DEREGULATION AND UTILITY INNOVATION: THE CASE OF JAPANESE ELECTRIC SECTOR

Nan Wang, Research Institute of Innovation Technology for the Earth, +81-774752304, nwang@rite.or.jp
Gento Mogi, the University of Tokyo, +81-358417046, mogi@tmi.t.u-tokyo.ac.jp

Overview

Over the last two decades, following the great trend of worldwide market-oriented reform, Japanese electric sector has being deregulated with the aim of stimulating competition, increasing efficiency, and reducing electricity price. The deregulation, in theory, should produce an increased alignment of managerial incentives with firm financial performance, which will ultimately promote a more efficient use of resources. The evaluations on the impacts of deregulation in electric sector generally show consistent efficiency gains and improvements in productivity (Goto and Sueyoshi, 2009).

However, some researchers have raised the concern regarding the "unintended consequence" of the deregulation on energy sector R&D input even at the beginning of the reform (Dooley, 1998). Other study also reports the declining private R&D effort after the deregulation (Margolis and Kammen, 1999). Recently, more scholars argue that the improvement of static efficiency may at the expense of dynamic efficiency (Kim et. al, 2012) and provide empirical evidence on the negative impact of deregulation by monitoring the R&D behaviour of the companies related to electric industry under deregulation in US and EU (Sanyal and Cohen, 2009; Jamasb and Pollitt, 2008). However, most studies focus on either innovation input, thus can not provide a general assessment on the impacts of deregulation on the firm innovation. This study intends to fill this gap to explore the factors in driving electric utility innovation and to expand the understanding of the impacts of deregulation on utility innovation input as well as innovation output.

Methods

This study employs panel econometrics to estimate the impacts of deregulation on utility innovation input and output, relying on a time series (1978-2014 for input) (1978-2011 for output) of the nine regional vertically-integrated monopolies in Japan. The utilities which are included in our sample account for more than 75% of total power generation, 99% of transmission and distribution and 95% of retailing in Japan. We use the R&D expenditure to proxy firm innovation input and the numbers of patent application and the average patent citation to proxy firm innovation output. The database is built on firm level. The regressions are estimated with fixed effects (FE) model.

The estimation of innovation input proceeds in two steps. The first step is to use basic model to capture the overall impact of deregulation with dummy variables of deregulation. The other explanatory variables are as follows: 1. Firm revenue is applied to capture the impact of firm size. 2. Share of nuclear in generation is included to capture the impact of fuel mix (Salies, 2010). 3. Government energy R&D expenditure is also included to capture the impact of public fund. We also checked leverage, cash-flow, ordinary income to proxy financial constraints, but the results suggest that financial costs do not seem to be an important barrier in the utility innovation. The second step we specify the deregulation process with deregulation in generation and build a series of indicators to capture the separate impact of deregulation. The impact of deregulation is separated as policy aspect (R&D cost recovery policy, generation deregulation policy, retail deregulation policy), and market aspect (generation competition variable and retail competition variable).

The estimation of innovation output proceeds in a similar two-step method. The number of patent application and the average citation of patent are applied to proxy both quantity and quality of the utility innovation output. The overall impact of deregulation is captured with deregulation dummy. The other explanatory variables includes: 1. R&D intensity with one year lag, 2. firm asset, 3. government R&D expenditure. The extended model separately estimates the impact of deregulation policy and competition in generation market and retail market.

Results

We find that government R&D fund, firm revenue and share of nuclear power in generation are positively correlated with utility R&D input. Government R&D expenditure, firm R&D intensity, firm assets are positively correlated with patent application count and average patent citation.

It is also observed that electric sector deregulation has a negative impact on utility R&D input while positively affects utility R&D output. In line with previous studies on this topic (Dooley,1998; Sanyal and Cohen, 2009; Salies, 2010; Kim et.al.2012), evidence is found that deregulation reduces incumbent utility R&D investment utilizing Japanese data. We further find that deregulation increases firm patent applications and patent average citations. In other word, deregulation can boost the utility R&D productivity. This is supposed to be the short-term benefit of deregulation. The increase in innovation productivity may lead to three possible conclusions. 1. There is possibly certain degree of inefficiency of utility R&D before deregulation. 2. Utility is becoming more commercialized. Growing competition encourages utility in patenting to get competition advantage. 3. Utility has changed research priority to short-term, business oriented/consumer-oriented research projects which can increase patenting. However, in the long run, the lasting declining R&D investment may eventually lead to a reduction in patent and innovation which has been observed in US (Sanyal and Ghosh, 2008) and UK (Jamasb and Pollitt, 2015).Our results also suggest that the influence of deregulation and competition in the retail market on utility innovation is stronger than that in the power generation market.

Conclusions

This paper explores the determinants that drive the utility innovation and investigates how deregulation affects R&D input and output of the incumbent electric utilities in Japan. This work seeks to contribute to the understanding of the impact of deregulation in terms of private utility innovation behavior. In this study, the overall impact of deregulation, as well as the separate effects of cost recovery policy, generation deregulation, retail deregulation, generation competition, and retail competition are examined based on firm-level empirical evidence. We find deregulation positively affect firm patenting activities but negatively affect R&D investment. This phenomenon, in short term, can be interpreted as gain in R&D productivity.

The results do not necessarily imply that utilities should simply increase or decrease R&D investment. It is impossible to determine current R&D investment is above or below the “optimal level” (if it does exist). However, the declining R&D effort may be detrimental to the reliability and dynamic efficiency of the electricity system, especially if more renewable energy has been incorporated, as well as the innovation maintenance in introducing smart grid and dealing with environmental concerns. We emphasize that trade-offs between static and dynamic efficiency also exist from the perspective of firm innovation. Less motivation in technological R&D investment will in long term negatively affect the efficiency of the electric sector. How to deal with this “unintended consequence” calls for further policy design during the implementation of deregulation. For example, the deregulation pioneer, UK set up mechanisms to support energy R&D as a response to the collapse of electricity deregulation (Jamasb and Pollitt, 2015). According to the results, government role is becoming much more important to maintain research on the future long-term, public-oriented project in the electric sector.

References

Dooley, J.J., 1998. Unintended consequence: energy R&D in a deregulated market. Energy Policy 26, 547-555.

Goto, M., Sueyoshi, T., 2009. Productivity growth and deregulation of Japanese electricity distribution. Energy Policy 37 (8), 3130-3138.

Jamasb, T., Pollitt, M.G., 2008. Liberalisation and R&D in network industries: the case of the electricity industry. Research Policy 37, 995-1008.

Jamasb, T, Pollitt, M.G., 2015. Why and how to subsidise energy R+D: Lessons from the collapse and recovery of electricity innovation in the UK. Energy Policy 83, 197-205.

Kim, J., Kim, Y., Flacher, D., 2012. R&D investment of electricity- generation firms following industry restructuring. Energy Policy 48, 103-117.

Margolis, R.M., Kammen, D.M., 1999. Evidence of under-investment in energy R&D in the United States and the impact of Federal policy. Energy Policy 27, 575-584.

Salies, E., 2010. A test of the Schumpeter hypothesis in a panel of European Electric Utilities. Innovation, Economic Growth and the Firm. Edward Elgar Publishing. US.

Sanyal, P., Cohen, L.R., 2009. Powering progress: restructuring, competition, and R&D in the U.S. electricity utility industry. Energy Journal 30, 41-79.

Sanyal, P., Ghosh, S., 2008. Product market competition and upstream innovation: theory and evidence from the US electricity market deregulation. Working paper, Brandeis Univerisity.