Income Volatility and Residential Mortgage

Delinquency: Evidence from 12 EU countries

Luis Diaz-Serrano

National University of Ireland Maynooth

IZA Bonn, CREB Barcelona

Corresponding author:

Luis Diaz-Serrano
National University of Ireland Maynooth
Department of Economics (Rhetoric House)
Maynooth, Co. Kildare, Ireland
Tel: +353 1 7083793
Fax: +353 1 7083934
Email: luis.diaz@may.ie

Abstract:

We investigate the socio-economic determinants of mortgage delinquency in 12 EU countries and observe that income volatility significantly increases the mortgage delinquency risk. This pattern even holds for borrowers with higher-income profiles if volatility in income is high enough. From this result we can draw the following conclusions: i) mortgage protection insurance policies might be failing to cover those borrowers most in need; ii) the existence of credit market imperfections, and; iii) the inability for a number of borrowers most at income risk to accumulate precautionary savings in order to meet mortgage payments when shocks in income arise.

1. Introduction

During the second half of the 1990s and early 2000s the rates of mortgage delinquency have fallen dramatically in most of the EU-15[1] countries. These downward trends coincide with falling interest rates and improving performances in most of the EU-15 economies. Paradoxically, this decline in the mortgage delinquency rates has also coincided with upward trends in the prices of housing, which in countries as Ireland, Spain, UK or The Netherlands has been dramatic. Besides the favorable economic conditions mentioned above, a greater effort by the lending industry to make mortgage take-up more affordable has been necessary to mitigate such a dramatic increase in housing prices.

Despite the decline in mortgage delinquency rates, this phenomenon still exist and raises issues not only for lenders but also for borrowers. For the former group, apart form the obvious well documented economic losses that a default would suppose, there are some studies that report health problems associated with the unsustainable housing and the mortgage arrears (see e.g. Burrows, 1998; Nettleton and Burrows, 1998, in the UK; Berry et al., 1999, in Australia; Doling and Ruonavaara, 1996, in Finland).

In tandem with the upward trends in mortgage take-up there exist a growing industry devoted to providing safety-nets to mortgage borrowers via the same lending institutions or insurance companies. The objective of the mortgage insurance policies is to counteract the potentially devastating effect of the unforeseen events that cause fluctuations in the mortgagor's income. Therefore, in the event of involuntary unemployment, sickness or other unexpected shock in the mortgagor's income, the mortgage payment is covered. However, the growing literature in this issue, mainly

---

[1] We refer to EU-15 as the 15 EU countries before the extension to 25 countries executed in May-2004.

focused on the UK mortgage market, provide evidence on the inefficiency and inadequateness of the private mortgage protection insurance (MPI) policies in both the low take-up from those borrowers most at income risk and the poor coverage of the risks (see Pryce and Keoghan, 2002; Ford and Quilgars, 2001).

In this paper we examine the determinants of mortgage delinquency in 12 of the EU-15 countries. We focus on the socio-economic factors rather than those regarding the characteristics of the mortgage or the mortgaged property. In this context, we believe that volatility in household's income is the variable that, in a risky world, best proxies the wide range of unforeseen events that might cause mortgage delinquency or mortgage arrears. Additionally, other socio-economic factors such as different types of employment, unemployment and income are considered.

To some extent, we believe that examining the effect of all these factors on the residential mortgage delinquency risk is also a plausible test on the performance of the mortgage insurance industry, the potential existence of capital market imperfections, or the (in)ability of those households most at income risk to accumulate precautionary savings to meet the mortgage payments when a shock in income arises. On the one hand, an efficient mortgage insurance market would be that capable of removing the effect of most of these factors from the mortgage delinquency propensities by providing both a suitable coverage of the risk as well as covering those most in need. On the other hand, in the absence of a mortgage insurance households susceptible to experience shocks in income are supposed to save from positive shocks to face the negative ones, or to borrow if there exist a perfect capital market. Under this scenario we should expect income volatility to exert an insignificant effect on the likelihood of mortgage delinquency once we control for the level of income.

Traditionally, the econometric analysis of the determinants of the probability of mortgage delinquency or default has been carried out using the standard logit or probit model. However, if the previous tenure choice process is not accounted for, estimates coming from this model are biased. To solve this we estimate a bivariate model with sample selection where both the homeownership and mortgage delinquency propensities are considered simultaneously.

The paper is structured as follows: Section 2 offers and overview of the literature on mortgage delinquency and default In section 3 we briefly discuss some of the main determinants of mortgage delinquency. In section 4 we describe the dataset and the empirical framework. Section 5 shows our main findings. And section 6 summarizes and concludes.

2. Overview of the literature: Mortgage delinquency, default and insurance

The literature on mortgage delinquency is quite scarce and most of the studies focus on mortgage default. However, given that mortgage delinquency in itself usually is the precursor of the ultimate default, it seems interesting to study this aspect of the mortgage market. Also most of the previous studies focus on the characteristics of the mortgage and the mortgaged property as the determinants of default, and leave borrower's socio-economic characteristics as a residual element. Two studies that explicitly examine mortgage delinquency in the US are Green and Furstenberg (1975) and Springer and Waller (1993). The first observed that in neighborhoods with increasing black population the propensity for mortgage delinquency is higher. The second focused on the lender's side and examined the factors determining the timing of the lender's foreclosure decision with delinquent mortgages. They observed that the

duration of the delinquency period and the final lender's foreclosure decision depend on the borrower's equity position. Anderson and VanderHoff (1999) also focused on the borrower's race and observed that black mortgagors are more likely to default.

Also in the context of the US housing market Kau and Keenan (1999) studied the probability of mortgage default and the severity loss of this default, and observed that the distribution of the default severity is critical in determining the borrower's decision to default. Vandell and Thibodeau (1985) examined the likelihood of mortgage default using US individual loan history data. These authors observed that both the loan-to-value (LTV) ratio and the difference between the market value of the mortgaged property and the par value of the mortgage are positively related to the probability of default, and surprisingly, the payment-to-income (PTI) ratio is negatively related. They justify such a striking result by arguing that higher PTI ratios are associated with borrowers who have ample additional resources to overcome a default. Deng et al. (1996) also found evidence of the relevance of the LTV ratio on the probability of mortgage default. They also observed that unforeseen situations as unemployment and divorce act as trigger events on the probability of default. Ross (2000) studied default propensities controlling for the sample selection caused by the approval process previous to the mortgage take-up.

Outside the US the number of studies examining the determinants of the mortgage default risk are more limited. Chinloy (1995) treats default as a three stage sequential process, initial delinquency, long-term non-payment and ultimate default. He applied this multistate mortgage default model to the UK and found that income and liquidity constraints determine the borrower's decision to keep a mortgage even when the home equity becomes negative. Eichholtz (1995) investigated the effect of regional economic

5

stability in the regional rates of default in the Netherlands. This author concludes that the regional employment characteristics are good predictors of the regional levels of mortgage default.

The literature on mortgage insurance is rapidly growing, though there are still relatively few theoretical studies. Brueckner (1985) constructed a two-period model to analyze the borrower's choice of the optimal time pattern of mortgage payments assuming future house values as uncertain. The amount of the premium will depend on the riskiness of the mortgage and the initial down payment. Pryce (2002) developed a theoretical model of the mortgage protection insurance decision taking into account the welfare system and the consumption lost in favor of the insurance premiums.

There are many more empirical studies, though most of them focus on the UK mortgage market. All of these studies emphasize the inadequateness and the failure of the MPI policies. Pryce and Keoghan (2001, 2002) and Ford and Quilgars (2001) found evidence that the main consumers of such an insurance policies were not those borrowers most at income risk. Burchardt and Hill (1997, 1998) found that MPI-holders did not have significantly greater unemployment risks than the uninsured mortgagors. Ford et al. (1995) indeed found that only a quarter of the insured mortgagors in arrears tried to claim. Kempson et al. (1999) observed that those borrowers with unstable work histories and ill-health are systematically precluded from being eligible for the MPI policies.

3. The determinants of mortgage delinquency

Mortgage delinquency represents a relevant problem to lenders. As mentioned earlier, though mortgage delinquency does not systematically lead to a default,

undoubtedly it tends to be the precursor of the ultimate default. Hence, the determinants of the initial delinquency will also influence the final mortgage default. However, analyzing the probability of default is somewhat more complicated since the foreclosure process can be systematically delayed because of government regulations or the lenders voluntarily allowing the lengthen of the delinquency period. Although variables such as the LTV ratio is one of the primary factors affecting the risk of default and hence also the initial mortgage delinquency, in this study we rather focus more on the borrower's socio-economic factors. The mortgagor's level of income and the variables determining this income (occupation, education, the type of employment, etc.) are expected to exert a significant effect on the mortgage delinquency risk.

As mentioned earlier, in a perfect world were households do not face borrowing constraints or can save during positive shocks to meet the negative ones, we should expect income volatility to have an insignificant effect on mortgage delinquency once we control for income level. However, the previous international empirical evidence on these issues does not allow us to admit the existence of "such a perfect world". One the one hand, the existence of credit market imperfections is well documented. For instance, Jappelli and Pagano (1989) observed for a selected group of OECD countries (Sweden, USA, UK, Japan, Italy, Spain and Greece) that the sensitivity of consumption to current income fluctuations was very high. They found this result to be caused by the existence of capital market imperfections. On the other hand, contradicting the precautionary motive for savings assumed in the theoretical literature, there exist little empirical evidence supporting that wealth accumulation and savings arise as a precaution against future income risk. (Guiso et al. ,2002, in Italy; Arrondel ,2002, in France; Skinner ,1988, and Lusardi ,1998, in the US). In this context, we believe that income volatility,

rather than income level, might be more suitable for capturing the borrower's ability to face the periodical mortgage payments. Therefore, we focus on this variable as the main determinant of mortgage delinquency.

Unexpected situations such as involuntary unemployment or job mobility, sickness, demand shocks or any other unforeseen event that cause fluctuations in household's income may also raise the risk of mortgage delinquency. To capture these effects we consider the unemployment history of the household head during the last 5 years previous to the survey and his/her self-reported health status during last 12 months previous to the survey. As mentioned above, in order to avoid mortgage delinquency all these risks might be covered by the mortgagor's own financial resources. Therefore, we also test the role of savings as a determinant of mortgage delinquency.

Additionally to the LTV ratio, the loan-to-income (LTI) ratio is also an important determinant of mortgage delinquency risk. Clearly, if the LTV and LTI ratios are too high this may significantly affect the paying capacity of the borrower. However, the effect of these variables can be smoothed throughout time by contracting a mortgage with longer duration. This would be the case of some northwestern EU countries as Denmark or The Netherlands where high LTV (above 80-90 percent) and high LTI (above 3) ratios are combined with longer mortgage durations (30-35 years). These figures contrast with other EU countries as Italy, Belgium or Austria whit LTV ratios bellow 50 percent and LTI values bellow 1 combined with mortgage durations that range form the 10-15 years in Italy to the 15-20 years in Belgium or Austria[2]. Therefore, since the a loan with a given size might become more affordable with a longer payment period, the payment-to-income (PTI) ratio is probably the variable that best measures

---

[2] See Neuteboom (2003) for an extensive analysis of the risks associated to the LTV and LTI ratios in a selected group of EU countries.

the extent to which the mortgagor's paying capacity is affected by the size of the loan. In our study we will also consider the PTI ratio as one of the determinants of the mortgage delinquency risk.

Finally, as in other previous studies in the US, we also consider two additional variables expected to be important determinants of the probability of mortgage delinquency. These are the characteristics of the mortgagor's neighborhood[3] and the age of the mortgage. As it is pointed out in Green and Fustenberg (1975), assuming the mortgagors "good faith" when taking-up a mortgage, it would be expected that mortgagors try to avoid mortgage delinquency at least during the firsts years but with increasing probability at a given point in time. This behavior may be collected by means of a quadratic function on the age of the mortgage.

4. Data and empirical framework

4.1. Data

The data comes from the European Community Household Panel (ECHP), a yearly panel of the EU-15 countries that started in 1994 and that was carried out during 8 consecutive waves. In this paper we use all waves, thus covering the period 1994-2001 for 12 of the EU-15 countries. Germany and Sweden are omitted from the analysis since for these countries the question regarding mortgage delinquency provides only missing values. We also omit Greece since the number of non-response to this question is remarkably high.

---

[3] See Green and von Furstenberg (1975) and Anderson and VanderHoff (1999) for further discussion. These authors emphasize in the racial component of the mortgage delinquency and default. Ross and Tootell (2004) also analyzed the neighborhood racial component influencing the lender's treatment of the mortgage applications.

The ECHP contain information not only at household, 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 when the household acquired the dwelling, and the motives for dwelling mobility. The survey also includes a set of questions regarding the financial situation of the household. More specifically, our indicator of mortgage delinquency is constructed using to the following question: *Has the household been unable to pay scheduled mortgage payments during the last 12 months?*.

Besides household information, we also use personal information (age, gender, etc.) and individual socio-economic characteristics (employment status, earnings, education, etc.). In order to keep the samples representative at a country level, households that leave the panel are randomly replaced. To carry out our analysis we impose and obvious restriction on our sample, i.e. homeowners must have outstanding mortgage payments. Since the number of mortgage delinquents per wave is relatively low, for our econometric estimates on the probability of mortgage delinquency we pool all available waves for each country. Hence, each wave is treated as a cross-section. We follow this procedure in order to have enough mortgage delinquents to obtain meaningful estimates on the determinants of mortgage delinquency.

In figure 1 we show the evolution of the mortgage delinquency rates in the US, the EU-15 and separated trends for the 12 EU countries considered in our analysis. Although there is a common decreasing pattern in most of the countries, there are marked differences among them. Austria, The Netherlands, Denmark, UK, Luxembourg and Portugal have shown low rates of mortgage delinquency, bellow 2 percent. A

second group composed by France, Belgium, Italy, Ireland and Spain show delinquency rates ranging from near 3 percent to 6 percent. Finally, Finland is the country with the highest rate of mortgage delinquency among the studied countries, above 10 percent.

The evolution of the mortgage delinquency rates in the EU-15 contrasts with the patterns observed in the US, where it is observed an increasing trend during the same period. In 1994 the mortgage delinquency rate in the US was about 4.2 percent, whereas for the UE it was about 5.5 percent. In 2001, this pattern reversed and in the US the rate rose to near 5.5 percent, while in the UE-15 the rate felt up to 2.5 percent. It would be interesting to compare these figures with the rates of mortgage insurance take-up, but unfortunately this information is not available in our dataset.

Insert figure 1 around here

4.2. Empirical model

The observed endogenous variable in our econometric model, $y_{it,}$ is binary, taking the value one if the household i was unable to pay the scheduled mortgage payments during the 12 months previous to the survey at period t and 0 otherwise. In this context, $y_{it,}$ is the realization of the unobserved propensity for mortgage delinquency for each household, y^{*}_{it}. Hence, the econometric specification can be written as

$$y_{it} = I(y^{*}_{it} > 0) = I(X^{'}_{it}\beta + \varepsilon_{it} > 0) \qquad (i = 1,...,N), \tag{1}$$

where $I(\bullet)$ is a binary indicator function that takes one if the argument is true and zero otherwise, X_{it} is a vector of explanatory variables, β is the vector of coefficients to be estimated, and ε_{it} is the error term. Usually, Eq. (1) is estimated by means of the pooled

11

probit model, or the random effects probit model if we add the assumption that the error term in (1) can be additively decomposed as $\varepsilon_{it}=\alpha_i+\nu_{it}$, where α_i is a time-constant household effect and ν_{it} is time-varying white noise error. The pooled probit model (1) has the unattractive feature that cannot identify the unobserved heterogeneity across households (α_i). However, in contrast with the random effects model this model is capable of identifying state dependence parameters even when the assumption of strict exogeneity is violated. It is also shown that the pooled probit model provides consistent estimates and under conditions performs so well as the random effects probit model (see Diaz-Serrano, 2004a).

When one estimates the probability of mortgage delinquency across homeowners, this propensity cannot be observed if the individual is a renter. Thus, our model consists in two simultaneous equations and can be expressed as follows

$$
\begin{aligned}
h_{it} &= I(h_{it}^* > 0) = I(Z_{it}^{'}\gamma + e_{it} > 0) \qquad (i=1,...,N) \\
y_{it} &= I(y_{it}^* > 0) = I(X_{it}^{'}\beta + \varepsilon_{it} > 0) \qquad (i=1,...,N)
\end{aligned}
\tag{2}
$$

where h_{it}^* is the latent variable indicating the propensity to be homeowner, and y_{it}^* is the latent indicator regarding the propensity to be mortgage delinquent for household i at period t, respectively, and $(e_{it},\varepsilon_{it}) \sim BVN(0,0,1,1,\rho)$. The matrixes Z_{it} and X_{it} do not need to contain the same variables. In this context, if we do not control for the home tenure selection process, as we do in Eq. (2), the standard pooled probit model expressed in (1) provides biased estimates.

According to Eq. (2) we face both a censoring and observation rule for both h_{it} and y_{it}, which lead us to consider the sample selection issue. Hence, we need to control for correlation between the error terms and the sequence of choices. For each mortgage

delinquency outcome we have three types of observation: being homeowner; being mortgage delinquent; and not being mortgage delinquent. This selection rule provides the following likelihood function:

$$LogL = \sum_{\substack{h_{it}=1 \\ y_{it}=1}} \log \Phi_2(Z_{it}\gamma, X_{it}\beta, \rho) +$$
$$+ \sum_{\substack{h_{it}=1 \\ y_{it}=0}} \log \Phi_2(Z_{it}\gamma, -X_{it}\beta, -\rho) + \sum_{h_{it}=0} \log(1 - \Phi(Z_{it}\gamma)), \quad \forall t \quad (3)$$

where Φ and Φ_2 denote the univariate and bivariate standard normal cumulative distribution functions, respectively.

4.3. Variable definition

As mentioned earlier, in this paper we will study the determinants of mortgage delinquency paying especial attention to the effect of household's income volatility. As in Haurin (1991) we will proxy income volatility as the coefficient of variation (CV) of the net annual household income over time. He used the CV to evaluate the effect of income uncertainty on the homeownership propensities in the US. In our study we assume this variable to play a role in both the homeownership and mortgage delinquency equation.

The matrix *X* in the mortgage delinquency equation in (2) contains a set of household characteristics, i.e. income volatility (CV), annual net household income, household size, a squared polynomial on the age of the mortgage[4], a dummy variable that takes 1 if the household could save during the last 12 months previous to the

---

[4] Our dataset does not include precise information on the age of the mortgage. However, we know the year when each homeowner moves to his/her current dwelling. We find this variable is a plausible proxy of the age of the mortgage.

survey, and a dummy variable indicating whether there is vandalism or crime in the area; and a set of household head characteristics, i.e. a squared polynomial on age, gender, marital status, a set of dummies for education, self-employment, public employment, a dummy variable indicating whether the household head was unemployed at least once during the last five years prior to the survey, and a dummy taking 1 if the household head reported bad health during the last 12 months previous to the survey.

In the homeownership equation the matrix Z contains the same variables than the X in the mortgage delinquency equation, except the age of the mortgage, plus a set of dummies collecting the occupation of the household head and a dummy variable indicating whether the household occupied the current dwelling because of job mobility. Additionally, we also carry out separate estimates of Eq. (2) including the PTI ratio as an explanatory variable in the mortgage delinquency equation. Table 1 shows a sample means summary of the variables used in this study.

Insert table 1 around here

5. Results

In table 2 we report summary statistics of the estimated household income volatility (CV) by homeownership status and by mortgage delinquency. A first look allows us to conclude that in all counties our key variable possesses enough variability to look for effects on both the homeownership and the mortgage delinquency equation. The southern European countries (Spain, Italy and Portugal) and the UK report higher levels of household's income volatility than the northern and central European countries. We observe that in most of the countries renters tend to have more volatile

incomes than homeowners, and only in Ireland and Austria are the levels of income volatility similar between both tenure types. Marked differences are also observed in most of the countries concerning the levels of household income volatility between mortgage delinquents and non-delinquents. Except in France and Finland, income volatility tends to be substantially larger for mortgage delinquents. These results suggest that both the homeownership and mortgage delinquency patterns might be influenced by this variable.

Insert table 2 around here

Table 3 reports the econometric estimation of the bivariate probit with sample selection on mortgage delinquency. Recall that given the nonlinear nature of the econometric model, the estimated coefficients lack of any economic interpretation and are just used to determine the direction of the relationship. However, since we are not interested in comparing the magnitude of the estimated effects across countries, the sign and significance of the estimated coefficients are enough to draw our conclusions. It is worth noting that except for Belgium, the correlation between both equations is highly significant ($\rho \neq 0$). This result indicates that controlling for sample selection is critical to obtain unbiased estimates in the mortgage delinquency equation.

For the sake of simplicity we will focus on the estimates concerning the variables we consider as important determinants of the mortgage protection insurance take-up. These variables indicate which households are most at income risk, and hence most in need of the MPI. These are household income, income volatility, savings, household's

15

head unemployment history and his/her self-reported health status. We assess significance at 5 percent.

As expected, household income is highly significant in both the homeownership and the mortgage delinquency equation, and with the expected sign in all countries. Our key variable, income volatility, turns out to be significant in both the homeownership and the mortgage delinquency propensities for most of the countries. We observe a negative effect on homeownership[5] and a positive one on mortgage delinquency. Exceptions to this general result are Portugal and Austria where the effect on homeownership is insignificant, Luxembourg where the effect on mortgage delinquency is insignificant, and Ireland with an insignificant effect on both the homeownership and the mortgage delinquency propensities.

Household heads that were unemployed at least once during the five years before the survey also shows a significant negative effect on homeownership, and positive on mortgage delinquency in most of the countries. An insignificant effect on homeownership is only observed in Spain and Luxembourg, while an insignificant effect on mortgage delinquency is observed in the UK, Portugal and Luxembourg. The self-reported bad-health of the household head also reveals itself as an important variable, though in Ireland, Spain and Austria the effect is not significant in either the homeownership or mortgage delinquency equations, and not significant for Belgium in the mortgage delinquency equation. We observe that in all countries the variable savings exerts a significant negative effect on the probability of mortgage delinquency, while the effect is positive on homeownership for all countries except for France, Italy and Finland.

---

[5] This result coincides with the previous empirical evidence analyzing the effect of income uncertainty on the probability of homeownership (Haurin, 1991; Robst et al., 1999, in the US; Diaz-Serrano, 2004a, in Germany and Spain; Diaz-Serrano, 2004b, in Italy).

Consistent with the previous evidence in the US, we also observe that in "bad neighborhoods", proxied as the existence of crime or vandalism, homeownership is less likely and there exist a greater propensity for mortgage delinquency. However, in contrast with what Green and Furstenberg (1975) observed, we find little evidence than mortgage delinquency is less likely in the earlier years of the mortgage take-up and with increasing probability at later stages. This effect is only observed in Belgium, while the opposite holds for Denmark, Luxembourg, UK, Ireland and Finland. In the rest of countries the effect of the age of the mortgage on the mortgage delinquency risk has turn out to be unimportant.

Insert table 3 around here

We have also carried out separate estimates of our bivariate probit model with sample selection including the PTI ratio as explanatory variable in the mortgage delinquency equation. Results are reported in table 4. We follow this procedure in order to avoid the potential inconsistency that the endogenous nature of this variable might cause in our estimates. However, in all the countries examined these new estimates are similar to the ones shown in table 3 concerning the sign, the size and the significance of the other explanatory variables. In all countries except in Denmark, UK, Ireland and Austria, the PTI ratio exerts a significant and positive effect on the mortgage delinquency risk. This result contrasts Vendell and Thibodeau (1985) in the US, who observed the opposite.

Insert table 4 around here

Finally, we shall point out that for a suitable understanding of the effect of income volatility on both the homeownership and mortgage delinquency propensities, this variable should be related with the level of income itself. One may be tempted to associate more volatile incomes to low-income profiles, however, it is not necessarily true. There are a number of studies in the labor economics literature where the risk-return trade-off in individuals' income is well documented[6]. To test to what extent this finding fits our data, we have carried out regressions taking our measure of income volatility (CV) as the endogenous variable. The results are shown in table 5.

After controlling for a number of factors we observe that more volatile incomes are associated to higher levels of income in all countries except in the UK and the southern EU countries (Italy, Spain and Portugal). This result is quite revealing since it indicates that higher-income profiles are also susceptible to incur in mortgage delinquency if the level of volatility in income is high enough. The countries were this pattern does not hold are those that reported the higher levels of income volatility (see table 2).

Insert table 5 around here

6. Discussion and concluding remarks

In this paper we examine the probability of mortgage delinquency in 12 EU countries. To avoid the bias caused by the homeownership selection process we use the bivariate probit model with sample selection. To examine the determinants of the mortgage delinquency risk we focus on the mortgagor's socio-economic characteristics

---

[6] King, 1975; McGoldrick (1995), Hartog and Vivejverg (2002), in the US and Hartog et. al. (2003), for a selected group of EU countries observed that more variable earnings distributions tend to possess also a higher mean.

rather than on the mortgaged property and the characteristics of the mortgage, as usual in the default risk literature. We pay special attention to those variables that are likely to cause shocks in the mortgagor's income, and hence are also likely as determinants of the mortgage insurance take-up. Our key variable is household's income volatility proxied as the coefficient of variation of net annual household income, which turns out to be crucial in explaining both the homeownership and the mortgage delinquency patterns. Other variables as unemployment, savings and the ill-health status of the household head also have significant effects. To some extent, one might find surprising that the same result persistently holds for such different countries in terms of both their housing and their mortgage markets[7]. However, it suggests that though there are marked differences among them, unsustainable homeownership and lender's attitude towards the mortgage delinquency risk is a common element across most of the countries examined in this study.

The fact that income volatility significantly increases the mortgage delinquency risk suggests the existence of credit market imperfections and the low ability for those households most at income risk to accumulate precautionary savings. Hence, when a negative shock in income arise mortgage delinquents reacts reducing housing consumption if the size of shock is big enough. Additionally, the significance of the others factors listed above also suggests that MPI policies are not adequate in covering those households most in need or the range of risks covered. As observed in the UK, a larger propensity of a low-income mortgagor profile to be a mortgage delinquent suggests that probably for this population stratum the low MPI take-up is driven by the non-affordability of the premiums. However, in this paper we not only observe that

---

[7] See Mercer Oliver Wyman's (2003) report for an extensive analysis of the mortgage markets in a selected group of EU-15 countries.

income volatility increases significantly the probability of mortgage delinquency, but also that more volatile incomes are associated to higher-income profiles. This result suggests that even being affordable, the low MPI take-up from the borrowers with higher income-profiles and with larger income volatility is probably driven by the limited coverage of the risks associated with the mortgagor's income.

Undoubtedly, both lenders and insurers are in business, therefore, efficiency and adequateness must be sacrificed for the sake of profitability. In the UK there is evidence that MPI premiums do rise during slumps and fall during booms (Goodman, 1998). And in Walker et al. (1995) there are listed a number of clauses in the MPI contracts that preclude a large number of claims. Hence, the number of events sensible to cause shocks in mortgagor's income covered by MPI policies is certainly limited. Our results suggest that similar analyses for the EU countries examined here using MPI take-up data will probably provide the same findings. It seems that both insurers and lenders play more with mortgagor's risk aversion than with his/her needs. Although this literature is growing, we find this issue is still under-researched. Given its importance and implications for both lenders and borrowers more research in these lines would be necessary.

References

Anderson, R., VanderHoff, J., 1999. Mortgage default rates and borrower race. J. Real Estate Res. 18, 279-289.

Arrondel, L., 2002. Risk management and wealth accumulation behavior in France. Econ. Letters 74, 187-194.

Berry, M., Dalton, T., Engels, B., Whithing, K., 1999. Falling out of Home Ownership. University of Queensland Press, Brisbane.

Brueckner, J.K., 1985. A simple model of mortgage insurance. AREUEA J. 13, 129-142.

Burchardt, T., Hills, J., 1997. Mortgage payment protection: replacing state provision. Housing Finance 33, 24-31.

Burchardt, T., Hills, J., 1998. From pubic to private: the case of mortgage payment insurance in Great Britain. Housing Stud. 13, 311-323.

Burrows, R., 1998. Mortgage indebtedness in England: an 'epidemiology'. Housing Stud. 13, 5-22.

Chinloy, P., 1995. Privatized default risk and real estate recessions: the UK mortgage market. Real Estate Econ. 23, 401-402.

Deng, Y., Quigley, J.M., Van Order, R., Mac, F., 1996. Mortgage default and low downpayment loans: the costs of public subsidy. Reg. Sci. Urban Econ. 26, 263-285.

Diaz-Serrano, L., 2004a. Labor Income Uncertainty, Skewness and Homeownership: a Panel Data Study for Spain and Germany. IZA Discussion Paper 1008, IZA, Bonn.

Diaz-Serrano, L., 2004b. On the negative relationship between income uncertainty and homeownership: risk-aversion vs. credit constraints. IZA Discussion Paper 1208, IZA, Bonn.

Doling, J., Ruonavaara, H., 1996. Home ownership undermined: an analysis of the Finnish case in the light of the British experience. J. of Housing Built Env. 11, 31-46.

Eichholtz, P.M.A., 1995. Regional economic stability and mortgage default risk in the Netherlands. Real Estate Econ. 23 (4), 421-439.

Ford, J., Kempson, E., Wilson, M., 1995. Mortgage arrears and possessions; perspectives from borrowers, lenders and the courts. Department of environment, HMSO, London.

Ford, J., Quilgars, D., 2001. Failing home owners? The effectiveness of public and private safety-nets. Housing Stud. 16, 147-162.

Guiso, L., Jappelli, T., Terlizzese, D., 1992. Earnings uncertainty and precautionary savings. J. Monet. Econ. 30, 307-338.

Green, R.J., Fustenberg, G.M., 1975. The effects of race and age of housing on mortgage delinquency risk. Urban Stud. 12, 85-89.

Hartog, J., Plug, E.J.S., Diaz-Serrano, L., Vieira, A.J.C., 2003. Risk compensation in wages: a replication, Empirical Econ. 28, 639-647.

Hartog, J., Vijverberg, W., 2002. Do wages really compensate for risk aversion and skewness affection, IZA discussion paper #426, IZA, Bonn.

Haurin, D.R., 1991. Income variability, homeownership, and housing demand. J. Housing Econ. 1, 60-74.

Jappelli, T., Pagano, M., 1989. Consumption and capital market imperfections: an international comparison. Amer. Econ. Rev. 79, 1088-1105.

Lusardi, A., 1998. On the importance of the precautionary savings motive. Amer. Econ. Rev. 88, 449-453.

Kau, J.B., Keenan, D.C., 1999. Patterns of rational default. Reg. Sci. Urban Econ. 29, 765-785.

Kempson, E., Ford, J., Quilgars, D., 1999. Unsafe safety nets?. Centre for Housing Policy, University of York.

King, A., 1974. Occupational choice, risk aversion, and wealth. Ind. Lab. Relat. Rev., July, 586-596.

McGoldrick, K., 1995. Do women receive compensating wages for earnings uncertainty?, Southern Econ. J. 62, 210-222.

MERCER OLIVER WYMAN, 2003. Study on the financial integration of European mortgage markets.

Nettleton, S., Burrows, R., 1998. Mortgage debt, insecure home ownership and health: and explanatory analysis. In: Bartley, M., Blane, D., Davey-Smith, g., (Eds.), The Sociology of Health Inequalities, Blackwell Press, Oxford.

Pryce, G., Keoghan, M., 2001. Determinants of mortgage protection insurance take-up. Housing Stud. 16, 179-198.

Pryce, G., 2002. Theory and estimation of the mortgage payment protection insurance decision. Scot. J. Polit. Economy 49, 216-234.

Pryce, G., Keoghan, M., 2002. Unemployment insurance for mortgage borrowers: is it viable and does it cover those most in need?. Eur. J. Housing Policy 2, 87-114.

Robst, J., Deitz, R., McGoldrick, R., 1999. Income variability, uncertainty and housing tenure choice. Reg. Sci. Urban Econ. 29, 219-229.

Ross, S.L., 2000. Mortgage lending, sample selection and default. Real Estate Econ. 28, 581-621.

Ross, S.L., Tootell, G.M.B., 2004. Redlining the community reinvestment act, and private mortgage insurance. J. Urban Econ. 55, 278-297.

Skinner, J., 1988. Risky income, life cycle consumption and precautionary savings. J. Monet. Econ. 22, 237-255.

Springer, T.M., Waller, N.G., 1993. Lender forebearance: evidence from mortgage delinquency patterns. AREUEA J. 21 (1), 27-46.

Vandell, K.D., Thibodeau, T., 1985. Estimation of mortgage defaults using disaggregate loan history data. AREUEA J. 13 (3), 292-316.

Figure 1: Mortgage delinquency rates in the EU and the US (1994-2001)
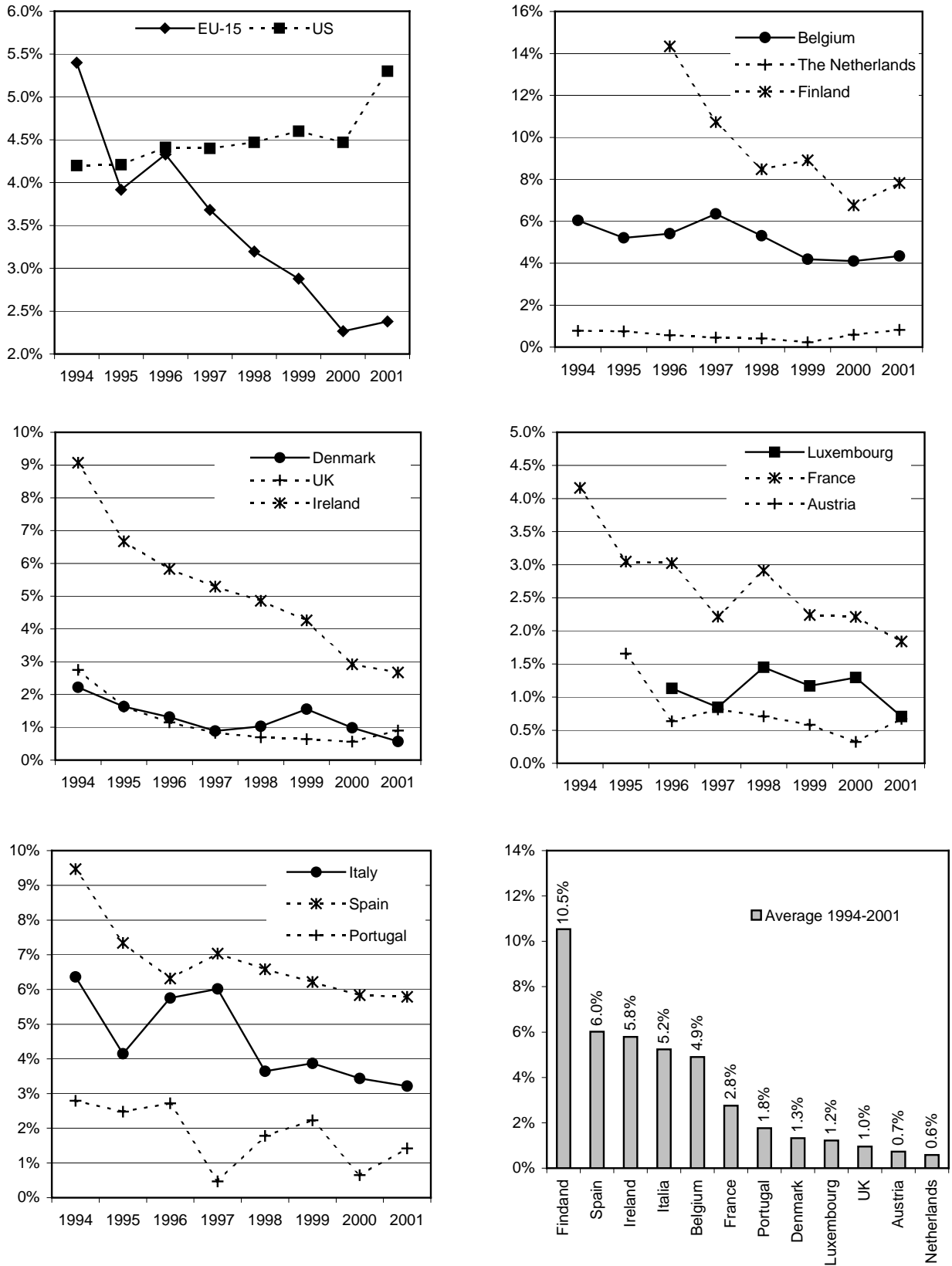
Source: EU (own computations based on the ECHP); US (MBA National delinquency Survey).

25

Table 1: Sample means summary

	Denmark	Netherlands	Belgium	Luxembourg	France	UK	Ireland	Italy	Spain	Portugal	Austria	Finland
Mortgage delinquency	0.013	0.006	0.050	0.012	0.015	0.010	0.058	0.052	0.060	0.018	0.007	0.105
Homeownership	0.635	0.548	0.690	0.712	0.579	0.703	0.856	0.752	0.823	0.699	0.598	0.706
Ratio Mortage/Income	0.233	0.246	0.201	0.177	0.226	0.179	0.155	0.229	0.216	0.212	0.130	0.247
Income volatility (CV)	0.218	0.197	0.266	0.265	0.226	0.298	0.255	0.291	0.286	0.297	0.238	0.163
Annual net income[*]												
(Real 2001 €)	39,509	35,083	37,264	51,034	32,997	40,132	35,985	25,458	23,878	17,130	34,477	34,002
Household head												
Age	40.703	43.568	42.394	41.146	41.665	46.125	44.006	44.761	46.075	45.740	43.251	40.703
Secondary education	0.409	0.282	0.301	0.339	0.263	0.133	0.271	0.258	0.114	0.063	0.645	0.367
Higher education	0.292	0.124	0.296	0.166	0.189	0.362	0.135	0.074	0.150	0.052	0.071	0.290
Female	0.403	0.240	0.264	0.244	0.229	0.526	0.209	0.181	0.190	0.244	0.334	0.471
Self-employed	0.053	0.053	0.090	0.058	0.072	0.066	0.206	0.171	0.133	0.211	0.080	0.145
Public employee	0.223	0.160	0.145	0.147	0.159	0.120	0.155	0.158	0.102	0.116	0.146	0.198
Unemployed												
(during last 5 years)	0.265	0.112	0.155	0.007	0.106	0.172	0.156	0.112	0.210	0.089	0.131	0.260
Married	0.497	0.685	0.622	0.613	0.592	0.542	0.716	0.764	0.737	0.738	0.633	0.567
Household size	2.305	2.617	2.651	2.743	2.610	2.790	3.503	3.061	3.169	3.016	2.820	2.672

Job mobility	0.030	0.017	0.014	0.004	0.045	0.048	0.006	0.011	0.012	0.010	0.011	0.033
Crime in the area	0.100	0.168	0.202	0.019	0.211	0.137	0.112	0.165	0.184	0.119	0.062	0.190
Age of the mortgage	10.372	11.451	11.226	11.155	10.222	9.567	13.605	13.119	13.356	13.637	13.791	9.556

Notes: (*) Values corrected for poverty thresholds.

Table 2: Summary statistics for income volatility (CV)

	Total		Renter		Owner		No mortgage delinquency		Mortgage delinquency	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Denmark	0.216	0.175	0.247	0.195	0.197	0.160	0.215	0.175	0.272	0.185
The Netherlands	0.192	0.208	0.210	0.218	0.178	0.197	0.192	0.208	0.283	0.198
Belgium	0.247	0.207	0.270	0.230	0.229	0.186	0.245	0.204	0.301	0.261
Luxembourg	0.219	0.187	0.232	0.203	0.208	0.171	0.219	0.187	0.246	0.148
France	0.228	0.215	0.246	0.220	0.204	0.206	0.228	0.216	0.218	0.168
UK	0.302	0.198	0.339	0.218	0.281	0.183	0.300	0.197	0.429	0.222
Ireland	0.250	0.164	0.252	0.182	0.250	0.158	0.249	0.164	0.284	0.168
Italy	0.279	0.219	0.293	0.230	0.253	0.194	0.277	0.218	0.370	0.263
Spain	0.291	0.215	0.299	0.221	0.284	0.210	0.287	0.213	0.402	0.250
Portugal	0.268	0.214	0.276	0.217	0.251	0.208	0.267	0.214	0.362	0.279
Austria	0.231	0.190	0.231	0.195	0.230	0.182	0.230	0.190	0.320	0.223
Finland	0.169	0.195	0.210	0.233	0.141	0.156	0.170	0.195	0.164	0.187

Table 3: Estimates of the bivariate probit model with sample selection on the homeownership and mortgage delinquency propensities.

| | Denmark | | | | The Netherlands | | | | Belgium | | | | Luxembourg | | | |
| | Ownership | | Mortage del. | | Ownership | | Mortage del. | | Ownership | | Mortage del. | | Ownership | | Mortage del. | |
	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.
Constant term	-1.685	-10.94	-2.704	-6.02	-2.269	-14.33	1.705	8.48	-4.126	-19.96	-2.880	-5.47	-4.591	-23.32	-3.099	-2.67
Income volatility	**-0.547**	**-7.45**	**0.661**	**3.81**	**-0.546**	**-11.27**	**0.602**	**11.89**	**-0.563**	**-7.56**	**0.636**	**4.59**	**-0.284**	**-3.56**	**0.285**	**1.44**
Household income/1000	0.195	9.99	-0.028	-1.27	0.265	93.31	-0.251	-37.73	0.137	9.59	-0.081	-3.65	0.071	7.77	-0.280	-6.55
Savings	0.142	5.65	-0.717	-8.54	0.349	17.25	-0.465	-13.55	0.158	5.45	-0.719	-11.00	0.095	3.13	-0.713	-4.72
Household size	0.149	8.93	0.007	0.20	0.096	9.49	-0.089	-8.21	0.159	11.36	0.093	3.97	0.202	14.28	0.099	3.02
Job mobility	-0.386	-5.89			-0.397	-5.51			-0.456	-5.14			-0.934	-4.16		
Crime in the area	-0.510	-13.88	0.171	1.56	-0.387	-16.76	0.389	15.27	-0.212	-6.39	0.163	2.39	0.223	2.22	0.256	1.39
Mortgage age			0.033	1.43			-0.004	-1.34			-0.073	-4.18			0.098	2.83
Mortgage age squared			-0.002	-1.97			0.000	1.12			0.003	3.63			-0.005	-2.73
Household head																
Age	0.051	10.82	0.021	1.23	0.076	14.13	-0.069	-10.29	0.174	19.17	0.052	2.21	0.152	19.13	0.079	1.59
Age squared	0.000	-9.66	0.000	-1.17	-0.001	-18.46	0.001	13.28	-0.002	-19.63	0.000	-1.85	-0.001	-18.06	-0.001	-1.57
Secondary education	0.195	6.75	-0.115	-1.23	0.408	12.53	-0.359	-10.55	0.266	8.01	-0.144	-2.23	0.383	11.15	0.029	0.30
Higher education	0.257	7.25	0.054	0.57	0.701	17.60	-0.655	-16.06	0.175	4.60	-0.430	-5.79	0.149	2.92	-0.394	-1.54

Female	-0.263	-10.82	-0.185	-2.24	-0.234	-9.33	0.225	8.00	-0.271	-7.69	0.252	2.93	0.157	3.88	0.133	0.85
Self-employed	0.483	6.46	0.441	4.31	0.207	4.43	-0.138	-2.95	0.222	4.46	0.177	2.12	-0.082	-1.27	-0.387	-1.29
Public employee	0.004	0.13	0.001	0.02	0.111	4.12	-0.117	-4.09	0.048	1.28	-0.037	-0.52	0.479	12.39	-0.493	-3.32
Occupation dummies	Yes		No		Yes		No		Yes		No		Yes		No	
Unemployed last 5 years	-0.219	-7.92	0.274	3.61	-0.430	-15.36	0.426	14.34	-0.358	-10.79	0.145	2.06	0.217	1.61	-0.213	-0.74
Bad Health	-0.397	-9.20	0.470	3.44	-0.283	-6.53	0.301	5.32	-0.291	-4.53	0.053	0.42	-0.807	-13.58	0.480	2.60
Married	0.577	19.50	-0.073	-0.21	0.355	11.98	-0.322	-6.19	0.496	13.27	-0.288	-4.82	0.243	5.86	-0.367	-2.41
Year dummies	Yes				Yes				Yes				Yes			
Rho	0.300				0.988				0.038				0.622			
Test rho=0	40.152				68.256				1.761				50.394			
Log-likelihood	-8,738				-11,777				-7,011				-5,459			
Sample size	16,644				24,036				12,399				9,848			

Table 3 (continuation)

	France				UK				Ireland				Italy			
	Ownership		Mortage del.		Ownership		Mortage del.		Ownership		Mortage del.		Ownership		Mortage del.	
	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.
Constant term	-3.747	-31.78	-2.071	-4.23	-1.019	-4.64	-4.714	-5.51	-2.179	-10.58	-0.197	-0.65	-2.491	-17.17	-0.774	-2.27
Income volatility	**-0.330**	**-6.69**	**0.261**	**2.54**	**-0.390**	**-3.43**	**0.716**	**2.29**	**-0.098**	**-0.90**	**0.215**	**1.81**	**-0.304**	**-5.37**	**0.489**	**4.24**
Household income/1000	0.113	8.14	-0.138	-4.32	0.348	18.80	-0.164	-3.06	0.297	15.93	-0.172	-13.39	0.505	13.77	-0.138	-4.59
Savings	0.008	0.677	-0.710	-8.00	0.379	9.65	-0.644	-4.21	0.213	5.22	-0.505	-9.46	-0.002	-0.06	-0.452	-5.85
Household size	0.031	3.73	0.108	5.87	-0.050	-2.97	0.026	0.53	-0.136	-11.62	0.103	7.64	0.031	3.15	0.113	5.11
Job mobility	-0.787	-18.87			-0.622	-7.47			-0.749	-5.52			-0.463	-5.99		
Crime in the area	-0.252	-12.03	0.281	5.86	-0.436	-8.26	0.129	0.63	-0.408	-10.14	0.294	5.98	-0.121	-4.55	0.186	3.48
Mortgage age			-0.008	-0.56			0.091	2.00			0.023	1.93			0.018	1.25
Mortgage age squared			0.001	1.48			-0.004	-1.68			-0.001	-2.26			-0.001	-1.02
Household head																
Age	0.152	30.14	0.019	0.88	0.046	6.65	0.139	3.73	0.122	13.89	-0.038	-2.69	0.077	13.00	-0.033	-2.56
Age squared	-0.002	-29.79	0.000	-0.80	-0.001	-8.63	-0.002	-3.65	-0.001	-13.68	0.000	2.93	-0.001	-14.01	0.000	2.78
Secondary education	0.185	8.46	-0.092	-1.79	0.275	4.60	-0.154	-0.79	0.328	8.55	-0.270	-6.30	0.288	10.98	-0.217	-4.14
Higher education	0.108	3.40	-0.191	-2.69	0.217	4.70	-0.225	-1.44	0.394	6.30	-0.229	-3.38	0.122	2.57	-0.369	-3.40

Female	-0.222	-8.11	0.163	2.11	-0.053	-1.33	-0.160	-1.12	-0.239	-5.39	0.273	5.00	-0.061	-1.63	0.189	2.43
Self-employed	0.095	2.53	-0.053	-0.75	0.535	6.15	-0.037	-0.19	0.216	3.60	-0.019	-0.33	0.038	1.16	0.214	3.57
Public employee	-0.144	-6.31	0.014	0.25	0.178	2.79	-0.501	-1.96	0.130	2.65	-0.150	-2.84	0.035	1.23	-0.001	-0.02
Occupation dummies	Yes		No		Yes		No		Yes		No		Yes		No	
Unemployed last 5 years	-0.369	-13.63	0.449	8.45	-0.179	-3.92	0.183	1.28	-0.523	-13.81	0.415	9.62	-0.249	-7.44	0.227	3.39
Bad Health	-0.165	-4.91	0.219	2.96	-0.339	-5.51	0.573	2.81	-0.098	-1.28	0.181	1.78	-0.139	-3.73	0.305	4.22
Married	0.708	30.71	0.014	0.23	0.359	7.80	-0.151	-1.50	0.965	17.73	0.276	3.43	0.273	6.93	-0.190	-2.44
Year dummies	Yes				Yes				Yes				Yes			
Rho	0.568				-0.146				0.906				0.516			
Test rho=0	186.638				8.922				53.163				122.877			
Log-likelihood	-15,027				-3,250				-4,061				-9,742			
Sample size	27,639				6,571				9,426				16,125			

Table 3 (continuation)

	Spain				Portugal				Austria				Finland			
	Ownership		Mortage del.		Ownership		Mortage del.		Ownership		Mortage del.		Ownership		Mortage del.	
	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.	Coef.	Z-val.
Constant term	-1.245	-8.57	-0.981	-3.29	-1.515	-10.79	-0.989	-2.04	-3.225	-18.38	-5.137	-3.51	-2.190	-11.07	-1.686	-5.26
Income volatility	**-0.247**	**-3.97**	**0.556**	**5.15**	**-0.103**	**-1.54**	**0.521**	**3.07**	**-0.103**	**-1.38**	**0.555**	**1.98**	**-0.331**	**-3.41**	**0.399**	**2.99**
Household income/1000	0.224	15.58	-0.244	-7.98	0.335	15.16	-0.205	-2.43	0.124	11.93	-0.254	-3.36	0.364	13.44	-0.154	-5.19
Savings	1.133	42.09	-0.324	-5.86	-0.196	-5.07	-0.612	-2.25	0.135	4.60	-0.576	-3.94	-0.032	-0.84	-0.618	-9.34
Household size			0.120	6.75	0.041	4.12	0.044	1.76	0.256	19.06	0.010	0.18	0.127	6.86	0.077	3.67
Job mobility					-0.158	-1.90			-1.336	-7.22			-0.805	-8.49		
Crime in the area	-0.637	-8.15	0.257	5.23	-0.060	-1.78	0.055	0.51	-0.615	-10.89	-0.298	-0.95	-0.460	-11.90	0.177	3.08
Mortgage age			0.000	-0.03			0.010	0.46			0.024	0.50			0.048	3.37
Mortgage age squared			0.001	0.79			-0.001	-0.75			-0.001	-0.60			-0.002	-2.87
Household head																
Age	0.056	9.19	-0.022	-1.78	0.035	5.61	-0.030	-1.58	0.083	13.53	0.155	2.58	0.053	7.47	0.025	1.92
Age squared	-0.001	-12.05	0.000	1.84	-0.001	-8.28	0.000	2.35	-0.001	-13.47	-0.002	-2.85	-0.001	-6.98	0.000	-1.66
Secondary education	-0.086	-2.49	-0.179	-2.59	0.119	2.78	-0.098	-0.84	0.004	0.10	-0.203	-1.32	0.141	3.40	-0.220	-3.87
Higher education	-0.040	-1.04	-0.121	-1.66	0.062	0.87	-0.133	-0.60	-0.158	-2.62	0.494	2.32	0.355	6.79	-0.302	-4.58

Female	0.066	1.61	0.086	0.94	0.016	0.46	-0.117	-1.00	-0.009	-0.27	-0.112	-0.59	0.102	2.95	0.017	0.36
Self-employed	0.102	2.83	0.068	1.12	0.320	8.64	-0.037	-0.36	0.018	0.28	0.176	1.00	0.210	3.30	0.066	0.96
Public employee	-0.043	-1.15	-0.232	-2.70	0.234	6.90	-0.127	-1.27	0.104	2.75	-0.083	-0.48	-0.028	-0.64	0.022	0.39
Occupation dummies	Yes		No		Yes		No		Yes		No		Yes		No	
Unemployed last 5 years	-0.011	-0.38	0.208	3.96	-0.284	-7.82	-0.023	-0.18	-0.229	-5.97	0.515	3.41	-0.188	-5.17	0.240	4.76
Bad Health	0.072	1.83	0.090	1.22	-0.156	-4.19	0.255	2.31	-0.088	-1.71	0.094	0.45	0.063	1.14	0.079	1.07
Married	0.471	11.21	-0.037	-0.47	0.352	8.80	-0.105	-0.79	0.143	2.89	-0.137	-1.01	0.203	4.70	0.050	0.81
Year dummies	Yes				Yes				Yes				Yes			
Rho	0.435				0.548				0.191				0.640			
Test rho=0	84.217				68.884				9.661				154.357			
Log-likelihood	-8,834				-7,477				-6,301				-4,464			
Sample size	13,386				14,393				11,527				7,348			

Table 4: Estimates of the bivariate probit model

	Income volatility		Payment-to-income	
	Coef.	z-value	Coef.	z-value
Denmark	0.6537	3.75	0.0598	0.50
The Netherlands	0.5906	9.19	0.0140	6.26
Belgium	0.5771	4.02	0.6486	3.66
Luxembourg	0.2121	1.02	0.5642	3.60
France	0.2602	2.55	0.4946	2.71
UK	0.6860	2.15	0.0854	1.12
Ireland	0.2081	1.74	0.3233	1.73
Italia	0.4758	3.88	0.4945	4.92
Spain	0.5321	4.70	0.6507	5.99
Portugal	0.5170	2.96	0.3530	3.22
Austria	0.5512	1.96	0.0322	0.76
Finland	0.3855	2.83	0.1839	3.00

Table 5: OLS estimation of the determinants of income volatility (endogenous variable: CV of household income).

	Denmark		The Netherlands		Belgium		Luxembourg		France		UK	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Constant	0.545	42.12	0.308	16.85	0.149	7.80	0.226	14.01	0.542	52.12	0.455	27.04
Household Income/10^4	0.090	11.62	0.163	19.96	0.074	13.23	0.075	11.51	0.103	20.44	-0.054	-5.23
Household size	-0.027	-20.44	-0.005	-3.98	-0.014	-9.11	-0.005	-3.57	-0.012	-12.84	0.002	0.98
Age	-0.011	-21.71	-0.003	-5.45	0.004	5.62	0.002	3.21	-0.008	-20.68	-0.003	-4.98
Age squared	0.000	18.00	0.000	4.25	-0.000	-4.66	-0.000	-4.34	0.000	13.51	0.000	1.53
Secondary education	0.020	6.37	0.003	1.19	0.015	4.01	-0.013	-3.81	-0.024	-9.99	0.008	1.27
Higher education	0.020	5.41	-0.030	-7.25	-0.001	-0.24	-0.003	-0.57	0.000	0.13	0.004	0.92
Female	0.014	5.32	0.011	3.20	0.028	6.24	0.039	9.09	0.020	6.58	0.034	7.95
Self-employed	0.175	30.64	0.180	31.72	0.197	33.34	0.067	10.31	0.126	28.48	0.054	6.66
Public employee	-0.018	-5.35	-0.025	-6.69	-0.047	-9.35	-0.019	-4.45	-0.052	-17.41	-0.011	-1.66
Professionals	-0.030	-6.35	-0.038	-8.18	-0.028	-4.31	-0.037	-5.87	-0.050	-10.66	-0.033	-3.93
Technicians	-0.024	-5.53	-0.044	-9.81	-0.020	-2.98	-0.023	-4.27	-0.051	-13.62	-0.068	-8.06
Clerks	-0.034	-6.44	-0.015	-2.57	-0.030	-4.73	-0.015	-2.39	-0.041	-8.51	-0.034	-4.68
Services and sales	-0.022	-3.83	0.002	0.30	-0.017	-1.98	-0.031	-4.16	-0.036	-6.56	-0.023	-3.11
Skilled primary sector	0.054	4.73	0.030	1.86	0.070	3.61	0.019	1.66	-0.020	-2.82	-0.014	-0.59

Craft and trade	-0.049	-9.09	-0.003	-0.65	-0.027	-3.76	-0.002	-0.32	-0.051	-13.57	-0.074	-8.05
Operators	-0.035	-5.81	-0.033	-5.07	-0.050	-5.50	-0.031	-4.72	-0.060	-14.43	-0.078	-8.66
Unemployed	0.013	4.20	0.038	9.32	0.026	5.72	0.100	6.09	0.000	0.14	0.027	5.09
Married	-0.015	-4.67	-0.038	-10.09	0.001	0.23	-0.015	-3.54	-0.022	-7.87	-0.048	-9.84
Crime in the area	0.010	2.38	0.003	1.05	-0.003	-0.65	0.125	12.44	0.002	0.83	0.037	6.55
Job mobility	0.065	9.01	0.021	2.14	0.030	2.29	0.085	3.66	0.057	11.65	0.036	3.84
R-squared	0.246		0.175		0.203		0.146		0.199		0.211	
Sample size	18,783		26,944		20,174		18,296		43,125		9,113	

Table 5 (continuation)

	Ireland		Italy		Spain		Portugal		Austria		Finland	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Constant	0.068	4.49	0.231	18.31	0.093	7.02	0.086	5.68	0.245	14.82	0.502	34.81
Household Income/10^4	0.025	9.37	-0.050	-20.10	-0.038	-4.33	-0.251	-15.59	0.029	3.16	-0.003	-0.28
Household size	0.004	4.48	0.015	17.42	0.020	24.54	0.010	10.56	0.001	0.95	-0.019	-12.44
Age	0.007	13.13	0.002	5.08	0.006	12.40	0.010	19.34	0.001	2.41	-0.009	-13.74
Age squared	-0.000	-14.37	-0.000	-6.50	-0.000	-13.78	-0.000	-21.40	-0.000	-4.12	0.000	8.24
Secondary education	0.001	0.38	-0.022	-8.69	0.001	0.24	-0.005	-0.93	-0.008	-2.08	-0.002	-0.42
Higher education	-0.010	-2.26	-0.009	-2.00	-0.009	-2.56	0.014	1.78	0.001	0.12	-0.022	-4.66
Female	0.021	5.75	0.023	6.71	0.010	2.69	0.012	3.10	0.005	1.42	-0.008	-2.28
Self-employed	0.112	26.48	0.156	53.91	0.199	65.19	0.124	34.70	0.160	23.38	0.097	16.78
Public employee	-0.041	-10.74	-0.044	-14.87	-0.054	-14.44	-0.060	-14.37	-0.036	-7.72	-0.015	-3.24
Professionals	-0.022	-3.67	-0.045	-7.89	-0.051	-9.39	-0.025	-2.64	-0.031	-3.18	-0.015	-2.45
Technicians	-0.018	-3.04	-0.064	-13.98	-0.040	-8.37	-0.068	-10.36	-0.018	-3.04	-0.018	-3.10
Clerks	-0.013	-1.95	-0.061	-15.39	-0.037	-6.34	-0.064	-9.38	-0.043	-6.47	-0.020	-2.72
Services and sales	0.015	2.28	-0.031	-7.03	-0.018	-3.79	-0.027	-5.03	-0.014	-2.17	-0.018	-2.56
Skilled primary sector	-0.097	-18.43	-0.004	-0.68			0.019	4.12	0.012	1.26	0.018	2.18

38

Craft and trade	0.009	1.81	-0.053	-15.62			-0.046	-10.83	-0.054	-9.48	-0.028	-4.19
Operators	0.009	1.70	-0.069	-14.46	-0.029	-6.89	-0.072	-12.70	-0.038	-4.92	-0.030	-3.94
Unemployed	0.036	10.16	0.095	30.62	0.083	31.60	0.029	6.65	0.016	3.67	-0.003	-0.85
Married	-0.020	-5.51	-0.007	-2.20	-0.039	-11.16	-0.037	-9.85	-0.034	-8.78	-0.022	-5.55
Crime in the area	-0.008	-2.18	0.015	5.85	-0.003	-1.35	0.016	4.20	0.007	1.13	-0.007	-1.74
Job mobility	0.088	5.70	-0.018	-2.00	0.068	7.49	-0.010	-0.86	0.083	5.77	0.103	11.46
R-squared	0.196		0.242		0.291		0.219		0.179		0.255	
Sample size	19,211		46,708		39,741		34,598		18,907		12,552	