The impact of commercial quality on electricity consumer satisfaction

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Abstract

Quality of supply has been one of the main aspects covered by the European Energy Policy in the last decades together with the competitiveness and the sustainability. Several regulatory actions have been taken in this regard and have been applied at European level. Most of Energy National Regulatory Agencies have implemented electricity distribution network retribution mechanisms based on the quality of supply provided by the companies responsible for that. These measures were mainly based on the technical quality: number and length of service interruptions. However, electricity consumer satisfaction has not been measured for checking how commercial quality is affecting it. In this working paper, technical and commercial quality of supply indicators for household electricity consumers in Spain are assessed together by means of an statistic model. The impact of commercial quality will allow us to identify possible policy recommendations to be implemented in the regulatory framework.

1. The framework of Spanish electricity quality of supply.

Consumer satisfaction is a key issue for ensuring the continuity of liberalization and privatization policies set up during the last decades in the public service sector. Citizens' support to public policies must be ensured since after all, citizens are their end users. During the last years, low satisfaction of citizens towards public services have made policy makers to consider changes in the way the public services are provided, including some relevant changes in South American countries [7].

For the European electricity sector this is not different. In this regard, the Council of European Energy Regulators (CEER) has recently recommended the monitoring of satisfaction as a potential performance indicators and incentive schemes for regulating network outputs [2].

This recommendation of the CEER is aligned to the findings obtained in satisfaction surveys carried out by IPSOS in 2007 and 2009 [8] were the main indicators to be measured were identified [1]. Surveys found that at European level less than three in five (58 %) consumers were satisfied with their electricity supplier. Additionally, one in ten consumers across the EU has had one or more problems with their supplier in the last two years (Figure 1). Specifically

for the Spanish case, more than 20 % of consumers have experienced problems with their supplier. This situation has provoked that Spanish citizens' overall quality perception were lower than the European average (

Figure 2).

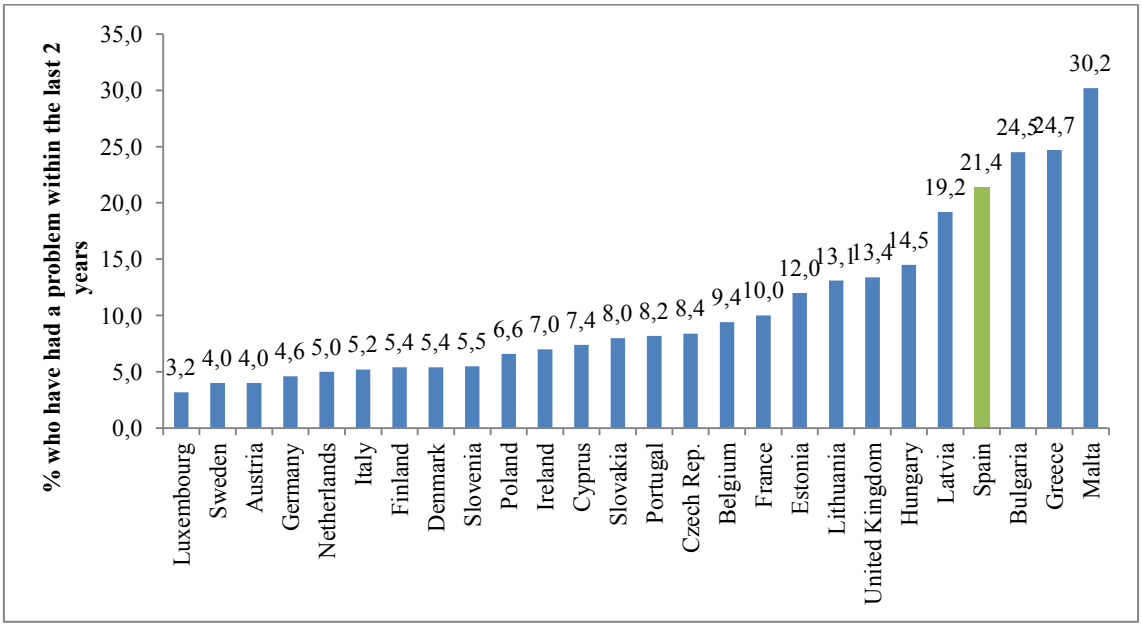

Figure 1: Incidence of problems with suppliers [1].

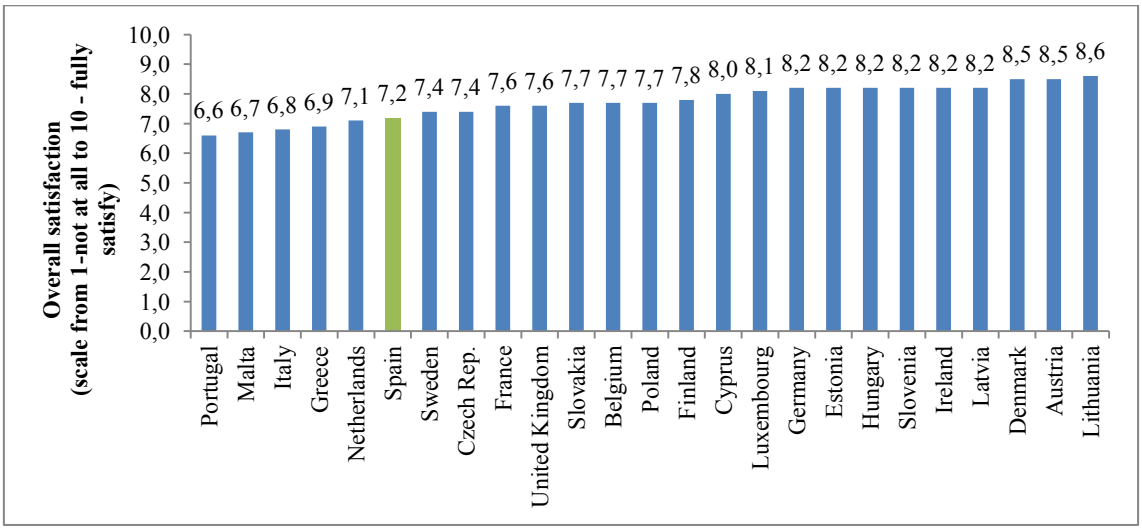

Figure 2: Overall satisfaction [1].

Nevertheless, for the Spanish case these negative figures regarding consumer satisfaction are surprising considering the electricity sector efforts for improving quality of supply. In Figure 3 the evolution of the number of unplanned interruptions in the European countries from 1999 to 2007 is shown. It can be appreciated how this indicator is improving year by year, reducing the average number of interruption from 3,7 in 1999 to 2,6 in 2007.

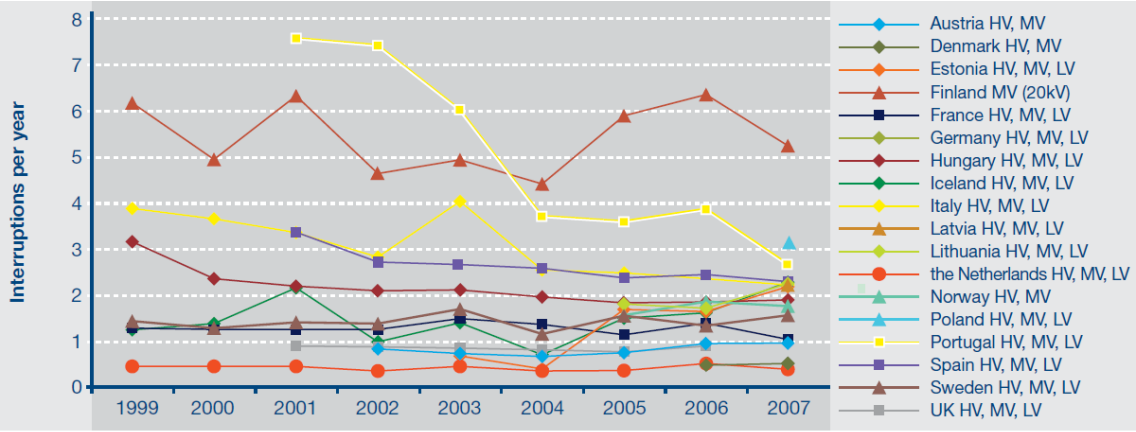

Figure 3: Unplanned interruptions including all events; number of interruptions per year (1999-2007) [4].

Additionally the Spanish regulator put in force in 2008 a new regulatory reward/penalty scheme based on the commonly adopted quality mechanisms in European countries [9]. Under these schemes, electricity distribution companies receive financial incentives if quality of service is above certain reference levels and pay penalties if quality of service is below those levels.

So, why Spanish citizens are still unsatisfied with the electricity supply? The reason could be that the regulation of quality of supply is not considering those aspects most relevant for consumer satisfaction, being focused in those problems less important for them, and avoiding crucial factors. In fact, the new quality regulation scheme in Spain is not addressing all quality dimensions in the same way: since technical quality regulation was completely refurbished, none improvements on non-technical quality regulation (quality related to the customer relationship) were included.

Therefore, the aim of this paper is to quantify how much is the relative contribution of non-technical quality perception over customers' overall satisfaction, also considering technical factors. The results obtained will provide a preliminary recommendation for the Spanish policy makers for improving Spanish electricity quality regulation. This recommendation will also contribute to follow CEER recommendations regarding the need of including satisfaction as a potential performance indicators and incentive schemes for regulating network outputs.

For doing so multivariable analysis mixing technical and non-technical quality indicators is needed. Therefore, technical SAIFI[1] and SAIDI[2] indicators will be combined with other non technical quality aspects obtained from the IPSOS Consumer Satisfaction Survey of 2006 [8], going beyond the results obtained in previous working papers addressing this issue [10].

This paper will be organized as follows. On the second section, quality of service definitions are going to be described covering both technical and non-technical dimensions. Additionally, international approaches for quality regulation will also be described for providing a wider vision of the problem beyond the Spanish case. On the third section the methodological approach is described, including the data description as well as the applied statistical models. The fourth section shows the results of this working paper, providing some preliminary conclusions about the regulatory proposal to be formulated. The last section includes a summary of the conclusions as well as of the further research to be done in this field.

[1] Average number of interruptions per consumer per year (SAIFI)
[2] Average interruption duration per consumer per year (SAIDI)

1. Quality of service dimensions

Quality of supply is normally split in three different dimensions: continuity of supply, voltage quality, and commercial quality [4].

Continuity of supply is related to availability of the service. The fewer the instances of interruptions and the shorter these interruptions are, the better the supply is from the customer's point of view. For that reason, continuity of supply is determined by the number and duration of supply interruptions and it is extremely related to network investments and practices of operation and maintenance by distribution operators. In many European countries (including Spain since de last regulatory reform) distribution companies are subjected to quality regulation and can be financially penalized if continuity supply standards are not met [5]. This aspect of quality of service is the most relevant for customers since power supply is crucial for today's way of living. For that reason continuity of supply is the focus of most of research works related to electricity quality and is permanently in the agenda of energy regulators.

Voltage quality refers to the usefulness of electricity when there are no interruptions. When the voltage quality (the usefulness) is very poor, several problems may arise in the use of electrical appliances and electrical processes. In simple terms, voltage quality can be described by deviations from nominal values for voltage frequency and voltage magnitude and by distortions of the voltage wave shape. The most common approach for regulating it is by means of setting mandatory values for compliance as indicated in EN 50160. These values are stated for only a few voltage disturbances under normal operating conditions and only for a given percentage of time and mean values over long time intervals. If these levels are ensured, like in the most of Spanish distribution grids, consumer satisfaction will not be affected. For that reason, voltage quality will not be considered within the scope of this work as a factor affecting satisfaction.

Regarding commercial quality, it is considered that is directly associated with transactions between electricity companies (either DSOs or suppliers, or both) and customers, and covers not only the supply and sale of electricity, but also various forms of contacts between electricity companies and customers. The most common approach for regulating this quality dimension is by the definition of timelines related to both pre-contract transactions, and transaction during the contract period. For the Spanish case the values are the following:

Transaction	**Quantity**
Time for response to claim of customers for network connection	15 days
Time for cost estimation for simple works	5-60 days[3]
Time for connecting new LV customers to the network	6-80 days
Time between signing contract and the start of supply	5 working days
Response time to customer queries in written form	5-15 days[4]
Rules on answering client letters - Time of	

[3] LV: a) supplies <15 kW: within 5 days b) Other without Substation investment: within 10 days c) Other supplies with Substation investment: within a range of 20 to 30 days. MVHV: (new supplies): a) 1-66kV: within 40 days b) >66kV: within 60 days.
[4] Customers: < 15 kW: within 5 working days Rest: within 15 working days

giving response to complaints	
Response time, queries on costs and payments	
Time of giving information on a planned interruption	Minimum 24 hours to private customers; Minimum 72 hours to Public Administrations
Yearly number of meter readings by the designated company	Minimum 6 times a year
Time from notice to pay until disconnection (DSO)	2 months
Time of restoration of power supply following disconnection due to nonpayment (DSO)	24 hours

The effectiveness of this regulation practice will be analyzed in the following chapters, assessing whether the current transactions are the most relevant for customers and are properly regulated.

Methodological approach for quality of service assessment

Quality of service assessment models

Regarding quality of service assessment models, this work aims to continue the research initiated in 2010 about the overall satisfaction assessment of electricity consumers in Europe [10]. In that work the main factors affecting overall satisfaction of European electricity consumers were investigated by means of a *probit* model. The data used as an input of the model was gathered from Eurobarometer 62.1 Survey (2004) about Services of General Interest. In that survey a subset of questions regarding quality perception was included, covering the 5 quality of service dimensions defined by the SERVQUAL methodology [11]:

- **Tangibles:** Physical facilities, equipment, and appearance of personnel.
- **Reliability:** Ability to perform the promised service dependably and accurately.
- **Responsiveness:** Willingness to help customers and provide prompt service.
- **Assurance:** Knowledge and courtesy of employees and their ability to inspire trust and confidence.
- **Empathy:** Caring, individualized attention the firm provides its customers.

The statistical analysis of the survey was complemented with additional personal, regulatory and macroeconomic control variables. As a result of the statistical analysis all dimensions of the SERVQUAL methodology were identified as representatives, showing the relevance of non technical aspects on overall electricity quality of supply.

One of the main limitations of that analysis was the leak of available data regarding actual values of SAIFI and SAIDI indicators (number of service interruptions and duration respectively). Another relevant limitation of that work was the reduced number of non technical quality of supply related questions, being only five questions for covering a wide range of dimensions.

As it will be widely exposed in the next section, the availability of new data regarding quality of supply has allowed us to perform a new analysis solving the problems stated about the previous model: inclusion of actual data about SAIFI and SAIDI; and inclusion of a wider range of non technical quality of supply related questions.

Statistical analysis of the main aspects affecting quality perception

The analyses performed on this work are based on the IPSOS Consumer Satisfaction Survey of 2006 [8]. This survey was held in all over the 25 countries that were members of the European Union and covered 11 services of general interests; one of them was the electricity supply. The total number of interviews was 29.227, but focusing on the Spanish citizens asked about the electricity supply satisfaction the size of the sample was 510 interviews. The variable of interest is the question about overall quality services, which has values from 0 (lower quality) to 10 (higher quality). The mean overall satisfaction is 6,99 with a standard deviation of 1,63 (Figure 4).

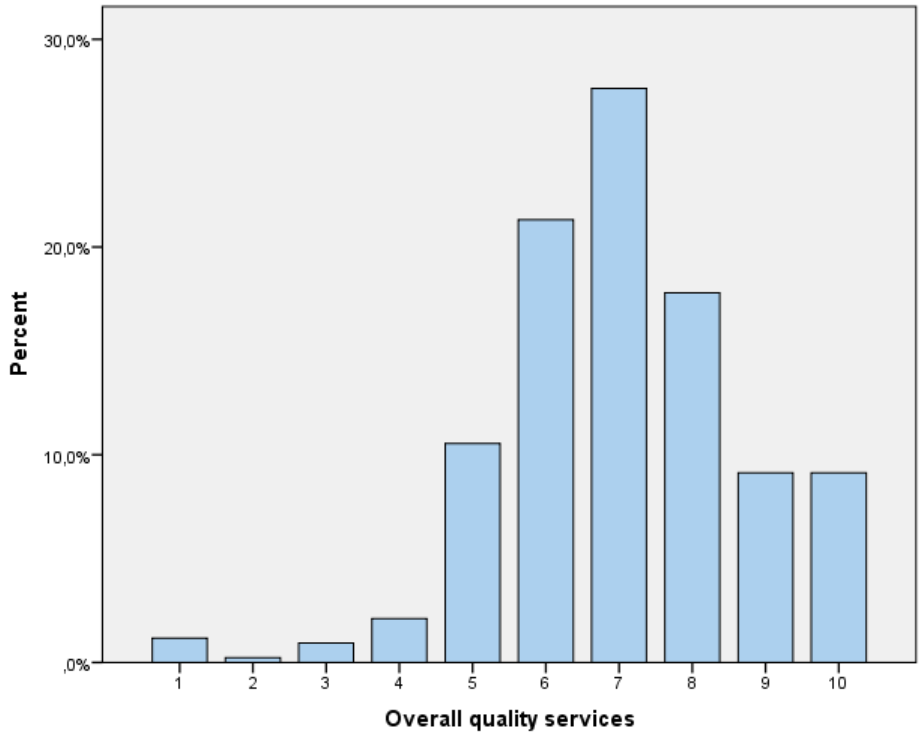

Figure 4: Overall qualification of the electrical quality service.

For explaining this overall perception, in the survey analyzed, there were thirteen questions about electricity quality of service which cover many aspects, such as technical support or confidentiality.

	Mean	**Standard Deviation**
RELIABILITY (SUPPLIER) offers a reliable service i.e. it works well, all the time, without cut offs	7,13	1,69
SAFETY My supplier provides a safe service	7.20	1,69
OFFER - RELEVANCE Their products/services fully meet my needs	6,98	1,79
INFORMATION They inform me regularly about their services and special offers	6,36	1,98
TECHNICAL SUPPORT My supplier offers a high quality technical service when it comes to new installations, repairs, etc	6,80	1,78
QUESTIONS/PROBLEMS HANDLING When contacting them for questions or problems, they react promptly and adequately	6,57	1,86
AVAILABILITY They can always be reached when needed, at any time	6,63	1,85
STAFF Their staff is professional, helpful and friendly	6,94	1,74
CONFIDENTIALITY (SUPPLIER) respects my privacy and demonstrates	7,16	1,75

discretion when dealing with delicate problems		
INFRASTRUCTURE They invest in modernizing their infrastructure	6,96	1,79
POINTS OF SALES They have an agency near to you	6,37	2,09
ORDER EASE It is very easy to buy new services from (SUPPLIER)	7,20	1,69

(Values from 0: Totally disagree to 10: Totally agree)

Table 1. Electricity quality of service questions

As it has been explained, one of the objectives of this study is to combine different sources of information in order to explain the quality perception of the user. Thus, by means of the demographic characteristics of the survey participants, two variables about the technical measurement of the quality of the electrical service have been incorporated: time of interruptions (SAIDI) and number of interruptions (SAIFI). Using the postal code of the survey it could be possible to classify users among urban, semi-urban, semi-rural, and rural from the electricity of supply point of view. In **¡Error! No se encuentra el origen de la referencia.**, the mean of the time of interruption and the number of interruptions for each level of urbanization is showed. It has to be notice that there are few observations from the rural category, so this information can be disregarded. In the case of the comparison between urban and semi-urban places, it seems that semi-urban places have better technical indicators for quality of services, this may be affected by two aspects: (1) the observations from the urban places have greater heterogeneity and asymmetry and (2) the samples from the semi-urban places do not cover all the Spanish geography, they are located in determinate areas, which could influence on the indicators result. For that reason it was finally decided to include only urban customers in the analysis, avoiding the possible effects caused by the survey special characteristics of the subset.

	Urbanization level			
	Urban (n=435, 86,5%)	Semi-urban (n=66, 13,1%)	Rural (n=2, 0,4%)	Total
Number of interruptions	1,84 (0,75)	1,68 (0,52)	0,92 (0,0)	1,82 (0,72)
Time of interruptions	1,26 (0,62)	0,94 (0,31)	0,76 (0,0)	1,22 (0,60)

Mean (standard deviation)

Table 2. Comparison of the technical QoS between the different levels of urbanization

Following the analysis done in the previous section, it is interesting to study the relationship between the answer to the question about overall electrical service quality with the two technical indicators over the different countries involved in the Survey. Figure 5 and Figure 6 represent the overall quality perception together with the time of interruptions and number of interruptions respectively. It can be observed that there is not a direct relationship between the technical indicators and the overall quality of service, the correlation in both cases are not statistically significant (ρ_{time} = -0386, p = 0,126; ρ_{number} = -0,241, p =0,368). This support the idea of other dimensions influencing in the overall quality perception of the user.

Finally, some socioeconomic variables have been taken into account as control parameters (see Table 3).

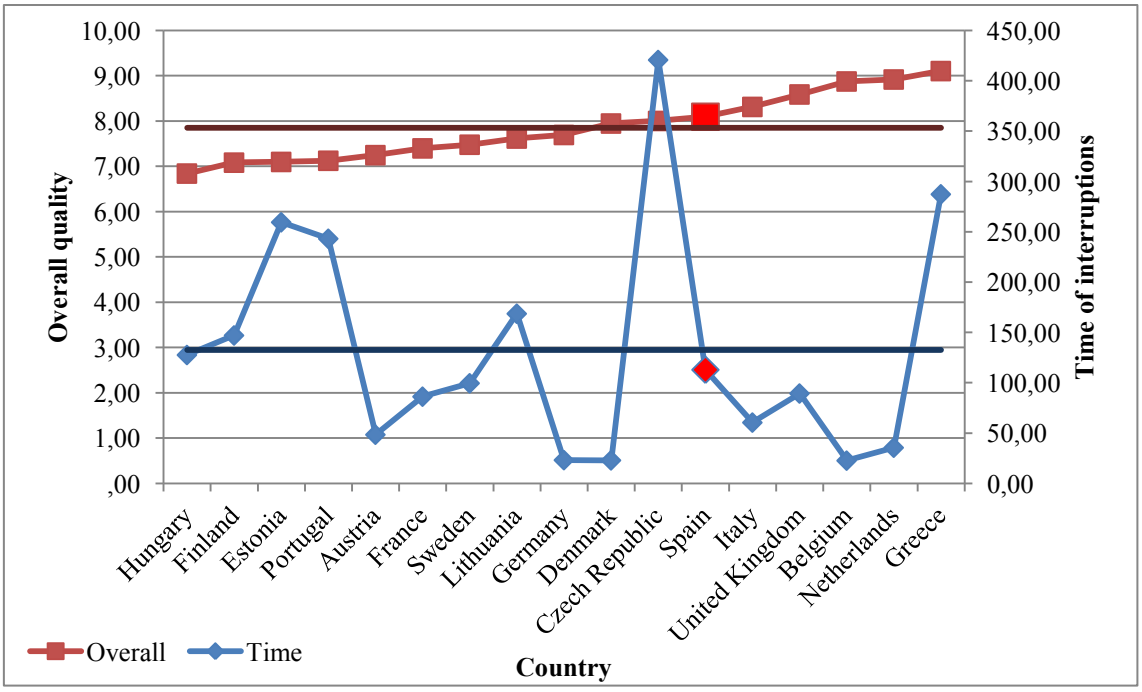

Figure 5: Overall quality perception and time of interruptions over countries.

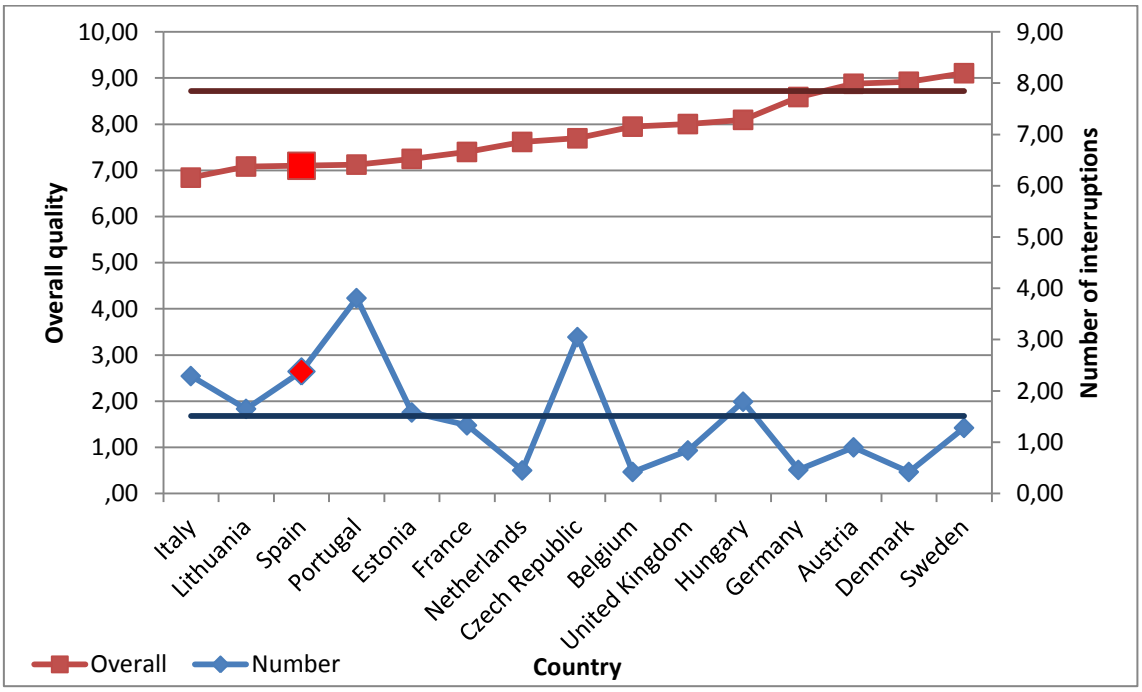

Figure 6: Overall quality perception and number of interruptions over countries.

	Mean	Standard Deviation
Age	41,82	13,56
Age when stopped full-time education	18,07	4,82
Members in the house	3,05	1,28
	N(%)	
Sex		
Men	51,6% (260)	
Women	48,6% (244)	
Employment		
Non-active	29,4% (148)	
Employed	70,6% (355)	

Table 3. Demographic characteristics

Results

Although informative, the results presented in previous section do not allow us to see whether there is any effect on quality perception depending on non technical parameters and commercial quality. In this section we try to shed some light on these issues for the Spanish household electricity market. We analyse consumers' satisfaction with electricity supply across the dimensions of technical quality and commercial quality of supply, depending on a set of information about each respondent and the country they live in.

As satisfaction to different commercial quality dimensions are coded with ordinal variables, we considered in a first approach to use an ordered model for each of them. However, since answers were coded with values from 0 to 10, it was also tested a minimum quadratic model providing more satisfactory results.

After applying the best subsets methodology for choosing the model providing the best fitting considering AIC criteria, the results obtained from the statistical estimation are shown below.

Table 4.a. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,907[a]	,823	,819	,666

Table 4.b ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	723,126	8	90,391	204,018	,000[b]
	Residual	155,069	350	,443		
	Total	878,195	358			

Table 4.b. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,025	,183		,137	,891
	QL.01) **RELIABILITY** (SUPPLIER NAME) offers a reliable service i.e. it works well, all the time, without cut offs	,153	,041	,158	3,784	,000
	QL.02) **SAFETY** My supplier provides a safe service	,086	,039	,092	2,193	,029
	QL.03) **OFFER - RELEVANCE** Their products/services fully meet my needs	,081	,036	,088	2,270	,024
	QL.06) **QUESTIONS/PROBLEMS HANDLING** When contacting them for questions or problems, they react promptly and adequately	,161	,031	,187	5,203	,000
	QL.09) **CONFIDENTIALITY** (SUPPLIER NAME) respects my privacy and demonstrates discretion when dealing with delicate problems	,088	,034	,095	2,557	,011
	QL.10) **INFRASTRUCTURE** They invest in modernizing their infrastructure	,172	,037	,194	4,686	,000
	QL.11) **POINTS OF SALES** They have an agency near to you	,071	,020	,094	3,500	,001
	QL.12) **ORDER EASE** It is very easy to buy new services from (SUPPLIER NAME)	,189	,037	,193	5,154	,000

a. Dependent Variable: QL.15) Quality of service : OVERALL (SUPPLIER NAME) offers high quality services, overall

Table 4. Estimation output.

Table 4 present the results obtained, where coefficients reported are the coefficients of model (1) that can be understood as marginal effects and their magnitude is directly related to their impact on overall quality perception. It can be seen how 8 out 15 commercial quality dimensions are representative and have a positive coefficient. Regarding technical parameters

SAIFI and SAIDI, it can be appreciated how they not appear in the model as representatives, together with socioeconomic parameters.

Table 5 shows the value of the representative dimensions of quality included in the model. It can be appreciated how 4 over 8 dimensions have the highest impact on consumer overall quality perception: reliability, questions/problems handling, infrastructure and order ease.

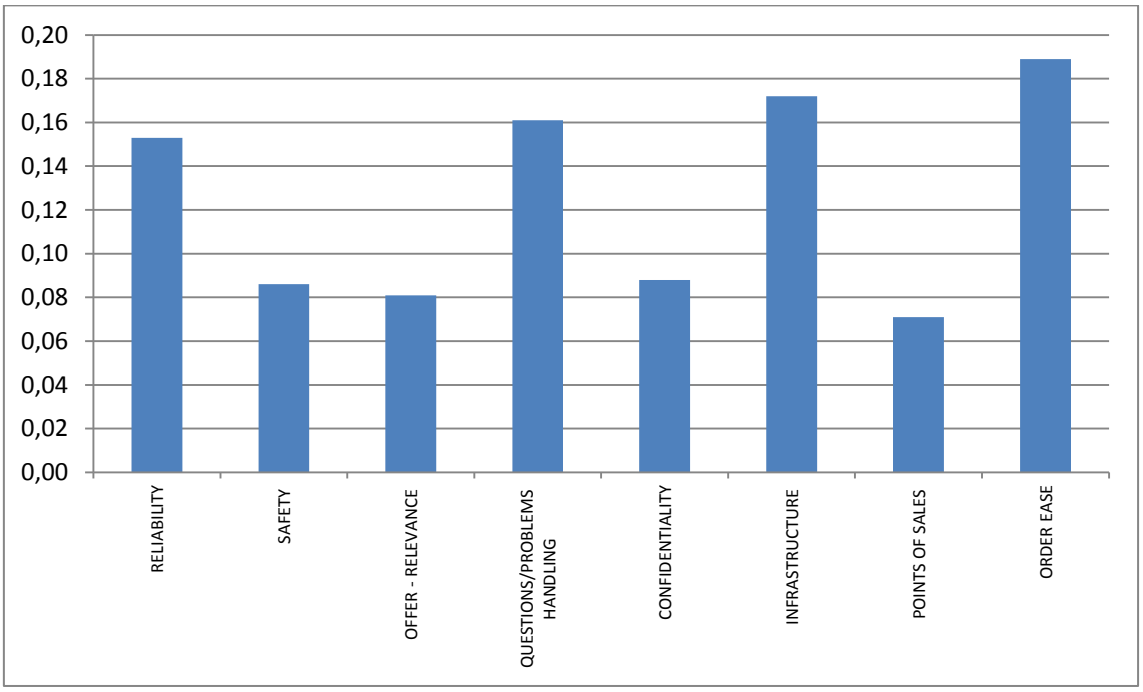

Table 5. Coefficient value of the quality dimensions.

Conclusions and further research

This paper has presented new findings on possible determinants of consumers' overall quality perception for electricity supply in Spain. No actual technical quality values have shown a significant effect on the overall quality. These results reinforce the hypothesis about the relevancy of commercial quality. No socioeconomic aspects contribute to explain the degree of overall quality perception.

The utility reforms in Europe over the last twenty years have often assumed that efficiency and welfare would be enhanced by two institutional changes: privatization and liberalization. In this paper we ask a simple question: are current quality regulations pursuing the proper objectives for ensuring customer satisfaction with electricity supply? Preliminary results of this working paper show how there is not direct relationship among the main regulatory parameters SAIDI and SAIFI and the overall quality perception. Therefore it can be concluded that current regulation of electricity quality of supply is not being focused on the most crucial dimensions from the customer perspective.

In order to provide a clear message about this issue to policy makers, further research will be needed for contrasting the results obtained with the ones obtained by using additional surveys: IPSOS Consumer Satisfaction Survey 2009, Flash Eurobarometer 243, 2008, and Flash Eurobarometer 278, 2009.

Literature

[1] The functioning of the retail electricity markets for consumers in the European Union. Commission Staff Working Paper, 2010.

[2] CEER status review of regulatory approaches to smart electricity grids, July 2011.

[3] The functioning of the retail electricity markets for consumers in the European Union. Final Report, 2010.

[4] CEER 4th Benchmarking Report on Quality of Electricity Supply 2008, December 2008.

[5] Camila Fernandes, Antonio Candela, Tomás Gómez, An approach to calibrate incentives for continuity of supply in the Spanish electricity distribution system, Electric Power Systems Research, Volume 82, Issue 1, January 2012, Pages 81-87, ISSN 0378-7796, 10.1016/j.epsr.2011.08.020.

[6] Costas, A. (2006), «Regulación y calidad de los servicios públicos liberalizados», Papeles de evaluación, 2/2006, Ministerio de Administraciones Públicas, Madrid.

[7] Costas, A. (2007), «De consumidor a ciudadano: el papel de la satisfacción del ciudadano en la sostenibilidad de los mercados de servicios públicos», Revista de economía INFORMACIÓN COMERCIAL ESPAÑOLA, nº 836, 33-50.

[8] IPSOS Consumer Satisfaction Surveys 2007 and 2009: http://ec.europa.eu/consumers/strategy/cons_satisfaction_en.htm

[9] Royal Decree 222/2008. Spanish Ministry of Industry.

[10] Cruz-Zambrano, M. (2010), «Calidad de los servicios públicos percibida por los ciudadanos: la evaluación», V Congreso de la Asociación Española de Economía de la Energía. Vigo, Enero 2010.

[11] Parasuraman, A. [et al.] (1988), «SERVQUAL: A Multiple-Item Scale for Measuring Customer Perceptions of Service Quality», Journal of Retailing, nº64, 1: 12-40.