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REGIONAL HETEROGENEITY IN THE INTERTEMPORAL SUBSTITUTION IN SPAIN

(PRELIMINARY VERSION)

*Antonio Cutanda Tarín**

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* University of Valencia, Spain.

e-mail autor: antonio.cutanda@uv.es

Correspondence: Antonio Cutanda Tarín
Departamento de Análisis Económico Facultad de Economía
Avda. de los Naranjos, s/n 46022-Valencia
Phone: 96 382 82 35. Fax: 96 382 82 49

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Abstract

In this paper the three first-order conditions of intertemporal optimization in an individual's choice model of consumption and leisure are nonlinearly estimated. Spanish regional data reject the model for leisure, whose results imply a non-concave utility function, although are more favorable to the hypothesis of intertemporal substitution for consumption, both for total and food expenditure. Moreover, nonlinear estimates of elasticity of intertemporal substitution of consumption are higher than usually resulting estimates with log-linearized first-order conditions.

Keywords: Euler equation, Instrumental variables, Intertemporal Substitution, Regional data.

JEL Code: C23, C26, C36, E21, E24, J22

1. Introduction.

The real business cycle theory is based on the assumption that cyclical fluctuations in consumption and employment are the result of optimizing behavior of rational economic agents in the absence of additional restrictions to the usual budget constraint. This paper estimates nonlinearly a model with these features with a regional database for the Spanish economy, obtaining results that are contrary to the implications of this theory.

The model analyzes the first order conditions of intertemporal optimization of a representative agent model, from a utility function both separable and no separable in leisure and consumption. These equations are estimated both separately and as a system of simultaneous equations by nonlinear techniques, following the proposal of Hansen and Singleton (1982), replicating for the Spanish case the analysis by Mankiw, Rotemberg and Summers (1985) with aggregated data for the US economy. Thus, this paper reviews the results in Cutanda (2015), where the log-linearized version of the first-order conditions from the same model, with a intratemporally separable utility function, with the same data used here, was estimated.

In that sense, this work is part of the program of empirical research on the value of the intertemporal elasticity of substitution, both from consumption and leisure. As is well known, the consensus on the results of that research for different countries, different periods, with data of different nature and different estimation techniques, is mostly contrary to the hypothesis of intertemporal substitution of leisure[1], although it is more favorable, albeit with difficulty, to intertemporal substitution of consumption[2].

Moreover, currently the literature questions widely the validity of the results of estimation of log-linearized Euler conditions, due to bias introduced in the analysis by the log-linearization procedure used. Since in Cutanda (2015) the results were very unfavorable to the hypothesis of intertemporal substitution of leisure, the question is whether the use of non-linear estimation methods can reverse these results, the main objective underlying this work. On the other hand, to the extent that the results obtained are free of bias attributable to log-linearization, we wait more reliable values of the parameters of the utility function than

[1] Recently, there have been some attempts to reconcile the different empirical results obtained in the analysis of intertemporal elasticity of substitution of leisure. See Chetty, Guren, Manoli and Weber (2011), Ljungqvist and Sargent (2011) and Keane and Rogerson (2012).

[2] On the estimation of intertemporal elasticity of substitution of consumption, you can see Deaton (1992).

those obtained using linear estimation techniques, provided that the estimation method used makes it possible to estimate these parameters.

In this frame, confirming the results obtained for other economies, our results are contrary to the hypothesis of intertemporal substitution of leisure, so they imply negative values of their intertemporal elasticity of substitution and, therefore, a not concave utility function. Meanwhile, and according to the above mentioned consensus, the results are more favorable to the hypothesis of intertemporal substitution of consumption.

The structure of work is as follows: section 2 presents the theoretical model and the first order conditions to be estimated; section 3 presents the estimation procedure and data; section 4 discusses the results and section 5 concludes.

2. The theoretical model.

Following MaCurdy (1981 and 1983), we assume an individual who chooses their consumption and leisure levels, respectively, C_t and L_t, at time t maximizing the following expected lifecycle utility function:

$$\underset{C_t L_t}{Max}\, U = E_t \sum_{i=0}^{T-t} \beta^i u\left(C_{t+i}, L_{t+i}\right) \qquad [1]$$

subject to the following budget constraint, which determines the evolution of individual financial wealth over time:

$$A_{t+i+1} = R_t \left[A_{t+i} + W_{t+i} N_{t+i} - P_{t+i} C_{t+i}\right] \qquad [2]$$

where U is the intertemporally separable utility function, and $u(.)$ is the uniperiod utility function, assumed increasing and concave in its two arguments. E_t is the mathematical expectations operator, conditional on the information set available at time t, and β is the discount rate. A_t is the financial nonhuman individual wealth, R_t is the nominal interest rate, W_t is the wage per hour worked, N_t is the number of hours worked by the individual and C_t her real consumption, all in period t. P_t is, then, the nominal price of a unit of C_t and $L_t = L^* - N$ is the number of hours of leisure enjoyed by the individual, where L^* is the total number of available hours in this period t.

As usual, both hourly wage and the nominal price of consumption are considered exogenous, independent of individual behavior.

From the previous budget constraint, we obtain the life cycle budget constraint, that, if there are no bequests (A_T=0), is given by:

$$\sum_{i=0}^{T-t} R_t^{-i} P_{t+i} C_{t+i} = A_t + \sum_{i=0}^{T-t} R_t^{-i} W_{t+i} N_{t+i} \qquad [3]$$

We are assuming that the individual operates in a perfect capital market, where he can lend or borrow at the same interest rate, *R*, in any period.

From the definition of the following value function *V*, which represents the maximum utility expected by the consumer in *t+1*, from their choice of consumption and leisure:

$$V(A_{t+1}) = Máx E_{t+1} \left\{ \sum_{i=1}^{T-t} \beta\, U(C_{t+i}, L_{t+i}) \right\} \qquad [4]$$

and under the principle of optimality of Bellman, the previous optimization problem is equivalent to:

$$V(A_t) = \underset{C_t, L_t}{Máx} \{ U(C_t, L_t) + \beta E_t V(A_{t+1}) \} \qquad [5]$$

where the following expression is derived

$$V'(A_t) = R\beta\, E_t V'(A_{t+1}) \qquad [6]$$

which allows to obtain the first order conditions, result of individual optimization:

$$\frac{W_t}{P_t} \frac{\partial u / \partial C_t}{\partial u / \partial L_t} = 1 \qquad [7]$$

$$E_t \beta \frac{\partial u / \partial C_{t+1}}{\partial u / \partial C_t} \frac{P_t R_t}{P_{t+1}} = 1 \qquad [8]$$

$$E_t \beta \frac{\partial u / \partial L_{t+1}}{\partial u / \partial L_t} \frac{W_t R_t}{W_{t+1}} = 1 \qquad [9]$$

Along the individual optimization's path, these three conditions must be satisfied simultaneously. At the optimum, the fulfilment of [7] implies that, given C_t and W_t, the individual cannot improve altering marginally their consumption in return for changing their level of leisure, or vice versa. The satisfaction of the Euler condition of consumption [8] implies that, given R_t, P_t and P_{t+1} along the optimization's path, the individual cannot increase their utility level between periods *t* and *t+1* reallocating consumption between them. On the other hand, the satisfaction of the condition [9] implies that, along this path optimization, and given in this case R_t, W_t and W_{t+1}, the individual cannot increase their utility between periods t and $t+1$ reallocating their leisure between them[3].

From this point, it is required to specify a functional form of the utility to derive a testable expression for the model. In this area, although you can find many different uniperiod utility functions in the literature, all of them obey the same general pattern, with very slight changes. Basically, it is a generalization of the CRRA utility function, which stands for *constant relative risk aversion*, widely used in the analysis of aggregate consumption, to which is incorporated the additional argument that represents leisure. In this regard, Mankiw, Rotemberg and Summers (1985) propose the following expression:

$$u(C_t, L_t) = \frac{1}{1-\gamma}\left[\frac{C_t^{1-\alpha_0}-1}{1-\alpha_0} + d\,\frac{L_t^{1-\alpha_1}-1}{1-\alpha_1}\right]^{1-\gamma} \qquad [10]$$

where γ, α_0, α_1 and d are all non-negative parameters. Note that this utility function has, as a particular case an additively separable function in consumption and leisure ($\gamma = 0$), where $1/\alpha_0$ is the elasticity of intertemporal substitution of consumption and $1/\alpha_1$ is the elasticity of intertemporal substitution of leisure. As is well known, the first is the percentage change in consumption growth, C_{t+1}/C_t over the percentage change in the real interest rate, P_tR_t/P_{t+1}, the *real interest rate adjusted with prices*, while the second is the percentage change in the leisure growth, L_{t+1}/L_t on the percentage change in W_tR_t/W_{t+1}, the *real interest rate adjusted with wages.*

From here, in Cutanda (2015) the model was log-linearized, imposing intertemporal separability between leisure and consumption, to obtain testable expressions of the first order conditions, which thereupon were estimated with our same data, treated as a panel. This procedure, widely used in the empirical literature of aggregate consumption, does not allow retrieve estimated values for all parameters of the utility function, except under very specific and demanding assumptions.

In addition, the estimation of log-linearized Euler equations is increasingly questioned: Ludvigson and Paxson (2001), from simulation techniques applied to a standard model of precautionary saving[4], found that log-linear approximations to standard Euler equation of

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[3] Analytically, as indicated by Mankiw, Rotemberg and Summers (1985), one of these conditions is redundant, which is easily verifiable. However, given the unlikelihood that [7] is verified exactly in data, these same authors consider that it is appropriate to contrast empirical and simultaneously the three equations, not being efficient the alternative of not doing in this way.

[4] This hypothesis is often tested regressing consumption growth on measures of uncertainty, deriving the equation to estimate from a second order's Taylor series of the Euler equation of consumption.

consumption will give very poor results provided that such equations are non-linear enough, being affected by significant bias in the estimation of the coefficient of relative risk aversion with panel data, that they call approximation bias[5]. The bias found by these authors amounts to between 12% and 30% in OLS estimates and 60% in IV estimates, precisely the most common in literature. On the same line, Carroll (2011) shows, using also simulation techniques, that standard methods of estimating log-linearized Euler equations with panel data are unable to recover the model's structural parameters, as is the coefficient of relative risk aversion , and therefore the elasticity of intertemporal substitution. This is because to the omission of higher order terms of log-linearization which are endogenous both with respect to the lower order terms of the same as with omitted variables, making it impossible to estimate it consistently. Nothing suggests that these biases do not have also be present in the estimates with aggregate data of log-linearized versions of first order condition of consumption; in fact, Reis and Fernandes (2015) get an estimate of the elasticity of intertemporal substitution of consumption much higher than usual when estimate a log-linearized Euler equation with aggregate US data, taking into account explicitly precautionary saving, that is, the above higher-order terms of log-linearization, traditionally ignored, as mentioned.

For all these reasons, non-linear estimators are required to estimate the first order conditions of individual optimization, according to Hansen and Singleton (1982), as do Mankiw, Rotemberg and Summers (1985), hereinafter MRS, with aggregated data from the US economy. In our case, we will follow this proposal with a regional database of the Spanish economy, which, when treated as time series, allow to analyze the homogeneity of the regional behavior of intertemporal substitution of Spanish consumption and leisure, not possible in our previous work, already mentioned.

It is therefore necessary to propose a utility function with which to engage the task. In our case, we will consider sequentially, as MRS, various alternative cases of the utility function. First, we will study the case where the utility function is intratemporally separable between leisure and consumption and then an alternative non-separable utility function in these same

[5] The explanation for the bias is that the instruments are correlated with higher order moments of consumption growth that are in the error term of the linearized equation.

arguments[6]. In the separable case, we assume that the utility function is isoelastic for both consumption and leisure. Thus, the separable utility function we consider is:

$$U = \frac{C_t^{1-\alpha_0}}{1-\alpha_0} + \frac{L_t^{1-\alpha_1}}{1-\alpha_1} \qquad [11]$$

in which case the respective first order conditions are:

$$\frac{W_t}{P_t}\frac{C_t^{-\alpha_0}}{L_t^{-\alpha_1}} = 1 \qquad [12]$$

$$E_{t+1}\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\alpha_0}\frac{P_t R_t}{P_{t+1}} = 1 \qquad [13]$$

$$E_{t+1}\beta\left(\frac{L_{t+1}}{L_t}\right)^{-\alpha_1}\frac{W_t R_t}{W_{t+1}} = 1 \qquad [14]$$

Secondly, we assume that the utility function is non-separable in consumption and leisure, by verifying the following expression:

$$u(C_t, L_t) = \frac{1}{\mu}\left[\left(\frac{C_t^{1-\alpha_0}}{1-\alpha_0}\right)\left(\frac{L_t^{1-\alpha_1}}{1-\alpha_1}\right)\right]^{\mu} \qquad [15]$$

being μ nonnegative. From this utility function, the first order conditions of the model become:

$$\frac{W_t}{P_t}\frac{C_t^{-\alpha_0}}{L_t^{-\alpha_1}} = 1 \qquad [16]$$

$$E_t\beta\left(\frac{C_{t+1}}{C_t}\right)^{\mu(1-\alpha_0)-1}\left(\frac{L_{t+1}}{L_t}\right)^{(1-\alpha_1)(\mu-1)}\frac{P_t R_t}{P_{t+1}} = 1 \qquad [17]$$

$$E_t\beta\left(\frac{L_{t+1}}{L_t}\right)^{\mu(1-\alpha_1)-1}\left(\frac{C_{t+1}}{C_t}\right)^{(1-\alpha_0)(\mu-1)}\frac{W_t R_t}{W_{t+1}} = 1 \qquad [18]$$

expressions that are directly testable with nonlinear estimation techniques[7]. Note that the expression of the static first order condition, or intratemporal condition, equation [16], is identical with respect to the separable case considered before, equation [12].

[6] Eichembaum, Hansen and Singleton (1988) perform a similar approach, although they consider a utility function in which leisure and consumption are simultaneously not intratemporally and not intertemporally separable.

[7] It should be noted that in the subsequent empirical analysis, along with the case where μ is settled free, we examine also the case μ = 1, with similar results.

It is important to note that, as in Cutanda (2015), the empirical test of the model requires the fulfillment of the above three first order conditions. In that sense, we are assuming that no violations of the canonical model of intertemporal choice occur, such as, for example, liquidity constraints in the field of consumption, or involuntary unemployment in that of the labor supply[8].

The equations [16], [17] and [18] are estimated separate and jointly. In that sense, MRS criticize the widespread practice, especially in the empirical literature of consumption, of isolating estimation of equation [13] regardless of the information contained in the other two first-order conditions, which may have an impact on efficiency of resulting estimators[9].

Finally, it should be noted that, since we are dealing with a representative agent model, C_t and L_t are measured in the empirical analysis in per capita terms, from the corresponding aggregate data, while W_t has the character of average salary. As Alogoskoufis (1987) points out, the assumption of representative agent applied to aggregate data circumvents some problems in this area that would be more serious with individual data, as is the modeling of the individual decision of participation in the labor market through a discrete choice model. Thus, according to this author, aggregation reduces these problems, given the assumption that participation decisions within each household, or between different households, are not synchronized.

3. The estimation procedure and data.

Since our data are the same that in Cutanda (2015), this section summarizes, in good measure, the corresponding section of that work. It should be noted that, in the estimation of any of the first-order conditions discussed in the previous section, we will solve the expectations operator applying rational expectations, so the error term of any of them will be independent of all the variables dated in t or before. Moreover, note that in the above equations, the nominal interest rate has no individual variability, contrary to the real interest rate, which is provided by the series of prices.

[8] In Cutanda (2003), the consequences of the presence of liquidity constraints in the Spanish consumption with data from the Continuous Household Budget Survey between 1985 and 1993 are analyzed, while in Cutanda (2013) the empirical adjustment of the intertemporal consumption condition is explored using similar estimation techniques to those used here.
[9] See note 3.

Therefore, our sample consists of the 17 Spanish autonomous communities[10], $i = 1, ..., 17$, of which we have available information about consumer spending, leisure hours, obtained from hours worked, wages and prices. To these, it is added the data of Spain obtained in the same database.

The model is estimated by the generalized method of moments, GMM, applied either separately to each of the first order conditions, either to the set of them, taken as a model of simultaneous equations, as appropriate. GMM estimators used are robust to heteroskedasticity and autocorrelation of first order of residuals.

Because by not treating the data as a panel, it is not necessary to remove the fixed effects, whose values are estimated directly. That is to say, the model is no differenced, on the Anderson-Hsiao mode, nor the time average of the variables is discounted, because the problems of endogeneity of regressors common in studies with panel data are not present. However, instrumental variables are important in estimating the model, given the hypothetical presence of measurement error, especially in all the variables related to labor supply. Since our measure of leisure hours is obtained from the number of hours worked and the salary used is also obtained from the same number and the income variable, measurement errors on hours worked and wages can be negatively correlated, as Altonji (1986) points out, and can lead to negative estimates of the intertemporal elasticity of substitution of leisure, as happens to MRS. Moreover, also measures of consumer spending may be affected by the problem of measurement error, as Altonji and Siow (1987) report. Assumed all these measurement errors are white noise, instruments dated t-2, or before, are robust to their presence, which is the solution adopted in this work, common in the literature. For added security, in our case only they have been taken instruments dated t-3 or before, so our results are robust to first order autocorrelated measurement errors. In any case, the estimation results are verified by Sargan tests of over-identifying restrictions to verify the absence of correlation between the instruments and the error term.

Entering to the detail of the data used and the construction of the variables, the database used has been the BDMORES, base 2008, but have also been used data from the Regional Accounting of Spain, CRE, also in base 2008, which are not considered in previous

[10] Our database is the BDMORES, which adds data from the autonomous cities of Ceuta and Melilla in Andalusia, providing the total number of regions cited.

mentioned database, along with other additional variables from other statistical sources[11]. Currently, the BDMORES, base 2008, provides information of variables from the Spanish autonomous communities, both nominal and real, and related both the supply and demand sides, for different time periods that, at best, extend from 1955 to 2010, or 2011, depending on the case.

Specifically, for our purposes, the BDMORES provides consumer spending data, nominal and real, between 1967 and 2010. Moreover, it also presents data of labor income between 1955 and 2011[12]. Unfortunately, it does not provide data on hours worked, although if it does the CRE since 2000, both for employees and for the total occupied. Despite the broad time period of the series of expenditure and revenue obtained from the BDMORES, the fact that the hours of work of the CRE were only available since 2000 is a major handicap, which we attempt to solve extending back in time the number of hours worked by various procedures. Thus, we obtained an increase in the number of observations until 1996, applying to the number of hours available the rate of growth in hours worked for each region in the Wage Survey for Industry and Services (2nd quarter). It was thus obtained a series of hours worked by autonomous communities, for employees between 1996 and 2012[13].

Since our dependent variable is leisure hours, following MRS, they are estimated by discounting the hours worked from the "annual allocation of available hours". Such "annual allocation of available hours" was obtained by multiplying the number of days available per year by 16 and by the number of individuals (which are given by the number of employees provided by the BDMORES). It is thus obtained a series of annual hours of leisure by autonomous communities for employees, between 1996 and 2011[14]. As MRS indicate, this specification is subject to criticism, since it does not distinguish between changes due to alteration in the number of workers and changes due to the alteration of the average number of hours worked[15].

[11] On the BDMORES, you can see Daban, Diaz, Escribá and Murgui (2002) and De Bustos Diaz, Cutanda, Escribá, Murgui and Sanz (2008), available in http://www.sepg.pap.minhap.gob.es/sitios/sepg/es-ES/Presupuestos/Documentacion/Paginas/Documentacion.aspx.

[12] Labor income, or any other variable that BDMORES or CRE provided only in nominal terms, had been expressed in real terms by using the corresponding CPI, base 2008.

[13] The same procedure was applied to the hours worked by occupied, verifying that the results were invariant to the consideration of one or another set of hours worked, so the results with this latter series are not reported.

[14] The data available on the BDMORES, base 2008, of employees for 2012 had the character of first estimate and was not credible, so it was discarded from the analysis.

[15] As noted earlier, since the fulfillment of certain first-order conditions of the model is incompatible with involuntary unemployment, this is a serious problem. Empirical work with individual data try to avoid it restricting the sample in some cases to such an extent that we must question the representativeness of the results obtained. See, in that sense, MaCurdy (1983) and Altonji (1986), already mentioned.

It should be noted that, in order to maximize the available sample, the number of temporal observations of hours worked, obtained as discussed above, was expanded from the data of annual hours worked by employees in the BDREMS , available since 1980. This has been done extending back the total for Spain of hours worked by the CRE with the growth rate of the number of hours worked in the BDREMS and, immediately afterwards, the number of hours worked of each region was obtained assuming that the ratio of hours worked in total is the same as the ratio of the labor income in total[16]. So a series of number of hours worked was obtained since 1980, and not since 1996, of which the corresponding leisure hours was obtained since 1980 by the same procedure explained above.

In any case, it has been checked that the results did not change when in the analysis it was considered the series of hours worked provided by the REGDAT database, developed within FEDEA. On the other hand, since this database does not contain data on consumption, it cannot be used alone, without considering variables taken from other databases, to analyze the issue of intertemporal substitution of consumption and leisure.

Alogoskoufis (1987) uses measures of labor supply, not leisure, obtained from the total of employment and from the unemployment rate. In our case, we chose not to follow this strategy, given the particular behavior of the unemployment rate in Spain, which has reached values higher than 25% in the three crises experienced since the 70s. In any case, since some of measures of Alogoskoufis labor supply were normalized based on the active population, and not on the total population, it was check that this does not affect the results.

With regard to wages, the hourly wage is obtained by dividing labor income, nominal and real, between the estimated hours worked, as usual in the works cited.

In addition, it has been taken spending on food, beverages and tobacco from the CRE, not available in the BDMORES, which has traditionally been considered a more appropriate expense that total spending on empirical analysis of consumption, to check the results obtained with this last category of expenditure.

[16] The BDREMS is available on the same web page that is the BDMORES, cited in footnote 12. The reader interested in this database can see Bosca, De Bustos, Diaz Domenech, Ferri, Perez and Puch (2007).

Moreover, it was also taken the population of the BDMORES, base 2008, to calculate the variables in per capita terms. The price series considered have been the CPIs of each autonomous community, written in base 2008, as already noted. On the other hand, although it has been considered different interest rates applied in Cutanda, Labeaga and Sanchis-Llopis (2001) and Cutanda (2013), finally we took the interest rate to 12-month treasury bills from the Statistical Bulletin of the Bank of Spain, with data from 1987, extended back with the growth rate of the interest rate of deposits from one year to less than two of banks, from the same source[17].

4. Empirical Results.

Then, we present and discuss the empirical results obtained in the nonlinear estimation of first order conditions studied, separate and jointly taken. First, will be analyzed the results of the estimation of the first order conditions when the utility is intratemporally separable between consumption and leisure, and thereafter, the results obtained in the estimation of the first order conditions with a utility function not separable in these arguments. Thus, Table 1 shows the results of estimating the static, or intratemporal, first order condition between consumption and leisure for total expenditure[18]. In this table the parameters of the two exponents of consumption and leisure in the utility function are statistically significant and below the unity, presenting, in all cases, a significance level of the Sargan test bigger than 79%. Against the theoretical postulates, leisure parameter has a negative sign in all cases, which is contrary to the concavity of the utility function[19]. Moreover, both parameters exhibit a high degree of homogeneity among the different autonomous communities, especially the exponent of consumption, which has a standard deviation of 0.010, compared to 0.164 for the parameter of leisure, with average values of 0.270 and -0.598, being the values for Spain 0.277 and -0.478, respectively. It should be noted the almost coincidence in the set of regions that have lower values than the average of both parameters: in the case of parameter of consumption these are Aragon, the Canary Islands, the two Castillas, Valencia, Murcia, Navarre, Basque Country and The Rioja; in the case of parameter of leisure it is the same set to which Cantabria is added.

[17] Alternative interest rates to that mentioned in the text to provide similar results to those presented, which are not reported.

[18] MRS attach special importance to this equation in the contrast of the model because its compliance does not require the absence of liquidity constraints, as occurs with the intertemporal condition of consumption.

[19] In addition, MRS emphasize that the coexistence of opposite signs in the two exponents implies that consumption or leisure should be an inferior good, given that, before an increase in nonwage income, or one or another must be reduced, so, moving in opposite directions for a given value of real wages.

Table 2 shows the results of the nonlinear estimation of intertemporal condition of consumption for total expenditure when the utility function is separable, equation [13]. As you can see, the test of Sargan overidentifying restrictions shows good results in all cases, with significance levels at less above 60%[20]. Fundamentally, these results are not overly favorable to the hypothesis of intertemporal substitution of consumption in the Spanish economy; although the estimated coefficient of relative risk aversion presents very reasonable values, less than unity (only higher in the case Andalusia), is statistically significant only in cases of this community, the Balearics and the two Castillas, which is a very poor fit for the specification we are considering. The average coefficient is 0.552, with a value of 0.623 for Spain, but it has a high dispersion, since the standard deviation amounts to 0.261. Thus, autonomous communities that show estimated values below the average parameter are Canary Islands, Cantabria, Valencia, Galicia, Madrid, Murcia, the Basque Country and The Rioja, all else being above. Note, moreover, that these results imply an average value of the intertemporal elasticity of substitution of Spanish regional consumption of 1.8 (1.6 in the Spanish case). These values are significantly above those obtained in Cutanda (2015), in which the same first-order equation in its loglinearized version with the same data is estimated[21].

As regards the discount factor, its estimated value is slightly above the unity in almost all regions (only Cantabria and Navarre hold a lower value), being the average value 1.012 and the value for Spain 1.011. Values of this parameter greater than unity are common in the results of non-linear estimation of consumption Euler conditions with aggregated data from the pioneering work of Eichenbaum, Hansen and Singleton (1988). This is also the case in Reis and Fernandes (2015), which estimate a loglinearized version of the Euler consumption equation[22]. In this case, the estimated coefficient is statistically significant in all cases, due to the high precision with which the parameter is estimated. On the other hand, the dispersion of the results is much smaller than in the case of the coefficient of relative risk aversion, amounting to 0.010, presenting all the Spanish autonomous communities a degree of remarkable homogeneity in this setting. Again, the regions that show a value lower than the average estimated parameter are the same in this case that with the coefficient of relative risk aversion, with the exception of Galicia, which Balearics and Navarre are added.

[20] A persistent feature in all exercises performed by MRS is the rejection of overidentifying restrictions, measured by the Sargan test.
[21] Specifically, in this work the average value of this elasticity for total expenditure was around 0.7.
[22] Strictly speaking, values of the discount factor higher than unity imply preference for future consumption compared to current consumption, generating savings for any positive real interest rate.

It should be noted that these results for Spanish autonomous communities are similar to those obtained by MRS for the US economy in the case of an intratemporally separable utility function and consumption of non-durables and services. In this case, these authors obtain an estimated value for α_0 between 0.092 and 0.333, not statistically significant in any case, therefore somewhat below our results, while obtaining an estimated value of β^{-1} between 0.996 and 0.997, very significant in all cases involving values of the discount factor somewhat lower than our, but also greater than unity.

Table 3 shows the results of the estimation of intertemporal condition of leisure in the intratemporally separable case, equation [14]. If the results in Table 2 were unfavorable to the intertemporal substitution of consumption, Table 3 are devastating for the same hypothesis referring to leisure, because, as happens with the static condition, the exponent of leisure in the first order condition has negative sign in all cases except Cantabria, with an average value of -0.709 and value for Spain of -1.215, although it is only statistically significant in the case of Murcia, Navarre, The Rioja and Spain. These results confirm those obtained in Cutanda (2015), where it is estimated as a panel the loglinearized version of this intertemporal condition with the same data, being also similar, as already mentioned, to the result of MRS for the US economy[23]. Moreover, the dispersion of the parameter between regions is very high, reaching a standard deviation of 0.628. The discount factor, as in Table 2, is estimated much better than this parameter, but much less precisely than was the case in that table. Its average value is now something bigger than in that case, 1.103, with an estimated value of 1.031 for Spain, obtaining a value less than unity in more cases than then (Castilla-Leon, Estremadura and Galicia); moreover, their dispersion among regions is higher in this case, with a standard deviation of 0.154. Additionally, if in Table 2 the estimated value of this parameter was statistically significant in every case, in Table 3 it is not in twice, Balearic Islands and Madrid.

Since the separate estimation of the first order conditions leads to losses of efficiency with respect to the joint estimation of all of them, according to MRS, the following Table 4 shows the results of the nonlinear estimation of the system of equations formed by our three first order conditions in the intratemporally separable case. The results presented in this Table confirm the conclusions drawn from the above analysis regarding the difficulties of the hypothesis of intertemporal substitution of leisure with empirical evidence: the

[23] Notably, Eichenbaum, Hansen and Singleton (1988) reach more favorable results to this hypothesis. The authors themselves find no more reason for the disparity of results with MRS than differences in the utility function considered in each case, very specifically not intertemporal separability of consumption and leisure.

parameter of leisure shows negative sign in every case, showing less than -1 in Andalusia, the Canary Islands, the two Castillas, Valencia, Galicia and the general case of Spain. Moreover, it is also statistically significant in all regions, as happened in the estimation of the static first order condition. The average value of the parameter is -1.017 (Spain, -1.129), and their standard deviation is 0.376. As regards the consumption parameter, also statistically significant in all cases, it has a value less than unity, with an average of 0.260 (Spain, 0.258) and a very low standard deviation of 0.011. Note that these values imply an intertemporal elasticity of substitution of almost 4, nearly twice the value obtained with the separate estimation of intertemporal consumption condition. Finally, the discount factor, estimated with great precision and highly statistically significant, presents in this case values both lower and higher than unity, which is relevant for their implication for the relationship between present and future consumption. The average estimated value amounts to 0.998 (Spain, 1), with a standard deviation of 0.010. The autonomous communities with β below one are Aragon, Canary Islands, Castilla-Leon, Navarre and the Basque Country, while presenting a substantially unitary β Andalusia, Castilla-La Mancha, Valencia and Spain, showing values above one all other regions. Notably, the group of regions with values of the parameter of consumption below the average (Aragon, the Balearic Islands, the two Castillas, Valencia, Galicia and Murcia) are, again, almost the same as those with values of parameter of leisure below average (the previous group, except Balearics and Murcia), although this correspondence is not given for communities that have values of the discount factor below average (only Aragon, Canary Islands, Navarre and the Basque Country).

At this moment, we present the results for the total expenditure in the case of non-separable utility function, in order to verify that the rejection of the model is not due to the assumption of intratemporal separability. It should be noted that the differences in the non-separable utility function between the work of MRS and considered in this work prevent comparing their results, as we have done so far. Table 5 presents the results of the nonlinear estimation of intertemporal consumption condition in the non-separable case. All estimates of the parameters of the utility function are positive, and although the exponents of consumption and leisure are no longer statistically significant in every case, they are, and much, the general exponent of the utility function, the μ parameter, and the discount factor, β. As regards the parameter of consumption, it is less than unity in all cases, except in Spain, which reaches the value of 1.093, being its average 0.387 and standard deviation 0.265, lower with respect to estimated values in the separable case. Regarding the parameter of leisure, the most important thing is that it presents a positive sign in all cases, compared to what we were getting in Tables 1, 3 and 4, with an average of 0.496 and a standard deviation of 0.402. However, the best results are obtained in the estimation of β and μ. As for the former, its estimated value is around unity in the different autonomous communities, as expected, with an average value of 1.001 and a remarkable standard deviation of 0.009[24]. Finally, the parameter μ is statistically very significant, with an average value of 1.348 and a standard deviation of 0.281. It should be noted that in this case, the correspondence between the group of regions with values of the parameter of consumption below average, and the group of communities with values of the parameter of leisure below the average, is very low.

Table 6 presents the results of the estimation of intertemporal condition of leisure in the non-separable case, which in principle could clarify the discrepancy between the results for the parameter of leisure obtained in the above Tables 1, 3, 4 and 5. While, in general, the results for the parameters of consumption, the discount factor and general exponent of the utility function not differ very much with respect to previously obtained, the parameter of leisure has both positive and negative signs, showing a negative average value. Specifically, this parameter holds negative in the case of the Balearic Islands, Castilla-Leon and Galicia. In addition, there appears to be a relationship between the estimated values for this parameter and the general exponent of utility, since the latter only falls below the unity when the former is negative. As regards the parameter of consumption is always positive and shows similar values to those held in the previous table, while reaching a value slightly greater than unity in the case of the Basque Country and Spain general value. The discount factor and general exponent of the utility also show similar values to those presented in previous table, although in this case their dispersion has increased significantly to reach, respectively, 0.297 and 1.276.

The following Table 7 shows the results of the nonlinear estimation of the equation system consisting of our three first-order conditions in the intratemporally non-separable case. The results in this table are very similar to those obtained in the above Table 4, which presented the estimation of the system of first order conditions when the utility function is separable and confirm the difficulties for the hypothesis of intertemporal substitution of leisure, as its parameter is negative in all cases, with an average of -1.060 and a standard deviation of 0.423, being the value for Spain -1.176. On the other hand, the parameter is always statistically significant except in cases of Catalonia and Estremadura. Thus, similar to what

[24] It is noteworthy that the estimated values for β^{-1} in the work of MRS in all cases of non-separable utility function are very inconsistent with the theoretical postulates.

happened in the separable case, we believe that the overall result of the nonlinear estimation of all first-order conditions, both isolated and jointly, when the utility function is not separable, is contrary to the hypothesis of intertemporal substitution of leisure in the Spanish economy. On the other hand, the exponent of consumption shows an average estimated value of 0.256, with the same value for Spain, and remarkably little dispersion between regions, since the standard deviation is 0.014. This value implies an average elasticity of intertemporal substitution of consumption of 3.90, almost twice the estimated with the intertemporal condition of consumption in the separable case, but similar to that implied by the results of estimating the system of equations in the same case. They have lower values of the parameter than the average Aragón, Canary Islands, Castilla-La Mancha, Valencia, Estremadura and Murcia.

Moreover, the good results provided in the estimation of the discount factor, around unity, and their low dispersion among the different autonomous communities, with a standard deviation of 0.001, even lower than evidenced by consumption, we believe that guarantee the reliability of these results. Finally, the estimated value for μ in the different autonomous communities is very close to unity, with communities above this value and other below. The average value obtained amounted to 0.874, with a standard deviation of 0.231[25].

The following Tables 8, 9 and 10 present the results of the estimation of the first order conditions for spending on food, beverages and tobacco for the separable case of the utility function, except the intertemporal condition of leisure, and they compare, respectively, with already commented Tables 1, 2 and 4, which present the results of the same estimates for total consumer spending.

As to Table 8, which is equivalent to Table 1 for total expenditure, and with regard to the goodness of fit, the Sargan test has significance levels at least 80% in every case, with the two estimated parameters highly statistically significant also in all cases. With regard to, first the coefficient of relative risk aversion is higher with spending on food, beverages and tobacco than with total consumer spending. If, in this case, this parameter amounted to 0.270, with this spending does to 0.320 (0.335 for Spain), which implies an elasticity of intertemporal substitution of food expenditure lower than for the total expenditure, 3.12 vs. 3.70, although the difference is, as you can see, very small. Present values of this parameter

[25] The same exercises discussed in the text were replicated when the utility function is not intratemporally separable and μ=1, obtaining very similar results to those presented.

below the average the Balearic Islands, Valencia, Estremadura, Galicia, Murcia and Navarre. On the other hand, the parameter of leisure presents negative values in all cases, confirming the rejection of the hypothesis of intertemporal substitution of this variable also with this category of expenditure.

Table 9 shows the first order condition for consumption expenditure on food, beverages and tobacco, directly comparable with the results obtained for the total expenditure in Table 2. As was the case when comparing Tables 1 and 2 for total spending, the estimation of this equation produces higher estimates of the coefficient of relative risk aversion that estimating the static condition (Table 8). The average of this parameter now amounts to 1.081 (1.402 for Spain), that you can compare with the average of Table 1, discussed above. However, the increase is much higher in this case what was happening to total expenditure: the estimated parameter is now 3.3 times higher from one to another table, where before it was only something more than 2 times higher. The result is, of course, further reducing the intertemporal elasticity of substitution estimated for such spending, supporting the largest differences obtained in the literature in its estimate for both types of spending, mainly based on the contrast of loglinearized versions of this equation. The results also support the greatest difficulties in estimating the model with this first order condition, if one takes into account that the estimated parameter is not statistically significant in a high number of regions, unlike what happened with the static condition in Table 8. Thus, the average intertemporal elasticity of substitution estimated amounts in this case 0.925. It should also be noted an increase in the dispersion of the estimated values of the coefficient of relative risk aversion in this table, 0.672, versus the results of Table 8, 0.001, with very few autonomous communities with a value above average in this case (Asturias, Cantabria, Catalonia, Estremadura and Galicia).

Meanwhile, the estimated discount factor presents in this case an average estimated value very similar to that obtained for total spending (Table 2), 1.007 (1.001 for Spain), versus 1.013 (1.011 for Spain). It is noteworthy that this parameter is statistically significant in all cases except for Navarre, in stark contrast to what happens with the coefficient of relative risk aversion. However, it should be noted that the distribution of discount factors estimated for this type of expenditure is unrelated to that obtained for the total expenditure in Table 2. If in this Table there were only three regions with an estimated value of the discount factor below the unity, in the case of the estimate for spending on food we have the following communities: Andalusia, Aragon, the Balearic Islands, Castilla-La Mancha, Valencia, Madrid and The Rioja. These differences endorse therefore separate both types of spending on empirical analysis of intertemporal consumption behavior, as, moreover, it is customary in the literature.

With regard to the joint estimation of the system of equations formed by the first order conditions when considering food spending, the result is presented in Table 10, directly comparable with the results in Table 4 for the total expenditure. The resulting estimated values of the coefficient of relative risk aversion are usually closer to the results in Table 8, than to Table 9, with an average estimated value of 0.325 (0.288 for Spain), being statistically significant in all cases except Andalusia and Catalonia. This result implies an intertemporal elasticity of substitution of about 3 for this type of expenditure. Note that Catalonia becomes a clear outlier, with the highest estimated value of the distribution, 0.602. Moreover, the standard deviation of the results, 0.046, despite the latter case, is also much closer to the results in Table 8 than to Table 9. With respect to exponent of leisure, presents an estimated average mostly negative; only in those cases of Andalusia and Catalonia is not so. With this, our negative conclusions about the intertemporal substitution of leisure, already commented, are reinforced.

Regarding the discount factor, this table provides estimated values mostly lower than the unity: only in Cantabria, Murcia, Navarre and the Basque Country is greater than one. This parameter is statistically significant in all cases, with an average value of 0.996 (0.997 for Spain) and a standard deviation of 0.055.

Finally, note that the results of the estimation of the first order conditions with spending on food, beverages and tobacco with the non-separable utility function, leaving free the value of μ parameter were similar to those obtained for the total consumption expenditure, reason why are not reported[26].

5. Conclusions.

In this paper we have estimated nonlinearly the first order conditions resulting from a model of individual optimization in consumption and leisure in order to analyze the intertemporal behavior of these variables with a regional Spanish database, the BDMORES.

[26] In any case, they are available to the interested reader, under request.

The results show an intertemporal behavior of Spanish regional aggregate consumption in line with the principles of the theoretical model. These results suggest that the elasticity of intertemporal substitution of Spanish consumption is higher than loglinearized versions of the model had previously obtained. Specifically, while previous studies with our same data with this approach to the problem indicated that this parameter was lower than the unity, even higher than show similar studies with pure macroeconomic data, estimated values of the same in this paper are above the unity. So, depending on the exercise concerned, the intertemporal elasticity of substitution of total consumption expenditure derived from our results would be in a range of values from slightly less than 2 to slightly below 4. At the same time, and in this line, our results indicate that consideration of all first-order conditions derived from the model of individual optimization, and not only the intertemporal first order condition in consumption, which is usually the traditional strategy to address the problem in the literature of aggregate consumption, is a relevant factor for the results obtained. In fact, the joint estimation of all first-order conditions of the model of intertemporal choice, as a system of equations, provides in all our exercises much higher estimates of the elasticity of intertemporal substitution of consumption than the separate estimation of the Euler condition.

In the case of spending on food, beverages and tobacco, the values obtained for the intertemporal elasticity of substitution for this type of expenditure are somewhat lower than those obtained in the case of total spending, ranging from a value slightly less than unity to about 3. In any case, it is much higher than the values obtained using loglinearized versions of Euler condition of consumption. Moreover, our results indicate that differences in relation to the intertemporal behavior of both types of spending are beyond the only difference in the value estimated for the respective elasticities of intertemporal substitution, given the significant differences in both the value and distribution of the estimated values of the discount factor in both cases. Undoubtedly, this issue deserves more attention than it has received so far in the literature.

Regarding the intertemporal substitution of leisure, our results are very negative for this hypothesis, as were MRS for the US economy: in almost every case considered the parameter of leisure in the utility function is negative, indicating no concavity of the utility function. Moreover, the fact that the estimation of the static first order condition reveal opposite signs of the parameters of consumption and leisure, which is a result most likely derived from its behavior throughout the economic cycle, can only be interpreted as one of the two should be an inferior good, what is implausible.

Finally, a later stage of this research should aim to check whether the consideration of intertemporal non separabilities in leisure and/or consumption in the model reverse the negative results obtained for the hypothesis of intertemporal substitution of leisure, as are Eichenbaum, Hansen and Singleton (1988) for the US economy.

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Table 1

$$\frac{W_t}{P_t}\frac{C_t^{-\alpha_0}}{L_t^{-\alpha_1}}=1$$

	α_0	α_1	Sargan
Andalusia	0.277	-0.495	9.819
	(0.001)	(0.026)	0.875
Aragon	0.266	-0.627	11.154
	(0.001)	(0.010)	0.799
Asturias	0.289	-0.569	10.063
	(0.001)	(0.017)	0.863
Balearics	0.275	-0.248	9.730
	(0.001)	(0.016)	0.880
Canary Islands	0.262	-0.789	9.160
	(0.001)	(0.022)	0.906
Cantabria	0.275	-0.630	11.067
	(0.001)	(0.011)	0.805
Cast.Leon	0.267	-0.729	10.002
	(0.001)	(0.029)	0.866
Cast.Man.	0.269	-0.743	9.541
	(0.001)	(0.020)	0.889
Catalonia	0.281	-0.440	9.644
	(0.001)	(0.014)	0.884
Valencian Com.	0.255	-0.774	10.578
	(0.001)	(0.013)	0.834
Estremadura	0.282	-0.344	9.686
	(0.001)	(0.015)	0.882
Galicia	0.275	-0.510	9.767
	(0.002)	(0.062)	0.878
Madrid	0.277	-0.429	10.322
	(0.001)	(0.012)	0.849
Murcia	0.253	-0.796	9.476
	(0.001)	(0.044)	0.892
Navarre	0.255	-0.679	9.655
	(0.001)	(0.004)	0.883
Basque Country	0.270	-0.725	8.971
	(0.001)	(0.017)	0.914
The Rioja	0.263	-0.641	8.524
	(0.001)	(0.008)	0.931
Spain	0.277	-0.478	10.770
	(0.001)	(0.008)	0.823

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 2

$$E_{t+1}\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\alpha_0}\frac{P_t R_t}{P_{t+1}}=1$$

	α_0	β	Sargan
Andalusia	1.096	1.020	5.120
	(0.460)	(0.007)	0.645
Aragon	0.972	1.035	7.308
	(0.219)	(0.005)	0.696
Asturias	0.611	1.026	7.880
	(0.411)	(0.012)	0.640
Balearics	0.738	1.001	6.079
	(0.347)	(0.010)	0.638
Canary Islands	0.377	1.010	5.771
	(0.235)	(0.007)	0.672
Cantabria	0.215	0.996	4.545
	(0.356)	(0.007)	0.715
Cast.Leon	0.591	1.014	7.268
	(0.170)	(0.006)	0.699
Cast.Man.	0.632	1.014	3.752
	(0.307)	(0.011)	0.807
Catalonia	0.747	1.022	4.729
	(0.902)	(0.016)	0.692
Valencian Com.	0.351	1.003	4.288
	(0.360)	(0.010)	0.746
Estremadura	0.794	1.018	3.645
	(0.590)	(0.016)	0.724
Galicia	0.490	1.018	8.127
	(0.318)	(0.007)	0.616
Madrid	0.379	1.008	6.501
	(0.272)	(0.006)	0.771
Murcia	0.398	1.012	2.404
	(0.436)	(0.008)	0.661
Navarre	0.591	0.998	3.371
	(0.496)	(0.010)	0.848
Basque Country	0.230	1.011	5.946
	(0.500)	(0010)	0.819
The Rioja	0.188	1.008	4.557
	(0.475)	(0.009)	0.803
Spain	0.623	1.011	2.794
	(0.716)	(0.011)	0.731

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 3

$$E_{t+1}\beta\left(\frac{L_{t+1}}{L_t}\right)^{-\alpha_1}\frac{W_t R_t}{W_{t+1}}=1$$

	α_1	β	Sargan
Andalusia	-0.499	1.110	0.496
	(1.374)	(0.169)	0.780
Aragon	-0.866	1.039	0.416
	(0.613)	(0.066)	0.812
Asturias	-0.440	1.034	0.924
	(0.263)	(0.032)	0.629
Balearics	-0.369	1.615	0.011
	(3.126)	(3.789)	0.913
Canary Islands	-0.801	1.138	0.003
	(1.239)	(0.271)	0.998
Cantabria	0.126	1.129	0.147
	(0.977)	(0.188)	0.700
Cast.Leon	-0.314	0.983	0.704
	(0.516)	(0.104)	0.703
Cast.Man.	-0.046	1.075	0.622
	(0.557)	(0.086)	0.732
Catalonia	-1.498	1.064	0.320
	(1.424)	(0.149)	0.851
Valencian Com.	-0.873	1.058	0.310
	(0.606)	(0.072)	0.856
Estremadura	-0.771	0.991	0.224
	(0.467)	(0.068)	0.893
Galicia	-0.625	0.996	0.165
	(0.383)	(0.049)	0.920
Madrid	-2.587	1.324	0.005
	(21.514)	(2.485)	0.941
Murcia	-1.029	1.079	0.315
	(0.470)	(0.099)	0.853
Navarre	-0.862	1.010	2.423
	(0.099)	(0.005)	0.876
Basque Country	-0.066	1.101	0.027
	(0.813)	(0.089)	0.868
The Rioja	-0.538	1.008	3.542
	(0.147)	(0.005)	0.738
Spain	-1.215	1.031	0.536
	(0.631)	(0.049)	0.764

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 4

	α_0	α_1	β	Sargan
Andalusia	0.267	-1.350	1.000	4.920
	(0.007)	(0.582)	(0.005)	0.841
Aragon	0.254	-0.961	0.998	5.830
	(0.007)	(0.201)	(0.005)	0.924
Asturias	0.280	-0.836	1.004	1.762
	(0.004)	(0.235)	(0.004)	0.940
Balearics	0.256	-0.810	1.002	5.049
	(0.006)	(0.176)	(0.005)	0.956
Canary Islands	0.249	-1.262	0.998	4.146
	(0.012)	(0.430)	(0.004)	0.980
Cantabria	0.273	-0.767	1.003	6.516
	(0.005)	(0.247)	(0.004)	0.887
Cast.Leon	0.260	-1.127	0.999	4.533
	(0.006)	(0.308)	(0.004)	0.971
Cast.Man.	0.245	-2.064	1.000	4.756
	(0.005)	(0.239)	(0.004)	0.965
Catalonia	0.274	-0.700	1.002	2.202
	(0.010)	(0.263)	(0.005)	0.900
Valencian Com.	0.235	-1.468	1.000	3.608
	(0.011)	(0.370)	(0.004)	0.989
Estremadura	0.270	-0.841	1.003	6.711
	(0.005)	(0.416)	(0.004)	0.876
Galicia	0.256	-1.252	1.001	4.761
	(0.006)	(0.304)	(0.004)	0.965
Madrid	0.262	-0.748	1.001	7.218
	(0.012)	(0.236)	(0.004)	0.842
Murcia	0.251	-0.912	1.007	7.620
	(0.009)	(0.282)	(0.005)	0.814
Navarre	0.266	-0.968	0.993	5.895
	(0.012)	(0.386)	(0.011)	0.921
Basque Country	0.264	-0.465	0.959	5.889
	(0.030)	(0.156)	(0.055)	0.921
The Rioja	0.264	-0.767	1.002	2.535
	(0.005)	(0.155)	(0.005)	0.864
Spain	0.258	-1.129	1.000	5.181
	(0.007)	(0.229)	(0.004)	0.951

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 5

$$E_t \beta \left(\frac{C_{t+1}}{C_t} \right)^{\mu(1-\alpha_0)-1} \left(\frac{L_{t+1}}{L_t} \right)^{(1-\alpha_1)(\mu-1)} \frac{P_t R_t}{P_{t+1}} = 1$$

	α_0	α_1	β	μ	Sargan
Andalusia	0.143	0.357	0.994	1.630	2.914
	(0.352)	(0.378)	(0.006)	(0.001)	0.713
Aragon	0.288	0.160	1.000	0.931	2.158
	(0.111)	(0.124)	(0.007)	(0.146)	0.706
Asturias	0.036	1.040	1.004	1.067	1.778
	(0.222)	(2.109)	(0.005)	(0.001)	0.878
Balearics	0.348	0.456	1.030	1.520	0.032
	(0.279)	(0.922)	(0.101)	(0.001)	0.856
Canary Islands	0.620	0.274	1.001	1.885	4.773
	(0.066)	(0.140)	(0.003)	(0.001)	0.781
Cantabria	0.478	0.557	1.003	1.267	1.312
	(0.339)	(0.492)	(0.006)	(0.001)	0.859
Cast.Leon	0.126	1.753	0.996	1.013	0.281
	(0.244)	(1.154)	(0.009)	(0.001)	0.868
Cast.Man.	0.660	0.058	0.998	1.550	1.305
	(0.123)	(0.238)	(0.004)	(0.001)	0.727
Catalonia	0.019	0.083	0.995	1.175	0.932
	(0.365)	(1.446)	(0.006)	(0.001)	0.817
Valencian Com.	0.370	0.581	1.000	1.249	1.764
	(0.337)	(1.143)	(0.004)	(0.001)	0.779
Estremadura	0.528	0.575	1.001	1.144	1.084
	(0.207)	(0.616)	(0.008)	(0.001)	0.896
Galicia	0.618	0.273	1.005	1.362	1.752
	(0.202)	(0.505)	(0.006)	(0.001)	0.882
Madrid	0.306	0.468	1.013	1.110	0.014
	(0.785)	(2.945)	(0.059)	(0.001)	0.903
Murcia	0.738	0.190	1.000	1.328	1.804
	(0.196)	(0.349)	(0.004)	(0.001)	0.771
Navarre	0.390	0.486	0.990	1.906	0.071
	(0.285)	(0.365)	(0.007)	(0.001)	0.788
Basque Country	0.031	0.590	0.991	1.453	1.836
	(0.267)	(0.448)	(0.005)	(0.001)	0.765
The Rioja	0.896	0.533	1.005	1.335	0.381
	(0.383)	(0.518)	(0.008)	(0.001)	0.943
Spain	1.093	0.385	1.007	1.574	0.868
	(0.468)	(0.537)	(0.011)	(0.001)	0.832

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 6

$$E_t \beta \left(\frac{C_{t+1}}{C_t} \right)^{(\mu-1)(1-\alpha_0)} \left(\frac{L_{t+1}}{L_t} \right)^{\mu(1-\alpha_1)-1} \frac{W_t R_t}{W_{t+1}} = 1$$

	α_0	α_1	β	μ	**Sargan**
Andalusia	0.636	0.505	1.086	2.806	0.604
	(1.684)	(0.552)	(0.118)	(0.001)	0.738
Aragon	0.483	0.291	0.994	2.443	1.416
	(0.279)	(0.137)	(0.007)	(0.001)	0.922
Asturias	0.741	0.497	1.002	3.144	2.445
	(0.189)	(0.077)	(0.010)	(0.001)	0.784
Balearics	0.241	-8.536	1.025	0.142	2.437
	(0.300)	(1.111)	(0.006)	(0.001)	0.875
Canary Islands	0.161	-2.097	1.018	0.565	1.625
	(0.667)	(1.896)	(0.010)	(0.005)	0.898
Cantabria	0.644	0.559	1.016	2.857	1.585
	(0.190)	(0.055)	(0.005)	(0.001)	0.902
Cast.Leon	0.514	-4.518	0.997	0.439	1.711
	(0.911)	(0.812)	(0.013)	(0.001)	0.887
Cast.Man.	0.551	0.508	0.923	2.232	0.226
	(0.882)	(0.330)	(0.128)	(0.001)	0.893
Catalonia	0.183	0.859	1.021	3.305	2.493
	(0.148)	(0.076)	(0.009)	(0.001)	0.869
Valencian Com.	0.504	0.580	0.991	4.195	0.710
	(0.299)	(0.125)	(0.013)	(0.001)	0.870
Estremadura	0.736	0.093	0.962	1.776	0.059
	(1.472)	(0.450)	(0.158)	(0.001)	0.970
Galicia	0.530	-2.973	1.006	0.529	2.204
	(0.838)	(0.700)	(0.009)	(0.001)	0.820
Madrid	0.547	0.585	0.991	3.378	0.095
	(0.258)	(0.208)	(0.020)	(0.001)	0.953
Murcia	0.067	0.148	1.015	1.519	1.707
	(0.345)	(0.109)	(0.005)	(0.001)	0.887
Navarre	0.805	0.052	1.012	1.839	1.587
	(0.356)	(0.101)	(0.004)	(0.001)	0.902
Basque Country	1.079	0.348	1.013	2.403	2.261
	(0.268)	(0.062)	(0.003)	(0.001)	0.800
The Rioja	0.319	0.604	0.998	2.953	1.957
	(0.256)	(0.031)	(0.008)	(0.001)	0.923
Spain	1.015	0.249	1.037	2.956	0.464
	(1.679)	(0.396)	(0.083)	(0.001)	0.792

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 7

	α_0	α_1	β	μ	Sargan
Andalusia	0.263	-1.551	1.007	0.904	1.702
	(0.004)	(0.250)	(0.008)	(0.153)	0.995
Aragon	0.245	-1.230	1.000	0.947	3.681
	(0.012)	(0.372)	(0.016)	(0.221)	0.931
Asturias	0.278	-0.979	1.008	0.861	4.056
	(0.002)	(0.124)	(0.008)	(0.119)	0.907
Balearics	0.261	-0.662	1.014	0.728	4.939
	(0.006)	(0.195)	(0.015)	(0.331)	0.839
Canary Islands	0.244	-1.460	1.000	0.978	1.937
	(0.005)	(0.247)	(0.008)	(0.132)	0.992
Cantabria	0.271	-0.816	1.005	0.972	5.121
	(0.006)	(0.296)	(0.009)	(0.143)	0.823
Cast.Leon	0.259	-1.196	1.009	0.839	3.947
	(0.002)	(0.118)	(0.011)	(0.172)	0.914
Cast.Man.	0.245	-1.912	1.005	0.911	3.033
	(0.004)	(0.229)	(0.005)	(0.059)	0.962
Catalonia	0.271	-1.041	1.016	1.027	4.084
	(0.025)	(0.664)	(0.034)	(0.173)	0.905
Valencian Com.	0.232	-1.536	1.006	0.892	2.196
	(0.004)	(0.130)	(0.004)	(0.080)	0.987
Estremadura	0.247	-0.234	1.003	1.128	1.238
	(0.079)	(0.578)	(0.044)	(0.225)	0.998
Galicia	0.260	-1.072	1.010	0.854	2.839
	(0.002)	(0.113)	(0.010)	(0.169)	0.970
Madrid	0.260	-0.771	1.002	0.983	4.662
	(0.004)	(0.089)	(0.026)	(0.449)	0.862
Murcia	0.231	-1.411	1.037	0.052	3.769
	(0.008)	(0.284)	(0.024)	(0.369)	0.925
Navarre	0.258	-0.718	1.011	0.833	2.620
	(0.001)	(0.044)	(0.008)	(0.136)	0.977
Basque Country	0.278	-0.699	1.007	0.955	11.169
	(0.004)	(0.100)	(0.008)	(0.095)	0.740
The Rioja	0.263	-0.734	1.003	1.016	4.342
	(0.002)	(0.064)	(0.007)	(0.129)	0.887
Spain	0.256	-1.176	1.001	0.980	4.936
	(0.009)	(0.294)	(0.005)	(0.068)	0.960

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 8

$$\frac{W_t}{P_t^a}\frac{(C_t^a)^{-\alpha_0}}{L_t^{-\alpha_1}} = 1$$

	α_0	α_1	Sargan
Andalusia	0.329	-0.663	9.714
	(0.001)	(0.041)	0.881
Aragon	0.324	-0.595	9.111
	(0.001)	(0.004)	0.908
Asturias	0.353	-0.327	8.826
	(0.001)	(0.014)	0.920
Balearics	0.312	-0.421	10.349
	(0.001)	(0.010)	0.847
Canary Islands	0.304	-0.836	10.225
	(0.001)	(0.012)	0.854
Cantabria	0.331	-0.548	9.710
	(0.001)	(0.018)	0.881
Cast.Leon	0.320	-0.914	9.012
	(0.001)	(0.018)	0.912
Cast.Man.	0.320	-0.968	9.215
	(0.001)	(0.026)	0.904
Catalonia	0.346	-0.320	10.264
	(0.001)	(0.006)	0.852
Valencian Com.	0.312	-0.778	10.628
	(0.001)	(0.020)	0.831
Estremadura	0.306	-1.253	9.959
	(0.001)	(0.020)	0.868
Galicia	0.304	-1.006	8.428
	(0.001)	(0.022)	0.935
Madrid	0.333	-0.574	11.019
	(0.001)	(0.008)	0.808
Murcia	0.271	-1.349	9.943
	(0.005)	(0.097)	0.869
Navarre	0.306	-0.739	9.094
	(0.001)	(0.003)	0.909
Basque Country	0.342	-0.574	10.369
	(0.001)	(0.002)	0.846
The Rioja	0.321	-0.586	10.872
	(0.001)	(0.019)	0.817
Spain	0.335	-0.499	10.800
	(0.001)	(0.007)	0.821

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 9

$$E_{t+1}\beta\left(\frac{C^a_{t+1}}{C^a_t}\right)^{-\alpha_0}\frac{P^a_t R_t}{P^a_{t+1}}=1$$

	α_0	β	Sargan
Andalusia	0.461	0.988	1.160
	(0.383)	(0.005)	0.948
Aragon	0.773	0.950	0.026
	(1.383)	(0.199)	0.870
Asturias	1.766	1.014	0.130
	(1.494)	(0.018)	0.936
Balearics	0.439	0.995	0.961
	(0.216)	(0.005)	0.915
Canary Islands	0.806	0.919	0.775
	(2.050)	(0.133)	0.941
Cantabria	1.156	1.003	0.321
	(0.638)	(0.012)	0.851
Cast.Leon	0.790	1.016	1.422
	(0.553)	(0.007)	0.840
Cast.Man.	0.204	0.992	0.504
	(0.674)	(0.005)	0.917
Catalonia	1.254	1.001	0.101
	(0.443)	(0.008)	0.950
Valencian Com.	0.519	0.993	2.212
	(0.240)	(0.005)	0.947
Estremadura	1.447	1.008	0.429
	(1.369)	(0.016)	0.806
Galicia	4.698	1.000	0.075
	(2.052)	(0.026)	0.963
Madrid	0.624	0.949	0.056
	(1.236)	(0.230)	0.812
Murcia	1.014	1.000	1.343
	(0.169)	(0.005)	0.853
Navarre	0.866	1.281	0.003
	(5.357)	(2.204)	0.955
Basque Country	0.594	1.013	0.007
	(0.797)	(0.013)	0.933
The Rioja	0.962	0.998	3.164
	(0.266)	(0.006)	0.869
Spain	1.402	1.001	0.068
	(0.672)	(0.009)	0.966

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.

Table 10

	α_0	α_1	β	Sargan
Andalusia	0.311	0.909	0.970	0.384
	(0.207)	(4.804)	(0.076)	0.998
Aragon	0.294	-1.346	0.995	2.084
	(0.014)	(0.404)	(0.006)	0.911
Asturias	0.321	-0.614	0.923	0.782
	(0.038)	(0.602)	(0.120)	0.992
Balearics	0.317	-0.424	0.994	8.577
	(0.004)	(0.089)	(0.006)	0.898
Canary Islands	0.287	-1.425	0.993	2.034
	(0.015)	(0.543)	(0.006)	0.916
Cantabria	0.322	-0.930	1.001	8.294
	(0.004)	(0.101)	(0.005)	0.911
Cast.Leon	0.312	-1.139	0.996	1.816
	(0.007)	(0.360)	(0.006)	0.935
Cast.Man.	0.302	-1.575	0.998	7.419
	(0.006)	(0.250)	(0.005)	0.944
Catalonia	0.602	0.993	0.967	1.846
	(0.544)	(2.611)	(0.062)	0.933
Valencian Com.	0.266	-1.986	0.995	2.053
	(0.020)	(0.617)	(0.005)	0.914
Estremadura	0.315	-0.390	0.928	0.550
	(0.147)	(0.804)	(0.230)	0.997
Galicia	0.312	-1.034	0.999	6.745
	(0.004)	(0.154)	(0.005)	0.964
Madrid	0.304	-1.075	0.994	2.369
	(0.015)	(0.290)	(0.005)	0.882
Murcia	0.293	-0.576	1.192	1.083
	(0.074)	(0.466)	(0.390)	0.982
Navarre	0.314	-0.711	1.000	9.139
	(0.003)	(0.055)	(0.005)	0.870
Basque Country	0.339	-0.720	1.003	4.385
	(0.008)	(0.198)	(0.005)	0.884
The Rioja	0.316	-0.782	0.998	6.014
	(0.003)	(0.091)	(0.005)	0.979
Spain	0.288	-1.712	0.997	2.060
	(0.046)	(0.712)	(0.041)	0.914

Note: The instruments for each autonomous community were different delays, starting in the third, of the interest rate adjusted for prices, adjusted for wages, real consumption and leisure.