VARIABLES DETERMINING TOTAL AND ELECTRICAL EXPENDITURE IN SPANISH HOUSEHOLDS

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Abstract

Our aim is to discover the variables influencing total and electrical expenditure in Spanish households in the Survey of Family Budgets. Using a principal component analysis, a cluster analysis, and a stepwise regression analysis, we find that income-related variables are the most influential factor in determining total expenditure; however, dwelling size is the most influential factor in determining electricity expenditure. Regional location is the second most important factor for total household expenditure but not electricity expenditure. We find that electricity expenditure depends on the surface area of the house and the number of people in the household, as well as heating and hot water systems and building type. Energy savings will not only reduce household electricity costs, but will benefit the environment. In general, in a developed consumer society, the determining factors go beyond income and include other lifestyle aspects.

Keywords: total expenditure, electrical expenditure, consumption, incomes, households, principal component, stepwise.

JEL classification: D12, D60, C12, C25.

Introduction

People who live in advanced societies tend to seek a high degree of material well-being, continuous improvement of their living conditions, and the immediate and permanent satisfaction of their needs and desires, both real and fictitious, for several decades already (Brändle, 2010). In addition, market economies in advanced societies tend to experience high levels of consumption and encourage "consumers of vocation" (Bauman, 2007). Because consumption becomes a transcendental determinant for many societies, consumers sense an "obligation" to consume, even when economic, social, or political conditions are not favorable.

To explain behavior patterns linked to expenditure in Spanish households in general and to expenditure on electricity in particular, we use socioeconomic factors such as number of household members, dwelling characteristics, and geography or dwelling location. According to Medina and Vicéns (2011), the socioeconomic factors that explain a household's electricity expenditure include number of household members and monthly income. We believe number of household members, dwelling characteristics, and location determine that expenditure. We believe that electrical expenditure is due to demand for a range of services associated with household equipment, such as lighting, heating, etc., which means that demand is a function of services and not directly of electricity. Meier et al. (2013) consider energy a necessary service for households.

The originality of this paper is not only its combination of three methodologies (principal component analysis, cluster analysis, and stepwise regression), but also its application of recent data for total and electrical expenditure in Spanish households. The objectives of this study are to determine which variables determine both types of expenditure and to what degree. We use household data from the Survey of Family Budgets (SFB). Spain's climate varies; accordingly, we investigate whether living in a geographical area changes both types of expenditure. This study also highlights the importance of consumption (total household expenditure is the dependent variable) as a distinctive element of current advanced societies. Our independent variables correspond to household characteristics, dwelling characteristics, and geographical area. Our working hypothesis try to answer the following questions: Is the income the variable that has the greatest impact on the total expenditure in households? Is the income the variable that has the greatest impact on the electrical expenditure in households? Does the geographical area impact on the total and electrical expenditure in households?

Our paper is structured as follows: section 1 develops the theoretical framework, and section 2 describes data. Section 3 proposes the methodology — specifically, the three methods applied (principal component analysis, cluster analysis, and stepwise regression). The last two sections discuss the results and conclude.

Theoretical framework

Brändle (2007) finds that if consumer items have social influence, social and familial changes over time have an unequivocal influence on consumer trends and patterns. Consequently, consumer society is characterized not only by high material well-being, but also by a configuration that involves the spread of an inherent lifestyle (Castillo, 2001).

We could consider a multitude of dwelling-related variables and living conditions: dwelling size in square meters, the number of people per room, and available utilities and infrastructures, for example. Fernandez-Villaverde and Krueger (2007) propose using age profiles for total consumption and expenditure structures, with particular emphasis on different approaches about changes in demographics. They find that changes in household size are responsible for half of consumption variation. Similarly, Lazear and Michael (1980) examine family size in relation to household incomes per person. Parker et al. (2013) study the distribution of household spending. Additionally, Aldás et al. (2006) provide a framework for the situation and evolution of consumption patterns among Spanish families. They consider 12 groups of consumption expenditure created from the disaggregation of individual consumption by purpose (COICOP) classifications. They conclude that household size generates significant economies of scale, with very important fixed costs in relation to total cost regardless of the number of members. In turn, reductions in the average size of Spanish households may reduce the effectiveness of expenditure and have significant consequences for sustainability. In another area, Ryabov (2016) investigates patterns of household power purchases; Pánková (2016) finds an econometric approach to consumption.

Various researchers also study the demand for electricity. Blázquez et al. (2013), for example, highlight some characteristics of Spanish residential electricity demand, with particular emphasis on the influence of prices, incomes, and weather. Jadraque et al. (2011) propose an energy model in residential sectors in Andalucía (Spain). Romero-Jordán et al. (2014) analyze the determinants of household electricity demand in Spain; they find that incomes affect electricity demand slightly more than prices do. Also, Matsumoto (2016) analyzes residential electricity demand in Japan and finds that family structure and household economic status determine the use of electrical devices. Further, Filippini (2010) finds that price changes have a moderate effect on energy consumption. Reiss and White (2005) show unequal consumer behavior toward price changes in electricity tariffs.

Frederiks et al. (2015) provide a deep review of theory and research on predictors of household energy use. They distinguish between sociodemographic factors (income, labor situation, type/size of housing, size of household, etc.) and psychological factors. However, the empirical evidence of the impact of these variables is not consistent or conclusive. Such inconsistency underlines the complexity of consumer behavior. A multitude of factors influences how households consume and conserve energy.

In the field of clean energy, and as Ameli and Brandt (2015) find, in most OECD countries, the residential sector represents approximately 30% of final energy consumption and CO_2 emissions (IEA, 2013). Furthermore, households make an important contribution to reducing greenhouse gas emissions by adopting energy-efficiency measures and renewable energy technologies. Household information about energy use, energy practices, and energy labels can influence individual decision-making. Furthermore, recent research shows that informing households about their energy or water consumption, comparing them to similar households, and providing conservation advice can generate important savings (Allcott, 2011; Ferraro and Price, 2013). Al Marri et al. (2018) state that the reducing energy consumption in households is a key step toward sustainability. In this regard, it is necessary to improve consumer behavior with respect to energy efficiency. Spain has established a target of 20 % of clean energy in 2020, which is aligned with the 17.5 % of the EU average in 2017, according with Eurostat report (Eurostat, 2019).

Data

We use the most important quantitative variables and some categorical variables from the household file in the Spanish Statistical Institute 2014 Survey of Family Budgets (see table 1) to explain total household expenditure and electricity expenditure. The survey provides information about the type and purpose of consumption expenditure, as well as various characteristics related to household living conditions. The annual survey goes back to 2006. Each household remains in the sample for two consecutive years. Each year, households report all the goods and services they acquire over a 14-day period. However, we apply purchase information over a longer period in order to cover the acquisition of a full range of goods and services susceptible to consumption. One of the SFB's priorities is to obtain estimates of the aggregate annual consumption expenditure for households in the national set and for autonomous communities, as well as their classification according to various household variables.

The annual survey includes a household file for each year, which includes as many records as households in the sample. Eleven different typologies of households are also collected as derived variables, based on different classification criteria, to facilitate estimations according to the most appropriate household typology in each case.

The household file comprises 22,146 households (sample size). After eliminating entries with incomplete data, we end up with 21,330 households. Our dependent variable, *TOTEXP*, is total monetary and nonmonetary annual household expenditure, weighted by time (a typical elevation factor in budget surveys) and population (an elevation factor used in any survey). The consumption expenditure in the SFB refer not only to money that household members spend on certain goods and services for final consumption, but also to the value of things households earn and consume, as well as wages in kind or free or subsidized food and rent. Expenditure is measured via acquisition price, which is the price a buyer actually pays for products at the time of purchase and according to their cash price. We include the real expense for goods and services, as well as the added expenses due to the purchase. The expenditure is recorded when the property changes hands or when the service is completed.

The survey methodology imposes a temporary elevation factor. In the SFB, the study period (time interval of the survey, in this case the year) is different, in general, from the reference period (length of time for acquisitions of consumer goods and services). In the current survey there are five reference periods: biweekly, monthly, quarterly, annual, and last receipt.

The temporary elevation factors (*TEF*) can be included in a single factor, formulated as T/t, where T is the study duration (365 days) and t is the respective reference period. Both measures are in numbers of days. So, for example, for a total household:

Biweekly expenditure $t = 14$, $TEF \approx 26$

Monthly expenditure $t = 30$, $TEF \approx 12$

Quarterly expenditure $t = 90$, $TEF \approx 4$

Annual expenditure $t = 365$, $TEF \approx 1$

Expenditure of last receipt, TEF = number of times paid the receipt in the last 12 months

We use spatial elevation factors to elevate the sample data to the population, so that for a household in the sample, this factor is the number of households in the population that represent the sample household.

Hypotheses: Is the income the variable that has the greatest impact on the total expenditure in households? Is the income the variable that has the greatest impact on the

electrical expenditure in households? Does the geographical area impact on the total and electrical expenditure in households?

Table 1 defines the independent variables. Table 2 includes descriptive statistics of quantitative variables used in the three analyses.

Table 1. Definition of independent variables

Variables used in PCA, cluster, and stepwise regression models	
Net monthly income intervals (*ININTER*)	1. Less than €500 2. €500 to less than €1000 3. €1000 to less than €1500 4. €1500 to less than €2000 5. €2000 to less than €2500 6. €2500 to less than €3000 7. €3000 to less than €5000 8. €5000 to less than €7000 9. €7000 to less than €9000 10. €9000 or more
Number of household members earning income (NUMBEARIN)	0–20 Number
Age of main wage earner (*AGEAR*)	16–84 Other people 85 Persons aged 85 or older
Number of rooms (*NROOMS*)	1–7 Number of rooms (1 to 7) 8 Number of rooms (>7)
Size of municipality (*SIZEM*)	1 Municipality with 100,000 inhabitants or more 2 Municipality with 50,000 or more and fewer than 100,000 inhabitants 3 Municipality with 20,000 or more and fewer than 50,000 inhabitants 4 Municipality with 10,000 or more and fewer than 20,000 inhabitants 5 Municipality with fewer than 10,000 inhabitants
Population density (*DENSI*)	1 Densely populated area 2 Intermediate area 3 Scattered area
Number of household members (*NMEMBERS*)	1-20
Equivalent household size. Oecd scale (*UC1*) 1 + 0,7 * (*NMEM1*[1] - 1) + 0,5 * *NMEM2*[2]	1-150
Exact amount of total net monthly household income (*EXACAMO*)	0–99999
Usable floor area of the dwelling (*FLOOR*)	35 35 meters or less 36–299 meters 300 300 meters or more
Building construction date (*CONDATE*)	1 Less than 25 years ago 6 25 or more years ago
Variables used in stepwise regression models	
Type of residence area (*RESAREA*)	1 Luxury urban 2 Urban high 3 Urban average 4 Urban lower 5 Industrial rural 6 Rural fisheries 7 Rural agrarian
Autonomous community of residence (*AACC*)	The 17 autonomous communities of Spain, Ceuta, and Melilla

[1] Number of household members of 14 or more years.
[2] Number of household members under the age of 14.

Region (*NUTS1*)	1 Northwest 2 Northeast 3 Community of Madrid 4 Central 5 East 6 South 7 Canary Islands
Source of energy for heating (*HEATSOURCE*)	1 Electricity 2 Natural gas 3 Liquefied gas 4 Other liquid fuels 5 Solid fuels 6 Solar energy
Type of building in which the housing is located (*BUILDTYPE*)	1 Independent detached house 2 Semi-detached or semi-detached house **Building with more than one house** 3 With less than 10 homes 4 With 10 or more homes 5 Others (for other purposes or fixed accommodation)

Source: Elaboration based on the Family Budget Survey (2014).

Table 2. Descriptive statistics of variables (quantitative)

	Mean	Standard deviation	N
ININTER	4.1035	1.87796	21330
NUMBEARIN	1.6312	0.70080	21330
AGEAR	54.6219	15.15880	21330
NROOMS	5.1381	1.19403	21330
SIZEM	2.7127	1.61663	21330
DENSI	1.8130	0.85182	21330
NMEMBERS	2.7258	1.25618	21330
UC1	2.1241	0.79500	21330
EXACAMO	1913.4569	1269.96396	21330
FLOOR	103.3180	47.32058	21330
CONDATE	4.1632	2.41050	21330

Source: Elaboration based on the Family Budget Survey (2014).

Methodology

We conduct a principal component analysis (PCA analysis) to group the first 11 variables in table 1 and therefore reduce the dimension. We obtain a new variable or factor with each grouping. The PCA can be applied to a group of variables in order to find out which sets form coherent subsets that are independent from one another (Dunteman, 1989; Everitt and Dunn, 2001; Bartholomew et al., 2008). Platis et al. (2015) is a recent study on PCA in economics.

In general, the principal component extraction is performed on standardized variables or variables expressed as deviations from the average. We use this method to transform a set of variables (interrelated original variables), into a different set of variables, which are linear combination of the original, called principal components. Principal component variables are characterized by being uncorrelated with one another; they can be organized differently. We consider variance as a measure of the incorporated information in a component.

Dunteman (1989) proposes that the first principal component, y_1, is a linear combination of x_1, x_2,..., x_p ($y_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p$) such that the variance of y_1 is maximized considering the constraint that the sum of the squared weights is equal to ($\sum_{i=1}^{p} a_{1i}^2 = 1$). If the variance of y_1 is maximized, then the sum of the squared correlations of y_1 with the original variables x_1, x_2,..., x_p ($\sum_{i=1}^{p} r_{y_1 x_i}^2$) is also maximized. The PCA finds the optimal weight vector (a_{11}, a_{12},…, a_{1p}) and the associated variance of y_1, which is denoted by λ_1. The second principal component, y_2, involves a second weight vector (a_{21}, a_{22},..., a_{2p}) such that the variance of $y_2 = a_{21}x_1 + a_{22}x_2 + \cdots + a_{2p}x_p$ is maximized subject to constraints of uncorrelation with the first principal component ($\sum_{i=1}^{p} a_{2i}^2 = 1$). So, y_2 shows the next biggest sum of squared correlations with original variables. However, the sum of squared correlations with original variables gets smaller as successive principal components are extracted. The first two principal components together show the highest possible sum of squared multiple correlations with p variables.

This process can continue until there are as many components as variables. The first few principal components usually represent the biggest variation in variables. The main results of PCA are the weight vector associated with each principal component, a= (a_{11}, a_{12},…, a_{1p}), and its associated variance, λ.

The determinant of the correlation matrix of the variables is almost zero (0.000). The KMO (Kaiser-Meyer-Olkin measure) value is 0.622 >0.500 (this indicates that the factor model is suitable). Bartlett's test has p=0.000<0.05, which shows significant correlation between the variables. Using the Quartimax rotation system and ordering the coefficients by size, we extract six components or factors (see table 3). The extracted factors explain more than 90% of the variability. In the diagonal of the rotated component matrix (table 3), we highlight in bold saturations >0.500, which indicate high correlation.

Table 3. Rotated component matrix (PCA analysis)[a]

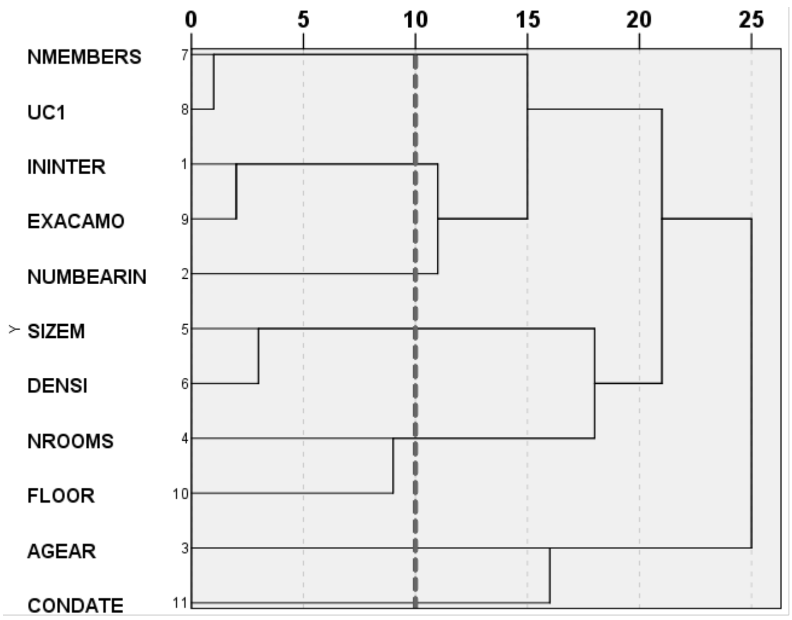
Variables	Component					
	1	2	3	4	5	6
ININTER	**0.944**	0.116	-0.079	0.134	-0.062	-0.081
EXACAMO	**0.934**	0.092	-0.084	0.163	-0.043	-0.074
NUMBEARIN	**0.650**	0.485	0.103	-0.046	0.029	0.200

UC1	0.186	**0.961**	0.007	0.105	-0.025	-0.085
NMEMBERS	0.164	**0.955**	0.003	0.099	-0.044	-0.144
SIZEM	-0.038	0.013	**0.956**	0.120	-0.024	0.003
DENSI	-0.061	0.017	**0.952**	0.136	-0.034	-0.001
NROOMS	0.110	0.129	0.101	**0.872**	0.046	0.123
FLOOR	0.152	0.050	0.161	**0.870**	-0.093	-0.012
CONDATE	-0.091	-0.061	-0.062	-0.049	**0.979**	0.146
AGEAR	-0.055	-0.201	0.001	0.124	0.155	**0.938**

Note: Extraction method: Principal component analysis.
[a] Rotation method: Quartimax with Kaiser normalization.
Source: Elaboration based on the Family Budget Survey (2014).

In figure 1, using a hierarchical cluster analysis and following the squared Euclidean distance method, we again find that the variables in the previous analysis regroup two by two, with the exception of the age of the main wage earner and the building construction date; the distance between these two variables is the highest.[3] Faletar et al. (2016), Hitka et al. (2017) use the same methodology as our study.

Figure 1. Dendrogram combination of rescaled distance clusters



Source: Elaboration based on the Family Budget Survey (2014).

[3] Vilà-Baños et al. (2014) and Pérez (2009).

With the factors (components) obtained from the PCA analysis, we perform a stepwise regression analysis to establish a hierarchy of these (standardized) variables to explain total household expenditure. Sánchez-Sellero et al. (2014) study this technique in economics. Combining these two methods (that is, a regression from the extracted factors of PCA) also occurs in Aizawa et al. (2015) and Sánchez-Sellero and Sánchez-Sellero (2016), where the regression is also stepwise.

We first perform this process with *Total expenditure* as the dependent variable, and then with *Expenditure on electricity in the main dwelling*, because electricity is a major expenditure in Spanish households. The equations to estimate are of the following type (model 2 of table 4):

$$TOTEXP\ i=\beta 0+\beta 1\ factor\ 1i + \beta 2\ factor\ 2i + \beta 3\ factor\ 3i + \beta 4\ factor\ 4i + \beta 5\ factor\ 5i + \beta 6\ factor\ 6i + \epsilon i$$

$$EXPELECT\ i=\beta 0+\beta 1\ factor\ 1i + \beta 2\ factor\ 2i + \beta 3\ factor\ 3i + \beta 4\ factor\ 4i + \beta 5\ factor\ 5i + \beta 6\ factor\ 6i + \epsilon i$$

Table 4 shows several stepwise regressions; there are several models for which the process is the same but the dependent variable changes for total expenditure versus electricity expenditure. In model 1, the independent variables are the first 11 variables in table 1 (original variables). Model 2 explains the previous equations (factors resulting from the PCA analysis), model 3 adds geographic information variables, and model 4 adds energy and building variables.

Table 4. Types of stepwise regression models and hierarchy of independent variables. Dependent variables: *TOTEXP* and *EXPELECT*

Dependent Variable: *TOTEXP*			Dependent Variable: *EXPELECT*			
Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
ININTER	Factor 1	Factor 1	ININTER	Factor 1	Factor 1	Factor 1
NUMBEARIN	Factor 2	Factor 2	NUMBEARIN	Factor 2	Factor 2	Factor 2
AGEAR	Factor 3	Factor 3	AGEAR	Factor 3	Factor 3	Factor 3
NROOMS	Factor 4	Factor 4	NROOMS	Factor 4	Factor 4	Factor 4
SIZEM	Factor 5	Factor 5	SIZEM	Factor 5	Factor 5	Factor 5
DENSI	Factor 6	Factor 6	DENSI	Factor 6	Factor 6	Factor 6
NMEMBERS		AACC	NMEMBERS		AACC	AACC
UC1		NUTS1	UC1		NUTS1	NUTS1
EXACAMO		RESAREA	EXACAMO		RESAREA	RESAREA
FLOOR			FLOOR			HEATSOURCE
CONDATE			CONDATE			BUILDTYPE
HIERARCHY OF VARIABLES						
EXACAMO	Factor 1	Factor 1	FLOOR	Factor 4	Factor 4	Factor 4
SIZEM	Factor 3	NUTS1	UC1	Factor 2	Factor 2	Factor 2
FLOOR	Factor 4	Factor 3	EXACAMO	Factor 1	Factor 1	HEATSOURCE

AGEAR NMEMBERS UC1 ININTER NUMBEARIN NROOMS	Factor 6 Factor 5 Factor 2	Factor 4 Factor 6 RESAREA Factor 2 AACC Factor 5	DENSI CONDATE AGEAR NROOMS ININTER NUMBEARIN NMEMBERS	Factor 5 Factor 3	Factor 5 Factor 3 RESAREA NUTS1 AACC	BUILDTYPE Factor 1 NUTS1 Factor 3 RESAREA Factor 5 AACC Factor 6
R = 0,416	**R = 0,396**	**R = 0,474**	**R = 0,368**	**R = 0,357**	**R = 0,365**	**R = 0,409**

Model 1: Regression with original variables.
Model 2: Regression with PCA factors.
Model 3: Regression with PCA factors + geographic information variables.
Model 4: Regression with PCA factors + variables of geographic information + variables of energy source and type of building.
Source: Elaboration based on the Family Budget Survey (2014).

Tables 5 and 6 show the summary of models that explain better total and electricity expenditure. Tables 5 and 6 are models 3 and 4 respectively for each case.

Table 5. Summary of the third stepwise regression model. Dependent variable: *TOTEXP*[j]

Step	R	Standard error of estimation	Change in R^2	Change in F	Sig.	Durbin-Watson
1	0.313[a]	19497993.91	0.098	2320.383	0.000	
2	0.411[b]	18715386.92	0.071	1822.007	0.000	
3	0.437[c]	18468841.83	0.022	574.199	0.000	
4	0.453[d]	18304712.33	0.014	385.154	0.000	
5	0.464[e]	18190679.49	0.010	269.200	0.000	
6	0.468[f]	18149592.45	0.004	97.656	0.000	
7	0.471[g]	18112495.44	0.003	88.435	0.000	
8	0.474[h]	18083868.20	0.002	68.560	0.000	
9	0.474[i]	18076808.30	0.001	17.657	0.000	2.018

a. Predictor variables: (Constant), factor 1
b. Predictor variables: (Constant), *NUTS1* is added to the previous
c. Predictor variables: (Constant), factor 3 is added to the previous ones
d. Predictor variables: (Constant), factor 4 is added to the previous ones
e. Predictor variables: (Constant), factor 6 is added to the previous ones
f. Predictor variables: (Constant), *RESAREA* is added to the previous ones
g. Predictor variables: (Constant), factor 2 is added to the previous ones
h. Predictor variables: (Constant), *AACC* is added to the previous ones
i. Predictor variables: (Constant), factor 5 is added to the previous ones
j. Dependent variable: *TOTEXP*
Source: Elaboration based on the Family Budget Survey (2014).

Table 6. Summary of the fourth stepwise regression model. Dependent variable: *EXPELECT*[l]

Step	R	Standard error of estimation	Change in R^2	Change in F	Sig.	Durbin-Watson
1	0.221[a]	441.79320700	0.049	722.557	0.000	
2	0.288[b]	433.84678120	0.034	521.175	0.000	
3	0.329[c]	427.86752920	0.025	396.991	0.000	
4	0.366[d]	421.65736840	0.026	418.468	0.000	
5	0.396[e]	416.04667060	0.023	382.993	0.000	
6	0.401[f]	414.99755990	0.004	72.212	0.000	
7	0.406[g]	414.14461210	0.004	58.999	0.000	
8	0.407[h]	413.96142330	0.001	13.451	0.000	
9	0.407[i]	413.80500180	0.001	11.635	0.001	
10	0.408[j]	413.69284390	0.001	8.626	0.003	
11	0.409[k]	413.60810550	0.000	6.763	0.009	1.996

a. Predictor variables: (Constant), factor 4
b. Predictor variables: (Constant), factor 2 is added to the previous
c. Predictor variables: (Constant), *HEATSOURCE* is added to the previous ones
d. Predictor variables: (Constant), *BUILDTYPE* is added to the previous ones
e. Predictor variables: (Constant), factor 1 is added to the previous ones
f. Predictor variables: (Constant), *NUTS1* is added to the previous ones
g. Predictor variables: (Constant), factor 3 is added to the previous ones
h. Predictor variables: (Constant), *RESAREA* is added to the previous ones
i. Predictor variables: (Constant), factor 5 is added to the previous ones
j. Predictor variables: (Constant), *AACC* is added to the previous ones
k. Predictor variables: (Constant), factor 6 is added to the previous ones
l. Dependent variable: *EXPELECT*
Source: Elaboration based on Family Budget Survey (2014).

Discussion

From the PCA analysis (table 3), factor 1 is mainly characterized by three household income variables (total income, number of wage earners, and monthly income interval); factor 2 includes two variables related to the people living in the dwelling (number of members and household size according to the OECD); factor 3 refers to the municipality (size of municipality and population density); factor 4 refers to dwelling size (floor area and number of rooms); factor 5 is the building construction date; and factor 6 is the age of the main wage earner.

The dendrogram (figure 1), considers on the horizontal axis (from 0 to 25) the distances between the variables. Although there may be subjectivity when counting the number of clusters, we can observe four clusters (indicated to the left of discontinuous line in figure 1) because the distances to the right of that hypothetical vertical line on the graph are a lot greater.

In the stepwise regression analysis, if the dependent variable is total household expenditure (table 4), the factor exerting the most influence is income (factor 1), followed by the size of municipality and dwelling size (factors 3 and 4, models 1 and 2). The results of the expenditure equation in Muñoz (2004) are in line with expectations for some variables, and the main determinant of expenditure is income.

However, to explain electricity expenditure in the main dwelling (table 4 and table 6), the first factor in order of importance is dwelling size (factor 4); the age of the main wage earner is no longer in the model. This result is according to Medina and Vicéns (2011), who use the same survey but with other methodologies; they show that household size (number of members) and housing (square meters) are the most influential variables in household electrical expenditure. In the same way, income affects energy expenditure differently than how it affects total household expenditure despite the positive relation between income and total household expenditure (Wei et al., 2014).

Household size is another key variable for total energy expenditure, electricity expenditure, and gas expenditure. However, Yue et al. (2013) consider a big conceptual framework with four factors (sociodemographic factors, consciousness of energy saving, behavior capacity, and situational factors). Their empirical results show that sociodemographic characteristics such as age, gender, income, household structure, and education level all influence energy-saving behaviors. They study a country with different consumption habits from Spain. In addition, they recognize situational differences among geographical areas. Hamnett (2009) shows that welfare spending is a key component of government expenditure and that it has a distinct regional and local geography. The models' goodness of fit is not high, because we do not include the personal characteristics of people living in the household.

According to the results in table 4, we affirm that region (*NUTS1*) is the second most important explanatory variable for total expenditure. That is not the case for electrical expenditure, however. Of course, not all regions have the same standard of living, and therefore their total expenditure may vary.

For electricity expenditure, we find that two variables (energy source and type of building) are the third and the fourth relevant explanatory variables after housing size and household size. That is to say, electrical expenditure depends not only on the surface area of the house and the number of members in the household, but also on the system used for heating and hot water, as well as building type.

The Durbin-Watson statistics of tables 5 and 6 are around 2, which justify the validity of models. We choose models with higher R^2, which have the higher goodness of fit (models 3 and 4 explain total and electricity expenditure, respectively).

Conclusions

Capitalism depends on consumption — a fact that does not go unnoticed by leaders even in an economy's most difficult moments. Consumer confidence is thus a useful tool to interpret and predict private consumption in Spain. This is the basis, on which we analyze current consumer trends and determinants of expenditure in Spanish households.

In explaining total expenditure among Spanish households, the first variable in order of importance is household income. However, for electricity expenditure, the most influential independent variables are floor area and number of rooms in the dwelling. The results of our models show that total expenditure in the region (*NUTS1*) is the second relevant explanatory variable after income, though this is not the case for electricity expenditure. For electricity expenditure, we find that two variables (energy source and type of building) are the third and the fourth relevant explanatory variables after housing size and household size. That is to say, electricity expenditure depend not only on housing surface and the number of members in the household, but also heating and hot water system, as well as the type of building.

Our empirical analysis confirms our initial theory that the most influential factors in total and electrical expenditure are cultural and consumption habits in Spanish society. Moreover, our intuition is that geographical scope – country – is also a factor to consider in the study of both types of expenditure. Other research could produce different results if done in another country with more or less development, or with different cultural habits.

Two variables (energy source and type of building) are relevant to explain electrical expenditure in households. Energy source and type of building are related each other, because energy source could be better than another, depending on the type of building. Improving the efficiency of energy use, as well as increasing energy production from renewable sources, will not only reduce electrical expenditure in households, but also will benefit the environment.

Energy efficiency aims to reduce energy consumption. It is not only about saving light, but for example, lighting better by consuming less electricity. Households and organizations, which are direct consumers of energy, can reduce energy consumption to reduce costs and to promote economic, political and environmental sustainability. Spain has established a target of 20 % of clean energy in 2020, which is aligned with the 17.5 % of the EU average in 2017. The residential sector currently represents around 30% of final energy consumption and CO_2 emissions. Households can make an important contribution to reduce greenhouse gas emissions. Some authors have already stated that a reduction in energy consumption in households is a key step towards sustainability. For this purpose, it would be good if the consumer behavior improves in relation to energy efficiency, the information about the energy use in households and the understanding of energy practices.

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