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Private Saving Rates and Macroeconomic Uncertainty: Evidence from Spanish Regional Data*

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Abstract: The aftermath of the recent financial crisis has been followed by increasing saving rates, which may well reflect precautionary behaviour of households. In spite of a broad agreement on the theoretical implications of uncertainty on saving rates, empirical work has not yet reached a consensus on which is the most reliable measure of uncertainty. In this paper we empirically test the precautionary saving theory and explore different measures of macroeconomic uncertainty, using Spanish regional data for the period 1980-2007. Our results suggest that part of the recent increase in saving rates is related to a precautionary motive and that increased uncertainty causes greater savings rates. Moreover, our results also suggest that, in Spain, the unemployment rate is a relevant variable as a measure of future income uncertainty.

I INTRODUCTION

The magnitude of the current recession in Europe is truly significant. Unemployment has soared to very high levels, GDP growth has remained low or negative for almost five years now, and the sovereign debt crisis has

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engulfed many countries with rescue programmes being invoked for a number of sovereigns. One of the main consequences of this series of events at a macroeconomic level is the increased level of uncertainty, which is reflected, for instance, in the greater risk premium in financial markets and the continuous revision of economic forecasts, such as those by IMF, OECD or the European Commission (see Mody *et al.*, 2012).

Economic models have stressed the influence of uncertainty on both micro and macroeconomic performance, especially in the context of consumption and saving. At any period, households have to decide whether and how much to save from their current income. This important decision is analysed with a number of models focusing on intertemporal optimisation within the theoretical framework of the Life-Cycle/Permanent Income theories.[1] Without uncertainty, the optimal consumption depends on permanent income and the conclusion is that individuals use saving and borrowing to smooth consumption through time.

Once it is assumed that individuals prefer a "stable" consumption path, there are several reasons to save: bequest motives, planning for retirement, buying something or investing, etc. However, the most important rationale for saving is the possibility of contingencies, where future income is not known with certainty. In other words, consumers are "prudent" in Kimball's (1990) sense and the degree of uncertainty affects the path of consumption and saving. To avoid instances of low consumption, households will tend to save during more "plentiful" times. This precautionary reason implies that savings will tend to be higher in those economies where income is more volatile and will increase with uncertainty.

However, precautionary saving is not the only type of saving associated with income uncertainty. In the context of a market experiencing a significant asset bubble, deleveraging can play a significant role. Deleveraging reduces the risk of heavy loss and default. But, in order to deleverage one needs to raise cash to pay debt, either from raising capital, selling assets or saving part of one's current income. Therefore, savings for deleveraging purposes are not just a direct consequence of the "prudent" behaviour of consumers, from a precautionary perspective, but a requirement of market conditions. This may also be an important reason for saving in the current context, particularly in Spain, a country facing very high debts.

An abundant empirical literature has analysed the determinants of private savings rates by expanding the basic life cycle/permanent income hypothesis model to include other relevant variables explaining saving

[1] Originally developed by Franco Modigliani and Milton Friedman (Modigliani and Brumberg, 1954; Ando and Modigliani, 1963; Modigliani, 1993; Friedman, 1957).

behaviour. Carroll and Summers (1987); Graham (1987, 1989); Raymond (1991); Kessler *et al.* (1993); Modigliani (1993); Cook (1995); Edwards (1996); Kazarosian (1997); Loayza *et al.* (2000); Bandiera *et al.* (2000); Bosworth and Chodorow-Reich (2007); Horioka and Terada (2010) or Mody *et al.* (2012) are a few examples of papers that have tried to identify the main determinants of savings. In general, macroeconomic, financial and demographic factors play an important role in the explanation of saving rates. In particular, empirical works show the importance of the real interest rate, per capita income, liquidity constraints (restricted access to credit), sectorial composition of the economy, tax burden, public debt (Ricardian equivalence effect) and socio-demographic factors like population growth, ageing and female labour force participation. Moreover, many of these studies include some measures of uncertainty.

This paper adds to the current literature on the determinants of savings rates by providing new econometric evidence on the relationship between saving and uncertainty, using information from the 17 Spanish regions for the period 1980-2007. Specifically, our contribution is twofold. First, our paper makes use of regional data to exploit the geographical variability in saving rates, and it is the first attempt (to the authors' knowledge) to analyse the relationship between uncertainty and saving at the regional level in Spain.[2] Second, we focus on two types of uncertainty measures (the unemployment rate and the future income volatility) and include standard macroeconomic control variables in the models, in order to isolate the effect of uncertainty on current saving behaviour.

The current recession is characterised by higher saving rates. We argue that increased uncertainty has forced households to increase the precautionary saving, and therefore to lower consumption expenditures with negative effects on economic activity rates. In the Spanish case, we do not expect this current increase in savings to be reflected in increased future consumption (as standard theoretical models predict). This is due to the very high financial leveraged position of households, as well as the high and increasing degree of future income uncertainty measured by the unemployment rate.

In this context, the paper is structured as follows: Section II provides information on the evolution of saving rates in Spain and other European countries through the last decades; Section III summarises our theoretical framework of precautionary saving; Section IV provides the econometric results; and Section V concludes.

[2] Marchante *et al.* (2001) analyse determinants of saving rates at a regional level in Spain for the period 1986-1994, but they do not explicitly include any uncertainty measure in their econometric model.

II THE SAVING RATE IN SPAIN: A COMPARISON WITH OTHER EUROPEAN COUNTRIES

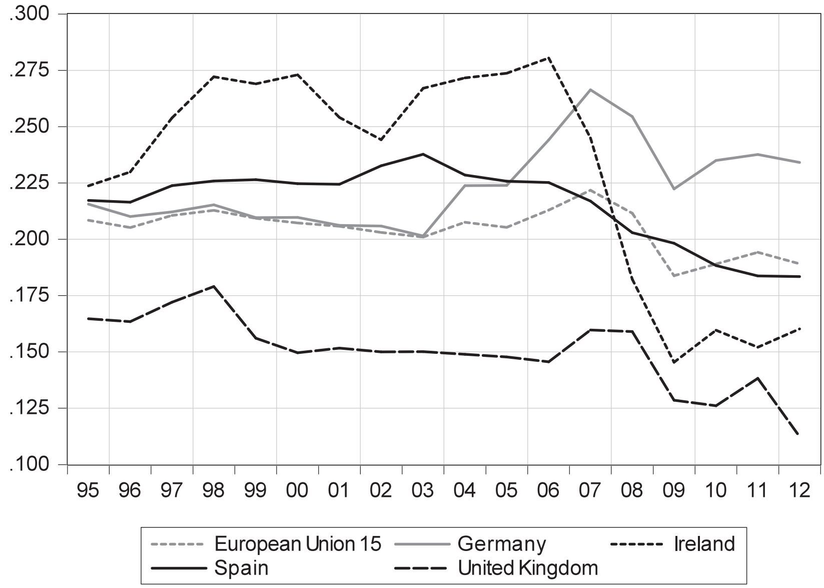
Saving rates have varied considerably in Europe throughout the last 15 years. Figure 1 provides some initial information. While the EU15 average has fluctuated around a value of 20 per cent since 1995, the variability among core EU countries is very high.[3] Thus, in Germany the saving rate was roughly constant from 1995 until 2004, increasing to 26 per cent in 2007. Since then, the rate has lowered somewhat to its current 23 per cent. Spain and Ireland share some common features as regards the behaviour of this variable, both countries had a greater than EU average rate before the recession, and both countries witnessed a dramatic fall, especially in the Irish case (14 percentage points) post-2006. The UK is an outlier in European terms, since its rate has been persistently lower than the average of the EU15 and other main core countries.

The total saving rate includes public saving and is, therefore, affected by changes in government budget deficits, which were reduced in the 1990s due to the Maastricht convergence criteria to enter the European Monetary Union. Nevertheless, they increased sharply with the onset of the recession in 2007, after the strong contractionary fiscal policies followed by most Western governments. Therefore, we focus our attention on private saving rates, which are depicted in Figure 2. Here we observe that the German rate has been the highest since 2003, followed by Ireland until 2007, whereas the Spanish rate has been experiencing reductions from 23.6 per cent in 1995 to a minimum of 14.6 per cent in 2007. Interestingly, Ireland shows a similar saving pattern to Spain since the beginning of the recession, with a marked increase in the private saving rate since 2007, even though this rise has not been as spectacular as the one registered by Spain. The UK, although exhibiting lower rates than the rest of the analysed countries, now shows a more "European" pattern, especially after the outbreak of the recession. Overall, this analysis suggests that the recession has been followed by an increase in the private saving rate in many countries, especially in Spain and Ireland. On the other hand, Figures 1 and 2 suggest that in many countries total saving rates were high due to the relatively good performance of public saving, which in many cases (once again Spain is a good example) more than outweighed savings of the private sector.

Table 1 provides some basic information on private saving rates in some EU countries for the period 1995-2012. While almost every country in the

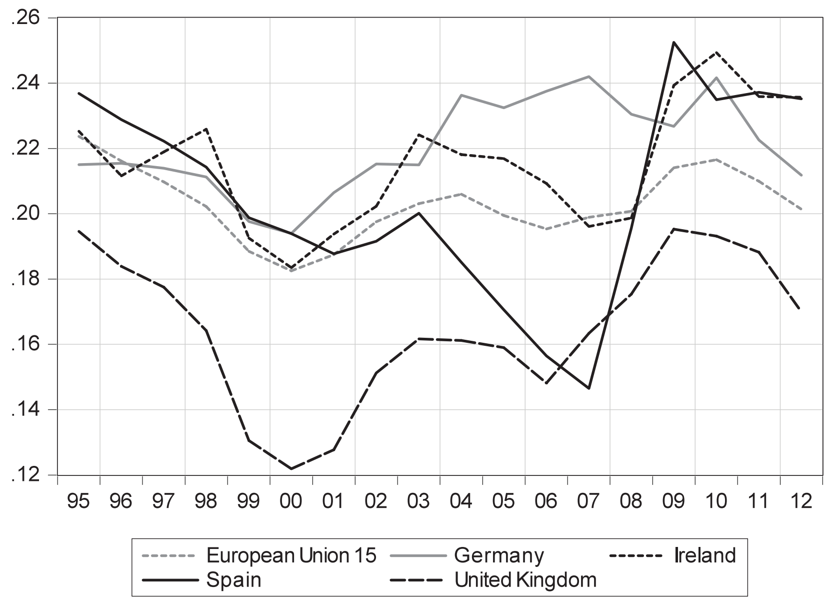
[3] The data for this section has been taken from the European Commission dataset AMECO. The saving rate is defined as total saving over total national disposable income.

Figure 1: *Total Savings Rate*



Source: AMECO database, European Commission.

Figure 2: *Private Savings Rate*



Source: AMECO database, European Commission.

sample (except the UK) had an average rate close to 20 per cent, the variability through time is much greater in some countries than in others. For instance, Germany has had a relatively stable saving rate with a standard deviation of 0.015, while Spain, Italy and Ireland had average rates of 20 per cent with a standard deviation of 0.03, 0.02 and 0.02 respectively. Moreover, the difference between the maximum and the minimum value in the time series is the highest in Spain (11 points of variation) and the lowest in France (2 points of variation). This table indicates an interesting pattern which deserves future research. Continental core EU countries tend to exhibit higher and stable saving rates, whereas Southern Mediterranean countries tend to exhibit lower (on average) and more volatile rates. The UK remains as an outlier, but its pattern resembles Spain, with low and volatile saving rates compared to other European countries. This may be because both countries experienced a real estate bubble in the last decade, which led to a very high level of household financial leverage and low saving rates.

Table 1: *Saving Rates: Descriptive Statistics. Selected Countries*

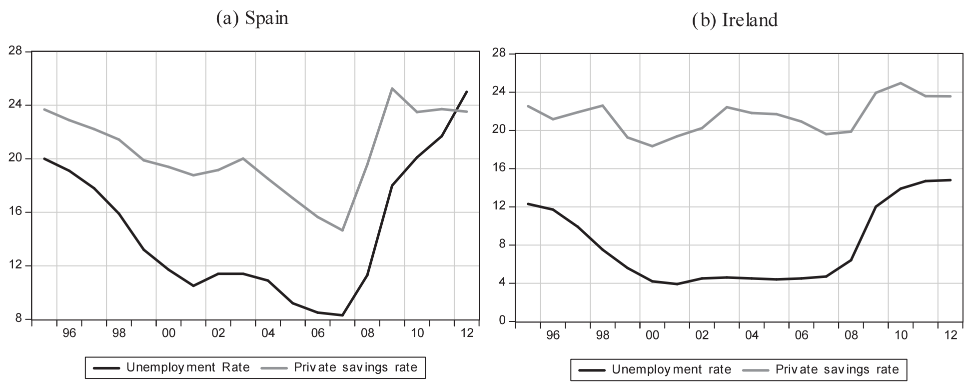
	EU15	*France*	*Germany*	*Italy*	*Spain*	*Ireland*	*UK*
Mean	0.20	0.19	0.22	0.20	0.20	0.21	0.16
Median	0.20	0.19	0.22	0.20	0.20	0.22	0.16
Maximum	0.22	0.21	0.24	0.22	0.25	0.25	0.19
Minimum	0.18	0.18	0.19	0.18	0.15	0.18	0.12
Maximum-Minimum	0.03	0.02	0.05	0.04	0.11	0.07	0.07
Standard Deviation	0.01	0.06	0.01	0.01	0.03	0.02	0.02

Source: Authors own calculation from AMECO data, European Commission.

The increase in the Spanish saving rate has coincided with an unprecedented rise in the unemployment rate, which soared from 8 per cent in 2007 to 26 per cent by 2012. Various strands of the existing literature have examined the relationship between the unemployment rate and precautionary savings, i.e., an increase in the saving rate of households to protect themselves from the possibility of lower future labour income (Dynarski and Sheffrin, 1987 or Malley and Moutos, 1996).

Figure 3a depicts both variables for the Spanish economy since 1995, whereas Figure 3b focuses on Ireland as a comparison, since, as noted previously, both countries exhibited rather strong increases in the saving rate. In the Spanish case, the downward trend in the unemployment rate, which started in 1994, was accompanied by a similar path in the saving rate. Also, there appears to be some correlation between the turning points in unemployment rates and the saving rate. For instance, at the beginning of the first decade of the current century there is co-movement in the rates and they also appear to change together in 2007. Ireland shows a similar relationship: during the 1990s both the unemployment rate and the saving rate showed a downward trend, and since 2008, the increase in the unemployment rate from 4.7 per cent in 2007 to 14.8 per cent in 2012 has been followed by an increase in the saving rate from 19.6 per cent to 23.6 per cent. Moreover, this relationship in these two countries is the strongest among the core EU countries, suggesting that the positive relationship between the unemployment rate and the saving rate is increasing with the level and variability of the unemployment rate. Table 2 presents the correlation coefficient between both variables for the same countries listed in Table 1, for the period 1995-2012. Note that Spain exhibits the largest coefficient (0.90), followed by Ireland (0.75), the UK (0.73) and Italy (0.56). Germany and France present much lower values (0.19 for the former, and –0.06 for the latter) which suggest that in these countries saving patterns are not affected by the uncertainty caused by the unemployment rate, most likely due to the stability of the unemployment rate through time. Once again, different patterns of savings emerge among the EU countries, which justify the need to study separately each national experience.

Figure 3: *Saving Rate and Unemployment Rate – Spain and Ireland*



Source: AMECO database, European Commission.

In sum, this section provides evidence that from the onset of the current recession, saving rates have increased in general, most likely as a response to the increased uncertainty caused by the worsening of the labour market prospects. During the expansion of the last decade, saving rates were low, especially in countries where financial leverage increased more due to housing

Table 2: *Correlation Coefficient Between Saving Rates and the Unemployment Rate*

EU15	0.66
Spain	0.90
Ireland	0.75
UK	0.73
Italy	0.56
Germany	0.19
France	–0.06

Source: Authors own calculation from AMECO data, European Commission.

bubbles or excessive credit growth. The collapse of the housing boom resulted in a significant fall in both consumption and investment. The next section will provide a general theoretical framework to analyse more precisely the effect of unemployment on saving.

III A SIMPLE MODEL OF PRECAUTIONARY SAVINGS

The purpose of this section is to provide a theoretical framework for the econometric analysis presented in Section IV. In particular, we try to highlight how uncertainty is expected to affect consumption and saving decisions and the way in which uncertainty is incorporated empirically into the analysis.

Leland (1968) and Dréze and Modigliani (1972), have shown that, under relatively mild assumptions concerning the intertemporal utility function, increased uncertainty about future income lowers current consumption and forces an increased "precautionary saving". This hypothesis has been extensively tested in the literature and there is ample evidence in favour of its existence (see for instance, Hahm, 1999; Hahm and Steigerwald, 1999; Lyhagen, 2001; Menegatti, 2007, 2010 or Mody *et al.*, 2012 for examples that use macroeconomic datasets for different sets of countries or regions, or Guiso *et al.*, 1992; Dynan, 1993; Lusardi, 1998 or Guarilia and Kim, 2003 for evidence with micro data). However, there is no consensus on what the most reliable measure of uncertainty is.

Several studies have proxied uncertainty with either the variability of household's income (Carroll, 1994) or the variability of expenditures (Dynan, 1993).The standard theoretical models of consumption show that the optimal intertemporal path is described by an Euler equation that relates expected future consumption growth to the conditional variance of consumption growth rates (see, for instance, Attanasio, 1999). However, this cannot be estimated directly since, as noted by Carroll (1992), the conditional variance can be an endogenous variable depending on wealth accumulation. This problem has been solved by substituting this variable with measures of future income growth uncertainty (see Hahm, 1999; Menegatti, 2007, 2010; Mody *et al.*, 2012). Income growth is often added, to capture the existence of liquidity constraints or consumer myopia, following the “rule- of-thumb” of consuming their current income.

However, other strands of the literature argue that the best way to measure uncertainty about future income growth is through the unemployment rate. During recessionary periods, overall insecurity about the future is increased, and much of the rise in uncertainty about the future is explained by the increase in unemployment. As noted by Deaton (2011), unemployment typically exerts a larger negative influence on well-being than what can be accounted for by the associated reduction in income. Since most consumers derive their income from labour, losing a job is the major negative shock to income and the risk of future unemployment spells is a good indicator of uncertainty (see Dynarski and Sheffrin, 1987; Malley and Moutos, 1996; Cuadro-Sáez, 2011 or Sastre and Fernández-Sánchez, 2011 for a discussion). Mody *et al.* (2012) include both types of measures and find that both are highly significant when explaining the evolution of saving rates in 27 of the world’s advanced economies.

In empirical work, income uncertainty due to unemployment risk is proxied by different variables. Taking macroeconomic variables, the usual practice is to use either the observed unemployment rate (Aron *et al.*, 2012) or subjective measures based on consumer opinion surveys on unemployment expectations (Carroll and Dunn, 1997); in both cases the conclusion is that savings increase when unemployment rises or expectations worsen. Studies based on micro data have proxied the unemployment risk by the *ex ante* probability of becoming unemployed, which is estimated on the basis of individual characteristics (Carroll *et al.*, 2003). However, other studies, also using micro-data, estimate the impact of unemployment on consumption expenditures by taking subjective expectations (Manski, 2004). Following that approach, several works (Hurd and Rowhedder, 2010; Christelis *et al.*, 2011) using data from survey questions for American households, find that individuals who become unemployed reduce their marginal propensity to consume with respect to income. Benito (2005), taking micro-data on British households, provides evidence of significant precautionary saving effects associated with unemployment risk and job insecurity.

Following the standard models commonly used in the precautionary savings literature, we consider a consumer who has to decide how much of their current income to consume in the present and how much to save for the future.

The intertemporal optimisation problem solved by the consumer can be expressed as follows. The consumer maximises the expected present value of their lifetime utility:

$$Max \sum_{t=0}^{\infty} \frac{1}{(1+\rho)^t} E_t[U(C_t)]; \quad U'(\cdot) > 0,\ U''(\cdot) < 0 \tag{1}$$

subject to the usual budget constraint:

$$\sum_{t=0}^{\infty} \frac{1}{(1+r)^t} C_t = A_0 + \sum_{t=0}^{\infty} \frac{1}{(1+r)^t} Y_t \tag{2}$$

where E is the expectations operator, $U(\cdot)$ is the instantaneous utility function, ρ is the subjective discount rate, C_t is consumption in period t, A_0 is the initial wealth, r is the (constant) interest rate[4] and Y_t is income in period t.

Given the non-satiation and risk aversion assumptions for the utility function, different authors (see *inter alia* Leland, 1968; Dréze and Modigliani, 1972) show that income uncertainty increases saving. That is, there is a precautionary saving if marginal utility is convex $(U'''(\cdot) > 0)$.

If a precautionary saving motive exists, an increase in income uncertainty increases current saving, decreasing current consumption and increasing expected future consumption. In such a case, two different relations can be analysed using two different tests (Hahm, 1999; Menegatti, 2007, 2010). On the one hand, we can test whether there is a positive relationship between income uncertainty and expected future consumption. On the other hand, we can analyse the effect of income uncertainty on the saving rate. These tests are different and, therefore, the results should be interpreted differently. Since income is either consumed or saved, it is clear that the dynamics of both variables are related. However, according to Menegatti (2010), "one is not simply the mirror of the other". In the first case, *consumption growth* from period t to period $t+1$ is considered which will depend on the degree of uncertainty in both periods, while the second considers the *level of the saving rate*, which will depend on the degree of uncertainty in period t only.

In order to obtain a formulation of consumption dynamics that allows us to run the first test, we assume that the instantaneous utility function takes

[4] We are interested in analysing the effects of income uncertainty caused by uncertainty about future labour income but we can also consider, as Mody *et al.* (2012), the investment risk from variations in saving return.

the form of a Constant Relative Risk Aversion (CRRA) utility function,[5] ($U(C_t) = C_t^{(1-\theta)}/(1 - \theta)$) where θ is the coefficient of relative risk aversion) and consumption shocks are log-normally distributed. With these assumptions, it can be shown (Hahm, 1999; Carroll, 1992, 1997) that optimal consumption will grow according to,

$$E_t(\Delta \ln C_{t+1}) = \frac{r - \rho}{\theta} + \frac{1}{2}\,\theta[\Delta \ln C_{t+1} - E_t\,(\Delta \ln C_{t+1})]^2 \tag{3}$$

where the term $[\Delta \ln C_{t+1} - E_t (\Delta \ln C_{t+1})]^2$is the conditional variance of consumption growth. By multiplying this term by $\theta/2$, we have the precautionary premium related to income uncertainty.

However, given that the conditional variance of consumption growth rates can be an endogenous variable depending on accumulated wealth (Carroll, 1992), Equation (3) cannot be directly estimated. In order to carry out empirical tests on precautionary saving, at least two considerations should be taken into account. As proposed by Hahm (1999), the conditional variance of consumption growth rates should be substituted by a measure of uncertainty on future income growth. Moreover, when explaining consumption growth, income growth should also be introduced as a control variable for the following reasons: the existence of liquidity constraints and/or a large fraction of individuals consuming all of their current income, which are a result of myopic behaviour (Campbell and Mankiw, 1989).

An increase in income uncertainty is expected to stimulate saving rates since households protect themselves against financial adversities.[6] The precautionary saving theory states that larger uncertainty implies larger saving and if uncertainty is constant, it also implies future consumption growth. However, if the degree of uncertainty varies over time, greater uncertainty in period t increases the saving rate, but does not increase consumption in period $t+1$. Consequently, an equation considering the relation between uncertainty and consumption growth cannot test the precautionary

[5] Constant relative risk aversion utility is widely used in macroeconomics and finance for analytical convenience, because of its homogeneity properties. When instantaneous utility is characterised by CRRA, prudence ($U''' > 0$), a characteristic of the utility function, leads to precautionary saving. Studies of precautionary saving under CRRA utility include, inter alia, those of Zeldes (1989); Hubbard *et al.* (1995); Carroll and Samwick (1997); Letendre and Smith (2001); Gourinchas and Parker (2001); Carroll *et al.* (2003); Bishop and Park (2004) and Menegatti (2007, 2010).

[6] Therefore, precautionary saving motives provide an explanation for the quite counter-intuitive consumption-saving behaviour, that is, why consumers do not reduce saving or increase borrowing during recessions.

saving theory and a *"saving rate"* test is necessary. So, as previously mentioned, we also directly test the saving theory by analysing the effect of uncertainty on the saving rate.[7]

Taking these arguments into account, we can conclude that under a low and stable degree of uncertainty, individuals choose optimal consumption and then save the rest of their income. In contrast, under a high and variable degree of uncertainty, individuals decide how much they need to save and then consume the rest of their income. This different approach on consumption-saving decisions influences the effects of uncertainty on the dynamics of consumption and the saving rate, as well as the way precautionary saving theory must be empirically tested.

Consequently, in Section IV we include measures of uncertainty on future income growth (that is, on income dynamics), per capita income growth rate and a number of control variables commonly used in the precautionary saving empirical literature, such as per capita disposable income (to capture the income level effects on saving), the inflation rate, financial and non-financial wealth (a negative correlation between wealth and saving rate is expected), socio-demographic factors (proxied by female activity rate), and domestic private credit (to introduce restricted access to credit).

IV EMPIRICAL EVIDENCE

4.1 *Data*

In this paper we use regional data from the 17 Spanish regions (*Comunidades Autónomas*), at NUTSII level, for the period 1980-2007. The use of regional data to address saving patterns can be justified on the grounds that regional variability complements the relatively short time dimension of existing datasets, in order to assess long-run relations between the relevant variables. Some of the control variables we will use in the econometric exercise have a rather short time dimension, and therefore the use of regional data can increase the quality of the estimations. Also, as Marchante *et al.* (2001) remark, the average propensity to save is usually neither uniform over time nor across regions, which implies that the national saving rate is in every period a weighted average of different regional saving rates. Taking this regional heterogeneity into account should help analyse the effect of

[7] This is a general test of the precautionary savings theory whose conclusions are not related to the assumption of a particular utility function.

uncertainty on saving (through its regional variability) and identifying other relevant determinants of saving.[8]

The main data source is the BD-MORES dataset, provided by the Ministry of Economy and the University of Valencia, which takes the form of regional accounting type data. From this dataset we have time series on regional gross disposable income and consumption expenditures (and therefore, saving), all in real terms.[9] We also take the regional GDP at constant 2000 market prices and the total regional population to measure *per capita* variables. For the remaining variables of our model the data sources are different, and are summarised in Table 3. The uncertainty measure has been computed following Menegatti (2010), through the estimation of individual optimal ARMA models on the growth rate of regional GDP on a first stage (using the Akaike information criteria to select among competing specifications). Next, we compute the fitted values from the optimal model,[10] and construct the uncertainty measure as the squared difference between actual and fitted values.[11] As stated by Menegatti (2010), given that we compute the expectation of the output growth rate on the basis of the specific dynamics of GDP in each region, this implies that we are using a measure of uncertainty of future GDP growth based on the actual data generating process for each region.

Our data is restricted to the period ending in 2007 as there is no available data from the Regional Accounting on household income.

Before deciding on the type of panel data model we examine the stationarity properties of the series. The use of dynamic panel data models has been discussed inter alia by Banerjee (1999); Baltagi and Kao (2000) and Smith and Fuertes (2010). Whether the involved variables in the analysis are

[8] Table A1 in the Appendix provides some descriptive statistics on Spanish regional saving rates during our sample period. From that table we conclude that the degree of variability in regional saving rates is remarkable, with differences on average values of more than 15 percentage points. Regional saving rates also differ in terms of volatility, with regions with high standard deviations (Baleares, Canarias or Cantabria) and regions with much less volatility (Andalucía, Cataluña or Valencia, for instance). In this empirical section we exploit this regional variability in saving behaviour.

[9] The BD-MORES dataset uses as its main input data from the official Regional Accounts, provided by the Spanish Statistical Office (INE), homogenising the different base years used in the latter. Therefore, in its construction the European System of Accounts (ESA) has been followed, and thus the main aggregates are defined according to a well established methodology. In particular, saving is defined in the ESA as the difference between Gross Disposable Income and Final Consumption, and therefore measures savings behaviour by households. See de Bustos *et al.* (2008) for a complete description of this dataset.

[10] This provides a measure of expected output growth.

[11] We do not report these auxiliary regressions for brevity, but results are available from authors upon request.

Table 3: *Variables in the Econometric Model*

Variable	*Definition*	*Source*
ΔLCPCi,t	First difference of the log of regional per capita consumption.	BDMORES dataset
$S_{i,t}$	Regional saving rate, defined as the ratio of regional gross private saving to regional disposable income.	BDMORES dataset
UNCERTAINTY$_{i,t}$	Expected variance of future regional output growth.	Author's elaboration, based on GDP series from the BDMORES dataset
URATE$_{i,t}$	Regional unemployment rate.	Labour Force Survey, INE
INFLATION$_t$	First difference of the log of national CPI.	INE
1/RBD$_{i,t}$	Inverse of the regional per capita real disposable income.	BDMORES dataset
CRED_RBD$_{i,t}$	Ratio of regional total credit to the private sector over gross disposable income.	Bank of Spain, Boletín Estadístico, and BDMORES dataset
NFWEALTH$_{i,t}$	Ratio of regional wealth at the beginning of the period over per capita disposable income. Wealth is proxied by the regional net stock of private capital stock.	BDMORES dataset
FEMALE_ACT$_{i,t}$	Regional female activity rate, defined as the ratio of female labour force over female working age population.	Labour Force Survey, INE

stationary or not determines the type of econometric methodology to follow next (see Smith and Fuertes, 2010). Thus, if the variables are non-stationary (i.e., *I(1)*) we should first test for panel cointegration (for instance, through the approach suggested by Pedroni (1999, 2004)) and construct an error correction model if such cointegration exists, or estimate the model in first differences otherwise. If the variables are stationary, then we can proceed with the standard techniques for stationary panel data models (Baltagi, 2008). Therefore, we next compute panel data unit root tests, in order to check the stationarity properties of the regional variables. Among the different available options in the literature, we opted for the Maddala-Wu (1999) test, based on an exactly non-parametric test based on Fisher (1932). Specifically, the test statistic is

$$\lambda = -2 \sum_{i=1}^{N} \ln p_i$$

which is distributed as a $\chi^2(2N)$, where p_i is the p-value of the ADF unit root test for each i-th cross section unit, $i=1,...,N$. This decision is based on the interesting characteristics of the test (see Maddala-Wu, 1999).

Table 4 summarises the results of the test for the regional variables included in the model. Note that the null hypothesis is non-stationarity, and that the value of the statistic for each variable is greater than the critical value for a $\chi^2(34)$, which is approximately 48, except for the female activity rate. In light of these results, we conclude that the regional variables involved in our model are panel-stationary (we included the first difference of the female activity rate), and, therefore, we may use standard stationary panel techniques.[12]

Table 4: *Panel Unit Root Tests*

	Fisher	*p-value*
ΔLCPC	108,74	0,00
S	50,71	0,03
UNCERTAINTY	214,81	0,00
URATE	70,22	0,00
RBD	50,88	0,02
NFWEALTH	61,10	0,00
FEMALE_ACT	28.73	0.72
ΔFEMALE_ACT	269.08	0.00

Notes: Δ is the first difference operator.

4.2 *Econometric Model*

Since regional data is used to assess the impact of uncertainty on saving and consumption, we build a panel of 17 regions for the period 1980-2007.[13] As discussed in Section III, Menegatti (2010) argues that the effect of uncertainty on consumption decisions derived from the standard models can be empirically analysed by using two partially different tests related to consumption growth and the saving rate. Therefore, we provide two sets of estimations: one for the consumption growth model and another for the saving rate equation.

The initially estimated equations are given by:

$$\Delta c_{it} = \alpha_i + \beta\sigma_{it} + \gamma\Delta y_{it} + \delta X_{it} + \varepsilon_{it} \tag{4}$$

[12] Furthermore, standard unit root tests on the national inflation rate indicate that this variable is also stationary in the sample period.

[13] Since we are considering the whole set of Spanish regions, fixed effects models are preferred to random effects models. Moreover, Hausman tests point to the validity of the fixed effects approach.

$$s_{it} = \lambda_i + \Psi\sigma_{it} + \phi\Delta y_{it} + \theta X_{it} + v_{it} \tag{5}$$

where c_{it} is the log of consumption in region i, s_{it} is the saving rate in region i (as defined in Table 3), σ_{it} is the measure of uncertainty in region i and Δy_{it} is the first difference of the log of per capita GDP (all variables measured in real terms). The vector X_{it} contains a number of macroeconomic control variables proposed in the previous literature. We use a fixed effects model to estimate the equations above, assuming that the error terms ε_{it} and v_{it} follow a one-way error component model. In other words, the fixed effect model assumes that slope coefficients and variances are identical across regions and only intercepts are allowed to vary.

Before presenting the results, the following should be observed: first, Loayza *et al.* (2000) suggest that the estimation of consumption or saving models should take into account the inertia in these variables, which is especially relevant when using annual data. This leads to a dynamic specification of the models above with lags of the dependent variable. This, in turn, introduces a second econometric issue to deal with. Let us consider the following illustrative model with homogenous slopes and differing constants to clarify the issues arising from the estimation of a dynamic version of a model as in Equations (4) or (5):[14]

$$y_{i,t} = \alpha_i + \beta x_{i,t} + \gamma y_{i,t-1} + u_{i,t}, \;\; u_{i,t} \sim iid\ N(0, \sigma^2)$$

where the independence assumption for the error terms refers to time and cross-section, i.e., $E(u_{i,t}, u_{j,t-s}) = 0$ for $i \neq j$ or $s \neq 0$. The fixed effect estimator (the most common for dynamic panels) is consistent in dynamic panels with constant slopes as $T \rightarrow \infty$, for fixed N.

It has been clearly shown in the literature that when T is small relative to N the OLS estimation is inconsistent (for example, when $N \rightarrow \infty$ for a fixed T gives rise to the Nickell bias). In this case, the standard approach is to use a General Method of Moments (GMM) estimator, such as the Arellano and Bond (1991) DPD or the Blundell and Bond (1998) BB estimators. In these estimators, the data is first differenced in order to eliminate the fixed effects. It is also well known that the GMM estimator is efficient for large cross sections with relatively few time periods (Baltagi, 2008).

Note that for our sample the time dimension is clearly greater than the cross-section dimension: 21 time observations × 17 regions. In other words, N/T is smaller than 1, so that we can confidently assume that T grows

[14] Here we follow Smith and Fuertes (2010).

sufficiently fast relative to N. Therefore, our estimation results are not likely to be affected by the Nickell bias or other inconsistencies, and we proceed with the standard one-way fixed effects estimation. Nevertheless, we also estimate the models with the Generalised Method of Moments (Arellano and Bond estimator) with little difference in the results.

4.3 *Econometric Results*

Tables 5 and 6 summarise the results of the estimation of different specifications of the consumption growth and saving rate equations. In each table we provide the one-way fixed effects OLS results and the General Method of Moments (GMM) results. As stated in Equations (4) and (5) we regress consumption growth and the saving rate on a measure of uncertainty and a number of macroeconomic control variables. Among the reviewed literature a consensus exists as to the type of control variables to include (see Loyaza *at al.*, 2000). Therefore, the inflation rate is usually included in order to control for macroeconomic stability. Higher inflation rates imply poorer forecasts of future income and asset returns and, therefore, should reduce consumption and increase saving rates. Additionally, we control for the effect of the income level in our dependent variables and the possibly nonlinear relationship by including the inverse of per capita disposable income level, following Modigliani (1993) and Marchante *et al.* (2001). We also control for liquidity constraints by adding the ratio of regional aggregate credit to the private sector to gross disposable income, following Japelli and Pagano (1994). An increase in the "credit rate" to the private sector should result in higher consumption growth and lower saving rates since access to credit is easier. We also include measures of non-financial wealth by using the ratio of per capita real wealth at the beginning of the period and per capita gross disposable income. Following Andrés *et al.* (1990) or Argimón *et al.* (1993) we proxy wealth data by the net stock of private capital stock, including residential real estate. Finally, we also control for socio-demographic changes at the regional level by including the growth of female activity rate, given the non-stationarity properties of the level of the series. We tried to use data on financial wealth at the regional level by including saving deposits over total deposits and several related variables, but none were significant in the empirical models. Demographic variables, such as the old age dependency ratio or the child dependency ratio were also specified, however, regional data is only available since 1998.

Focusing first on the consumption model, column (1) of Table 5 summarises the initial results. In this model we estimate a static version of Equation (4) and find that the uncertainty measure has a negative but insignificant effect on consumption growth. Moreover, the Durbin-Watson statistics indicate that some type of serial correlation is present in the model. Therefore, following Loayza *et al.* (2000) we extend the model with a lag of the dependent variable. Results are summarised in columns (2) and (2′). In general, coefficients have the expected signs, even though some of them are not statistically significant. The uncertainty measure is only significant at the 10 per cent level with a negative impact on consumption growth. Inflation and the change in female activity rates are not significant at conventional levels. Income levels have a positive effect on consumption growth, validating the hypothesis of Modigliani (1993). Non-financial wealth has a surprising negative and significant effect, which deserves further research. As expected, the credit rate has a positive effect on consumption growth.

Given the low significance of the uncertainty measure, we replace it by the unemployment rate to examine the effect of job loss on consumption and saving. Columns (3) and (3′) summarise the results. We find that the unemployment rate has a strong and significant negative effect on consumption (coefficient of –0.102 in the OLS estimation and of –0.135 in the GMM estimation), while the remaining control variables (except the female activity rate) are significant, with the same signs as models (2) and (2′). We next combine both types of uncertainty measures (as in Mody *et al.*, 2012) to control for different sources of uncertainty affecting consumption growth. Results reported in columns (4) and (4′) of Table 5 show that whereas unemployment remains highly significant, income uncertainty is now not significant at conventional levels, suggesting thus a greater impact of the labour market status on household consumption behaviour than expected shocks to income. Finally, and given that the female activity rate remains non-significant, we drop it from the model and estimate Equation (4) again including both measures of uncertainty. Results are shown in columns (5) and (5′), and are in line with those reported previously.

Table 6 summarises the results of the saving rate model. Column (1) shows the estimated static model, in which uncertainty impacts positively on saving rates, providing evidence in favour of the precautionary savings hypothesis. Moreover, the remaining control variables have the expected signs and are significant, except for the female activity rate. However, the value of the Durbin-Watson statistic (0.48) indicates that the model is misspecified. Therefore, we include the first lag of the saving rate and estimate again the dynamic model by OLS and GMM. We first use the income uncertainty measure (columns (2) and (2′) in Table 6). Results show a significant and positive effect of income uncertainty on saving (coefficient of 0.063). Income growth, income levels, credit to income ratios and non-financial wealth have the expected negative sign, whereas the inflation rate and the female activity rate are non-significant. We next use the unemployment rate as the measure

Table 5: *Consumption Growth Model*

	(1)	*(2)*	*(2′)*	*(3)*	*(3′)*	*(4)*	*(4′)*	*(5)*	*(5′)*
ΔLCPC(–1)		0.239**	0.248**	0.193**	0.182**	0.197**	0.188**	0.195**	0.187**
		(5.30)	(5.19)	(4.02)	(3.59)	(4.12)	(3.69)	(4.08)	(3.69)
UNCERTAINTY	–0.049	–0.053	–0.053			–0.046	–0.043	–0.046	–0.044
	(–1.63)	(–1.83)	(–1.67)			(–1.60)	(–1.38)	(–1.60)	(–1.41)
ΔYPC	0.608**	0.525**	0.514**	0.505**	0.487**	0.488**	0.469**	0.492**	0.469**
	(11.45)	(9.83)	(8.74)	(9.31)	(1.98)	(8.83)	(7.87)	(8.97)	(1.93)
U RATE				–0.102**	–0.135**	–0.096**	–0.128**	–0.096**	–0.129**
				(–2.58)	(–3.03)	(–2.42)	(–2.85)	(–2.40)	(–2.88)
INFLATION	–0.020	–0.135	–0.189	–0.276**	(–0.38) **	–0.276**	–0.378**	–0.274**	–0.379**
	(–0.20)	(–1.37)	(–1.79)	(–2.42)	(–3.10)	(–2.43)	(–3.08)	(–2.41)	(–3.10)
1/RBD	0.547**	0.515**	0.587**	0.722**	0.893**	0.736**	0.900**	0.746**	0.908**
	(3.85)	(3.77)	(3.89)	(4.41)	(4.87)	(4.50)	(4.91)	(4.58)	(4.98)
CRED_RBD	0.017**	0.015**	0.018**	0.011**	0.014**	0.012**	0.0146**	0.012**	0.014**
	(3.65)	(3.19)	(3.42)	(2.44)	(2.74)	(2.48)	(2.75)	(2.61)	(2.83)
NFWEALTH	–0.019**	–0.015**	–0.019**	–0.02**	–0.027**	–0.020**	–0.027**	–0.020**	–0.027**
	(–3.12)	(–2.53)	(–2.67)	(–3.20)	(–3.54)	(–3.26)	(–3.55)	(–3.25)	(–3.55)
△FEMALE ACT	0.01	0.05	0.026	0.052	0.021	0.050	0.024		
	(0.16)	(0.67)	(0.34)	(0.70)	(0.28)	(0.72)	(0.31)		
R^2	0.42	0.47		0.47		0.48		0.48	
DW	1.81								
MLL	925.12	939.65		941.40		942.79		942.50	
Sargan			262.79		270.50		268.24		268.94
D.o.F.			274		274		273		273
p-value			0.67		0.54		0.56		0.55

Notes: ΔLCPC is the growth rate of per capita consumption, uncertainty is the uncertainty measure based on the estimation of the conditional variance of expected future income, ΔYPC is the growth rate of per capita GDP, URATE is the unemployment rate, INFLATION is the inflation rate, 1/RBD is the inverse of per capital gross disposable income, CRED-RBD is the ratio of total private credit to gross disposable income, NFWEALTH is the ratio of wealth at the beginning of the period over gross disposable income and △FEMALE_ACT is the change in female activity rate. Sargan is the value of the Sargan test of over-identifying restrictions derived by Arellano and Bond (1991); DoF is the number of degrees of freedom of this test. ** indicates significance of 95 per cent. t-ratios in parentheses.

Table 6: *Saving Rate Model*

	(1)	*(2)*	*(2′)*	*(3)*	*(3′)*	*(4)*	*(4′)*	*(5)*	*(5′)*
S(–1)		0.650**	0.644**	0.643**	0.638**	0.643**	0.637**	0.644**	0.638**
		(18.88)	(19.36)	(18.80)	(18.97)	(18.92)	(19.21)	(19.00)	(19.24)
UNCERTAINTY	0.067**	0.063**	0.062**			0.056**	0.056**	0.057**	0.056**
	(1.91)	(2.60)	(2.70)			(2.36)	(2.43)	(2.36)	(2.43)
ΔYPC	–0.289**	–0.173**	–0.186**	–0.138**	–0.149**	–0.118**	–0.128**	–0.115**	–0.125**
	(–4.67)	(–3.99)	(–4.52)	(–3.06)	(–3.43)	(–2.58)	(–2.93)	(–2.54)	(–2.89)
U RATE				0.111**	0.118**	0.105**	0.113**	0.106**	0.114**
				(3.56)	(3.94)	(3.38)	(3.81)	(3.42)	(3.83)
INFLATION	–0.701**	0.019	0.004	0.186	0.184	0.186	0.185**	0.189**	0.187**
	(–6.02)	(0.21)	(0.06)	(1.83)	(1.87)	(1.84)	(1.90)	(1.88)	(1.92)
1/RBD	–0.140	–0.396**	–0.396**	–0.606**	–0.622**	–0.628**	–0.646**	–0.623**	–0.641**
	(–0.85)	(–3.42)	(–3.58)	(–4.54)	(–4.80)	(–4.70)	(–5.05)	(–4.70)	(–5.01)
CRED_RBD	–0.020**	–0.013**	–0.125**	–0.010**	–0.008**	–0.010**	–0.008**	–0.009**	–0.008**
	(–3.59)	(–3.29)	(–3.29)	(–2.22)	(–2.06)	(–2.29)	(–2.14)	(–2.22)	(–2.08)
NFWEALTH	–0.059**	–0.022**	–0.026**	–0.018**	–0.021**	–0.017**	–0.020**	–0.017**	–0.020**
	(–8.20)	(–4.24)	(–4.77)	(–3.33)	(–3.78)	(–3.25)	(–3.73)	(–3.23)	(–3.73)
ΔFEMALE ACT	0.115	0.047	0.042	0.037	0.034	0.036	0.032		
	(1.28)	(0.75)	(0.72)	(0.60)	(0.57)	(0.59)	(0.55)		
R^2	0.86	0.93		0.93		0.93		0.93	
DW	0.48								
MLL	871.12	1001.34		1004.45		1007.43		1007.24	
Sargan			356.89		341.84		346.03		346.24
D.o.F.			311		311		311		311
p-value			0.23		0.11		0.18		0.18

Notes: ΔLCPC is the growth rate of per capita consumption, uncertainty is the uncertainty measure based on the estimation of the conditional variance of expected future income, ΔYPC is the growth rate of per capita GDP, URATE is the unemployment rate, INFLATION is the inflation rate, 1/RBD is the inverse of per capital gross disposable income, CRED-RBD is the ratio of total private credit to gross disposable income, NFWEALTH is the ratio of wealth at the beginning of the period over gross disposable income and △FEMALE_ACT is the change in female activity rate. Sargan is the value of the Sargan test of over-identifying restrictions derived by Arellano and Bond (1991); DoF is the number of degrees of freedom of this test. ** indicates significance of 95 per cent. t-ratios in parentheses.

of uncertainty (columns (3) and (3′)) and find that it is highly significant with a large impact on saving rates (coefficient of 0.11). In this case, the inflation rate becomes significant at the 10 per cent level while female activity rates are still non significant. We finally combine both measures of uncertainty (columns (4) to (5′)) and find strong evidence of a significant and positive effect of uncertainty on saving rates, validating thus the precautionary savings hypothesis. Furthermore, income growth has the expected negative sign and the inflation rate acts now as an important determinant of saving rates. Income levels, credit to income ratios and non-financial wealth have the expected negative effect.

In summary, the evidence found in Tables 5 and 6 suggests the existence of an important precautionary savings motive, which should be taken into account when designing public policies.

V CONCLUSIONS

This paper provides new empirical evidence regarding consumption and saving behaviour of Spanish households using regional data. The main conclusion is that at the macroeconomic level, one of the most important determinants of private saving rates is the degree of uncertainty about future income, which is in line with results from the previous literature (inter alia Edwards, 1996; Loayza *et al.,* 2000 or Menegatti, 2007, 2010). This indicates that there exists a precautionary motive for saving, especially when the level of uncertainty is variable and persistent through time. Among the different options for measuring uncertainty, we highlight that for the Spanish regions the unemployment rate is particularly appropriate.

As Menegatti (2007, 2010), we demonstrate that, while the amount of consumption and saving with respect to a unit of income are necessarily mirror images in a fixed moment of time, this does not hold when we consider the dynamics of consumption and saving. With regional Spanish data we find that the same set of exogenous variables has rather different impacts on consumption growth and saving rates.

The standard consumption theory indicates that higher current savings reduces current consumption, but increases future consumption (agents intertemporally allocate their income to smooth consumption through time). However, when macroeconomic uncertainty about future income increases over time, the consumption of accumulated saving is postponed. This is especially relevant to the Spanish economy because: the very high level of household financial leverage (according to IMF's calculations, household sector had a debt/GDP ratio of 136 per cent of disposable income in 2010, IMF, 2012); the collapse of the housing bubble, which reduces the value of real estate assets and, therefore, of non-financial wealth; and the increased difficulties in accessing credit. Thus, increased savings today will not cause increased consumption in the future and, therefore, will not trigger investment and the creation of employment through an expansion in demand (Bande and Riveiro, 2013). Furthermore, the rise in unemployment will create more uncertainty, which in turn will increase further saving rates and worsen the state of the labour market. These aforementioned factors may lead to a circle of greater uncertainty, increased precautionary saving, weaker aggregate demand and higher unemployment, which in turn leads to more uncertainty.[15]

These results are significant at the macroeconomic policy design level, given that they suggest that the measures currently focusing on labour market flexibility will increase precautionary saving rates. According to the results presented here, the only way to break this vicious cycle is to directly stimulate consumption, which would have a direct effect on investment (Bande *et al.*, 2011; Bande and Riveiro, 2012). This would increase employment and reduce the unemployment rate. The reduction in the level of uncertainty regarding future income in a context of decreasing unemployment rates lowers precautionary saving rates and increases current consumption.

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[15] Unfortunately, the last year for which there is available data was 2007, i.e., before the major rise in unemployment took place. This, obviously, conditions our results, but the evolution of the aggregate saving rate since that year (see Figure 2) reinforces our conclusions.

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APPENDIX

Table A1: *Regional Saving Rates – Descriptive Statistics*

	Mean	*Median*	*Maximum*	*Minimum*	*Standard Deviation*
Andalucia	0.063	0.067	0.096	0.019	0.025
Aragón	0.150	0.152	0.199	0.111	0.025
Asturias	0.080	0.077	0.128	0.034	0.029
Baleares	0.100	0.112	0.165	–0.005	0.054
Canarias	0.186	0.192	0.228	0.096	0.036
Cantabria	0.174	0.154	0.262	0.107	0.047
Cataluña	0.132	0.128	0.185	0.094	0.023
Castilla-La Mancha	0.215	0.216	0.285	0.154	0.038
Castilla-León	0.178	0.180	0.223	0.136	0.027
Extremadura	0.080	0.092	0.135	0.013	0.039
Galicia	0.128	0.136	0.202	0.053	0.045
Madrid	0.089	0.098	0.133	0.044	0.029
Murcia	0.111	0.096	0.192	0.048	0.045
Navarra	0.214	0.217	0.252	0.177	0.020
País Vasco	0.198	0.196	0.236	0.152	0.023
La Rioja	0.216	0.218	0.268	0.163	0.029
Valencia	0.115	0.115	0.150	0.070	0.020

Source: Authors own calculations using data from BD-MORES dataset.