Performance consequences of water utility aggregation: the role of structure and behavior

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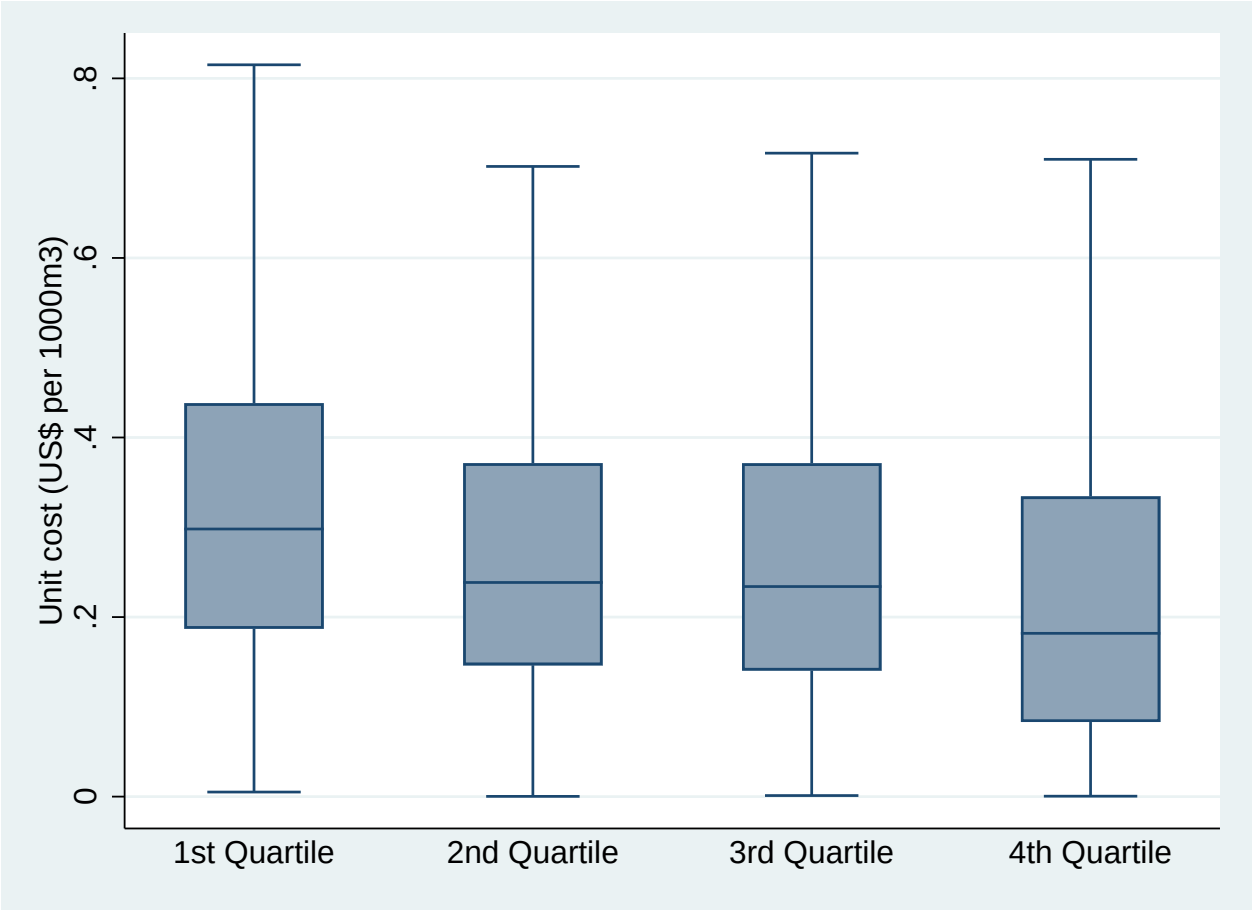
Motivation

Typical argument for consolidations: Economies of scale



Large literature recommending consolidations based on finding of economies of scale

Contribution

Problem:

- In the multi-output case, economies of scale are not sufficient for monopoly to be the least cost production mode (Panzar and Willig [1977])
- Studies of actual consolidations are much more nuanced, with ambiguous results

Research questions:

1. How should consolidations affect water utilities to improve performance?
   - $\Rightarrow$ Structure of large, well-performing utilities
2. How do consolidations actually affect water utilities?
   - $\Rightarrow$ Movement in direction of well-performing utilities? (cost structure)

Literature Review

Huge literature on economies of scale in the water sector (50+ papers since 1970's, several literature reviews

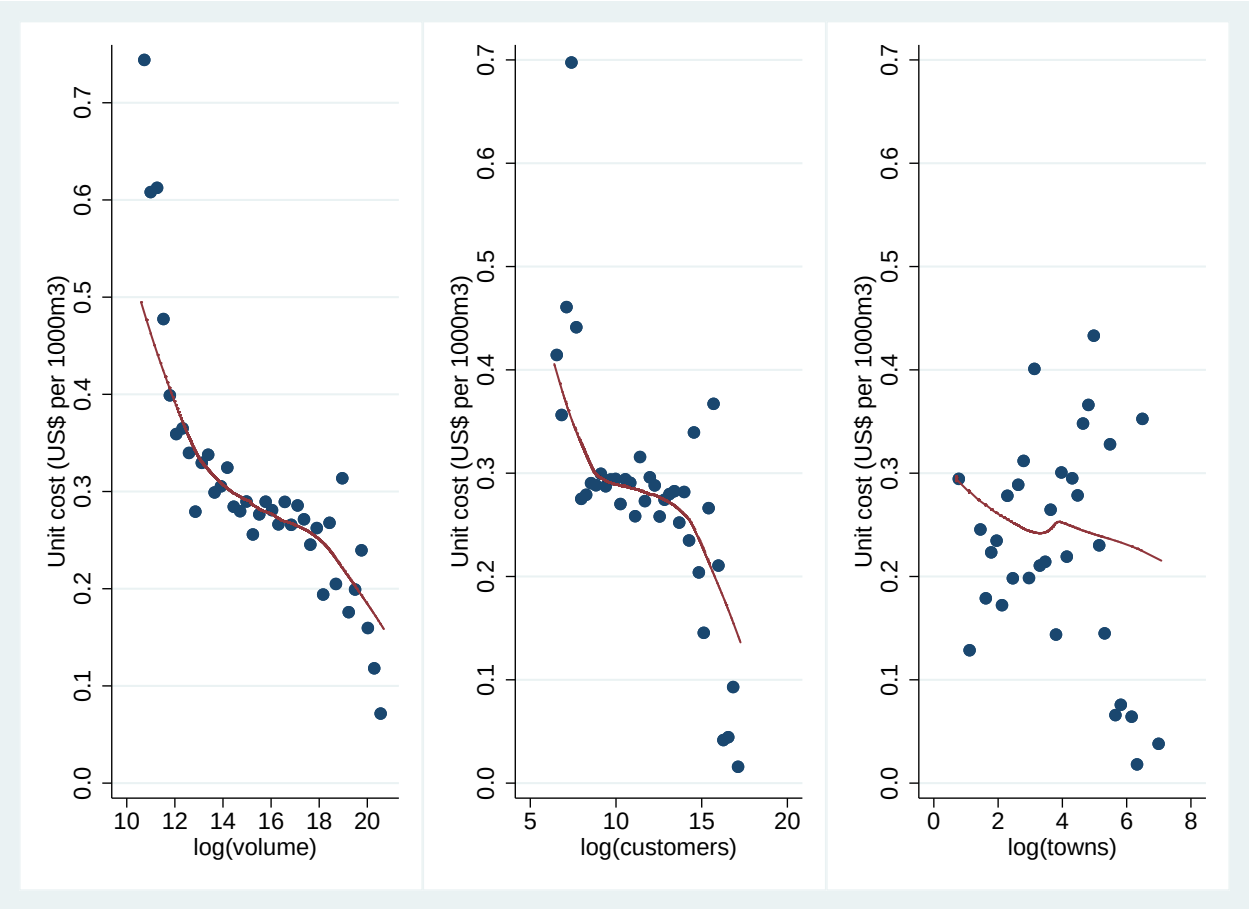
- Important economies of scale – González-Gómez and García-Rubio (2008), Abbott and Cohen (2009), and Saal et al. (2013))
  - But not unlimited and even diseconomies of scale
  - Optimal size varies across countries but also within countries across studies
  - Results are stronger for volume and customers, less so for service area or towns

Very few quantitative consolidation studies

- Ambiguous results
- No/little cost savings because
  - Utilities are already too large – De Witte and Dijkgraaf (2010)
  - Loss in network density – Urakami and Parker (2010)
  - One-off cost increases – Klien and Michaud (2017)

Size dimensions and cost

Stylized fact also present in IBNet:



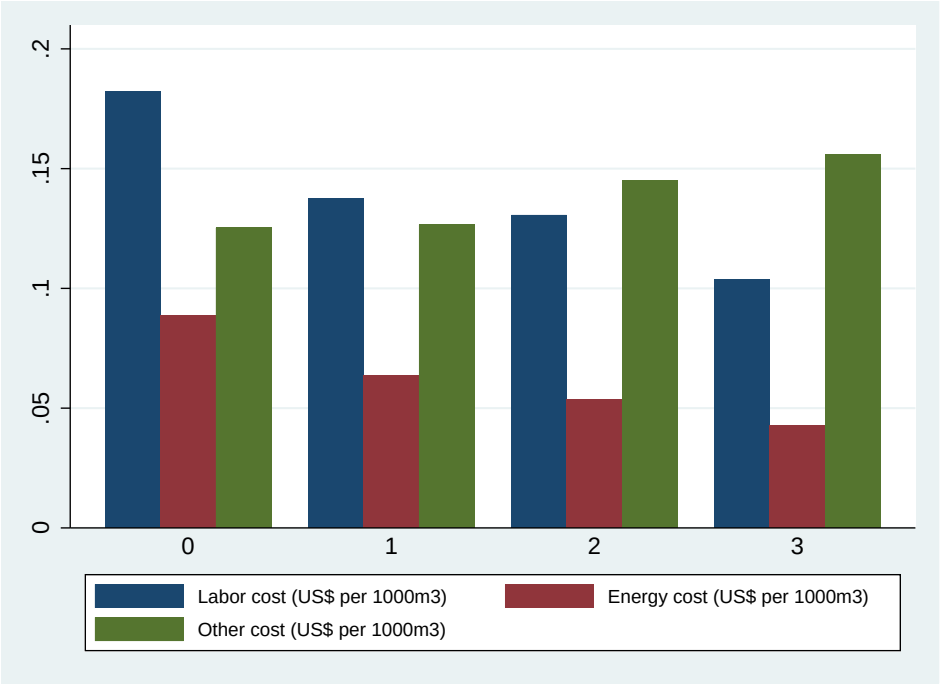
Consolidations adding more volume/customers relative to towns or service area should be more beneficial

Origins of economies of scale

Very small literature on origins of economies of scale:

- Shih et al. (2006) find largest cost savings for capital, labor and material cost
- Still, but somewhat less from energy and outsourced services

Relationship in IBNet data...



Cost advantages from large firms are related to labor and energy

The Data

- Global sample from International Benchmarking Network (IBNet) database
  - Initiated and maintained by World Bank
  - Detailed utility level data
  - Unbalanced panel with 79 consolidations in 25 countries between 1996 and 2015 (>8000 utility-year cells)
- Industry and dataset features
  - Rather large utilities
  - Mostly utilities providing water and wastewater
  - Variable cost only, outside sources for investment finance
  - Removed all utilities which reduced number of towns served - compare merging utilities with those that remain stable

Methodology

We rely on a generalized diff-in-diff strategy to identify the effects

- Consolidating vs non-consolidating firms and before vs after
- Outcome: average variable cost (in USD)
- Consolidation is 1 if # served towns increase and zero otherwise

$$ln(AVC_{it}) = \beta_0 + \beta 1 * Consolidation_{it} + \gamma_i + \eta_t + u_{it} \quad (1)$$

Matching to choose control group

- Use 3 different methods: i) Nearest Neighbor Propensity Score Matching, ii) 4 Nearest Neighbor Propensity Score Matching iii) Radius Matching
- Matching based on structural characteristics (water and wastewater separately): i) population ii) the number of towns already served iii) the volume distributed, iv) the performance of a utility (WUPI indicator), v) country and year fixed effectes

Consolidation Results

Difference-in-Difference

	(1) AVC	(2) AVC	(3) AVC	(4) AVC
Consolidation	-0.00666	-0.0103	-0.0153	-0.0512**
	(0.0221)	(0.0217)	(0.0220)	(0.0202)
N	865	1159	5721	7621
Sample	NN PSM	4-NN PSM	Radius Matching	Full Sample

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Post-consolidation phase

	(1) AVC	(2) AVC	(3) AVC	(4) AVC
Consolidation	-0.0000858	0.00115	0.00123	-0.00124
	(0.00572)	(0.00568)	(0.00581)	(0.00523)
N	639	759	1848	5700
Sample	NN PSM	4-NN PSM	Radius Matching	Full Sample

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Discussion

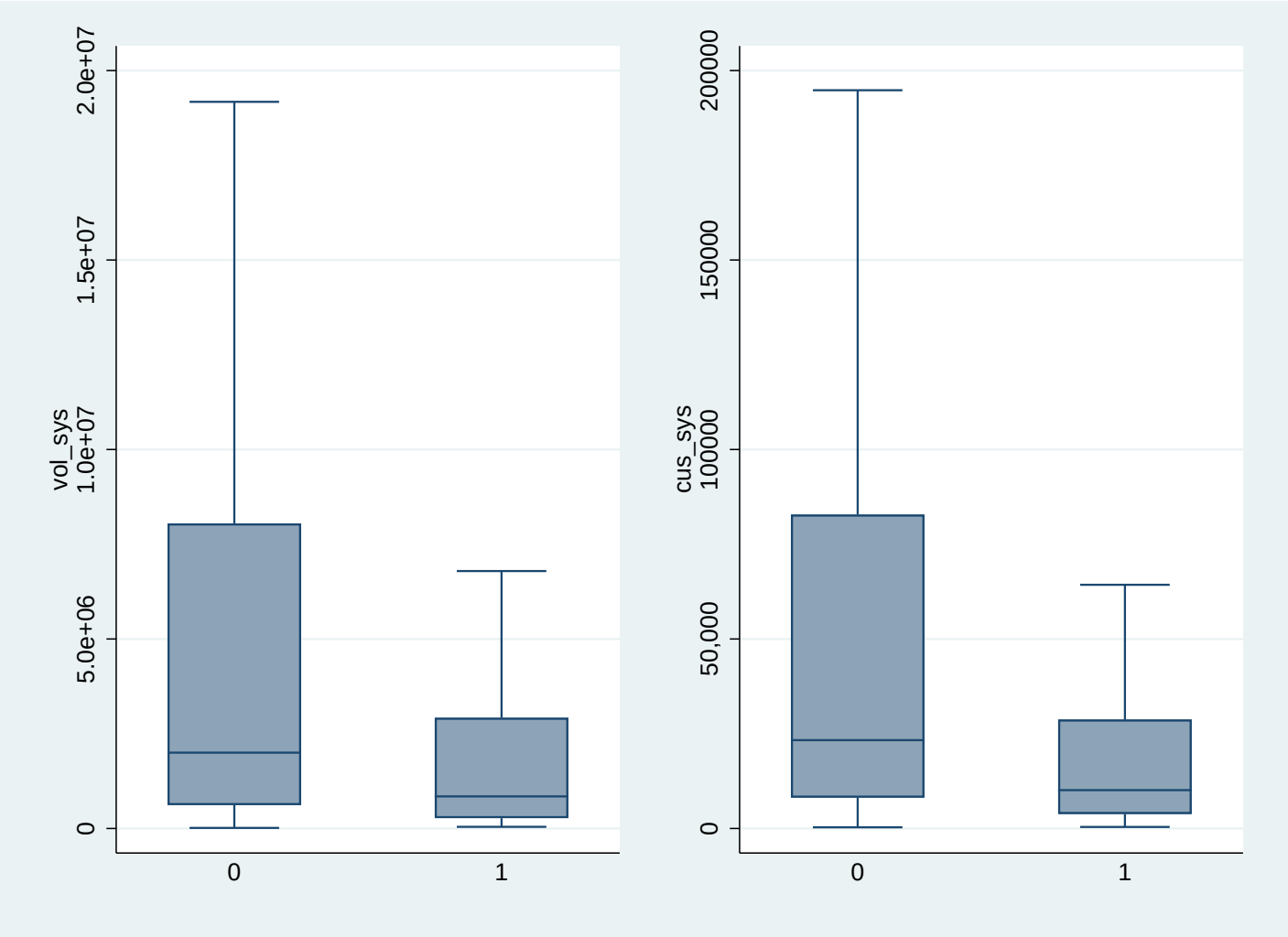
Previous conjectures:

- Consolidations adding more volume/customers relative to towns or service area should be more beneficial
- Cost advantages from large firms are related to labor and energy

Look at consolidations in IBNet sample...

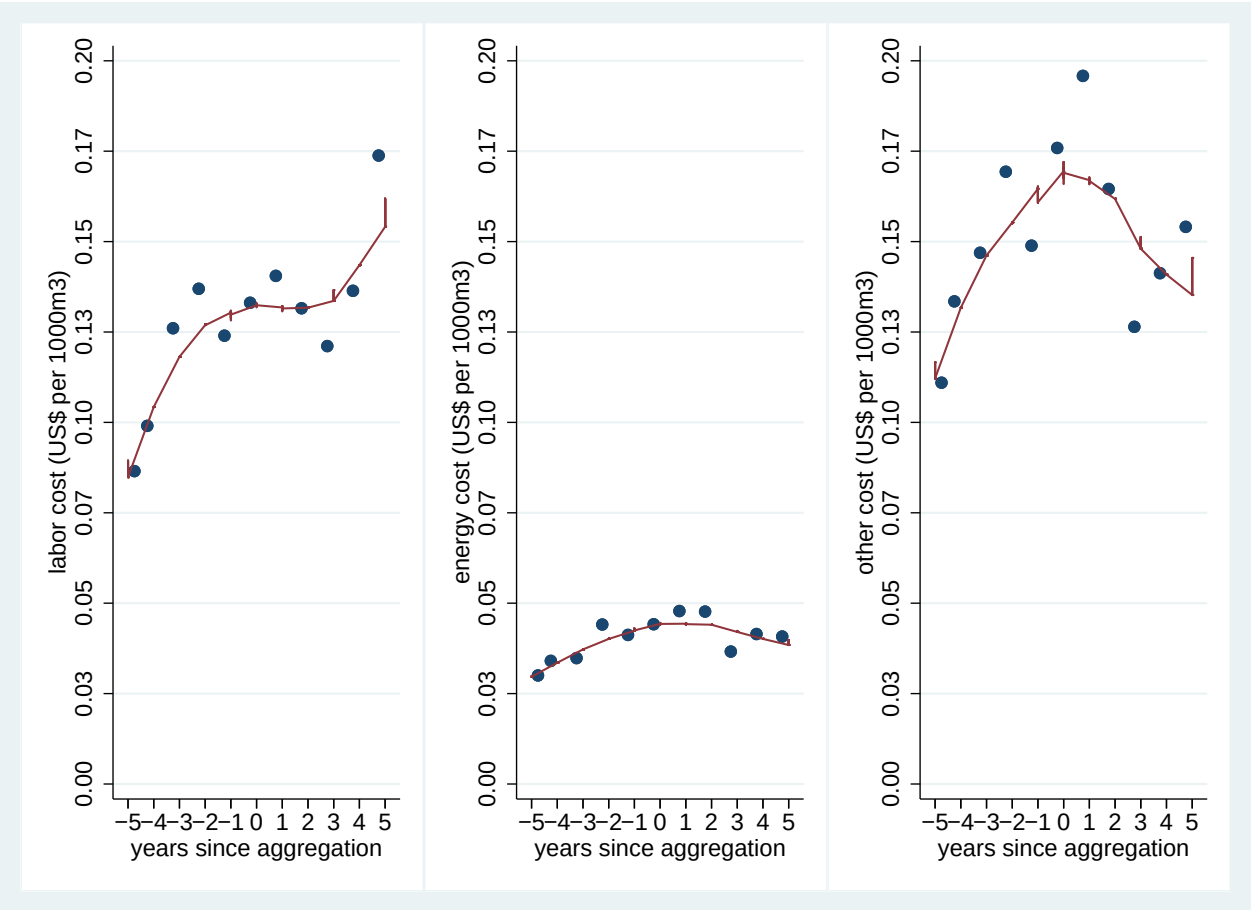
Consolidations and utility structure

Consolidations reduced density



Consolidations and cost structure

Consolidations did change cost structure as expected



Conclusion

Should be more cautious with recommendation to consolidate utilities

- Presence of economies of scale is only a necessary, not sufficient condition for benefits
- How consolidations change structure and behavior of utilities appears crucial...
  - which utilities to consolidate? - density!
  - how to restructure the consolidated utilities to ensure efficiency gains? - reducing staff is very tricky!

Limitations of this study

- Most consolidations in ECA, specific countries and time-frame
- Only variable/operational cost
- No long-term analysis
- Objective of consolidations might be different than to save cost