST:ONE-ONE* represents the elimination of a potential competitor. Consistent with previous discussion, this would be expected to reduce the competitive constraint on incumbent pricing and thus appear with a positive sign, although the magnitude of the effect would be smaller than for the elimination of an actual competitor (*POST:TWO-ZERO*). Finally, *POST:RIVALS* may be positive insofar as rivals can take advantage of higher post-merger prices in the market, although the effect of the merger on their competitive circumstance may not be described so simply.¹⁷

The remaining variables represent characteristic and control variables typically found in such studies:

DISTANCE, measured as the log of nonstop miles between origin and destination;

¹⁷ Rivals may not be able to take advantage of higher prices, or even find themselves disadvantaged by the emergence of a larger dominant carrier in their market. We shall examine these issues below.

POP for population, measured by as the sum of city populations at endpoints;

HHI for market concentration among incumbents, measured as the log of HHI;¹⁸

POT-ENTS for the number of potential entrants, measured as described above;

TOURIST, a dummy variable equal for one for a tourist destination, generally associated with a lower price due to the discretionary nature of travel to such destinations;

SLOT, a dummy variable equal to one for a slot-controlled airport,¹⁹ resulting in a higher price due to limitations on numbers of flights;

HUB, a dummy variable equal to one for a route whose origin and/or destination is a hub airport, generally found to be associated with higher price due to domination of traffic by a particular airline.

In order to isolate the effect of the USAir-Piedmont merger, the post-merger values of both the number of potential entrants and HHI are calculated apart from the merger itself. That is, the post-merger and premerger values differ only insofar as there are changes in the shares or presence of *non*-merging carriers. Incorporating merger-related changes in HHI or the number of potential competitors would have the effect of treating them as equivalent to all other changes

¹⁸ Different studies in the literature use either HHI or the log of HHI; these give equivalent results in our estimations. We also note the possibility that HHI is endogenous, but as the literature acknowledges, exogenous determinants of HHI are difficult to identify. As one check on this concern, we estimate all the reported models without HHI. Results (available on request) are unchanged, suggesting that any possible endogeneity does not greatly affect these results.

¹⁹ Slot controlled airports at the time of the merger were Chicago O'Hare, New York's LaGuardia and JFK, and Washington National Airport.

in share or presence, preventing identification of the effects of this particular merger.²⁰ The latter are captured by the merger-specific characterizations of changes in USAir's and Piedmont's role on routes.

The complete fare model therefore can be written as follows:

$$LNFARE_{it} = \alpha_{1} + \alpha_{2} RouteType_{i} + \alpha_{3} Post:RouteType_{it} + \alpha_{4} POST:MERGER_{t}$$
$$+ \alpha_{5} DISTANCE_{i} + \alpha_{6} POP_{it} + \alpha_{7} HHI_{it} + \alpha_{8} POT-ENTS_{it} + \alpha_{9} TOURIST_{i}$$
$$+ \alpha_{10} SLOT_{i} + \alpha_{11} HUB_{i} + \mu_{it}$$
(3)

Observation *i* denotes a specific route served by a particular carrier (a "route-carrier"), while *t* is the relevant time period. The variable labelled *RouteType*_i represents the alternative route configurations involving USAir, Piedmont, and their rivals, configurations that were previously labeled *TWO-ZERO*, *ONE-ONE*, *ONE-ZERO*, and *RIVALS*. *Post:RouteType*_{it} denotes the analogous postmerger terms, and *POST:MERGER*_t is the shift variable that captures other sources of fare differences in the latter period.

Due to the panel nature of the data, we use both pooled OLS and also a fixed effects/random effects model. Pooled OLS allows for inclusion of standard control variables which validate the model and measure the effect of some other factors of interest, for example, distance or slots. Fixed effects (or random effects GLS) regression controls for these and other, unobserved factors, thereby ensuring that the results are not due to specification issues. In all specifications, the Hausman test favors the fixed effects model over random effects, and so we

²⁰ See Bamberger et al (2004) for a similar procedure.

report the pooled OLS and fixed effects models only.²¹ It should be noted, however, that the results of all three specifications are very similar in magnitude and statistical significance, suggesting that the estimated effects of the merger are robust to a range of model specifications.

3.2. Results of Estimation

3.2.1. Preliminary Results

Table 2 reports the results of estimating the basic fare model. We first note that in the pooled OLS model in Column (a), and indeed throughout all such specifications, characteristics of the route are strongly and significantly related to log of fare. Consistent with past work, these results imply that fares increase with route length (*DISTANCE*), slot controls (*SLOTS*), and hubs (*HUB*), but decrease if it is a tourist destination (*TOURIST*), *cet. par*. The effect of slot controls is to increase fare by 4.5 percent and hubs by 12.0 percent in this specification, while tourist destinations are associated with a 12.2 percent lower price.²² The effect of population is negative, presumably reflecting the effect of larger market size and traffic density on fares.

Moreover, in Table 2 and in all results reported below, measures of concentration among incumbents and with respect to potential entrants both show statistically significant effects on incumbent fares. Higher incumbent concentration as measured by *HHI* increases fares, while a larger number of potential entrants (*POT-ENTS*) reduces them. All of these effects are

²¹ The results of Hausman tests are reported in the tables that follow.

²² As explained in Wooldridge (2005, p. 226), the estimated coefficients of dummy variables in a regression model with the dependent variable in natural logs require transformation to obtain the usual numerical effect, but the difference is trivial. See also Morrison (1996, p. 15).

statistically significant and consistent with numerous studies, reviewed above, of the effect of various dimensions of airline concentration on fares.

Dummy variables representing the four major categories of routes for which we have ticket observations in the data base - *TWO-ZERO*, *ONE-ONE*, *ONE-ZERO*, and *RIVALS* - are included to control for any specific properties of each type of route. This ensures that any incremental effects we find are in fact associated with the merger and are not simply inherent properties of those routes. We also include the variable *POST:MERG* to control for systemwide changes in pricing after the merger, and, in order to account for general inflation, the dependent variable is adjusted using the transportation CPI.²³

Focusing now on the effects of the merger itself, there are several important results in Column (a). We begin by noting that on routes served by both USAir and Piedmont, the merger resulted in a 9.0 percent increase in fares. The relevant coefficient, that on *POST:TWO-ZERO*, is statistically highly significant with a t-value of 12.0. This result is of considerable importance in its own right and corroborates the findings of prior studies that found this particular merger to have had substantial anticompetitive effects. This is not, however, the primary focus of the present research. Rather, we wish to examine the further question of a price effect on routes where the merger eliminated either USAir or Piedmont from its role as a potential, rather than an actual, competitor.

²³ Use of general CPI does not change our results over the four calendar years of the data.

This latter question is tested with the variable *POST:ONE-ONE*, which is designed to measure the merger-related change in fares on routes where one of the merging carriers was an incumbent and the other a potential entrant. The estimated coefficient on *POST:ONE-ONE* is .050, indicating that the price charged by the incumbent is five percent higher as a result of the elimination of a potential entrant. This result is statistically highly significant, with a t-value of 8.2. This represents direct confirmation of an effect of merger not previously measured or emphasized: In addition to the reduction in actual competition, on all the routes where the merger eliminated potential competition it had the separate and important effect of relaxing a competitive constraint and permitting a significant price increase.

The magnitude of the estimated effect prompts two further observations. First, the effect of *POST:ONE-ONE* is more than half as large as the nine percent fare increase resulting from elimination of either USAir or Piedmont on routes where they were actual competitors. The difference is statistically significant (t = 4.33), making clear that an actual competitor represents a stronger constraint. Nonetheless, the effect of eliminating a potential competitor is quantitatively important. Second, the effect of eliminating the merger partner as a potential competitor is considerably larger than the effect of reducing the number of potential entrants in general. The latter - 1.9 percent - is less than 40 percent the size of the price increase resulting from the merger, and the difference is statistically highly significant (t = 11.2). This implies that USAir and Piedmont were distinctly more important potential competitors to each other than were other potential competitors, so that the elimination of the merging party relaxed the

competitive constraint considerably more than a reduction (by one) in the number of other potential competitors. This corroborates the previously noted observation that this merger, like all others, arises between particular firms for specific reasons and has effects that differ from those associated with non-merging industry members.

Two other results deserve brief mention. *ONE-ZERO* denotes unaffected routes, and as would be expected the estimated coefficient on the variable capturing the effect of the merger on these routes - *POST:ONE-ZERO* - is essentially zero. The estimated coefficient on POST:RIVALS, however, is negative. This is rather unexpected since this variable denotes the effect of the merger on fares of rivals to USAir and Piedmont on routes where those carriers operated as actual or potential competitors. One might expect prices to be strategic complements, so that the higher price charged by the merged carriers would elicit a higher price from its rivals. We will examine this empirical result further in the next section.

In Column (b) of Table 2, the same model is run using fixed effects. In the fixed effects regression, of course, control variables that do not change over time - e.g., distance, slots, tourist destination, and hub - are differenced out and thus do not appear in the specification. One result is that the adjusted R^2 has risen from about .33 to .67, reflecting the number of characteristics effectively held constant. The remaining variation is related to carrier-route variables, which perform in a manner very similar to what has just been described for pooled OLS. We limit commentary here to these latter variables that capture changes in the competitive structure of these markets.

Preliminarily, we note the competitive effect of the merger on routes previously served by both USAir and Piedmont. The fixed effects specification implies a 10.2 percent fare increase from the merger-related reduction in competition, a slightly larger effect than in the OLS version. The result of eliminating either USAir or Piedmont from its role as a potential competitor on a route where the other was an actual competitor is now estimated as 6.0 percent, again somewhat larger than the increase in the OLS model. The relative magnitude of these effects remains much the same, however, with the elimination of a potential competitor. The difference is again statistically significant (t = 6.23). Compared to the effect from the loss of one potential competitor from among other carrier, however, the elimination of either USAir or Piedmont has an effect more than four times as large. The former effect is given by the coefficient on *POT-ENTS*, which is now 1.3 percent, while the latter is 6.0 percent, the difference again highly significant (t = 16.3).

While the coefficient estimates in the two models vary a bit, overall they are quite similar and establish the importance of a reduction both in potential competition as well as in actual competition resulting from a merger.

3.2.2. Small vs. Large Competitors

The model and data employed in Table 2 constitute the conventional approach used in studies of the effects of airline mergers on fares. Some studies, however, have contended that a carrier with only a few percentage point share is limited in its importance in market price
determination, or even that observations on such small carriers may be data anomalies rather than reliably measured competitors. This has prompted some studies of airline competition to consider only those actual carriers with a share in excess of five or even ten percent (e.g., Morrison, 1996), or potential competitors with some small minimum share of traffic at an endpoint of the route (e.g., Hurdle).

While these concerns may have merit, none of the studies advancing such arguments has put the proposition regarding minimum sizes to empirical test. We do so here in the context of the USAir-Piedmont merger. Where the two carriers were actual competitors but one was small, we define a category *SM-ACTUAL* as a subset of *TWO-ZERO*. *SM-ACTUAL* takes on a value of one for those observations where one or both carriers had less than a five percent share of traffic on the route. Of the 807 routes with actual competition, 458 are classified as SM-ACTUAL. For routes on which either USAir or Piedmont was a potential competitor, we define *SM-POT* as those cases where the potential entrant's traffic constituted less than two percent of all traffic at the endpoint of the route. There were 239 such routes out of the 1443 involving potential competition.

Columns (a) and (b) of Table 3 report the results of re-estimating the model in Table 2 but now drawing the distinctions between sizes of actual and potential competitors. Focusing on the variables of interest, we note that on routes where the merger eliminated a sizeable actual competitor (*POST:TWO-ZERO*), fares rose by 11.1 or 12.1 percent in the pooled OLS and fixed effects specifications, respectively. But the effect was indeed different where one of the merging parties had less than a five percent share (*POST:SM-ACTUAL*). There the price increases were 7.5 and 8.7 percent in the two specifications, but equally important, they were sizeable and statistically significant in both (t = 7.7 and t = 12.7). Clearly the elimination of small competitors does matter, although it matters less than when a larger competitor is eliminated. A t-test on the difference between the coefficient estimates for large and small actual competitors yields t-values of 2.45 and 3.24 in the pooled OLS and fixed effects models, respectively, implying that the price impact of eliminating a small actual competitor is statistically different from the case where a more sizeable actual competitor is party to the merger.

We are, of course, at least as interested in the effects of eliminating a potential competitor. Table 3 results show that when the merger between USAir and Piedmont eliminated a small potential competitor, price rose by 4.3 percent compared to 5.2 percent for the case of a more sizeable potential competitor, both estimates for the pooled OLS specification in Column (a). In the fixed effects model, the corresponding values are 5.4 percent for a small potential competitor, 6.2 percent for a larger one. All of these estimates are statistically significant and in both cases the larger effect is associated with the larger potential entrant. Nonetheless, neither of the differences between small and large potential entrants is significant. T-values on the comparisons are 0.55 and 0.69 for pooled OLS and fixed effects, respectively.

We conclude that where the USAir-Piedmont merger eliminated one of them as a potential entrant, the effect of its elimination on pricing was essentially the same regardless of

the magnitude of the carrier that was the potential entrant. Put differently, for purposes of constraining incumbent behavior, an endpoint competitor appears to be viewed as essentially equivalent constraint regardless of its share. Unlike the case of actual competitors, for potential entrants it is presence rather than share that matters.

The results in Columns (a) and (b) imply that actual competitors of different sizes should be distinguished, but that cases involving potential entrants may be treated together regardless of their size. That specification differs from both of those reported to this point. Accordingly, we re-run the basic model using this new specification and report the results in Columns (c) and (d) of Table 3. These results, which constitute our core findings, hold no surprises. Where the merger eliminated one of the firms as a sizeable actual competitor, price increased by 11-12 percent; where it eliminated one as a small actual competitor, price increased by 7-8 percent; and where it eliminated one as a potential competitor, price increased by 5-6 percent. All of these effects are statistically strongly significant, and significantly different from each other.

Based on these core results, we can now perform a rough calculation of the relative importance of the reduction in actual vs. potential competition as a result of the merger between USAir and Piedmont. As noted, there were 349 routes with direct competition between the two carriers when they exceeded a five percent share, 458 with direct competition when one carrier was "small", and 1443 routes on which one was an actual competitor and the other a potential entrant. The first category accounted for \$405.3 million dollars of annual revenue to those carriers combined, the second represented \$871.8 million, and the last totaled \$815.9 million.

The percentage price increases due to the merger were 12.1 percent, 8.7 percent, and 6.0 percent, respectively. It follows that the loss of actual competition (large and small) caused an annual out-of-pocket impact on the merged firm's consumers in the amount of \$124.9 million, compared to \$49.0 million from the loss of potential competition. Thus, the aggregate adverse impact from the loss of potential competition was nearly 40 percent as large as that from the loss of actual competition between USAir and Piedmont. ²⁴

One additional noteworthy result concerns the estimated coefficient on *POST:RIVALS*. The persistent negative coefficient estimate implies that rivals were somehow disadvantaged in the post-merger market, so that their prices actually decreased. This might occur for at least two reasons. First, the now-larger merged carrier might be able to more effectively exploit its dominance, using actions and threats to constrain its smaller competitors. Indeed, small carriers regularly complain of their vulnerable circumstances. A second possible explanation follows from the fact that a carrier with the largest number of scheduled flights attracts a disproportionate fraction of traffic as a result of a least-cost search strategy by customers. Customers tend to make their initial inquiries to such a dominant carrier - a phenomenon known as the "S-curve" - resulting in the need for smaller carriers to compete by offering, e.g., lower prices (Borenstein, 1992).

If these forces are at work and underlie the negative coefficient on *POST:RIVALS*, we might expect a rival's disadvantage to vary with its market share compared to the leading carrier.

²⁴ It should also be noted that these calculations are strictly for USAir and Piedmont themselves and do not include other carriers.

That is, a rival would be worse off being in a dominated market, and moreso as its share is smaller and/or as that of the merged entity is larger. Columns (e) and (f) of Table 3 test for such an effect. The single variable *POST:RIVALS* is now divided into two categories, *POST:SM-RIVAL* and *POST:LA-RIVAL*, based on the market share of the rival whose fare is being examined. The two categories are delimited by a 15 percent market share for the rival.²⁵ The results indicated that indeed smaller rivals are more disadvantaged by being in a more dominated market. Their prices fall by 5.9 percent in both specifications, whereas larger rivals' prices decline by half that amount (2.8 and 3.4 percent). The differences are statistically significant (t = 5.63 and 5.79), corroborating the proposition of differential post-merger pricing discretion by rivals of different size (although the full explanation for the decline in *both* larger and smaller rivals to the merged carrier is not apparent).

We note that this refinement makes essentially no difference in the core results on actual and potential competition. We now return to those results, which is our main focus.

3.2.3. Variation with Concentration

The elimination of a competitor is likely to affect incumbent pricing differently depending upon the degree of market concentration. The loss of one competitor - whether actual or potential - in an unconcentrated industry, for example, is not likely to alter market equilibrium greatly. On the other hand, the loss of a single competitor in a concentrated market seems likely

²⁵ The mean share of rivals is 16 percent, so this delimiter lies roughly in the center of the distribution. Alternative share delimiters were examined. Smaller values resulted in poorer fits, while higher values added very little explanatory power (and involved many fewer observations).

to matter - unless perhaps that competitor is small or the industry otherwise already wellcoordinated. For such reasons, the estimated price effects from eliminating a competitor may vary across combinations of market concentration and shares.

This section investigates the dependence of the price effect on market concentration in the USAir-Piedmont merger. It does so by first creating subsets of the data based on the level of HHI concentration and then rerunning the basic regression model on each subset. Specifically, we define quartiles of observations based on the magnitude of route HHI, the cutoffs being HHI values of 6055, 4310 (which is the median value), and 3175. Thus, the largest quartile consists of those observations on HHI in excess of 6055; the next quartile those between 4310 and 6054; the third quartile those between 3175 and 4309; and the lowest quartile those less that 3175. These relatively large HHI values, of course, reflect the generally high level of airline market concentration. Each quartile consists of just over 33,000 observations.

We then rerun the model in equation (3) for each of these subsets of the data. Rather than reporting the full results for all eight regressions (four data subsets, each using pooled OLS and fixed effects), Table 4 reports the coefficient estimates and t-statistics only on the key variables. These are *POST:TWO-ZERO*, *POST:ONE-ONE*, and *POST:SM-ACTUAL*, which measure the price effects from eliminating one of the carriers when it is a sizeable actual competitor, a potential competitor, and a small actual competitor, respectively. All other variables, both route-carrier categories and controls, behave predictably.

In Table 4, in both the pooled OLS and the fixed effects models, the largest price effect from eliminating an actual competitor occurs in the middle ranges of HHI. Columns (a) and (d) indicate that the post-merger price increase on routes served by both USAir and Piedmont grows from about ten percent in relatively less concentrated markets to between 13.4 percent and 17.7 percent for the middle two HHI quartiles in the pooled OLS and fixed effects models. In both approaches the price effects for yet higher concentration levels actually decline to 4.5 and 5.3 percent, respectively, and indeed one of those lacks statistical significance.

The most likely reason for this inverted-U pattern of price effects is that at very high concentration levels price is already elevated, so that the actual elimination of the rival has less incremental impact. For example, the mean value of HHI in the highest quartile is 8000, roughly consistent with a 90 percent and a 10 percent firm comprising the market. Such firms might already succeed in coordinating prior to the merger, or perhaps the 90 percent firm is already exerting dominance sufficient for the desired pricing outcome, in either case resulting in less incremental effect from a merger. At relatively low values of HHI, the effect of merging with a direct competitor is somewhat diminished, presumably the result of more robust competition among incumbents, so that the elimination of one has less of an incremental impact on price.

With respect to eliminating either USAir or Piedmont as a *potential* competitor on the other carrier's route, the same inverted-U pattern of price effects emerges. Consistent with past results, the level of all such effects is more modest in columns (b) and (e) of Table 4. Prices increase by about 3 percent in the smallest HHI categories (HHI no greater than 3175), rising to

between about 7 or 8 percent for the middle range of HHIs, and then declining to less than 4 percent in the upper range of HHIs. These effects are all statistically significant. The likely explanation for this inverted-U shape is analogous to that previously noted: Where concentration among incumbents is already high, dominance or coordination may be sufficient to achieve price elevation. In high HHI markets, therefore, either an actual or a potential competitor likely exerts less of a constraint and its elimination therefore results in less of a further price elevation. At the low end of HHI, where competition among incumbents may already be determinative of price, the potential competitor - and its elimination - may matter less.

Finally, the impact of the loss of either USAir or Piedmont when it is a *small* incumbent is notably different. As shown in Columns (c) and (f), the loss of even such a small competitor matters considerably at high levels of concentration, with effects in the 6 to 10 percent range for the top two HHI quartiles. In the lower two quartiles, however, the effect is considerably more modest - about 3 percent. Indeed, two of the four coefficient estimates in these latter cases are significant at only 10 percent, while two others fall short of even that level of significance. Thus, the loss of a small competitor due to this merger appears problematic on routes where concentration was moderate to high, whereas in low concentration markets, such elimination again matters less.

3.2.4. Endpoint and Carrier Distinctions

This section examines two further distinctions that are potentially important to the results - whether a potential competitor at two endpoints has a larger effect than one at a single

endpoint, and whether the potential competition effects for USAir and Piedmont are symmetric. With respect to endpoints, we have previously noted that many studies define a potential entrant as a carrier present at both endpoints of a route, while some view presence at either endpoint a sufficient criterion. It might be expected that two-endpoint presence signifies a carrier better positioned to enter a route, hence representing a more effective constraint on incumbent pricing, and therefore one whose elimination may permit a greater price increase. No study, however, appears to have subjected these hypotheses to empirical test. We do so here.

We disaggregate our prior category *ONE-ONE* into cases where the potential competitor is positioned at a single endpoint (labeled *ONE-1END*) and cases where it serves both endpoints (*ONE-2END*), this on a route that is served by the other merging partner. Results of testing the one- vs. two-endpoint distinction are reported in Column (a) of Table 5 for pooled OLS and Column (b) for the fixed effects regression. Since the control and other variables behave much as before, we focus on the variables of interest. Preliminarily, however, we note that the price effect of the merger on routes where the two carriers were sizeable actual competitors is 11.1 and 12.1 percent, and where one was a small actual competitor 7.5 and 8.7 percent, in the pooled OLS and fixed effects, respectively. These are identical to previous results. More importantly for present purposes, we find that the effect of eliminating one of the carriers as a two-endpoint potential competitor (*POST:ONE-2END*) is a 5.7 percent price increase in the pooled OLS, compared to 4.9 percent for a one-endpoint potential competitor (*POST:ONE-1END*). A test of statistical significance determines that these effects are indistinguishable (t = 0.52). In the fixed effects model, the two-endpoint effect is 5.9 percent, whereas the one-endpoint effect is actually larger - 6.1 percent.

These results demonstrate that the elimination of a potential competitor of either type significantly affects prices, corroborating the findings in Table 2. But there is no evidence of a significant difference between the effects of eliminating a one-endpoint vs. a two-endpoint potential competitor. Whether at one or both endpoints, USAir and Piedmont represent essentially equivalent constraints on each other's pricing. As before, the estimated effect from eliminating such a firm is smaller than in the case of an actual competitor but it is nonetheless a substantial and important effect of the merger.

The final distinction involves the identity of the incumbent carrier and the potential competitor in this merger: We test whether the price increase is the same when USAir is the incumbent and Piedmont the potential entrant, as when their roles are reversed. We do so by respecifying the regression model reported in Table 4 so as to distinguish the two incumbent-potential entrant configurations. With the incumbent listed first, these are given by the variables *US-PD* and *PD-US*. Each of these with the prefix *POST:* therefore measures the effect of eliminating Piedmont and USAir, respectively, as the potential competitor on a route served by the other carrier.

The results of these regressions are reported in Table 5, with Column (c) representing pooled OLS and Column (d) the fixed effects alternative. In Column (c), the effect of eliminating USAir as a potential competitor to incumbent Piedmont (*PD-US*) is 4.0 percent,

compared to 5.7 percent when Piedmont is eliminated as a potential competitor to incumbent USAir (*US-PD*). In the fixed effects model, the magnitudes are 5.1 percent and 6.8 percent, respectively. The relative magnitudes suggest that Piedmont may have represented more of a competitive constraint on USAir's pricing than vice-versa, a fact that might explain USAir's initiative in the merger and its status as the surviving entity. The differences in the magnitudes, however, are not huge and in any case not overwhelmingly significant: The t-value for the difference in the pooled OLS results is 1.47, and for the fixed effects model, 2.04, suggestive but not dispositive with respect to their asymmetric roles. Certainly, however, these results continue to confirm that each carrier did indeed represent a significant constraint on the other.

4. Conclusions

This study extends prior work on the price effect of a reduction in actual competition resulting from merger to an examination of the price effect of eliminating potential competition. We have chosen an industry, a merger, and an approach that bring this issue into sharp focus, and we have obtained well-defined conclusions. As do other studies, we have found significant and substantial price increases on routes where USAir and Piedmont were direct competitors, but we extend the analysis to routes where the merger eliminated one of the carriers as a potential entrant on a route served by the other. This price effect is smaller - as to be expected - but it is both substantial and significant. This represents clear evidence of the effect of potential competition as a constraint and of the adverse effect on competition when such a firm is eliminated. Indeed, because of the extensive number of routes on which USAir and Piedmont were potential entrants on each other's routes, the aggregate consumer loss on those routes represented a substantial addition to the consumer loss on routes where they had directly competed.

While there is no reason to expect these specific quantitative results to be characteristic of other mergers in airlines or other industries, neither is there any reason to doubt the applicability of the more general point of this study. That is, insofar as a merger eliminates a potential entrant, it significantly relaxes the competitive constraint faced by the incumbent firm and thereby adds to the consumer harm due to the reduction in actual competition between the firms. This result has important policy implications for antitrust policy in the U.S. and other jurisdictions. Current policy treats the elimination of potential competition quite differently and rather cautiously relative to actual competition grounds for some time. This approach has been challenged specifically on potential competition grounds for some time. This approach has been prompted in part the lack of direct evidence of the effect of potential competitors and of their elimination. This research should help inform that policy debate as well.

FIGURE 1

Route Configurations: Actual and Potential Competitors



Variable	Definition	No. of Routes
TWO – ZERO	Both USAir and Piedmont present	807
ONE – ONE	Either USAir or Piedmont present, other is potential entrant	1,443
RIVALS	Incumbent rivals to USAir and Piedmont	6,377
CONTROL	Unrelated	13,005
$TOTAL^1$		21,673

 TABLE 1

 Route Interactions between USAir and Piedmont

Note: ¹TOTAL includes a small number of additional routes with either USAir or Piedmont present but the other carrier is neither an actual nor a potential competitor.

	(a)	(b)
Variable	Pooled OLS	Fixed Effects
DISTANCE	.308	
	(217.1)	
РОР	037	360
	(27.5)	(11.6)
SLOTS	.045	
	(15.9)	
TOURIST	122	
	(61.2)	
HUB	.120	
	(48.6)	
ННІ	.023	.057
	(11.5)	(20.3)
POT-ENTS	019	013
	(38.8)	(17.1)
TWO-ZERO	010	
	(1.90)	
ONE-ONE	.038	
	(8.55)	
ONE-ZERO	- 216	
ONE-ZERO	(8.52)	
	050	
KIVALS	.059 (23.6)	
POST: MERG	.118	.117

 TABLE 2

 Regression Results on Fares: Preliminary Results

POST: TWO-ZERO	.090	.102
	(12.0)	(18.9)
POST: ONE-ONE	.050	.060
	(8.18)	(13.6)
POST: ONE-ZERO	.008	008
	(.25)	(.30)
POST: RIVALS	049	048
	(14.2)	(18.7)
CONSTANT	3.73	10.65
	(132.6)	(22.8)
ADJ-R ²	.333	.672
F	4123	1001

Notes: t-statistics in parenthesis. Results of Hausman tests reject random effects model in favor of fixed-effects model at any level of significance.

	(a)	(b)	(c)	(d)	(e)	(f)
Variable	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
DISTANCE	.309		.308		.310	
	(216.9)		(217.0)		(218.1)	
РОР	036	359	037	359	035	362
	(27.2)	(11.6)	(27.4)	(11.6)	(26.0)	(11.7)
SLOTS	.046		.046		.044	
	(15.9)		(15.9)		(15.6)	
TOURIST	122		122		123	
	(61.3)		(61.2)		(61.8)	
HUB	.119		.120		.110	
	(48.3)		(48.6)		(43.9)	
HHI	.024	.057	.024	.057	.030	.056
	(11.8)	(20.3)	(11.7)	(20.3)	(14.8)	(19.9)
POT-ENTS	019	013	019	013	018	014
	(38.7)	(17.0)	(38.5)	(17.1)	(35.4)	(17.3)
TWO-ZERO	005		005		004	
	(.65)		(.69)		(.52)	
SM-ACTUAL	013		014		015	
	(1.95)		(1.98)		(2.23)	
ONE-ONE	033		038		038	
	(6.9)		(8.55)		(8.6)	
SM- POTENTIAL	063					
	(5.94)					
ONE-ZERO	215		215		218	
	(8.52)		(8.52)		(8.62)	

 TABLE 3

 Regression Results on Fares: Small vs. Large Competitors

RIVALS	059		059			
	(23.6)		(23.6)			
SM-RIVALS					.031	
					(10.3)	
LA-RIVALS					092	
					(27.6)	
DOGT MEDO	110	117	110	117	117	117
POST: MERG	.118	.11/	.118	.11/	.11/	.11/
	(56.9)	(54.8)	(56.9)	(54.8)	(56.7)	(54.9)
POST: TWO-ZERO	.111	.121	.111	.121	.111	.121
	(9.85)	(15.1)	(9.86)	(15.1)	(9.96)	(15.1)
POST: SM-ACTUAL	075	087	075	087	076	087
1001. Sin Refere	(7,72)	(12.7)	(7,73)	(12.7)	(7.85)	(12.6)
	(1.12)	(12.7)	(1.15)	(12.7)	(7.85)	(12.0)
POST: ONE-ONE	.052	.062	.050	.060	.050	.060
	(7.81)	(12.8)	(8.18)	(13.6)	(8.22)	(13.6)
POST: SM- POTENTIAL	.043	.054				
	(2.95)	(5.07)				
DOGT ONE ZEDO	000	000	000	000	000	000
POST: UNE-ZERU	.009	008	.009	008	.009	008
	(.24)	(.30)	(25)	(.30)	(.24)	(.30)
POST: RIVALS	049	048	049	048		
	(14.2)	(18.7)	(14.2)	(18.7)		
POST: SM-RIVALS					059	059
					(14.3)	(18.7)
					(11.5)	(10.7)
POST: LA-RIVALS					028	034
					(5.94)	(9.55)
CONSTANT	3.74	10.64	3.74	10.64	3.65	10.7
	(131.3)	(22.8)	(131.8)	(22.8)	(127.8)	(22.9)
ADI-R ²	333	672	332	672	336	672
F	3301	802	3666	891	3354	734

Notes: t-statistics in parenthesis.

Results of Hausman tests reject random effects model in favor of fixed-effects model at any level of significance.

HHI Quartile	Pooled OLS		Fixed Effects			
	(a) POST: TWO- ZERO	(b) POST: ONE- ONE	(c) POST: SM- ACTUAL	(d) POST: TWO- ZERO	(e) POST: ONE- ONE	(f) POST: SM- ACTUAL
6055 - 10,000	.045 ²	.034	.095	.053	.039	.109
4310 - 6054	.170	.080	.087	.177	.079	.063
3175 - 4309	.134	.068	.036 ²	.150	.076	.0261
0 - 3174	.102	.033	.034 ²	.101	.035	.026 ¹
OVERALL	.111	.050	.075	.121	.060	.087

TABLE 4 Key Coefficient Estimates: Regressions by HHI Quartile

Notes: All coefficients statistically significant at 5 percent or better, except as noted. ¹Not significant. ²Significant at 10 percent.

	(a)	(b)
VARIABLE	POOLED OLS	FIXED EFFECTS
DISTANCE	.309	
	(217.8)	
POP	036	359
	(27.2)	(11.6)
SLOTS	.046	
	(16.1)	
TOURIST	123	
	(61.6)	
HUB	.119	
	(48.1)	
HHI	.022	.057
	(10.8)	(20.3)
POT-ENTS	020	013
	(39.6)	(17.1)
TWO-ZERO	005	
	(.59)	
SM-ACTUAL	012	
	(1.81)	
ONE-1END	.049	
	(5.64)	
ONE-2END	062	
	(12.7)	
ONE-ZERO	012	
	(1.81)	

 TABLE 5. Regression Results on Fares: One vs. Two Endpoints

RIVALS	.059	
	(23.8)	
POST: MERG	.118	.117
	(57.0)	(54.8)
POST: TWO-ZERO	.111	.121
	(9.83)	(15.1)
POST: SM-ACTUAL	.075	.087
	(7.70)	(12.7)
POST: ONE -1END	.049	.061
	(7.19)	(12.2)
POST: ONE-2END	.057	.059
	(4.56)	(6.55)
POST: ONE-ZERO	.008	008
	(.24)	(.30)
		0.40
POST: RIVALS	049	048
	(14.2)	(18.7)
CONCEANT	2.75	10 (4
CONSTANT	3.75	10.64
	(132.0)	(22.8)
Adi \mathbf{P}^2	224	672
Ацј-К Е	.554	.072
1	.).)∠()	002

Notes: t-statistics in parenthesis. Results of Hausman tests reject random effects model in favor of fixed-effects model at any level of significance.

	(a)	(b)
ARIABLE	POOLED OLS	FIXED EFFECTS
STANCE	.307	
	(215.7)	
OP	036	359
	(27.2)	(11.5)
LOTS	.045	
	(15.9)	
URIST	121	
	(60.6)	
UB	.120	
	(48.5)	
HI	.023	.057
	(11.5)	(20.3)
DT-ENTS	020	013
	(39.2)	(17.1)
VO-ZERO	006	
	(.75)	
S-PD	010	
	(1.72)	
D-US	068	
	(11.0)	
1-ACTUAL	014	
	(1.98)	
VE-ZERO	216	
	(8.54)	

TABLE 6Regression Results on Fares: USAir vs. Piedmont

RIVALS	.059	
	(23.7)	
POST: MERG	.118	.117
	(57.0)	(54.7)
	((((()))))	(0.117)
POST: TWO-ZERO	.111	.121
	(9.83)	(15.1)
		· /
POST: SM-ACTUAL	.075	.087
	(7.71)	(12.7)
POST: US-PD	.057	.068
	(6.96)	(11.5)
POST: PD-US	.040	.051
	(4.64)	(8.21)
POST: ONE-ZERO	.009	008
	(.25)	(.30)
POST: RIVALS	049	048
	(14.2)	(18.7)
CONSTANT	3.75	10.61
	(132.1)	(22.7)
Adj-R ²	.333	.672
F	3309	802

Notes: t-statistics in parenthesis. Results of Hausman tests reject random effects model in favor of fixed-effects model at any level of significance.

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CHAPTER 2

The Effects of Incentive Regulation and Quality Provisions on Quality of Service of

the U.S. Electric Distribution Utilities

1. Introduction

Performance of electric utilities is a multidimensional issue. Performance can be evaluated from the prospective of cost efficiency, service affordability, etc. One of the important parameters of utility's performance is quality of its services. Reliability of electric service is an important factor that affects quality of life of residential customers as well as business and production processes of non-residential consumers. However, almost no attention in the economic literature has been paid to the effects of policy changes on the level of reliability of electric service in the electric services. This paper examines the effects of incentive regulation on quality of service in the electric industry.

Incentive regulation (also called performance-based regulation) refers to innovative regulatory mechanisms that provide regulated firms with incentives to improve efficiency that are stronger than incentives provided under traditional rate of return regulation.

In the recent years more and more state public utilities commissions (PUCs) started considering incentive regulation as an alternative to rate of return regulation for their regulated electric distribution utilities. Though some states started their experiments with incentive regulation as early as in 1980s, the major wave of incentive regulation plans did not start until mid 1990s.

The mechanisms of incentive regulation - price caps, revenue caps, rate freezes, and rate case moratoriums - are based on the theory that relaxing the link between a utility's costs and its rates will provide a utility with incentives to achieve cost savings. The problem is that one of the ways to achieve these savings is to cut funds on tasks and programs that affect

reliability. An example is tree trimming programs. Inadequate amount of efforts on tree trimming was repeatedly named as one of the major causes of outages and blackouts in investigation of these events.²⁶

Some state public utilities commissions try to mitigate any potential adverse effects from incentive regulation plans by combining these plans with quality provisions. When faced with a threat of financial punishment under a quality provision a utility has less incentive to cut its reliability expenses. The present paper examines whether incentive regulation indeed has an adverse impact on reliability and whether this impact can be mitigated with the help of quality provisions.

The paper is organized in the following way. Section 2 summarizes findings of the existing relevant studies. Section 3 provides information on incentive regulation in the U.S. electric industry. Section 4 discusses the sources and limitations of the data employed in the study. Section 5 describes an applicable theoretical model from the literature. Section 6 describes econometric models and results from application of these models. Section 7 concludes.

2. Literature Review

First, I provide a summary of theoretical findings on quality provided by a monopoly²⁷ under different regulatory regimes. I am particularly interested in the findings about the level of quality provided by firms subject to incentive regulation regimes. The second part of the literature review discusses empirical studies.

Seminal articles of Spence (1975) and Sheshinski (1976) show that even in the basic

²⁶ For example, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, U.S.-Canada Power System Outage Task Force, April 5, 2004.

²⁷ Distribution utilities that are in the focus of this paper remain mostly local monopolies subject to different types of regulation.

setting, in which an unregulated monopoly provides a single product or service, the level of delivered quality might be below, above, or equal to the welfare-maximizing level. The results depend on customers' marginal valuation of quality.

An unregulated monopoly sets quality at the level where the incremental revenue from additional quality is equal to the incremental cost of increasing quality: ²⁸

$$xP_q(x, q) = C_q(x, q), \tag{1}$$

where C(x, q) is the firm's cost of producing x units of service of quality q, and P(x, q) is the maximum unit price that consumers are willing to pay.

At the same time, the welfare-maximizing level of quality is achieved at the point where the incremental surplus that customers obtain from additional quality is offset by the extra cost of increasing quality:

$$\int_{0}^{x} P_{q}(\tilde{x},q) d\tilde{x} = C_{q}(x,q)$$
(2)

An unregulated monopoly will deliver more than the welfare-maximizing level of quality if

$$P_q(x,q) > 1/x \int_0^x P_q(\widetilde{x},q) d\widetilde{x} , \qquad (3)$$

i.e. if the marginal customer values an addition to quality more than does an infra-marginal customer.

An unregulated monopolist delivers less than the welfare-maximizing level of quality if

$$P_q(x,q) < 1/x \int_0^x P_q(\widetilde{x},q) d\widetilde{x}$$
(4)

The third outcome when the level of quality delivered by the monopolist is equal to the

²⁸ The equations on this page (equations (1) - (4)) are taken from Sappington (2005).

welfare-maximizing level can also take place.

In addition to the situation of unregulated monopoly Spence (1975) and Sheshinski (1976) also examine the effect of regulation on monopoly's quality. Spence (1975) examines the effect of rate of return regulation on quality and Sheshinski (1976) examines the effects of price regulation, quality regulation, and quantity regulation on the level of quality. The sets of necessary conditions derived by the papers cannot be applied easily, and the papers conclude that a regulator needs a substantial amount of information (that might not be available to regulators) to know how a regulatory intervention will affect the level of quality.

Baron (1981) also examines the effects of price regulation on quality. The paper finds that price regulation leads to an undersupply of quality relative to the socially optimum level of quality. The regulatory authority might not be in a position to mitigate this undersupply due to the lack of authority to directly regulate quality and due to the asymmetry of information on costs and quality available to the regulator. The paper shows how to overcome these obstacles by developing a mechanism that relates price and cost in the way that provides a firm with incentives to supply higher quality.

Frazer (1994) examines from the theoretical prospective the question relevant to the question of my paper. The paper looks at the effects on quality of price caps that do not include quality provisions and price caps that include such provisions. I provide a detailed description of the paper's model and its findings in Section 5.

Another paper that examines the relationship between characteristics of price caps and the level of quality is Weisman (2005). The first factor examined is the level of the price cap (i.e. tightness of the price cap). Incentives to invest in quality of service are found to increase with the level of the price cap. The second characteristic is the participation of the regulated firm in the complementary, competitive markets. The paper finds that participation in such markets might temper the incentives of a firm to have lower quality of services. The paper provides an example of complementary, competitive markets in the telecommunications industry. Local exchange telephone companies are regulated for local service, and at the same time they also participate in complementary, competitive markets such as long-distance, wireless, and internet access. In the electric industry, vertically-integrated utilities provide distribution services subject to price regulation, and generation and transmission services that are supplied at the competitive markets. Reputation for lower quality of local exchange telephone service (or distribution electric service) might cause spill-over effects on other markets, where customers can choose from a number of competitors. The paper finds that investments in quality in a regulated market are increasing with a firm's participation in competitive markets.

As for the effect of inclusion of quality provisions into price caps, the paper distinguishes two types of such provisions: revenue-sharing penalties and profit-sharing penalties. The effect of revenue-sharing provisions on investments in quality was found to be in general ambiguous. Revenue-sharing provisions make a firm bear all the costs of investments in quality and allow a firm to keep only a fraction of corresponding revenues. Profit-sharing penalties were found to provide firms with incentives to increase investments in quality. In the electric industry, most of incentive regulation plans include profit-sharing, not revenue-sharing provisions.²⁹

²⁹ Weisman (2005), p. 170.

The last factor examined in the paper – provision of public with information on firm's compliance with quality benchmarks – was found to increase investments in quality.

Kidokoro (2002) examines a shift from rate of return regulation to price cap regulation in terms of effects on quality. The paper approaches the issue by distinguishing two components of quality: investment-related component, e.g., capacity expansion, and effort-related component, e.g., speed of response to customers' complaints. If quality depends mostly on the amount of investments, its level is found to decline in response to the shift to a price cap; this quality decline is accompanied with a decline in price. If quality is determined primarily by the level of firm's efforts, the result of the shift is different - an upgrade in quality and lower price. The explanation is that when faced with incentives to achieve cost savings under a price cap a firm might respond by enhancing its efforts, including efforts that affect quality. At the same time, price caps do not provide incentives to increase the level of investment in quality upgrades. However, to be able to make conclusions about the impact on the overall level of quality in any particular industry, a thorough analysis of this industry's characteristics has to be carried out. In the electric industry the level of quality depends both on the amount of investments and on the amount of efforts, thus an empirical analysis is required in order to answer the question.

A detailed review of the theoretical studies of service quality regulation, including some of the above studies, can be found in Sappington (2005).

Most of the empirical papers that examine the effects of incentive regulation focus on the telecommunications industry. This is not surprising given that incentive regulation has a long history of implementation in this sector. Papers examine incentive regulation in the

telecommunications industry from different perspectives: effects on costs, quality, profits, prices, revenues, investments, etc. As for the effects on quality, the findings of the existing studies are far from being conclusive. This can be explained in part by the fact that quality of telecommunication services is a multidimensional issue: different aspects of quality vary in their response to the introduction of incentive regulation. Banerjee (2003) looks at twelve measures of quality of retail telephone service and finds that on average quality has not worsened but even improved in the states that replaced rate-of-return regulation with incentive regulation for their local exchange carriers over the period from 1991 to 1999. The review of other studies that examine the question of incentive regulation and quality of service in the telecommunications industry - studies that were available prior to 2003 - can be found in Sappington (2003).

The more recent papers are Ai et al. (2004), Clements (2004), and Uri (2004). The first one examines the effects of incentive regulation plans on five dimensions of quality of retail telephone service in 1991-2002. The authors find mixed results: while customers of telephone companies subject to incentive regulation benefited from faster installation of new telephone service, a smaller number of trouble reports, and higher customer satisfaction, they also started to experience longer delays in addressing service problems and a decline in the number of installation commitments met. Clements (2004) concludes that non-rate-of-return regulation improved equipment- and system-oriented quality in 1992-1998. Uri (2004) finds that between 1991 and 2000 the overall level of service quality of local exchange carriers declined in response to the adaptation of incentive regulation in the form of price caps.

Many fewer papers look at how incentive regulation affects the performance of utilities in

the electric industry. Berg and Jeong (1991) examine the outcomes of the first experiments with incentive regulation in the electric generation sector in the late 1970s and early 1980s. The authors do not find evidence that incentive regulation is associated with improvements in the overall operating cost performance.

The only paper that provides a systematic analysis of the effects of performance-based regulation on quality of service of the U.S. electric utilities is Ter-Martirosyan and Kwoka (2009). The paper employs the panel data on 78 U.S. electric distribution utilities for the period of 1993-1999. The paper finds that incentive regulation is associated with an increase in the duration of electric outages, however not necessarily with an increase in the number of these outages. Quality provisions included into incentive regulation plans are found to mitigate the adverse effect of these plans on the duration of outages.

CPB report (2004) summarizes the experience of various countries with reliability policies in network industries. The study undertakes an empirical analysis of the effects of the introduction of price-cap regulation on quality and costs of Norwegian electric distribution utilities. This policy was found to be successful in providing utilities with incentives to achieve cost savings. The quality is measured with the help of three parameters: number of interruptions, duration of interruptions, and the amount of energy non-supplied due to interruptions. The results indicate that both duration and frequency of interruptions increase with incentive regulation; at the same time the amount of energy non-supplied declines under the incentive regulation regime. The study explains that utilities might be more concerned with the latter reliability measure since it directly affects utilities' revenues.

Hines et al. (2008) look at the historical trends of large blackouts in North America over

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the period of 1984-2006 and find that frequency of these events in the United States has not declined over time. The paper does not attempt to distinguish effects of any particular event or policy.

It should be noticed that there are no studies that examine the effects of incentive regulation on quality of service of the U.S. electric utilities in the recent years from 2000 to 2006. The data for this period is examined in this present paper in addition to the data for the earlier period.

3. Incentive Regulation in the Electric Industry

The experience with incentive regulation comes primarily from two industries: telecommunications and electricity. State public utility commissions started to replace rate of return regulation with incentive regulation in the telecommunications industry in the mid 1980s. Today the majority of commissions rely on incentive regulation (mostly in the form of price caps) to regulate interstate operations of local exchange carriers on the territory of their states.

Even though the extensive knowledge about incentive regulation was accumulated in the telecommunications industry, there are no straightforward ways of applying this knowledge to regulation of electric utilities, given all the differences between these two sectors. At this point, however, enough information has been generated in the electric industry to be able to make some conclusions about how incentive regulation affects electric utilities and their customers. A number of utilities have been experiencing the effects of incentive regulation plans for already more than 10 years.

The most common types of incentive regulation employed in the electric industry are price

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caps, revenue caps, rate freezes, and rate case moratoria.³⁰ Under a price cap, a price is initially set to allow a company to recover both its operating costs and its cost of capital. Thereafter, a price is allowed to increase at the rate of inflation, minus the productivity change. This is a generic formula of a price cap:

$$P_t \le P_{t-1} \left(1 + I - X \right) + Z, \tag{1}$$

where P_t is a maximum level of a price that a utility can charge its customers in period t, P_{t-1} is a price of the previous period t-1, I is an inflation level, X is a productivity factor, and Z are costs that are not subject to a price cap (costs due to natural disasters, changes in taxes and environmental regulation, and other costs outside of a utility's control). X is based not only on a given firm's past performance, but on performance of other firms in the industry as well. If a utility subject to a price cap manages to achieve productivity level that is higher than X factor, it can keep associated cost savings. Thus, inclusion of a productivity factor in the formula provides a utility with incentives to improve its efficiency. In practice estimation of a productivity factor represents a significant challenge.

Under a revenue cap, the same mechanism is applied to revenues instead of prices. Price caps might encourage utilities to oversell electricity, which is contrary to objectives of energy efficiency goals that most of the state commissions pursue nowadays. The advantage of revenue caps is that they do not provide utilities with such incentives to increase sales.

Under a rate freeze, utility cannot change its rates for a specified period of time. Under a rate case moratorium, utility achieves an agreement with a commission to discontinue rate cases for a given period of time thus increasing the period of time between rate reviews. Rate case

³⁰ A detailed discussion of different incentive regulation mechanisms, their application in the electric industry, and examples of the plans can be found in Joskow (2006) and Sappington at el. (2001).

moratoria are implemented in many cases in exchange for a utility's agreement not to raise prices and/or a promise to upgrade its system. Both mechanisms (rate freeze and rate case moratorium) allow a utility to benefit from cost savings that it might achieve during the extended time period between rate cases that reset rates.

Incentive regulation plans might contain a revenue sharing provision which is an explicit sharing of savings realized by a utility under an incentive regulation plan between a utility and its customers. If a utility earns more than a threshold return determined in a plan then a specified share of these extra earnings goes to customers through lower rates or direct payments; the other part of extra earnings goes to a utility's shareholders.

The purpose of all types of incentive regulation plans is to provide regulated firms with incentives to improve their performance. Traditional cost of service regulation does not provide firms with incentives to be efficient since under this type of regulation firms are allowed passing their costs to customers through rates. Cost of service regulation is based on a strong and direct link between firm's costs and its rates; alternative regulation mechanisms described above weaken this link. Thus, firms are given an opportunity to earn more by reducing their costs since they can keep savings. In addition to cost saving incentives, performance - based plans can provide utilities with incentives in other areas of performance. Plans can include incentives to improve quality of service or to upgrade systems by including punishment/rewards mechanisms for performance in these areas.

There are also additional advantages of incentive regulation over cost of service regulation. Incentive regulation plans are expected to reduce administrative and regulatory burden through a reduction in a number of litigated rate cases. Also, an incentive regulation plan can serve as a transitional mechanism of moving to restructured markets by replicating some of the market forces.

Most of the utilities in my dataset are subject to either rate freezes or price caps. The above listed mechanisms (price caps, revenue caps, rate freezes, and rate case moratoria) might vary in the degree of incentives they provide to utilities, and thus might have somewhat different impacts on utilities' performance. Price caps and revenue caps might have stronger incentive effects than rate freezes and rate case moratoria since these regimes are usually put in place for longer periods of time and provide utilities with more pricing flexibility. These mechanisms are also more sophisticated and take into account a potential of a particular utility to improve its efficiency. However, all performance based mechanisms are expected to affect utilities in the same direction – in the direction of cost savings. Presence of a sharing provision might also have its own effect on the strength of incentives provided by performance based mechanisms. If a utility has to share a large percent of its earnings with customers this might reduce its incentives to achieve cost savings.

Ai and Sappington (2002) use separate dummies for price cap regulation, earning sharing regulation, and rate case moratoria to examine the effects of these regimes on different parameters of utility performance (network modernization, aggregate investment, operating revenue and cost, profit, basic local service rates, and telephone ubiquity). The results suggest that there might be some differences in the effects of different regimes on utility performance. The paper finds that operating costs are generally lower under rate case moratoria than under traditional rate-of-return regulation. As for the other two regimes (earning sharing provisions

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and price caps) they also result in the decline of operating costs but only when local competition is strong enough.

Ter-Martyrosyan and Kwoka (2009) try to distinguish the effects of different regimes on quality of electric service by including dummies for rate case moratoria, price caps, revenue caps, and rate freezes. They found that only price caps and rate freezes have statistically significant effects on duration of outages. However, this can be related to the fact that there is a very small number of observations on other two regimes (rate case moratoria and revenue caps).

In this paper I do not distinguish among different types of incentive regulation, but rather analyze the effects of incentive regulation in general. All of the regimes are expected to affect utilities' performance in the same direction.

All of the incentive regulation mechanisms encourage utilities to achieve cost savings, and at the same time provide these utilities with some degree of freedom in choosing the ways of achieving this goal. The problem, however, is that some of these ways might involve cutting expenses that are directly linked to the level of utilities' reliability.³¹ Such expenses include, among others, maintenance of station equipment, maintenance of underground and overhead lines, maintenance of line transformers, operation supervision and engineering, maintenance supervision and engineering. The effect of incentive regulation on quality of service of electric utilities is in the focus of this study.

A number of state public utility commissions acknowledge the existence of the mentioned danger and try to mitigate it by including quality provisions into incentive

³¹ The question exists of whether the level of reliability is at its optimal level under rate of return regulation to begin with, and if not, whether a switch to incentive regulation moves utility's level of reliability closer to this optimal level. This question is outside the scope of this study. Sappington (2005) provides a summary of theoretical insights into this issue.

regulation plans. Even though a commission can introduce a quality provision as a separate program, most often these provisions exist as a part of performance-based regulation plan.

Regulators take one of the following approaches to quality regulation: (a) monitoring (utilities have to report to a commission specific indicators of their quality performance or categories of costs), (b) setting service quality targets (benchmarks) on specific parameters of utility performance; if a utility fails to achieve a certain level of performance it might be required to submit an action plan to a commission, and (c) penalties or penalties/rewards mechanisms that relate utility's performance parameters with changes in utility rates or allowed revenues. There are fewer provisions in place that have explicit penalties and rewards than provisions that include only penalties. Commissions seem to believe that most of the customers do not see many benefits in quality of service being beyond a benchmarked level and are not interested in paying for this superior quality; thus most of the commissions focus only on penalties.

According to the survey conducted by Pacific Economic Group in 2007³², 14 states employed monitoring, 4 states set targets, 20 states had penalties or penalties/rewards mechanisms, and 13 states did not have any plans. The quality regulation approach is in most cases utility-specific rather than state-wide.

Quality regulation that incorporates a mechanism with penalties is expected to have the strongest safeguarding impact on utilities' behavior. Thus, in this paper I look at the effect of only this type of quality provisions.

The following quality parameters, among others, are considered in quality provisions: (a)

³² PEG report (2007), p. 58.

outage related measures (duration and frequency): these parameters are included into the majority of quality provisions, (c) circuit performance, (d) speed of service restoration, (d) percent of customer calls answered by a utility within a certain period of time (i.e. 30 or 60 seconds), (e) metering and billing accuracy, and (f) number of customer complains.

Benchmarks that are used in quality provisions are usually based on historical performance of a utility subject to quality regulation or on performance of a group of peer utilities. Often penalties/rewards mechanisms include deadbands around benchmarks within which a utility is neither rewarded no penalized.

Incentive regulation plans as well as quality provisions are implemented for a certain number of years (e.g. 5 years). At the end of this period a commission decides whether a utility should continue to operate under an incentive regulation plan/quality provision with original or new conditions or it should switch back to rate of return regulation. In some cases a type of incentive regulation plan changes over time: for example, utility might start with a rate freeze and later move to a price cap.

Table 1 shows how the number of the utilities in my dataset subject to incentive regulation plans and quality provisions changed over the period of the study.

4. Data

The paper employs a unique dataset with information on reliability of about 130 electric distribution utilities in 40 states over the period from 1994 to 2006. No systematically collected data is available for the earlier years. Data collection on reliability of electric utilities presents a significant challenge due to the fact that decisions regarding data collection are left to the discretion of individual states. Data availability varies greatly by state: some states consider

reliability data confidential and do not provide it, some states have started to collect data only recently; thus information is available only for a couple of years, and so forth. Data for some states are obtained from publicly available sources such as state public utility commissions' reliability reports published at their web-sites. However, to obtain information for the majority of states I had to contact state commissions directly.³³ In general, the process of putting together a dataset on reliability requires a significant amount of effort since it is carried out on utility by utility, year by year basis. Due to discrepancies in data availability, the current dataset represents an unbalanced panel: for some utilities information is available for all 13 years (35 utilities have data on SAIDI for each year and 32 utilities have data on SAIFI for each year) and there are also utilities with a limited amount of information (27 utilities have less than 5 years of information on outage indices).³⁴

Reliability of electric service is a multidimensional issue; there are a number of measures that reflect different aspects of it. For example, reliability of Consolidated Edison of New York is evaluated based on 14 different measures. Reliability measures can be separated into three major categories: power quality indexes, measures of customer satisfaction, and outage indexes.

Power quality indexes include voltage stability, spikes, transients, flickers, sags, surges, harmonic distortion, and noise. This side of quality performance is becoming more important with an increase in the use of digital equipment that is sensitive to power quality and requires resetting. There are no standardized measures of power quality that would allow comparing

³³ Data on the years from 1990 to 2000 for more than half of the utilities in the dataset was graciously provided by Anna Ter-Martirosyan.

³⁴ The elimination of utilities with a small number of yearly observations on SAIDI and SAIFI does not affect the results of the study (presented in Section 6) in any significant way.

utilities' performances to each other. The only exception is momentary average interruption frequency index (MAIFI) that measures an average frequency of momentary outages (momentary interruptions are usually defined as interruption of less than five minutes). A number of utilities collect data on MAIFI. However, many more utilities collect data on the outage statistics SAIDI and SAIFI that I employ in this study.

The category of customer satisfaction includes the following measures: number of customer calls answered within a certain period of time (e.g. 30 or 60 seconds), appointments missed (repair, installation services), average time between placing an order and meeting this order, billing and metering errors. Information on customer satisfaction is usually collected through customer surveys. Thus, the results are affected by the questions asked and the sampling methods used. As a result, the results vary significantly across utilities and make a comparison difficult if not impossible.

The only relatively standardized measures are the ones related to outages; most of the electric utilities keep the record of frequency and duration of outages that their customers experience throughout a year.

In this paper I focus on indexes that reflect duration and frequency of outages by utility for two reasons. First of all, these are the only measures that are collected on a systematic basis across utilities. Second, state commissions pay a particular attention to these reliability parameters and include them into almost all of the quality provisions (penalties and rewards mechanisms are set around benchmark values of SAIDI (outage duration measure) and SAIFI (outage frequency measure)).

An average duration of outages experienced by a utility's customer throughout a year is

measured with the help of System Average Interruption Duration Index (SAIDI), which is an average outage duration for each customer served and is calculated according to the formula below. SAIDI is measured in units of time (minutes or hours).

SAIDI = (sum of all customers interruptions durations) / (total number of customers served per year) (1)

System Average Interruption Frequency Index (SAIFI) measures an average frequency of outages per customer per year. SAIFI is measured in units of interruptions per customer. SAIFI = (sum of all customers interruptions per year) / (total number of customers served per year) (2)

Duration and frequency of outages are affected by both exogenous (weather, characteristics of service territory) and endogenous (utility's level of efforts and expenditures) factors. In order to separate the effect of anomalous weather effects, it is a standard practice for utilities to calculate SAIDI and SAIFI without inclusion of major weather events (major storms, hurricanes, etc.). The problem is, however, that some utilities differ in the way they define major events. Companies may also differ in the extent to which they rely on manual or automated systems (such as outage management systems) to collect reliability data. This might affect the accuracy of statistics reported by utilities. In addition, some utilities are vertically-integrated, thus their SAIDI and SAIFI indices reflect transmission, distribution, and generation related outages. Others are stand-alone distributors and their outage statistics reflect only distribution related outages. This issue is mitigated by the fact that most of outages are caused by the problems in local distribution systems. Despite the above mentioned issues with the data, duration and frequency indexes remain the best available measures of reliability of electric systems.

Most of the additional data, including information on utilities' characteristics, is publicly available and comes primarily from the Federal Energy Regulatory Commission (FERC) Form 1 filings and Energy Information Administration (EIA) Form 861.

Table 2 presents the means of SAIDI and SAIFI indexes for the examined period. This information suggests that customers of the utilities subject to incentive regulation plans that do not incorporate quality provisions experience electric service that is worse (both in terms of duration and frequency of outages) than customers of the utilities not subject to incentive regulation plans or subject to plans that include quality provisions . The presence of quality provisions seems to lead to lower duration and frequency of outages. The next section presents the formal analysis of the data.

5. Theoretical Model

The theoretical model applicable for this study is the model developed in Frazer (1994). This model examines the relation between reliability and price cap regulation in the electric industry. Frazer (1994) defines reliability in the electric sector as the likelihood of capacity exceeding demand. Frazer (1994) examines from the theoretical point of view the question similar to the one that I examine with the help of empirical work in the present paper. The model in Frazer (2004) examines the effects of two types of price caps on the level of reliability. First type are price caps that do not include reliability provisions and focus only on price level. The second type are price caps that contain both price and quality parameters. In my dataset I distinguish two types of incentive regulation plans: (1) incentive regulation plans that include quality provisions, and (2) plans without quality provisions. Frazer's model looks at the effects of only price caps. According to Sappington et al. (2001), "by 1996, however, pure price cap

regulation had become the predominant form of regulation, and remains so today." In this study I do not distinguish different incentive regulation regimes. As was discussed above in Section 3, all types of incentive regulation are expected to affect utility's incentives in the same direction.

From the findings of the theoretical model of Frazer (1994) I expect negative effects on the level of reliability of utilities in my dataset from the introduction of incentive regulation. Also the findings of the Frazer (1994) model suggests that inclusion of reliability factor into the price cap might help to mitigate negative effects of incentive regulation.

6. Econometric Models and Results

This section provides a systematic examination of the effects of incentive regulation and quality provisions on, first, duration of outages, and second, frequency of outages.

6.1. Duration of Outages

First, I explore the effects of incentive regulation and quality provisions on duration of outages with the help of the following model.

SAIDI _{it} =
$$\beta_0 + \beta_1 IR_PLAN_{it_1} + \beta_2 QUAL_PROV_{it_1} + \beta_3 DAMAGE_{it} + \beta_4 NON-RES_{it} + \beta_5$$

SALES_{it}+ $\mu_i UTILITY_i + \delta_t YEAR_t + \varepsilon_{it}$ (1)

The unit of observation is a regulated electric distribution utility. The dependent variable in the above specification is the average duration of outages per customer per year (SAIFI). To measure the effect of policy changes I include the following two variables: IR_PLAN, a dummy variable equal to one if utility i is subject to an inventive regulation plan, and QUAL_PROV, a dummy variable for quality provision with explicit penalties for utility i.

The policy variables enter the specification with lagged effects. Studies of the effects of performance-based regulation differ in whether they employ contemporary values of policy

variables or their lagged values. The use of lagged values assumes that it takes time for the effects of policy changes to materialize and it might be difficult or even impossible for a company to adjust its level of quality immediately in response to a policy change. In case of incentive regulation plans, first, it takes time for a utility to adjust its behavior to a policy change (for example, to start cutting its tree trimming expenses in response to cost saving incentives provided by incentive regulation). And then it takes time for these adjustments (inadequate amount of tree trimming expenses) to reveal themselves in a different level of reliability. The effects of quality provisions are also expected to reveal themselves over time. There are also arguments in favor of using policy variables in their present terms. First, a change in a regulatory regime might be anticipated before its implementation. Second, reliability data collected on a yearly basis reflects average performance over an entire year, thus in cases when a new policy is introduced at the beginning of the year data might already reflect lagged effects. According to Sappington (2003), "when possible, it generally is preferable to allow for lagged effects of regulatory policy, and to let the date reveal the strength of these effects".³⁵ Examples of studies that use present terms of regulatory regimes include Ai and Sappington (2002) and Roycroft and Garcia-Murrilo (2000). Banerjee (2003) and Clements (2004) use lagged policy variables.

I try models both with contemporaneous values and with lagged values. The results of the models that employ incentive regulation and quality provisions in their present terms do not indicate existence of any statistically significant relation between policy variables and reliability level (both for duration and frequency of outages)³⁶. Thus, the following discussion will focus on the models with lagged variables.

³⁵ Sappington (2003), p. 366.

³⁶ The results of these regressions are available upon request from the author (shumilkina.e@neu.edu).

In addition to the policy variables, a number of other variables are expected to have impacts on reliability of service in one way or another. The survey of the literature that looks at the reliability issue both from economic and engineering perspectives³⁷ reveals that the following control variables belong to the model.

Weather is an important factor that affects reliability of electric service. As discussed in Section 4, the outage indexes employed in this paper are already constructed in the way that excludes effects of major storms. However, since not all relevant weather events are subject to exclusion and because exclusion rules differ somewhat across utilities, an explicit measure of weather severity is added to the model. It is measured with the help of the variable DAMAGE: In of damages (measured in thousands of dollars) from major weather events (storms, hurricanes, lightning, tornadoes, floods, temperature extremes, snow and ice, fire) on the territory of the state where utility i operates.³⁸ It is possible to employ other measures that reflect weather effects, for example, number of major weather events (as listed above), number of days with unusually hot or cold weather, and damages from a specific type of weather events. Ai et al (2004) use damages from hurricanes (in thousands of dollars) to capture the effect of severe weather on level of service quality of telecommunication companies. They found the impact of weather on some aspects of quality of service (such as commitments met for new service installation for business customers, network service problems, line losses, and average downtime from outages), but not on other aspects (including the number of outages). I also try the specification that employs the number of major weather events on the territory of the state instead of the measure

³⁷ CPB report (2004), Ter-Martirosyan and Kwoka (2009), Pacific Economics Group report (2007), Brown (2002).

³⁸ This data was obtained from the web-site of National Climatic Data Center http://www.ncdc.noaa.gov/oa/ncdc.html

of damages to control for weather effects. The results of this model are not significantly different from the results of the original specification.

Another factor that might play role in determining the level of quality of an electric utility's services is the composition of a utility's customers. Non-residential customers might place higher value on uninterrupted electric service, and at the same time they might enjoy some political power over utility's decisions on how much effort and money to spend on reliability. The engineering aspect of providing electric service also differs across different groups of customers. For both these reasons, I include the variable NON-RES - a percent of sales that goes to industrial and commercial customers – to measure the effect of changes in the presence of non-residential customers. I also tried a specification that separates industrial and commercial groups of customers. The effects of these two groups of customers are similar, thus I combine them into one group of non-residential customers.

The other variable that appears on the right hand side is SALES - In of the amount of utility's kWh sales. Delivering larger amounts of electricity might increase burden on a utility's system and, thus, cause problems with reliability. On the other hand, larger utilities might have more resources available to deal with outages. The variable SALES tests the direction of the effect of sales on reliability.

The descriptive statistics on the variables employed in econometric models (3) and (4) are presented in Table 3.

The utility-specific dummy variable (UTILITY) captures characteristics of a utility and its business conditions that do not change over time. Time-specific dummy variable (YEAR) captures macroeconomic factors that change over time and affect all utilities in the sample. Such factors might include industry-wide technological advances, changes in federal regulations, etc.

I employ fixed and random effects models to estimate models (1) and (2). The fixed effects model considers μ_i to be fixed parameters that should be estimated. Random effects model considers μ_i as random drawings from the population and treats them as part of an error term. Random effects model is more efficient than fixed effects model when length of time series is relatively long. However, it is appropriate to apply random effects only if we can make an assumption that μ_i are uncorrelated with explanatory variables. If there are omitted variables in an equation then μ_i are correlated with explanatory variables. Fixed effects model controls for all omitted variables that affect a utility's quality of service and thus produces unbiased estimates while random effects model does not. Allowing for the possibility that there are omitted variables in the models (1) and (2), the application of fixed effects. The results of the Hausman test favor fixed effects over random effects for both duration of outages model (1) and frequency of outages model (2). The results of fixed effects and random effects are similar in magnitude and statistical significance.

Table 4 presents the results from the application of fixed effects model for specification (1). The results indicate that incentive regulation plans have an adverse impact on reliability in terms of the length of outages. Implementation of incentive regulation is associated with an increase in duration of outages by about 17 minutes³⁹; the result is statistically significant at 5 percent level. This result confirms that the benefits expected from incentive regulation come at

³⁹ Given the average number of outages this corresponds to the increase of about 13 percent.

the expense of quality deterioration.

The next question is whether this adverse effect can be mitigated with the help of quality provisions. It appears that indeed a threat of financial penalty for lowering quality of its services induces a utility to reduce average duration of outages by about 16 minutes. The coefficient is statistically significant at 10 percent level. The magnitude of this mitigating effect is very similar to the negative effect associated with incentive regulation plans. This allows me to conclude that when policymakers plan to introduce incentive regulation they should consider accompanying this policy with well-designed quality provisions. F-test of the combined effect of incentive regulation and quality provisions being zero cannot be rejected at any conventional level (p-value = .92).

Next, I turn my attention to other explanatory variables. The coefficient on DAMAGE indicates that duration of outages increases by about 2 minutes as a result of severe weather conditions. The result is not statistically significant at 10 percent level (t=1.40). This can be due in part to the fact that SAIDI is already adjusted for major weather effects (as explained in section 4).

Having more non-residential consumers encourages a utility to supply its services at the higher level of reliability. One percent increase in the amount of sales that go to non-residential customers (NON-RES) reduces the length of outages by less than one minute. The coefficient is statistically significant at 10 percent level. As for the other explanatory variable employed in the model - the amount of utility's sales - the magnitude of the coefficient indicates a positive effect on reliability in terms of the duration of outages (a decrease of about 6 minutes), but the variable falls short of being significant at 10 percent level (t=1.57); most of the variation in this variable

might be captured by fixed effects.

The results of the random effects model presented in Table 7 show a very similar picture. Duration of outages increases by about 14 minutes in response to the introduction of the incentive regulation plan. Quality provisions help to reduce the length of outages by 19 minutes. Both results are statistically significant at 5 percent levels. The coefficients on the additional explanatory variables behave in the fashion similar to the results of the fixed effects model. As was mentioned before, the results of the Hausman test favor the fixed effects model over the random effects.

6.2. Frequency of Outages

Next I examine how another aspect of reliability of electric service - frequency of outages - is affected by incentive regulation. The results of the previous study that examined the reliability in the period from 1994 to 1999 suggest that incentive regulation might have stronger effect on duration of outages than on frequency since a utility has less control over the later parameter. The present study seeks to shed some additional light on this question by employing a larger dataset, larger both in terms of number of utilities and number of years. The larger number of observations should help to establish the relation between incentive regulation and frequency of outages more precisely. The following model is employed in order to do this.

SAIFI _{it} = $\beta_0 + \beta_1 IR_PLAN_{it_1} + \beta_2 QUAL_PROV_{it_1} + \beta_3 DAMAGE_{it} + \beta_4 NON-RES_{it} + \beta_5 SALES_{it} + \mu_i UTILITY_i + \delta_t YEAR_t + \varepsilon_{it}$ (2)

The dependent variable is frequency of outages. Duration and frequency reflect two characteristics of the same event – outage. Utility might have different power over these two aspects of reliability: incidents of outages are usually caused by failure of equipment, while the

length of outages depends mostly on availability of maintenance crews, effective communications, and other factors within utility's efforts. Thus, frequency of outages mostly depends on utility's preventive measures, and duration of outages depend more on the speed of service restoration. Other factors that are expected to affect frequency of outages and thus enter the model include: severe weather effects that can lead to equipment failures, percent of nonresidential customers served by a utility (these customers might be more sensitive to service interruptions than residential customers), and utility's sales. Table 5 provides the results of the application of the fixed effects model.

In regards to incentive regulation, the results indicate that, again, this policy has a significant negative impact on frequency of outages. Incentive regulation is associated with an increase in the average number of interruptions by about .08 times^{40.} The coefficient is statistically significant at 5 percent level.

Unlike in the case of duration of outages, quality provisions do not appear to be a useful tool in keeping quality in terms of frequency of outages from deterioration. The coefficient on quality provisions is negative .04, but it is not statistically significant at any conventional level.

The effects of additional explanatory variables are similar to their effects on the length of outages (SAIDI). Severe weather is associated with an increase in the number of outages; the finding is statistically significant at 5 percent level. One percent increase in the share of non-residential customers reduces the occurrences of outages by .04 times (about 3 percent); statistically significant at 5 percent level. The changes in the amount of sales do not have a statistically significant effect on the frequency of electric outages.

⁴⁰ Given the average number of outages this corresponds to the increase of about 7 percent.

The results of the random effects model that can be found in Table 7 also indicate the presence of adverse effect on the frequency of outages from performance-based regulation plans (an increase of .07 times, significant at 5 percent level). The effects from the presence of quality provisions are not statistically significant (t=1.08). The results of the Hausman test favor the fixed effects model.

Based on the information from tables 4-7 we can conclude that incentive regulation has adverse impact on both the length of interruptions of electric service and their frequency. At that, quality provisions play an important safeguarding role in case of duration of outages. However, these provisions are not very useful in dealing with the number of outages. It might be the case that when a regulatory agency introduces quality provisions utilities focus on the aspects of quality that are easier to improve, for example by hiring more maintenance workers, and organizing more efficient communications with customers. Such actions might tend to affect duration of outages. The factors that affect frequency of outages might require more dramatic changes and more substantial investments (for example, replacement of old equipment). The utility might decide to invest in small changes that can help avoid penalties for an increase in duration of outages, but that more substantial investments required to improve frequency of outages might outweigh financial penalties for quality degradation. Carefully crafted quality provisions might be required to provide utilities with incentives to improve quality in terms of both duration of outages and frequency of outages.

We can compare the results of the present study with the results of the other two studies that examine the effects of incentive regulation and quality provisions on reliability of service of electric utilities. In regards to the duration of outages, I find that incentive regulation plans increase this statistic by about 17 minutes (13 percent), and quality provisions reduce it by about 16 minutes. The CPB (2004) study finds that duration of outages of Norwegian electric utilities increased by about 22 percent in response to the introduction of performance-based regulation in the form of a price cap. The introduction of quality provision reduced duration of outages of Norwegian utilities by about 17 percent. Ter-Martyrosyan and Kwoka (2009) examine reliability of US electric utilities in the period from 1993 to 1999 and find that incentive regulation increases duration of outages by about 115 minutes which almost doubles duration of outages (mean of SAIDI is 121 minutes for the dataset employed in that study). Quality provisions were found to mitigate this negative effect by reducing length of outages by about 130 minutes.

As was noted in Ter-Martyrosyan and Kwoka (2009), a utility might have less control over frequency of outages than over their duration thus it might be more difficult to discern empirically the effects of policy variables on this aspect of reliability. Ter-Martyrosyan and Kwoka (2009) do not find any effects of incentive regulation or quality provisions on number of outages. Having a larger dataset should help to estimate these effects more precisely. My findings regarding frequency of outages indicate that number of outages increases by .08 times (6 percent) in response to introduction of incentive regulation and at the same time frequency of outages is not affected by introduction of quality provisions. The CPB (2004) study finds that incentive regulation is associated with an increase in the number of outages by about 34 percent and does not find a significant effect from the introduction of quality provisions.

Other existing studies of incentive regulation and quality of service focus on the telecommunication sector. These studies look at numerous aspects of the telecommunication quality which is measured differently than the quality of electric service. The studies find mixed

effects from the introduction of incentive regulation plans. Also, there were no practices of introduction of quality regulation in the telecommunications sector. Thus, the results of telecommunication studies do not present good reference for comparison to the findings of my study.

7. Conclusions

Incentive regulation plans were introduced by different states in the recent years with the promise of improvements in cost efficiency. In some cases, however, cost efficiency might have been achieved at the expense of reliability.

The results of this study confirm the existence of this danger. I find that incentive regulation is associated with deterioration of electric service both in terms of duration of outages and their frequency.

This problem can be solved in part by accompanying incentive regulation plans with quality provisions that contain explicit penalty mechanisms. I find that quality provisions help to restore the level of reliability in terms of duration of outages. These provisions, however, are not capable of mitigating negative impact of incentive regulation on frequency of outages.

By extending the knowledge about the effects of incentive regulation on quality of electric service the paper sends a note of caution to regulators that consider introduction of incentive regulation.

Table 1.	Incentive re	gulation j	plans and	quality	provisions f	or
the U.S.	distribution	utilities i	n the peri	od from	1994 to 20	06

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Utilities under incentive regulation	7	17	17	33	50	66	73	83	80	77	70	67	54
Utilities under quality provisions	4	7	6	9	16	30	31	42	42	39	37	37	28

Note: The numbers represent only the utilities that are included in the dataset for this study, not all the utilities in the U.S. subject to incentive regulation or quality provisions. The total number of utilities in my dataset is 130.

	SAIDI (mean), min	SAIFI (mean), times
All utilities	127	1.19
With incentive regulation and without quality provision	146	1.24
With incentive regulation and with quality provision	103	1.05

 Table 2. Means of duration and frequency of electric outages

Variable	Unit of measurement	Mean	Min	Max	St. dev	Number of observations
SAIDI duration of outages	minutes	127	.25	1550	89	1173
SAIFI frequency of outages	times	1.19	.0032	4.57	.55	1116
IR_PLAN	0/1	.32	0	1	.47	1989
QUAL_PROV	0/1	.15	0	1	.36	1989
DAMAGE damages from unusual weather conditions on the territory of utility's operations	\$ (ln)	11.26	.16	18.62	1.96	1986
NON-RES percent of sales that go to industrial customers	%	63.45	28.44	100.00	9.96	1850
SALES utility's total sales	thousands of kWh (ln)	15.55	5.66	18.46	1.76	1853

Table 3. Descriptive statistics of dependent and independent variables

Variable	Fixed Effects
IR_PLAN	16.68** (2.27)
QUAL_PROV	-15.88* (1.74)
DAMAGE	1.91* (1.40)
NON-RES	73* (1.84)
SALES	-5.40 (1.57)
CONSTANT	239.02*** (4.03)
Adj-R ²	.47

Table 4. Regression results on duration of outages (SAIDI). Fixed effects

Notes: t-statistics in parenthesis

*=10%, **=5%, ***=1% significance level

Results of the Hausman test reject random effects model in favor of fixed-effects model at any level of significance

DAMAGE is subject to one-tail t-test

Variabla	Fixed Efforts
v al lable	Effects
IR PLAN	.08**
—	(2.16)
QUAL_PROV	04
	(.84)
DAMAGE	01/**
DAMAGE	(1.92)
	(1.92)
NON-RES	04**
	(2.01)
SALES	02
	(1.28)
CONSTANT	1.69***
	(5.38)
	× /
Adj-R ²	.63

Table 5. Regression results on frequency of outages (SAIFI). Fixed Effects

Notes: t-statistics in parenthesis

*=10%, **=5%, ***=1% significance level

Results of the Hausman test reject random effects model in favor of fixed-effects model at any level of significance

DAMAGE is subject to one-tail t-test

	Random
Variable	Effects
IR_PLAN	14.05**
	(2.03)
QUAL_PROV	-18.56**
	(2.20)
DAMAGE	1.23
	(.95)
NON-RES	64**
	(1.89)
SALES	-3.90
	(1.56)
CONSTANT	200 7(***
CONSTANT	288./6***
	(4.81)

Table 6. Regression results on duration of outages (SAIDI). Random effects

Notes: t-statistics in parenthesis

*=10%, **=5%, ***=1% significance level

Results of the Hausman test reject random effects model in favor of fixed-effects model at any level of significance

DAMAGE is subject to one-tail t-test

	Random
Variable	Effects
IR_PLAN	.07**
	(1.89)
QUAL_PROV	05
	(1.08)
DAMAGE	.01*
	(1.53)
NON-RES	01**
	(2.45)
SALES	02
	(1.27)
CONSTANT	1.70***
	(6.41)

Table 7. Regression results on frequency of outages (SAIFI). Random Effects

Notes: t-statistics in parenthesis

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*=10%, **=5%, ***=1% significance level

Results of the Hausman test reject random effects model in favor of fixed-effects model at any level of significance

DAMAGE is subject to one-tail t-test

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CHAPTER 3

The Effects of Mergers with Claims of Cost Savings on the Operating Costs of the U.S. Electric Utilities

1. Introduction

A substantial number of electric utilities participated in merger activities in the previous 10-15 years. Mergers of electric utilities are subject to review at both the federal level (FERC, DOJ, FTC) and at the state level (public utilities commissions (PUCs)). The agencies take the following factors into consideration when they evaluate proposed mergers: degree of market concentration, changes in concentration due to a merger, entry conditions, weakening of competition through coordinated interaction, financial status of merging companies, and efficiencies generated by a merger.

Efficiencies from electric mergers are in the focus of this paper. Estimates of such efficiencies are usually found in the merger applications submitted to state regulators but not in the documents presented to the federal agencies that tend to focus on other factors. The analysis of merger-related documents (such as merger applications and merger agreements) reveals that in many cases merging parties claim substantial cost savings from proposed mergers, even after taking into account costs associated with a merger (transitional and regulatory costs, system integration costs, etc.). Merging parties attempt to estimate magnitude of merger cost savings and identify sources where these cost savings are expected to come from. The list of sources of cost savings usually includes the following: reduction in corporate and operations labor, combining corporate and administrative programs, purchasing economies, strategic benefits, fuel savings, and business optimization.

It is unclear how much trust we can place in the ex ante estimates of cost savings since the methodologies of the estimation used by merging parties in many cases are vague and because ex ante analysis has its limitations. The merging parties might have an incentive to overestimate cost savings from mergers if these savings are used as an argument for a merger's approval. There is also a possibility that unexpected events (for instance, unexpected difficulties in integration of operations and differences in the cultures of two utilities) will prevent merger savings from realization. "Almost all mergers are undertaken with the ex ante prediction that benefits and efficiencies will occur. However, ex post, the vast majority (60-80%) of merges can be characterized as unsuccessful."⁴¹

This paper examines whether mergers with claims of cost savings have effect on the level of merging utilities' costs. This is done by examining changes in operating costs of utilities that underwent mergers with ex ante promises of cost savings and changes in costs of utilities that merged without such claims as well as changes in costs of utilities that did not participate in mergers.

The results of the paper should provide some guidance to the competition authorities on how to view claims of cost savings from future mergers.

The paper is organized in the following way. Section 1 provides a literature review. Section 2 discusses mergers of electric utilities and cost savings from these mergers. Section 3 describes the data. Section 4 discusses the econometric model. Section 5 describes the results of the application of the model and discusses econometric issues. Section 6 concludes.

2. Literature Review

The credibility of ex ante claims of cost savings from mergers in the electric industry is in the focus of the present study. Besides case studies that analyze individual mergers, there are no studies that directly test credibility of efficiency claims in a systematic way for the mergers in the electric industry as well as in any other industry. In this literature review, first, I will discuss

⁴¹ Hartman (1996), p. 438.

studies that examine efficiencies from mergers. Then I will look at the studies that include some discussion of claims of merger efficiencies.

There are several types of studies that study the existence of efficiencies from mergers. First group of studies directly examines the effects of mergers on costs and productivity. The second group of studies uses a less direct approach by looking at the company performance measured by accounting profits or share prices. If a company's performance is found to increase after a merger, this can be due either to an increase in market power or to efficiency gains, or to a combination of these two factors. The problem with studies of company performance is that they do not allow telling which effect (market power or efficiency gains) takes place. In order to solve this problem some studies try to distinguish two effects by employing additional information such as market shares, prices, and stock prices of the merging companies and their rivals. Below I discuss studies from each group. I am mostly interested in the studies of the electric industry.

Studies that directly examine changes in costs and productivity from mergers find different results for different industries. The following are the studies from baking industry, telecommunications industry, life-insurance industry, and electric industry. Peristiani (1997) looks at the large number of mergers in the U.S. banking industry in 1980-1990 and finds that buyers experience moderate improvements of their scale efficiency and profitability but not X-efficiency (managerial efficiency). Berger and Humphrey (1992) also look at the banking industry for the similar period of time (1981-1989) but concentrate on the largest mergers (57 in total). They examine two types of efficiencies: economies of scale and X-efficiencies. Because of the diseconomies of scale associated with the mergers of large entities the study finds that

merged firms on average performe worse after mergers. However, this effect is small and statistically insignificant. As for X-efficiencies, the effect of the mergers on average was less than 5 percent and statistically insignificant. By looking at the individual cases, the study finds that there were some very successful mergers as well as some very unsuccessful mergers.

Cummins et al. (1998) look at the large number of life-insurance firms over the period 1988-1995 with the help of data envelopment analysis (DEA). The study finds beneficial impact of mergers and acquisitions: target firms improve their efficiency significantly in comparison to firms that were not involved in mergers or acquisitions (control group).

Gort and Sung (2000) examine the following potential sources of cost savings from telecommunications mergers: economies of scale and scope, reduction in excess capacity, and the role of mergers as catalysts for changes in companies. The study utilizes information on eight large regional U.S. telephone companies for the period of 1951-1991. The paper employs a cost function to forecast the effects on costs from telecommunications mergers in the short run and in the long run. For the long run they estimate a total cost function under the assumption of full-capacity utilization. For the short run they apply a variable cost function that takes into account the possibility of under- and over-investment into the capital stock. Given the scale of operations of the major regional telephone companies, the study also rules out the economies of scope from combining local and toll services. The study finds that mergers do not lead to a significant reduction in excess capacity. The study also tries to separate specific sources of economies of scale. The results suggest that there might be economies of scale from some specific sources (namely, the efficiency of the introduction of new capital that increases with scale), but these

economies might be offset by a decrease in effectiveness in the use of labor. The study does not provide any evidence on whether mergers serve as catalysts of changes or not.

In electricity, Hattori et al (2005) study productivity of UK and Japanese electric distribution firms in the period of 1985-1998. With the help of data envelopment analysis (DEA) and stochastic frontier analysis the study finds that there was an acceleration in the productivity growth in the period of 1994-1998, a period characterized by mergers and changes in regulation.

Kwoka and Pollitt (2007) examine the wave of mergers that took place in the period from 1994 to 2003. In total, the study examines 73 mergers. With the help of DEA method, efficiency scores were created for each operating unit in the dataset. The DEA score shows the efficiency of an operating unit relative to the best practice identified in the sample. Two sets of efficiency scores were created based (1) on operating costs and (2) on total controllable costs. The study then examines these scores in the several years before and after the mergers. The study separates the experiences of sellers and buyers. The paper tests the efficient-merger hypothesis that states that it is highly efficient firms that initiate mergers and that mergers result in improved efficiency to one or both sides of a transaction. The results show that this hypothesis does not hold, and in fact the reverse is true. It is below average performing or ordinary performing utilities that initiate mergers with more efficient parties. The efficiency of these better performing (prior to mergers) sellers declines towards a norm as a result of mergers. These losses in sellers' efficiency are not compensated by buyers' efficiency gains: the study finds little or no changes in efficiency of acquiring firms after mergers.
Another strand of the merger literature looks at the effects of mergers on company performance. First, I will talk about studies of profitability and after that I will look at the event studies.

Most of the profitability studies find mergers to be welfare-reducing. The following three studies examine mergers that took place in different time periods. Gugler et al. (2003) employ a large dataset on mergers that took place in different countries in recent years. A large proportion of mergers were found to result in lower profits and lower efficiency. However, there is also a group of mergers that led to increased profits that can be explained either by a gain in market power and an improved efficiency. Healy et al (1992) study the performance of the participants of the 50 largest US mergers in the period of 1979-1983. Pre-tax operating cash flow returns on assets is used as a measure of performance. The study examines performance five years before a merger and five years after a merger and uses industry performance as a benchmark for comparison. The study finds improvement in asset productivity and higher operating cash flow returns of the merged firms after the mergers. Mueller (1980) looks at about 250 mergers of US companies in the period of 1962-1972 and compares profitability three years before a merger and five years after a merger. The study finds a decline in profitability of merging firms to compare to the control group of non-merging companies.

Other studies of company performance concentrate on stock prices instead of profits. These are so called event studies (where an event is a merger announcement). The advantage of the event studies over the profitability studies is that they examine the present value of the expected future profits while studies of profits focus on current profits. Most of the event studies make an assumption that the stock market operates efficiently. The event studies usually look separately at the returns to targets and the returns to bidders. Most of the existing event studies, including studies of the electric utility mergers, conclude that it is target shareholders that benefit from mergers. According to a summary of the event studies provided in Roller et al (2000), target shareholders usually benefit from mergers with 20-35 percent increase in share prices. Bidder shareholders in general break even and combined gains of targets and bidders are usually positive and up to 10 percent. Leggio and Lien (2000) examine 76 electric utilities mergers in 1983-1996 and find that merger announcement returns were positive and significant for target companies' shareholders. However, these returns are lower than returns to target shareholders of companies that operate in non-regulated industries. At that, acquirers receive negative announcement returns. Berry (2000) analyses 21 mergers of electric utilities that took place in 1995-1998. The results indicate that target shareholders benefit modestly from the merger announcements. The other finding is that markets are more favorable towards the mergers between electric and gas utilities that have potential economies of scope than to the mergers

As was mentioned above, the problem with studies of company performance is that they do not allow distinguishing whether the company performance was affected by changes in market power or by changes in efficiency. Some studies try to separate these two effects by using additional information such as information on market shares and share prices of rivals.

If a merger is driven by market power then a merged firm is expected to increase prices and reduce output after a merger. Thus, if we see a decrease in a firm's market share after a merger this can serve as an indication of the gain in market power; an increase in firm's market share would indicate the effect of synergies generated by a merger. The findings of studies of market shares are summarized in Roller et al (2000). These findings suggest that market shares usually decline after horizontal mergers and that the evidence is mixed in regards to other kinds of mergers. Baldwin and Gorecki (1990) find a significant decline in market shares of firms that were acquired in horizontal mergers. The study does not find significant changes in market shares of firms that participated in other types of mergers.

Some studies attempt to separate the effects of market power and efficiency gains by looking at the rivals' stock prices. Competitors benefit from mergers that result in an increase in market power since merging firms try to increase prices and/or reduce production with the help of the acquired market power. An increase in efficiency hurts rivals since it allows merged firms to reduce prices. Thus, if a merger is associated with an increase in market power, the prices of rivals' stocks should increase. A gain in efficiency from mergers is expected to have an opposite effect on rivals' stock prices. Studies that use this approach do not provide conclusive evidence. Stillman (1983) examines stock return data for rivals to the participants of 11 horizontal mergers that took place in 1964-1972. He does not find statistically significant effect on rivals' stock prices. Eckbo (1983) finds a small increase and it is statistically significant. However, shares of rivals of the merging firms for which regulatory authorities announced investigations were not affected in a significant way.

Now I turn my attention to the studies that look at the claims of merger efficiencies. As was mentioned above, no study examines in a systematic way whether predictions of cost efficiencies from mergers are credible. Below I discuss studies that discuss the treatment of efficiency claims by regulatory agencies and some case studies. FTC conducted a detailed study (Coate and Heimert (2009)) on how claims of merger efficiencies are treated by two branches of FTC: Bureau of Competition Analysis (BC) and Bureau of Economics Analysis (BE). The study looks at the efficiency claims in 186 mergers in different industries for which FTC issued a second request investigation in the period from 1997 to 2007. The study is particularly interested in what types of efficiencies were claimed by the merging parties and how BC and BE treated each category of claims. The conclusions of the study include the following. The likelihood of accepting fixed cost savings was the same as the likelihood of accepting claims of variable cost savings. The claims of dynamic efficiencies were more likely to be accepted than claims of savings in other categories. Dynamic efficiencies are savings that come from sources other than reduction in the cost of day-to-day operations, such as vertical integration that reduces transactions costs, savings from the introduction of new products and services, and savings in related markets. Claims of generic efficiencies (savings that could not be identified as fixed or variable savings) were more likely to be rejected than other claims.

Hartman (1996) argues that ex ante efficiency predictions of merger applicants are not very reliable. The study does not undertake a comparison of ex ante predictions of merger efficiencies and the actual outcomes, though it stresses the importance of such study. Rather, the study summarizes the information that can help regulators in assessing the credibility of efficiency predictions from mergers and provides recommendations on how to apply this information. The study summarizes the relevant findings of the studies on economies of scale, economies of scope, and density economies in the electric industry. These are the factors from which regulators can expect the merger efficiencies to come from. According to the study, the minimum efficient size (MES) for a vertically integrated firm was found to be in the range of 10,000-35,000 GWH of sales. As for the scope economies, Hartman (1996) suggests discouraging combinations of gas and electric utilities; the combined-fuel scope economies might exist only for very small firms. As for the density economies, the only relevant study (Roberts (1986)) suggests that mergers that lead to an increase in the customer base within the existing service territories and/or an increase in the size of the service territory are efficiency neutral. Mergers result in density economies only if the service territories of the merging firms intersect.

Hartman (1996) suggests using the above evidence in the following ways. If the merging entities are smaller than the mean of MES (19,000-22,000 GWH) it is likely that the merger will produce efficiency gains; the predictions of merger efficiencies are more credible in this case. The ex ante claims of substantial savings from mergers of utilities of larger sizes are not credible as they are unlikely to produce any efficiencies associated with economies of scale. Since much less evidence exists on economies from scope and density economies, Hartman (1996) recommends using this information only as suggestive.

The following discusses the insights from case studies of mergers.

Fisher and Lande (1983) look at the number of case studies of mergers in different industries that they find mostly in business and trade press. They warn against generalizing from examples, given the techniques used in case studies and small sample sizes. Nevertheless, they conclude that while many mergers produce substantial efficiencies, there are also many mergers that turned out to be failures. As for the ex ante predictions of efficiencies, according to the study, the record of these predictions is too poor to be used as a major basis for public policy decisions. I discuss two case studies from the electric industry. These case studies are part of the Energy Information Administration (EIA) report "The changing structure of the electric power industry 1999: merger and other corporate combinations." The first study focuses on the merger of Cincinnati Gas & Electric and PSI Resources that formed Cinergy Corporation in 1994. The second study examines the merger of Entergy and Gulf States Utilities into Entergy Corporation that took place in 1993. The purpose of both studies was to determine whether the merging parties realized their pre-merger objectives with the use of the publicly available data. The studies utilize the following data sources: FERC merger applications and testimonies, FERC Form 1, and 10-K filings of the Securities and Exchange Commission.

Among the main objectives of the first merger (Cincinnati Gas & Electric and PSI Resources) were a creation of a larger and more efficient utility and lower electricity rates. The study examines different parameters of utility performance after the merger: costs, worker efficiency, rates, sales, revenues, and stock prices. I am primarily interested in the findings on costs. There were two ex-ante estimates of cost savings from the merger: \$750 million over the period of 1994-2003 in the original public announcement made in 1992, and the second estimate of approximately \$1.3-\$1.5 million made before the FERC's approval of the merger in 1994.

The case study finds that the merger indeed resulted in operating efficiency gains. In the three years following the merger real O&M costs declined by 11 percent, and customer expenses declined by 12 percent. The study estimated that the actual cost savings were \$950 million over the decade following the merger. After subtracting the merger-related costs of \$225 million, the actual savings are in line with the companies' original estimate of \$750 million, and less than the later estimate of \$1.3-\$1.5 million. The study finds that most of the savings came from workload

reduction, deferral of the construction of new generation capacity, and greater efficiency in electricity production.

The objectives of the merger between Entergy and Gulf States that is in the focus of the second case study included the following: cost savings of \$1.7 billion over the period of 1994-2003 (minus total estimated merger costs of about \$111 million), lower electricity rates, and a creation of financially and operationally stronger company. The latter objective is examined by looking at electric revenues, sales, and income before and after the merger.

The cost savings were expected to come from fuel savings, non-fuel O&M reductions, and deferral of capacity additions. The study finds that actual O&M costs per net generation kWh declined by 13 percent over the next 4 years after the merger compared to the increase of 2.5 percent over 2 years before the merger. Since the case study was conducted in 1999, the EIA study did not have the data for the whole period of the promised cost savings and could only look at the first four years after the merger. However, based on the data available, the study estimates the actual cost savings from the merger for the period of 1994-2003 to be around \$1.5 billion. This estimate is relatively close to the pre-merger claims.

To summarize, both case studies find that the claims of cost savings presented by the companies before the mergers were in line with realized cost savings.

3. Cost Savings from Mergers in the Electric Industry

Merger-related efficiencies arise from a number of sources and can be grouped based on different criteria. The following are the examples of categorizations found in the literature⁴².

⁴² The following discussion about typologies of merger-related efficiencies is based on Roller et al. (2000).

The first categorization identifies the following sources of efficiencies based on the concept of a production function:

1. Rationalization (cost savings from reallocation of production across merging companies)

- 2. Economies of scale and scope
- 3. Technological progress (diffusion of know-how; increased incentives to invest in R&D)
- 4. Purchasing economies
- 5. Reduction of managerial slack (X-efficiencies).

The other categorization separates efficiencies into two groups: (1) Real cost savings (savings of productive resources in the economy) and (2) Redistributive cost-savings (e.g., lower taxes). Usually only real cost savings are considered in efficiency defense. A distinction can also be made between savings of (1) Fixed costs and (2) Variable costs. Efficiencies can also arise at (1) Firm level and (2) Industry level (for example, efficiencies related to reallocation of production from merging companies to their competitors). In addition, efficiencies can be distinguished according to a market where they are found: (1) Efficiencies in the relevant market, (2) Efficiencies in other markets.

The above are the examples of general topologies of merger efficiencies. Sources of cost savings differ somewhat across industries. For example, while merger efficiencies from technological progress play a large role in the IT industry, this source does not seem to be important in the mergers of electric utilities. An analysis of a specific merger requires looking into the sources of efficiencies typical for the industry.

In the electric industry that is in the focus of this research the largest amounts of savings, according to the claims of merging parties, are expected to come from reductions in labor costs

(both corporate and operation labor) and from consolidation of corporate and administrative programs.

The following figure was constructed by the Energy Information Administration (EIA) based on the information from pre-merger testimonies in five mergers of electric utilities.⁴³

Figure 1. Estimated Cost Savings from a Merger (Percent of Total Savings)⁴⁴



The examination of the documents related to the mergers in my dataset indicates that the merging parties in my data expect most of the savings from the same sources: reduction in labor expenses, combination of corporate and administrative programs, purchasing economies, and

⁴³ Limitations of the data employed in this paper (discussed in the following section) do not allow constructing a similar chart for the mergers examined in the paper.

⁴⁴ "The changing structure of the electric power industry 1999: merger and other corporate combinations", EIA, 1999, p. 26.

fuel procurement. The other sources of savings cited in some cases include: business optimizations, implementation of new technologies, enhanced financial strength, deferred capacity additions, sharing of best practices, joint dispatch of electric power, and strategic benefits (e.g., company's growth, expanding into new territories). The latter category is nonquantifiable.

Merging companies that make forecasts of cost savings usually expect these cost savings to realize in 5 or 10 year after a merger. Merger efficiencies are offset by transaction costs and regulatory costs, and costs related to system integration. There are a number of reasons why merging entities might not be able to achieve claimed benefits. These reasons include conflict in corporate cultures, the winner's curse, the loss of managerial control, and unexpected changes in economic and regulatory conditions. Also, in many cases cost savings serve as an argument in favor of merger's approval and thus merging parties have incentives to show sufficient cost savings.

The question is whether merging parties manage to realize claimed cost savings in practice. This question is examined in the next sections of the paper.

4. Data

The study examines the period from 1994 to 2006. This period covers the merger wave that took place in the electric industry around 1997-2001. Thus, for the majority of the mergers the length of the dataset allows examining 5 to 9 years after a merger. The paper employs a dataset with information on about 130 electric utilities in 40 states. The number of mergers that involved utilities in my dataset is 73. Some of the utilities were involved into more than one merger during the examined period of time. More than half of the mergers had claims of cost

savings prior to a merger. Table 1 shows the number of mergers for utilities in my dataset for each year of the study period.

Mergers of electric utilities usually represent an addition of operating subsidiary to a holding company. Upon joining a holding company, utilities usually continue to serve their separate territories, keep separate identities, and submit separate and unchanged reports to FERC and state regulators. FERC requires maintaining separate reporting for operating companies. All of this allows obtaining a consistent dataset on merging utilities before and after mergers.

Information on utilities' costs comes from the Federal Energy Regulatory Commission (FERC) Form 1 filings. Data on utility's characteristics (number of customers, amount of sales, amount of own generation, different categories of customers) comes from the Energy Information Administration (EIA) Form 861. The source of information on fuel costs is EIA Form 423⁴⁵. The information on costs of labor (annual wages) comes from the Bureau of Labor Statistics.

Information on timing of mergers, identities of merging parties, and cost savings come from the FERC's web-site, state public commissions' filings, and trade press.

The collection of information on cost savings represented the major data challenge. As was mentioned above, the claims of cost savings are typically found in the documents submitted to state regulators, and not in the documents submitted to the federal agencies. However, states do not have a systematic way of submitting and analyzing information on merger efficiencies. The burden of proof of any cost savings is on merging utilities and they present this information to regulators on a voluntarily basis. The format of the information provided by utilities varies

⁴⁵ The compiled data on fuel costs was graciously provided by Vlada Sabodash.

greatly. Utilities differ in the way they categorize cost savings and in the number of years they make forecasts for. Some utilities conduct throughout analyses and provide testimonies of economic experts, while others provide raw estimates without explaining how these estimates were derived. Some merging parties provide savings net of merger-related costs; others do not include such costs. In some cases utilities look at specific sources of cost savings, in other cases utilities present gross estimates. Some merging parties present estimates of cost savings in monetary units for one category, but not for other categories. In most cases merging parties claim savings that consist of both fixed costs (mostly in the form of reduction of administrative and general functions and administrative and general labor) and variable costs. The data used for this study does not allow separating claims of fixed costs and claims of variable costs.

The lack of consistency in the data on cost savings does not permit a constriction of a continuous variable that would reflect the magnitude of cost savings (for example, cost savings as a percent of utility's annual revenues or as dollars per kWh). Thus, this paper uses the following categorization of all mergers in the dataset: (a) mergers for which parties claimed cost savings ex ante and (b) mergers for which parties did not make claims of cost savings.

5. Model

My model is based on the cost function that captures the relationship between utility's costs and its output. The general form of the cost function can be written as:

$$C = C (Q, P, X)$$

where C is utility's costs, Q is utility's output, and P is input prices. X is a vector of exogenous factors that affect utility's costs; mergers are included into this vector since they are expected to affect utility's costs.

I examine utility's total operating costs for the reasons discussed below. I measure the utility's output with the help of utility's total sales. I also tried another measure of output - a number of customers. As for the factor prices, I include costs of labor and different types of fuel (coal, natural gas, and petroleum). Capital costs are assumed to be fixed over the short run period covered by this study for the reasons discussed later in the text.

I estimate the average cost function. Having average costs as opposed to total costs on the left hand side helps to solve to some degree the problem of heterogeneity (examined utilities vary greatly in their scale of operations).

The following model is built to capture short-run operating efficiencies (if there are any) associated with mergers of two types: mergers with ex ante claims of cost savings and mergers without such claims.

OPER COSTS_{it} = β_0 /SALES_{it} + β_1 + β_2 MERGER NO SAV+ β_3 MERGER_{it} SAV_{it} + β_4 SALES_{it} + β_5 LABOR_{it} + β_6 COST COAL_{it} + β_7 COST NAT GAS_{it} + β_8 COST PETROLEUM_{it} + β_9 PCT NON RES_{it} + β_{10} PCT OWN GEN_{it} + β_{11} DIV_{it} + μ_i Utility_i + ϵ_{it}

(1)

The dependent variable in this model is utility's total operating costs per kWh of sales (OPER COSTS). In the short run the major effects from mergers are expected to come in the form of operating efficiencies. In the long run mergers might also affect the expenditures on capital investments. However, most of the claims from the examined mergers are in the area of operating efficiencies. In addition, a life circle of capital assets in the electric industry is long (about 30-50 years, depending on a type of asset) and a utility has a limited control over changes

in capital stock that are subject to regulatory approval. Thus, the paper focuses only on changes in operating expenses and the assumption is made that it is operating costs that were mostly affected by the mergers in the short run covered by this study. The question of the effects of the mergers on capital expenditures is outside the scope of this study.

Total operating costs consist of O&M (operation and maintenance) costs, customer support costs (customer accounts expenses, customer service and informational expenses, and sales expenses), cost of fuel, and administrative and general costs. The majority of claims of merger cost savings are associated with these categories. The dependent variable is adjusted for inflation with the help of PPI.

 β_0 /SALES is the result of transformation of the total cost function into the average cost function.

MERGER SAV is a dummy variable that is equal to one for the year of the merger with claims of cost savings and all the years after. MERGER NO SAV is a dummy variable equal to one for the year of the merger without claims of cost savings and all the years after. The variables should help to shed the light on the question of whether the promises were realized by comparing the effects on the level of operating costs of the mergers with claims of costs savings and the effects of mergers that did not have such claims. If merging parties make forecasts of any cost savings they tend to do this for a period of 5 or 10 years. As was mentioned above, the majority of the mergers took place in the years 1997-2001, which gives observations for 5-9 years after mergers. Thus, the period of time of the study should allow examining whether these promises were realized. The data limitations discussed in the previous section do not allow constructing and employing a continuous variable on cost savings in the form of dollars of

savings per kWh. The control group is the group of utilities that did not participate in the mergers.

Utility costs are expected to be affected by a number of other factors. First of all, costs might vary with the amount of output. In the above model I use SALES (total sales in mWh).⁴⁶ I also tried a model that included another measure of output - a number of customers. I discuss the results of the use of the number of customers below in the discussion of results. There is a high correlation between sales and number of customers (.92). At that, sales appear to be a better reflection of output than a number of customers. For example, a utility that serves only a few industrial customers can produce the same amount of output (in kWh) as a utility with a hundred of residential customers. Thus, in my final model I use only sales as a measure of output.

As was mentioned above in Section 3, after a merger utilities continue to report their information to FERC separately, including the information on sales. Thus, the amount of sales in the model (1) is at the separate utilities' level. Mergers are not expected to have any effect on the amount of sales of separate utilities since, being regulated monopolies, utilities remain under the obligation to serve the same certain number of consumers. However, the output of the holding company – parent of the merging utilities – increases as the result of a merger.

A merger can affect the cost function in the following three ways.

First, the cost function can shift up or down as the result of a merger. Such shifts will be reflected in the changes in the average level of utility's unit costs.

 $^{^{46}}$ The inclusion of the quadratic term SALES² could potentially allow capturing possible nonlinearities in the relation of costs and output. However, the two variables are highly correlated (the coefficient of correlation between SALES and SALES² is .93). I include SALES in linear form only to avoid the effects of multicollinearity.

Second, a merger can cause a movement along the cost curve to the right since a merger increases sales at the holding company's level. Depending on the size of utilities, this movement can bring merging companies either closer to the MES point and help them to realize the economies of scale or bring utilities further away from this point and, thus, subject utilities to the diseconomies of scale.

Third, the shape of the cost function can change as the result of a merger. This will take a place if a merger changes the relationship between costs and sales. If, for example, before the merger a one percent increase in sales resulted in .5 percent decline in costs and after the merger this effect becomes 1 percent, the portion of the curve before the MES point changes its shape and becomes steeper.

The model (1) with the help of the variables MERGER NO SAV and MERGER SAV allows capturing only the first effect that represents all the non-scale related effects of mergers. The model does not allow capturing the scale-related changes (movements along the curve and changes in the shape of the cost function). The variables 1/SALES, SALES, and the constant term β_1 in the model (1) that capture the general relationship between sales and costs assume that this relationship is the same for all firms (merging and non-merging) and that it does not change over time.

The results of the application of the model (1) to two separate samples (a sample of only merging utilities and a sample of only non-merging utilities) should shed some light into the question whether the sales-cost relationship (and thus the shape of the cost function) is the same for both types of utilities. The results are presented in Tables 8 and 9.

These results suggest that these two categories of utilities (merging and non-merging) might have different sales-cost relationships. All the scale-related coefficients (1/SALES, SALES, and the constant term) are different in the two regressions suggesting that cost functions of merging and non-merging utilities might look different.

At that, the coefficient on MERGER SAV (Table 9) is not statistically significant (t=.98) indicating that there is no difference in the levels of costs of merging utilities with claims of cost savings and merging utilities without such claims. Since the sub-sample includes only merging utilities the results already take into account that cost functions of merging and non-merging utilities might be different. These results serve as an additional confirmation of the results that I find using the total sample.

To summarize the above discussion, the model (1) allows capturing only the non-scale related merger effects. The examination of the effects of the merger-induced changes in the scale of utilities' operations on costs is outside the scope of this study.

The levels of labor costs and fuel costs should also have effect on utility costs. For labor costs I use average annual manufacturing wages in the state. This measure of labor costs is used in Nielsen and Primeaux (1988) and Kwoka (2005). Average manufacturing wages in the state are not expected to be affected by mergers of specific electric utilities.

The model includes costs of three types of fuel: coal, natural gas, and petroleum. For these costs I use average annual prices of different types of fuel in the state. The prices of fuels and wages are adjusted for inflation with the help of PPI. The majority of utilities operate in the same state. Since merging parties often expect significant cost savings from purchasing economies there is a possibility that fuel costs might be affected by mergers through this channel. Fuel costs, however, are measured with the help of prices of fuels at the state level, and thus are not likely to be affected by the mergers of particular electric utilities.

Operating costs can also be affected by cost of capital. Capital assets in electricity are long lived (30-50 years) and built on the basis of long-term load forecasts. Adjustments to changes of the time profile of electricity demand are costly and most of the changes in capital stock require regulatory approval. At that, utilities are obliged to maintain excess capacity to meet sudden increases in demand. Thus, the quantity of capital is most likely not being adjusted to achieve minimum total costs and not at the optimum level in the short run. Thus, I assume that the level of capital is fixed over the short run period of my study and unaffected by mergers. The capital is taken as fixed in the following studies, among others: Farsi et al (2010), Filippini (1996), Hiebert (2002), Nelson and Primeaux (1988), Nemoto et al. (1993).

The differences in the levels of capital stock (that is assumed to be fixed at the utility level) across utilities might help to explain to some degree the differences in the unit costs of the utilities in the dataset. These differences in the capital stock will be captured by the utilityspecific dummy variables (UTILITY) along with other characteristics of utilities and their business conditions that do not change over time.

Different types of customers (residential, commercial, and industrial) might be associated with different levels of expenses. Residential customers typically require more spending on service and support as well as on additional infrastructure. This observation is controlled with the help of the fraction of a utility's non-residential customers in the utility's sales (PCT NON RES).

Two variables are included into the model to control for the economies of vertical integration. The first is PCT OWN GEN – a percent of utility's sales which is generated by utility itself. The findings of Kaserman and Mayo (1991), Gilfsdorf (1994), and Kwoka and Pollitt (2007) suggest the existence of efficiencies from the higher percent of self-generation. The second variable - DIV - is expected to reflect the effect of divestitures. It is a dummy variable equal to 1 in the year of a significant divestiture and the years after. In a number of cases a divestiture of generating units was a condition for a merger's approval. As a result of divestitures, distribution utilities might experience a decline in their operating efficiency due to a loss of vertical integration. Kwoka et al. (2008) examine the effects of divestitures on the efficiency in electric distribution and find that all divestitures taken as a group did not have a significant effect on distribution efficiency. However, a more detailed examination that separates divestitures into the ones mandated by states public utility commissions and the ones undertaken by utilities on a voluntarily basis reveals that the first group has a large statistically significant negative effect on efficiency. In defining a significant divestiture I follow Kwoka et al. (2008) that characterize "a major divestiture as a year-to-year decline in a utility's generation plant of at least one-half its initial amount, where that initial amount had to represent a substantial fraction of its requirements".47

The utility-specific dummy variable (UTILITY) captures characteristics of a utility and its business conditions that do not change over time (including the level of capital stock that is assumed to be fixed over the short run).

⁴⁷ Kwoka et al. (2008), p. 13.

The fixed effects model is employed in the estimation of the model (1). The fixed effects model considers μ_i to be fixed parameters that should be estimated. The fixed effects model controls for all omitted variables that affect utility's costs and thus produces unbiased estimates. In comparison random effects model does not produce unbiased results in the presence of omitted variables. Allowing for the possibility that there are omitted variables in the model (1), the application of fixed effects is more appropriate in this case.

6. Results of the Estimation and Econometric Issues

6.1. Results

The results of the estimation of the model (1) are presented in Table 4. I am primarily interested in the variables that capture the effects of mergers. The variable MARGER NO SAV is not statistically significant (t=.02) which indicates that mergers that were not expected to result in any savings indeed do not change the level of operating costs. The next question is whether mergers with ex ante claims of cost efficiencies produce a different effect. A positive coefficient on this group of mergers would indicate that mergers in this category perform better than mergers that did not have claims of cost savings. This, however, is not the case in terms of the level of operating costs, as indicated by the coefficient on MERGER SAV that is not statistically significant at any conventionally accepted level (t=.19).

From the above results I draw a conclusion that mergers of any type (with claims of cost savings and without such claims) do not have on average an effect on the level of operating costs. As was mentioned above, these results serve as an indication of the absence of non-scale related effects of the mergers and do not state anything about scale related effects. The results of the other control variables for the most part are in line with expectations and findings of the literature. Costs are found to decline as sales increase. The coefficient on SALES shows that an increase in sales by one thousand mWh leads to a decline in a unit cost by .1 cent; the coefficient is statistically significant (t=6.67). As was mentioned above, I also tried a number of customers as an alternative measure of output. The results of the regression that uses a number of customers instead of sales mirror the results of the model (1): unit costs increase with output.

Increase in labor costs has a small (.00003) positive effect on the unit costs that is statistically significant (t=3.45).

Different types of fuels have somewhat different effects on utility's operating costs. Increases in prices of coal and natural gas are associated with increases in operating costs. Both coefficients are statistically significant (t=2.54 for coal and t=2.57 for petroleum). However, the cost of natural gas does not seem to have any effect on utility's operating costs (t=.71).

As expected, if a utility serves a larger percentage of non-residential its operating costs decline. A one percent increase in the share of commercial and industrial customers decreases the unit cost by about 6 cents. The coefficient is highly statistically significant (t=6.18). I also try the model with two separate variables: a percent of sales to commercial customers and a percent of sales to industrial customers. The coefficients on these two variables indicate the same: lower unit costs to compare to residential customers. Thus, in the final model I combine commercial customers and industrial customers into a single category of non-residential customers.

The result on the percentage of self-generation finds no effects from changes in this parameter on costs since the coefficient is not statistically significant (t=.93).

The other measure of the effects of vertical integration - DIV - shows that on average a divestiture is associated with a decrease in utility's unit costs by about .72 dollar; the result is statistically significant (t=2.14). This result is different from the results of the study of divestitures in the electric industry (Kwoka et al. (2008)) that finds no effects from divestitures as a group and a negative effect from the divestitures mandated by state public utilities commissions. The present study is different from the study of divestitures in terms of econometric model, data, and measure of efficiency employed (DEA scores versus accounting costs).

6.2. Endogeneity

The above results can potentially be affected by the presence of endogeneity in the model. Utilities that choose to merge and to claim or not claim cost savings are not randomly selected. It might be the case that utilities with particular high levels of costs try to use a merger as a way to improve their cost efficiency. The utilities that claim cost savings from mergers also might have higher level of costs a priori and thus have more to potentially gain from mergers. Endogeneity of the merger variables will result in inconsistent and biased results from the application of the model (1).

Table 3 reports the means of costs (average and total costs) and sales for different categories of utilities: non-merging utilities, all merging utilities, merging utilities with claims of cost savings, and merging utilities without claims of cost savings. The numbers in the table indicate the possibility of the following selection patterns. Utilities that choose to merge tend to have higher costs (both average and total costs) to compare to non-merging utilities and at the same time they are smaller in size. Such utilities might view a merger as a way to improve their

efficiency and/or to expand in size. The merging utilities with claims of cost savings have higher average and total costs than the merging utilities without claims of cost savings and they tend to be larger. The claims of cost savings from mergers might be related to the fact that involved utilities are relative inefficient to begin with.

In order to solve a potential endogeneity problem I follow the practice employed, among others, in Donald and Sappington (1997) and Ter-Martirosian and Kwoka (2009). At the first stage, I run a probit model that explains an event that is represented by a zero-one dummy in the main regression (i.e. merging with claims of cost savings and merging without claims). Then, at the second stage, I use the predicted probabilities from the first step as the instruments for the potentially endogenous dummy variables in the main regression.

I employ two probit models. The first model predicts the probability of merging with claims of cost savings and the second model predicts the probability of merging without claims of cost savings. The following explanatory variables are employed in the probit models.

ADJACENCY is a dummy variable equal to 1 if territories of merging utilities were adjacent, and 0 otherwise. There are more possibilities of cost savings from the mergers for utilities that operate on the territories that are adjacent than from the mergers of utilities located in different areas of the country.

Two variables reflect the political situation in the state; one of the political parties might view merging activity more favorably. GOVERNOR is a dummy variable equal to 1 if a governor was a republican, and 0 otherwise. HOUSES is a dummy variable equal to 1 if both houses were controlled by republicans, and 0 otherwise. In addition, I include the variable that reflects such characteristic of the state commission as whether commissioners are elected or appointed. ELECTED is a dummy variable equal to 1 if commissioners of the state public utility commission are elected, and 0 if they are appointed. The elected commissioners might be under more pressure to show the results (i.e. benefits to ratepayers from mergers) to the public in order to increase their chances to be reelected for the next term.

The results from the estimation of the probit models are presented in Table 5 and Table 6. Probability of merging with claims of cost savings increases if territories of the merging utilities are adjacent. At the same time, such probability decreases if the governor of the state belongs to the republican party and if the state commissioners are elected. Whether the houses are controlled by republicans or not does not have statistically significant effect.

As for the probability of merging without claims of cost savings (Table 6), it is reduced by the adjacency of the utilities' territories, as well as by the governor being a republican, and the state commissioners being elected for the office. The coefficient of the political control of the houses is again not statistically significant.

The next step is to use the predicted probabilities from the probit models in the main regressions instead of variables MERGER NO SAV and MERGER SAV. The results are presented in Table 7.

The use of the instruments does not change the main results: mergers without claims of cost savings and mergers with such claims do not have effects on the level of operating costs; both coefficients are statistically insignificant (t=.19 and t=.83, respectively). The results of the

other control variables are virtually unchanged. The use of instrumental variables helps to build more confidence in the main results of this study.

7. Conclusions

The main task of this paper was to examine whether mergers with claims of cost savings have effects on the level of utilities' operating costs. The results show that mergers that were expected to result in cost savings did not perform any better in terms of the level of operating costs than mergers that did not claim any savings. Mergers of both types do not have any nonscale related effects on utility costs. The question of whether there are any scale-related effects of mergers is outside the scope of this study.

The implication for the public policy from the results of the study is that claims of merger savings should be viewed carefully. Regulators might consider requiring merging utilities to provide more evidence on the forecasted cost savings.

Year	Number of mergers	Number of mergers with claims of cost savings
1994	0	0
1995	1	0
1996	0	0
1997	11	4
1998	7	3
1999	15	7
2000	17	13
2001	8	5
2002	3	1
2003	0	0
2004	1	1
2005	2	2
2006	8	2
Total	73	38

Table 1. Mergers in different years of the study period

Variable	Unit of measurement	Mean	Min	Max	St. dev	Number of observations
OPCO Operational costs	\$ per unit of sales (kWh)	.51	.0006	36.90	2.89	1698
SALES Utility's total sales	kWh	1.39e+10	0	1.04e+11	1.74e+10	1844
CUST Total number of customers	number	572721.6	0	5108588	799810.3	1844
WAGE Average annual wages	\$	55356.62	33566.45	103032.7	8805.982	1976
COST COAL Price of coal	Cents per MMBTU	187.23	85.86	355.72	47.13	1976
COST NAT GAS Price of natural gas	Cents per MMBTU	551.36	171.29	1241.13	199.74	1967
COST PETROLEUM Price of petroleum	Cents per MMBTU	515.70	76.70	1698.54	256.85	1908
NON-RES Percent of sales that goes to non- residential customers	%	63.43	28.44	106.58	9.99	1837
PERC OWN GEN Percent of sales that is generated by a utility itself	%	80.56	0	195.68	45.52	1636

 Table 2. Descriptive statistics of dependent and independent variables

	Average operating costs (mean), \$	Total costs (mean), \$, mln	Sales (mean), mWh, thousands
All utilities	.51	1359.71	13872.5
Non-merging utilities	.40	1302.60	14320.00
Merging utilities	.69	1459.01	13060.1
Merging utilities with claims of cost savings	.75	1474.10	13267.94
Merging utilities without claims of cost savings	.57	1419.42	12395.24

 Table 3. Means of costs and sales of different categories of utilities

Variable	Fixed Effects
1/SALES	14.43
	(25.90)***
MERGER NO SAV	003
	(.02)
MERGER SAV	.034
	(.19)
SALES	0001
	(6.67)***
LABOR	.00003
	(3.45)***
COST COAL	.007
	(2.54)**
COST NAT GAS	.00003
	(.71)
COST PETROLEUM	.0007
	(2.57)**
PCT NON RES	063
	(6.18)***
PCT OWN GEN	0033
	(.93)
DIV	72

Table 4. The results of the estimation of the model (1)

	(2.14)**
CONSTANT	2.52
	(2.27)***
Adj-R2	.43

Notes: t-statistics in parenthesis

Variable	Probability of merging with claims of cost savings
ADJACENT	1.66
	(20.09)***
GOVERNOR	32***
	(4.5)
HOUSES REPUBLICAN	.11
	(1.52)
ELECTED	87
	(7.32)***
CONSTANT	-1.49
	(17.43)***
Pseudo R2	.26

 Table 5. Probability of merging with claims of cost savings: probit model

Notes: standard errors in parenthesis.

Variable	Probability of merging without claims of cost savings
ADJACENT	12
	(1.50)***
GOVERNOR	58***
	(7.3)
HOUSES REPUBLICAN	.02
	(.22)
ELECTED	47
	(4.68)***
CONSTANT	98
	(13.09)***
Pseudo R2	.05

Table 6. Probability of merging without claims of cost savings: probit model

Notes: standard errors in parenthesis.

Variable	Fixed Effects
1/SALES	14.42
	(25.92)***
MERGER NO SAV	097
	(.19)
MERGER SAV	.82
	(.83)
SALES	0001
	(6.69)***
LABOR	.00003
	(3.41)***
COST COAL	.008
	(2.60)**
COST NAT GAS	.00003
	(.81)
COST PETROLEUM	.0007
	(2.63)***
PCT NON RES	065
	(6.30)***
PCT OWN GEN	0033
	(.93)

Table 7. The results of the estimation of the model (1) with instruments for

MERGER NO SAV and MERGER SAV

DIV	73
	(2.17)**
CONSTANT	2.44
	(2.18)**
Adj-R2	.46

Notes: t-statistics in parenthesis

Variable	Fixed Effects
1/SALES	14.32
	(38.04)***
SALES	0001
	(4.88)***
LABOR	.00001
	(1.48)
COST COAL	.003
	(.91)
COST NAT GAS	.0008
	(2.12)**
COST PETROLEUM	.0004
	(1.27)
PCT NON RES	031
	(3.05)***
PCT OWN GEN	005
	(1.64)
DIV	75
	(2.12)**
CONSTANT	2.49
	(2.35)**

Table 8. The results of the estimation of the model (1) on the sample of

only non-merging utilities.

Adj-R2	.38
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Notes: t-statistics in parenthesis
Variable	Fixed Effects
1/SALES	921.64
	(41.80)***
MERGER SAV	.24
	(.98)
SALES	00004
	(2.33)**
LABOR	.00008
	(6.88)***
COST COAL	.003
	(1.03)
COST NAT GAS	.0009
	(2.08)**
COST PETROLEUM	.0005
	(1.98)
PCT NON RES	007
	(.64)
PCT OWN GEN	004
	(.93)
DIV	41

Table 9. The results of the estimation of the model (1) on the sample of

only merging utilities.

	(1.12)
CONSTANT	-5.01
	(3.85)**
Adj-R2	.41

Notes: t-statistics in parenthesis

*=10%, **=5%, ***=1% significance level

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