UNIVERSITÀ DEL PIEMONTE ORIENTALE

Efficiency in the consolidation of the Italian water sector

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Motivation

- The Italian water sector has always been characterized by high fragmentation
- Legislative pressure towards consolidation started with the Galli's Act (1994), and was later confirmed by the Legislative decree 152/2006, with the target of having a single integrated supplier for each regulated area (ATO).
- More than 20 years after the beginning of the reform, this goal is far from being achieved.
- Legislative and regulatory bodies are still stressing the importance of consolidation as a way to improve operational efficiency.

Efficiency gains from consolidation

Which are the right mergers?

Several approaches can be employed for inferring the existence of gains from consolidation:

→ The presence of scale and/or scope economies constitutes ex-ante evidence in favour of merger operations. However it is difficult guess the final efficiency result of actual mergers.

→ The actual gains from mergers can be evaluated ex-post, by comparing the efficiency of merged and non-merged units (need of having data on both the groups, or before and after the mergers)

→ Bogetoft and Wang (2005) – B&W – Suggest a method to evaluate the potential (ex-ante) gains from mergers by comparing virtual merged units with a technology defined by existing (observed) starting units.

Methodology: B&W 2005

Bogetoft and Wang (2005) suggest a method to estimate the potential gains (or losses) deriving from a merger

Overall potential merger gain

Let us define E^J as the potential overall gain from merging J of the N units in the dataset.

Just pooling the J units gives a (virtual) unit using $\sum_{j \epsilon J} x^j$ as input to produce $\sum_{j \epsilon J} y^j$ as output. Therefore we can define the potential overall gain from the merger as

$$E^J = Min \left\{ E \epsilon R_0 \middle| \left(E \left[\sum_{j \epsilon J} x^j \right], \sum_{j \epsilon J} y^j \right) \epsilon\ T \right\}$$

i.e. it is the maximal radial reduction in the aggregate input that allows the production of the aggregate output, in the production possibility set (*T*), defined through the N units.

$E^J < 1$ → potential benefit from merging

$E^J > 1$ → potential losses from merging

Methodology: B&W 2005

$$E^J = T^J * E^{*J} = T^J * H^J * S^J$$

→ T^J is the technical efficiency effect. It is isolated from the other effects because inefficiency does not need necessarily a merger to be eliminated. The index can be computed residually knowing the value of the other ones, which are computed projecting the original units on the production possibility frontier.

→ E^{J*} is the gain from merger "cleaned" by the effect of individual inefficiency of the starting units.

$$E^{*J} = Min\left\{E \epsilon R_+ \middle| \left(E\left[\sum_{j\epsilon J} E^j x^j\right], \sum_{j\epsilon J} y^j\right) \epsilon\ T\right\}$$

Methodology: B&W 2005

→ H^J is the harmony effect. It indicates whether the merger lead to a better input and output mix. It is defined as

$$H^J = Min\{H \epsilon R_0 | (H[|J|^{-1} \sum_{j \epsilon J} E^j x^j], |J|^{-1} \sum_{j \epsilon J} y^j) \epsilon\, T\}$$

$H^J < 1$ → harmony gains

$H^J > 1$ → harmony losses

(In our framework, with just one input, harmony potential gains can just be related to an improved output mix)

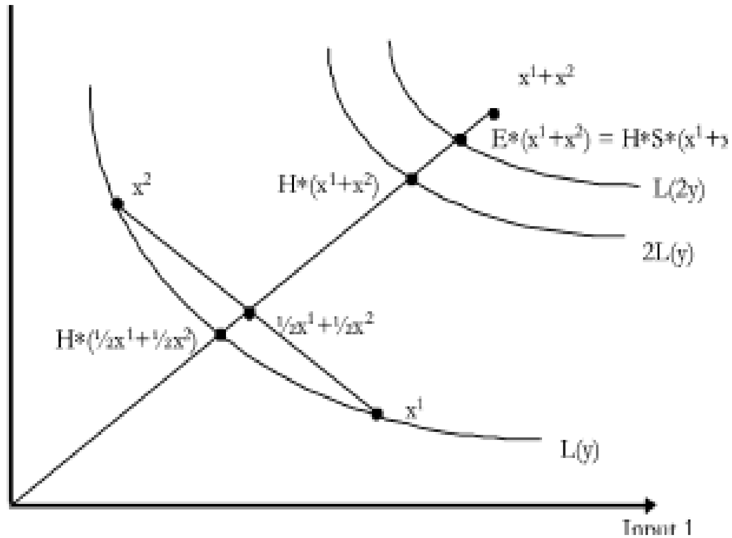
→ S^J is the size effect: the new units will be larger than the merged ones.

$$S^J = Min\{S \epsilon R_0 | (S[H^J \sum_{j \epsilon J} E^j x^j], \sum_{j \epsilon J} y^j) \epsilon\, T\}$$

$S^J < 1$ → size gains

$S^J > 1$ → size losses

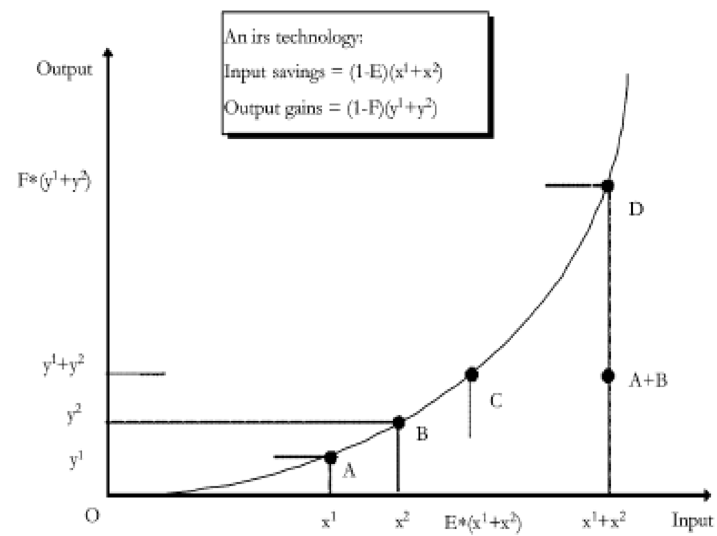
Harmony and size...



Harmony effect

Size effect

(Source: Bogetoft and Wang, 2005)



Methodology: B&W 2005

→ Other works relying on this methodology are Simper and Weyman-Jones (2008), Goulay et al. (2006), Bagdadioglu et al. (2007), Walter and Cullmann (2008), Blancard et al. (2009), Kristensen et al. (2010), Zschille (2014).

→ All these contributions employ non-parametric approaches (DEA, FDH).

→ Moreover Bogetoft and Otto (2011) report examples of studies commissioned by regulatory and government agencies in which the method is implemented in either parametric or non-parametric framework.

→ For this work we have chosen a parametric framework (SFA), which appears particularly suitable for our data, since

- Few observations with high levels of output: DEA estimates would present large bias in that segment of the frontier.
- It avoids the risk of not having solutions (possible with DEA super-efficiency estimation under particular RTS assumptions).
- H is not constrained to be smaller than 1

Estimation procedure

Step 1. Estimate the (translog) input distance function as:

$$\ln C = \alpha + \sum_{i}^{n} \beta_i lnY_i + \sum_{i}^{n} \frac{1}{2} \delta_i lnY_i^2 + \sum_{j(j \neq i)}^{n} \sum_{i}^{n} \gamma_{ij} lnY_i lnY_j + u + v$$

Step 2. Create the pooled and the average output variables for each simulated merger (including the quadratic terms and the interactions).

Step 3. Employ the estimated parameters to fit the necessary values of cost in order to estimate the following (see Bogetoft and Otto, 2011).

Estimation procedure

- $E^J = c(\sum_{j \epsilon J} y^j) / \sum_{j \epsilon J} x^j$
- $E^{*J} = c(\sum_{j \epsilon J} y^j) / \sum_{j \epsilon J} c(y^j)$
- $T^J = \sum_{j \epsilon J} c(y^j) / \sum_{j \epsilon J} x^j$
- $H^J = c(\frac{1}{|J|} \sum_{j \epsilon J} y^j) / \frac{1}{|J|} \sum_{j \epsilon J} c(y^j)$
- $S^J = c(\sum_{j \epsilon J} y^j) / (|J| c(\frac{1}{|J|} \sum_{j \epsilon J} y^j))$

Data and variables

- → 77 observations related to Italian water suppliers for the years 2012.
- → Data retrieved from annual reports and questionnaires.
- → Summary statistics:

Variable	Definition	Mean	St_dev	Min	Max
COST(€ millions)	OPEX	19.7	40.8	0.096	273
ywi (millions m3)	Water delivered	22.5	50.8	0.09	367
ywn (km)	Water network	2,090.87	3,230.39	17	21,819
ysn (n. inhab)	Population served by sewerage	242,506	631,113	0	4,196,307
ysi (eq.inhab)	Wastewater treatment	314,218	839,898	0	6,097,386

Results (1)

Translog cost function

lncost	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnywi	.2510542	.0894752	2.81	0.005	.0756859	.4264224
lnywn	.2326229	.0668876	3.48	0.001	.1015255	.3637202
lnysn	.31457	.125057	2.52	0.012	.0694627	.5596773
lnysi	.2189165	.0860899	2.54	0.011	.0501833	.3876497
lnywi2	-.1356146	.0858438	-1.58	0.114	-.3038654	.0326362
lnywn2	-.2299437	.1337923	-1.72	0.086	-.4921719	.0322844
lnysn2	.1496335	.0460372	3.25	0.001	.0594022	.2398649
lnysi2	.0254952	.0092459	2.76	0.006	.0073736	.0436169
lnywiywn	.1646286	.1004046	1.64	0.101	-.0321608	.361418
lnywiysn	-.0254447	.0141161	-1.80	0.071	-.0531118	.0022223
lnywiysi	.0139094	.0142885	0.97	0.330	-.0140955	.0419143
lnywnysn	-.0206269	.0179593	-1.15	0.251	-.0558265	.0145727
lnywnysi	.0088538	.018549	0.48	0.633	-.0275015	.045209
lnysiysn	-.0590722	.0240377	-2.46	0.014	-.1061853	-.0119591
_cons	.0429076	.0926147	0.46	0.643	-.1386139	.2244291

Results (2)

Potential gains from mergers: 18 simulated mergers within the ATOs boundaries - Summary

Index	Mean	St_dev	Min	Max
E^J	0.72	0.21	0.31	0.92
E^{*J}	0.91	0.22	0.43	1.23
T^J	0.78	0.10	0.48	0.91
H^J	0.93	0.26	0.44	1.46
S^J	0.99	0.10	0.66	1.18

Results (2)

Potential gains from mergers: 18 simulated mergers within the ATOs boundaries

Merger	E^J	E^{*J}	T^J	H^J	S^J
15	0.31	0.44	0.71	0.44	1.00
17	0.34	0.47	0.71	0.47	1.01
11	0.43	0.57	0.76	0.48	1.19
12	0.36	0.75	0.48	0.75	1.00
13	0.61	0.88	0.69	0.90	0.98
14	0.83	0.96	0.87	1.46	0.66
1	0.75	0.97	0.77	0.96	1.01
7	0.88	0.97	0.91	1.03	0.95
8	0.86	0.99	0.87	1.02	0.97
18	0.84	0.99	0.84	1.05	0.95
6	0.78	0.99	0.78	1.03	0.97
5	0.78	0.99	0.79	1.03	0.97
4	0.86	1.00	0.87	0.99	1.00
10	0.85	1.01	0.85	1.02	0.99
3	0.86	1.04	0.83	1.03	1.01
9	0.89	1.05	0.85	0.97	1.08
2	0.93	1.10	0.84	1.06	1.04
16	0.84	1.23	0.68	1.15	1.07

Conclusions

- On average, some potential exists over the simulated mergers in our sample
- Maily driven by the output re-mix
- Limited potential for scale improvements
- Relevant role of the individual inefficiency of the starting units.
- Difficult to identify a priori if a merger is beneficial
- The illustrated methodology appears very suitable for a case-by-case evaluation.