The Response of Investors in Publicly-Traded Utilities to Blackouts

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Abstract
Large blackouts are economically costly and socially disruptive, but in some cases can also be beneficial to investors in publicly-traded utilities. Large blackouts, particularly those that damage capital equipment, can increase future cash flows of utilities if replacement capital expenditures are permitted to be included in the rate base. The semi-strong version of stock-market efficiency suggests that these future cash flow increases will be reflected in utility stock prices following blackouts (but before the conclusion of any rate case proceedings). We use an event-study framework to examine abnormal returns for U.S. electric utilities in the 60-day period following large blackouts. In many cases utility stock returns decline immediately following the blackout as cash reserves are depleted. In the case of blackouts that are unlikely to involve large-scale capital replacement, the blackout has little impact on abnormal returns over a longer time horizon. In the case of blackouts caused by natural disasters or extreme weather, we observe that fast recovery times (one week or shorter) are associated with a slight increase in abnormal stock returns, suggesting that investors have confidence that future rate cases will turn in the utility's favor. Finally, blackouts affecting more than one million customers and those that take more than 10 days to achieve full restoration are associated with a decline in abnormal stock returns for affected utilities; this decline persists for several weeks following restoration.

1. Introduction
The aim of this paper is to investigate, using an event study method, investor reaction after customers of a publicly traded electric power utility experience a power outage. Blackouts of various sizes and effects are undesirable occurrences that plague the electric grid system leading to negative impacts on economic productivity and human lives. Annual estimates of losses in productivity tally up to $79 billion [1]. Despite considerable efforts by utilities and regulators to reduce the occurrence of blackouts, there is no evidence that the incidence of large blackouts has declined over the past several decades [2,3]. The North American power grid is a highly complex interconnection of many parts, designed and operated by humans, hence prone occasional failures [4].

While the impacts of power interruptions on social welfare and direct economic activity are straightforward (even if difficult to measure directly), these events may also impact the value of the affected firms. News regarding a blackout may have an impact on investors’ perception of the future financial performance of an electric utility. While we cannot directly measure investor perception, changes in stock returns after a blackout occurs can provide some insight into how investors interpret the effect of blackouts and the utility’s response to blackouts.

In this paper, we consider a sample of large blackouts occurring between the years 2000 and 2010, and use a measure of utility stock performance to assess investor reactions. Stock-market efficiency theories suggest that news about an event such as a blackout will be quickly incorporated into the price of a utility stock [5]. Events considered to be good news, for instance better than expected earnings, will drive the share price up, while bad news will drive the price down. By checking for abnormal returns in the aftermath of a blackout, we attempt to shed light on how investors interpret the effect of blackouts and the utility’s response to blackouts.

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1.1. Event Studies and the Electricity Industry
Over the last four decades, the event study method has been used to detect abnormal stock returns around the dates of specific events. Fama et al [6], in the pioneering event study paper, discussed the
informational content of stock splits and the speed of reaction of the stock market to publicly available information. They concluded that investors associated stock splits with substantial dividend increases leading them to re-evaluate the future expected income stream in a positive light, hence higher stock prices.

Since then event studies have been used to study a diverse range of issues including the effects of regulation changes on insider trading [7], the effect of mergers on shareholder wealth [8], the informational content of corporate forecasts of earnings per share [9], investor reaction to a company’s pollution track record [10], effects of corporate equity ownership on firm value [11], and the impact of the Fukushima nuclear accident in March 2011 on electric power utilities in Japan [12]. Our work adds to the limited use of event studies in the context of electric power systems, and links historical technical data on power outages with stock market returns for publicly-traded electric utilities in the United States.

2. Blackouts, Rate Cases and Semi-Strong Stock Market Efficiency

An investor must make a decision about the value of a stock partly based on beliefs and perceptions about the future performance of a firm. Theoretically, using a model that does not account for risk, an investor would value a stock as the expected value of its discounted future dividend stream:

\[ V_i = \int_0^T C_{i,t} e^{-rt} \, dt \]

where \( V_i \) is the valuation of the \( i \)-th firm’s stock, \( C_{i,t} \) is a variable representing the cash flow of the \( i \)-th firm at time \( t \), \( r \) is an appropriate rate of discounting, and \( T \) is an arbitrary time horizon for valuation (which may vary depending on the type of investor). The cash-flow variable \( C_{i,t} \) is intended to represent any appropriate cash-flow measure, such as dividends. While firms employ different policies for issuing dividends, and thus we might replace ‘dividends’ with ‘profits’ in the valuation equation, the logic behind stock valuation is the same.

Certain industry or firm specific events may lead investors to revise their perception of the future performance of a particular firm or all firms within a particular industry. Our analysis starts with the premise that blackouts will have some impact on the perceived value of affected utilities, and that this value is fairly reflected in the utility’s stock price. Assuming financial markets are informationally efficient, we must expect that investors will react to news in a manner that influences the changes, positive or negative, in stock returns. Firms that experience blackouts may experience changes in returns depending on how investors perceive the impact the blackout would have on future earnings, and the relevant time horizon that investors consider.

In the aftermath of a blackout, utilities must restore power to customers with little regard for how much the restoration effort would cost. This process involves deploying technical crews to affected areas and may also require more expensive efforts involving purchasing and installing new electrical equipment. The funds required to complete these tasks may be obtained for the affected utility’s cash reserves and in some cases; short-term loans are required to supplement the cash reserves. In addition, utilities are unable to earn revenue from customers that have lost access to power. Since the utility must restore power as quickly as possible, we would expect the valuation of the utility to fall in the period immediately following the blackout.

Recouping restoration costs involves a rate case before the relevant Public Utility Commission (PUC), whose responsibility is to ensure nondiscriminatory service at reasonable rates while allowing the utility to earn a “fair and reasonable” return to encourage private investment [13]. The PUC permits costs to be passed on to ratepayers and sets a rate of return for the utility according to the rate-of-return equation:

\[ R = (s \times B) + E + d + T \]

where \( R \) is the utility’s revenue requirement; \( E, d \) and \( T \) represent variable expenses (such as labor and fuel), depreciation and taxes for which the utility is permitted cost recovery; \( s \) is the allowed rate of return, and \( B \) is the ‘rate base,’ which may incorporate cash, non-depreciated capital assets and other items associated with hardware investments required to provide the necessary level of service to ratepayers. Utilities are typically permitted to earn returns (profits) on the rate base, but not on variable expenses (including depreciation or taxes). While a profit-maximizing utility may set levels of capital that are inefficient relative to labor [14], the PUC does have the authority to dis-allow costs and reject requests for rate increases [15].

Since regulated electric utilities have historically not retained profits in the form of cash and have generally paid regular dividends [16], a larger size of the rate base would imply a larger dividend per share and thus a higher valuation for the utility. The framework in equations (1) and (2) suggests that blackouts whose restoration requires primarily variable costs (e.g. overtime labor) would not affect the market
valuation of the utility. Blackouts whose restoration requires the replacement of damaged capital, or blackouts that are sufficiently severe to warrant additional capital upgrades following restoration, would impact the future cash flows of the utility after approval by the PUC to place those capital investments in the rate base.

The mechanism by which blackouts could increase future cash flows for utilities (conditional upon sufficiently favorable rate-case outcomes) are reasonably straightforward. Our work in this paper effectively examines whether investors incorporate this possibility into their current valuations for the utility.

3. Data and Methods

We gathered data on every reported power outage reported to the U.S. Department of Energy (via Form OE-417) between January 2000 and December 2010. A total of 844 power disturbances were documented for this period. Disturbances meeting the following criteria were utilized in our analysis:

1. Only blackouts affecting at least 100,000 customers were considered.
2. Cases that had no report of the number of customers affected were discarded. Although there is no reason to believe that these cases affected zero customers, there was no reliable means to quantify the number of customers affected. There were 129 instances of this in our original data set.
3. Blackouts affecting non-public utilities (i.e., municipal utilities, co-ops or other utility companies without stock traded on a public exchange) were removed from consideration.

Applying criterion 1 reduced the sample to 355 relevant blackouts. The second and third criteria further reduce the sample to 282 blackouts, as shown in Figure 1. Eight cases were dropped from the sample because these utilities became privately owned entities and were no longer actively traded on the day of the blackouts. Hence, the final sample used in this paper contained 274 blackouts, 32.5% of all the blackouts reported between 2000 and 2010.

Stock market data was obtained from the Center for Research in Security Prices (CRSP; www.crsp.com). The relevant data gathered include daily share prices, number of shares outstanding, daily returns, and value-weighted market returns from January 2, 1998 to February 28, 2011. Some utilities included in the DOE blackout reports were subsidiaries of larger holding companies. In those cases, we utilized the share price of the holding company in our analysis.

3.1. Event Study Method

We use the event study method to study investor reaction to blackouts affecting publicly traded electric power utilities. Event studies implicitly serve as tests of a semi-strong form of the efficient markets hypothesis, which argues that new publicly available information is quickly incorporated into share prices [5]. We use this event study framework to examine how the stock returns of publicly-traded utilities adjust during the period following a large blackout (those affecting more than 100,000 customers).

Some information is likely to affect the electric utility sector broadly; the effects of a fuel price increase, for example, are unlikely to be isolated to just a few utilities. Other information may be specific to one or a small number of particular utilities. Since many blackouts fall into this latter category, we develop a measure of ‘abnormal returns’ that effectively captures the difference between the returns exhibited by a specific utility company and the returns exhibited by a broader index of the utility sector.

We define the return for the i-th electric utility on a daily basis as follows:

\[
R_{i,t} = \frac{(p_{i,t}f_{i,t} + d_{i,t}) - p_{i,t-1}}{p_{i,t-1}}
\]
where $p_{i,t}$ is the closing price for a share of stock in utility $i$ on day $t$; $f_{i,t}$ represents a split factor; and $d_{i,t}$ represents dividends issued during day $t$. Since dividends and splits are relatively infrequent events, during most periods the calculation of the return for the i-th utility on day $t$ is simply the percentage change in closing price between day $t$ and day $t-1$:

$$R_{i,t} = \frac{p_{i,t} - p_{i,t-1}}{p_{i,t-1}}.$$

We also develop an industry-specific utility sector return as a value-weighted average of all publicly-traded utility company share prices. We identify utility companies for our utility sector return using SIC codes (4911 for ‘electric services’ and 4931 for ‘electric and other services combined’). Returns for each company in these two SIC codes are weighted by total market capitalization (share price multiplied by the number of outstanding shares) to develop our utility sector return index $R_{ind}$:

$$R_{ind} = \frac{\sum_j MC_{j,t-1}r_{j,t}}{\sum_j MC_{j,t-1}},$$

where $MC_{j,t}$ represents the market capitalization of firm $j$ during the previous period ($t-1$). The summation in equation (5) is taken over all firms $j$ identified to be part of the electric utility sector.

Some blackouts affect multiple electric utilities on the same day. In these situations we create a portfolio return $R_p$ for all affected utilities as a value-weighted average return for all utilities in the portfolio:

$$R_p = \frac{\sum_k MC_{k,t-1}r_{k,t}}{\sum_k MC_{k,t-1}}.$$  

In equation (6), the summation is taken over all firms $k$ that are affected by the same blackout on the same day.

New information is expected to drive the security prices in a manner directed by the nature of the information, hence, any news that is detrimental, perceived or actual, to the future cash flows of the company will make investors pessimistic about the future. A downward revision of a utility's future cash flows will result in a decreased demand for its stock ultimately leading to a lower stock price as a result of investors selling their shares. For positive news, an upward revision can be expected. We attempt to determine, by using an event study, how investors react to blackouts. This process involves checking for abnormal returns (AR) which is the difference between the actual return and an estimated expected return in the absence of a blackout.

Abnormal returns are defined as the difference between the observed return and an estimated expected return in the absence of a blackout. We generate estimates of expected returns using a method referred to as the ‘market model’ [17] that is essentially an application of the Capital Asset Pricing Model (CAPM). In the market model, the return on the i-th security during period $t$ is a function of the market return and a disturbance term specific to the i-th security. An estimate of the disturbance term is thus the abnormal return for that security during period $t$. To implement this method for estimate abnormal returns we define a portfolio of utilities that experience blackouts on the same day (in some cases, the portfolio will contain only one utility) and estimate the regression equation:

$$R_{p,t} = \alpha_{p,t} + \beta_{p} R_{ind,t} + \epsilon_{p,t}.$$  

In equation (7), $\alpha$ and $\beta$ are parameters estimated in the regression and $\epsilon_{p,t}$ is the portfolio-specific error term. We adopt the portfolio approach since we found evidence of cross-correlation of stock returns which renders the assumption of independent and identically distributed observations invalid, hence the central limit theorem essential for the inference testing invalid as well. Creating and using portfolio returns in place of individual stock returns solve this problem. We use a time period of 180 trading days prior to each blackout to estimate equation (7). The abnormal return $AR_{p,t}$ is then calculated based on the estimated $\alpha$ and $\beta$ parameters:

$$AR_{p,t} = R_{p,t} - E(R_{p,t})$$

$$= R_{p,t} - (\hat{\alpha} + \hat{\beta} R_{ind,t})$$

Defining Day 0 as the day that a blackout is instigated, we also calculate cumulative abnormal returns for the portfolio of utilities experiencing a given blackout as the sum of abnormal daily returns over some time horizon $T$ days following the blackout.
4. Results

For each of the 274 blackouts that meet our criteria as identified in Section 3, we determined the portfolio of affected utilities and calculated the cumulative abnormal returns for that portfolio for a period of 60 trading days beyond the onset of the blackout. We chose a period of 60 days to ensure that we captured the recovery period and the period before rate-case decisions or other events that might impact the returns of affected utilities. We first examine the impact on utility company returns for all of the blackouts in our sample, and we then focus on the impacts of different blackout causes (natural disasters or extreme weather); blackout recovery times; and scope (number of customers affected).

4.1. Average Effects

Figure 4.1 shows the average cumulative abnormal returns (ACAR) of the entire sample for the 60-day period after a blackout has occurred. The estimated values increase after an initial drop in the first few days, although the average increase in cumulative abnormal returns is not large (less than 1%).

The result shown in Figure 4.1 reflects the nature of the sample (see also Table 4.1). A majority of the blackouts in this sample have very short restoration periods (less than 5 days) and also affect less than half a million people. Utilities are well positioned to handle these types of events and restore power very quickly to customers. In light of this, investors do not view most blackouts as a threat to future cash flows of a utility. It is possible that quick response times coupled with proposed capital upgrades to prevent future interruptions (which would then be incorporated into the rate base) could explain the sustained increase in cumulative abnormal returns for weeks following blackout recovery.

4.2. Blackouts Caused by Natural Disasters

Natural disasters (earthquakes, flooding, ice storms, hurricanes, tornadoes, and so forth) can cause significant damage to electrical equipment and infrastructure. Table 4.2 provides an overview of the blackouts in our study instigated by natural disasters.

As discussed in Section 2, we might expect that recovery from a natural disaster or extreme weather event would be more likely to require capital investments to replace or repair damaged equipment. If these expenditures are allowed into the rate base, then investors may profit. Fig 4.2 shows the daily variation in ACAR of utilities that have suffered blackouts caused by natural disasters. The initial period of declining returns is longer than for the average blackout, due to the nature of the recovery effort as compared to blackouts instigated during periods of less extreme weather (which have ACARs consistently close to zero across the entire 60-day time horizon). Returns over a longer horizon (35 to 60 days following the instigating event) are also negative. Cumulative abnormal returns for utilities suffering blackouts due to natural disasters or extreme weather are positive (but generally less than 1%) during a window from 25 days to 35 days following the instigating event.
4.3. Long and Short Duration Blackouts

We categorize the blackouts into groups based on the time it takes the affected utilities to restore power to all its customers. We define ‘long’ recoveries as those taking 10 days or longer, while ‘short’ recoveries are defined as those taking fewer than ten days. The definition of recovery that we use assumes complete restoration of power. While this definition does not recognize that blackout recovery may be an uneven process with a large proportion of customers seeing restored service relatively quickly (even during a ‘long’ blackout by our definition), we do observe significantly different behavior in utility share prices based on our definition of long and short recovery times.

Figure 4.3 shows average cumulative abnormal returns for utilities experiencing blackouts with long and short recovery times. Long recovery times are clearly harmful to utility valuations, as cash depletions and the utilization of short-term loans may be larger than initially anticipated by the utility, their regulators or their shareholders. Figure 4.3 indicates a steep drop in ACARs after day 10 which is likely caused by the longer than usual recovery times (and is the reason that we chose a 10-day recovery horizon to differentiate long and short duration blackouts). By day 25, we observe an ACAR of nearly -9%, although only a small number of blackouts in our sample lasted that long. Aside from the direct financial consequences of long recovery times (the utility’s use of cash on hand and short-term loans to finance recovery efforts, combined with loss of revenues), long recovery times may leave regulators and the public with the perception that the utility did not manage the recovery effort in a competent manner. While this is a topic for future research, it would seem reasonable to expect that PUCs would look less favorably upon utility cost-recovery requests if blackout durations are lengthy.

The case of short-duration blackouts is markedly different. Utilities suffering short-duration blackouts do not, on average, exhibit the drop in valuation observed in other circumstances immediately following the start of the blackout. Further, the average cumulative abnormal returns in the period following the 10-day restoration window increase, although the magnitude is not large in percentage terms (around 1%).

4.3. Number of Customers Affected

As with blackout durations, we observe significantly different behavior in utility share-price returns for blackouts affecting a very large number of customers, versus those affecting fewer customers. Figure 4.4 shows average cumulative abnormal returns for all blackouts affecting fewer than one million customers (referred to as ‘Group 1’ in the figure) and blackouts affecting one million customers or more (referred to as ‘Group 2’ in the figure).

<table>
<thead>
<tr>
<th>Group</th>
<th>Customers</th>
<th>N</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>200</td>
<td>251,575,5</td>
<td>100,000</td>
<td>964,000</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>15</td>
<td>1,971,450</td>
<td>1,100,000</td>
<td>3,241,437</td>
<td></td>
</tr>
</tbody>
</table>

The blackouts that took the longest to achieve full restoration also tended to be those that affected a larger number of customers (Table 4.3), so there is some correspondence between the post-blackout pattern of
utility stock returns shown for Group 2 in Figure 4.4 and for blackouts with a long recovery period in Figure 4.3.

![Fig 4.4 ACAR for blackouts affecting fewer than one million customers (Group 1) and one million or more customers (Group 2)](image)

5. Discussion and Future Work

In this paper, we investigated the reaction of investors to blackouts and the impact it has on stock market value of publicly traded electric power utilities. As a whole, blackouts tend to depress the share prices of affected utilities (relative to the electric utility sector as a whole) for several days immediately following the blackout. This period is followed by a much longer period (30 to 40 days) of increasing returns for affected utilities relative to the utility sector as a whole. This is broadly consistent with what the semi-strong form of the efficient markets hypothesis would predict – there may be some increases in value for utility companies affected by blackouts, and that increase in future cash flows is reflected in share prices long before those future cash flows (through higher rates) ever materialize.

This conclusion is a reflection of the nature and distribution of most blackouts in this sample. More than 80% of the sample blackouts affect less than half a million customers and the average recovery period for all the events studied in this paper was 3 days. We did find significantly different patterns of behavior in utility share-price returns based on certain characteristics of blackouts. Unsurprisingly, blackouts with long restoration times or those affecting a large number of people (keeping in mind that many events with long restoration times also affected a large number of people) tended to reduce utility stock returns, in some cases by substantial margins of close to 10%. Blackouts of shorter duration and affecting fewer customers did not, on average, yield any significant decline in returns to affected utilities’ shares. Returns for these utilities actually increased by small amounts in the weeks following restoration.

This paper has focused largely on exploratory analysis of the behavior of utility stock-prices following large blackouts between 2000 and 2010. While it uses an event-study framework and appears largely consistent with a semi-strong form of the efficient markets hypothesis for asset pricing, our analysis itself does not suggest whether or how investors in utility stocks are incorporating the possibility of increases or decreases in future cash flows into their valuations of utility shares. The analysis in the paper does suggest two distinct lines of future research that are currently underway.

First, if the semi-strong form of the efficient market hypothesis holds, then investors in utility stocks are effectively making valuation decisions based on anticipated outcomes of future rate cases – specifically, the rate case that a utility might file in the months following restoration. How accurately investors are able to predict the outcome of a rate case that may not occur until six or more months have elapsed since the blackout is not known.

Second, our hypotheses implicitly assume that all investors in utility stocks are long-term investors that intend to hold shares in utility companies for time horizons much longer than those involved in this study. The behavior in cumulative abnormal returns that we observe may reflect fundamental valuation judgments being made by these long-term investors (as described in the previous paragraph), or it may reflect the activities of investors with shorter time horizons. If this were the case, we may be able to observe changes in the ownership profile of utility stocks in the quarter immediately following a blackout.

6. References


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