DEREGULATION & PRIVATIZATION: TEXAS ELECTRIC POWER MARKET EVIDENCE

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ABSTRACT

The electric power industry is moving away from a regulated utility model, toward a deregulated market-based model—thereby intending to improve system efficiency by reducing generation costs and customer prices, while at the same time improving capital expenditures and service reliability. This paper is the first in the literature to statistically test Texas' electricity prices, relative to U.S. electricity prices—and use energy emergency alerts and reserve margin forecasts to determine Texas' power system reliability—since deregulation in 2002. Implementation of suggested reforms will help ensure the market-based design succeeds. Recommendations are offered for future research.

JEL: G31, G38, H44, K23

KEYWORDS: Texas Electricity Market, Deregulation, Privatization, Reserve Margins

INTRODUCTION

Electricity is important. The Edison Electric Institute (May 2013) reports the United States (U.S.) electric power industry is an $840-billion dollar a year business—totaling 5.25% of GDP. Electric power is the most capital-intensive U.S. industry, and is planning to spend $85 billion a year, through 2015, for new, energy-efficient and environmentally friendly generation capacity, including advancements in transmission, distribution, and smart-grid system upgrades.

The electrical power grid in Texas is an interconnected system, providing electricity from supply generation to end-use consumers, over a wide geographical area. In the U.S. there are three major wide-area synchronous electric power grids: 1) Western Interconnection, serving the western states (excluding Alaska and Hawaii); 2) Eastern Interconnection, serving the eastern states; and 3) Texas Interconnection, serving only Texas. Interestingly, Texas is unique; it has a separate power grid from the rest of the country. Consequently, the Texas deregulated and privatized electric power market is an excellent subject to study and compare with what is occurring across the U.S.

The Electric Reliability Council of Texas (ERCOT) (2013) administers the Texas Interconnection grid for 23 million Texas customers. ERCOT is an independent system operator (ISO)—consisting of consumers, cooperatives, electric power generators, retail electric providers, electric power marketers, investor-owned electric utilities and municipal-owned electric utilities. ERCOT schedules electricity delivery on the Texas Interconnection grid linking 40,500 miles of transmission and distribution lines, with more than 550 power generating units. ERCOT is a membership-based 501(c) (4) nonprofit corporation, governed by a board of directors, overseen by the Public Utility Commission of Texas (PUCT) and the Texas Legislature.

This research tests whether ERCOT is achieving its stated mission, "to ensure a reliable electric grid and efficient electricity market." This is the first research in the literature to use means testing to statistically analyze electricity prices for the Texas Interconnection grid, pre-and-post 2002 deregulation, relative to U.S. electricity prices. Energy emergency alerts, since 2006, and ERCOT reserve margin forecasts, through 2023, are presented to determine Texas' power system reliability.

Beginning in the 1990s, the literature describes countries from around the world that deregulate their electric power markets. Expectations were that prices would naturally fall under "free market" competition and reliability would improve. Results for retail customers worldwide disappoint. Electricity prices globally, after deregulation, far exceed general price and wage gains.

The rest of the paper's organization is as follows. Section 2 discusses relevant electricity market deregulation literature. Section 3 provides the data source and statistical methods used. Energy emergency alert and reserve margin system reliability indicators are explained. Section 4 presents the empirical results and a discussion of electric power deregulation in Texas, including bankruptcy. Section 5 offers concluding remarks and recommendations for future research.

LITERATURE REVIEW

Internationally, in the early 2000s, Turkey restructures its electricity market, establishing an independent regulatory authority, privatization of state-owned electrical generation and distribution companies, development of a wholesale market for electricity, and increased retail competition designed to improve diversification and better utilize renewable energy sources (Ertuna, 2010). Nevertheless, significant deficiencies in the Turkish electricity market become evident. Wholesale market participants act irresponsibly, and new regulation becomes necessary. Also, transparency and accountability in the Turkish electric market require improvements. For instance, regulators should announce all decisions and their justifications, up-front and publicly. In addition, the market/system operator must share market data, providing symmetric information availability among market participants (Camadan and Kölmek, 2013).

India opens its electric power industry to foreign companies' direct investment, by developing the Dabhol Power Project. Nine fast-track private electric power plants are constructed across India. The disappointing results are nothing like the foreign companies' initial promises of lower prices and higher reliability. This conclusion is based on key participants' information and archival data. Instead, the foreign companies manipulate India's social institutions including the Congress party that initially approved the new electricity market policy and the legal systems and regulations implemented to assist foreign direct energy investments (Ahmed, 2010).

Harvey (2005, 2006) and Peet (2007) contend that the electric power deregulation experience in India shows the true intent of the market-based model, which is that international corporations are in search of ever-increasing profit at the expense of electricity power consumers. Deregulation and privatization are not about "free markets," but the extraction of profits from "new markets." That is, previously public assets that were considered off-limits to corporate revenue, prior to deregulation. Those that acclaim the unassailable benefits of deregulated "free markets," do so only from the standpoint of financial markets and multinational corporations, not from the viewpoint of protecting retail consumers' pocketbooks (Peck, 2001, Peck and Tickell, 2002).

Since late 1998, the majority of electricity generated in Australian is traded on a newly created national wholesale market. Government monopolies are dissolved, and many of the new companies are sold privately. Electrical generation and retail sectors were expected to invite competition (Chester and Morris, 2011). The majority of Australian households choose their own electricity supplier. Unfortunately for most Australian households, a rapid increase in electricity prices, well above 50%, started about a decade after deregulating the electricity industry began. Electricity prices, after deregulation, have experienced increases far exceeding general price and wage gains, making the general Australian population poorer, but the power generators and retailers richer (Chester, 2013).

Notwithstanding the many different approaches used to restructure electricity into market-based sectors around the world, one of the consistent trends has been the rapid escalation in electricity prices paid by households, after deregulation. This is in direct opposition to the purported benefit of electricity deregulation—that is, lower prices (Anderson, 2009). Nominal percentage increases in household electricity prices, because of market-based deregulation in the following countries, from 2000-2010, are: Canada; +72%; Chile, +166%; Czech Republic +133%; Hungary, +117%; Ireland, +100%, New Zeeland, +203%; Norway, +106%; Sweden, +88%; United Kingdom, +86%; and the United States, +42% (Marcus, 2011, Lagendijk, 2011). The premise that market-based electricity deregulation, using a "free market" model, is efficient is not evident in the resulting high-priced electricity in countries worldwide.

California deregulated electrical generation and retail power industry, in the late 1990s, with the assumption that prices would naturally fall under "free market" competition. However, wholesale electricity prices soared 800% because of market manipulation, including megawatt laundering and overscheduling by trading companies such as Enron, triggering California's electricity crisis of 2000-01. Retail electricity prices were fixed in California causing the power companies to become unprofitable and driving Pacific Gas & Electric Co into bankruptcy because they were required to purchase electricity on the wholesale market at prohibitively uncompetitive prices. California's electric power market became overpriced and unreliable, experiencing rotating blackouts throughout California (Chick, 2007, Hausman, 2010).

The Bonneville Power Administration in the Pacific Northwest, produces inexpensive hydroelectric power, for about half the U.S. price for electricity, and attracts many electricity-intensive industries to Washington State such as aluminum production and airline manufacturing. Coupal and Holland (2002) develop a 31-sector computable general equilibrium model to evaluate the impact on Washington's economy, as a result of electricity deregulation. In the model, electricity is sold to high-priced regions, reducing Washington's gross state product as a result of higher electricity prices. This translates into lower wages, lower employment, and lower industry profits, except for power generators and retailers, who increase profits.

National electricity price movements mask regional variations. For example, U.S. prices, post−restructuring, increase over 40%, between 2000 and 2010 (Marcus 2011). However, household electricity prices in 12 American states undergoing deregulation, between 1999 and 2007, surge by more than 50%, with the highest gain being 74% in Texas (Showalter 2008). In U.S. states that have deregulated their electricity sectors, household prices are at least 10% higher than elsewhere (Anderson 2009). Assuming that deregulation and "free markets" will automatically produce efficient industries, without a well thought out business-oriented plan, is not proven historically (Prentis, 2013).

The move to a decentralized market-based design highlights the need for efficient demand-response for power by consumers. The expectation was that the market-based system would provide accurate price signals along the electricity supply chain, making the delivery of electricity less costly and more efficient. However, ERCOT's demand-response capability is trailing levels achieved prior to restructuring. The experience in Texas, to properly value and accommodate demand-response, demonstrates the degree of demand-response participation—in a deregulated market—is dependent on market design and new regulatory requirements. Special high-tech demand-side programs are required to encourage better demand-response capabilities (Zarnikau, 2010).

Market-based reforms have fragmented electricity supply, now associated with many independent power generation companies. Decentralized electricity supply reduces coordination among generators. The ability to optimally match volatile electrical supply with final demand is central to a well-functioning electric power supply chain. Consequently, centrally controlled and synchronized electricity systems are most efficient. The independent system operator (ISO)—which monitors, coordinates and controls the operation of the electric power system, usually within a single state—has the best information about the entire power system, to manage commitment and dispatch decisions (Hunt, 2002).

The just-in-time quality of well-functioning electric power systems necessitates electricity supply and demand to be constantly and exactly balanced—at every node location in the electrical network—using Kirchhoff's and Ohm's laws (Chaniotakis and Cory, 2006). If not, the resulting voltage or frequency deviations will damage electrical generators, customer electrical appliances, and jeopardize power system stability. In addition, Kirchhoff's laws govern power flows within a transmission network, which defy direction. The uniqueness of the electric power industry and electricity economics favor centralized control, rather than a decentralized market-based design (Sioshansi and Nicholson, 2011), localized electric power production in fixed geographic markets (Robinson, 2009), and a just-in-time supply chain that exactly balances constantly changing electricity demand with supply generation (Sioshansi and Tignor, 2012).

Sioshansi et al. (2008, 2012) use a one-day ISO New England data set to evaluate settlement costs and efficiency of centralized control of power generation versus decentralized market-based systems. The evidence shows that even when assuming perfect competition, loss of coordination in a decentralized design decreases efficiency by 4%, and increases settlement costs by 85%. Sioshansi and Nicholson (2011) use a symmetric duopoly model to test the effects of relaxing the perfect market competition hypothesis. They show the decentralized market-based design is more costly than the centralized power control design, depending on the Nash equilibrium the ISO follows to balance supply and demand. These important high-tech demand-response capabilities can be incorporated in the market-based design's laws and regulations.

DATA AND METHODOLOGY

In 1977, the Department of Energy (DOE) establishes the U.S. Energy Information Administration (EIA) (2013), as the sole authority for energy statistics and information. EIA is the source of electric power price data for this study, both for the Texas Interconnection grid and for the U.S. electrical power system.

Electric power price data for the Texas Interconnection grid, from 1970-through-2011, are analyzed in comparison to U.S. electricity prices. Linear least squares trend lines are fit to the Texas Interconnection electricity price data, as well as for the U.S.—using Excel—to produce comparison equations of price increases, representing electrical operating efficiency.

The SPSS statistical program is used to compare relative price changes in Texas Interconnection electric power data, compared to U.S. electric power prices, pre-and-post Texas 2002 electricity deregulation—utilizing one-way ANOVA. The null hypothesis of the equality of the two population sample means, for each year, is tested, to determine if there is a significant difference in relative means for Texas' electricity prices, to U.S. electricity prices—before and after Texas' 2002 electricity deregulation.

The inferential statistic, homogeneity of variance Levene's test is performed to exam the equality of group variances in the data. If the equal variance assumption is found to be violated in the Levene's test, the more generalized Welch test is performed, which assumes the data do not have identical standard deviations. In addition, the Brown-Forsythe test, which uses group median instead of the mean calculations, will be presented, to provide robustness against using non-normal data. The nonparametric Mann-Whitney U test—which compares mean ranks, is employed because it is very robust, even when sample populations do not represent any specific distributions, and insures against falsely rejecting a true null hypothesis. Consequently, the significance of the results presented in this study are extensively tested and assured.

The North American Electric Reliability Corporation (NERC) (2013) is a nonprofit company, whose mission is to safeguard the reliability of the electric power system in North America. NERC is certified by the Federal Energy Regulatory Commission and establishes U.S. electrical reliability standards for the three major electrical interconnection grids and issues yearly, a reliability assessment. The reliability of the Texas Interconnection grid, since 2006, is analyzed using NERC energy emergency alert reliability indicators.

The Electric Reliability Council of Texas (ERCOT) (2013) is the Texas region's independent system operator (ISO), and performs financial settlement for the competitive wholesale bulk-electricity market and manages retail power switching for 6.7 million locations in competitive choice markets. ERCOT forecasts electricity power reserve margins for the Texas Interconnection grid—from 2014-through-2023—which are presented and explained.

RESULTS AND DISCUSSION

United States electric power prices, represented by its linear least squares trend line (y = 0.0402 x + 0.74), shows U.S. prices increasing about 4% a year, from 1970-through-2011. Over the same period, Texas Interconnection electric power prices, represented by its linear least squares trend line (y = 0.0649 x + 0.56), increase by about 6.5% a year. Texas Interconnection grid electricity prices rise about 60% faster than electricity prices throughout the U.S., from 1970-2011.

Electric power prices for the U.S. and the Texas Interconnection grid change yearly. To identify when prices are rising the fastest in Texas, relative price changes are calculated. The electric prices for the U.S. are subtracted from the prices in Texas, for each year, from 1970-2011. Deregulation of the retail electric power market in Texas occurs in 2002. By comparing relative electric power price sample means for the U.S. and Texas, it is determined if electric power prices in Texas are rising faster under deregulation and privatization of Texas' electricity market, when compared to the rest of the U.S.

The one-way ANOVA, for the regulated versus deregulated data sets, shows a significance level of 0.000. However, the Levene statistical significance is 0.002, therefore, a difference between population variances is assumed. The Welch test, used when standard deviations are different, reports a significance level of 0.005. The Brown-Forsythe test, used for non-normal data, also reports a significant level of 0.005. The nonparametric Mann-Whitney U test, which has no assumptions on data distributions, shows a significance level of 0.003.

This study's highest statistical p-value of 0.005 is much less than this study's predetermined alpha value of 0.05. Therefore, the statistically significant results are very strong evidence against accepting the null hypothesis. Consequently, the equality-of-means null hypothesis is rejected. There is a highly significant difference between the mean price data, prior to the 2002 deregulation in Texas, than after deregulation.

The relative electric power price mean for 1970-to-2001is 0.1938, and for 2002-to-2011 is 0.7970. Relative to U.S. electricity prices, Texas has electric prices, during the market-based deregulation and privatization period, from 2002-2011, increase about four times faster than increases in electricity prices prior to deregulation, from 1970-2001. Significantly higher relative prices, evident after deregulation, are a new burden on Texas' electricity customers—putting Texas at a competitive disadvantage when trying to attract new industry and jobs.

The North American Electric Reliability Corporation (NERC) reports on deficient capacity electrical power levels during peak load periods. Energy emergency alerts are a leading indicator of electrical capacity shortfalls, which may lead to electricity brownouts, defined as a reduction or decrease in electric power due to a shortage of supply, and possibly, system-wide blackouts, with no electrical power available throughout the system. Different levels of energy emergency alerts are defined as:

Energy Emergency Alert 1 (EEA1): All available resources are in use.

Energy Emergency Alert 2 (EEA2): Electricity load management is in effect and residential, commercial or industrial users, who have agreed to rotate power curtailments, may now be affected.

Energy Emergency Alert 3 (EEA3): Emergency procedures for EEA1 and EEA2 are in effect. In addition, electricity availability to all power users may experience rotating power curtailments. This is done to protect the electric power grid from the possibility of a cascading power shut down, causing a widespread blackout, with no electrical power throughout the system.

Since 2006, the following EEA2 and EEA3 events have occurred in the Texas Interconnection grid, yearly by quarter (Q).

Texas EEA2 events have occurred in:
2008 1Q
2009 4Q
2011 3Q

Texas EEA3 events have occurred in:
2011 1Q
2012 2Q

The Texas Interconnection grid is increasingly under stress, as shown by three Energy Emergency Alert 2 (EEA2) events and two more severe Energy Emergency Alert 3 (EEA3) events, occurring since 2006.

The electrical power industry follows a straightforward yet effective strategy for maintaining system reliability. That is, “always have more electrical supply available than may be needed, at any time.” This is called reserve margin, defined as: “capacity” minus “demand,” divided by “demand.” Where "capacity" is the expected maximum available electrical supply, and "demand" is expected peak electrical demand in the system. Reserve margins are calculated for individual electrical systems or for a larger region, consisting of a number of electrical systems. A reserve margin of 30% indicates the electrical system has excess capacity totaling 30% of expected peak demand, and prior to deregulation in Texas, was the target norm.

The North American Electric Reliability Corporation (NERC) analyses and disseminates historical reserve margin data for the Texas Interconnection grid in Figure 1: NERC Historical Reserve Margin Analysis of Texas Summer Peak 1st Year Forecasts. Values represent reserve margins forecast for the next year. The Texas electrical power system actual reserve margins approach the NERC target standard of 13.75%, in 2006, and drop below 13.75%, for two years, beginning in 2007.

Texas is not constructing enough electric power generation plants to meet the NERC power demand reserve margin target of 13.75%._The Electrical Reliability Council of Texas (ERCOT) (2013) forecasts Texas’ electric power reserve margins. In the 2013 ERCOT Report on the Capacity, Demand and Reserves in the Texas Interconnection grid, the forecast Texas reserve margins are shown in Table 2. ERCOT Forecasts: Texas Electric Power Reserve Margins. Based on current information, concerning future-planned electric power generation for the Texas Interconnect grid, Texas will significantly fall below the NERC mandated planning reserve margin target of 13.75%, beginning in 2015 and continuing through 2023.

Capital expenditures in Texas’ electric power industry, because of market-based reforms, are lagging demand. Predictably, brownouts and system-wide blackouts may result. TXU Corporation, headquarter in Dallas, TX, was the leading provider of electricity and natural gas in Texas. In the largest private equity leveraged buyout, valued at $48 billion dollars in 2007, at the top of the last credit bubble, Kohlberg Kravis Roberts & Co., Texas Pacific Group, and Goldman Sachs Capital Partners took TXU private, through a forward triangular cash merger, and renamed the new company Energy Future Holdings Corporation (EFHC). In 2009, EFHC violated certain loan covenants and wrote down $8 billion of assets, thereby admitting EFHC paid too much for TXU (DePamphilis, 2011).

Table 1: NERC Historical Reserve Margin Analysis of Texas Summer Peak, 1st Year Forecasts.

Year	Actual Reserve Margin	Target Reserve Margin	Year	Actual Reserve Margin	Target Reserve Margin
1990	0.2690	0.1375	2002	0.3215	0.1375
1991	0.2420	0.1375	2003	0.3449	0.1375
1992	0.2005	0.1375	2004	0.2499	0.1375
1993	0.2255	0.1375	2005	0.1461	0.1375
1994	0.2286	0.1375	2006	0.1383	0.1375
1995	0.1946	0.1375	2007	**0.1245	0.1375
1996	0.1686	0.1375	2008	0.1377	0.1375
1997	0.1483	0.1375	2009	0.1576	0.1375
1998	0.0987	0.1375	2010	0.2046	0.1375
1999	0.1212	0.1375	2011	0.1711	0.1375
2000	0.1942	0.1375	2012	**0.1340	0.1375
2001	0.2306	0.1375			

*Values represent reserve margin forecast for the next year. The Texas electrical power system actual reserve margins approach the NERC target standard of 13.75%, in 2006, and drop below 13.75%, for two years, beginning in 2007. ** The Texas electrical power system actual reserve margins approach the NERC target standard of 13.75%, in 2006, and drop below 13.75%, for two years, beginning in 2007. Source: North American Electric Reliability Corporation (NERC), office of Reliability Assessment.*

Table 2: ERCOT Forecast: Texas Electric Power Reserve Margins

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Texas Reserve Margin	13.8%	11.6%	10.4%	10.5%	9.4%	7.4%	6.5%	6.0%	5.2%	4.5%

Texas Electric Power Reserve Margins. Based on current information, concerning future-planned electric power generation for the Texas Interconnect grid, Texas will significantly fall below the NERC mandated planning reserve margin target of 13.75%, beginning in 2015 and continuing through 2023. Source: ERCOT Report on the Capacity, Demand and Reserves in the Texas Interconnection grid

EFHC reportedly, cannot meet the $20 billion in debt repayments maturing in 2014, and is exploring a pre-packed bankruptcy with creditors, representing the largest non-financial bankruptcy in 30 years. During this uncertain time, EFHC cannot look ahead and invest in new plants and equipment to meet expected future consumer demand. This threatens the Texas electricity market. The lack of reserve margin in Texas is crucial. Because the Texas electric power market is a separate power grid, being its own interconnection, it is not synchronous with the rest of the country. Therefore, Texas cannot rely on excess power from Eastern or Western Interconnection grids, during any expected future energy emergency alert events.

The Texas Interconnection grid has two characteristics unique to the U.S. First, the Electricity Reliability Council of Texas (ERCOT) is regulated solely by the Public Utility Commission of Texas (PUCT), outside the control of the Federal Energy Regulatory Commission. Second, Texas did not adopt the installed-capacity type market, based upon resource adequacy requirements to meet consumer demand, but has an energy only market, utilizing a scarcity-pricing model. Thereby implementing the Australian approach, along with other polices, hoping that energy-only pricing is sufficient to compensate owners adequately to supply generation for peak demand, while protecting consumers from unreasonably high electricity prices (Felder 2011). Consequently, the Texas electric market lacks incentives or requirements for the construction of excess generation capacity to maintain NERC planning reserve margin standards. This policy is in jeopardy and requires revision.

The existing Texas electric power industry marketplace design needs reform to become competitive. This includes reducing the barriers to entry and exit, ensuring access of primary energy sources, and addressing economies of scale, advertising and market structure. Guarding against market manipulation and anticompetitive special interest laws and regulations, such as attempts to exploit consumers through biases of framing effects, availability heuristics, decoy options, sunk cost fallacy and bounded rationality—rather than wholesale and retail companies competing on price and reliability. An example of anticompetitive special interest laws and regulations, in the electric power market, is charging a monthly minimum access fee that is not dependent on electricity usage.

Economic theory and experience worldwide show the successful conversion to market-based wholesale and retail markets is not automatic. Doing it correctly necessitates implementing market regulations that ensure competition, rather than allowing practices that subvert it (Hess, 2011). Appropriate application and enforcement of antitrust laws are essential to secure the advantages of competition benefit retail consumers and corporations.

CONCLUDING COMMENTS

The goal of this research is to determine whether the Electrical Reliability Council of Texas (ERCOT) is achieving its stated mission, "to ensure a reliable electric grid and efficient electricity market." U.S. Energy Information Administration (EIA) data are analyzed, from 1970-2011, using one-way ANOVA means testing to identify significant difference between electricity prices in the Texas Interconnection grid, relative to U.S. electricity prices, pre-and-post 2002 Texas deregulation. North American Electric Reliability Corporation (NERC) energy emergency alerts, since 2006, and ERCOT's planning reserve margin forecasts for Texas, through 2023, are presented to determine Texas' power system reliability.

From 1970-2011, Texas Interconnection grid electricity prices rise about 60% faster than electricity prices throughout the U.S. This study's statistical p-value of 0.005 is highly significant, thus the equality-of-means null hypothesis is rejected. Relative to U.S. electricity prices, Texas has electric prices, during the market-based deregulation and privatization period, increase about four times faster than increases in electricity prices prior to deregulation— rising from 0.1938 during 1970-to-2001, to 0.7970 during 2002-to-2011.

NERC data shows the Texas Interconnection grid is increasingly under stress, with three Energy Emergency Alert 2 events and two more severe Energy Emergency Alert 3 events, occurring since 2006. Based on future-planned electric power generation for the Texas Interconnect grid, ERCOT forecasts Texas will significantly fall below the NERC mandated planning reserve margin target of 13.75%, beginning in 2015 and continuing through 2023.

Price and reliability evidence, since deregulation, suggest ERCOT is failing in its mission. To correct this, the Public Utility Commission of Texas (PUCT) and Texas Legislature should pass laws and set regulations in the electric power market to incorporate high-tech demand-response capabilities, ensure competition in the Texas Interconnection grid market by prohibiting anticompetitive special interest laws—such as charging a monthly minimum access fee—and mandate capital expenditures on new generating plants to meet expected future demand, subject to penalties. Future research should statistically test and analyze the Eastern and Western Interconnection grids.

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