

Deep reforms in electricity pricing: Evidence from a Natural Experiment

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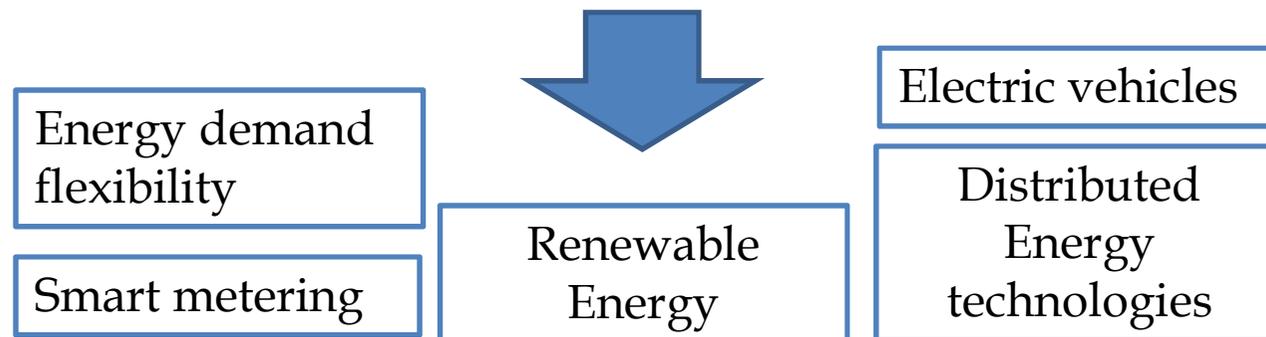
A Toxa , 21 June 2018

Outline

1. Motivation
2. The reform
3. Data and Identification Strategy
4. Results
5. Conclusions

Motivation

- Optimal electricity pricing: Trade-off between allocative efficiency and financial sustainability.
- Two-part tariff (Coase 1946): Two main price components:
 - a fixed part $f \rightarrow$ cover fixed costs
 - volumetric part $p \rightarrow$ marginal cost price
- The distribution activity is currently going through **major changes**, which may affect the structure of optimal regulatory schemes (RFF 2).



Motivation

- [European Commission \(2015\)](#): “New investments are required to accommodate renewable generators to the distribution network”.
- [MIT Energy Initiative \(2016\)](#): “Current pricing systems are proving inadequate as these face increasing penetration of distributed energy resources and opportunities for flexible demand.”
- “Tariffs should evolve towards higher relative weight of the fixed part price components” ([Eurelectric 2016](#)).

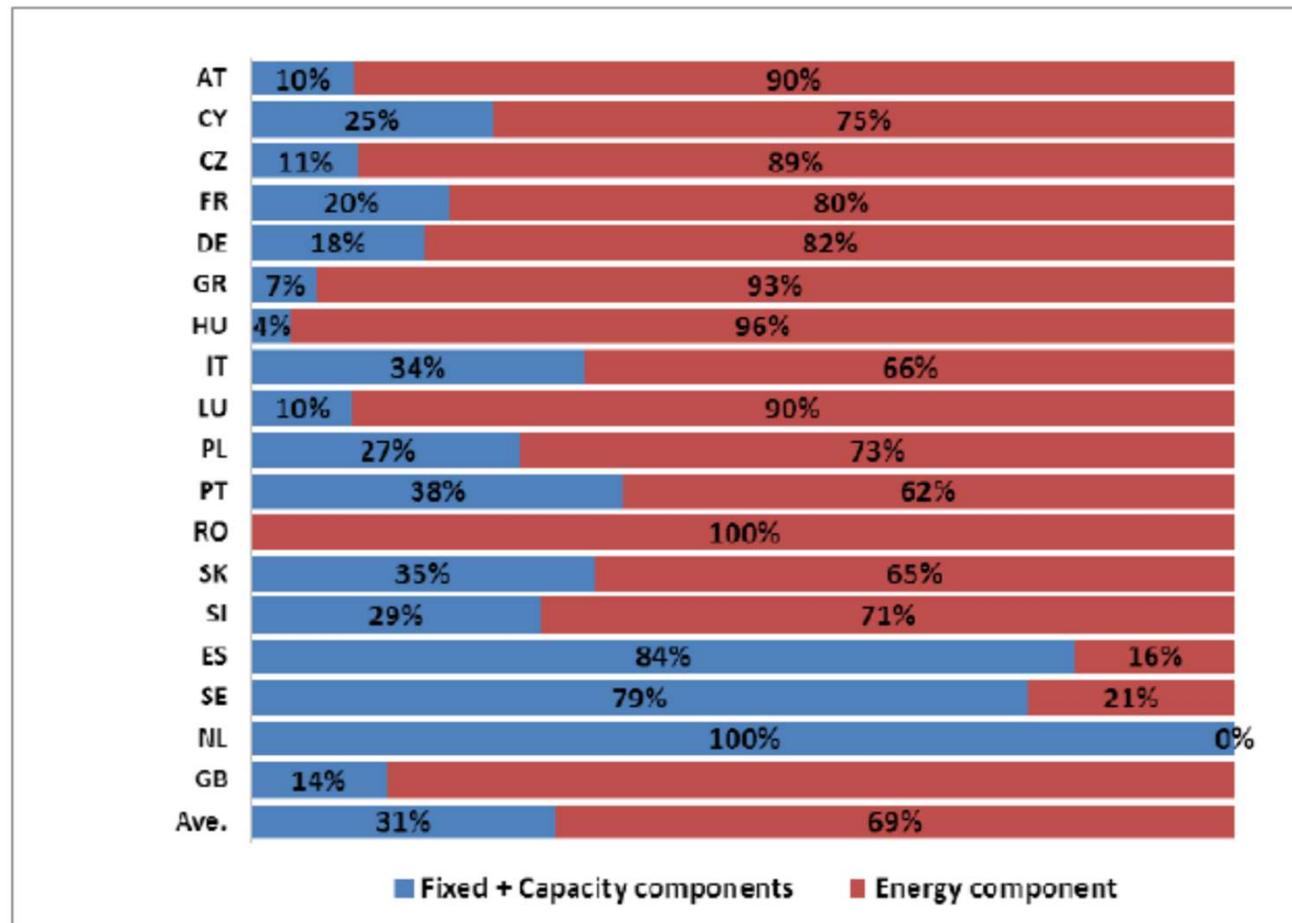


Some regulators are revising, or have in agenda revising, the fixed part of the tariff.

How this kind of reform affects household electricity demand?

Motivation

Figure 3: Distribution Tariff component weight in Households



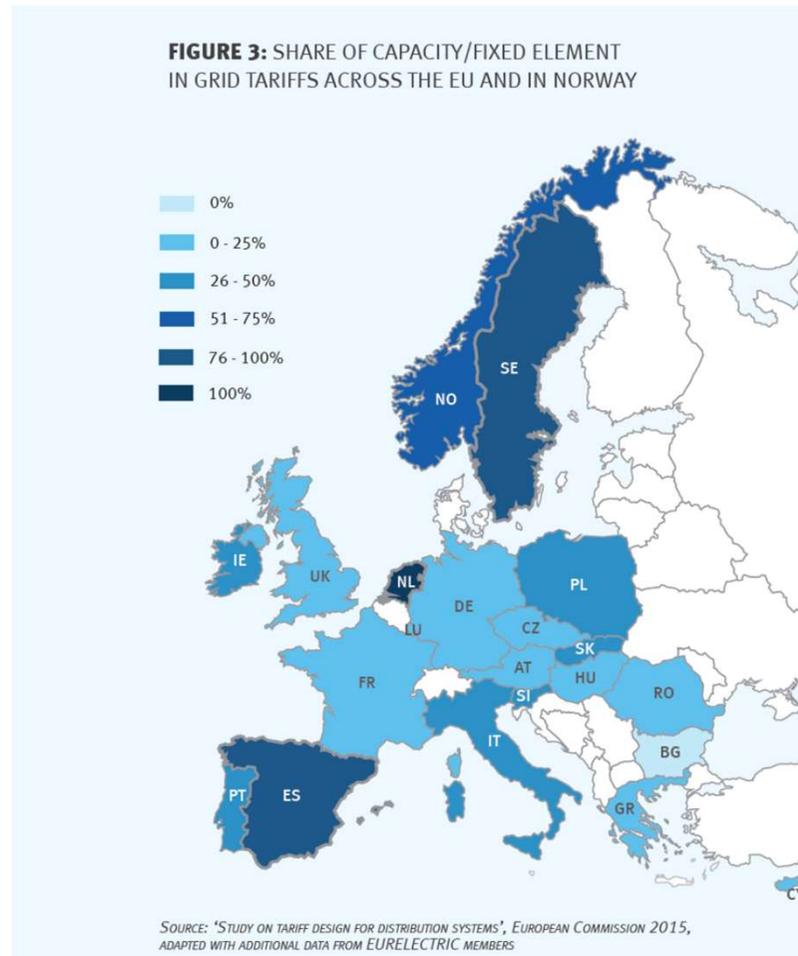
Source: Own elaboration on Fixed charges, Capacity charges and Energy charges values facilitated by national regulators. Data of Belgium, Bulgaria, Croatia, Denmark, Estonia, Ireland, Latvia, Lithuania and Malta are not available.

Household consumer with an annual consumption of 3500 kWh connected to the low voltage grid and 6 kW of contracted capacity. Situation in 2013.

Details on values of each component by country is summarised in “Annex 5: Breakdown of electricity network annual charges by country – customer types”.

Motivation

- But for ES, SE and NL, most countries keep financing fixed costs with variable price components (Euroelectric 2016)

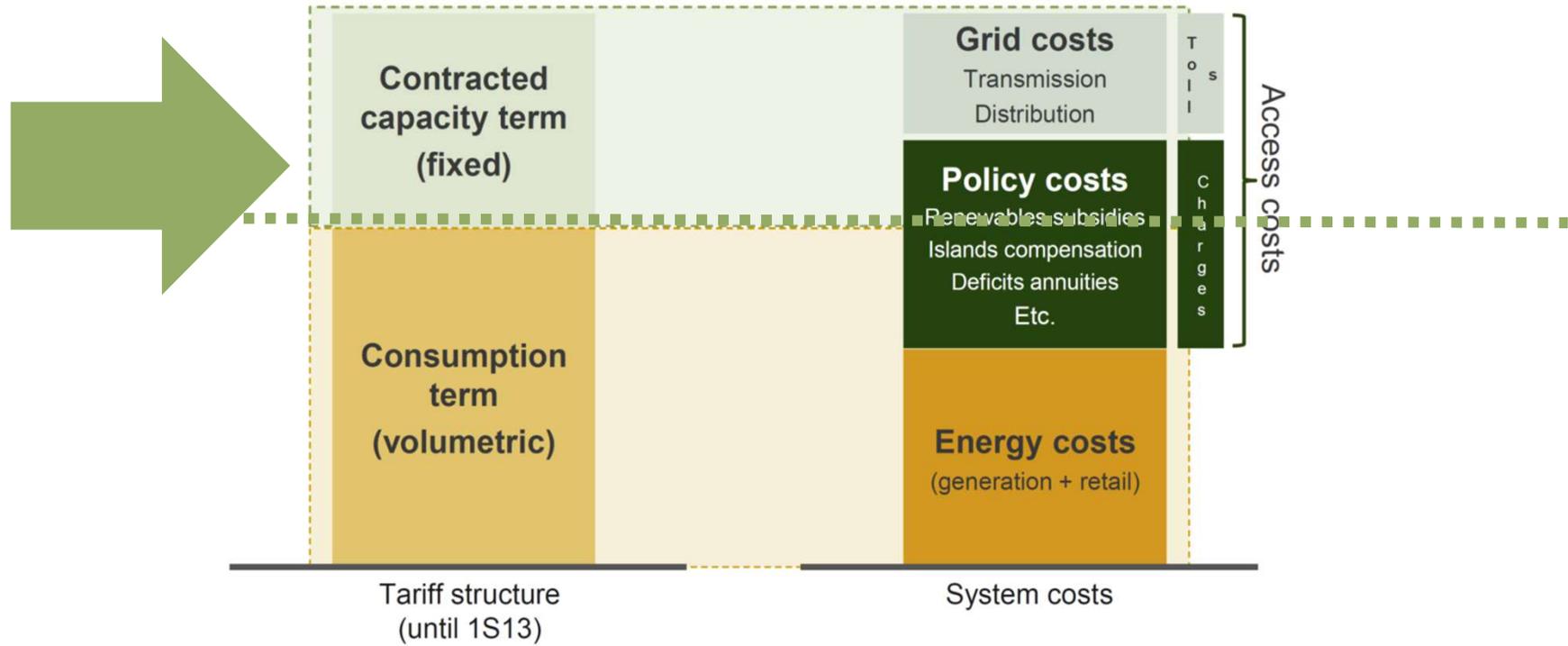


Euroelectric (2016)

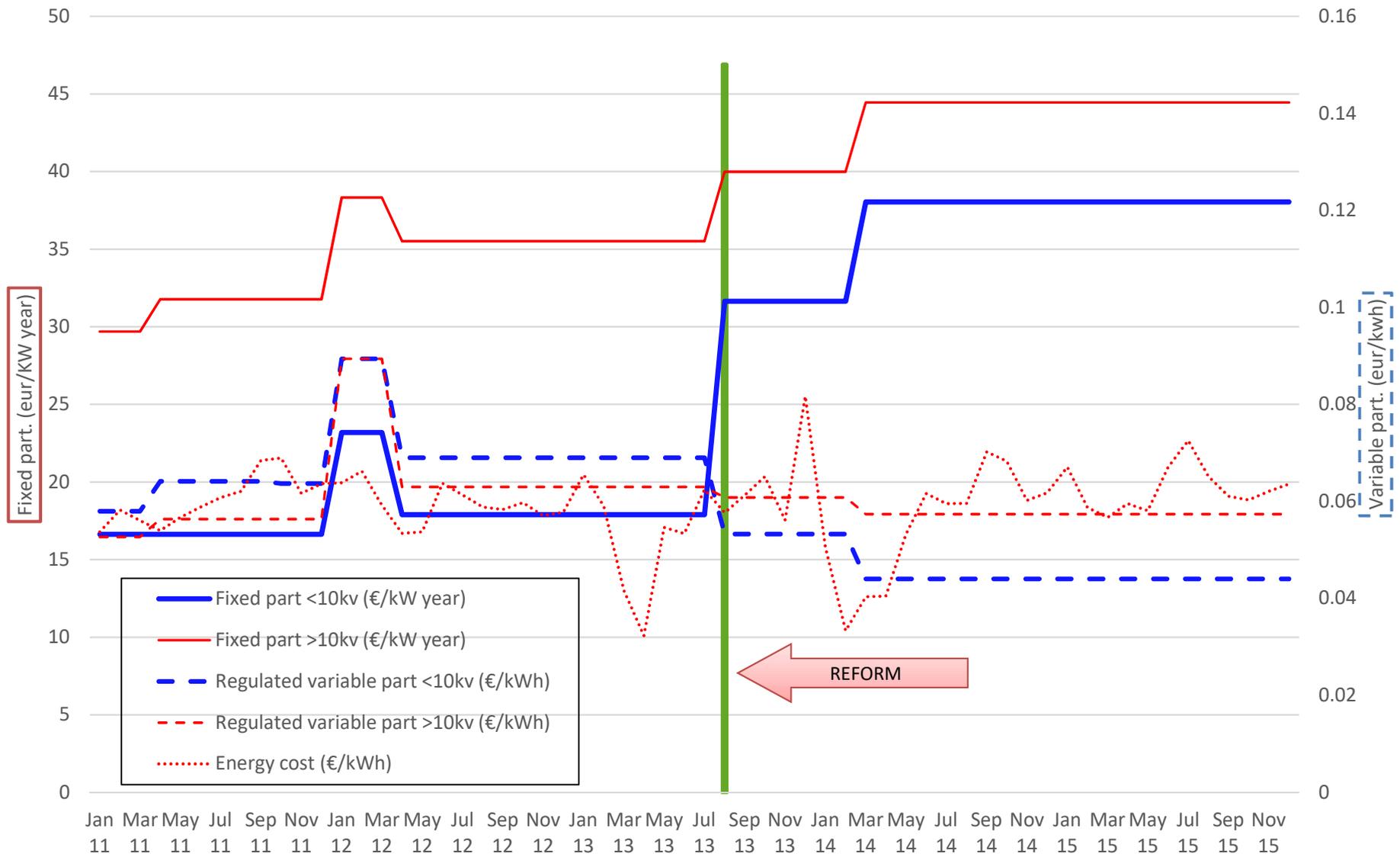
The Reform

The Reform

Consumers pay through the bill the energy cost and the access cost

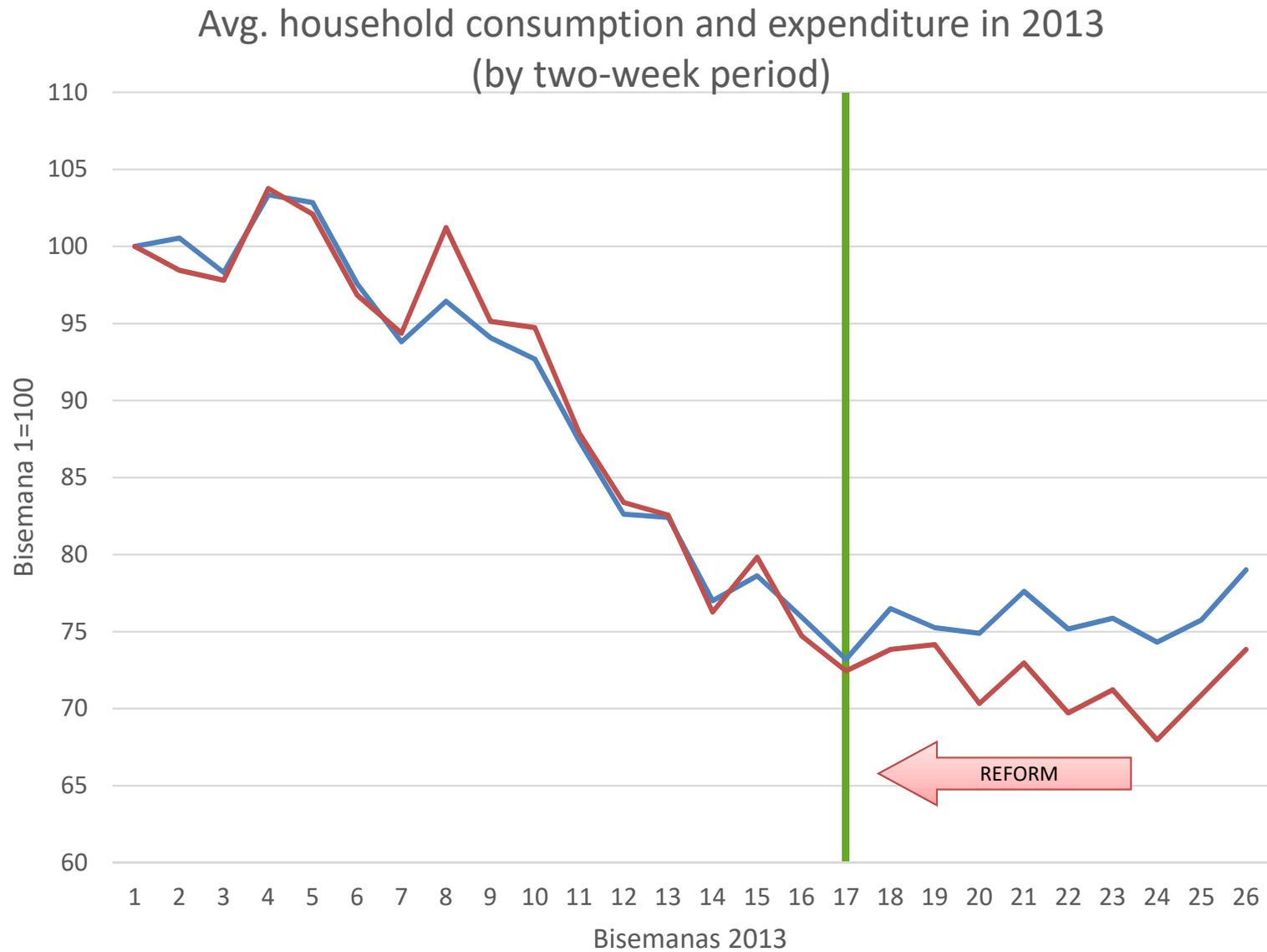


The Reform



Source: Authors from IDAE data)

The Reform



Source: Authors from EPF data

— Expenditure — Consumption

Data & Identification strategy

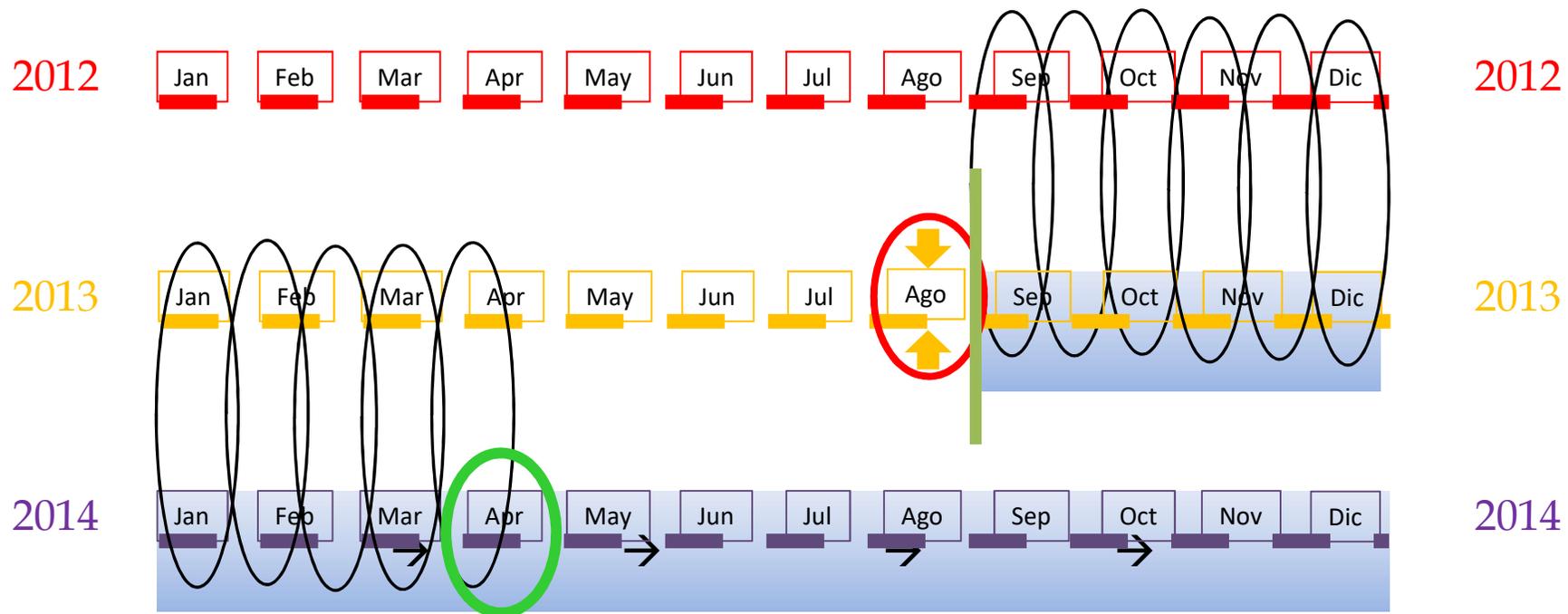
Data & Identification strategy

- DATA: Spanish Household Budget Survey (INE).
- Surveyed households collaborate for two consecutive years and their observations will be in an annual basis (Panel T=2).
- Since the reform we are to evaluate was on August 2013, our analysis is limited to 2011-2014.
- Key to the identification strategy are the 26 interview dates (two-week period) in which the sampling is **statistically homogenous**.



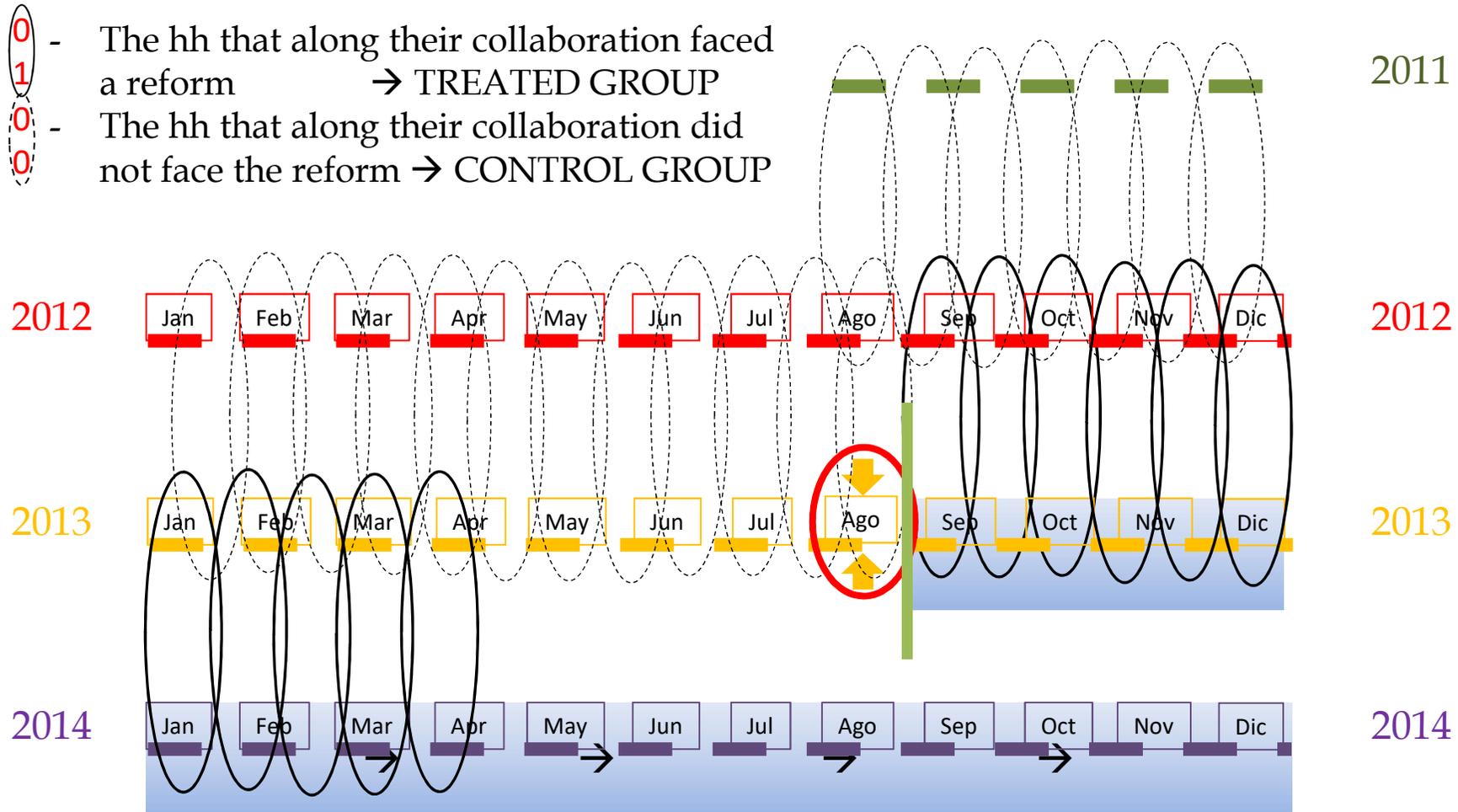
Data & Identification strategy

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1 - The hh that along their collaboration faced a reform → TREATED GROUP



Change in the auction system that reduced variable price

Data & Identification strategy



$$\ln(q_{it}) = \alpha + \beta \ln(p_{it}) + \beta \ln(y_{it}) + \gamma X_{it} + \delta T_{it} + \theta_i + \varphi_t + \varepsilon_{it}$$

Data & Identification strategy

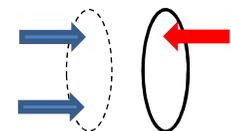
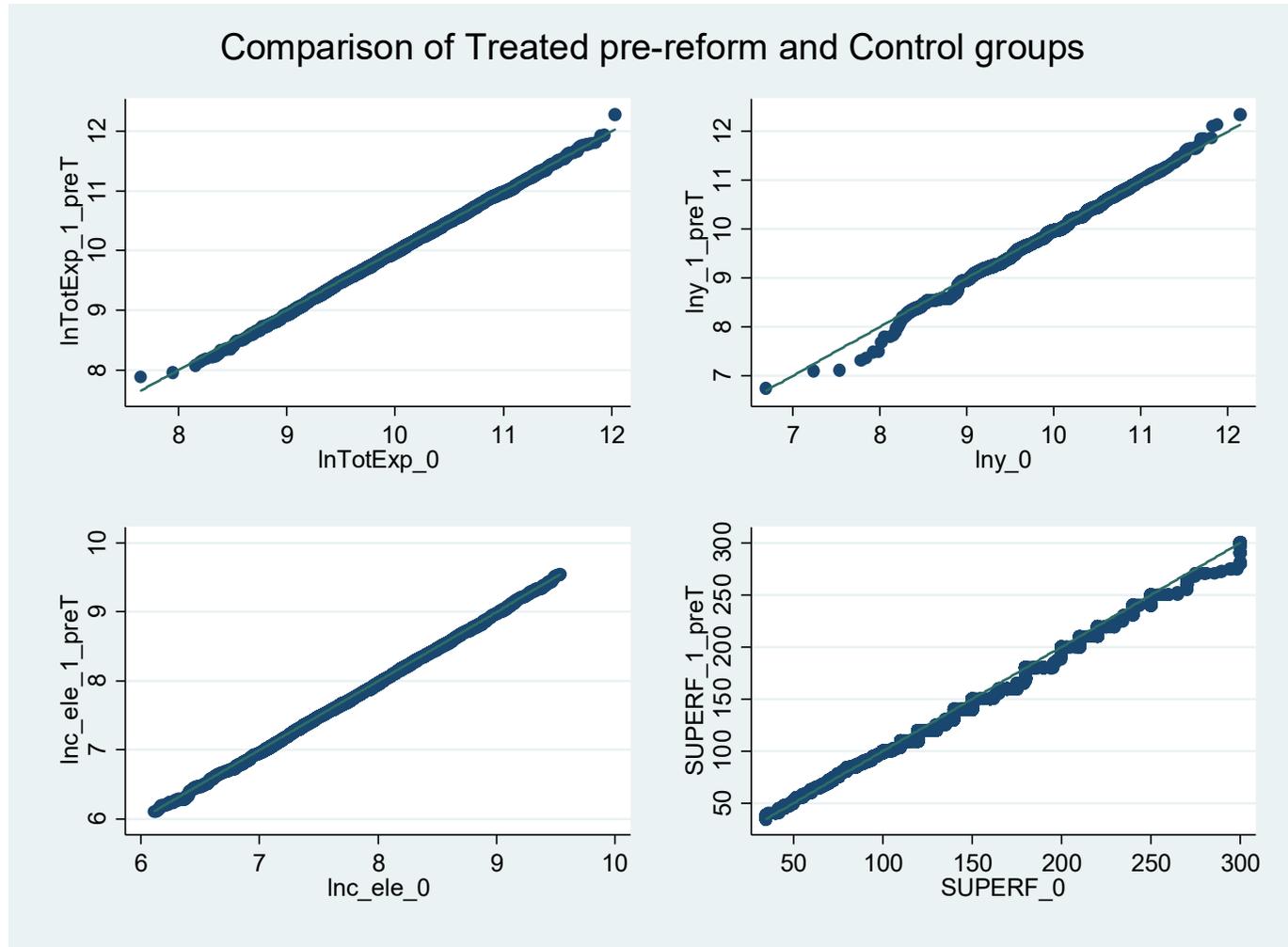
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Variable	Full sample		Control Group (D=0)		Treated Group (D=1)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
<i>Data from August 2011 to April 2014</i>						
T (Treatment dummy)	0.19	0.39	0	0	0.5	0.5
Electricity Consumption (kwh)	3,425	2,029	3,524	2,084	3,264	1,927
Electricity Expenditure (€)	754	409	756	414	750	400
Individual price (€/kwh)	0.23	0.04	0.22	0.04	0.24	0.04
Total Income (€)	23,793	14,791	23,919	14,753	23,588	14,850
Total Expenditure (€)	29,614	16,834	29,762	16,782	29,372	16,918
Education level (head of the household)	2.56	1.09	2.56	1.08	2.56	1.09
Household economic situation	1.73	0.87	1.73	0.87	1.74	0.86
Household size	2.81	1.25	2.81	1.27	2.82	1.23
Elderly (dummy)	0.32	0.47	0.32	0.47	0.33	0.47
Retirement income (dummy)	0.41	0.49	0.41	0.49	0.42	0.49
Rooms	5.25	1.18	5.26	1.19	5.23	1.16
Surface (m2)	105	47	106	48	104	46
Province Capital	0.32	0.47	0.34	0.47	0.31	0.46
Autonomous Community (region)	9.01	5.03	8.95	5.02	9.1	5.04
Municipality size	2.75	1.63	2.7	1.63	2.83	1.61
Population density	1.84	0.86	1.83	0.87	1.86	0.84
Renting (dummy)	0.1	0.3	0.09	0.29	0.1	0.3
Urban area (dummy)	0.81	0.4	0.8	0.4	0.81	0.39
Building age >25years (dummy)	0.63	0.48	0.63	0.48	0.62	0.49
Two-week period	14	8.35	13.43	7.63	15	9.35
Year	2,012	1	2,012	1	2,013	1

Data & Identification strategy

Comparison pre-treatment



Results

Results - ATE

Table 3. Effect of the reform T+1 on residential electricity consumption and expenditure (2011-2014).

VARIABLES	(1) ln(q)	(2) ln(pq)	(3) ln(q)	(4) ln(pq)
Reform_	-0.199*** (0.026)	-0.177*** (0.026)	-0.165*** (0.025)	-0.109*** (0.025)
Distance to T	0.021** (0.008)	0.010 (0.008)	0.008 (0.008)	-0.016* (0.008)
ln(income)	0.194** (0.068)	0.190** (0.068)	0.212* (0.095)	0.213* (0.095)
ln(price kwh)	-1.186*** (0.021)	-0.191*** (0.021)	-1.026*** (0.023)	-0.027 (0.023)
ln(income) ^2	0.003 (0.007)	0.003 (0.007)	-0.018 (0.010)	-0.018 (0.010)
Constant	-0.673** (0.215)	4.208*** (0.215)	0.724** (0.269)	5.643*** (0.269)
Hh Fixed Effects	no	no	yes	yes
Time FE (year & Trim)	yes	yes	yes	yes
Observations	25,613	25,613	25,613	25,613
R-squared	0.203	0.080	0.175	0.025
w/ controls	NO	NO	NO	NO
R2 adj.	0.203	0.0794	0.175	0.0243
Number of id			12,868	12,868



Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05

Results – ATE

CROSS-SECTIONAL MODELS 2013

VARIABLES	(1) ln(q)	(2) ln(pq)	(3) ln(q)	(4) ln(pq)	(5) ln(q)	(6) ln(pq)
ATE (D)	-0.191***	-0.150***	-0.156***	-0.137***	-0.151***	-0.132***
	-0.0115	-0.0107	-0.0103	-0.0103	-0.0107	-0.0107
ln(price kwh)			-1.184***	-0.197***	-0.996***	-0.0127
			-0.0315	-0.0315	-0.0396	-0.0395
ln(income)			0.135	0.131	0.438***	0.434***
			-0.0962	-0.096	-0.111	-0.111
ln(income) x ln(income)			0.00994	0.0102	-0.0313**	-0.0311**
			-0.00986	-0.00985	-0.0113	-0.0113
Constant	8.017***	6.531***	-0.56	4.369***	-0.248	4.656***
	-0.00683	-0.00641	-0.307	-0.307	-0.364	-0.364
Observations	10088	10088	10016	10016	8185	8185
R-squared	0.024	0.017	0.209	0.091	0.301	0.202
Controls	NO	NO	NO	NO	YES	YES
R2 adj.	0.0238	0.0167	0.208	0.0902	0.298	0.198

Robust standard errors in parentheses

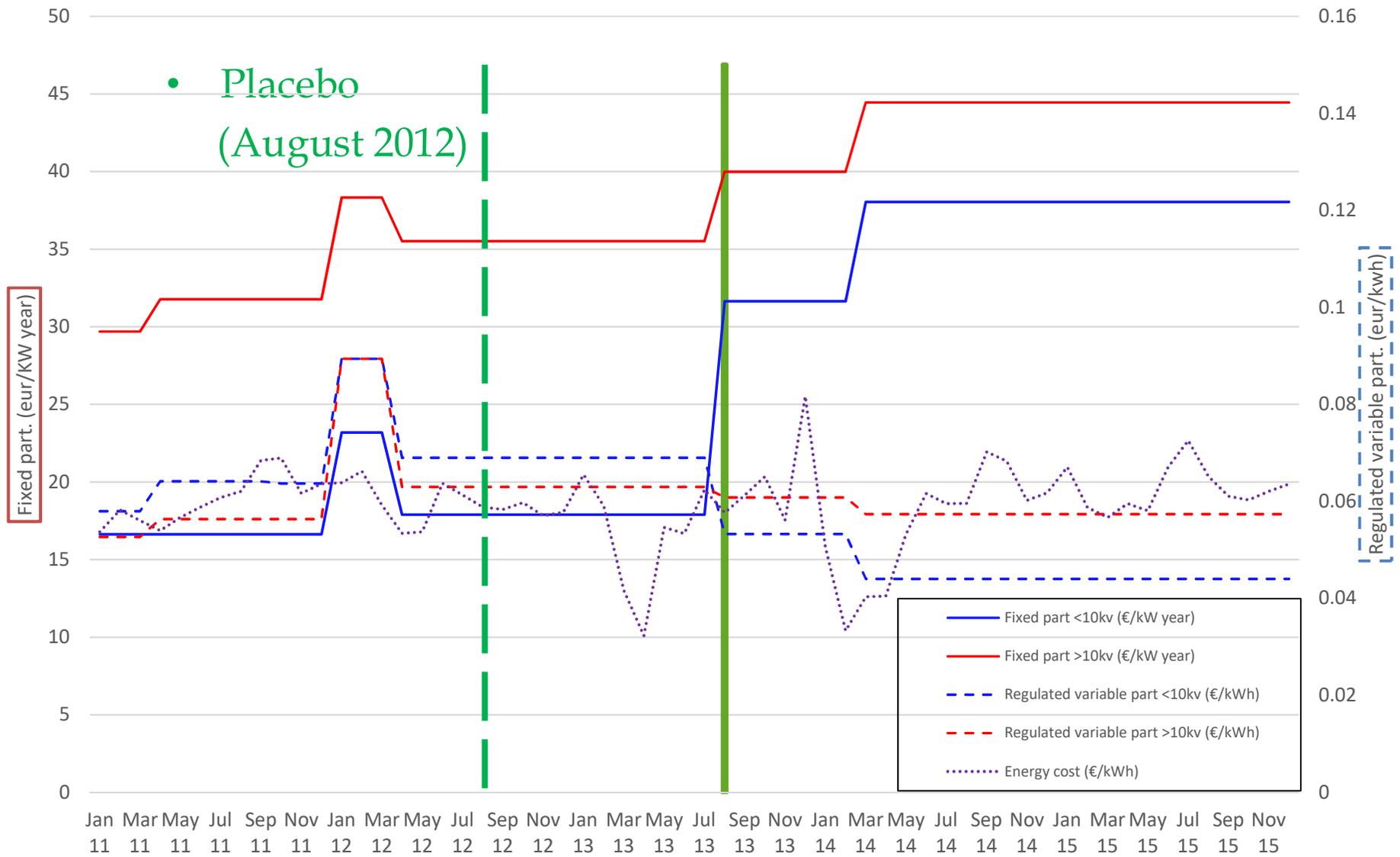
*** p<0.001, ** p<0.01, * p<0.05

Results - Robustness checks

Robust to

- Other estimation methods: Matching estimator nearest-neighbor (Mahalanobis distance)
- Different specifications
- Controlling for the purchase of new (and more efficient) utilities.
- Controlling for any change in the energy source of heating or water boiler.
- Clustering errors to two-week period.
- ➔ • Placebo test as if the reform was in any other period.

Results - Robustness checks



Results - Robustness checks

- Placebo
(August 2012)

	Electr. Consumption	Electr. Expenditure
ATE (PLACEBO) (1 vs 0)	-0.008 (0.0150)	0.0584*** (0.0147)
Estimator:	Nearest N.	Nearest N.
Matches requested:	10	10
Distance Metric:	Mahalanobis	Mahalanobis
Observations	10,946	10,946

Results - Robustness checks

- Placebo
(August 2012)

VARIABLES	(1) ln(q)	(2) ln(q)	(3) ln(pq)	(4) ln(pq)
ATE (PLACEBO)	0.005		0.036**	
	-0.012		-0.012	
ATE (D)		-0.151***		-0.132***
		-0.011		-0.011
ln(price kwh)	-1.145***	-0.996***	-0.150***	-0.013
	-0.036	-0.04	-0.036	-0.039
ln(income)	0.277**	0.438***	0.277**	0.434***
	-0.095	-0.111	-0.095	-0.111
ln(income) x ln(income)	-0.015			
	-0.01			
Constant	-0.686*	-0.248	4.250***	4.656***
	-0.333	-0.364	-0.333	-0.364
Observations	10,456	8,185	10,456	8,185
R-squared	0.282	0.301	0.172	0.202

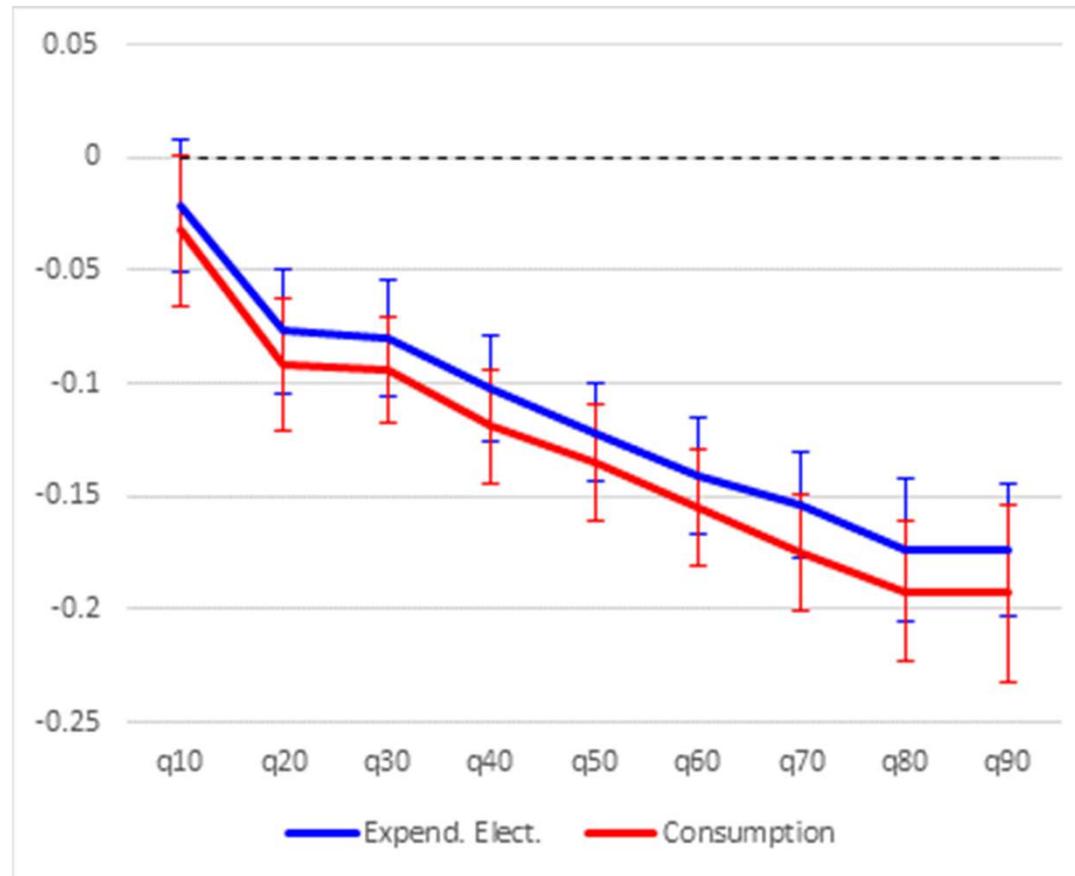
Robust standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Results – Distributional impact

Results - Distributional impact

- Quantile regression



- Interacting T with income deciles further confirms that richer households react in a stronger way.

Conclusions

- How do households electricity demand react when they face a rise in the fixed part component of their electricity bill?
- Households reduce consumption.
 - Households responding to average pricing and not to marginal pricing (Ito 2014): evidence for a raise in the fixed part of the tariff.
- Expenditure per household also reduced: the reform did not increase revenues.
 - Spanish Government did not intend this.
 - Changes in contracted load capacity further reduced household electricity expenditure.
- Distributional impact:
 - Higher consumers (richer hh) reduced more than lower consumers (poorer households), i.e. stronger adaptation to higher electricity prices.
 - Welfare implications.

Thanks!

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