The Effect of Procuring Electricity In-House on the Utility's Performance: Evidence from the U.S. Electric Industry

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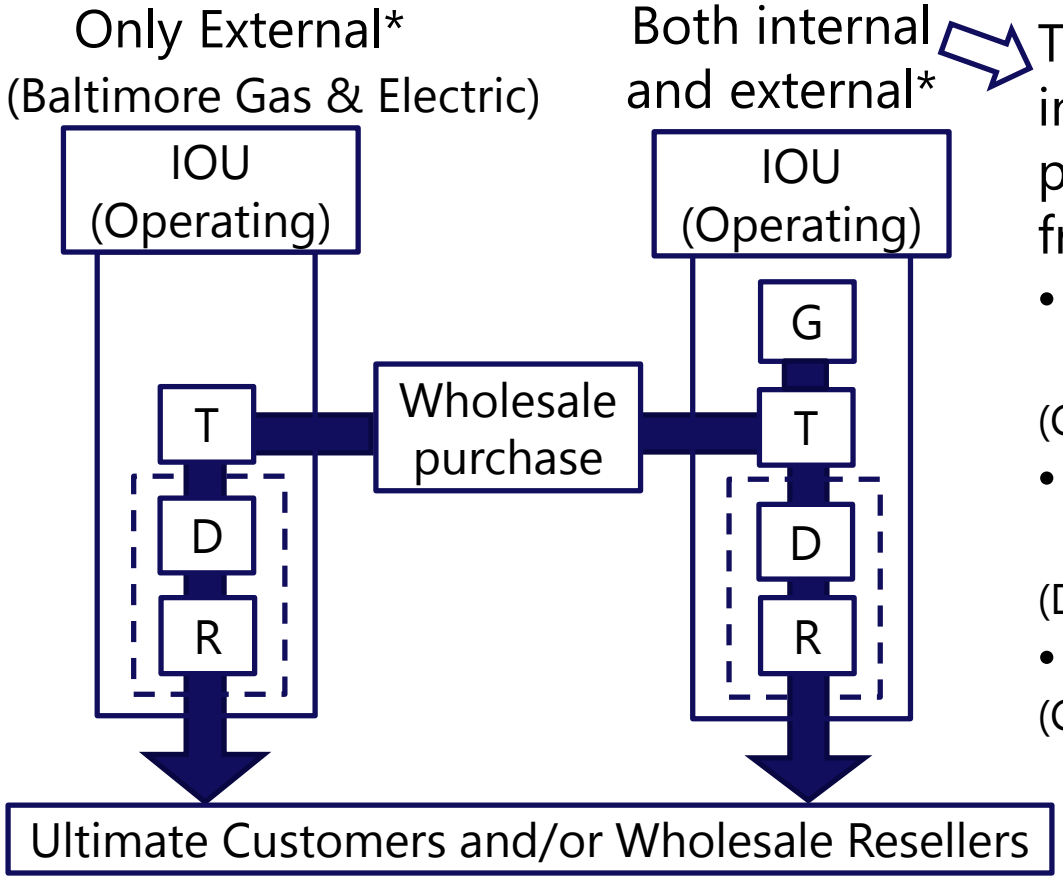
Outline

1. Introduction
2. The role of the demand uncertainty
3. Data and methodology
4. Estimation Results
5. Conclusion

1. INTRODUCTION

Motivation

- There is a wide variety of the degree of the internal procurement among IOUs (Operating Company).



The degree of the internal procurement varies from utility to utility.

- Heavily relies on the external
  (Commonwealth Edison)
- Heavily relies on the internal
  (Duke energy Progress)
- About fifty-fifty
  (Consumer Energy)

Main Disposition

Ownership

G: Generation

T: Transmission

D: Distribution

R: Retail

: Flows of electricity supply

* The transaction within a same holding Company is treated as the external procurement.

Motivation

- Some previous literatures theoretically argued that the internal procurement could affect the costs of IOUs.
- Meyer (2012) summarizes merits and demerits of depending on the internal procurement.
  - Merits : It could reduce costs stemming from;
    - duplicated tasks, departments, and/or IT systems.
    - price and demand uncertainty (i.e. Adjustment costs).
  - Demerits
    - The loss of specialization economies
    - The increase of administrative costs (Besanko et al. 2013)

Motivation

- To my knowledge, there are no empirical works that explicitly estimate the effect of the internal procurement on the cost performance.
- However, we need to reconsider the role of the internal procurement.
  - A lot of non-utility generators have emerged.
  - They expanded potential procurement options for IOUs.

Motivation

- It is important to know how the degree of the internal procurement affects the utility's costs.
  - Purchasing and/or generation costs account for a large part of the utility's annual costs (about 51%*).
  - Regulated retail prices are affected by their costs.

*Calculated as $\frac{\text{Generation Costs + Wholesale purchasing costs}}{\text{O\&M +Depreciation \& Amortization + Interest for Longterm Debt}}$, Source: FERC Form 1

Research Question

- This paper tries to answer,
  - How does the internal procurement affect the costs of IOUs?
  - Especially, we focus on the role of the retail demand uncertainty.
  - Meyer (2012) pointed out that the demand uncertainty plays an important role when considering the effect of the procurement decision on the cost performance.

2. THE ROLE OF THE DEMAND UNCERTAINTY

Why is the retail demand uncertainty important?

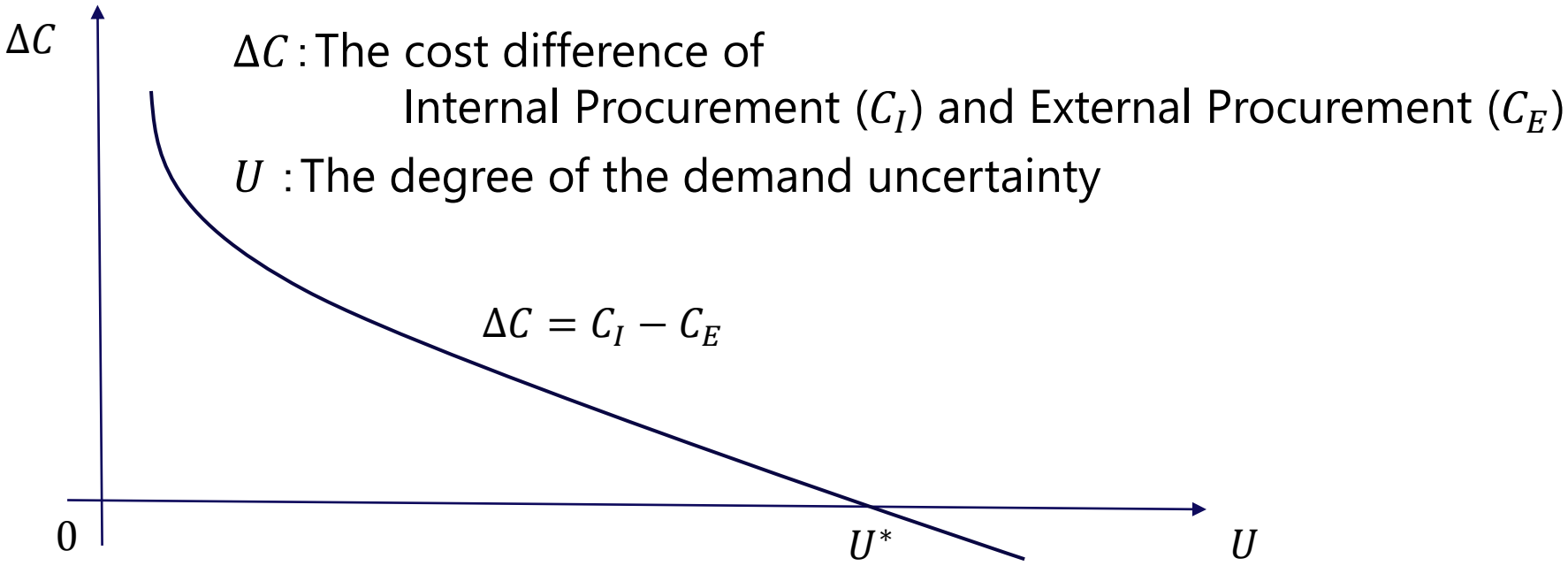
- According to Transaction Cost Economics (TCE), there are some costs that occur when we use external transactions such as bilateral contracts and spot markets. (i.e. Transaction costs)
  - Transaction costs include costs for negotiation, monitoring, and enforcement of the contracts, as well as for hedging against price volatility in the spot market transactions.
- TCE says these transaction costs are formidable when the retail demand uncertainty is high.

Why is the retail demand uncertainty important?

- When the demand is uncertain, it is difficult to foresee the future events and future prices.
  - Utilities might have to readjust contracts and/or transaction in the spot markets in accordance with the demand and price fluctuation
  - Of course, utilities could hedge against these uncertainty by using forward markets, option markets, and/or long-term contracts.
- However, TCE expects that these hedging strategies are more costly than the adjustments within a utility.

Why is the retail demand uncertainty important?

- TCE expects that the internal procurement is more (less) cost efficient than the external procurement when the demand uncertainty is high (low).



3. DATA AND METHODOLOGY

Data and Methodology

- Data
  - Focus : Operating company level IOUs providing bundled service (regulated retail service) in the U.S.
  - Source : EIA-861, FERC Form 1
  - Years : 2010-2015
- Methodology
  - Regression analysis using panel data
    - It is similar approach to previous literatures in other industries. (Rothaermel et al. 2006, Li et al. 2016 etc.)

Why focus on these IOUs?

- It is easy to build an consistent data set.
  - Their operating and cost information are collected by EIA-861, and FERC form1
- It could mitigate an endogenous problem often occurs when analyzing firms' decisions.
  - IOUs in this paper are regulated utilities.
  - Furthermore, generation assets of utilities are divested mandatory in many deregulated states.
    - These divestitures make some utilities procure electricity from outside regardless of their intentions.
  - Procurement decisions are considered as exogenous.

Regression model

- We estimate the following fixed effect model.
- The important parameter is β_4.
  - β_4 represents how the effect of the internal procurement on the cost performance varies with the demand uncertainty.
  - β_4 will be negative if the theoretical argument is true.
    - Utilities could avoid transaction costs by depending on the internal procurement.

$$\ln C_{it} = \beta_1 + \beta_2 RIP_{it} + \beta_3 U_{it} + \beta_4 RIP_{it} \times U_{it} + \sum_j \gamma_j Z_{it}^j + d_i + d_t + \epsilon_{it}$$

i: The index of utility
t: The index of year
C_{it}: The cost performance variable
RIP_{it}: The ratio of the internal procurement
U_{it}: The degree of retail demand uncertainty
Z_{it}^j: Control variables
d_i: Individual effect for utility i
d_t: Time effect
ϵ_{it}: Error term

Definition of Variables

Variables	Definition
Cost Performance	
O&M	Operation & Maintenance (Companywide or Electricity segment, 1000$)
Fixed cost (FC)	Depreciation and Amortization (1000$) + Interest on long term debt (1000$)
TC	Total cost = O&M + FC
The ratio of the internal procurement	
RIP_{it}	Ratio of internal procurement = Net Generation (MWh) / Total Sources (MWh)
Uncertainty : similar approach to Leiblein and Miller (2003) and Lieberman (1991)	
U_{it}	■ Measured by the squared percentage of the forecasting error $\left(\frac{\eta_{it}}{D_{it}}\right)^2$ of the following regression of the retail demand. ■ $D_{it} = \alpha + \beta_1 D_{i,t-1} + \beta_2 D_{i,t-2} + t + \eta_{it}$ □ D_{it}: Retail demand (MWh), t: Time trend

Definition of Variables

Variables	Definition
Control variables	
R_{it}	Retail Sales (MWh)
W_{it}	Sales for Resale (MWh)
T_{it}	Wheeling (MWh)
D_{it}^{G}	Gas Retail Dummy : 1 if firm i is active at year, 0 otherwise
D_{it}^{m}	Merger Dummy : 1 from year t if firm i merged at year t, 0 otherwise
RD_{it}	The Ratio of Retail Sales in Deregulated States (%) $\frac{\text{Sales of the utiliy } i \text{ at year } t \text{ in deregulated states (MWh)}}{\text{Sales of the utility } i \text{ at year } t \text{ (MWh)}}$

Summary Statistics

Variables	obs.	Mean	Std. Dev.	Min	Max
O&M (Companywide, 1000$)	772	1369489	1611818	3005	1.16E+07
O&M (Electricity, 1000$)	774	1232599	1422783	3005	1.01E+07
Depreciation and Amortization (1000$)	762	207628.9	296114.1	162	2545957
Interest on Long-Term Debt (1000$)	774	99463.84	118264.1	-534	763144
Retail Sales (MWh)	774	1.87E+07	2.11E+07	16457	1.10E+08
Sales for Resale (MWh)	774	3197052	4750439	0	4.15E+07
Transmission (MWh)	774	3776632	9257836	0	1.02E+08
Uncertainty ($\%^2$)	769	2862418	5.25E+07	3.31E-05	1.34E+09
Gas Retail Dummy	774	0.26	0.44		
Merger Dummy	774	0.09	0.29		
Ratio of Retail Sales in Deregulated States (%)	774	0.46	0.48	0	1

4. ESTIMATION RESULTS

Estimation results

- As for the overall average effect, the procurement decision (RIP*) does not affect O&M, and Total Cost (Model 1,3, and 8), while FC increases as the degree of the internal procurement increases (Model 6).
- The effect of the internal procurement on O&M, and Total costs varies with the demand uncertainty (Model 2,4, and 9), while FC does not depend on the demand uncertainty (Model 7).

	O&M				FC		Total Cost	
	Companywide		Electricity Segment					
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 6	Model 7	Model 8	Model 9
RIP	-0.0337	0.0194	-0.0432	0.0126	0.456***	0.458***	0.0400	0.0871
	(0.0745)	(0.0785)	(0.0865)	(0.0917)	(0.155)	(0.155)	(0.0737)	(0.0783)
RIP*ln(Uncertainty)		-0.0236***		-0.0246***		0.000198		-0.0207***
		(0.00522)		(0.00539)		(0.00536)		(0.00490)
ln(Uncertainty)		0.00716**		0.00823**		-0.000594		0.00642**
		(0.00303)		(0.00326)		(0.00324)		(0.00290)
Individual Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	772	767	774	769	762	757	762	757
Number of utility	130	129	130	129	128	127	128	127

Note: Standard errors, clustered by utility, are in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1

All regressions include control variables (R, W, T, D^G, D^m, RD). FC = Depreciation and Amortization + Long term Interest

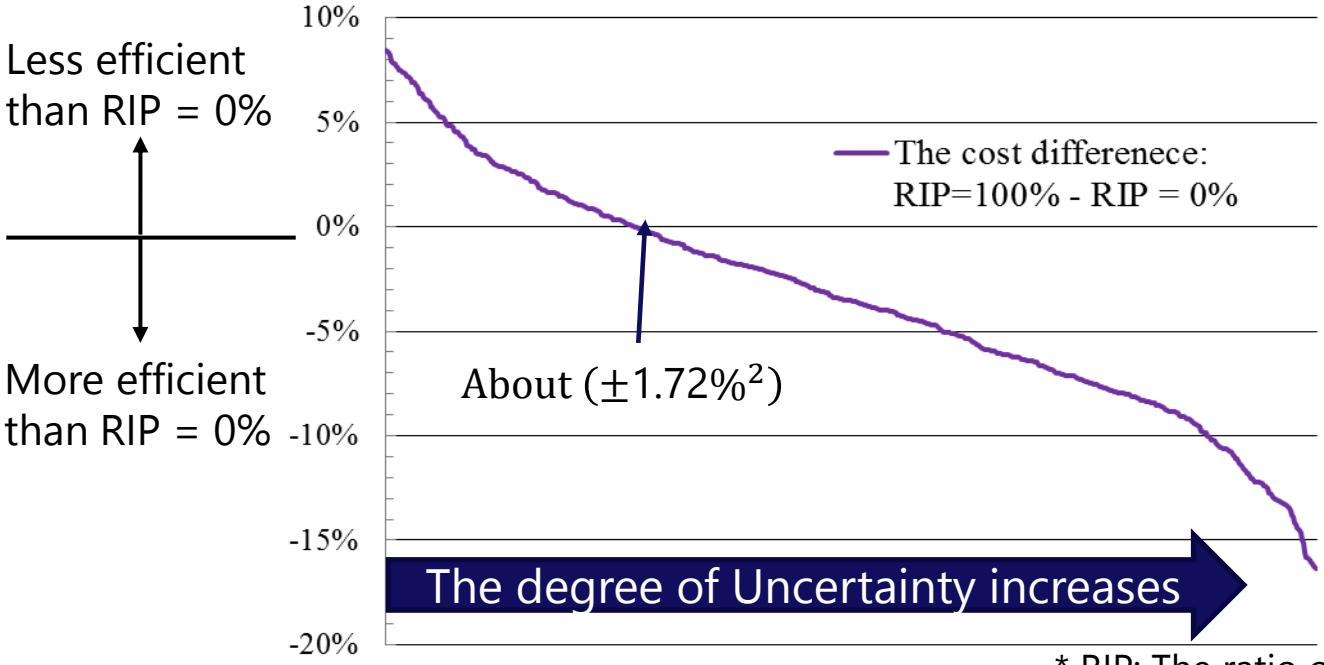
Total Cost = Companywide O&M + FC

* RIP: Ratio of internal procurement

The impact on O&M (Companywide)

- We found that relying on the full internal procurement is cost efficient when the uncertainty exceeds ($\pm 1.72\%^2$).
- This results is consistent with the prediction of TCE. (cf. slide 12)

The cost difference ΔC
[Full internal procurement (RIP*=100%) – Full external procurement (RIP=0%)]



The degree of uncertainty
(The squared % of the forecasting error)

* RIP: The ratio of the internal procurement

The impact on the total costs

- Utilities could reduce their costs by increasing their internal procurement when the demand uncertainty is high.
  - Turning point is between 75th and 90th percentiles of the 6-year average of the demand uncertainty of the utility.
  - RIP = 0 (i.e. full external procurement) is cost efficient in the most part of our sample.

	Degree of demand uncertainty			
The reduction rate of Total Costs	$(\pm 1.37\%)^2$	$(\pm 3.64\%)^2$	$(\pm 5.42\%)^2$	$(\pm 13.61\%)^2$
Ratio of internal procurement : 0% → 25 %	1.7%	1.2%	0.4%	-0.5%
Ratio of internal procurement : 0% → 50 %	3.4%	2.3%	0.9%	-1.0%
Ratio of internal procurement : 0% → 75 %	5.1%	3.5%	1.3%	-1.6%
Ratio of internal procurement : 0% → 100 %	6.9%	4.7%	1.7%	-2.1%

Note: Calculated using Model 9. Degree of demand uncertainty represents 6-year average of squared parcentage of the forecasting error of the utility. Each value in the second row respresents 25th, 50th, 75th, and 90th percentiles of the demand uncertainty, respectively.

5. Conclusion

- This paper estimates how the internal procurement affects the costs of IOUs.
- Findings and implications
  - An increase in the internal procurement decreases the utility's costs as the retail demand uncertainty increases.
  - However, the full external procurement seems cost efficient in most situations in our sample.
  - Promoting the external procurement could reduce the cost of IOUs in the U.S., as long as the demand uncertainty is low.

Thank you for your attention.

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