An Alternative Utility Structure:

Incentivized Management and the PrincipAl-Agent Problem

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Overview

This paper looks into Regional Electricity Trading, Energy Finance and Asset Valuations, and Energy Markets and Regulation.

According to Glachant and Rossetto (2019), AI, Block-Chain, and the internet of things will transform the power utilities of the world to become hyper-competitive. The idea is that information technology is going to make the electric utilities of the world super competitive so that everyone benefits with much lower electric power prices. However, Mould, (2019) shows how cell phone services in Nigeria have indeed become competitive and low cost with competition, but that curiously electric utilities have not. The implication is that electric utilities in a developing economy can become as competitive as cell phone services, and yet no where has that happened, not even in the developed world.

One way to maximize computing power for electric utilities, then, is to organize a centralized planning authority that can facilitate the data collection and facilitate the use of the data for locating and designing of various power generation suppliers and electric power consumers, taking into account long range trends in a region's growth and power needs. In this paper, we **revisit the electric utility structure itself including: regulated utilities, government owned utilities and de-regulated, competitive-based utilities**. Then an alternative utility structure is proposed based on **the principal-agent problem and competition where rational agents can improve benefits and reduce costs**. The idea is that a centralized data-base authority can reduce externalities in the planning and implementation of grid expansions.

The aim is to get a grasp on the long-term dynamics of utility costs, price settings and system wide externalities, by accounting for:

- power generation locations;
- economies of scale;
- Technical constraints (such as electric power connections);
- Incentivised operations.

We present an example utility organizational structure that allows us to investigate three major directions in electric utilities:

1. How electric utility management works;

2. What the incentives are for power generation optimization;
3. What the incentives are for power demand changes.

This example utility organizational structure can be tailored to coal, natural gas or renewables depending on what the government sees as the most important social or cost critical needs for that region.

Methodology

We show an example organization for an electric power utility grid and how the decision to add new generation or the decision to add new demand can be made by a simple cost benefit analysis. Then we add risk context into the analysis and look at how an incentivized data system, which takes into account the principal-agent problem, would work. By adding simple information system authority to coordinate utility contracts, the risks associated with maximizing system benefits can be better dealt with.

One interesting scenario is shown where a new power generation and a new demand side customer can secure a long run competitive contract to optimize both of their mutual benefits and reduce their costs and where a centralized authority can provide data that may allow for flexible rate making to work better. Based on this scenario, we look at how incentives work to organize both demand side loads and supply side generation by adding characteristics of the principal-agent problem. The principal-agent problem is where a manager has inside information compared to the stakeholders which can lead to inefficiencies, therefore we add an incentivized management plan to reduce the inefficiencies of a typical grid.

Results

1. Coordinated Utility Data

A coordinated utility data authority can correct inefficiencies within a competitive utility framework. Using data trends and AI can help induce a higher level of benefits for different risk scenarios.

2. The Principal-Agent Problem

One problem with coordination of a grid is the principal-agent problem which can be solved with a bonus option plan.

3. How a Bonus Option Helps

A dedicated bonus option plan is given for different utility scenarios. By reducing risks to new generation and new demand, the overall grid can be maximized for all demand side customers and generation suppliers.

Conclusions

Using some simple example cases for an electric power grid, we can show various ways to optimize the grids benefits while reducing the costs. By adding risk scenarios into the cases and using an incentivized management plan for a central data authority for the grid, we can reduce the principal–agent problem of not obtaining optimal long run contacts for various parties. This can reduce externalities of the utility system, not just pollution externalities but the externalities associated with a hyper-competitive supply and demand

grid network where too many supply generators are built or where electric utility customers are not well coordinated to take advantage of various supply opportunities.

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