



Operational synergy in the US electric utility industry under an influence of deregulation policy: A linkage to financial performance and corporate value

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ABSTRACT

Sueyoshi et al. (2009) have examined a synergy effect between electricity and gas services in the US electric utility industry. They have compared electricity-specialized firms with diversified utility firms in their financial performance and corporate value. A problem of their study is that it has not empirically measured the operational performance of the electric utility firms. As an extension of the preceding study, this research investigates the operational performance of 104 US electric utility firms (1990–2004) by fully utilizing DEA (Data Envelopment Analysis). This study finds the three new policy implications. First, the synergy effect has not existed in the operational performance of diversified utility firms before and after the deregulation on the US electricity markets. Thus, core business concentration is more effective for electric utility firms than corporate diversification to enhance their operational performance under the current US deregulation policy. Second, the operational performance has had an increasing trend until 1996 and a decreasing trend after 1996. Thus, the US deregulation policy has been influential on their operational performance. Third, the enhancement in operational performance of electric utility firms has improved their financial performance. The improvement in financial performance has increased their corporate value. Thus, this study finds the business causality among operational performance, financial performance and corporate value in the US electric utility industry.

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1. Introduction

The research of Sueyoshi et al. (2009) examined a synergy effect between electricity and gas services¹ in the US electric utility industry. They compared electricity-specialized firms with diversified utility firms in their financial performance (measured by Altman's *Z* score) and corporate value (measured by Tobin's *q* ratio). Then, they confirmed an existence of the synergy effect in the two performance measures because the diversified firms outperformed the electricity specified firms until 1996. Unfortunately, their study

did not empirically measure their operational performance.² As an extension of the preceding study, this research investigates the operational performance of 104 US electric utility firms (1990–2004) by fully utilizing DEA (Data Envelopment Analysis).

The operational synergy effect discussed in this study has a close linkage with Energy Policy Act (EPAct: enacted in 1992) that has introduced deregulation policy into US wholesale electricity markets. The deregulation became more effective and influential after it gradually restructured US retail electricity markets at the state

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¹ A synergy between gas and electricity can be found in similarities between their businesses. For example, gas serves as a fuel for electricity generation. If an electric firm and a gas firm merge, then the combined business may have a bargaining power on a gas price because it can purchase a large amount of gas. In addition, the company can achieve an optimal use of gas between a gas supply and an electricity generation, depending upon changes in demand for electricity and gas. Furthermore, it is possible for the two utility services to integrate customer services such as a meter reading of electricity and gas as well as a call center service. Then, a retailing cost may reduce by an efficient management of the customer services.

² The concept of synergy is conventionally measured by the cost reduction of a joint production. For that purpose, economic concepts of economies of scale and scope are often examined on a base of the cost-based econometric approach. This study does not measure a cost-based synergy effect because we need to specify a flexible functional form for a cost function (e.g., a translog cost function). See Charnes et al. (1988), Sueyoshi and Anselmo (1986) and Sueyoshi (1991) for the use of a translog cost function to discuss "cost subadditivity", "economy of scope" and more generally "natural monopoly". See also Sueyoshi and Goto (2009) and Goto and Sueyoshi (2009) for recent functional forms. It is true that none knows what an appropriate cost function is. To avoid specifying a cost function, this study directs toward a non-parametric approach, or the DEA/SCSC approach. This study does not believe that the proposed approach is the best, rather considering that the proposed one is an alternative approach to the cost-based synergy measurement.

level after 1996. The deregulation policy was due to the economic assertion that competition in the electric utility industry would enhance a corporate effort to improve business efficiency, to reduce consumers' financial burden, and to increase economic prosperity.

The implementation of the EPAct yielded a strategic change in the industry. Existing firms and new entrants faced diminishing revenue due to core business competition so that many electric utility firms expanded to gas business, and vice versa. Such a strategic change was supported by well-known researchers such as Wilson (2002) who expressed his view that the diversification was beneficial because a synergy effect may exist between electricity and gas services in the electric utility industry. His claim was important in supporting the firm's strategic change under the influence of EPAct.

To examine the economic assertion from an empirical perspective, Sueyoshi et al. (2009) investigated whether the synergy effect existed in the US electric utility industry. They compared electricity-specialized firms with diversified utility firms in terms of their financial performance and corporate value. Their study (2009) also investigated causality among them and examined how the deregulation had influenced the two performance measures. Their study provided the three important policy implications: First, the synergy effect existed in their financial performance before the deregulation (1996). However, the synergy effect disappeared after the deregulation. Second, the synergy effect existed in the corporate value of diversified utility firms, but it disappeared after the deregulation. Therefore, their study (2009) has recommended that core business concentration is more effective for US electric utility firms than corporate diversification in terms of enhancing their financial performance and corporate value under the current US deregulation policy. Third, their financial performance had an increasing trend until 1996 and a decreasing trend after 1996. Thus, the study confirmed that the US deregulation policy influenced their financial performance. The improved financial performance increased their corporate value.

Acknowledging the contribution of their study (Sueyoshi et al., 2009), we need to mention that their study has not explored the operational performance of the electric utility firms so that it does not examine the existence of an operational synergy effect and a policy influence of EPAct on the operational synergy. Moreover, their study (2009) did not discuss an important linkage among operational performance, financial performance and corporate value in the electric utility industry. Such are methodological drawbacks of their study (2009).

The purpose of this study is to investigate the important evidences related to the electric utility industry, all of which the previous study (Sueyoshi et al., 2009) have not examined. Thus, this study is an extension of the preceding research.

This study organizes the remainder as follows: Section 2 reviews previous DEA studies on the electric utility industry and energy policy in order to indicate the position of this study. Section 3 describes two methodologies (DEA and rank sum tests) used in this study. Section 4 applies the proposed DEA approach to examine the operational performance of US electric utility firms. The section discusses policy implications newly obtained from this study. Section 5 summarizes this research along with future research agendas.

2. Literature review

DEA applications to electric power industry: This study starts with a literature review on DEA applications to the electric power industry. The industry is functionally separated into the following four categories: (a) generation, (b) transmission, (c) distribution and (d) retailing. Many previous studies applied DEA to evaluate

the performance of electricity generation facilities in many industrial nations. For example, Lam and Shiu (2001), Lo et al. (2001), Nag (2006), Olatubi and Dismukes (2000), Park and Lesourd (2000), Pombo and Taborde (2006), Sueyoshi and Goto (2001) and Sueyoshi et al. (2010) belonged to the research group. Meanwhile, the other research group was interested in DEA applied to the performance evaluation of distribution and transmission. For example, Abbott (2006), Chien et al. (2003), Jamasb and Pollitt (2003), Pahwa et al. (2002), Resende (2002), Sanhueza et al. (2004) and Sarica and Or (2007) belonged to the research group. Research on retailing was often treated as part of the distribution.

It is clear that this study belongs to the two research groups because we apply DEA to the total operation revenue as an output. The whole business effort from generation to retailing yields the total operation revenue. Acknowledging a contribution of such previous studies, this study needs to mention that most of them have not considered an occurrence of zero on multiples (dual variables). The problem implies that an inputs and/or an output, corresponding to the multiplier with zero, are not fully utilized in the DEA performance evaluation. As a result, all the previous DEA applications may have a difficulty in deriving reliable empirical results. It is true that such a problem is a mathematical concern, not a policy issue. However, we cannot obtain any reliable empirical results for preparing policy suggestions without a mathematically appropriate use of DEA. This study documents the mathematical concern in such a manner that the proposed DEA approach can prepare reliable information for guiding energy policy and utility management although the research effort is not the main purpose of this study.

DEA applications to energy policy: Many research efforts applied DEA to discuss various energy policy issues. For example, Zhou and Ang (2008) used Russell Measure and an additive model (one-sided output efficiencies and deviations) to discuss macroenergy policy on GDP, CO₂ emission and various energy consumptions in OECD nations. Such policy-oriented DEA studies included Boyd and Pang (2000), Ramanathan (2000), Hawdon (2003), Agrell and Bogetoft (2005), Thakur et al. (2006) and Azadeh et al. (2007, 2009). This study belongs to the research group as well, because the use of DEA proposed in this study is policy-oriented.

Differences between this study and the previous study (Sueyoshi et al., 2009): Fig. 1 visually describes differences between this study and the preceding study of Sueyoshi et al. (2009). The research of Sueyoshi et al. (2009) was interested in the financial performance and corporate value of US electric utility firms. The study (2009) measured their financial performance by DEA-DA (Data Envelopment Analysis-Discriminant Analysis) and measured their corporate value by Tobin's q ratio. The study (2009) could investigate whether a synergy effect existed in the financial performance and the corporate value, but being unable to measure causal relationship among their operational performance, financial performance and corporate value, as depicted in Fig. 1. In contrast, this study is interested in the operational performance of US electric utility firms where their operational performance is measured by a newly proposed DEA model. The research provides us with information regarding an operational synergy effect between electricity and gas in the electric utility industry. That is a research concern of this study. As a byproduct of such DEA-based investigation, we can measure the causality among the three performance measures. Thus, this study can examine whether the US electric utility industry should concentrate core business or consider corporate diversification in terms of such business linkages among the three performance measures. Consequently, we can examine a policy inquiry on how the deregulation policy of the industry has influenced their corporate strategy in a time horizon. We cannot find such a policy result in the preceding study (Sueyoshi et al., 2009).

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