Work Project: An impact evaluation of Programa de Apoio à Economia Local (PAEL) on the water services provided by municipalities in Portugal

Caroline Isabell Ørvik

Appendix

1. Details and information

Table 1: Calculations of quality indicators

Definitions of the calculations of quality indicators and reference values for the level of service quality, produced by ERSAR. Source: ”Water and waste service quality assessment guide - 2nd generation of the assessment system” – ERSAR 2012.

Indicator	**Definition of how the indicator is calculated**
Economic accessibility (%): It is defined as the weight of the average burden with the water supply service in the average disposable income per household in the system’s intervention area.	AA02ab = dAA52ab / dAA53ab * 100 Where dAA52ab = average cost of the water supply service (€/year) and dAA53ab = average disposable household income (€/year). **Reference values for:** Good service quality: [0; 0.50] Average service quality:]0.50; 1,00] Unsatisfactory service quality:]1,00; +∞[
Water quality (%): It is defined as the percentage of tests carried out from among those required and that complied with the parametric values.	AA04ab = (dAA25ab / dAA23ab) * (dAA22ab / dAA24ab) * 100 Where dAA22ab = tests carried out on the quality of water for human consumption, from among those required by law (No./year), dAA23ab = tests carried out on the water quality (No./year), dAA24ab = tests required on the water quality (No./year) and dAA25ab = conformity of water tests (No./year). **Reference values for:** Good service quality: [99.00; 100,00] Average service quality: [97.50; 99,00[Unsatisfactory service quality: [0.00; 97.50[
Coverage of total costs: It is defined as the ratio between the total income and gains and the total spending.	Ratio between total income and gains and total costs. AA06ab = dAA50ab / dAA51ab Where dAA50ab = total income and gains (€/year) and dAA51ab = total costs (€/year) **Reference values for:** Good service quality: [1.0; 1.1] Average service quality: [0.9; 1.0[or]1.1; 1.2] Unsatisfactory service quality: [0.0; 0.9[or]1.2; +∞ [
Rehabilitation of pipes (%/year): It is defined as the average annual percentage of abduction and distribution	Annual average percentage of abduction and distribution pipes more than ten years old, that were rehabilitated in the last five years.

pipes more than ten years, old that were rehabilitated in the last five years.	AA10ab = dAA32ab / dAA31ab * 100/5 Where dAA31ab = average length of pipes (km) and dAA32ab = pipes rehabilitated in the last five years (km) **References values for:** Good service quality: [1.0; 4.0] Average service quality: [0.8; 1.0] or [4.0; 100] Unsatisfactory service quality: [0.0; 0.8]

Table 2: Drinking water supply services

The drinking water supply services in Portugal includes the following services:
Source: ERSAR 2015: Annual report on water and waste services in Portugal (2013) – Executive Summary

1) Extraction of water from surface or groundwater sources
2) Correction of physical, chemical and microbiological characteristics of water in order to make it fit for human consumption
3) Elevation of water in order for it to circulate under pressure and to enable it to overcome terrain barriers
4) Transport of treated water from the production zone to consumption areas
5) Storage of treated water in such a way as to ensure continuity of supply
6) Water distribution in sufficient quantity and adequate pressure for users' needs

Table 3: Cost recovery principle

In accordance with the cost recovery principle, tariffs of water and waste services must comply with the provisions of Article 82 of the Water Act, and consider the recovery of the following costs

a) Reintegration and amortization, on time and according to the relevant accounting practices, of the value of the assets allocated to service provision, resulting from investments made with the implementation, maintenance, modernization, rehabilitation or replacement of infrastructure, equipment or resources assigned to the system.
b) Operating costs of the operator, including those incurred in the acquisition of materials and supplies, transactions with the other operators, outsourced services, including the values resulting from the allocation of costs incurred with activities and shared means with other services provided by the operator, or in the salaries of their staff;
c) Financial costs attributable to financing the services and, when applicable, the appropriate return on capital invested by the operator;
d) Costs which legally arise from service provision, including those of tax nature.

2. Descriptive Statistics

Table 4: Quality Indicators
Descriptive statistics of the quality indicators used in the analysis.

Variable		Mean	Std. Dev.	Min	Max	Observations
quality	overall	98.66819	1.581416	87.57	100	N = 1368
	between		1.302023	93.056	100	n = 292
	within		.9118352	89.13419	104.7522	T-bar = 4.68493
cover	overall	.9014867	.4399702	.1	7	N = 1204
	between		.3661632	.1333333	2.81	n = 291
	within		.2556615	-.5385133	5.961487	T-bar = 4.13746
access	overall	.4355604	.1573938	.08	.98	N = 1365
	between		.1540354	.088	.902	n = 292
	within		.0372278	.2075604	.6855604	T-bar = 4.67466
rehab	overall	1.066946	3.4039	0	96.97	N = 1074
	between		3.233806	0	48.485	n = 270
	within		2.27824	-47.41805	49.55195	T-bar = 3.97778

Table 5: Water Quality
Detailed descriptive statistics of the variable «Water Quality»:

Water Quality

Percentiles		Smallest		
1%	93.24	87.57		
5%	95.55	88.3		
10%	96.61	88.93	Obs	1,368
25%	98.04	89.01	Sum of Wgt.	1,368
50%	99.24		Mean	98.66819
		Largest	Std. Dev.	1.581416
75%	99.78	100		
90%	100	100	Variance	2.500876
95%	100	100	Skewness	-2.239503
99%	100	100	Kurtosis	10.74586

Table 6: Rehabilitation of Pipes

Detailed descriptive statistics of the variable «Rehabilitation of pipes»

Rehabilitation of pipes

Percentiles		Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	1,074
25%	.1	0	Sum of Wgt.	1,074
50%	.4		Mean	1.066946
		Largest	Std. Dev.	3.4039
75%	1.1	13.3		
90%	2.5	13.3	Variance	11.58653
95%	4.1	24.5	Skewness	21.49004
99%	8.1	96.97	Kurtosis	590.7626

Table 7: Economic Accessibility of the Service

Detailed descriptive statistics of the variable «Economic accessibility of the service»

Economic accessibility

Percentiles		Smallest		
1%	.13	.08		
5%	.18	.08		
10%	.24	.09	Obs	1,365
25%	.32	.09	Sum of Wgt.	1,365
50%	.43		Mean	.4355604
		Largest	Std. Dev.	.1573938
75%	.54	.93		
90%	.64	.93	Variance	.0247728
95%	.7	.95	Skewness	.3494403
99%	.84	.98	Kurtosis	2.911562

Table 8: Coverage of Total Costs

Detailed descriptive statistics of the variable «Coverage of total costs»

Coverage of total costs

Percentiles		Smallest		
1%	.2	.1		
5%	.3	.1		
10%	.4	.1	Obs	1,204
25%	.6	.1	Sum of Wgt.	1,204
50%	.9		Mean	.9014867
		Largest	Std. Dev.	.4399702
75%	1.1	2.9		
90%	1.3	3.2	Variance	.1935738
95%	1.5	4.9	Skewness	3.274195
99%	2.02	7	Kurtosis	39.40249

3. Output tables

The following tables are output tables from Stata, providing evidence of the results described in the Work Project.

Table 9: Fixed effects model to check for change in Economic Accessibility

We run a fixed effects regression model with the quality indicator Economic Accessibility of the Service being the dependent variable, and find that the treatment effect was an increase of 0,059. This implies that the water supply service as a weight of the burden in the average disposable income per household has increased, thus it implies a less affordable service.

VARIABLES	(1) Access
Treatment	0.0590***
	(0.0109)
Constant	0.434***
	(0.00116)
Observations	1,365
Number of companies	292
R-squared	0.027

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Breusch-Pagan Lagrange Multiplier

```
Breusch and Pagan Lagrangian multiplier test for random effects

        quality[companynum,t] = Xb + u[companynum] + e[companynum,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+------------------------------
                 quality |   2.502291       1.581863
                       e |   1.056663       1.027941
                       u |   1.450266        1.20427

        Test:   Var(u) = 0
                                chibar2(01) =   859.40
                              Prob > chibar2 =   0.0000
```

Table 11: Hausman test

```
. hausman fixed random

                 ---- Coefficients ----
                 |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                 |    fixed        random       Difference          S.E.
-----------------+------------------------------------------------------------
startprogram     |   .6127778     .4634018         .149376        .1035852
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        2.08
                Prob>chi2 =      0.1493
```

Table 12: Hausman test

Hausman test with more covariates:

	Coefficients (b) fixed	(B) random	(b−B) Difference	sqrt(diag(V_b−V_B)) S.E.
startprogram	**.6045384**	**.4711653**	**.1333731**	**.111746**
access	**.1395855**	**−.1824437**	**.3220292**	**.6347687**

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(**2**) = (b−B)'[(V_b−V_B)^(−1)](b−B)
= **2.46**
Prob>chi2 = **0.2920**

Table 13: Nearest Neighbor Matching

. teffects nnmatch (quality rehab cover access size) (startprogram), atet

Treatment-effects estimation — Number of obs = **556**
Estimator : **nearest-neighbor matching** — Matches: requested = **1**
Outcome model : **matching** — min = **1**
Distance metric: **Mahalanobis** — max = **3**

quality	Coef.	AI Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
ATET						
startprogram (1 vs 0)	**.6634**	**.3381163**	**1.96**	**0.050**	**.0007043**	**1.326096**

Table 14: Nearest Neighbor Matching with bias adjustment

. teffects nnmatch (quality rehab cover access size) (startprogram), biasadj(rehab cover access) atet

Treatment-effects estimation — Number of obs = **556**
Estimator : **nearest-neighbor matching** — Matches: requested = **1**
Outcome model : **matching** — min = **1**
Distance metric: **Mahalanobis** — max = **3**

quality	Coef.	AI Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
ATET						
startprogram (1 vs 0)	**.6421438**	**.3296163**	**1.95**	**0.051**	**−.0038922**	**1.28818**

4. Do file from Stata

```
//Do File for the Work Project at Nova SBE by Caroline Isabell Ørvik #814

use "/Users/carolineorvik/Desktop/Dataset PAEL January2017.dta"

//Set the panel variables (first the panel identifier, then the time identifier)
xtset companies year

// Create yearly dummies
gen year2011=1 if year==2011
gen year2012=1 if year==2012
gen year2013=1 if year==2013
gen year2014=1 if year==2014
gen year2015=1 if year==2015

replace year2011=0 if year2011!=1
replace year2012=0 if year2012!=1
replace year2013=0 if year2013!=1
replace year2014=0 if year2014!=1
replace year2015=0 if year2015!=1

//To check the Common trend assumption:
//Create mean of variable if/if not in treatment group at any point in time, by year
egen average_quality1 = mean(quality) if treatment==1, by (year)
egen average_quality0 = mean(quality) if treatment==0, by (year)
egen average_access1 = mean(access) if treatment==1, by (year)
egen average_access0 = mean(access) if treatment==0, by (year)
egen average_cover1 = mean(cover) if treatment==1, by (year)
egen average_cover0 = mean(cover) if treatment==0, by (year)
egen average_rehab1 = mean(rehab) if treatment==1, by (year)
egen average_rehab0 = mean(rehab) if treatment==0, by (year)

//Average of water quality for treatment group post treatment:
egen avgq_post1 = mean(quality) if Dt==1 & treatment==1

//Average of water quality for treatment group pre treatment:
egen avgq_pre1 = mean(quality) if Dt==0 & treatment==1

//Average water quality for control group pre treatment:
egen avgq_pre0 = mean(quality) if treatment==0 & year<=2013

//Average quality for control group post treatment:
egen avgq_post0 = mean(quality) if treatment==0 & year>=2013

//Fixed effects model
xtreg quality Dt, fe
xtreg quality Dt cover, fe
xtreg quality Dt cover access, fe
```

```
xtreg quality Dt cover i.year, fe
xtreg access Dt, fe

//Test for heteroskedasticity for the fixed effects model (userwritten command)
xtreg quality startprogram, fe
xttest3

//Random Effects Model
 xtreg quality Dt, re
 xtreg quality Dt cover, re robust
 xtreg quality Dt access cover, re robust
 xtreg quality Dt cover i.year, re robust

 //Breusch and Pagan Lagrangian multiplier test (LM) for random effects (userwritten
command)
 xttest0

//Hausman test to check random vs fixed effects, model with one covariates
xtreg quality Dt access, fe
estimates store fixed
xtreg quality Dt access, re
estimates store random
hausman fixed random

//Hausman test to check random vs fixed effects, model with two covariates
xtreg quality Dt access cover, fe
estimates store fixed
xtreg quality Dt access cover, re
estimates store random
hausman fixed random

//Regression Adjustment estimator
teffects ra (quality rehab cover access size) (Dt), atet
teffects ra (quality access size) (Dt), atet
//To express the ATET as a percentage of the mean water quality without treatment
teffects ra (quality access size) (Dt), coeflegend atet
nlcom _b[ATET:r1vs0.Dt] / _b[POmean:0.Dt]

//Nearest Neighbor Matching
teffects nnmatch (quality rehab cover access size) (Dt), atet
teffects nnmatch (quality rehab cover access size) (Dt), biasadj (rehab cover access) atet
```