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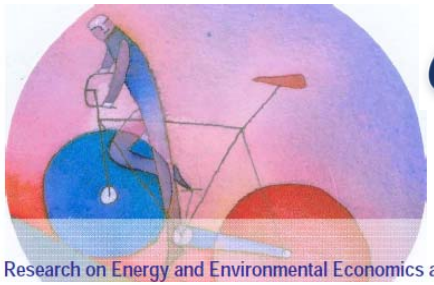

EconomiX

What determines efficiency? An analysis of the Italian water sector

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Milano, February 28 - 2013

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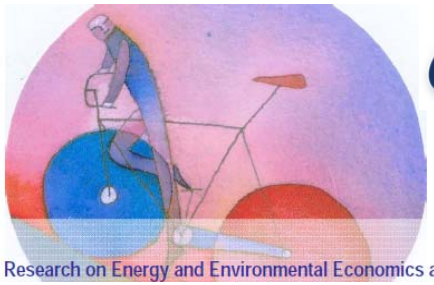
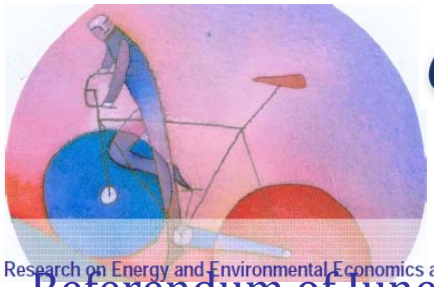


EconomiX

STRUCTURE OF THE PRESENTATION

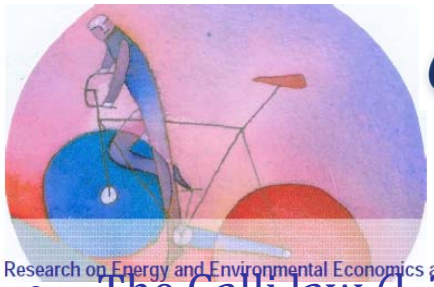
- Introduction and Motivation
- The Italian Water Sector
- Literature Review
- Methodology and Data
- Results
- Policy Recommendations



INTRODUCTION AND MOTIVATION

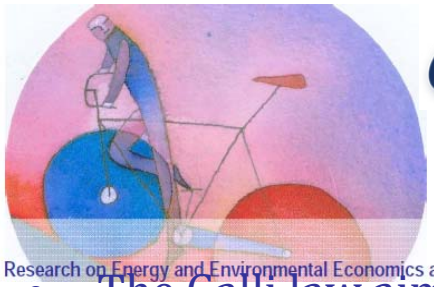
- Referendum of June 13, 2011:
  - abolished an "adequate" return on invested capital; and
  - reduced the possibility of private investors to enter the water sector;
- De facto legislative vacuum;
- The "Salva Italia" decree gave the Italian energy regulator the power to regulate also the water sector:
  - New water tariffs must be defined within 2 years;
  - AEEG has started in May the consultation process.

- Why studying the efficiency of the sector?
  - ➢ Till 2011, there was a pure cost of service regulation;
  - ➢ In light of the new tariff scheme, it is important to study water companies performance.
- What determines efficiency?
  - ➢ Water companies differs in various aspects (population served, geographical location, services provided, ownership, etc.).
- Are there links among efficiency, public ownership and local governments?
  - ➢ A key concern in the present policy debate



THE ITALIAN WATER SECTOR: THE INSTITUTIONAL FRAMEWORK

- The Galli law (l. 36/94), and subsequent amendments, completely reshaped the Italian water services system, which was characterized by huge fragmentation (8,000 companies – one per municipality). Key elements:
  - The reform identified 92 optimal license areas (ATO), each governed by an *ad hoc* authority (AATO), plus a National Authority responsible for protecting consumers' general interests while pursuing efficiency and productivity (CONVIRI).
  - Two types of delegation foreseen:
    - Direct assignment to a public enterprise (for ATOs with special economic, social and geographical conditions); and
    - Tender.
  - Objectives and investment plans set by the AATO with the "Piano d'Ambito", a 20-year investment and management plan;
  - Operators manage the services in a cost-efficient manner and must comply with the Piano d'Ambito;
- The implementation of the reform took several years; at the end of 2007, only half of the ATOs were fully compliant with the law: in many ATOs we have still a plurality of operators.

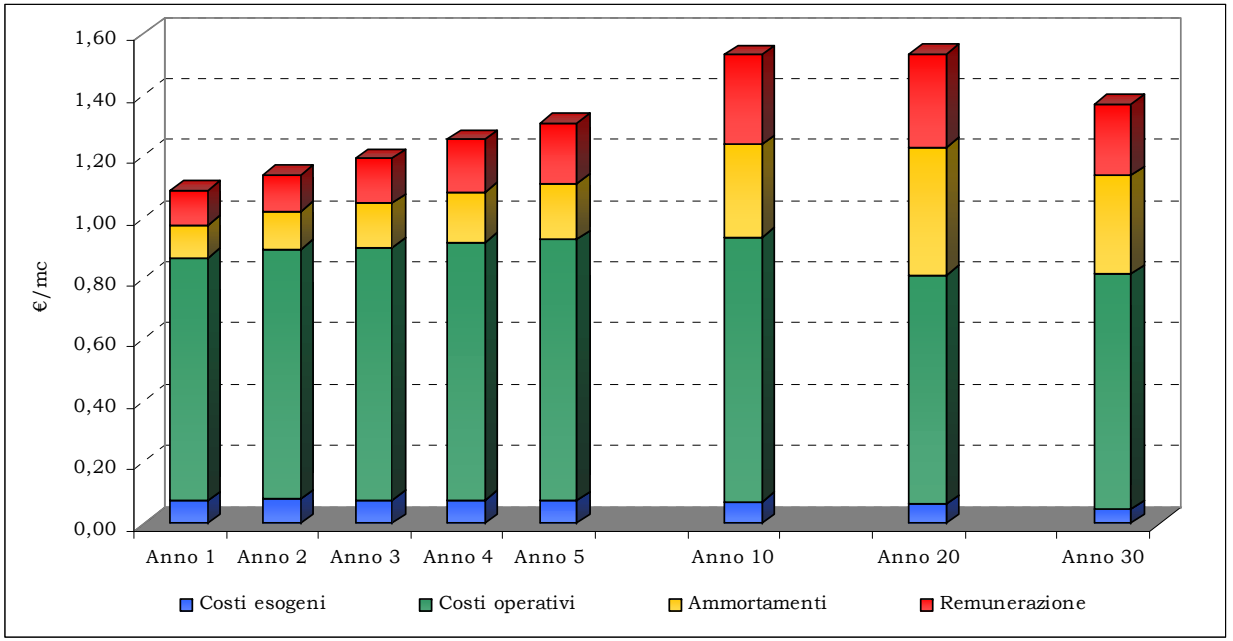


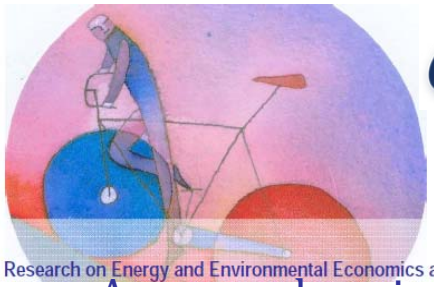
THE ITALIAN WATER SECTOR: THE RATIONALE

- The Galli law aimed at rationalizing and improving the efficiency of the sector:
  - The water sector was thought to benefit from scale economies and coordination;
  - Concessions are complex contracts; their enforcement requires symmetric information. Single municipalities where not considered capable of this.
- Historical reasons:
  - In 1992, Italy was hit by a financial crisis, forcing the Country to leave the ERM, the fluctual band of the the European Monetary System;
  - The Central Government started a devolution process aimed at
    - reducing its debt by granting more (budget) autonomy to local governments;
    - Letting private operators operate utility services.

THE ITALIAN WATER SECTOR: THE OLD TARIFF SCHEME

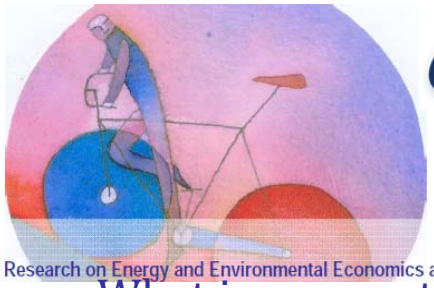
- The law introduced a common tariff formula : $T_n=(C+A+R)_{n-1}\times(1+K)$
  - Which is nothing more than a "capped" cost of service regualtion, as K represents the maximum allowed tariff increase, given by $K= RPI + (K-RPI)$;
  - The evolution of the CAPEX component (A+R) can be derived by the 20-year investment and management plan, and it is straightforward that to keep tariffs low in the first years, one has just to postpone investments (eventually tariffs increase!);
  - In the first years of operations, OPEX account for more than 80% of all costs.





LITERATURE REVIEW

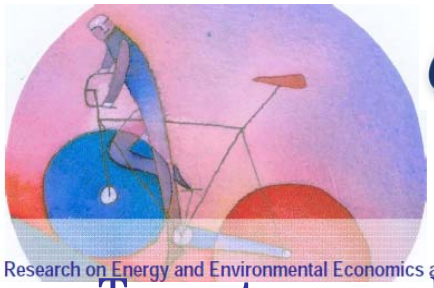
- A comprehensive review on efficiency analysis of the water sector has been performed by Walter et al., 2009.
  - Almost all the studies confirm that population density plays a fundamental role;
  - Water quality seems to affect efficiency;
  - Scale and scope economies are more controversial;
  - Public vs private ownership is extremely controversial.
- Efficiency in the Italian industry:
  - Antonioli and Filippini (2001): 32 water utilities from 1991 to 1995 with a SFA:
    - Losses and chemical treatments impact significantly efficiency;
  - Fabbri and Fraquelli (2000): 173 water utilities in 1991 with a Cobb Douglas:
    - Scale economies present till 18 M litres distributed;
    - High and positive impact of population density on efficiency.
  - Caliman and Nardi (2010): 35 water utilities in 2005 a Cobb Douglas:
    - Mono business strategy not efficient: integrated water services are more efficient;
    - High and positive impact of population density on efficiency;
    - Different ownership structures have no impact on efficiency – location matters more!
  - Romano and Guerrini (2011): 43 water utilities in 2007 with a DEA
    - Water utilities in central and south Italy more efficient (scale economies);
    - Public utilities more efficient than private.



PROGRESS BEYOND THE STATE OF THE ART

- What is our contribution? Well…

- We are the first to perform a two-stage analysis;
- We have collected the biggest sample after the introduction of the Galli law:
  - by the way, as we will see later, is extremely representative of the whole sector;
- We are the first to use sectorial data from multi-utilities;
- We are the first to take into account:
  - Interruptions and
  - political influence on the sector

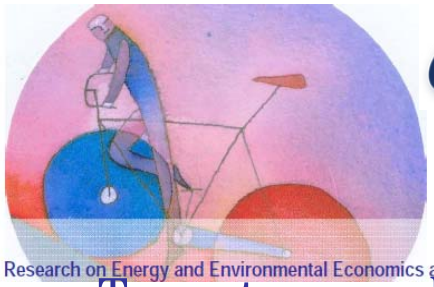


METHODOLOGY

- Two-stage analysis:
  - **First step:** Data Envelopment Analysis (DEA) to estimate efficiency scores
    - Nonparametric approach based on linear programming;
    - Assumption of input-orientation:

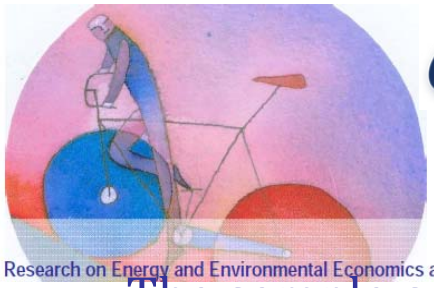
$$\begin{aligned} \min_{\theta,\lambda} \quad & \theta \\ \text{s.t.} \quad & \theta x^{o} \geqslant X\lambda, \\ & Y\lambda \geqslant y^{o}, \\ & \lambda \geqslant 0, \\ & e\lambda = 1, \end{aligned}$$

      - where $x \geq 0$ is a DMU's $N \times 1$ vector of inputs, $y \geq 0$ is a DMU's $M \times 1$ vector of outputs, $X=[x_1,...,x_I]$ is an $N \times I$ matrix of input vectors, $Y = [y_1,...,y_I]$ is an $M \times I$ matrix of output vectors, $\lambda=[\lambda_1,...,\lambda_I]$ is an $I \times 1$ vector of peer weights, $e = [1,...,I]$ is an $I \times 1$ vector, and there are I DMUs in the sample. Inputs and outputs for the unit evaluated are indicated by the superscript "o";
    - Both constant return to scale (CRS) – proxy for technical efficiency – and variable (VRS) – allocative efficiency (Coelli, 2008);
    - ***Inputs:*** labor costs, raw material costs and other costs (concession fees);
    - ***Outputs:*** revenues and length of mains (proxy for density; Thanassoulis, 2000)
    - Both normalized taking into account the number of clients served



METHODOLOGY (II)

- Two-stage analysis:
  - **Second step:** OLS Regression to study the determinants of the efficiency scores (tobit regression used as comparison).
  - Tobit:
    - DEA introduces a censoring problem in the upper tail of the distribution?(Dusansky and Wilson, 1994).
    - Tobit assumes that the dependent variable has a number of obs clustered at a limiting value and gives back unbiased results (McDonald Moffit, 1980).
    - estimates may be inconsistent if errors are not normally distributed or if they are heteroskedastic
  - OLS:
    - DEA does not have a censoring data generating process, as its results are a kind of fractional or proportional data (Mac Donald, 2009);
    - Only with OLS hypothesis tests can be validly carried out if allowance is made for heteroskedasticity (which we do with White's method).
  - Notwithstanding the regression methods used, Simar and Wilson (2007) shows that DEA scores might suffer from serial autocorrelation, which can be corrected only with a bootstrap procedure.



DATA COLLECTION

- The sample consists of 54 companies that operate in the provision of water, wastewater and sewerage services (WWS), the largest sample ever used and collected after the Galli reform;
- DEA
  - Financial data collected from the Bureau Van Dick's database;
  - For multi-utilities sectorial data found in annual reports (IAS oblige to give sectorial and geographical information);
  - Asset data (water and sewerage networks) collected from:
    - » CONVIRI database;
    - » Companies internet sites; and
    - » Direct questionnaires.
- Second Stage
  - Ownership structure and managerial data from Bureau Van Dick's database;
  - Exogenous variables: ISTAT, CONVIRI and Ministry of Internal Affairs.

DATA SAMPLE

- The selected companies are representative of the Italian WWS as for location, size, ownership structure, type of business and clients served.

	Sample			CoNViRI, 2009		
Geographical location	n. of firms	% of firms	% of clients	n. of firms	% of firms	% of clients
North-East	14	25.93%	17.21%	28	26.42%	23.92%
North-West	14	25.93%	14.01%	39	36.79%	19.34%
Central	15	27.78%	37.59%	19	17.92%	29.69%
South	9	16.67%	29.11%	14	13.21%	24.08%
Island	2	3.70%	2.08%	6	5.66%	2.97%
Size						
Small	6	11.11%	0.58%	32	30.19%	1.28%
Medium	16	29.63%	8.27%	32	30.19%	11.85%
Large	32	59.26%	91.15%	42	39.62%	86.88%
Ownership structure						
Public	30	55.56%	43.63%	63	59.43%	50.58%
Private	11	20.37%	19.68%	17	16.04%	16.21%
Mixed	13	24.07%	36.69%	26	24.53%	86.88%
Type of business						
Mono-utility	37	68.52%	79.69%	72	67.92%	74.71%
Multi-utility	17	31.48%	20.31%	34	32.08%	25.29%

- The positive correlation between revenues and costs confirms the cost of service structure of the tariff, while the negative effect of mains over revenue suggests likely economies of density.
- Indirect costs are mostly concession fees (no high correlation with revenues).

	Mains length per capita	Revenues per capita	Cost of materials per capita	Operative costs per capita	Indirect costs per capita
Mains length per capita	1				
Revenues per capita	-0.02	1			
Cost of materials per capita	0.03	0.18	1		
Operative costs per capita	-0.02	0.90	0.10	1	
Indirect costs per capita	0.03	0.21	0.00	0.06	1

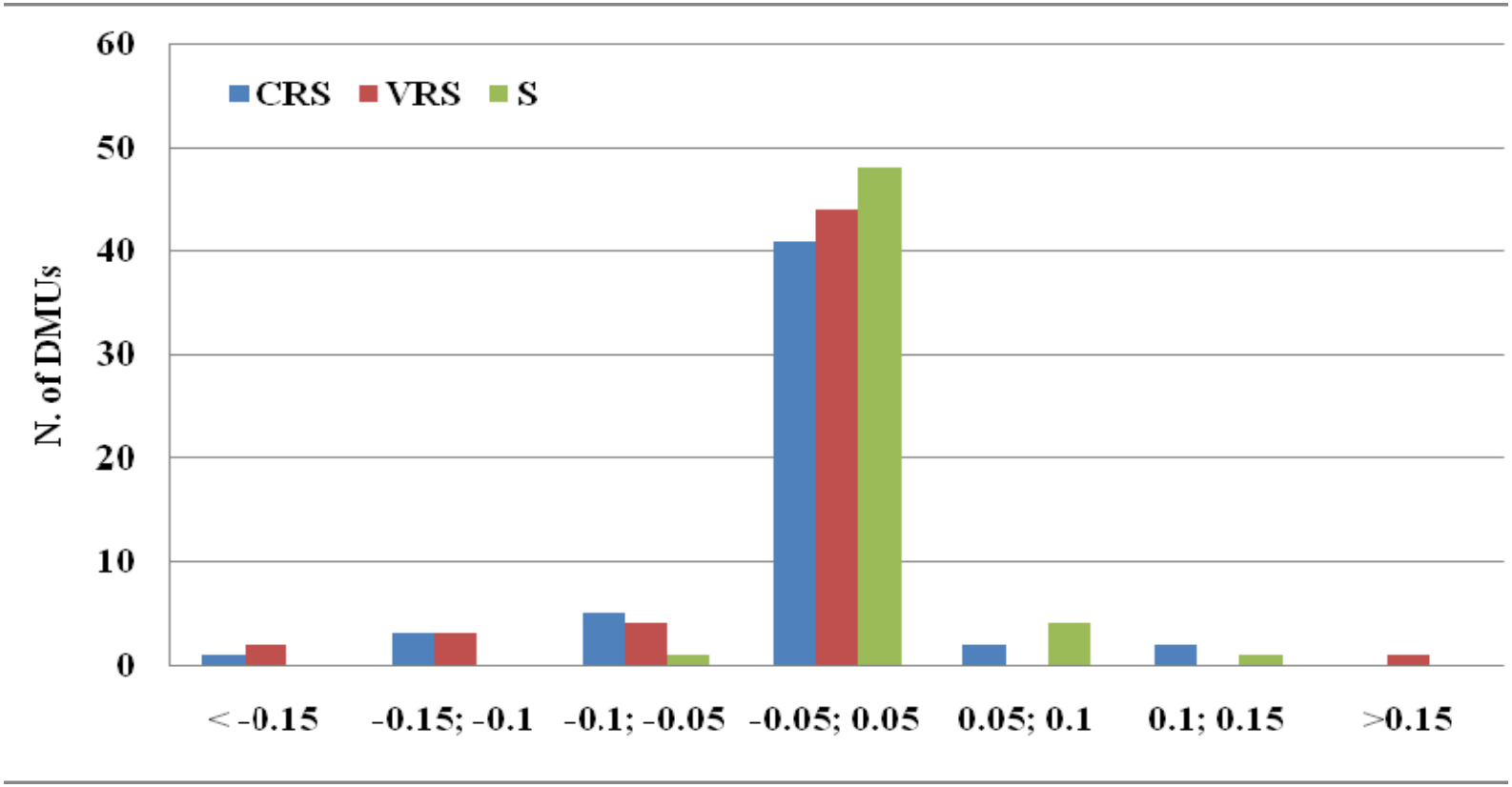
DEA (II)

•S represents the scale efficiency given by the ratio: TE_{CRS}/TE_{VRS} and tells whether the firm is operating at optimal scale

	Obs.	Min	Median	Mean	DMU at fron.	Std. Dev.
CRS 07	54	0.44	0.81	0.83	10	0.15
CRS 08	54	0.48	0.82	0.83	10	0.14
CRS 09	54	0.40	0.81	0.84	11	0.16
CRS 10	54	0.42	0.80	0.81	12	0.17
VRS 07	54	0.46	0.87	0.94	20	0.15
VRS 08	54	0.48	0.87	0.91	19	0.14
VRS 09	54	0.40	0.85	0.89	17	0.16
VRS 10	54	0.42	0.83	0.86	15	0.17
S 07	54	0.69	0.94	0.98	10	0.08
S 08	54	0.64	0.95	0.97	10	0.07
S 09	54	0.66	0.95	0.99	11	0.07
S 10	54	0.65	0.96	0.99	12	0.06

DEA (III)

- Most utilities have not improved their efficiency over time neither in technical nor in allocative terms



SECOND STAGE ANALYSIS

- Variables related to governance and management:
  - *PP :* measures the percentage of shares owned by the public;
  - *SH* :measures the percentage of shares hold by the main shareholder;
  - *M* : dummy which takes value 1 if the company is a mono-utility and 0 otherwise;
  - *HHI* : n. of clients served expressed as a share of the population in the ATO;
  - *Inter* : frequency of interruptions in water distribution;
- Exogenous variables
  - Geographic dummies (*North* and *South*);
  - *D_flex* : incidence of metropolitan areas (daily in/outflows of people);
  - *S_flex* : and incidence of touristic areas (seasonal in/outflows of people).
  - *DX*: center-right coalition local government;

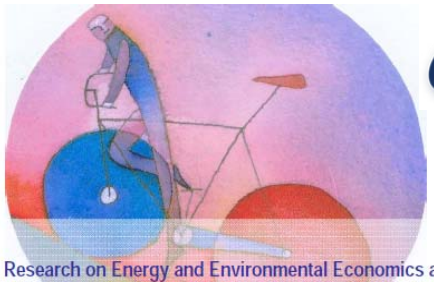
SECOND STAGE ANALYSIS

- Independent variables correlation matrix

	PP	Mono	SH	HHI	Inter	South	North	D flex	S flex	DX
PP	1.00									
Mono	0.02	1.00								
SH	-0.40	0.05	1.00							
HHI	-0.09	0.12	0.01	1.00						
Inter	-0.27	0.28	0.16	0.23	1.00					
South	-0.11	0.24	0.13	0.19	0.77	1.00				
North	0.11	-0.24	-0.13	-0.19	-0.77	-1.00	1.00			
D flex	0.03	0.01	0.30	0.05	-0.11	-0.13	0.13	1.00		
S flex	0.17	-0.01	-0.21	0.22	-0.04	-0.15	0.15	-0.03	1.00	
DX	0.09	-0.02	-0.05	-0.06	-0.06	-0.04	0.04	0.08	0.02	1.00

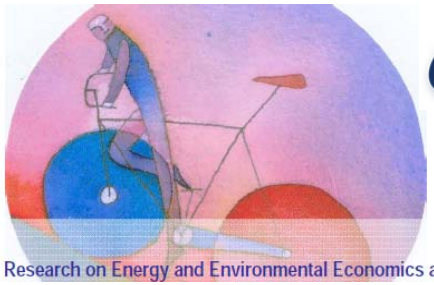
RESULTS (II)

Variable	OLS Dep. CRS	Tobit Dep. CRS	OLS Dep. VRS	Tobit Dep. VRS
Cost	0.8190 (24.94)***	0.8283 (18.32)***	0.9060 (27.59)***	0.9711 (16.43)***
PP	-0.011 (-4.55)***	-0.0014 (-4.31)***	-0.0010 (-2.89)***	-0.0017 (-4.16)***
Mono	-0.0265 (-1.38)	-0.0333 (-1.47)	-0.0537 (-3.17)***	-0.0749 (-2.70)***
SH	-0.0002 (-0.01)	-0.0028 (-0.12)	-0.0239 (-1.03)	-0.0336 (-1.00)
HHI	0.0001 (0.38)	0.0002 (0.58)	0.0004 (1.26)	0.0007 (1.39)
Inter	0.0022 (1.20)	0.0023 (1.10)	0.0039 (2.35)**	0.0041 (1.75)*
South	-0.0724 (-2.74)***	-0.0825 (-4.39)***	-0.1034 (-4.12)***	-0.1300 (-3.92)***
D_flex	2.2890 (4.97)***	3.0008 (4.70)***	1.7715 (3.71)***	3.1194 (3.59)***
S_flex	0.07311 (0.61)	0.0971 (0.64)	-0.0711 (-0.57)	-0.1064 (-0.59)
DX	-0.0416 (-2.17)**	-0.0429 (-1.99)**	-0.0360 (-1.83)*	-0.0426 (-1.60)
Summary Stats				
Adj R2	0.23		0.24	
chi2	121.08	97.25	184.03	137.63
Prob>chi2	0.000	0.000	0.000	0.000



CONCLUSION AND POLICY INSIGHTS

- Private participation increases the efficiency at both technical and allocative levels ⟹ exclusion may slow down efficiency gains
  - Result at odd with complaints by local authorities
  - What if outcomes are adjusted for service quality?
- The possibility to purchase, mix and combine inputs for water and other services increase the allocative efficiency of a DMU, while leaving its technical counterpart unaffected. This explains why *Mono* is significant only when the dependent variable is *VRS*. Indeed, network services are characterized by scope economies that, however, do not span to technological assets given their sector-specific value;
- Interruptions have a positive impact on (allocative) efficiency. Indeed, interruptions are commonly used in southern region (and islands) to optimally deal with shortages.



CONCLUSION AND POLICY INSIGHTS

- While seasonal in/outflows of people do not statistically contribute to efficiency, daily in/outflows do matter, indicating that urban density is one important determinant of efficiency:
  - Diversified tariffs to take into account concentration of clients;
  - The more disperse the clients, the lower the efficiency $\Longrightarrow$ serving metropolitan areas may be more profitable:
    - Which specific policy measures to avoid this?
- DX impacts negatively on performance. We can imagine that conservatives are less experienced or less interested in efficient local public service provisions.

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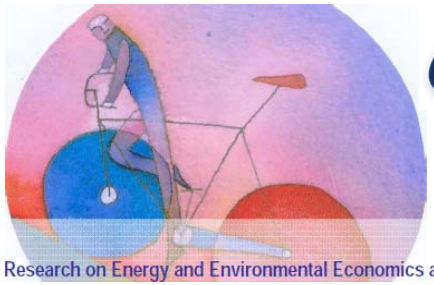

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Thank you!

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