Title: ***How Power System Restructuring & Deregulation Would Affect Competition and Profitability Among Electric Utility In Terms of Porter Five Forces.***

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Abstract

There is an argue that lack of competition in electricity power sector is led to inefficient operation of power system. In order to increase the social welfare and cope with environmental issues raised from industrialization, power market start transition toward market restructuring to increase operation efficiency through competition. After two decades that efforts have been made to restructure the electricity market, still there's a doubt in benefit of electricity system reforms. It is argued in some literature that True or real competition is one of the restructuring objective that has been failed to reach. This paper studies current restructuring activities in terms of porter five forces to recognize the area could be improved in order to improve competition in electricity market.

Introduction

One of the reasons for deregulating electric market monopoly was inefficiencies in traditional market, such as inefficiencies in generation investment decision, construction costs, retail prices, operation costs, uneconomical generating plants and stimulating innovation areas[1]. Vertically integrated electricity market was tried to deregulate its system by introducing competition and increasing competitiveness of utility industry with vertically unbundling — liberalization— and removing entry barrier in generation and supply — privatization—[2][3]. Several theoretical basis and their rational on how reforms like liberalization and privatization affects economical efficiency improvement are discussed in [4]. Theories such as property rights —assets utilization would be optimized under privatization—, Bureaucracy — budget maximization may be targeted by publicly owned companies rather than cost minimization or profit maximization—, regulation and incentives —regulating privatized activities may introduce negative incentives and would reduce economical efficiencies— , modern theories of regulation — the importance of related problem to imperfect information about firms' true cost—, and influence activities —ownership changes affect relationships and create some extra costs—. In [5] & [4] stated that ownership does not affect the industry performance as much as technological development and economic-political balances[5] and market liberalization that subjects players to market forces[4].

Experience with liberalized electric system in OCED (Organization for Economic Co-operation and Development) countries showed common problem such as customer resistance, failed competitive market, high retail prices, no technical innovation and etc[6]. However, [1] discusses that poorly designed reforms could result in problems and challenges, and emphasizes that reforms are not wrong idea and it's better to understand the problems and find a solution for them.

Previous literature tried to adopt economical theories to argue the benefit and disadvantages of restructuring efforts like liberalization and privatization, however this study finds porter five forces useful

to recognize the improvements to have more competitive market. Porter introduced five forces behind competitive interactions within an industry, those five competitive forces are as follows: the treat of new entrant, bargaining power of suppliers, bargaining power of buyer, threat of substitute products or services, rivalry among existing competitors[7]. Though companies suppose to use porter's five forces to understand industry's competition and shape strategic plan to cope with it, this study intends to use five competitive forces to analyze restructuring efforts and find the gaps that hinder shaping efficient competitive market.

Since there are different approaches to restructure the electricity power system, this paper tries to study one case to understand in what places this different approach could have different impact. Other study requires to compare the impact of different approaches.

The rest of paper is organized as follows: electricity market backgrounds to give some perspective on electricity industry formation and development; market reform section explains the implemented activities to reform the traditional market; Porter's five forces section explains the porter's believe about the impacts that shape market's competition; cognitive map section that describes the concept behind simple causal cognitive map; cognitive map of porter's model section that maps all the forces and their drivers potentially would shape the competition; case study section describes one of reformed market in U.S.; discussion section discusses the porter's model with respect to case study; conclusion section concludes the discussions in previous section and the problems associated with Porter's model with respect to competition analysis in power industry; limitation and future research section explains the improvement possibilities for this study.

Electricity Market Background

This section gives perspectives on how electricity power industry has been formed and developed with respects to its unique economical and technical characteristics. This section discusses 5 different periods in which those characteristics are remained almost the same.

Development of Traditionally Regulated Markets [8]

From 1920 to 1945, industry was developed in direction of building central source of power, consolidating utilities to serve franchised service territory. Central source of power is supplied by efficient , low-cost utility generation, transmission, and distribution. A rapid increase in electricity generation encouraged growth and consolidation of the industry to achieve economies of scale and then Consolidated utilities monopoly franchises with exclusive service territories for private owned utilities. During this period, some abuses imposed by holding companies on utilities, and ultimately on their

customers, causing the price of electricity to increase. In order to deal with raised abuses publicly owned utility was born during Franklin Roosevelt presidency.

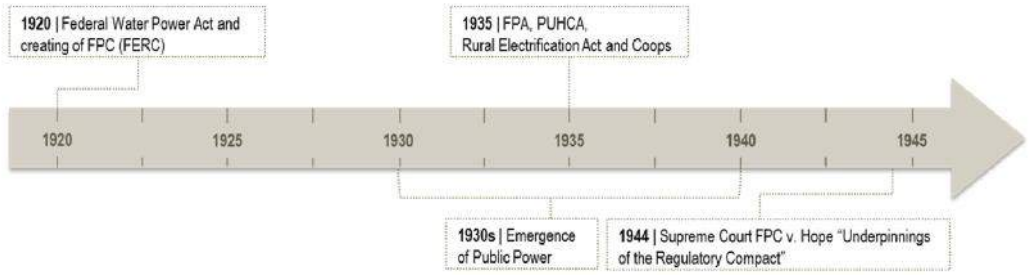

Figure 1 - Power industry changes from 1920 to 1945

Period of Growth and Declining Costs [8]

From 1945 to 1970, increasing electricity consumption led to extensive growth. The utilities provided services to all customers in franchised area and got compensated according to rate cases that guaranteed reasonable ROI for them. Rate cases were determined based on the normal costs of providing services and required revenue. If the assumption for determining rate cases remained accurate, utilities would operate successfully if not adjustments would have sought. This practice worked fine until the Northeast blackout of 1965 which raised pressing concerns about reliability.

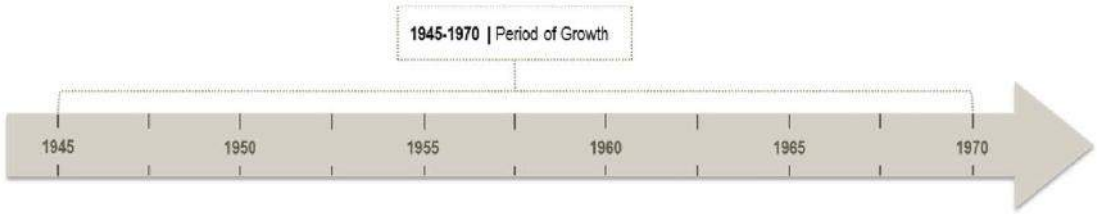

Figure 2 - Power industry changes from 1945 to 1970

Slowed Growth and Inflation, Seeds of Competition [8]

From 1970 to 1990, fuel costs escalated, demand growth was reduced, utilities' operating cost was raised by the passage of the Clean Air Act of 1970, and the oil Embargo of 1973-1974, increased public awareness of energy issues, higher energy prices, and contributed to unprecedented inflation in construction costs that all slowed down the incremental cash flows helped finance new construction in the past. To deal with the situation the Public Utility Regulatory Policies Act of 1978 (PURPA) was passed to allow utility to purchase energy form certain types of third-party suppliers, in addition, congress pursued legislation to reduce U.S. dependence on foreign oil, develop renewable and alternative energy sources , sustain economic growth, and encourage the efficient use of fossil fuels.

The economic challenges of the 1970s fed directly into the 1980s such as inefficiency in generation section investment, to face with problem, in the late 1970s and early 1980s actions were taken to promote conservation and demand-side management (DSM) the number of rate cases expanded dramatically. In addition, The number of rate cases expanded dramatically, and to solve the problem, the least cost utility planning and integrated planning process gained lots of attention. New method took into account information and alternatives, forecasted and evaluated demand and supply options, and sequentially integrated the planning and rate case together. In late 1980s with increasing utility interest in selling generation in wholesale transactions, FERC began allowing utilities to sell power at market based rates as compared to cost-based.

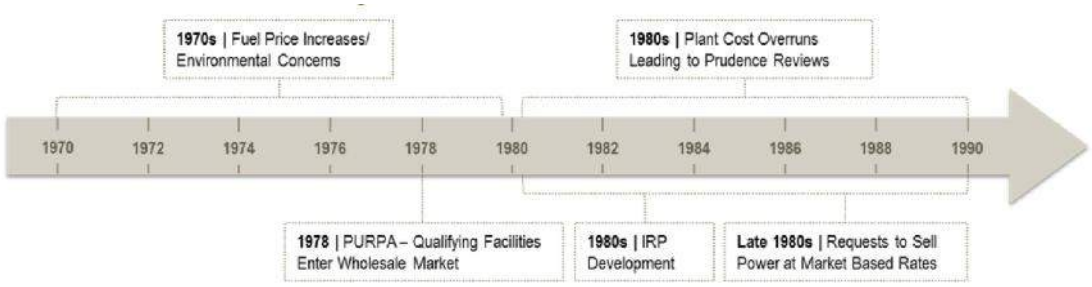

Figure 3 - Power industry changes from 1970 to 1990

The Advent of Centralized Markets [8]

From 1990 to 1999, the federal Energy Policy Act of 1992 (EPACT) broke up the vertical integration , enabled market development and introduced market-based rate policy, new class of electric suppliers and retail competition. Besides, FERC order No. 888, eliminated impediments to wholesale competition and anti-competitive practices such as open-access transmission and recovery of stranded costs.

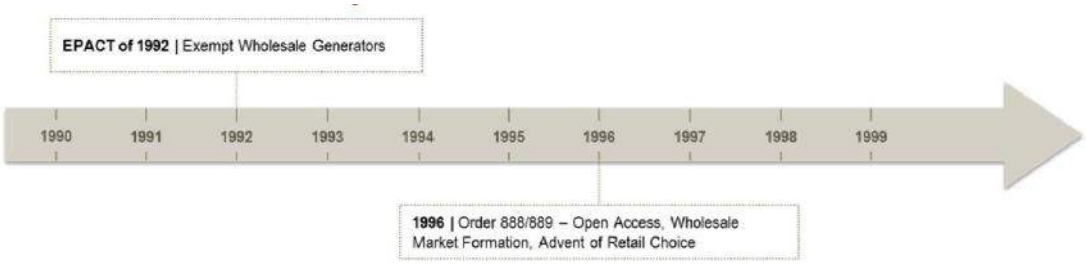

Figure 4 - Power industry changes from 1990 to 1999

Traditional Regulation and Centralized Markets Today [8]

From 1999 to 2009, is the period to improve the policies to have better the market conditions such as establishing series of orders to emphasize on non discriminatory access to transmission and clarify of market base rate policy, and improving previous ones such as order No. 888. One of new established order in this period is FERC order No 2000 that let voluntary formation of RTOs to operate the

transmission and wholesale market and plan regional transmission. Though California market crisis at 2001 slowed down the rapid formation of RTOs and stalled the retail choice.

Figure 5 - Power industry changes from 1999 to 2009

Market Reform

Electricity market liberalization could be consists of one or more of following steps: restructuring —vertically and horizontally unbundling the power system infrastructure—, competition and market —introducing wholesale and retail market and allowing new entrants—, regulation — such as FERC order No. 888 to ensure equal access to transmission system—, ownership — entrance of new private sector and privatization of public utilities. Table 1. outlines the reform steps for traditional electricity market.

Restructuring	Vertical unbundling of generation, transmission, distribution, and supply activities
	Horizontal splitting of generation and supply
Competition and Markets	Wholesale market and retail competition
	Allowing new entry into generation and supply
Regulation	Establishing an independent regulator
	Provision of third-party network access
	Incentive regulation of transmission and distribution networks
Ownership	Allowing new private actors
	Privatizing the existing publicly owned business

Table 1 - Market reform steps [9]

At the early ages of industry —refer to background section—, utilities consolidated and franchised with territory to gain economy of scale. Figure 6. shows traditional, vertically bundled power grid structure in which utilities generate, transmit and distribute electricity to their exclusive territory.

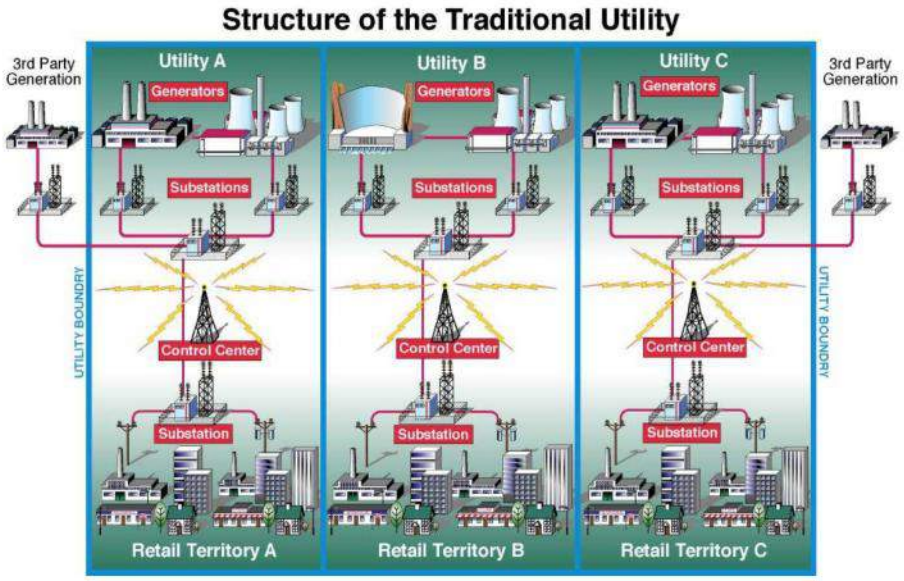

Figure 6 - Traditional vertically bundled structure [10]

Vertically and horizontally unbundling of the infrastructure as shown in Figure 7. no longer allowed utilities to own all three main structures. At most cases transmission system owned by transmission company, yet in other cases some utilities kept the generation and distribution system or each of them alone under vertical unbundling. However horizontal unbundling did not allow any utilities to own each infrastructure section — generation, transmission and distribution— exclusively.

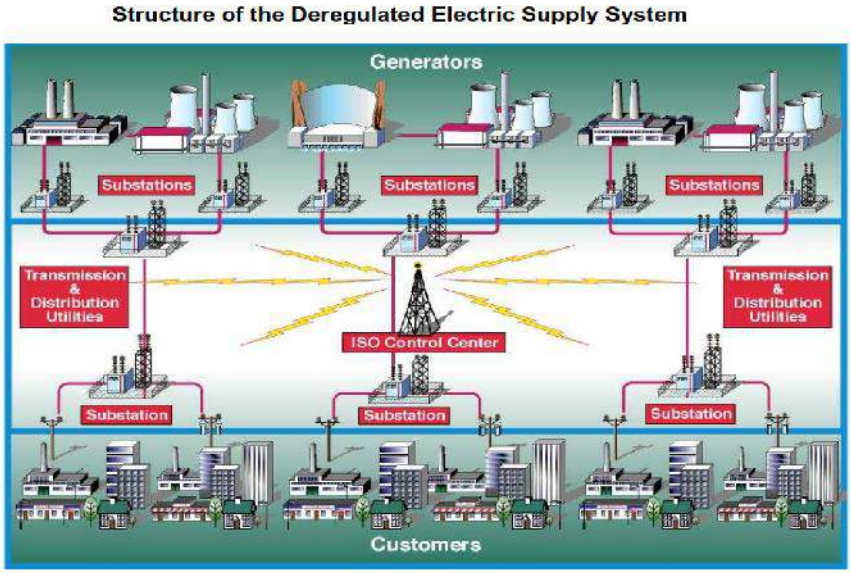

Figure 7 - Vertically and horizontally unbundled structure [10]

Porter Five Forces

Strategy is important factor in company's success. To establish effective strategy, it is required to understand the dynamic of market competition. Though mostly considered competition is the direct one among the rivals, Michael Porter believes that competition for profits goes beyond the existing rivals and four other forces: customers, suppliers, potential entrants, and substitute product need to be considered along. He introduced the five forces that shape industry competition as follows: rivalry among existing competitors, threat of new entrants, threat of substitute products or services, the bargaining power of suppliers and the bargaining power of buyers. The configuration of competition forces would not be the same in different industries. Economic and technical characteristic of industry define the structure and determine the strength of each competitive forces. To examine the dynamic of competition and understand the impact of each forces, drivers for each forces should be taken into consideration from the perspectives of incumbents. [7]

Porter believes that "industry instructor drives competition and profitability, not whether an industry is emerging or mature, high tech or low tech, regulated or unregulated"[7]. Therefore, this study used Porter's five forces in reverse way to understand the impact of each electricity market reforming activities on create competition forces, and recognize the drivers that could improve the competition status in electricity market.

To obtain complete picture of Porter's five forces and their drivers, cognitive map is adopted to illustrate forces and their positive and negative impact on competition, as well as drivers and their positive and negative impact on forces. Next section briefly explains the concept of cognitive map.

Cognitive Map

A political scientist, Robert Axelrod [11] first introduced cognitive mapping to represent political elites' social knowledge. Cognitive maps are directed graph structures that represent experts' knowledge or perception of a complex causal system. Systems are modeled via variables (concepts) and causal connections (edges) in between them. Concepts could have positive or negative impacts on each other.

A positive causality between concept C_1 and concept C_2 means, by increasing or decreasing concept C_1, concept C_2 would be increased or decreased respectively -if no other concepts or edges exist in the system. For example, Figure 8. depicts a casual cognitive map in which concept C_1 impact positively on both concept C_2 and C_3, while concept C_3 itself has a negative impact on concept C_2. Therefore by increasing the concept C_1, concept C_2 may increases or decreases based on the strength of the impacts.

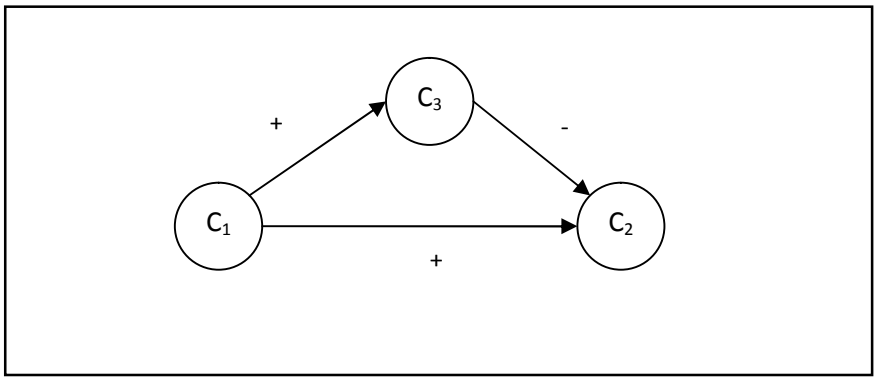

Figure 8 - A simple casual cognitive map

In the early introduction of the cognitive maps by Axelrod [11], the strength of the connections was not taken into account, in another word, all edges considered to carry equal impact but in negative or positive direction. An adjacency matrix is used to show these association in-between concepts where -1, 0 and 1 represent negative impact, no impact and positive impact. Therefore an adjacency matrix (M) would be a square n by n matrix where n is the number of concepts. An element of the matrix (m_{ij}) is a value function of the corresponding concepts: $m_{ij}= f (C_i, C_j)$. If C_i causally increases C_j , $m_{ij}= +1$, if C_i decrease C_j, $m_{ij}=-1$ and if there is no causality $m_{ij}=0$. Adjacency matrix of **Error! Reference source not found.** would be as follows;

$$\begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & -1 & 0 \end{bmatrix}$$

Adjacency matrices are not necessarily symmetric and would have values other than zero on the main diagonal only if a concept directly impacts itself, also known as self-loop.

Cognitive Map of Porter's Five Forces and Their drivers

Figure 10. illustrates Porter's cognitive map that applicable in the electricity market case. Mental Modeler software is used to map the forces and drivers. Mental Modeler is a software that helps individuals and communities capture the subject matter knowledge in standardized format. Captured knowledge could be used to define the important components of the system, the relation between these components and run what-if scenarios. Mental Modeler can be accessed in two ways, as a downloadable desktop app and as an online tool. The online tool used in this study. [12]

As illustrated in cognitive map, all the introduced forces have positive effect on competition while their drivers could affect each forces either positively or negatively. The red arrow with minus represents negative impact and blue arrow with plus represents positive impact. For instance, increasing the equal

access to distribution channels increase the threat of new entrants and as results competition would increase, however, increasing the customer switching cost decrease the threat of new entrant and as result competition would decrease. In addition in cognitive map the bargaining power of buyers is split into two sections of negotiation leverage and price sensitivity for more clarity.

Case Study

In 1995, The Electric Reliability Council of Texas's (ERCOT) responsibilities expanded after the Texas Legislature amended the Public Utility Regulatory Act to deregulate the wholesale generation market. ERCOT became responsible to enable wholesale competition and facilitate efficient use of the power grid by all market participants. As an independent system operator, ERCOT manages and plans the generation units and transmission lines to ensure the availability of 90% of electric grid's loads. [13]

ERCOT is also responsible to perform financial settlement for the competitive wholesale bulk-power market and administer retail switching in competitive choice areas. In the beginning of ERCOT competitive market formaation, incumbent were required to separate business activities into: power generation company, transmission and distribution utility, and retail electric providers or load serving entities. All the utilities are required to under supervision of Public Utility commission of Texas (PUCT) which is regulated as well as ERCOT, Transmission and distribution service provider (TDSP), while generation, load serving and scheduling entities are not regulated. Power marketer and aggregator introduce as an optional entities in Texas restructured market.

Figure 9. illustrates the ERCOT competitive market structure and entities. Public Utility Commission of Texas (PUCT) combined all the steps — discusses in market reform section— to transform Texas traditional market.

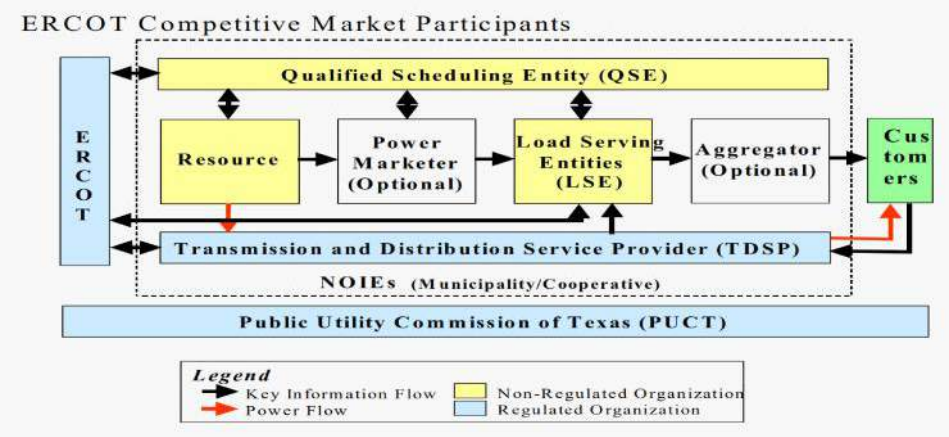

Figure 9 - ERCOT competitive market structure.

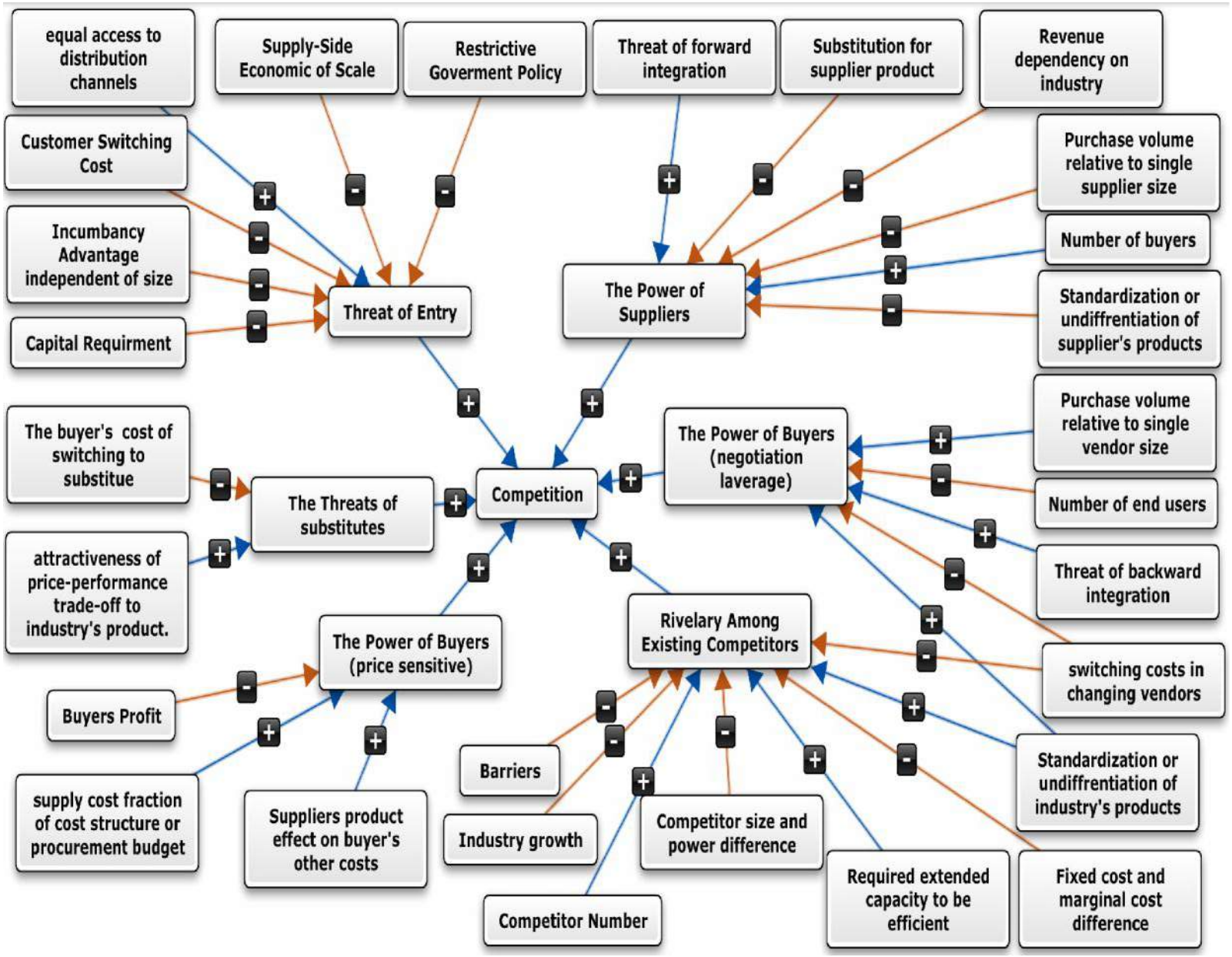

Figure 10 - Cognitive map of Porter's five forces and their drivers

ERCOT's wholesale market is based on bilateral contracts. Though competitive day ahead ancillary services and real-time spot markets are available for load serving utilities to balance their energy. Load service provider allowed to self-service load balance resources.

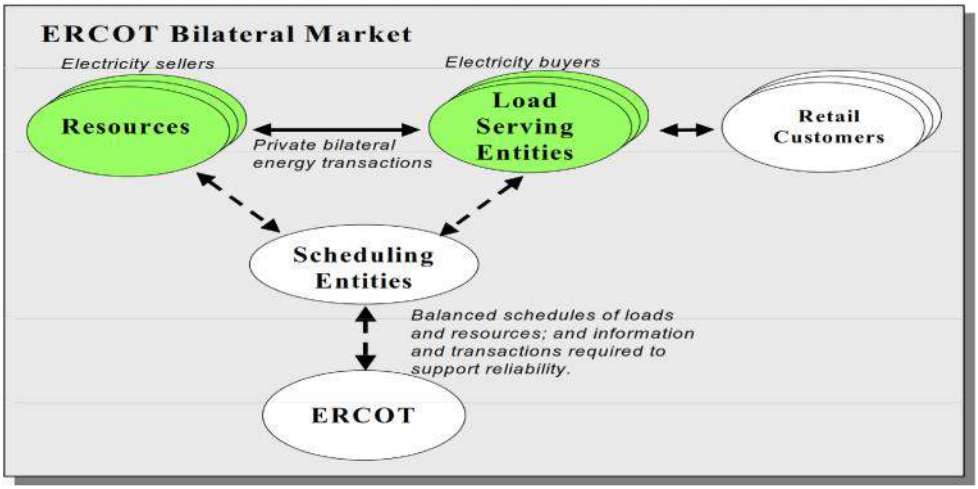

Figure 11 - ERCOT wholesale market

Retail market statistics shows that 47% of customers and 57% of loads are served by more than 60% of registered retail energy providers (REPs), though only 25% of them compete with affiliated REPs in their incumbent service area. In addition, average rate reduction for residential, commercial and industrial customer is about 17%, 34% and 26% respectively.

Discussion

Public Utility Commission of Texas (PUCT), took all the steps to reform its traditional power system. It created suppliers and buyers by two directions unbundling , but it limits competition among generation and load providers and regulated transmission and distribution providers, and introduced wholesale electricity market and retail electricity market. In this section, Porter's five forces and their drivers put into perspectives with respect to ERCOT's wholesale and retail market structure.

- Threat of substitutes: There is no substitute for electricity so far , so this force does not effect in both of markets.
- Threat of entry: unbundling and privatization are created this force in both markets.
  - Restrictive government policy: the entities involved in trading in both markets are unregulated, so it has positive effect on competition.
  - Equal access to distribution channels: in order to FERC No. 888 transmission companies are obligated to provide equal access to all participant in market. This order applicable to

wholesale market. However, regulating distribution system provides the same impact for retail market as well.

- Customer switching cost: There is no cost for switching unless it was motioned in contract signed by both side, the possibility of this switching cost strengthen in bilateral based market.
- Incumbency advantage independent of size: trust and reliability has a big impact in bilateral market and this could be incumbency advantage in both market.
- Capital requirement: capital cost for entering wholesale market depends on used technology to generate electricity and do not get effected by market situation, also it is mostly high in wholesale market. On the other hand entering retail market does not require high capital investment and it is somehow easy to enter.

- The bargaining power of suppliers: unbundling is created this force.
  - Threat of forward integration: this is highly possible in wholesale market and has no meaning in retail market. It is totally depend on profitability of retail market and market structure.
  - Substitution for supplier products: in wholesale market this is completely depend on technology used to generate electricity. In the retail market, conservation program and distributed generation to some degree could be considered as a substitute for supplier product.
  - Revenue dependency on industry: in retail market, revenue of suppliers is highly depend on industry while in wholesale market it depends on technology. However, this driver do not depend on market structure in none of the markets.
  - Purchase volume relative to single supplier size: in wholesale market this is completely depend on technology used to generate electricity. While in retail market, it is potentially high with respect to the number of active load service providers in the market and market structure.
  - Number of buyers: in wholesale market this is completely depend on technology used to generate electricity. while in retail market, it is potentially high with respect to the number of active load service providers in the market and market structure.
  - Standardization or undifferentiating of supplier product: in retail market all the supplier product is standardized but in wholesale market, it depends on technology. However, this driver do not depend on market structure in none of the markets.

- The bargaining power of buyers (negotiation leverage): unbundling is created this force.
    - Purchase volume relative to single supplier size: bilateral contracts are for purchasing considerable volume of electricity, so it is relatively high for wholesale market. While, the end users purchase volume it depends on the type — residential, commercial and industrial— it usually low relative to providers size.
    - Number of end user: in retail market with respect to 72 active load service provider, the end users numbers considered numerous and decreases the power of buyers, however, for wholesale market, number of generation is required to analyze the impact, yet bilateral market increase the bargaining power of buyers more probably rather than other market structure.
    - Threat of backward integration: threat of backward integration is low in wholesale market because of barriers for entrant like high capital costs. Yet threat of backward integration in retail is low because of bilateral based wholesale market.
    - Switching cost in changing vendors: switching cost is almost zero, unless this cost has been seen in bilateral contracts.
    - Standardization or undifferentiating of industry product: the industry product are standardized so it increases the bargaining power of buyers. It needs to be considered that this is the characteristic of industry and would not change by market structure.
- The bargaining power of buyers (price sensitivity): unbundling is created this force.
    - Buyers profit: customers in retail market are not price sensitive since they are not exposed to real-time market and this directly affect the price sensitivity of buyers in wholesale market.
    - Supply cost fraction of cost structure or procurement budget: it is different in two markets, this is higher in retail market rather than wholesale market. However, the dependency of this driver is very low on market structure.
- Rivalry among existing competitors: unbundling is made this force happen.
    - Switching cost in changing vendors: it is non unless it mentioned in the contract because of that the chance of having considerable switching cost is higher in bilateral contracts.
    - Standardization or undifferentiating of industry product: electricity as a product of both markets are standardized and has no positive effect on competition.
    - Barriers: one of potential barriers is capital investment for wholesale market, as discussed before, it could have negative impact on competition and depends on technology progress in generation area.

- Industry growth: it is mostly affected by external factors and it is hardly related to market structure.
- Competitor number: in retail market, potentially there are 130 competitor however only 20 of them actively compete against each other, this number would grow and potentially has a good impact on competition.
- Fixed cost and marginal cost difference: this is different in two markets, the difference in wholesale market depends on technology used to generate electricity. In retail market, the gap is bigger since marginal cost is almost so small compared with fixed costs.

The above discussion shed light on how power system and technical, market characteristics and market structure have an impact on drivers and subsequently on competition. Next section concludes the findings in this section.

Conclusion

Conclusion is broken into two parts. One part includes decency of electricity market's reform activities in terms of Porter's five forces and their drivers. The second part includes the limitation of Porter's model in order to analyze competition in restructured electricity market.

The threat of substitute is the weakest force for electricity market since there is no real substitute for electricity. In some cases, utilities considered conservation programs as an substitute for electricity but under porter's model, it would be considered as buyers price sensitivity. Though, unbundling creates buyers and supplies and rivalry among competitors forces, and threat of new entrants is created by adding privatization step, theses reform activities just create competition forces and do not guarantee the effectiveness of forces. Other steps like regulation are required to affect the drivers in a way that increase competition. For instance, FERC order No.8888 is required to provide equal access to distribution channels which is important for increasing competition through increasing the threat of new entrants. The rest of drivers that somehow overlooked, are influenced by either competitive market structure or technical characteristics. While market structure could be changed to increase competition, technical characteristics are hard to be changed.

Restructured power industry could consists of one up to four separate competitive markets that dynamic and each and every ones affect the others. For instance, whole sale market's purpose is to create competition among generator units, buyers in this market — load serving entities (LSEs)— are involved in retail market in which the characteristic of retail buyers — Customers— would affect the bargaining power of LSEs in wholesale market. Though buyers profit could capture the effect of this interaction

between two markets to some degree, it is definitely not an inclusive way, and porter model needs to be improved to capture these interactions according to what discussed in discussion section.

Electricity customers are not realized as a price sensitive ones, since there is no required infrastructure to expose customers to real-time electricity price. The information dissemination has not been considered in porter 's model as a driver that could impact the bargaining power of buyers by being price sensitive. Also, the porter's model does not take into consideration the relation among each forces' drivers and between one force's drivers with others.

Limitation & Future Study

The improvement areas for this study are as follows:

- This study did not consider different competitive market structure like bilateral market vs. pool market or energy only market vs. capacity market. Another study is required to compare the impact of different market structure on drivers.
- Power infrastructure modernization's effect did not consider in this study. Another study is required to consider the impact of these changes on drivers.
- The strength of relation between drivers and forces and forces with competition did not consider in this study, this is another area that could be improved further.

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