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Labor income uncertainty, skewness and homeownership: A panel data study for Germany and Spain

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Abstract

In this paper we empirically investigate the effect of labor income uncertainty on the probability of homeownership in Germany and Spain. This study is motivated by two facts. Firstly, theoretical models tend to provide ambiguous results on this issue. Secondly, previous empirical evidence focuses exclusively on the US housing market. To carry out our analysis we propose more precise income uncertainty measures based on panel data labor income equations. We observe that households facing high levels of income uncertainty display a preference for renting, while those located in more positively skewed income distributions show a greater propensity for homeownership.

JEL classification: D1; R0; J0

Keywords: Homeownership; Income uncertainty; Income skewness; Transitory income; Permanent income; Credit constraints; Risk aversion

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1. Introduction

The determinants of households' housing tenure choices have been extensively analyzed in the economic literature. Of these determinants the uncertainties faced by the households during the planning period have been the focus of considerable theoretical research. It is well known that house purchases cannot be easily altered in response to fluctuations in income. As a consequence of this lack of flexibility, uncertainty in future income turns out to be one of the most relevant variables in the decision of homeownership. On the one hand, borrowers facing greater income uncertainty may face restrictions in accessing the mortgage market. On the other hand, even if they have access to the credit market, it might be expected that risk-averse households with more volatile incomes will try to avoid a mortgage default. Understanding to what extent income (un)certainty acts as a barrier to homeownership in turn has important implications for the design of public housing policies and private mortgage insurance products. While these uncertainties are usually accounted for in most of the theoretical models, there are hardly any empirical tests addressing the issue.

Theoretical models analyzing how income uncertainty affects homeownership propensities tend to provide ambiguous predictions, while the limited empirical evidence using US data suggests that this effect is negative. In this paper we provide additional empirical evidence drawn from Spain and Germany. This allows us to consider variations arising from institutional differences across countries. These institutional differences may generate not only different attitudes towards risk, but also differences in the individuals' perception of risk in itself, i.e. what is viewed as risky in one country is not necessarily perceived as risky in another country.[1] The reason we choose these two countries for the comparative analysis is that they represent the two opposite extremes in terms of labor, credit and housing market performance among European countries. On the one hand, Spain is the paradigm of what can be called "the culture of the property"; on the other hand, German households show a marked preference for renting.

Existing studies analyzing the impact of income uncertainty on the probability of homeownership mainly focus on the variance of income. We question whether the single use of the variance is sufficient to examine individuals' responses to risk. There exists a growing literature that shows the importance of the skewness for many economic decisions. This literature starts with Tsiang [29], who argues that individuals show a preference for skewness, in addition to dispersion-aversion, in any economic decision involving an uncertain outcome. Some recent labor economic literature (see e.g. Hartog and Vijverberg [13] or Diaz-Serrano et al. [6]) shows that individuals like positively skewed income distributions, and they incorporate this information in their occupational and educational choices. Garrett and Sobel [11] find evidence that risk-averse individuals, playing lottery games in the US, base their participation decision on the skewness of the prize distributions. In this paper we

[1] Neuteboom [26] offers a comparison of the costs and risks for owner-occupiers among a selected group of European countries. He uses loan-to-income and loan-to-value ratios to measure risks faced by households in the mortgage market and shows that the risks within these countries differ substantially.

extend the usual empirical analysis of income uncertainty in housing tenure decisions so as to incorporate a more detailed measure of income uncertainty based on both the variance and the skewness of income.

The remainder of the paper is structured as follows. In Section 2 we provide a brief summary of the institutional arrangements in Germany and Spain. In Section 3 we review the previous studies of the effect of income uncertainty on homeownership and introduce the concept of skewness. Section 4 outlines the empirical strategy. The data used are described in Section 5. Section 6 reports the empirical results, and Section 7 summarizes and concludes.

2. The institutional settings in Germany and Spain

The German housing market[2] is characterized by the largest private rental sector among the EU-15 countries.[3] The percentage of rented dwellings remained relatively constant at 58 percent from 1995 to 1999. German housing legislation has historically supported the design of policies to promote the renting market. Individual owners enjoy generous tax incentives if they offer their properties in the private rental market, and can receive subsidized loans if they do so in the social rental sector. Local authorities also provide an important amount of urban land for the construction of small flats intended for renting to disadvantaged sectors of population. However, in the German income tax system, subsidies to homeownership are extremely limited. Homebuyers may deduct a percentage of the house price and property taxes, subject to certain limits, from their taxable income. This tax relief is about 9 percent. However, these tax deductions can only be enjoyed during the first eight years. In addition, the imputed rent on the owned dwellings is taxable and mortgage interest payments are not deductible; these further increase the attractiveness of the rental market and explain why, in Germany, the housing rental market is a strong alternative to homeownership.

In contrast to Germany, the Spanish rental sector is the smallest in the EU-15. In 1995, only 14 percent of the dwelling stock was rented, and this percentage fell to 11 percent in 1999. Housing policies in Spain have traditionally been exclusively aimed at promoting homeownership.[4] Unlike Germany, the tax deductions for homebuyers are very generous. Mortgage interest rates, property taxes, and a percentage of the house value, without limit, are deductible at very generous rates that range from 13.5 to 16.5 percent, depending on the value of the house and some conditions associated with household composition. In addition to this, imputed rents are not taxable. Neither supply or demand in the rental market have been encouraged in any way. For example, the 1998 Personal Income Tax reform abolished

[2] See Clark et al. [4] for an overview of the housing market and an analysis of the transition to owning in Germany.

[3] EU-15 refers to the fifteen member states of the European Union before its extension to 25 countries in May 2004.

[4] For a more detailed description of the housing market in Spain see Eastaway and San Martin [8,9].

the 15 percent personal tax-relief on household's renting costs.[5] As a result of this lack of incentives in the rental market, the Spanish dwelling vacancy rate is just above 20 percent, which after Greece is the second highest in Europe.

Significant differences between Germany and Spain are also apparent in the labor market. The Spanish labor market is dominated by persistently poor performance. Spain possesses the highest unemployment and temporary work rates among the EU-15 countries, and one of the highest levels of wage inequality among developed economies. In contrast, the German labor market is very stable and reports one of the lowest levels of wage inequality among developed economies. Hence, it seems likely that labor market uncertainty arising from either unemployment or income fluctuations is higher in Spain than in Germany.

Apart from the differences in the institutional context outlined above, differences in the mortgage market are also crucial to understand differences in behavior of German and Spanish households. During the late 1990s the Spanish mortgage market became very accessible. On the one hand, mortgage downpayments were practically removed and lending institutions allowed households to undertake very high levels of indebtedness. On the other hand, the costs derived from a mortgage default are relatively low, since the purchased dwelling serves, by itself, as a guarantee. This means that after a mortgage default the lender can seize the house and the borrower is not liable for the remaining mortgage debt.

In contrast, the German mortgage market is very conservative. In the event of a mortgage default the borrower still remains liable for the remaining mortgage debt. The lender has legal recourse to a proportion of the borrower's salary, other income and assets. The ability to seize a portion of the borrower's earnings directly from his employer acts as a strong disincentive against homeownership for those households with a relatively high probability of mortgage default. Given that there is no "exit" option, German borrowers are generally more reluctant to assume the higher levels of debt associated with homeownership. The marked differences between the two credit markets result in substantial discrepancies in the mortgage delinquency rates. In Spain the probability that, at a given point in time, a household cannot meet the mortgage payments is ten times higher than in Germany.[6]

3. The theory of income uncertainty and homeownership

Housing purchases are usually driven by consumption and investment motives. Therefore, the choice problem involves the simultaneous allocation of the optimal level of housing devoted to consumption or the optimal level devoted to portfolio holding (see e.g. Henderson and Ioannides [18,19]). From a theoretical point of view, this dual use of housing means that the majority of the models analyzing the effect of income uncertainty on homeownership systematically tend to provide ambiguous results. Hence, the sign of

[5] As a result of this tax reform, Spain is the unique EU country without these deductions.

[6] In 1994 the percentage of households that could not pay the mortgage was about 0.8 percent in Germany, whereas in Spain this percentage was about 8.2 percent. In 1996 these percentages were about 0.5 and 5.6 for Germany and Spain, respectively (own calculations based on ECHP data).

such a relationship may vary depending on the differences in the construction and the assumptions underlying each model.

DeSalvo and Eeckhoudt [5] analyze the effect of income uncertainty, proxied by the probability of unemployment, on housing consumption and find a negative effect. Using a similar framework Turnbull et al. [30] find a negative effect of income risk on housing demand. However, the authors also point out that labor income uncertainty could have a non-negative effect if expected labor income embodies compensating wage differentials for income risk.[7] Thus no unambiguous conclusions can be drawn. Fu [10] analyzes the demand for housing in the presence of liquidity constraints. He shows that with liquidity constraints and constant risk aversion, certainty in income increases investment in housing and reduces consumption. However, if risk aversion is high enough investment may fall if investors increase liquidity. Once more the effect of income uncertainty is ambiguous.

Despite the ambiguity shown by theoretical models, the existing empirical evidence in the US reveals an unequivocal negative effect. Haurin and Gill [15], Haurin [16] and Robst et al. [27] find empirical support that both housing demand and the probability of homeownership in the US fall when income risk increases.

The existing studies aiming at disentangling the impact of income uncertainty on the probability of homeownership focus on the variance of income. The negative effect found in the empirical studies is consistent with the increased probability of default associated with increased risk. Hence, risk-averse households must show a preference for renting. McGoldrick [24] and Hartog and Vijverberg [13] for the US, and Hartog et al. [14] and Diaz-Serrano et al. [6] for a selected group of EU countries show that individuals like positively skewed income distributions. This is due to the fact that in positively skewed income distributions, both the probability of reaching high incomes and the probability of a big loss, are smaller relative to a more symmetric income distribution. In other words, a large deviation bellow the mean is less likely in a more positively skewed distribution. This behavior is called "skewness affection" (see Hartog and Vijverberg [13]).

The skewness hypothesis presented above is supported by prospect theory (Kahneman and Tversky [21,22]). This states that the individual's disutility caused by a loss is greater than the utility caused by a gain of the same size. Following this reasoning, risk-averse households would feel safer in a positively skewed income distribution. Our conjecture is that risk-averse households positioned in more positively skewed income distributions are more likely to purchase their dwelling, since their expectations of mortgage default are smaller. We believe that a suitable analysis of the impact of income uncertainty on the housing tenure choices should account for this effect. In order to capture this behavior, we propose to extend uncertainty analysis on tenure decisions up to the third moment (skewness).

[7] The existence of compensating wage differentials for income risk is well documented in the labor economics literature (see King [23] and McGoldrick [24] for the US, Hartog et al. [14] for Spain, Germany, the Netherlands and Portugal, and Diaz-Serrano et al. [6] for Denmark). All these studies provide empirical evidence that reinforces the ambiguity in the relationship between income uncertainty and homeownership.

4. Empirical framework

4.1. Measuring household's labor income uncertainty

To proxy labor income uncertainty we turn to the additive decomposition of income into a permanent and a transitory component. Variables affecting permanent labor income such as experience, education, gender or public/private sector are expected to generate systematic variations in income, which are foreseeable by individuals. Therefore, a suitable measure of income uncertainty should be purged of these systematic variations that have nothing to do with risk. To do this we estimate separate panel data regressions for owners and renters as follows

$$W_{it} = X_{it}\beta + u_i + \varepsilon_{it}, \tag{1}$$

where the subscripts i and t refer to households and time, respectively. W_{it} is the combined real wage income of both the household head and the spouse or co-habiting partner, X_{it} is a set of explanatory variables, u_i is a time-constant permanent shock in labor income, and ε_{it} is a white noise time-varying residual. In Eq. (1) the matrix X consists of a set of human capital variables, a set of demographic dummies, and a set of work status dummies expected to generate systematic wage differentials.

One advantage of the income panel Eq. (1) is that it estimates the systematic component (u_i) due to unobserved factors such as ability, effort, etc. Hence, this systematic component can also be netted out of the estimated residuals (ε_{it}) and added to the fitted values $(X_{it}\beta + u_i)$ to proxy permanent income. In order to estimate household's permanent and transitory income we not only estimate separate household labor income equations for owners and renters but also separate estimates for household heads and spouses. This is necessary in order to obtain a "clean" measure of the effect of the X's on labor income. Hence, for each household and tenure status we estimate

$$W_{it1} = X_{it1}\beta_1 + u_{i1} + \varepsilon_{it1}, \tag{2}$$

$$W_{it2} = X_{it2}\beta_2 + u_{i2} + \varepsilon_{it2}, \tag{3}$$

where the subscripts 1 and 2 indicate the household head and the spouse or co-habiting partner, respectively. Given the linearity of Eqs. (1) to (3) we have that

$$W_{it} = W_{it1} + W_{it2} = X_{it1}\beta_1 + X_{it2}\beta_2 + u_{i1} + u_{i2} + \varepsilon_{it1} + \varepsilon_{it2}. \tag{4}$$

Hence, for a household i, in a given period t, permanent (P_{it}) and transitory (T_{it}) income are estimated as the sum of the separate estimates of the household head and the spouse as

$$P_{it} = X_{it1}\hat{\beta}_1 + X_{it2}\hat{\beta}_2 + \hat{u}_{i1} + \hat{u}_{i2}, \tag{5}$$

$$T_{it} = \hat{\varepsilon}_{it1} + \hat{\varepsilon}_{it2}. \tag{6}$$

Labor income uncertainty and skewness are computed for each household using the intertemporal variance and skewness of the annual transitory labor income defined in Eq. (6), i.e.

$$\sigma_i^2 = \frac{1}{T-1}\sum_{t=1}^{T}\left(T_{it} - \overline{T}_i\right)^2 \quad \text{and} \quad \kappa_i^3 = \frac{T}{(T-1)(T-2)}\sum_{t=1}^{T}\left(\frac{T_{it} - \overline{T}_i}{\sigma_i}\right)^3,$$

where $\overline{T_i} = (1/T)\sum_{t=1}^{T} T_{it}$ and T is the number of waves in which each household has participated.

4.2. Econometric model

4.2.1. Pooled probit model

The observed endogenous variable in our econometric model, y_{it}, is binary, taking the value one if the household i is an owner in period t, and zero otherwise. In this context, y_{it} is the realization of the unobserved propensity for homeownership for each household at each period, y_{it}^*. Hence, the econometric specification can be written as

$$y_{it} = I\left(y_{it}^* > 0\right) = I\left(Z_{it}'\gamma + \nu_{it} > 0\right) \quad (i = 1, \ldots, N;\ t = 1, \ldots, T), \tag{7}$$

where $I(\cdot)$ is a binary indicator function that takes the value one if the argument is true and zero otherwise, Z_{it} is a vector of explanatory variables, γ is the vector of coefficients to be estimated, and ν_{it} is the error term. Equation (7) represents the standard pooled probit model, which ignores heterogeneity across households. If ν_{it} is independent of Z_{it} the estimates coming from this model are consistent but might not be asymptotically efficient. However, Bertschek and Lechner [2] provide a clustering correction that allows us to estimate the standard errors efficiently. The clustering correction used here is

$$\widehat{V}(\hat{\beta}) = \left(\frac{N}{N-1}\right)\left(-H^{-1}\right)\left(\sum_{i=1}^{N} g_i g_i'\right)\left(-H^{-1}\right), \tag{8}$$

where g_{it} and H are the gradient and the Hessian of the corresponding likelihood function of Eq. (7), respectively, and $g_i = \sum_{t=1}^{T} g_{it}$.

4.2.2. Random effects probit model

If we make the standard assumption that the error term in Eq. (7) can be additively decomposed into an unobservable household-specific component, δ_i, which is constant over time and normally distributed with zero-mean and variance σ_δ^2, and a time-varying white noise error term, e_{it}, independent of both δ_i and Z_{it}, then Eq. (7) becomes

$$y_{it} = I\left(y_{it}^* > 0\right) = I\left(Z_{it}'\gamma + \delta_i + e_{it} > 0\right) \quad (i = 1, \ldots, N;\ t = 1, \ldots, T). \tag{9}$$

Equation (9) corresponds to the standard random effects probit model for which maximum likelihood estimates are generally consistent and asymptotically efficient (see e.g. Green [12]). We can also obtain an estimate of ρ defined as

$$\rho = \mathrm{corr}(\delta_i + e_{it}, \delta_i + e_{is}) = \frac{\sigma_\delta^2}{(\sigma_\delta^2 + \delta_e^2)} \quad \forall t \neq s. \tag{10}$$

This term is the correlation between the composite latent error, $\delta_i + e_{it}$, across any two time periods, but also measures the relative importance of the household's unobserved effect, δ_i.

While the standard random effects probit model described above has the advantage of taking into account heterogeneity across households by means of δ_i, it does not allow for correlation between the explanatory variables, Z_{it}, and the time-constant household effect, δ_i. Following Mundlak [25], we can deal with this by specifying the term δ_i to be distributed as $\delta_i|Z_{it} \sim N(\eta + \overline{Z}_i\lambda, \sigma_\alpha^2)$ where $\overline{Z}_i$ is the time-average of Z_{it}, and σ_α^2 is the variance of α_i in the equation $\delta_i = \eta + \overline{Z}_i\lambda + \alpha_i$. Hence, the standard random effects probit model expressed in Eq. (9) now reads as the correlated random effects model expressed as[8]

$$\begin{aligned} y_{it} &= I\left(y_{it}^* > 0\right) \\ &= I\left(\eta + Z_{it}'\beta + \overline{Z}_i'\lambda + \alpha_i + e_{it} > 0\right) \quad (i = 1, \ldots, N;\ t = 1, \ldots, T). \end{aligned} \tag{11}$$

4.2.3. *Pooled vs. random effects model*

The use of the random effects model is, however, conditioned on the strict exogeneity assumption. That is, to be consistently estimated, it is necessary that feedback effects between homeownership in period t and future values of the explanatory variables be absent.[9] To some extent, the former assumption is not very realistic. In a given context, the financial burden that represents facing a mortgage debt might influence future employment decisions or even future plans about family composition. Hence, the strict exogeneity assumption is at least questionable. Although the pooled probit model is restrictive in that it cannot identify the unobserved heterogeneity across households, this model is capable of identifying state dependence parameters even in the presence of feedback effects. Moreover, after applying the correction expressed in Eq. (8) the properties of the pooled probit model are similar to those of the random effects model. As a result, we will use the clustering corrected pooled probit as a baseline against which we compare the estimates coming from the correlated random effects model. The use of both econometric models allows us to check the robustness of our estimates.

5. Data and variables

5.1. *The data*

The data comes from the European Community Household Panel (ECHP), a yearly panel of the EU-15 countries that started in 1994. This survey is carried out by *Eurostat* in cooperation with the national agencies of statistics of each of the EU-15 countries. In this paper we use the waves covering the period 1994–2001 for Germany and Spain. For the first three waves (1994–1996), the ECHP files for Germany contain information coming from both the German Socio-Economic Panel (GSOEP) and the original ECHP, whereas for the period (1997–2001) the whole sample comes from the GSOEP. Given that the original ECHP files are available only for a short period, we exclude them from the analysis and focus on the GSOEP files for the entire sample period. For Spain all data come from the

[8] In our specification the matrix $\overline{Z}_i$ includes the time-average of the household's permanent income, transitory income and other sources of income. In the case of the transitory income we have that by definition $(1/(nT))\sum_{i=1}^n\sum_{t=1}^T e_{it} = 0$. However, since our measure of average transitory income is just the average over time for each household we get that $\overline{T}_i = (1/T)\sum_{t=1}^T e_{it} \neq 0$, $\forall i$. In using this approach we face one restriction; given that our measures of income uncertainty and skewness are constant over time, we cannot allow for correlation between δ_i and these two variables.

[9] See Biewen [3] for more details.

Table 1
Sample sizes and structure of the data

Year	Number of households per wave				Distribution of the sample according to the number of waves in which each household has participated		
	Spain		Germany				
	(1)	(2)	(1)	(2)	Number of waves	Spain	Germany
1994	7206	4261	6207	4484	1	13.1%	7.7%
1995	6522	3560	6336	4445	2	9.0%	6.9%
1996	6267	3198	6259	4244	3	9.5%	6.8%
1997	5794	2810	6163	4046	4	6.7%	6.8%
1998	5485	2589	5962	3738	5	5.9%	5.2%
1999	5418	2408	5847	3593	6	5.8%	5.3%
2000	5132	2184	5693	3424	7	7.7%	8.9%
2001	4966	2027	5563	3216	8	42.3%	52.4%
Sample size	46,790	23,037	48,030	31,059		8608	7892

Notes: (1) Total number of households. (2) Number of households receiving labor income from at least one either the household head or spouse.

original ECHP. The number of surveyed households for Germany varies from 6207 in 1994 to 5563 in 2001, and from 7206 in 1994 to 4966 in 2001 for Spain. Table 1 shows a summary of the sample sizes and the structure of the data.

The ECHP and the GSOEP contain information not only at household level, but also at individual level. The household characteristics that we consider relevant for the present study are the household size and composition, demographic characteristics, income and accommodation. The accommodation questions provide information about the type of dwelling, the year in which the household moved there, and the motives for dwelling mobility. Besides household information, we also use personal information (age, gender, etc.) and individual socio-economic characteristics (employment status, earnings, education, etc.).

5.2. Selected samples

As it is shown in Table 1, our panel is unbalanced (42.3 percent of the sample is balanced for Spain and 52.4 percent for Germany). To carry out the estimates of the labor income equations defined in Eqs. (2) and (3) we use the whole sample, i.e. households that participated from 1 to 8 waves. However, in order to estimate skewness we need a minimum of three observations per household. Therefore, when estimating the tenure choice equations the sample is restricted to households that have participated in at least three waves. This restriction leaves us with unbalanced panels of 6705 household for the Spanish sample and 6739 for Germany. Of these samples, 54 percent are balanced observations for Spain, and 61 percent for Germany.

In order to test the effect of labor income uncertainty on the homeownership propensities, the labor income variables are computed for each household as described in Section 4.1, and matched with the household information. To check for the consistency of our results, the tenure choice equations described in Section 4.2 are estimated using two different samples of households. The first sample consists of all those households used to estimate the labor income equations. In this case the restrictions are that either the household head or the spouse, or both, received labor income and participated for a minimum of three waves. Households where both the household head and the spouse are pensioners or do not receive any labor income are kept out of the analysis. We call this the *unrestricted sample*.

The second sample (hereafter *restricted sample*) is restricted to homeowners having outstanding mortgage payments. By applying the former restriction we omit households that purchased their dwelling too long ago, did not make use of a mortgage or have inherited the dwelling. Obviously, these households might never experience a mortgage default. Therefore, they are not expected to follow the same choice rules as homeowners that are currently mortgage borrowers. By including these households in the sample the true relationship between income uncertainty and the probability of homeownership could be obscured.

5.3. Variables

As is usual in the literature analyzing the households' tenure decisions, the homeownership propensities in Germany and Spain will be modeled by means of a set of household head characteristics (gender, marital status, age, education and unemployment trajectory), a set of household characteristics (the presence of children, income and geographical location) and the user costs. Additionally, our data set also allows controlling for the reasons that motivated the change between dwellings in the event that the household is a mover and the year the change was made. As noted earlier in the previous section, the set of household income variables consists of a permanent and transitory component for household's labor income, a measure of non-labor income, and our two key variables, the variance and the skewness of the transitory income.

Following Henderson and Ioannides [19] and Rosen et al. [28] we define the opportunity cost of owner occupancy as

$$OC_{kt} = P_{kt}\big[(r_t + p + m) - h(r_t + p)\big], \tag{12}$$

where P_{kt} is the deflated annual average price in region k at year t, r_t is the nominal mortgage rate at period t, p is the property tax rate, m is the maintenance rate, and h is the marginal tax rate. User costs are computed for each of the NUTS regions for Spain and Germany available in the ECHP.[10] In Eq. (12) P_{kt} varies regionally within each country and year, r_t varies by year, and m, p and h are assumed to be constant across the sample in each year and region. We estimate the opportunity cost of owner occupancy for both Spain and Germany for a standard 90 square meter dwelling (average size in Germany and Spain).

[10] The NUTS (nomenclature of territorial units for statistics) classification for Germany is Bader-Wuntterberg, Bayern, Berlin, Brandenburg, Bremen, Hamburg, Hessen, Mecklenburg-Vorpommem, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, Saarlan, Sachsen, Sachsen-Anhalt, Schleswig-Holstein, and Thuringen. The Spanish NUTS are North-West (Galicia, Cantabria, Asturias), North-East (Pais Vasco, Navarra, Aragon), Center (Castilla-Leon, Castilla-La Mancha, Extremadura), East (Catalunya, Valencia, Baleares), South (Andalucia, Murcia), Canarias and Madrid.

For Spain, average prices per square meter are taken from the *Ministerio de Fomento* (Ministry of Construction). These data are collected quarterly and come from transactions and house valuations of newly constructed dwellings (less than one year old) during each quarter. We use the annual average. The mortgage interest rate is taken from the *Banco de Espana* (Central Bank of Spain). We use the annual average of the monthly rates. These rates vary from 10.5 percent in 1994 to 5.8 percent in 2001. The marginal tax rates for each household are not available in our data set, but since they range from 13.5 to 16.5 percent depending on the house value and economic conditions of the household we take an average value of 15 percent.[11] Although the local governments are the revenue recipients of property taxes, the rate is fixed at a national level, at 7 percent.

In the case of Germany average prices for a standard 90 square meter dwelling are taken from *Immowelt* and are based on available dwellings for sale and recent transactions from several German real estate agencies. Since the estimated average of the regional prices correspond to year 2004, we have deflated these regional prices using the housing price indicators for each region coming from the *Statistisches Bundesamt Deutschland* (Federal Statistics Office Germany) and the *Deutsche Bundesbank* (Central Bank of Germany). In Germany mortgage interest rates are not deductible and as a result r_t is omitted from the second parenthesis of the right-hand side of Eq. (12). As mentioned in Section 2, imputed rents are also taxable, however, this information is not available at a regional level and it is also omitted from the analysis. The marginal tax rates and the mortgage interest rates are available from the *Deutsche Bundesbank*. We take a marginal tax rate of 9 percent, and for the interest rates we use the annual average of the monthly rates. These rates vary from 7.3 percent in 1994 to 5.6 percent in 2001. The property tax rate is taken from the *International Bureau of Fiscal Documentation*. In Germany property tax rates are a combination of the federal basic rate and locally determined municipal coefficients that may vary from 280 to 600 percent. This combination provides effective rates that range from 0.98 to 2.1 percent depending on the municipality. We use the average rate, around 1.55 percent. As in Robst et al. [27] we assume a maintenance rate of 1.5 percent in both Germany and Spain.

Following Robst et al. [27] the renter occupancy costs for both Germany and Spain are directly estimated from our dataset by averaging the self-reported monthly rents in each NUTS region and year.

Table 2 provides summary statistics of the variables used to explain the tenure status propensities. We provide separate summaries for owners and renters. Permanent labor income tends to be remarkably higher for owners than for renters, about 30 percent higher in both Germany and Spain. Other sources of income (non-labor, capital income, etc.) also show systematic differentials (20 percent higher for owners in Spain and 40 percent higher in Germany). Regarding our two key variables, labor income uncertainty and skewness, the summary statistics reveal that both possess enough variability to identify effects in the tenure choice equations. We also find important intra-country differences across tenures, i.e. less income uncertainty and more positive skewness for owners than for renters. Own-

[11] House prices are estimated at a regional level. Given that the house value for each household is not available in our data, we cannot compute precise average marginal rates by region based on specific household's income situation and composition. However, as there is only a slight difference between the lower and upper bound, such a refinement would probably lead to negligible changes in the estimated effect of the owner-occupancy costs.

Table 2
Summary statistics computed over the period 1994–2001

	Spain						Germany					
	Renters		Owners		Full sample		Renters		Owners		Full sample	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Household income												
Permanent labor income	13,866	8664	18,065	10,057	15,312	8820	21,082	10,289	27,492	12,993	23,680	11,886
Transitory labor income	−67	1650	89	1665	43	1662	−41	1281	21	1073	−16	1201
Other income	3867	5314	4764	6018	4652	5942	5939	6082	8213	8742	6861	7363
Labor income uncertainty/10^7	2.53	9.52	1.93	2.50	2.00	4.02	4.52	86.91	3.86	18.68	4.25	67.89
Labor income skewness	0.02	1.01	0.10	0.99	0.09	1.00	−0.08	1.06	0.07	0.99	−0.02	1.03
Household head characteristics												
Female	0.19	0.39	0.12	0.33	0.13	0.34	0.38	0.49	0.28	0.45	0.34	0.47
Married	0.66	0.47	0.83	0.37	0.81	0.39	0.62	0.49	0.85	0.36	0.71	0.45
Age	43.64	12.44	48.20	11.15	47.63	11.42	40.91	11.67	46.07	10.84	43.00	11.62
Primary education	0.59	0.49	0.64	0.48	0.64	0.48	0.23	0.42	0.10	0.30	0.17	0.38
Secondary education	0.17	0.37	0.15	0.35	0.15	0.36	0.56	0.50	0.57	0.49	0.56	0.50
Higher education	0.24	0.43	0.21	0.41	0.21	0.41	0.21	0.41	0.33	0.47	0.26	0.44
Long-term unemployed	0.24	0.43	0.16	0.36	0.17	0.37	0.18	0.39	0.10	0.30	0.15	0.36
Children	0.37	0.48	0.41	0.49	0.40	0.49	0.33	0.47	0.40	0.49	0.36	0.48
Sample size (# obs.)	2686		20,351		23,037		18,229		12,830		31,059	

ers tend to be married, older and less likely to be long-term unemployed (12 months or more) than renters.

6. Econometric results

We estimate separate labor income Eqs. (2) and (3) for the household head and the spouse, respectively, and for each tenure using the random effects linear model (see e.g. Hsiao [20]). Our dependent variable is net annual labor income deflated to real 2000 Euro. The explanatory variables are dummies for education, a squared polynomial on age, dummies for gender and marital status, and a set of dummies measuring labor conditions such as public employment, full-time employment, and the type of contract. All the estimated coefficients have the expected signs and are statistically significant.[12] We observe a positive effect of education, age, public worker, permanent contract, full-time employee and married on labor income, whereas the respective effect for females and age-squared is negative.

The probit estimates of the determinants of homeownership in Spain and Germany are presented in Tables 3 to 6. We start with the pooled probit estimates reported in Tables 3 and 4. To allow for comparisons across models we report the average partial effects (column labeled as APE). The column labeled t-stat1 reports the t-values for the estimated coefficients computed using the inefficient standard errors, while the column labeled as t-stat2 reports the estimated t-values using the efficient standard errors obtained after applying the clustering correction given in Eq. (8). Even after applying the former correction our key variables are significant at 5 percent level or better.

The correlated random effects estimates are shown in Tables 5 and 6. For this model we also report the APE.[13] In this model our two key variables are also highly significant. As expected, comparisons between the random effects and the pooled probit model show that the corresponding estimated effects are similar in sign and magnitude in both models.

For a detailed consideration of the effect of the exogenous variables on the probability of homeownership we focus on the correlated random effects estimates. In this model we observe values of ρ that are quite high and statistically significant for both countries and across alternative samples. These values are 0.905 and 0.869 for Spain, and 0.946 and 0.937 for Germany. Recall that ρ picks up the relative importance of the household's unobserved heterogeneity. These high values suggest that unobserved factors account for an important share of the variation of the outcome variable. However, this is a common problem in panel data models estimating the probability of homeownership.[14] Most of the coefficients are statistically significant at 10, 5 percent level or better. Our estimates

[12] These results are not reported, but are available from the author on request.

[13] To compute the partial effects in the random effects model we follow Arulampalam [1]. Thus, after re-scaling by $\sqrt{1-\hat{\rho}}$ the marginal effects can be estimated as

$$\partial\big[\Pr(y_{it}=1|Z_{it})\big]/\partial Z_{it}=\phi\big(Z'_{it}\gamma\sqrt{1-\rho}\big)\big(\gamma_j\sqrt{1-\rho}\big)$$

where ϕ is density of the standard normal distribution.

[14] For instance, using US data Haurin et al. [17] estimate a value of ρ of 0.87.

Table 3
Pooled probit estimates for Spain

	Unrestricted sample				Restricted sample			
	Coeff.	APE	t-stat1	t-stat2	Coeff.	APE	t-stat1	t-stat2
Constant term	−3.5213		−4.17	−3.92	−2.7032		−2.58	−2.29
Household income								
Labor income uncertainty/10^7	−0.1214	−0.0203	−10.39	−5.11	−0.1091	−0.0351	−8.21	−4.20
Labor income skewness	0.0404	0.0127	3.19	1.51	0.0411	0.0132	2.50	1.27
Transitory labor income/1.000	−0.0049	−0.0008	−1.13	−1.68	−0.0051	−0.0017	−0.92	−1.24
Dummy	0.0159	0.0027	0.45	0.52	0.0301	0.0097	0.67	0.75
Dummy × Tran. inc./1.000	0.0009	0.0001	10.15	4.86	0.0007	0.0002	6.78	3.43
Permanent labor income/1.000	0.0140	0.0023	6.55	3.18	0.0300	0.0097	11.18	5.70
Other income/1.000	0.0074	0.0012	3.28	1.88	0.0076	0.0025	2.62	1.57
Household head char.								
Female	0.1802	0.0275	3.98	1.88	0.2721	0.0814	4.44	2.31
Married	0.5484	0.1139	13.57	6.80	0.6290	0.2233	12.04	6.62
Age	0.0669	0.0112	9.77	4.84	0.0323	0.0104	3.25	1.77
Age-squared	−0.0005	−0.0001	−7.40	−3.62	−0.0004	−0.0001	−3.77	−2.07
Primary education	0.1794	0.0309	4.66	2.21	0.2199	0.0713	4.75	2.40
Secondary education	0.0731	0.0118	1.73	0.93	0.1535	0.0478	3.08	1.72
Long-term unemployed	−0.2353	−0.0435	−7.22	−3.47	−0.2493	−0.0841	−6.16	−3.20
Children	0.0072	0.0012	0.22	0.12	0.0880	0.0284	2.20	1.29
User costs								
Owner costs/100	−0.0026	−0.0004	−1.12	−1.18	−0.0033	−0.0011	−1.14	−1.14
Renter costs/100	0.2239	0.0374	1.84	1.86	0.1568	0.0505	1.05	1.00
Dwelling mobility								
Job related reasons	−0.7532	−0.1900	−8.94	−4.68	−0.5206	−0.1893	−5.59	−2.92
House related reasons	−0.3251	−0.0642	−7.97	−3.95	0.1207	0.0379	2.76	1.40
Sample size	20,005				8243			
Log-likelihood	−6368				−4277			
Pseudo-R^2	0.113				0.121			

Notes. All estimates include control dummies for year and region. t-stat1 refers to t-statistic without clustering correction. t-stat2 refers to t-statistic with clustering correction.

show that married household heads are more likely to own their dwelling in both Spain and Germany, whereas the effect of gender differs between the two countries. Age exerts a positive but decreasing effect. The effect of education differs between the two countries, i.e. more educated household heads are more likely to be homeowners in Germany, while the reverse holds for Spain. The household heads that have experienced long-term unemployment at least once report an unequivocal negative response to homeownership. The presence of children exerts a significant positive effect in Germany but does not in Spain. This is consistent with the fact that German households become homeowners at later ages than in Spain. User costs are also significant and with the expected signs, i.e. negative for the owner occupancy opportunity cost and positive for the renting costs. These effects tend to be higher in Germany than in Spain.

Turning to our major findings we focus on the effect of the household income variables. The estimates concerning the effects of household permanent labor income and non-labor

Table 4
Pooled probit estimates for Germany

	Unrestricted sample				Restricted sample			
	Coeff.	APE	t-stat1	t-stat2	Coeff.	APE	t-stat1	t-stat2
Constant term	−3.4546		−9.31	−7.79	−3.9707		−11.28	−9.34
Household income								
Labor income uncertainty/10^7	−0.0046	−0.0018	−5.82	−3.26	−0.0059	−0.0020	−6.54	−3.86
Labor income skewness	0.0553	0.0211	6.82	2.91	0.0724	0.0247	8.07	3.58
Transitory labor income/1.000	−0.0006	−0.0002	−0.17	−0.17	−0.0051	−0.0017	−1.33	−1.27
Dummy	0.0435	0.0166	2.08	2.50	0.0412	0.0141	1.79	2.11
Dummy × Tran. inc.	0.0008	0.0003	0.16	0.13	0.0073	0.0025	1.33	1.11
Permanent labor income/1.000	0.0294	0.0112	31.78	14.44	0.0340	0.0116	32.87	15.45
Other income/1.000	0.0303	0.0116	22.15	9.78	0.0320	0.0109	20.55	9.36
Household head char.								
Female	0.0344	0.0132	1.80	0.76	0.0314	0.0108	1.51	0.67
Married	0.3873	0.1429	17.73	8.09	0.4190	0.1351	17.14	8.30
Age	0.0449	0.0172	7.93	3.57	0.0817	0.0279	10.52	5.19
Age-squared	−0.0002	−0.0001	−3.62	−1.62	−0.0008	−0.0003	−8.80	−4.34
Primary education	−0.5688	−0.1998	−19.25	−8.43	−0.4994	−0.1531	−15.26	−7.02
Secondary education	0.0061	0.0023	0.30	0.13	0.0049	0.0017	0.22	0.10
Long-term unemployed	−0.3079	−0.1129	−12.46	−5.75	−0.2851	−0.0916	−10.49	−5.04
Children	0.2961	0.1139	14.48	7.32	0.2855	0.0990	12.68	6.60
User costs								
Owner costs/100	−0.0088	−0.0034	−2.97	−3.77	−0.0127	−0.0043	−3.86	−4.45
Renter costs/100	0.0872	0.0333	2.26	3.18	0.0873	0.0298	2.06	2.67
Dwelling mobility								
Job related reasons	−0.8863	−0.2697	−14.33	−6.97	−0.7203	−0.1915	−11.43	−5.58
House related reasons	0.0007	0.0003	0.03	0.02	0.1793	0.0627	8.08	3.76
Sample size	29,005				25,552			
Log-likelihood	−15,846				−13,098			
Pseudo-R^2	0.194				0.196			

Notes. All estimates include control dummies for year and region. t-stat1 refers to t-statistic without clustering correction. t-stat2 refers to t-statistic with clustering correction.

income are consistent with expectations, with the effect being significant and positive for both Spain and Germany. We consider two different specifications to test for the effect of the transitory income on the probability of homeownership. In the first approach (not reported here) we include transitory income, as defined in Eq. (6), without interactions. In this specification the estimated coefficient is negative but statistically insignificant for both Spain and Germany. This finding is consistent with Robst et al. [27] for the US. In the second approach we explicitly test for the effect of positive shocks in income by including, in addition to transitory income, a dummy that takes the value one if for household i at period t the shock in income is positive and zero otherwise, and also the interaction of this dummy with transitory income. Consistent with the findings of Dynarski and Sheffrin [7] for the US, our results for Spain indicate that positive shocks in income exert a positive and significant effect on the homeownership propensities, whereas for Germany this effect is statistically insignificant.

Table 5
Correlated random effects probit estimates for Spain

	Unrestricted sample			Restricted sample		
	Coeff.	APE	z-stat	Coeff.	APE	z-stat
Constant term	−12.1855		−5.98	−6.2425		−3.10
Household income						
Labor income uncertainty/10^7	−0.4648	−0.0224	−8.66	−0.3147	−0.0318	−6.21
Labor income skewness	0.1066	0.0151	2.10	0.1641	0.0166	3.06
Transitory labor income/1.000	−0.0019	−0.0001	−0.19	−0.0029	−0.0003	−0.27
Dummy	0.0075	0.0004	0.09	0.0549	0.0056	0.66
Dummy × Tran. inc./1.000	0.0038	0.0002	9.84	0.0025	0.0003	6.50
Permanent labor income/1.000	0.0367	0.0018	3.63	0.0399	0.0040	3.83
Other income/1.000	0.0164	0.0008	2.28	0.0161	0.0016	2.07
Household head char.						
Female	0.4461	0.0215	2.35	0.6497	0.0657	3.47
Married	1.3043	0.0629	10.32	1.0942	0.1107	7.15
Age	0.2785	0.0134	11.29	0.0745	0.0075	2.65
Age-squared	−0.0018	−0.0001	−7.67	−0.0008	−0.0001	−2.64
Primary education	0.4452	0.0215	2.98	0.5616	0.0568	3.72
Secondary education	0.4959	0.0239	3.31	0.5673	0.0574	3.92
Long-term unemployed	−0.7061	−0.0341	−5.75	−0.2881	−0.0292	−2.24
Children	−0.0724	−0.0035	−0.83	0.0626	0.0063	0.67
User costs						
Owner costs/100	−0.0101	−0.0005	−1.88	−0.0092	−0.0009	−1.70
Renter costs/100	0.4680	0.0226	1.66	0.1778	0.0180	0.64
Dwelling mobility						
Job related reasons	−1.1020	−0.0532	−5.57	−1.1360	−0.1149	−6.08
House related reasons	0.8459	0.0408	7.87	0.8878	0.0898	9.34
Sample size		20,005			8243	
Log-likelihood		3061			−2549	
ρ		0.905			0.869	
Likelihood-test $\rho = 0$		6432			3390	

Notes. All estimates include control dummies for year and region. To estimate the correlated random effects probit model as expressed in Eq. (11) estimates also include the time average of permanent, transitory and other incomes.

Finally, the effect of our two key variables is the expected one, i.e. negative for income uncertainty and positive for skewness in both Spain and Germany. In general the estimated effect of income uncertainty tends to be greater in Spain, whereas the skewness appears to be more important for Germany. The estimated effects of income uncertainty for Spain and Germany are generally consistent with those observed in the US. However, there is no previous empirical evidence on the effect of skewness against which we can compare our results. It is worth noting that despite the marked differences in the institutional settings between Germany and Spain noted in Section 2, the positive effect of labor income skewness on the probability of homeownership persists independently of the econometric method used or the restrictions imposed on our data.

Table 6
Correlated random effects probit estimates for Germany

	Unrestricted sample			Restricted sample		
	Coeff.	APE	*z*-stat	Coeff.	APE	*z*-stat
Constant term	−22.5136		−20.94	−15.5569		−16.19
Household income						
Labor income uncertainty/10^7	−0.0247	−0.0022	−9.44	−0.0187	−0.0017	−5.73
Labor income skewness	0.3160	0.0277	7.96	0.2114	0.0189	5.28
Transitory labor income/1.000	−0.0048	−0.0004	−0.49	−0.0127	−0.0011	−1.27
Dummy	0.1106	0.0097	1.96	0.1115	0.0099	1.92
Dummy × Tran. inc./1.000	0.0004	0.0000	0.03	0.0183	0.0016	1.26
Permanent labor income/1.000	0.0549	0.0048	10.65	0.0571	0.0051	10.47
Other income/1.000	0.1936	0.0170	29.18	0.1130	0.0101	15.90
Household head char.						
Female	−0.2710	−0.0238	−2.54	−0.7769	−0.0693	−7.94
Married	0.7671	0.0673	9.43	0.8725	0.0778	10.38
Age	0.2683	0.0235	13.26	0.2343	0.0209	10.40
Age-squared	−0.0014	−0.0001	−6.30	−0.0022	−0.0002	−9.16
Primary education	−0.8564	−0.0751	−6.90	0.0791	0.0071	0.64
Secondary education	0.5877	0.0515	5.42	0.7988	0.0713	8.81
Long-term unemployed	−0.8471	−0.0743	−9.41	−0.6553	−0.0585	−6.87
Children	0.2768	0.0243	4.02	0.2627	0.0234	3.74
User costs						
Owner costs/100	−0.0290	−0.0025	−3.76	−0.0323	−0.0029	−3.90
Renter costs/100	0.3015	0.0264	2.94	0.2756	0.0246	2.63
Dwelling mobility						
Job related reasons	−0.1309	−0.0115	−0.89	−0.4493	−0.0401	−2.97
House related reasons	2.3514	0.2062	30.18	2.2805	0.2034	29.65
Sample size		29,005			25,552	
Log-likelihood		−5731			−5308	
ρ		0.946			0.937	
Likelihood-test $\rho = 0$		20,000			15,000	

Notes. All estimates include control dummies for year and region. To estimate the correlated random effects probit model as expressed in Eq. (11) estimates also include the time average of permanent, transitory and other incomes.

To illustrate how the homeownership propensities might be affected by movements throughout the distribution of the variance and skewness of the transitory labor income we carry out a very simple simulation exercise. We take the average household and his predicted probability of homeownership and evaluate changes in this probability as this average household moves from the mean to the upper and lower quantiles of the labor income uncertainty and skewness distribution. To do so we use the estimated APE of the correlated random effects probit model in the unrestricted sample. The results are shown in Table 7. For the sake of brevity we just comment the most extreme scenarios.

The average Spanish household has an average income uncertainty of 2, an average skewness of 0.9, and an average predicted probability of homeownership of 0.86. A movement from the mean to the lowest decile of the income uncertainty or skewness distribution

Table 7
Increase of the probability of homeownership (using the APE of the random effects probit model in the unrestricted sample)

	Spain					Germany				
	Income uncertainty		Income skewness		Combined effect	Income uncertainty		Income skewness		Combined effect
	Value[a]	$\widehat{P}(y_{it}=1)$[b]	Value[a]	$\widehat{P}(y_{it}=1)$[b]	$\widehat{P}(y_{it}=1)$[c]	Value[a]	$\widehat{P}(y_{it}=1)$[b]	Value[a]	$\widehat{P}(y_{it}=1)$[b]	$\widehat{P}(y_{it}=1)$[c]
Mean	**2.001**	**0.869**	**0.090**	**0.869**	**0.869**	**4.251**	**0.416**	**−0.028**	**0.416**	**0.416**
10th	0.087	0.906	2.764	0.904	0.941	0.080	0.418	2.802	0.447	0.449
25th	0.696	0.894	0.398	0.873	0.898	1.319	0.417	0.832	0.425	0.425
50th	2.524	0.859	−0.571	0.860	0.850	2.853	0.415	−0.966	0.404	0.403
75th	12.677	0.661	−1.256	0.851	0.644	5.406	0.413	−1.511	0.398	0.394
90th	25.862	0.405	−2.626	0.833	0.369	36.796	0.384	−2.810	0.383	0.351

[a] The columns labeled "Value" show the quantiles of the distribution of income uncertainty and skewness.
[b] The columns labeled $P(y_{it}=1)$ show the change of the probability of homeownership as a household moves from the mean to the upper and lower quantiles above and bellow the mean of the income uncertainty or skewness distribution.
[c] The combined effect considers a movement in both the income uncertainty and skewness distribution.

raises the predicted probability[15] of homeownership up to 0.91 and 0.9, respectively. The combined effect of a simultaneous movement in both variables raises the probability up to 0.94. On the contrary, the opposite movement up to the top decile in either income uncertainty or skewness makes the probability fall to 0.4 and 0.83, respectively. In this case, the combined effect would decrease the probability to 0.36. The gap in the predicted probability between the lowest and the highest decile caused by the combined effect is around 66 percent.

In the case of Germany, the average household has an average income uncertainty of 4.25, an average skewness of -0.028, and an average predicted probability of homeownership of 0.41. An upward movement from the mean to the highest decile of the income uncertainty distribution makes the predicted probability fall to 0.38. A similar movement in the skewness distribution causes the same effect. And a simultaneous movement in both distributions makes the probability decrease to 0.35. In Germany the gap in the predicted probability between the lowest and the highest decile caused by the combined effect is more modest than in Spain but is still substantial, around 23.5 percent.

7. Concluding remarks and discussion

In this paper we looked at the effect of income uncertainty on homeownership. To facilitate comparisons with the previous US evidence, we carried out the analysis for Germany and Spain. We also extended the usual analysis by including the skewness of income as a downside risk measure in the discussion. We have estimated several models using both the clustering corrected pooled probit and the correlated random effects model, and applied a number of restrictions to our data set. Our empirical results indicate that the variance of income has a negative effect on homeownership, while skewness has a positive effect for both Germany and Spain across alternative models and samples. However, despite the fact that the institutional settings in the two countries are very different, the effects of the two key variables, income uncertainty and skewness, on the homeownership propensities are similar.

As it has been mentioned in Section 2, the main differences in the institutional settings between both countries stem from the mortgage market and the public policies aimed at their respective housing markets. A test highlighting how such marked differences affect the homeownership propensities in both countries would require a richer dataset providing more detailed information on the households' financial situation, tax deductions and taxable income and their relationship to the tenure status. Given the limitations of the available data in this respect, this remains a topic for future research.

[15] To compute the percentage chance in the predicted probability with movements from the mean to upper or lower quantiles (qth) we first do the following: (qth-mean) $\times$ $APE = \Delta$. The calculus of the change in the estimated probability is straightforward by: $\Delta \times P(y = 1)$.

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