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Modelling and Forecasting UK Mortgage Arrears and Possessions

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Abstract
This paper presents new models for aggregate UK data on mortgage possessions (foreclosures) and mortgage arrears (payment delinquencies). The innovations include the treatment of difficult to observe variations in loan quality and shifts in forbearance policy by lenders, by common latent variables estimated in a system of equations for arrears and possessions, for quarterly data over 1983-2009. A second innovation is the theory-justified use of an estimate of the proportion of mortgages in negative equity, based on an average debt to equity ratio, as one of the key drivers of possessions and arrears. A third is the systematic treatment of measurement bias in the months in arrears measures. Finally, the paper does not impose a proportional long-run relationship between possessions and arrears assumed in the previous UK literature. A range of economic forecast scenarios for forecasts to 2013 reveals the sensitivity of mortgage possessions and arrears to different economic conditions, highlighting potential risks faced by the UK and its mortgage lenders. A comprehensive review of data on arrears and possessions completes the paper.

Key words: foreclosures, mortgage possessions, mortgage payment delinquencies, mortgage arrears, UK mortgage market, defaults, unobserved components model
JEL Classifications: G21, G28, G17, R28, R21, C51, C53, E27

1. Introduction

The international financial crisis of 2008/9 has had costly implications for some home-owners through a surge in mortgage possessions and arrears, raising political concern. However, the rise in problem mortgages has been less severe than in the early 1990s crisis. New research presents more sophisticated models than previously for UK aggregate arrears and possessions. Forecasting with these models, under varying scenarios to 2013, highlights possible risks faced by policy makers.

There has been great uncertainty about the scale of the UK's new mortgage difficulties. The Council of Mortgage Lenders' (CML) adjusted their forecasts twice, from 75,000 mortgage possessions in 2009 (November, 2008), to 65,000 (June, 2009) and to 48,000 (November, 2009). The estimated number of possessions is 46,000 for the year.[1] The uncertainty concerned both the tightening of the credit market on house prices, interest rates, unemployment and income, and the effects of changing lending quality and policy interventions. Credible models for mortgage arrears and possessions, taking account of loan quality and policy, which can be used to forecast future trends on alternative scenarios, should be invaluable to policy-makers in assessing risks ahead. Understanding the past should also improve long-term policy making.

This paper presents new quarterly models for forecasting aggregate UK data on mortgage possessions (foreclosures) and mortgage arrears (payment delinquencies), revealing sensitivity to different economic conditions. The fundamental economic drivers of aggregate arrears and possessions are the debt service ratio (the product of the mortgage interest rate and the level of debt divided by disposable income), an estimate of the incidence of negative equity based on the ratio of average mortgage debt to average home prices, and the unemployment rate. Together with proxies for loan quality and government policy, this suggests just five variables are needed to explain the history of arrears and possessions over 1983-2009, and to assess future trends.

The paper contains several innovations. The first is to address variations in loan quality and shifts in forbearance policy by lenders, something which is difficult to observe, by common latent variables estimated in a system of equations. This method is more satisfactory than

[1] In May 2010, the CML revised their mortgage possession figures from Q1 2009 onwards to be representative of the entire first charge mortgage market. The revised figure for properties taken into possession in 2009 is 47,700. Earlier data relate to CML members only and so are not directly comparable.

widely used of loan-to-value measures for first mortgages, which are not comparable over time and omit further advances. The second is the theory-justified use of an estimate of the proportion of mortgages in negative equity, calibrated to micro data, and based on the ratio of average debt to average equity. The third is the systematic treatment of measurement bias in the available "months-in-arrears" measures, previously neglected. Finally, the assumption in previous studies of a proportional relationship between possessions and arrears is relaxed.

A careful study of the aggregate data is pertinent in the UK given the paucity of micro data on mortgage defaults (by contrast with the US). The only micro-candidate for a random sample is the British Household Panel Study (BHPS). These data are sparse and not timely, however, and there are major problems drawing aggregate implications from them.[2]

Fluctuations in UK possessions and arrears rates are shown in Figures 1 and 2, using data from the CML [3]. The flow into possessions peaks in 1991, at a quarterly rate of 0.2 of one percent of the number of mortgages. From the subsequent trough in 2004 to 2008 the possessions rate has traced out just over half the previous rise from 1989 to 1991. The arrears rate peaked in 1993 (proportions of mortgages with greater than 6 months or greater than 12 months payment arrears), lagging significantly behind the 1991 possessions peak. The lag can partly be attributed to a shift in government policy and coordinated efforts by mortgage lenders from the end of 1991 (Muellbauer and Cameron, 1997).[4] The policy shift reduced the possessions rate, but mortgages in arrears rose. There are strong parallels between these and later government interventions and discussions with lenders towards greater leniency, in 2008-9.[5]

An alternative data source from the Ministry of Justice records the court possessions actions and orders made for England and Wales. In Figure 3 these are plotted as a fraction of the number of UK mortgages outstanding. The court actions data show a dramatic drop in the last quarter of 2008, confirming the forbearance policy shift by lenders. This was undoubtedly related to the Mortgage Pre-action Protocol. It is likely that part of the effect of the policy

[2] The BHPS sample under-represents some types of households; the possessions data are too sparse to make full use the panel structure (see Cooper and Meen, 2001); some variables are poorly measured; and the history is too short to identify complex time-varying influences, such as policy variations.
[3] Available data on UK mortgage possessions and arrears is documented in Annex 1.
[4] Policies included the shift to direct payment of income support to mortgage lenders and a Stamp Duty holiday, in return for a collective agreement by lenders to be more lenient.
[5] The recent policy shifts include more generous Support for Mortgage Interest, the application of the Mortgage Pre-action Protocol from November 2008, the Mortgage Rescue Scheme, and Homeowners Mortgage Support (see Stephens (2009) for a summary of these measures). Indirect recent policy support includes another Stamp Duty holiday and mortgage loan targets for lenders owned by tax-payers (Northern Rock), or partly owned (Royal Bank of Scotland and Lloyds TSB), to underpin mortgage availability and house prices.

shift was to postpone possessions, though the magnitude of this effect is unknown. The court orders data experienced a larger proportionate rise from 2004 to 2008 (though with a drop in the last quarter of 2008) than the CML possessions rate data, which tend to lag behind. The court actions and orders data are consistent with the stabilization in the possessions rate in 2009.

There are, however, differences between the recent economic downturn and that of the early 1990s, the most radical being in the monetary policy response in rapidly bringing down interest rates. In 1990-92, monetary policy was constrained by the high rate of inflation, and sterling's membership of the European Exchange Rate Mechanism until the UK exited in September, 1992. The average cost of servicing mortgage debt as measured by the debt service ratio has thus fallen in 2009 to below early 1990s levels, despite far higher levels of mortgage debt relative to income. The rises in the unemployment rate and in the average debt equity ratio are more comparable to the previous downturn (see Figure 4).

The next section develops a model for the economic drivers of possessions and arrears using a double trigger framework for defaults and payment delinquencies, and surveys empirical work. In section 3, the methodology and data issues are discussed. The fourth section presents results for a joint estimation of arrears and possessions with proxy functions for lending quality and policy shifts, and forecasts to the end of 2013. Section 5 concludes. A comprehensive review of data on arrears and possessions completes the paper (Annex 1).

2. The Economic Drivers of Possessions and Arrears

2.1 Conceptual Framework: the Double Trigger Model for Defaults

There is general agreement that mortgage defaults or possessions result from some mix of excessive debt relative to home equity and cash flow problems. This is consistent with the 'double trigger' approach, a more general view of mortgage possession than the option pricing approach popular in some of the US literature, see Kau et al. (1992) and Deng et al. (2000), and applied to UK data by Ncube and Satchell (1994). In the option pricing model, default is chosen by the household once housing equity falls below the mortgage debt level by a given percentage, which depends mainly on house price uncertainty. Even in the US, where mortgages in many states are non-recourse loans (i.e. where the lender's rights are restricted to the equity in the home, excluding recourse to the borrower's income or other assets), doubt has been cast on this 'ruthless default' literature (Vandell, 1995). Recent empirical literature

adopts a more general approach that encompasses cash flow problems, for example, Gerrardi et al. (2008) and Foote et al. (2008).

A thorough early exposition of the double trigger model is by Elmer and Seelig (1998). A recent exposition and application to US micro data on sub-prime mortgages is by Bajari et al. (2009). They argue that, abstracting from variations in interest rates, default for household i at time t, due to a weak net equity position, occurs when

$$\log \ \text{mortgagedebt}_{it} / \text{equity}_{it} \ > \ c_{it} \qquad (1)$$

where the threshold c_{it} depends positively on the expected growth rate of house prices, given transactions delays, and also on house price volatility (Bajari et al. (2009), equation (4), p.10). They argue that when interest rates can change, c_{it} depends additionally on an interest rate term (equation (10), p. 13). Default due to a weak net equity position can occur even if the household does not have cash flow problems. This is particularly relevant in the US where, in states such as California, borrowers have a 'walk away' option so that their liability is confined to the value of the home.

Default can also occur because of cash flow problems induced by credit constraints, when a function of the debt service ratio exceeds a threshold. Bajari et al. argue that this function depends also on the credit worthiness of the household, its employment status and its expected income growth (their equation (13), p.15). This can be expressed by a trigger function being positive:

$$f(\text{debt service ratio}_{it}, \ ur_{it}, \ cs_{it}, \ \Delta y_{it}^{e}) > 0 \qquad (2)$$

where ur is the household's unemployment rate, cs its credit score and Δy^e represents its expected income growth. Bajari et al. embed condition (1) in a stochastic utility model, so that if the utility associated with this type of default is positive, the household will default. Condition (2) is treated as an aspect of the budget constraint, outside the control of the household. Default then occurs if either or both conditions are fulfilled. This is modelled as a bivariate probit, given some unobserved stochastic components reflecting tastes and household characteristics.

There is a problem with this formulation. It makes little sense for a household with positive net housing equity to default, even when there are cash flow problems. With positive equity,

such households may have refinancing possibilities or could sell the home rather than lose it through possession. It seems more plausible that default condition (2) should be replaced by:

$$\begin{aligned} &f(\text{debtservice ratio}_{it},\ ur_{it},\ cs_{it},\ \Delta y_{it}^{e}) > 0 \\ &\textit{and} \quad \log \ \text{mortgage debt}_{it} / \text{equity}_{it} \ > \ c_{0t} \end{aligned} \tag{3}$$

The parameter c_{0t} is likely to be negative since significant positive equity is likely to be needed for refinancing, while transactions costs need to be covered when selling. Then default occurs if *either* condition (1) *and/or* condition (3) are fulfilled. This differs from the either/and or condition specified by Bajari et al. since it suggests that problems with debt relative to equity are present in all defaults.

Given individual heterogeneity and knowledge of (or assumptions on) the distributions of the observables (such as the debt/equity ratio) and of the unobservables (such as tastes) at the micro level, one could obtain the aggregate proportion of defaults as a function of the means of the observables and of the parameters of the distributions. Without knowledge of the distributions of observables and unobservables, the functional form of the relationship between the aggregate proportion of defaults and the means of the observables is unknown, but in general will be non-linear. Specifically, there is an important common element in conditions (1) and (3) involving a threshold for log (mortgage debt/equity). Although c_{0t} is expected to be a little below zero (e.g. from transactions costs), while option pricing theory implies c_{it} would be a little above zero, the proportions of households satisfying each condition should be highly correlated with the proportion in negative equity (the proportion for whom log (mortgage debt/equity) exceeds zero).

On specific assumptions, it is possible to derive a simple relationship between the proportion of households with negative equity, and mean debt and mean equity. Suppose, for example, that debt and equity have log-normal distributions, so that the log (mortgage debt/equity) is also normally distributed. The proportion of mortgages with negative equity, i.e. log (mortgage debt/equity) greater than zero, is then given by the normal distribution function $F(\mu, \sigma; 0)$, with the mean of log (mortgage debt/equity) denoted by μ and its standard deviation by σ. This is shown in Figure 5. As the mean of the distribution shifts to the right, the area under the tail increases proportionately *more* than does the mean. For the log-normal distribution, there is a simple relationship between the mean of log debt, which we do not observe, and the log of mean

debt, which we do observe; and, correspondingly for the mean of log equity.[6] The logistic function is a good approximation to the normal, with a distribution function implying:

$$\begin{aligned} &\text{proportion of negative equity} \\ &\quad = 1/(1+\exp(-\lambda\ (\text{mean logdebt/equity})) \\ &\quad = 1/(1+\exp(-\lambda\ (\log(\text{mean debt/mean equity}) - \lambda_0)) \end{aligned} \tag{4}$$

where λ_0 is half the difference in the variances of log debt and log equity. Given data on the ratio of mean debt to mean equity, and estimates based on micro data of the proportion of households with negative equity, the coefficients λ and λ_0 can be calibrated to match the estimated proportion of negative equity to the micro data. This equation should yield a good time-series approximation to the most important non-linearity in the relationship between the aggregate rate of possessions and the means of its fundamental drivers. A further advantage is that if later estimates of negative equity based on micro data become available, the relationship could be recalibrated for improved accuracy.

In the UK, unlike the US, it is probable that relatively few possessions cases arise through condition (1) since the consequences of possession are more painful. Mortgage borrowers can be pursued for up to six years for negative equity remaining after the lender has sold off a home in possession (by contrast with non-recourse mortgage loans and 'walk away' options in the US).

The probability associated with condition (3) can be written as the product of the probability of 'bad (debt/equity)' and the probability of a 'bad trigger' given 'bad (debt/equity)'. Modelling the log of the probability, i.e. the log possessions rate, results in an additive model. If the two events in condition (3) were independent, the log possessions rate would be given by a function of (debt/equity) plus a function of the means of the variables appearing in the trigger function, i.e. the debt service ratio, unemployment etc.. A log-linear formulation can thus be used in which the log possessions rate is driven by the log of the unemployment rate, the log of the debt service ratio and the log of the imputed proportion with negative equity. In addition, without data on the aggregate credit score, an aggregate loan quality indicator is needed (section 3.3.2).

The reasoning just set out for modelling the possessions rate can be adapted for modelling mortgage arrears or 'payment delinquencies'. As noted in section 2.2, the US literature is here sparser than that on possessions. The count of mortgages exceeding a threshold level of arrears (such as 6 months of regular payments, or 5 percent of mortgage debt.) measured relative to the total number of mortgages, should be governed by a less stringent version of condition (2). The

[6] It is well-known that if X is log normally distributed, then log EX=E log X + 0.5Var log X = $\mu + 0.5\sigma^2$.

debt equity ratio is also important for determining the arrears count. The outflow from an arrears count above a given threshold enters one of four states: possession; partial (or full) repayment in order for arrears levels to fall below the threshold; the sale of the property; or refinancing. The last two options may be blocked by low net equity. Thus, the proportion of mortgages in negative equity is likely to have a significant effect on the arrears count. The relative importance of the cash flow drivers, however, the debt service ratio and unemployment, is likely to dominate the proportion in negative equity in the arrears equation, particularly for lower arrears thresholds. While a poor debt equity ratio is a necessary condition for possession for rational households, arrears can arise without the household necessarily being close to negative equity.

2.2 Empirical Survey on Models of Possessions and Arrears

By contrast with an extensive US empirical literature on borrower mortgage default or lender foreclosure (possession or repossession), and the more modest contribution on borrower payment delinquency (arrears), the set of UK empirical studies on possession and arrears is strikingly limited. Comprehensive reviews of the earlier US literature into the 1990s on mortgage default and delinquency by Quercia and Stegman (1992), and a special focus on empirical testing of option theoretic models of default by Vandell (1995), reveal a wealth of micro-data based studies[7] from both lender and borrower perspectives. The paucity and limited quality of corresponding micro-data sets in the UK has constrained the types of analyses that can be carried out. This largely accounts for the small number of predominantly macro-based empirical studies that employ a hybrid of the recent default/delinquency theories in reduced form regression models.

A small set of UK studies using varied data sets adopts a disaggregated approach (Table 1). Muellbauer and Cameron (1997) and Cooper and Meen (2001) use the CML database and regional possession court orders for England and Wales to explore the determinants of regional possessions. Lambrecht et al. (1997, 2003) employ a proprietorial data set supplied by a mortgage insurance company. Their earlier study extends the traditional option theoretic approach to examine both ability-to-pay and equity variables influencing default, finding that the former variables have more influence on default than the latter. Their 2003 study examines similar influences over the timing of delinquency and voluntary and forced possessions, using a hazard model. The loan-to-value ratio was positively associated with

[7] Examples of the underlying data sets include individual/family loans and their characteristics from Freddie Mac, Federal Housing Administration, Department of Veteran Affairs, Federal Home Loan Bank Board, Morgan Guarantee Insurance Corporation and other banking institutions or institutional bodies (e.g. Mortgage Bankers Association) or Savings and Loans by US state. Panel data sets of income dynamics e.g. by the University of Michigan have also been employed.

time to default; this was rationalized by the increased use of second mortgages, when initial loan-to-value ratios were low, with a higher probability of default. The sample used is not random, however, consisting only of a set of defaulting borrowers; and the available data limit the borrower characteristics to the loan-to-value ratio, salary, marital status and the interest rate, all measured at point of mortgage origination (the ensuing drawbacks are discussed by Cooper and Meen (2001)). The theoretical and empirical ambiguities of the role of loan-to-value ratios in such micro studies are replicated in macro studies, discussed below.

The Survey of English Housing (SEH), operating since 1993, covers about 20,000 households, and is a series of cross-sections not a panel. It is rich in information on individual characteristics, but is not suitable to analyse trigger events (Cooper and Meen (2001)). Burrows (1998) use the SEH to analyse mortgage arrears with a logit model, as a function of borrower and lender characteristics, measured not at time of origination or default but in the current sample wave. Several studies use the British Household Panel Survey (BHPS), an annual survey since 1991, covering approximately 10,000 individuals in 5,000 households (extended since 1999). Also rich in individual characteristics, the default coverage of the BHPS is in practice miniscule, further affected by sample attrition, so that pooling of observations is necessary for econometric analysis. Even with pooling, Cooper and Meen suggest that a focus on owner-occupiers alone would generate only 46 default observations (during 1991-2000). The individual data, on the other hand, allows the examination of trigger events such as loss of income or divorce. A study of evictions and possessions by Boheim and Taylor (2000) for 1991-97, across all tenures (to increase the number of default observations), offers some evidence for the importance of negative equity, unemployment and its duration, and family size and tenure. The effect of Mortgage Payment Protection Insurance (MPPI) on arrears[8], insignificant in their study, is further explored in Battacharjee et al. (2009), using the BHPS.

Brief Overview of the US Literature on Default and Delinquency

The evolution of mortgage default studies in the US is characterised by Quercia and Stegman (1992) in a typology of three generations or sets of studies. The earliest work on default and delinquency risk rates from the 1960s onwards focused from a *lender's* perspective on simple correlations or empirical regression models capturing, at loan origination, the characteristics

[8] Mortgage protection policies have been somewhat controversial - some lenders and insurance companies have been accused of selling expensive policies with fine print that excludes risks that borrowers thought they were protected against. Conceivably, their more widespread use could have reduced the impact of unemployment on arrears and possessions.

of the mortgages (e.g. loan-to-value ratio, interest rate and mortgage term) and of borrowers (e.g. family size, location, marital status, junior financing and characteristics of employment) that might be correlated with later default.

A second generation of empirical models derived from theoretical models that instead emphasised factors influencing the *borrowers'* decisions on payment, prepayment, delinquency or default. Couched in a utility maximising framework, such models allow four alternative choices at each payment period, where the chosen outcome maximises utility over time, given the borrower's circumstances. A special case is the large literature on option theoretic models from the mid-1980s, in its simplest form abstracting from transactions costs ("frictionless" models), where prepayment is treated as a call option and default as a put option in a competitive market. Such models predict immediate default if a property's value drops to the level of the mortgage value minus a small margin depending on house price volatility ("ruthless default", Vandell, 1995).[9] These models emphasise the *financial* aspects of the decision via negative equity, and borrower characteristics are excluded. Thus, such frictionless models predict identical default behaviour for borrowers with similar mortgages and houses. Much of the empirical literature, however, has explored the evidence for "default under-exercise" rather than "ruthless default", whereby the default decision is delayed on reaching sufficiently negative equity. Some studies rationalise such evidence by transactions costs, such as from moving house, and by future credit restrictions (e.g. Kau *et al*., 1993). Others suggest a role for "trigger events" (Riddiough, 1991), or crises affecting income, such as divorce or loss of employment, that when intersecting with marginal equity, may precipitate the move from a delinquent state with negative equity, to default. This introduces a role for ability to pay factors in addition to equity. The evidence on both sides of the "ruthless default" was summarized by Vandell (1995), who stressed, *inter alia*, a better empirical understanding of the role of trigger events through improved micro-data sets and analyses of mortgage case studies, of credit constraints and solvency, of the functional forms of various transactions costs, and of lender influences on default and delinquency.

The so-called third generation of models mainly represent a technological improvement on the second generation models in applying proportional hazard models to estimate default probabilities, and utilizing a measure of mortgage risk that better reflects lenders concerns: expected mortgage loss[10] rather than default rates, as in most second generation studies.

[9] Even within the option theoretic model, however, it may not be optimal to default immediately that negative equity is reached if there are possibilities to default in the future which could be more valuable, given volatile prices.

[10] Mortgage loss varies with the size of the loan, and this is not picked up when using default rates.

The predominant theoretical model in the literature stems from the second and third generational research, finding an important role for net equity in default risk, but also some evidence for borrower effects and transactions costs, though these effects are less well understood (two examples focused on the sub-prime crisis are Gerardi et al. (2008) and Bajari et al. (2008)). However, as Bajari et al. makes clear, the neglected factors of lending quality or credit constraints do not find an obvious place in the utility-maximising framework underlying second generational and option theoretical models. These require an extension to such models, see section 2.1 for discussion.

Studies on delinquency are far fewer, mainly due to the difficulty in modelling the delinquency decision, not easily set within the option theoretic model unless a competing risk model is contemplated (Quercia and Stegman, 1992). These authors contend that the analysis of default should be in a framework that incorporates the delinquency decision, and, instead of treating these two decisions as distinct alternatives, they should be sequential and related.

UK Macro-studies on Arrears and Possessions

The UK macro-literature is summarized in Table 1[11]. The few macro-analyses in the UK are more often of arrears outcomes (e.g. Whitley et al., 2004; Figueira et al., 2005). Of those that treat possessions, these tend to be sequential or simultaneous models with arrears (e.g. Breedon and Joyce, 1992; Brookes et al., 1994; Allen and Milne, 1994; and Cooper and Meen, 2001). Brookes et al. (1994) and some others (e.g. Figueira et al.) base their possessions model on the analysis of Wadhwani (1986) for the frequency of corporate bankruptcies, but applied to mortgage default. Brookes et al. employ a utility maximizing consumption framework for arrears, with un-withdrawn equity[12] and ability to pay variables, plus a measure of gearing of first-time buyers to capture the vulnerability of borrowers.

When modelling possessions conditional on arrears, all authors impose the constraint that in the long run, the flow of possessions moves in proportion to the number of households in long-term arrears. This is a questionable restriction: while most possessions cases are preceded by arrears, most arrears cases do not end in possession. Notably, the non-linearity linking the debt equity ratio with defaults is neglected in all aggregate UK studies. Moreover, shifts in lenders'

[11] There are other types of quantitative study e.g. by Ford (1993), who analyses borrower characteristics of possessions and in arrears using data from one major lender.

[12] Unwithdrawn equity is measured by Brookes et al. as net equity divided by the number of mortgages. Post-sample, their measure would thus have risen far more than the arrears rate. Figueira et al. (2005) use the ratio of net equity to the stock of debt, but define the debt service ratio as mortgage payments divided by *real*, as opposed to nominal personal disposable income.

forbearance policy, shifts in credit constraints and changing lending quality are usually omitted, though some of the dummies used by Cooper and Meen (2001) can be interpreted this way. Indeed, econometric studies of aggregate mortgage possession data, such as Breedon and Joyce (1992), Brookes et al. (1994) and Allen and Milne (1994), estimated on data up to 1990 or 1991, break down on later data. There is some treatment of credit factors: Whitley et al. (2004) in modelling arrears with similar variables find a role for competing unsecured borrowing (via credit card arrears). A rise in the loan-to-value ratio for first-time buyers *reduces* the level of arrears in the short run, suggesting that the loan-to-value ratio acts as a proxy for refinancing opportunities for those facing risk of delinquencies. The short-run role of the loan-to-value ratio as a proxy for refinancing opportunities and its long-run role as a proxy for one aspect of lending quality (with opposite signed effects), can produce apparently contradictory findings in different studies with loan-to-value controls.

3. Empirical specification, methodology and data issues

Empirical models for possessions and arrears are motivated by the double trigger approach outlined in section 2.1. The modelling methodology is described in section 3.1 and data issues in section 3.2. The models utilize dummy-based equations capturing difficult to measure institutional changes in lending quality and policy. The timing and shapes of these institutional dummies are discussed in section 3.3.

3.1 Modelling methodology

The models for possessions and arrears are formulated in an equilibrium correction form, illustrated as follows for the log possessions rate:

$$\begin{aligned}\Delta \log poss_t = {} & a_4(a_0 + \sum_{l=1}^{n} a_l X_{l,t} + LQ_t + PS_{t-1} - \log poss_{t-1}) + \sum_{l=1}^{n}\sum_{j=0}^{k} \beta_{l,j} \Delta X_{l,t-j} \\ & + \sum_{j=1}^{k} c_j \Delta \log poss_{t-j} + \Delta PS_t + \varepsilon_t \end{aligned} \quad (5)$$

The dependent variable is the quarterly change in the log possessions rate.[13] The equilibrium correction term is defined in terms of levels of the key drivers in a vector X of variables, and

[13] The log formulation, used in our models, has the advantage of plausible multiplicative effects, but may exaggerate movements at low levels of possessions, e.g. in 2004, unless the explanatory variables similarly reflect these extremes. We find, however, that the log of the estimated proportion of mortgages with negative equity, together with the log of the debt service ratio, does an excellent job in capturing these low levels.

the loan quality and policy functions, LQ and PS . The speed of adjustment to long run equilibrium is a_4. The long-run relationship between the log possessions rate and the long-run X variables, loan quality and policy function is thus:

$$\log poss = (a_0 + \sum_{l=1}^{n} a_l X_l + LQ + PS) \quad (6)$$

The set of X variables includes an estimate for the proportion of mortgages in negative equity (see equation (4)), the log mean debt service ratio, the log unemployment rate and potentially a measure of mortgage arrears. Note that among the short-run effects, ΔPS_t appears with a unit coefficient. This imposes the testable restriction that the short and long-run effects of policy are identical.

It is important to distinguish between two types of policy shifts. First, forbearance exercised by lenders and the courts lowers possessions, other things being equal, but raises arrears (see examples in section 3.3). The second type of policy shift relaxes the economic constraints faced by households, for example by making income support more generous, hence shifting possessions and arrears in the same direction. The formulation and empirical identification of the dummies which represent policy shifts and lending quality are discussed in section 3.3.

The arrears models have a broadly similar structure to the possessions equation (5), and are applied to data on the proportion of mortgages that are more than 6 months and more than 12 months in arrears. There are two key differences from the possessions equation: the first concerns the role of policy, which has the opposite-signed effect on arrears from that on possessions; the second arises from the correction of a bias from the commonly used "months-in-arrears" measure.

Beginning with forbearance policy, two channels affecting arrears must be distinguished. One arises from a stock-flow relationship with possessions. If all possession cases were previously at least 6 months in arrears, then a reduction in the number of possessions cases should raise the arrears count by a similar number, other things being equal. To be more precise, the change in the count of any measure of arrears equals the inflow minus the outflow of arrears. The total outflow consists of the 'good' outflow into repayment or refinancing, and the 'bad' outflow into possessions. Suppose that (inflow into arrears – 'good' outflow from arrears)/(stock of arrears$_{t-1}$) is a function of a vector Z, F(Z). Hence

$$\text{total change in arrears}_t/\text{arrears}_{t-1} = F(Z_t) - \text{flow into possession}_t \,/\, \text{arrears}_{t-1} \qquad (7)$$

Hence approximately,

$$\Delta \log \text{arrears}_t \approx F(Z_t) - \text{flow into possession}_t \,/\, \text{arrears}_{t-1} \qquad (8)$$

As a result, the ratio of negative possessions to lagged arrears was included in each arrears equation to account for this link between possessions and arrears.[14]

The second channel where policy on possessions affects arrears is via a demonstration or incentive effect. The knowledge that lenders and courts are exercising forbearance makes borrowers less concerned about the risk that a rise in their arrears levels will induce possession. For example, borrowers with this belief may pay off credit card debt before mortgage debt, or may cut back less on other household expenditure. The parameter $-b_6$ (note the negative sign) where b_6 is positive, captures the incentive effect of increased forbearance on arrears. The formulation in the equation below also allows a lag in the operation of this effect when κ takes a value below 1.

The two policy effects are shown in an arrears equation corresponding to equation (5), for a percentage of arrears measure, arr* (e.g. a count of arrears cases where ratio of arrears to mortgage debt exceeds say 5 percent):

$$\begin{aligned} \Delta \log arr^*_t \;=\; & b_4\Big(b_0 + \sum_{l=1}^{n} a_l X_{l,t} + b_5 LQ_t - b_6(\kappa PS_t + (1-\kappa)PS_{t-1}) - \log arr^*_{t-1}\Big) \\ & + \sum_{l=1}^{n}\sum_{j=0}^{k} \beta_{l,j}\Delta X_{l,t-j} - poss_t \,/\, arr^*_{t-1} + \sum_{j=1}^{k} c_j \Delta \log arr^*_{t-j} + \varepsilon_t \end{aligned} \qquad (9)$$

Correcting the bias from the "months-in-arrears" measure is discussed next. It is unfortunate that a long history of arrears data is available only for a count of arrears measured as "months in arrears" (those with an accumulated level of arrears in excess of an equivalent number of months of normal payments). When mortgage rates fall, normal payments fall and unfortunately the "months-in-arrears" count *rises*[15].

[14] Since it is likely that some possessions arise before arrears reach the 12-month level, the 12-month arrears equation uses 0.8 of the ratio of possessions to lagged arrears.

[15] With a 25 year conventional repayment mortgage, at a 7.5 percent mortgage rate, being 2.5 percent in arrears (e.g. arrears of £2500 on a £100,000 loan) translates into being 3.3 months in arrears (see

A bias correction based on the log debt service ratio is used to convert a relationship formulated for arr* (a count of arrears by the ratio of arrears to mortgage debt) into one for arrm (a count by months).[16] We approximate the relationship between the two measures in equation (10):

$$\log arr*_t = a + \log arrm_t + \theta \log dsr_t \tag{10}$$

where arrm is the month in arrears count which best matches the percentage in arrears count represented by arr*, and θ log dsr proxies the measurement bias. The parameter θ will differ for 6-month and 12-month arrears rates, see discussion in section 4.1. By substituting equation (10) into equation (9), we obtain an equilibrium correction model for the proportion of mortgages measure by "months-in-arrears":

$$\begin{aligned}\Delta \log arrm_t = {} & b_4(b_0 + \sum_{l=1}^{n} b_l X_{l,t} + b_5 LQ_t - b_6(\kappa PS_t + (1-\kappa)PS_{t-1}) \\ & -(\log arrm_{t-1} - \theta \log dsr_{t-1})) + \sum_{l=1}^{n}\sum_{j=0}^{k} \beta_{l,j} \Delta X_{l,t-j} + \theta \Delta \log dsr_t \\ & - poss_t / arrm_{t-1} + \sum_{j=1}^{k} c_j (\Delta \log arrm_{t-j} - \theta \Delta \log dsr_{t-j}) + \varepsilon_t\end{aligned} \tag{11}$$

The equation specifications (5) and (11) have a general lag structure in the dynamic terms. With two arrears measures, there are three equations in all, jointly estimated imposing cross-equation constraints through the common LQ and PS functions. There is much heterogeneity in individual circumstances, including the timing of the initial mortgage, and in behaviour by lenders and the courts. This suggests that fluctuations in debt service ratios and in the proportion of mortgages in negative equity have long, drawn-out effects in aggregate that could be well-represented by moving averages of these variables. The evidence pointed to the relevance of four-quarter moving averages of the log debt service ratio and of the negative equity indicator in parsimonious models, for both possessions and arrears. These formulations were incorporated in the three-equation system, and tested against more general lag structures.

CML information notes on release of arrears data, e.g. February 20, 2009). For a similar interest-only mortgage, the number of months in arrears is higher at 4 months, as monthly payments do not incorporate a repayment element. If the current interest rate falls and so the regular monthly payments, the accumulated arrears translate into a higher monthly payment equivalent at the new lower interest rate, and months in arrears *rises*. With a lower 4.5 percent interest rate, being 2.5 percent in arrears translates into 4.4 months for a conventional mortgage, and 6.7 months for an interest only mortgage. This pushes more existing cases into the 3-6 months and the 6-12 months in arrears categories.

[16] Basing the bias correction on log of the tax-adjusted mortgage rate instead of the log debt service ratio gives closely similar results for the arrears equations and jointly estimated possessions equation.

3.2 Data issues

3.2.1 Interpolation of bi-annual data

CML publishes quarterly data for arrears, possessions and the outstanding mortgage stock, beginning in 2008. Half-yearly data for earlier years can be interpolated into quarterly data from the early 1980s, and linked to unpublished quarterly data from CML from 1999Q1. The interpolation for arrears, which are stock data, is straightforward, as a smoothed step-function. The H1 value is given to Q1 and Q2 and the H2 value to Q3 and Q4. Then logs are taken and a two-quarter moving average is taken of the log values. For the flow of possessions, the interpolation is a bit more complex. The quarterly data are created and scaled using H1 and H2 biannual data (scaling ensures that the total of the implied quarterly flows into possession add up to the published biannual data).[17]

3.2.2 Measuring the debt-equity ratio and negative equity.

One commonly used definition of the *ratio of mortgage debt to housing equity* measures equity by the estimated value of the residential housing stock owned by the household sector (as published in the National Income and Expenditure Blue Book, and interpolated to a quarterly frequency). A substantial proportion of owners of housing equity, however, have no mortgages. We prefer, therefore, to adopt a measure defined as the average mortgage for those with mortgages relative to the average house price. We take the mix-adjusted index of second-hand house prices, normalized to the average value of houses traded in some year, as a proxy for the average house price of mortgaged properties.

An estimate of the *proportion of mortgages in negative equity* can be derived from the average debt equity ratio, using equation (4). The coefficients λ and λ_0 can be calibrated approximately to match estimates of the proportion of households with negative equity. CML research (Tatch 2009) suggests that between 7.6 percent and 10 percent of UK mortgages were in negative equity in February 2009 (using Halifax and Nationwide house price indices, respectively, for the fall in UK house prices between December and February). CML previously estimated a peak of 17 percent of mortgages with negative equity in the early 1990s. A figure of 9 percent is assumed

[17] $Q1_t = H2_{t-1}/6 + H1_t/3$, scaled by $H1_t/(Q1_t + Q2_t)$; $Q2_t = H1_t/3 + H2_t/6$, scaled by $H1_t/(Q1_t + Q2_t)$; $Q3_t = H1_t/6 + H2_t/3$, scaled by $H2_t/(Q3_t + Q4_t)$; and $Q4_t = H2_t/3 + H1_{t+1}/6$, scaled by $H2_t/(Q3_t + Q4_t)$.

for 2009Q1 and 15.5 percent for 1995Q4, to calibrate λ and λ_0.[18] The debt equity ratio defined by the average mortgage to average house price is plotted in Figure 6, with the implied proportion in negative equity from equation (4). The calibration implies 9 percent of mortgages were in negative equity in 2009Q1 compared with 1.5 percent in 2002Q4 and 15.5 percent in 1995Q4. Comparable figures at the same dates for the debt equity ratio were 71.4 percent, 51.6 percent and 77.9 percent. Moves in the proportion in negative equity become more pronounced as the average debt equity ratio rises, due to the non-linearity of their relationship, see equation (4).

One further small adjustment is made in the assumed relationship between negative equity and the ratio of average debt to average equity. It seems likely that a high number of recent possessions would have temporarily depleted the count of mortgages in negative equity, below those implied by the average debt-equity ratio. To take account of this, we subtract the cumulated number of possessions cases over the previous two years[19], scaled by the number of mortgages outstanding, from the proportion of negative equity implied by equation (4).

3.3 Use of dummies to proxy policy shifts and lending standards

3.3.1 Policy shifts

Table 2 explains the dating of forbearance and other policy shifts, and the expected effects on possessions and arrears. The model described above incorporates both the stock-flow measurement and the incentive effects of forbearance policy on arrears. The incentive effect operates through a forbearance policy function which is a simple function of dummy variables. The first is a step dummy equal to one from 1992Q1 and zero before. This reflects the December 1991 policy response to the mounting possessions crisis with an agreement between mortgage lenders and the government. The government acceded to the lenders' request to pay income support for mortgage interest direct to the lenders and also announced a Stamp Duty holiday, while lenders agreed to greater leniency on possessions. After 1995, it seems likely that a gradual return began toward more standard behaviour since, in that year, the government substantially reduced the generosity of SMI, despite lender criticism. We use smoothed step dummies (described further in section 3.3.2) for 1995 to 1997 to capture this return to normal, imposing the restriction that the 1991 shift is eventually cancelled out.

[18] We take λ=7 and λ_0 = - 0.001*(t-40)+ 0.04. The slight drift in λ_0 with time improves the match with estimates of negative equity.

[19] The average debt equity ratio eventually captures attrition from possession since defaults by vulnerable cases reduce the average debt equity ratio for the remaining mortgages. In the short term, removal of negative equity cases through possession will temporarily reduce the negative equity count by more. Limiting the adjustment to the previous two years captures the temporary nature of the effect.

In 2008Q4, forbearance policy shifted again, with government pressure on lenders – some of whom the government saved from bankruptcy and so partially owned – to exercise generosity. The industry's mortgage code of practice was also tightened through the Mortgage Pre-action Protocol. The latter shift would have introduced delay on possessions procedures, and implies a partial reversal after a few quarters of the initial impact of the policy shift. A step dummy beginning in 2008Q4 and two and three quarter lags of this dummy capture these possibilities. As noted above, while the possessions equation enforces the same short-run and long-run effects of the policy function, the arrears equations allow for a lag since it is plausible that incentive effects do not operate instantaneously.

3.3.2 Lending quality

Lending quality is difficult to measure directly. Since 1968, micro data have been collected from mortgage lenders on loan-to-value and loan-to-income ratios. The UK literature on arrears and possessions has used these as indicators of lending quality or credit availability or both. These indicators cannot be pure measures of lending quality as they are endogenous and depend also on interest rates, house prices, incomes and other factors (Fernandez-Corugedo and Muellbauer, 2006). Moreover, the available data are not fully comparable over time. The original survey, based on a five percent sample of building society mortgages, became unrepresentative of the market as the banks entered the mortgage market from 1980, and as centralized mortgage lenders increased their share of the market from the mid-1980s. The latter suffered possessions rates around three times as large as those of high street banks and building societies, Ford et al. (1995). Coverage was extended to the banks from 1992 in the Survey of Mortgage Lenders (SML), but not to the centralized mortgage lenders. Sample coverage after 2002 included full electronic records from some lenders, see Tatch (2003); there may have been problems, however, in classifying borrowers into first-time and repeat buyers. The new Regulated Mortgage Survey (RMS) was introduced in 2005 with a larger coverage of types of lender. There was jump in the fraction of high loan-to-value loans recorded for first-time buyers, and other differences with the SML, Tatch (2006). These data capture only first mortgages, omitting second mortgages and the home equity loans that later added to mortgage debt (LaCour-Little et al. (2009) give US evidence on the relevance of such further loans). The data do not fully capture the quality of the screening carried out by lenders. The shares of self-certification and of securitized mortgages rose sharply in 2005-7 (Turner (2009)), and such mortgages have shown higher default rates more recently.

These are the reasons why this paper prefers to use a latent variable, common to all three equations, based on dummies, to capture changes in loan quality. 'Loan quality' affects possessions and arrears rates in the same direction but must necessarily do so with a considerable lag. 'Loan quality' does not measure the quality of loans at the time they were issued, but rather the later impact of quality change on possessions and arrears. Two other effects will be reflected by this loan quality indicator. The first of these is from altered access to credit. It is typical that a period of poor quality lending with high defaults will affect bank balance sheets and generate more cautious lenders. This will constrain the refinancing route out of payment difficulties. For instance, a dummy reflecting earlier poor quality lending from 1989 and from 2007 will additionally capture reduced refinancing opportunities. The second effect derives from improvements in income support to those with payment difficulties that affect arrears and possessions in the same direction and comprise part of the 'loan quality' function. Examples are the policy shifts announced in 2008, offering more generous income support for the unemployed with mortgages and those already on Pension Credit and Income Support, and the Mortgage Rescue Scheme.[20]

Lending standards evolve more slowly than policy and have gradual effects on mortgage defaults; heterogeneity of individual borrowers and of lender behaviour results in smoothness in aggregate default rates in responding to shocks. A double moving average of step dummies is a good potential proxy for loan quality. For example define a step dummy *sd89* which is zero up to 1988Q4 and one from 1989Q1. The four-quarter moving average of this, termed *sd89ma*, takes the value 0.25 in 1989Q1, 0.5 in 1989Q2, 0.75 in 1989Q3 and 1 in 1989Q4. Now take a five-quarter moving average of *sd89ma*, termed *sd89mm*. This rises in an 'S-shape' from zero in 1988Q4 to reach one in 1990Q4. Linear combinations of such double moving averages of step dummies provide a simple way of representing smooth transitions.

The late 1980s and early 1990s and 2007 onwards are obvious candidates for the impact on defaults of periods of lax lending standards. After a default crisis, lending quality always improves, as lenders' experience of bad loans creates caution, and the shortage of funds available for lending induces credit rationing (witness the decline in loan-to-value and loan-to-income ratios since mid-2007). Improved methods of credit scoring and arrears management probably raised lending quality in the later 1990s and early 2000s. Table 2 sets out the priors used to check for loan quality and the other influences on the LQ function.

[20] The Mortgage Rescue Scheme was intended to help a small minority of vulnerable households and should reduce both arrears and possessions, and hence be part of the 'loan quality' function. However, Homeowners' Mortgage Support, which became fully operational in April 2009, was intended to lower mortgage payments for up to two years for those with payment problems expected to be temporary. It should lower possessions and raise arrears and therefore be part of the forbearance policy function.

4. Empirical results for the estimation of possessions and arrears

4.1 An empirical joint model for mortgage possessions and arrears, with variable lending quality and policy shifts.

Models are simultaneously estimated for total possessions and two different arrears measures (greater than 6 months and greater than 12 months), together with two linear functions for the dummy proxies of loan quality, broadly conceived, and forbearance policy changes.[21] Parsimonious versions of the estimated equations are presented below, with the variables defined in Table 3. Equation estimates are given in Table 4a and 4b.

Possessions and arrears are driven by three economic fundamentals: the debt service ratio; the proxy for the proportion of mortgages in negative equity, calibrated from an average debt to equity ratio; and the unemployment rate. Modelling the three equations as a system with common lending quality and policy shifts helps greatly in the identifying the unobservables. By sharp contrast with earlier UK literature, there is no significant effect on the rate of possessions from either measure of arrears. This important finding is discussed further below.

The selected possessions equation

$$\begin{aligned}\Delta \log poss_t = a_4 \times (a_0 + LQ_t + PS_t + a_1 \log dsrma_{t-1} + a_2 \log negeqma_{t-1} \\ + a_3 \log ur_{t-4} - \log poss_{t-1}) + (PS_t - PS_{t-1}) + a_7 \Delta \log negeq_t + \\ a_8 \Delta \log negeq_{t-1} + a_9 \Delta \log poss_{t-2} \\ + a_{11} q1_t + a_{12} d89q3_t + a_{13} d03q1_t\end{aligned} \tag{12}$$

As in equation (5), the dependent variable is the change in the log possessions rate. The speed of adjustment is given by the parameter, a_4, which multiplies the long-run solution for the log possessions rate. The coefficients on loan quality and policy indicators, a_5 and a_6 are normalized at one. The debt service ratio, $\log dsr$, is a lagged four-quarter moving average, as is negative equity, $\log negeq$, while the unemployment rate, $\log ur$, has a lag of four quarters. In the dynamics, the change in the policy indicator has a unit coefficient, restricting the short-run and long-run effects of policy to be the same. The change in the lagged possessions rate enters with a two quarter lag. The current and lagged changes in the negative

[21] The computations were performed in Hall, Cummins and Schnake's Time Series Processor (TSP 5) package, using TSP's SUR procedure to obtain seemingly unrelated regression estimates of a set of nonlinear equations (the maximum likelihood results were almost identical).

equity indicator reflect changed expectations of house prices influencing both borrowers and lenders. A seasonal dummy and two impulse dummies complete the specification.

The quarterly speed of adjustment, estimated at 0.43, suggests the regressors have most of their effect within a year.[22] The debt service ratio is highly significant with a robust t-ratio of 18. The estimate suggests that a 1 percent rise in the debt service ratio raises the possession rate by almost twice as much. The log proportion of those in negative equity is also highly significant with a t-ratio of 15. A one percent rise in this proportion is estimated to increase the possessions rate by 0.7 of one percent. The effect of the log unemployment rate is far less accurately estimated, with a point estimate of 0.2, but a standard error of 0.15, suggesting that a value of 0.4 would also have been statistically acceptable. Unemployment is important for arrears: given the regional evidence from Muellbauer and Cameron (1997) and micro-evidence from Boheim and Taylor (2000), it was retained in the possessions equation.[23]

The long-run effects[24] on the possessions rate are shown in Figure 7 for the debt-service ratio, estimated proportion in negative equity and the unemployment rate. Figure 8 shows the long-run impact of loan quality and forbearance policy, discussed further below. The figures suggest that in the *first* possessions crisis in 1989-93, the initial rise in possessions was driven mainly by the rise in the debt-service ratio, combined with lower loan quality, but later the rising incidence of negative equity emerged as an important driver. The persistence of negative equity prevented a faster decline in possessions, despite lower interest rates and the forbearance policy introduced at the end of 1991. In the *second* possessions crisis, the rise in possessions from its low level in 2004 again was caused by a growing debt-service ratio, and later the increasing incidence of negative equity, which rose sharply in 2008-9.

Data on the voluntary possessions rate are available only for a shorter sample: this equation was estimated separately, but incorporating the estimated lending quality indicator from the three-equation system. As expected, the policy shift measure proved insignificant.

[22] With two of the regressors entering as lagged four-quarter moving averages, however, the response to the underlying drivers is further delayed.

[23] A specification of the loan quality function including a step-dummy for 1992 results in the unemployment rate coefficient being larger and more significant. The negative coefficient on the dummy suggests that the earlier deterioration in loan quality was partially reversed in 1992, perhaps because of the switch in income support payments for mortgage interest direct to lenders.

[24] This assumes the base scenario (see section 4.3) for interest rates, house prices, unemployment, income and average debt, for 2009-13.

The selected voluntary possessions equation

$$\begin{aligned}\Delta \log vposs_t = v_4 \times (v_0 + v_1 \log dsrma_{t-1} + v_2 \log negeqma_{t-1} \\ + v_5 LQ_t - \log vposs_{t-1}) + v_7 q4_t\end{aligned} \tag{13}$$

The dependent variable is the change in the log of the voluntary possessions rate; the long-run debt service and negative equity terms are four quarter moving averages. The speed of adjustment, v_4, is estimated at 0.24, lower than for total possessions. The long-run effects of the debt service ratio, negative equity and loan quality are larger than on the total possessions rate. Unemployment and the lagged arrears rate are not significant in this equation. Given the short sample and problems in measuring the voluntary possessions rate, these results need to be treated with caution. Nevertheless, they suggest that the voluntary component of possessions is particularly vulnerable to lower loan quality and to debt service problems.

The selected arrears equations

The two arrears equations have a similar structure; the three main drivers are the log debt service ratio, the log imputed proportion in negative equity and the log unemployment rate.

Arrears > 12 months

$$\begin{aligned}\Delta \log arr12_t = b_4 \times (b_0 + b_1 \log dsrma_{t-1} + b_2 \log negeqma_{t-1} + b_3 \log ur_{t-5} \\ + b_5 LQ_t \text{-} b_6 (\kappa \mathrm{PS}_t + (1\text{-}\kappa)\mathrm{PS}_{t-1}) - (\log arr12_{t-1} - \theta_{12} \log dsr_{t-1})) \\ + \theta_{12} \Delta \log dsr_t - 0.8\, poss_t / arr12_{t-1} \\ + b_7 \Delta \log negeq_t + b_8 \Delta \log negeq_{t-1} \\ + b_9 (1 - sd99_t)(\Delta \log arr12_{t-1} - \theta_{12} \log \Delta dsr_{t-1}) + b_{10} \Delta_4 \log ur_t\end{aligned} \tag{14}$$

Arrears > 6 months

$$\begin{aligned}\Delta \log arr6_t = c_4 \times (c_0 + c_1 \log dsrma_{t-1} + c_2 \log negeqma_{t-1} + c_3 \log ur_{t-5} \\ + c_5 LQ_t \text{-} c_6 (\kappa \mathrm{PS}_t + (1\text{-}\kappa)\mathrm{PS}_{t-1}) - (\log arr6_{t-1} - \theta_6 \log dsr_{t-1})) \\ + \theta_6 \Delta \log dsr_t - poss_t / arr6_{t-1} \\ + c_7 \Delta \log negeq_t + c_8 \Delta \log negeq_{t-1} \\ + c_9 (1 - sd99_t)(\Delta \log arr6_{t-1} - \theta_6 \log \Delta dsr_{t-1}) \\ + c_{10} \Delta_4 \log ur_t + c_{11} d84q3_t\end{aligned} \tag{15}$$

The dependent variables are the changes in the log of arrears measures (greater than 6 months and greater than 12 months). In each equation, the long-run debt service and negative equity terms are lagged four quarter moving averages. The speed of adjustment for $\log arr12$ is estimated at almost 50 percent per quarter and around 35 percent for $\log arr6$. Without the

adjustment for the outflow into possessions, however, the estimated speeds would be rather lower. The estimate of the long-run effect of the debt service ratio, with t-ratios of 11 and 12, suggests that a 1 percent rise in the debt service ratio raises $arr12$ by about 1.6 percent and $arr6$ by 1.5 percent. The log proportion of those in negative equity is highly significant, with t-ratios of 9 for $arr12$ and 7.5 for $arr6$: a one percent rise is estimated to increase $arr12$ by 0.6 of one percent and $arr6$ by 0.4 percent.. The estimate of the long-run effect of log unemployment rate is 0.8 for $arr12$, and 1 for $arr6$.[25]

The long-run effect on the stocks of arrears of loan quality is measured by the parameters b_5 and c_5 with the same-signed effect on arrears as on possessions. Forbearance policy has the opposite signed effect from that on possessions. Its incentive or demonstration effect is measured by the parameters b_6 and b_7 , expected to be negative since PS is negative when forbearance policy is in force. The formulation allows a lag in the incentive effect of policy, when κ takes a value below 1, and the hypothesis that $\kappa = 0.5$ is accepted and so imposed. For both arrears equations, the long-run effects of loan quality on stocks of arrears are more than double that on the flow into possessions. The incentive or demonstration effect of forbearance policy on arrears, however, is similar in proportionate terms to that on possessions, a little higher on $arr6$ than $arr12$. This seems plausible, as those with lower levels of arrears can be expected to relax more than those already on the brink of possession.

The correction factors for the bias in the arrears count when interest rates change (section 3.1) are strongly significant, with t-ratios above 4. Such an explicit correction has not been made in previous studies of UK arrears. The measurement bias hypothesis implies a dynamic restriction imposed on each arrears equation, and its validity can be tested by adding unrestricted Δdsr terms (at times t and t-1) to each arrears equation. These terms prove insignificant on individual t-tests and by a likelihood ratio test on the three-equation system.

Figures 9 and 10 plot the long-run contribution of loan quality and policy variables to the 6-month arrears rate. As for possessions, the rise in arrears in 1989-93 was initially driven by

[25] Whitley et al. estimate the unemployment effect to be smaller at 0.7 for 6-month arrears, using the claimant count measure of unemployment, not the LFS measure. In contrast, they report a t-ratio of only 1.3 for the long-run coefficient of a measure of unwithdrawn equity on 6-month arrears, intended to capture a similar effect to negative equity. However, to compensate for the weak role of debt to equity, they estimate the long-run elasticity w.r.t. the debt service ratio to be around 3, almost double our estimate. Cooper and Meen (2001) find long-run elasticities of around 3 for the debt-service ratio, the unemployment rate and for the debt-equity ratio. This would make the arrears rate even more sensitive in the long-run to the interest rate and to unemployment than implied by our estimates. However, the estimated speed of adjustment is far lower at 0.08 with a standard error of 0.025, so that there are considerable margins of uncertainty around these estimates.

the rise in the debt service ratio and lower loan quality. The impact of negative equity, higher unemployment and forbearance policy came later. The contributions of the debt service ratio and of loan quality were larger than for possessions, while that of negative equity was smaller. The rise in arrears in 2008-9 is explained mainly by previous rises in the debt service ratio, the increased incidence of negative equity, the effect of forbearance policy, and, in 2009, by the rise in the unemployment rate.

Details of the selected loan quality and forbearance policy functions are discussed next.

The selected loan quality equation

$$\begin{aligned} LQ_t = {} & l86 \times sdmm86_t + l89 \times sdmm89_t + l94 \times sdmm94_t \\ & + l95 \times sdmm95 + l97 \times sdmm97_t + l05 \times sdmm05_t \\ & + l06 \times sdmm06_t + l07a \times sdmm07_{t-2} + l09a \times sd2008q4_{t-2} \\ & + l09b \times sd2008q4_{t-4} + l10 \times sdmm10_t + l12 \times sdmm12_t \end{aligned} \tag{16}$$

The formulation in equation (16) was selected from a general specification by eliminating terms which contradicted the priors set out in Table 2 or were insignificant. The equation includes a post-sample step dummy for 2008Q4, lagged two and four periods, and smoothed dummies for 2010 and 2012. Parameter estimates are reported in Table 4b. (Assumptions on the parameters *l*09b, *l*10 and *l*12 for the forecast scenarios are discussed below.) The first sign of deteriorating lending quality in the latter 1980s was apparent in defaults in 1986-7, exacerbated in 1989, and peaking in 1990Q4. These are reflected in positive estimated values for *l*86 and *l*89, probably also capturing some decline in credit availability typically following lax standards. By 1994-6, subsequent tighter standards lowered default levels, reflected in negative estimated values for *l*94 and *l*95. By 1997, the earlier tightening of rules on income support for mortgage interest (SMI) in 1995 had begun to raise arrears and possessions. Further small improvements in loan quality or, more likely, improved refinancing possibilities, seen in negative estimates of *l*05 and *l*06, lowered subsequent defaults from 2005 and 2006.[26] A pronounced deterioration in defaults from 2007Q3, reflects both earlier lax lending standards and evaporation of refinancing opportunities (parameter $l07a$).

[26] Refinancing opportunities also increased through sale and rent-back deals with the development of the buy-to-let market. Sale and rent-back involves the sale of an owner-occupied home to an investor, shifting the occupier to a rental contract. Concerns about lack of regulation and of misinformed selling led to an Office of Fair Trading Inquiry in 2008. The 2008 OFT report suggests that there may have been 50,000 sale and rent back deals up to mid-2008, and up to 60 percent related to households at risk of possession. A significant equity cushion is necessary for sale and rent-back to be feasible, so this claim may be exaggerated. If sale and rent-back was a permanent institutional change, both possessions

It is difficult to estimate the longer run consequences of large policy shifts that affect loan quality from this relatively short sample. A softening of the SMI rules announced in the second half of 2008 took effect from January 2009. The point estimate (parameter $l09a$) suggests the beneficial effect on defaults could offset as much as two thirds of the damage attributable to lax loan standards and tighter credit. This seems too large and too immediate an effect to attribute entirely to the introduction of more generous income support rules. It probably also reflects strenuous efforts by the government to improve mortgage credit availability.[27] The estimate is based on only two observations; given the estimated standard error, the true effect could be smaller, which will become apparent with more data.[28]

An alternative formulation of the loan quality indicator, based on median loan-to-value ratios for first-time buyers (CML data), proved less successful in fitting the data. The estimates suggest a negative short-run affect (probably reflecting access to refinancing), but positive effects of loan-to-value ratios, expressed as four-quarter moving averages at lags of four or more quarters (probably reflecting more slowly evolving loan quality). The estimates of the key economic drivers on possessions and arrears are little affected by adopting the alternative specification of loan quality, however.

The selected forbearance policy equation

$$PS_t = p91\times(sd91_{t-4} - sdmm97_t) + p08\times sd2008q4_t + p09a\times sd2008q4_{t-3} + p09b\times sd2008q4_{t-4} \quad (17)$$

The estimated policy function represents the possessions-lowering and arrears-raising effect of increased forbearance practiced by lenders and the courts (parameter estimates in Table 4b). A sharp change in policy in December 1991 is represented by a step dummy from 1992Q1. In 1997-8, the earlier withdrawal of this forbearance and resumption of 'normal' practice is confirmed by the data. The restriction is imposed that this cancelled the earlier increase of forbearance. A step dummy for 2008Q4 represents newly reinforced forbearance: the point estimate of -0.25 compares with an estimate of -0.17, for the 1991 policy shift. Some of the shift in 2008 would have been only temporary in nature if the revised mortgage code of

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and arrears might be a little lower relative to economic fundamentals than in the early 1990s. Tighter regulation and lower credit availability, however, are likely to reduce the numbers of such deals.

[27] This occurred through reversing the previous contraction of Northern Rock's loan book, and agreements of high mortgage lending targets with Royal Bank of Scotland and Lloyds TSB as a condition for allowing them to take part in the Asset Protection Scheme.

[28] Data published by CML on February 11, 2010 suggest that indeed the effect is smaller, as the model forecasts for the last quarter of 2009 proved a little too optimistic both for arrears and possessions.

practice merely delayed some possessions actions. Experimentation with lags in the 2008Q4 step dummy, suggest a partial reversal of the earlier forbearance by 2009Q3. There is considerable uncertainty around the size of this effect, however. The estimated net effect at 2009Q3 of -0.16 is close to the estimated 1991 policy shift. The last term in equation (17) allows different post-sample assumptions to be made for forecast scenarios, see below.

All published possessions models for UK macro data have imposed a 1:1 long-run effect of the arrears rate on the possessions rate. Our point estimates of the long-run coefficient on $\log arr6$ are *negative*, though not significant. We tested this restriction by imposing a long-run coefficient of one, and selecting, from general specifications, parsimonious equations consistent with sign priors on the economic variables and the loan quality function. This gave a possessions model where the log arrears rate was the only long-run driver of possessions. The arrears rate was corrected for measurement bias in this model. The debt service ratio, negative equity, the unemployment rate and the loan quality index were all insignificant or appeared with the wrong sign. The speed of adjustment of the possessions equation fell from over 0.4 to around 0.12. The fit of the resulting possessions equation was substantially worse, while estimates for the two arrears equations, the loan quality and policy functions were little changed. A likelihood ratio test for the three equation system of the hypothesis that the long-run coefficient on $\log arr6$ is one, rejects this with chi-squared at 35.

Since it seems plausible that most possessions cases would first have been in arrears, the above rejection of the 'one-for-one' relationship is paradoxical. Most arrears cases do not end in possession, however, which much reduces the paradox. The evidence of our preferred model further implies that possessions are less sensitive to unemployment (and loan quality) than arrears. Forcing a one-for-one effect of arrears on possessions would then require a counter-intuitive *negative* impact of unemployment (and loan quality) on possessions to offset a too strong effect coming through arrears. In our approach, these potential 'wrong signs' are excluded by sign priors applied in selecting a parsimonious 'one-for-one' model.

4.2 Forecasts of mortgage possessions and arrears, 2009-2013

Forecasts are given for 2009-2013 of total and voluntary mortgage possessions, arrears (≥6 months) and arrears (≥12 months), based on different economic scenarios. These forecasts were generated using the model described in section 4.1. The different scenarios are outlined in Table 5 with assumptions for the exogenous variables: unemployment rates, interest rates (and hence debt service ratios), house prices (and hence debt to equity ratios), and per capita

real income and prices, with details on the economic assumptions in Annex 2. The varying scenarios illustrate possible risk factors in the outlook for arrears and possessions.

Eight contrasting scenarios are given in Table 5. The first five are broadly based around November 2009 forecasts by Oxfordeconomics.com for underlying variables including interest rates, unemployment rates, inflation, house prices, disposable income, the mortgage stock and working age population. Key features of the base scenario, *Scenario 1* are unemployment peaking at 8.6 percent in 2010 then declining gently to 6.9 percent by the end of 2013, and interest rates remaining moderate, so that even by mid-2012 mortgage rates are only 100 basis points higher than in mid-2009, rising another 90 basis points to the end of 2013. In the base scenario, house prices dip a little in 2010, remain subdued, recovering in nominal terms to end 2009 levels only in mid-2012, and then rising gently. Inflation is extremely subdued, under 0.5 percent per annum in 2010, drifting up to around 1 percent in 2011, and under 2 percent in 2012 and a little over 2 percent in 2013. Real per capita income growth is moderate at around 2 percent per annum from the end of 2009 to the end of 2013. The mortgage stock grows a little below the growth rate of aggregate nominal personal disposable income.

In the base scenario and all others except *scenario 1A*, forbearance policy continues to the end of 2013. In all scenarios except *scenario 1B*, modest improvements in loan quality are assumed beginning in 2010 and extended from 2012 by assuming that parameters $l10$ and $l12$ in equation (16) are both equal to -0.02. This is intended to reflect the improved loan quality on loans made after mid-2007, and an assumed return to more normal lending conditions, albeit under tighter financial regulation under terms still to be worked out under national and international agreements.

Thus, *scenario 1A* makes the base economic assumptions, but assumes that forbearance on possessions comes to an end in 2009Q4 by taking p09b=0.17 in equation (17), cancelling out the net contributions reflected in .p08 and p09a. *Scenario 1B* takes the base economic scenario as given, leaves policy unchanged from 2009Q3, but makes a more negative assumption on loan quality, assuming $l09b=0.1$, see equation (16), cancelling most of the benefits of more generous income support policies. Moreover, $l10$ and $l12$ are taken as zero, so that the further marginal improvements under the other scenarios do not occur. *Scenario 2* is a higher growth version of the base scenario, in which unemployment peaks at 8.4 percent and falls to 6.4 percent at the end of 2013. Income growth is a little faster and house prices do not fall in 2010, and start rising at first gently, but ultimately by over 4 percent in 2011, over 5 percent in 2012 and over 6 percent in 2013. Interest rates rise earlier in this scenario and from

the end of 2010 are around 70 basis points higher than in the base scenario. The mortgage stock grows somewhat faster than in the base scenario, so that by the end of 2013 it is 6 percent higher than in the base. *Scenario 3* is a lower growth variant of the base scenario, with higher unemployment, lower growth but also even lower interest rates.

These scenarios all make rather optimistic assumption that mortgage interest rates remain low for an extended period and that the unemployment rate will peak at moderate levels. Alternative scenarios with more volatile interest rates, unemployment and house prices were therefore considered. *Scenario 4* assumes a more rapid fall in unemployment from a higher peak in 2011, an earlier recovery in house price growth and hence earlier rises in interest rates. The mortgage stock assumption is the same as in the base scenario. *Scenario 5* is an optimistic variant of *scenario 4* in which, after rising further initially, unemployment falls rapidly from a peak in 2011Q1, while interest rates remain remarkably subdued, rising only 150 basis points from 2009Q2 to 2012 and remaining constant in 2013. House prices rise sharply, at over 6.5 percent per annum between the end of 2010 and 2013 and the mortgage stock rises more strongly than in the base scenario. *Scenario 6* takes a far more pessimistic case. Unemployment peaks at 11.4 percent in 2011 and is down only to 8.5 percent at the end of 2013. Interest rates rise rapidly in 2010, perhaps because of a sovereign debt crisis in the UK, and remain high to the end of 2013. House prices fall in nominal terms in 2010, remain constant in 2011, then recover gradually, reaching nominal levels of end-2009 only by the end of 2013. The mortgage stock grows only in line with working age population and the price level in this scenario.

Graphical forecasts of the logs of possessions, voluntary possessions, arrears (≥6 months) and arrears (≥12 months), for each of eight scenarios, for 2009Q4 to 2013Q4, are shown in Annex 3. The underlying assumptions are traced out from 2000Q1 to 2013Q4 in the graphs beneath these figures. The forecasts of the numbers of properties taken into possession in the period, and of the numbers of household with loans in arrears (≥12 months and ≥6 months) are given in Table 6. Table 7 shows the corresponding forecasts for the estimated proportion of mortgages in negative equity, given assumptions on the ratio of average debt to average equity and forecasts of possessions.

Despite these assumptions of the continuation of forbearance policy and mild improvements in loan quality, the forecast rate of possessions under *scenario 1*, rises to new heights by the end of 2013 after declining in 2010 and 2011. This is partly due to the assumed rise in the mortgage interest rate, the assumed rise in the average mortgage size and the relatively weak recovery in house prices. The same factors imply a more gradual upward drift in both

measures of mortgage arrears. The gradual fall in the unemployment rate, to which arrears are more sensitive, moderates the rise in the arrears rates.

Scenario 1A assumes that forbearance on possessions ceases from 2009Q4 which, by the end of 2013, raises possessions flows by 19 percent, but lowers 6 month arrears by 46 percent and 12 month arrears by 40 percent compared to *scenario 1*. It is unlikely that such a policy shift would occur. The model suggests that forbearance policy is having a large effect on outcomes from 2009.

Scenario 1B assumes that just over half the improvement seen in 2009Q2 and Q3 (due to improved income support for those with payment difficulties) is switched off from 2009Q4. In addition, small improvements in loan quality due to tighter lending criteria are now assumed away – or offset by lack of access to refinancing possibilities (parameters $l10$ and $l12$ in equation (16) are set to zero). Not surprisingly, both possessions and arrears deteriorate relative to *scenario 1* by the end of 2013, by 15 percent for possessions, 43 percent for 6 month arrears, and 65 percent for 12 month arrears.[29]

The larger falls in unemployment and rises in house prices in *scenario 2* are partially offset by higher interest rates and growth in mortgage debt. The net effect is that possessions dip in 2010 and 2011, as in *scenario 1*, but they rise again in 2012 and 2013, not quite to the 2009Q1 peak and substantially below *scenario 1*. Arrears rates peak at the end of 2010 for 6 month arrears and the end of 2011 for 12 month arrears, but lower almost throughout than in *scenario* 1 (by 23 percent for 6 months and 11 percent for 12 months arrears by 2013).

In *scenario 3*, higher unemployment, weaker house prices, but lower mortgage interest rates induce lower possessions rates than in *scenario 1*, but arrears rates are higher. By the end of 2013, possessions are 6 percent lower, 6 month arrears 5 percent higher and 12 month +arrears 4 percent higher. The fact that *scenario 3* is only a little worse than *scenario 1* is a symptom of the sensitivity to mortgage interest rates.

In *scenario 4*, possessions decline a little in 2010 but then climb more sharply than in *scenario 1*, as interest rates rise more, and peak in early 2013. Arrears rates peak in 2012 above those in *scenario 1* given a higher unemployment peak, but then decline strongly under the impact of rapidly declining unemployment and rising house prices.

[29] The larger impact on arrears rates comes from the larger elasticity of arrears w.r.t. loan quality and from the reduction in the ratio of possessions to lagged arrears, which in equations (14) and (15) adjusts for the stock-flow relationship between possessions and arrears.

Scenario 5 considers a positive high volatility economic environment. Possessions decline in 2010, climb a little in 2012 and 2013, but remain well below 2009 peaks, given strong house price growth despite some rise in interest rates and in average mortgage debt. Sharper rises in unemployment and the lagged response of arrears to the shift in forbearance policy, causes arrears to exceed 2009 levels in 2010 before falling substantially below 2009 levels thereafter, with sharply falling unemployment and rising house prices.

Finally, *scenario 6* assumes a negative high volatility economic environment. In this 'disaster' scenario, possessions in 2012 are almost four times higher than in 2009, and both types of arrears are almost three times above 2009 levels. The combination of higher interest rates and weak house prices, is negative for possessions. Unemployment peaking at 11.4 percent is a further factor lowering arrears. The combination of assumptions for the underlying variables is unlikely to happen in practice; this scenario is extremely pessimistic and included mainly to highlight the sensitivity of forecasts to the path of the economy.

Turning to voluntary possessions, the estimated model is necessarily less reliable but suggests that voluntary possessions are even more sensitive in the long run than total possessions to negative equity, the debt service ratio and lending quality (especially the last two). The forecasts of voluntary possessions in different scenarios confirm this finding. In *scenario 1*, voluntary possessions are usually between one fifth and one quarter of total possessions from 2010 to 2011 and a little over one quarter in 2012 to 2013, as interest rates rise. In *scenario 1B*, the negative assumptions on loan quality raise the forecast voluntary possessions level to around half of the higher total of possessions by the end of 2013, compared with *scenario 1*. In the higher growth *scenario 2* voluntary possessions are roughly one third of total possessions; in the lower growth *scenario 3*, they exceed a quarter of total possessions, given the greater sensitivity to higher interest rates and the higher rates assumed.

Similar differences emerge in the higher volatility *scenarios 4* to 6. For example, in the positive high volatility *scenario 5*, voluntary possessions are forecast to remain at between one third and one quarter of total possessions, given fairly benign assumptions about interest rates. But in the 'disaster' *scenario 6*, voluntary possessions rise at the end of 2013 to almost two thirds of total possessions as interest rates continue to rise, despite the weak housing market.

Figure 11a to d shows the total and voluntary possessions numbers and the two arrears numbers under four of the scenarios. These are the base scenario and its variant scenario 1a,

which switches off forbearance policy, and respectively the most positive and the most negative of the economic scenarios considered. It is striking how the most negative scenario stands out. It is driven by an assumed rise in interest rates which pushes down house prices and so raises negative equity and the unemployment rate. In the other scenarios, interest rates are mainly determined by economic success or otherwise, so that weaker growth is compensated by lower interest rates, while stronger growth is partly offset by higher rates. This means that the effects on arrears and possessions are also moderate under these scenarios.

5. Summary and conclusions

Models for aggregate arrears and possessions rates have been developed in this paper, with sound economic foundations. These incorporate policy shifts and proxies for loan quality that affect arrears and possessions rates in predictable directions at particular times. Jointly estimating a three-equation system for the arrears and possessions rates, with cross equation restrictions, results in plausible magnitudes for the effects of policy shifts and lending quality. Parsimonious arrears and possessions models were tested successfully against more general specifications. The long-run impact of four major drivers, house prices, interest rates, debt levels, income, is captured by just two coefficients: on the debt equity ratio, transformed into a proxy for the fraction of mortgages with negative equity; and on the debt service ratio. Tests for interaction effects, e.g. whether the effect of unemployment was higher in years where negative equity was more prevalent, found no supporting evidence.

The measurement distortion in the months-in-arrears measure was handled systematically, again with the help of parameter restrictions. The analysis of different forecast scenarios allows an assessment of risks for different views on the UK and global economies. There are inevitable uncertainties around the evaluation of temporary and permanent effects of recent policy shifts, however, and of the decline in lending quality in recent years. With further data these estimates should become more accurate. A priority for future work is to endogenize UK house prices and the aggregate mortgage stock, checking for possible feedbacks from possessions, and perhaps arrears, onto house prices and the mortgage stock.[30]

A notable conclusion of this research is to demonstrate the striking sensitivity of arrears and possessions to higher interest rates. If UK short-term interest rates were to increase mortgage

[30] Evidence from annual regional data in Cameron et al. (2006) is that a downside risk measure, based on recent negative investment returns, outperforms the aggregate possessions rate in explaining house prices. The direct feedback from possessions to house prices may not be so important, therefore.

rates would also increase, though probably by a smaller amount.[31] The bad loans resulting from significantly higher mortgage rates could further impair the financial system, reducing economic growth. However, as noted above, mortgage possessions rates in 2009 in the UK were under one tenth of US rates so that the magnitude of the risks should not be overstated.

To illustrate the magnitudes implied by this research, a 10 percent increase in the debt-service ratio, for example due to the mortgage interest rate rising from 4 percent to 4.4 percent, is estimated eventually to raise the possessions rate by around 19 percent, and the 6 month arrears rate, corrected for measurement bias, by 15 percent. This calculation holds the proportion of mortgages in negative equity and the unemployment rate fixed.

At 2009Q3 house price and debt levels, a fall in house prices of 1.4 percent would raise the proportion of mortgages with negative equity from an estimated 8.5 percent to 9.35 percent, a 10 percent proportionate increase. An increase of this magnitude in the rate of negative equity is estimated eventually to increase the possessions rate by 7 percent and the 6 month arrears rate by 3.5 percent. A ten percent increase in the unemployment rate from 8 percent to 8.8 percent is estimated to increase the possessions rate by 2 percent[32] and the 6 month arrears rate by 10 percent.

A second conclusion is that lenders' forbearance policy and the more generous government income support for those with mortgage payment difficulties at present appears to have had a notable effect in lowering possessions. As noted in the introduction, conditions in mortgage and housing markets in the UK have been far more benign in 2009 than feared in the autumn of 2008. This has been achieved through policy interventions on an unprecedented scale, including the drastic reduction in base rates, and large-scale quantitative easing by the Bank of England, which brought down gilt yields and reduced rates on fixed rate mortgages. The bank rescues, and the direction given to expand mortgage lending, not only to Northern Rock (now wholly owned by the public sector), but also to Royal Bank of Scotland and Lloyds-TSB as a condition of rescue, have compensated significantly for the evaporation of lending from other sources, especially those financed by securitisation. In addition, there has been a Stamp Duty holiday, and a raft of further support measures already discussed. The sustainability of these relatively benign conditions is questionable, however, given the

[31] In late 2009 the spread between mortgage rates on new loans and base rate was close to 350 basis points, with base rates at 0.5%. It seems likely that the spread would narrow with base rates at 1.5 or 2 %. Also with slightly higher base rates and hence higher deposit rates, retail saving flows into banks are likely to improve, perhaps easing credit constraints on lending.

[32] This estimate is less accurate than the others and the figure could well be as high as 4 percent.

funding gap between retail deposits in UK banks and their loan book[33], the time-table of withdrawal of the Special Liquidity Scheme and the Credit Guarantee Scheme, and concerns over the UK's sovereign debt.

Two UK government objectives are to improve housing affordability and to restore financial stability. Housing has become unaffordable for many younger people, perpetuating the inequality from the redistribution of housing wealth of the late 1990s to 2007, from potential first-time buyers to older and wealthier households. However, substantial falls in house prices, triggered by the removal of income support, higher interest rates and potentially by supply and demand side reforms[34], could increase negative equity and exacerbate the problem of bad banking loans. It would, however, be a mistake to take the risk of substantial falls in house prices as an excuse for not expanding residential land supply. For if reforms of the planning system and of incentives for local governments to expand the supply of residential building land were to increase the rate of future building, DCLG's housing affordability model and research done for the Barker review suggests that the effects on house prices would be felt only gradually. A further advantage in the short-run would be employment gains in the building industry at a time when the public sector will be shedding jobs. In the long-run, a more sustainable level of house prices relative to the financial capabilities of households should reduce the risk of new crises.

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[33] See CML (2010) for an analysis of the funding gap.

[34] Muellbauer (2005), and a sequence of earlier newspaper articles, argued for property tax reforms to reduce the risk of financial instability.

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Table 1: A typology of UK empirical studies on mortgage arrears and repossessions

Study	*Dependent Variable & Sample*	*Equity Measures*	*Ability To Pay/Cash Flow Measures*	*Lending quality/ Policy*	*Methodology*
Selected Dissagregated Studies					
Muellbauer and Cameron (1997)	*Regional possessions relative to mortgage stocks* Regional possession court orders; constructed regional mortgage stocks; 1987-96 (annual)	Debt/equity	Debt service ratio, change in unemployment rate, lagged business de-registration rate	Lending quality proxy based on market share of centralized mortgage lenders, policy dummies	Pool across 8 English regions and Wales; fixed effects panel regression
Cooper and Meen (2001)	*Unscaled regional possessions* Regional possession court orders; 1990-99 (annual)	Debt/equity for some regions	Debt service ratio, change in unemployment rate, change in business de-registration rate	Shift and other dummies	Pool across 8 English regions and Wales, using regional shift dummies; stacked OLS
Lambrecht, Perraudin and Satchell (1997) (2003)	*Average time to default* *Times to forced possession and times to voluntary possession* 5,272 defaults, from an insurance co. database of claims for compensation from a UK building society; 1987-9	No treatment of current equity	*Borrower characteristics:* initial salary; initial marital status. Interest rate at which the mortgage was originally granted.	Initial loan-to-value ratio	Hazard model, using panel data
Boheim and Taylor (2000)	*Incidence of arrears* *Incidence of eviction* BHPS; 1991-97	No treatment of current equity or debt. Loan-to-value ratios are initial values only.	*Borrower characteristics:* Rich set of household characteristics; tenure; employment; income. Regional unemployment; interest rate.	Initial size of mortgage and initial house value	Pooled time series-cross sectional model, across all tenures
Gathergood (2009)	*Repayment difficulties* BHPS; 1992-2001	No treatment of current equity or debt. Loan-to-value ratios are initial values only.	*Borrower characteristics:* marital status, family size, employment, income etc.. Proxies for risk: health, employment & separation	First-time buyer status; initial loan to value and loan to income ratios	Random effects probit model, pooling household-observations over a 6 year period
Burrows (1998)	*Mortgage arrears* SEH; 1993-94	Year of house purchase; loan-to-value dummy.	*Borrower characteristics:* rich set of household characteristics *Lender characteristics:* region, mortgage type, lender type.	First-time buyer status	Logit model

Study	*Dependent Variable & Sample*	*Equity Measures*	*Ability To Pay/Cash Flow Measures*	*Lending quality/ Policy*	*Methodology*
Selected Macro-Based Studies					
Breedon and Joyce (1992)	*Arrears and possessions* 1971-91	Level of unused housing equity	Unemployment rate, debt-service ratio	-	Three-equation model of house prices, arrears and repossessions
Brookes, Dicks and Pradhan (1994)	*Mortgage arrears rate 6m+ and possessions as ratio of total mortgages outstandi*ng Quarterly interpolation of data from CML; 1970Q2 to 1990Q4	*Unwithdrawn equity*: net personal sector housing wealth /no. of mortgages.	Interest rates, inflation (instrument), debt service ratio using PDI, inflow to unemployment, divorce rate	Loan-to-value ratio for first-time buyers in arrears but not possessions equation	Engle-Granger two step method
Allen and Milne (1994)	*Mortgage arrears rate 6m+ and possessions/arrears* Half yearly data from CML, interpolated before 1980. arrears: 70H1-91H2 possessions:1974H1-1991H2	No equity treatment in arrears, but debt/equity drives possessions/arrears	Arrears equation: debt service ratio, rates of change of house price/income and of employment	-	OLS
Cooper and Meen (2001)	*Possessions and arrears data* Quarterly interpolation of bi-annual CML data 1985-2000	Debt/gross housing equity ratio in both arrears and possessions	Debt service ratio for first-time buyers, LFS unemployment rate and income inequality in arrears equation	Impulse dummies	Equilibrium-correction model with OLS
Whitley et al. (2004)	*Aggregate UK household arrears: proportion of mortgage loans in arrears of six months or more* Quarterly interpolation of bi-annual CML data 1985-2000	*Undrawn equity*: gross housing wealth minus mortgage debt as a percentage of housing wealth.	Debt service ratio: building societies' average mortgage interest rate x mortgage debt/PDI; unemployment rate (claimant count); lagged credit card arrears	Loan-to-value ratio for first-time buyers *(borrower quality)* Tested proportion of households with MPPI.	Error-correction representation using OLS regression
Figueira et al. (2005)	*Arrears in excess of 3 months relative to total mortgages* Monthly data for England and Wales, May 1993 to April 2001. Data on owner-occupier borrowers from a consortium of mortgage lenders (36 per cent of the total UK mortgage book)	*Level of unwithdrawn equity*: (average house price minus average mortgage)/average mortgage	Unemployment rate; lenders' mortgage interest rates; real personal disposable income *Debt–service ratio*: mortgage interest payments to real (sic.) PDI	Loan to income ratio for first-time buyers 1. Test for structural breaks. 2. Dummy for effect of changes to social security entitlement and increases in MPPI	Johansen methodology, VAR with 2 lags on monthly data. Error correction model is estimated for long-run and short-run dynamics in mortgage arrears.

Table 2: Priors on lending standards and policy shifts

Date	*Shift*	*Arrears Impact*	*Possessions Impact*
1986-1989	Bad lending, reduced credit access at end.	Arrears up	Possessions up
End 1991	Policy shift to reduce possessions	Arrears up	Possessions down
1994/5	Better lending quality	Arrears down	Possessions up
1997	Policy reversal (back to normal) and SMI lending quality	Arrears ?	Possessions up
1999-2006	Good lending quality and/or easy credit access	Arrears down	Possessions down
2007-2009	Bad lending, reduced access to credit	Arrears up	Possessions up
2008q4	Policy shift to reduce possessions	Arrears up	Possessions down
2008-9	Income support made more generous	Arrears down	Possessions down

Table 3: Definitions of variables used in the regressions

Symbol	*Definition*	*Means*	*Source*
$\log poss_t$	Log of the ratio of possessions to number of mortgages outstanding	-7.361	CML
$\log vposs_t$	Log of the ratio of voluntary possessions to number of mortgages outstanding	-9.209	CML
$\log arr6_t$	Log of the ratio of arrears (greater than or equal to months) to number of mortgages outstanding	-4.690	CML
$\log arr12_t$	Log of the ratio of arrears (greater than or equal to 12 months) to number of mortgages outstanding	-5.942	CML
$\log ur_t$	Unemployment rate (ILO measure)	1.993	ONS
$\log dsr_t$	Cost of loan to income, measured as: $((arbm/100)(avmort(-1))/(avpdi)$ arbm=average mortgage interest rate, rbm[1], adjusted for tax before 2000; avmort=amwt/mortno; amwt=mortgage lending, stock, personal sector (£mn), from Financial Statistics; mortno=mortgages outstanding from CML; avpdi=4 x quarterly personal disposable income[2], current prices (£mn)/popw; popw=population of working age, 15 to 59 for women, 15 to 64 for men ('000s), quarterly interpolation.	-7.164	mortno: CML popw: ONS amwt: ONS rbm: ONS pdi: ONS
$\log negeq_t$	Log of the debt equity ratio, measured to proxy average mortgage to house prices. Implied proportion of negative equity (*normalised*) (see equation (4), section 2.1): $negeq = ([1/(1+\exp(-\lambda * (\log(avdebt/equity) - \lambda_{0t}))])$ Then adjust $negeq$ by subtracting the cumulated number of possessions cases over the previous 2 years, scaled by no. of mortgages outstanding. (average debt)/((average equity)=avmort(-1)/(ph); ph=2nd-hand mix-adjusted house prices[3] (2002Q1=100), *normalized.* λ=7, λ_0 = - 0.001*(t - 40) + 0.04.	-3.150	ph: ONS
$sd2008q4_t$	step dummy =1 from 2008Q4, and 0 otherwise	-	Constructed
$sdmmxx_t$	Double moving average of step dummies, with a smooth increasing transition from zero to one over 8 quarters, from zero in the last quarter of year xx-1, to one in the last quarter of year xx+1	-	Constructed
$d84q3_t$	Impulse dummy for 1984Q3 for an outlier in 12month+arrears.	-	Constructed
$d89q3_t$	Impulse dummy for 1989Q3 for an outlier in possessions.	-	Constructed
$d2003q4_t$	Impulse dummy for 2003Q4 for an outlier in possessions.	-	Constructed

Notes: The sample is the longest available for both arrears and repossessions, 1983Q2 to 2009Q3. Interpolated quarterly CML data are used before 1999, see section 3.2.1.

1. Mortgage rate: from 2007Q1 FSA MLAR, Table 1.22 - Residential loans to individuals: Interest rate analysis. Overall weighted average interest rate on balances outstanding, all loans. From 2000 to 2006, linked to average of mortgage rate on balances outstanding for banks and building societies, previously reported in Financial Statistics. Before 2000, linked to average mortgage rate on balances outstanding for building societies, previously reported in Financial Statistics, code AJNL.

2. Nominal household disposable income = real household disposable income x consumer expenditure deflator, where the latter = current price measure of consumer expenditure/chained volume index of consumer expenditure from Consumer Trends, both seasonally adjusted. Real household disposable income SA Table 38 from UK Economic accounts, code NRJR.

3. Mix-adjusted index for UK for old dwellings from DCLG website Table 594.

Table 4a: Estimation results for arrears and possessions equations, 1983Q2-2009Q3

Variable	*Symbol*	*Possessions equation:* Δlog poss	*Robust std. errors*	*Symbol*	*Arrears equation:* Δlog ass12	*Robust std. errors*	*Symbol*	*Arrears equation:* Δlog arr6	*Robust std. errors*
Constant	a0	7.60**	0.96	b0	3.39**	1.35	c0	3.06**	1.11
log dsrma(-1)	a1	1.86**	0.10	b1	1.59**	0.15	c1	1.47**	0.12
log negeqma(-1)	a2	0.718**	0.046						
log negeqma(-2)				b2	0.598**	0.065	c2	0.397**	0.053
log ur(-4)	a3	0.199	0.146				c3	0.976**	0.267
log ur(-5)				b3	0.782*	0.331			
Speed of adjustment	a4	0.434**	0.047	b4	0.474**	0.038	c4	0.345**	0.034
LQ (loan quality)	a5	1	-	b5	2.90**	0.65	c5	2.35**	0.54
PS (policy shift)	a6	-1	-	b6	0.815*	0.435	c6	1.14**	0.42
Correction factor	-	-	-	θ12	-0.303**	0.074	θ6	-0.239**	0.052
Δlog negeq	a7	0.172**	0.046	b7	0.0798*	0.0323	c7	0.0508*	0.0218
Δlog negeq (-1)	a8	0.158**	0.047	b8	0.0947**	0.0323	c8	0.0632**	0.0223
$\Delta_4$log ur	a9	0	-	b9	0.313**	0.113	c9	0.246**	0.069
Δlog POSS(-2)	a10	0.323**	0.056						
dynamic shift adjustment				b10	0.322**	0.096	c10	0.493**	0.078
d89q3	a11	0.0709**	0.0165	-	-	-	-	-	-
d2003q4(-1)	a12	-0.182**	0.064	-	-	-	-	-	-
q1	a13	-0.159*	0.063	-	-	-	-	-	-
d84q3	-	-	-	-	-	-	c11	0.133**	0.028
Diagnostics									
Eq. standard error		0.062			0.043			0.028	
R squared		0.990			0.997			0.998	
LM Het test P-val		0.050			0.343			0.471	
Durbin-Watson		1.55			1.65			2.09	

Notes:

1. Estimates are reported to three significant figures. See the equations that generated these results in section 4.1; variables are defined in Table 3.
2. ** indicates significant at the 1 percent level; * indicates significant at the 5 percent level.
3. The policy function enters as (kappa*PS+(1-kappa)*PS(-1)), with kappa fixed at 0.5.
4. The dynamic shift adjustment is for the 12-month and 6-month arrears, respectively,

$1 - sd99_t \ * \ \Delta \log arr12_{t-1} \ - \ \theta_{12} \Delta \log dsr_{t-1}$ and $1 - sd99_t \ * \ \Delta \log arr6_{t-1} \ - \ \theta_6 \Delta \log dsr_{t-1}$

where sd99 is a step dummy beginning in 1999 when data frequency shifted to quarterly.

Table 4b: Estimation results for policy and lending quality equations, 1983q2-2009q3

Variable	*Symbol*	*Estimate*	*Robust std. errors*	*Robust t-statistic*
Policy function				
(*sd*91(-4) - *sdmm*97)	*p*91	-0.173**	0.047	-3.66
*sd*2008q4	*p*08	-0.252**	0.057	-4.42
*sd*2008q4(-3)	*p*09	0.093	0.061	1.52
Lending quality function				
*sdmm*86	*l*86	0.053*	0.026	2.04
*sdmm*89	*l*89	0.324**	0.078	4.14
*sdmm*94	*l*94	-0.095**	0.036	-2.66
*sdmm*95	*l*95	-0.074	0.040	-1.86
*sdmm*97	*l*97	0.080*	0.034	2.37
*sdmm*05	*l*05	-0.031	0.033	-0.94
*sdmm*06	*l*06	-0.070	0.042	-1.66
*sdmm*07(-2)	*l*07a	0.274**	0.083	3.32
*sd*2008q4(-2)	*l*09a	-0.190**	0.058	-3.28

Notes:

1. Estimates are reported to three significant figures. See the equations that generated these results in section 4.1; variables are defined in Table 3.
2. ****** indicates significant at the 1 percent level; * indicates significant at the 5 percent level.

Table 5: Scenarios for mortgages arrears and possessions forecasts 2009q1-2013q4

EXOGENOUS VARIABLE	*SCENARIO 1 BASE*	*SCENARIO 1A BASE* policy intervention effects switched off	*SCENARIO 1B BASE* sensitivity test around the lending quality variable	*SCENARIO 2 POSITIVE*	*SCENARIO 3 NEGATIVE*	*SCENARIO 4 HIGHER VOLATILITY*	*SCENARIO 5 POSITIVE HIGHER VOLATILITY*	*SCENARIO 6 NEGATIVE HIGHER VOLATILITY*
Policy Lending Quality **Unemployment Rate** *UP*	p09b=0 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP=UPBASE	p09b=0.17 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP=UPBASE	p09b=0 *l*09a=0.1 *l*10=0 *l*12=0 UP=UPHG	p09b=0 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP=UPHG	p09b=0 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP=UPLG	p09b=0 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP= UPBASEALT	p09b=0 *l*09a =-0.02 L112 =-0.02 UP=UPXPOS	p09b=0 *l*09a=0 *l*10 =-0.02 *l*12 =-0.02 UP=UPXNEG
House Price *PH*	PH=PHBASE	PH=PHBASE	PH=PHBASE	PH=PHHG	PH=PHLG	PH= PHBASEALT	PH=PHXPOS	PH=PHXNEG
Real Income *PEDY*	PEDY= PEDBASE	PEDY= PEDBASE	PEDY= PEDBASE	PEDY=PEDHG	PEDY=PEDLG	PEDY= PEDYBASEALT	PEDY= PEDYXPOS	PEDY= PEDYXNEG
Price Level *PC*	PC=PCBASE	PC=PCBASE	PC=PCBASE	PC=PCHG	PC=PCLG	PC=PCALT	PC=PCALT	PC=PCALT
Mortgage Rate *ARBM*	ARBM= ARBMBASE	ARBM= ARBMBASE	ARBM= ARBMBASE	ARBM= ARBMHG	ARBM= ARBMLG	ARBM= ARBMBASEALT	ARBM= ARBMXPOS	ARBM= ARBMXNEG
Population *POPW*	POPWR= POPWRBASE	POPWR= POPWRBASE	POPWR= POPWRBASE	POPWR= POPWRBASE	POPWR= POPWRBASE	POPWR= POPWRALT	POPWR= POPWRALT	POPWR= POPWRALT
No. of Mortgages *MORTNOINT*	MORTNO= MORTNOBASE	MORTNO= MORTNOBASE	MORTNO= MORTNOBASE	MORTNO= MORTNOBASE	MORTNO= MORTNOBASE	MORTNO= MORTNOALT	MORTNO= MORTNOALT	MORTNO= MORTNOALT
Mortage Lending Stock *AMWT*	AMWT= AMWTBASE	AMWT= AMWTBASE	AMWT= AMWTBASE	AMWT= AMWTHG	AMWT= AMWTLG	AMWT= AMWTALT	AMWT= AMWTALT	AMWT= AMWTALT

Notes: The actual values of the assumed variables for 2009q4-2013q4, e.g. UPBASE, are given in Annex 2. The different policy and lending quality assumptions are explained in Section 4.2.

Table 6: Forecast results 2009q4-2013q4

SCENARIO 1 *Forecast quarter*	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9843	61612	151210
2010q1	10171	61134	150421
2010q2	9076	62041	154343
2010q3	8944	63759	160628
2010q4	8478	64346	162999
2011q1	9225	64377	164139
2011q2	9014	64709	165761
2011q3	9477	65635	168873
2011q4	9645	66356	171036
2012q1	11056	67035	173423
2012q2	11398	68828	177519
2012q3	12365	69663	179981
2012q4	12842	71119	183635
2013q1	14640	71467	185942
2013q2	14729	71131	186425
2013q3	15480	71392	188352
2013q4	15549	71702	189992

SCENARIO 2 *Forecast quarter*	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9843	61650	151283
2010q1	10052	59832	147951
2010q2	8891	59766	150444
2010q3	8737	60955	156300
2010q4	8300	60175	156980
2011q1	9188	61066	161434
2011q2	9123	62234	166333
2011q3	9709	63256	171480
2011q4	9856	63935	175472
2012q1	11022	63197	176865
2012q2	10929	62515	177558
2012q3	11312	61084	176484
2012q4	11202	60685	177195
2013q1	12183	59104	175687
2013q2	11738	57658	173598
2013q3	11904	56552	172070
2013q4	11573	55256	169411

SCENARIO 6 *Forecast quarter*	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9847	62745	153375
2010q1	10512	61576	151354

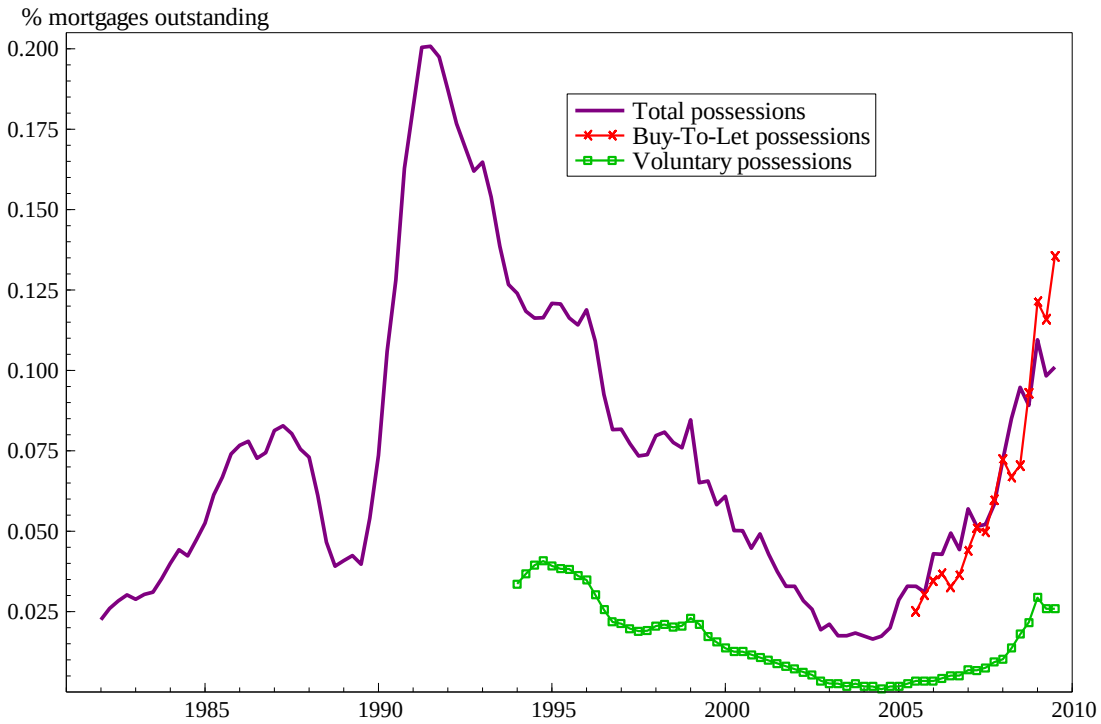
2010q2	10385	67596	164427
2010q3	12044	78314	186219
2010q4	14140	88686	203941
2011q1	19456	103761	230903
2011q2	23885	120422	262737
2011q3	30372	138457	300661
2011q4	35134	156115	341472
2012q1	42840	168437	375412
2012q2	43761	177746	402844
2012q3	44879	181265	420551
2012q4	43041	182622	433208
2013q1	44845	180250	440029
2013q2	41313	176672	442059
2013q3	40017	170814	437238
2013q4	37324	164811	429003

Notes: Results for the other scenarios are contained in Annex 4.

Table 7: Forecast negative equity and debt to equity ratio 2009q1-2013q4

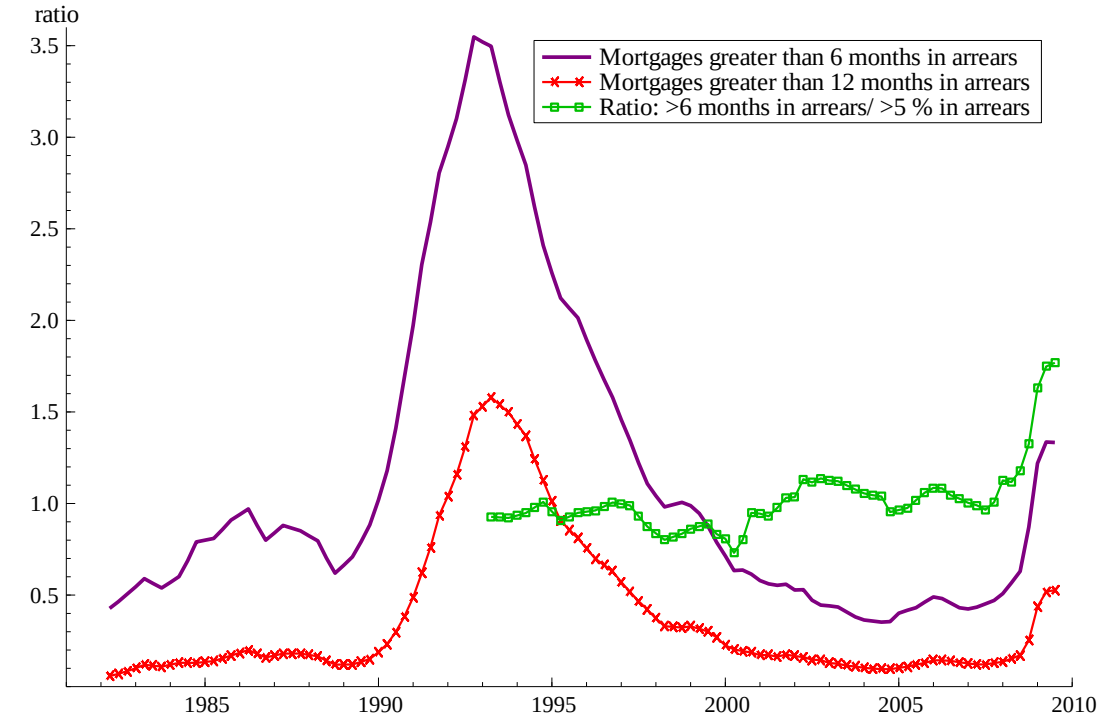
Forecast quarter	*Negative Equity*	*Debt equity ratio*	*Negative Equity*	*Debt equity ratio*	*Negative Equity*	*Debt equity ratio*	*Negative Equity*	*Debt equity ratio*	*Negative Equity*	*Debt equity ratio*
	Scenario 1		***Scenario 2***		***Scenario 3***		***Scenario5***		***Scenario 6***	
1995q4	0.155	0.780	0.155	0.780	0.155	0.780	0.155	0.780	0.155	0.780
2008q1	0.026	0.627	0.026	0.627	0.026	0.627	0.026	0.627	0.026	0.627
2008q2	0.030	0.642	0.030	0.642	0.030	0.642	0.030	0.642	0.030	0.642
2008q3	0.039	0.667	0.039	0.667	0.039	0.667	0.039	0.667	0.039	0.667
2008q4	0.062	0.713	0.062	0.713	0.062	0.713	0.062	0.713	0.062	0.713
2009q1	0.090	0.753	0.090	0.753	0.090	0.753	0.090	0.753	0.090	0.753
2009q2	0.095	0.760	0.095	0.760	0.095	0.760	0.095	0.760	0.095	0.760
2009q3	0.079	0.741	0.079	0.741	0.079	0.741	0.079	0.741	0.079	0.741
Forecasts										
2009q4	0.074	0.736	0.074	0.736	0.074	0.736	0.074	0.736	0.074	0.736
2010q1	0.079	0.744	0.074	0.737	0.079	0.744	0.074	0.738	0.092	0.760
2010q2	0.084	0.751	0.075	0.739	0.084	0.752	0.067	0.728	0.113	0.785
2010q3	0.085	0.753	0.071	0.734	0.087	0.756	0.062	0.720	0.140	0.812
2010q4	0.086	0.755	0.068	0.730	0.088	0.757	0.057	0.713	0.143	0.816
2011q1	0.088	0.758	0.065	0.726	0.088	0.759	0.053	0.706	0.146	0.820
2011q2	0.089	0.760	0.063	0.723	0.089	0.760	0.050	0.701	0.149	0.824
2011q3	0.091	0.763	0.061	0.720	0.090	0.762	0.048	0.697	0.152	0.829
2011q4	0.093	0.766	0.059	0.717	0.091	0.764	0.047	0.694	0.154	0.833
2012q1	0.095	0.768	0.057	0.714	0.093	0.766	0.045	0.692	0.156	0.837
2012q2	0.095	0.770	0.055	0.711	0.094	0.768	0.045	0.690	0.145	0.831
2012q3	0.095	0.771	0.052	0.709	0.093	0.769	0.044	0.691	0.135	0.825
2012q4	0.094	0.770	0.050	0.705	0.093	0.769	0.044	0.691	0.125	0.819
2013q1	0.092	0.769	0.048	0.702	0.093	0.770	0.045	0.693	0.116	0.814
2013q2	0.089	0.768	0.046	0.699	0.093	0.771	0.045	0.695	0.107	0.808
2013q3	0.086	0.765	0.044	0.696	0.092	0.772	0.046	0.697	0.100	0.803
2013q4	0.084	0.763	0.042	0.693	0.092	0.773	0.047	0.700	0.093	0.798

Figure 1: Aggregate possessions rates: total, voluntary and Buy-to-Let (percentage of mortgages outstanding)



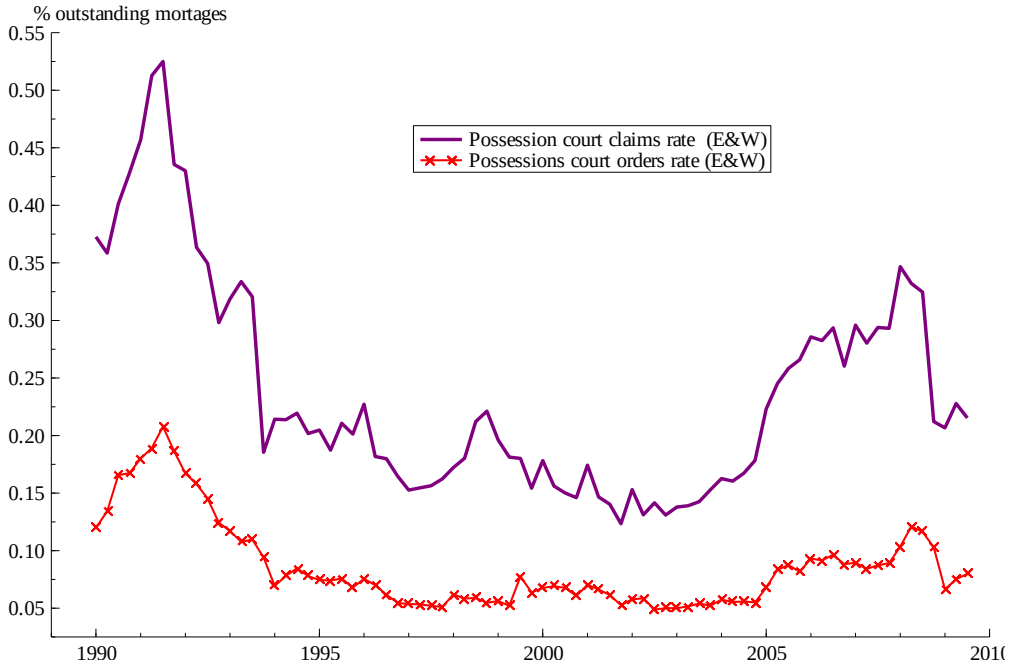
Source: CML; our interpolations to quarterly CML data are used before 1999.

Figure 2: Arrears rates by months in arrears and ratio of 6 months in arrears to 5 percent in arrears



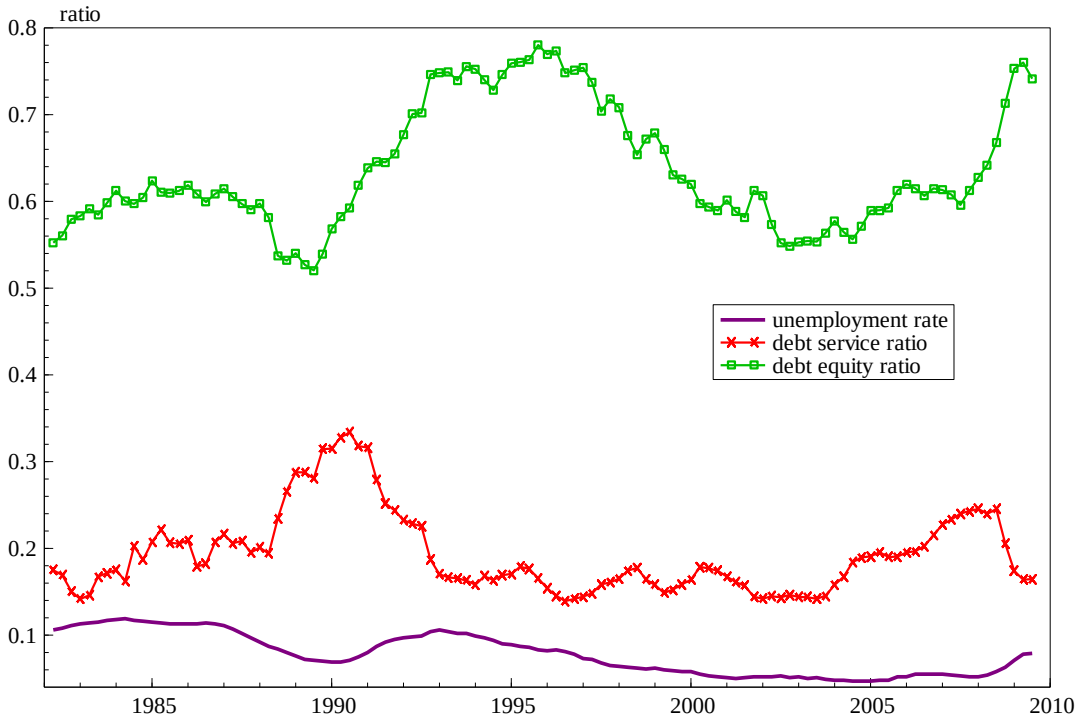
Source: CML; our interpolations to quarterly CML data are used before 1999.

Figure 3: Ministry of Justice data on possessions: court orders and claims, expressed as a rate using the count of CML mortgages outstanding



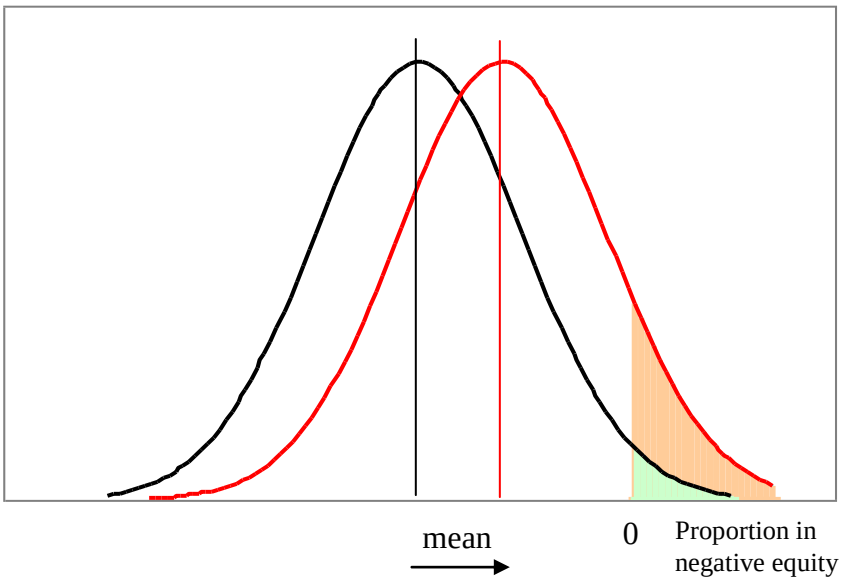
Source: Ministry of Justice (MoJ)quarterly date on court orders and actions. CML; interpolations to quarterly CML data are used before 1999, see section 3.2.1.
Note: The MoJ court figures cover second charge lenders as well as first charge lenders, whereas the CML figures cover only first charge lenders, and therefore the proportions may seem slightly inflated (see Annex 1).

Figure 4: The three key drivers: unemployment, the interest rate and debt equity



Source: See Table 3 for sources of data and definitions.

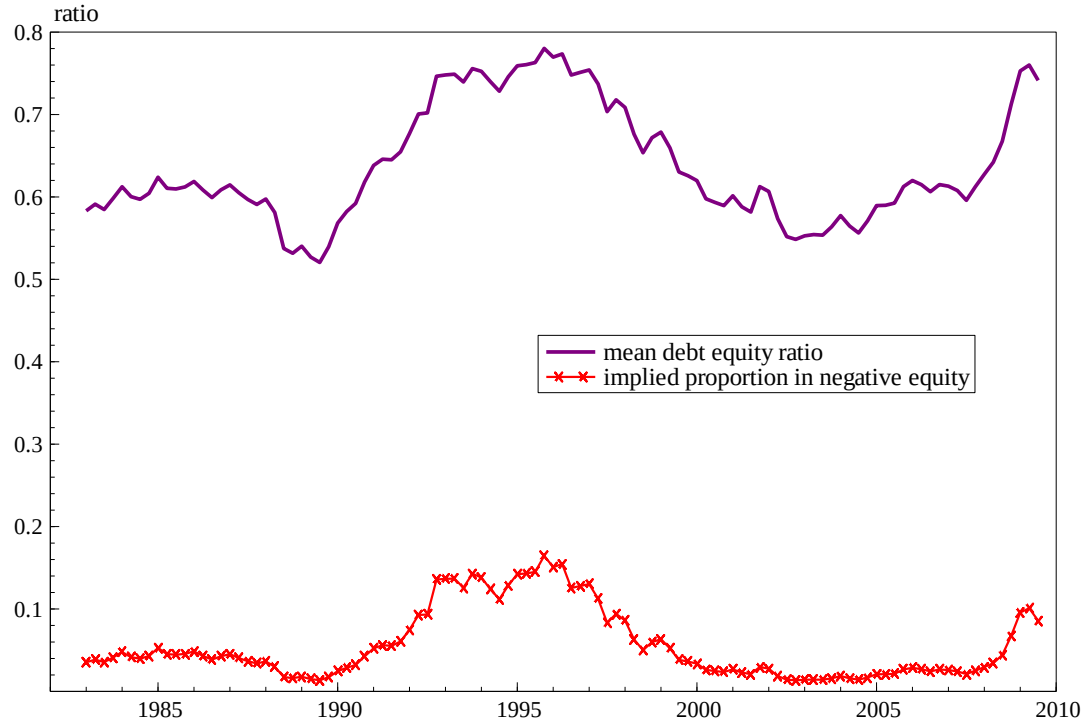
Figure 5: The impact of an increase in the average debt equity ratio on the proportion of mortgages in negative equity



Probability distribution of log debt equity ratio

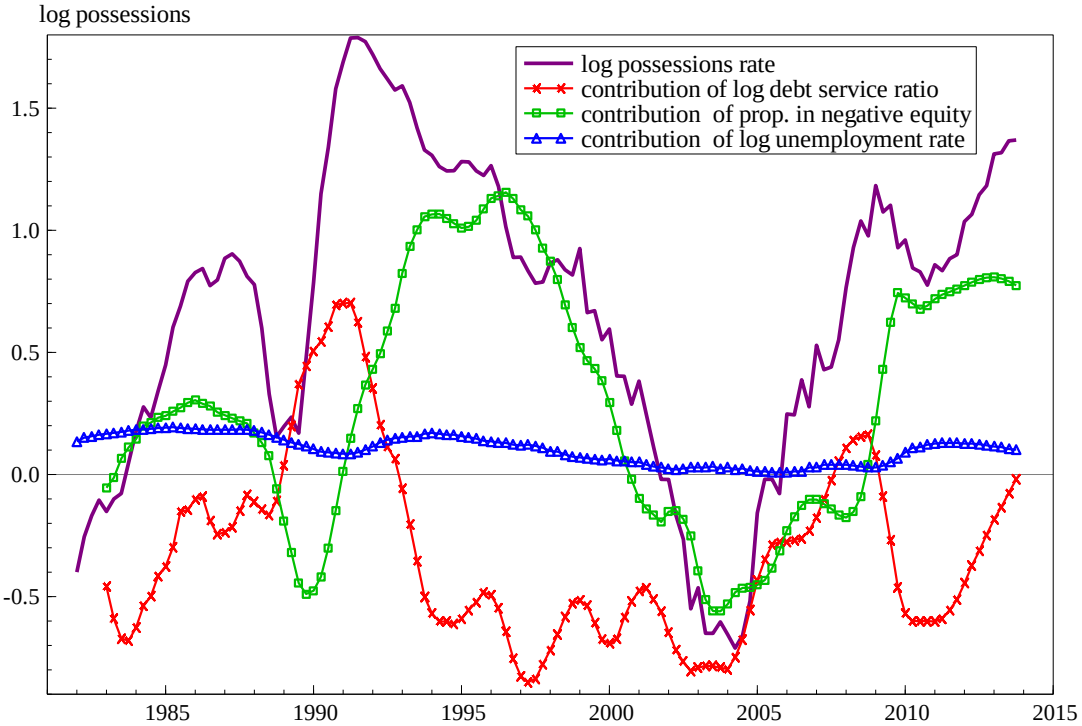
Source: Authors' own calculations.

Figure 6: Average debt equity ratio and the implied proportion of mortgages in negative equity



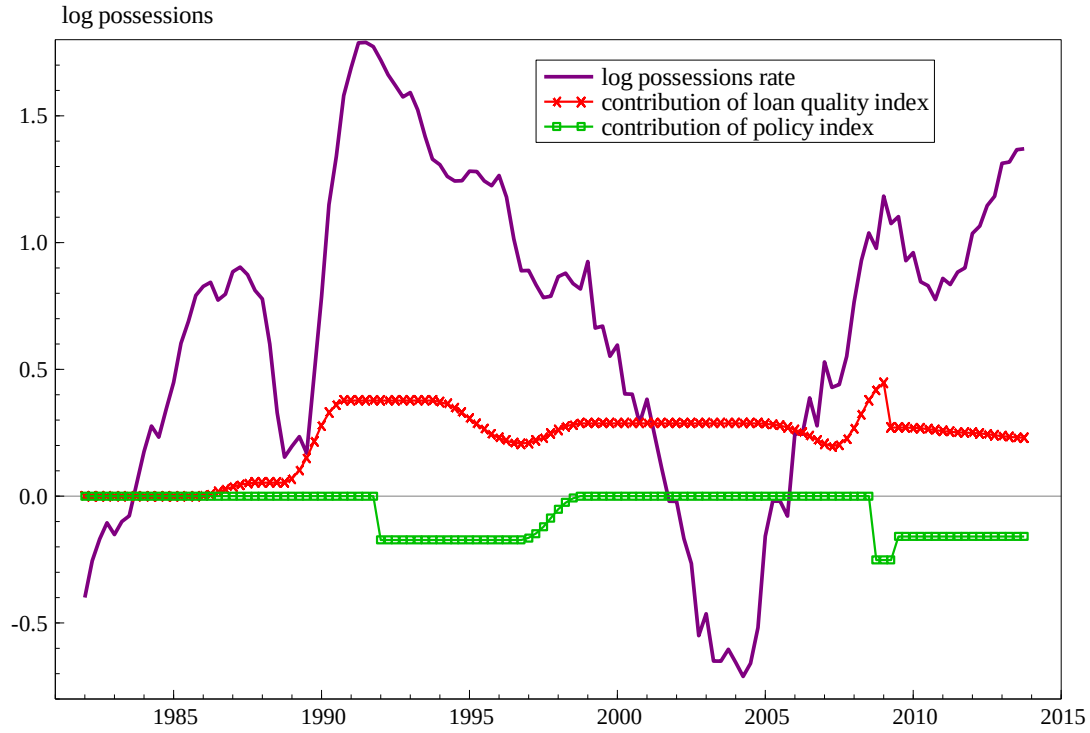
Source: See definitions in Table 3.

Figure 7: Estimated long-run contributions of key explanatory variables to the log possessions rate.



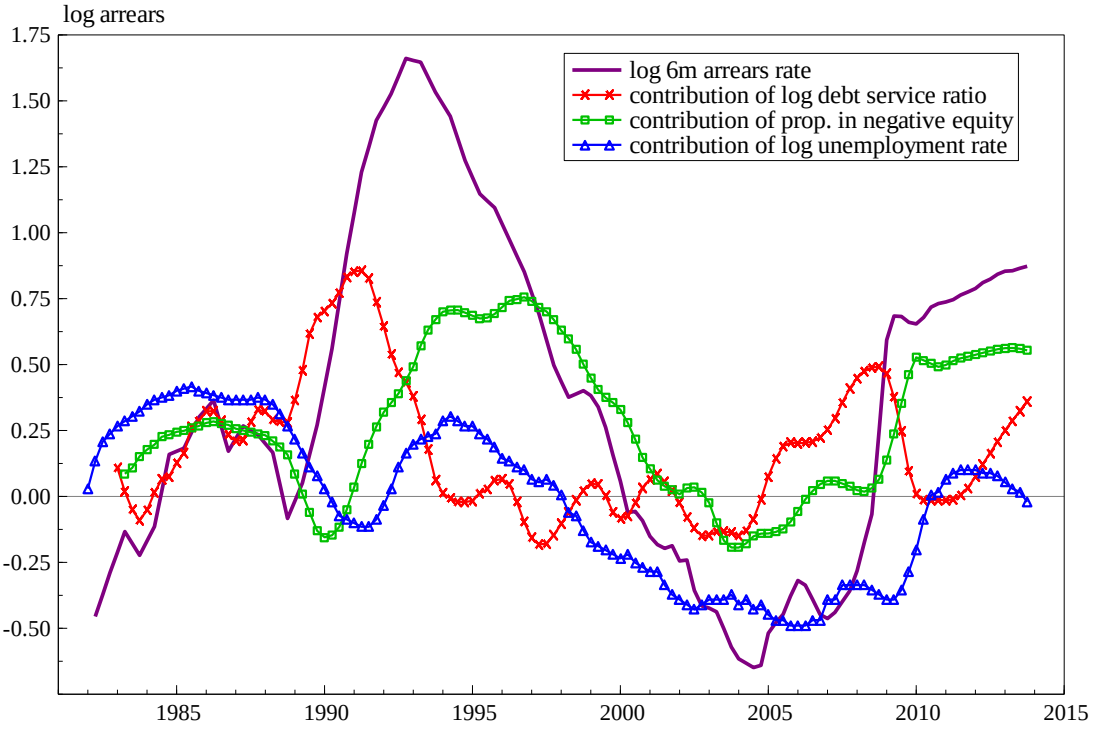
Note 1: Variables are level-adjusted for visual purposes. Scenario 1 is assumed for 2009q4 to 2013q4.

Figure 8: **Estimated long-run contribution of lending standards and policy shift proxies to the log possessions rate.**



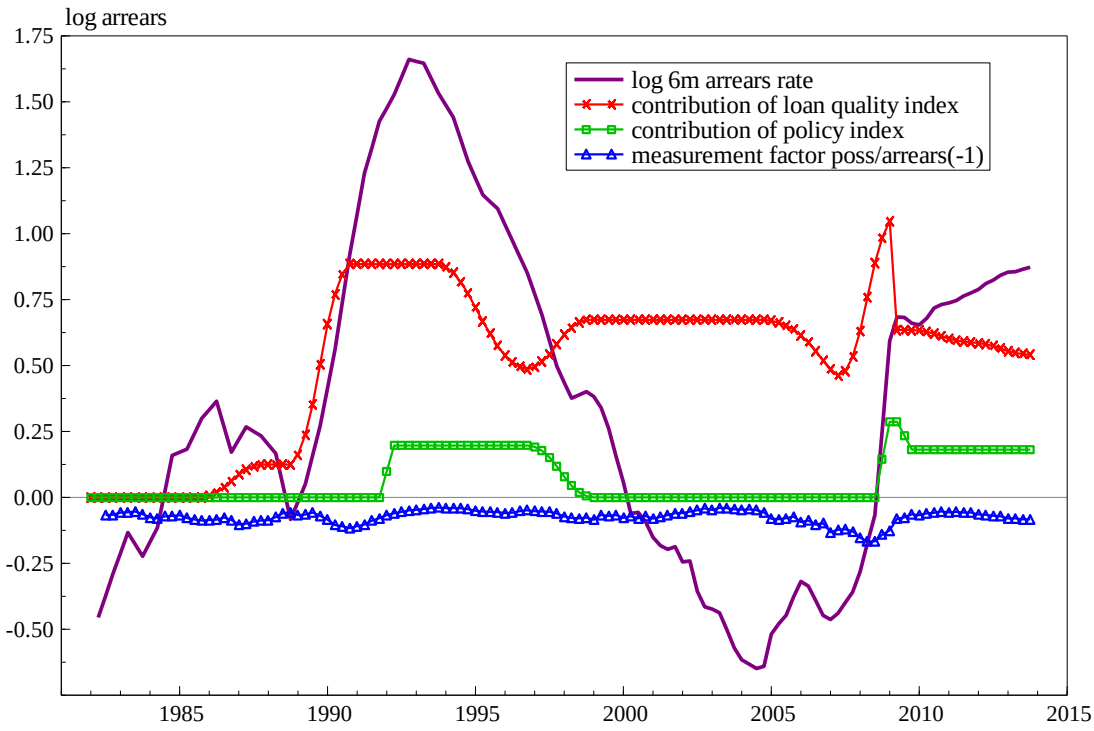
Note 1: Variables are level-adjusted for visual purposes. Scenario 1 is assumed for 2009q4 to 2013q4.

Figure 9: **Estimated long-run contributions of key explanatory variables to the log 6 month arrears rate.**



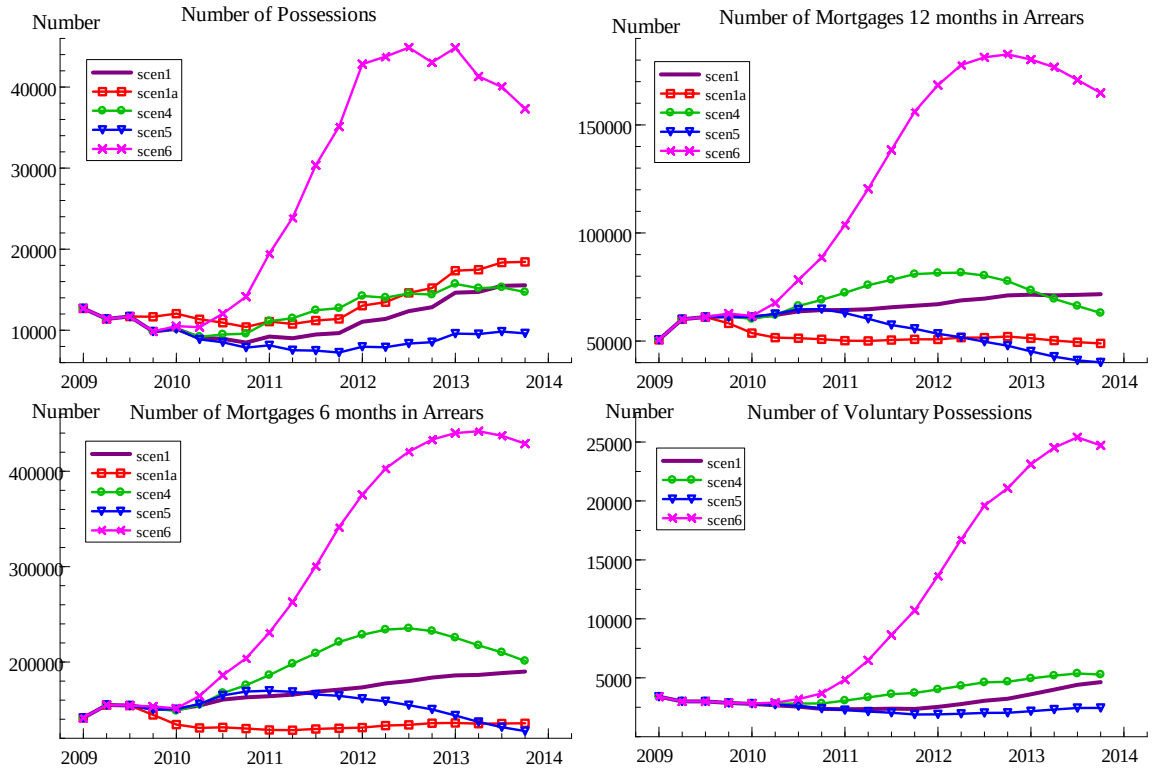
Note 1: Variables are level-adjusted for visual purposes. Scenario 1 is assumed for 2009q4 to 2013q4.

Figure 10: Estimated long-run contribution of lending standards and policy shift proxies to the log 6 month arrears rate.



Note 1: Variables are level-adjusted for visual purposes. Scenario 1 is assumed for 2009q4 to 2013q4.

Figure 11: Forecast aggregate possessions and arrears numbers, under four scenarios.



Note: Forecasts for the other scenarios will lie between the extremely pessimistic scenario 6 and the optimistic scenario 5, but closer to the latter. For details of these forecasts, see Annexes 3 and 4.

ANNEX 1: Availability and Quality of Mortgage Possessions and Arrears Data

A1. Publicly available data on mortgage possessions and arrears

The available data on different measures of mortgage arrears and possessions (including voluntary and Buy-to-Let possessions) are summarised in Table A1[35] for the three main providers: Council of Mortgage Lenders (CML), Ministry of Justice (MoJ), Financial Services Authority (FSA).

To summarize, basic mortgage arrears (a count of mortgages classified by number of months in arrears) and possessions data from CML begin effectively in 1970, move from annual reporting to biannual reporting in 1981 or 1982, and to quarterly reporting in 2008.[36] The 1970s data are of limited interest, since credit market liberalization began only in 1980. From 1994, the CML arrears data are additionally available expressed as a count of mortgages classified by percentage of the loan outstanding. The percentage data are a preferable measure, as the "number of months" measure is distorted by changes in the mortgage interest rate, tending to rise as the interest rate falls, see section 3.2. Buy-to-Let arrears information becomes available from 1998. The CML data on aggregate possessions include only first charge loan data reported by CML members. The CML data on Buy-to-Let possessions begin in 2005h2; and CML estimates of 'voluntary' possessions begin in 1994. CML data on Buy-to-let possessions rates as a proportion of Buy-to-Let first charge mortgages show a broadly similar rise to those for non-Buy-to-Let mortgages, except for a sharper rise in 2008Q4, when the non- Buy-to-Let possessions rate actually fell by a small amount, presumably because of government policy interventions and a more lenient attitude by lenders, for example via the Mortgage Pre-action Protocol. CML data on voluntary possessions suggests that as a proportion of total possessions, voluntary possessions fell between the aftermath of the 1990s crisis and 2006, but have been rising strongly, though still far below the previous peak of close to 45 percent of all possessions. This suggests that data from county court orders for mortgage possessions could be understating the rise in the overall rate at which home owners are losing their homes.

The FSA data on arrears begin only in 2007Q1. They are classified by counts of mortgages by percentage of the loan outstanding and by the balances outstanding in each category. Since the FSA figures on arrears relate to the number of loan accounts that are in arrears, and not the number of mortgages (which is the basis for CML figures), the former will be significantly higher, see section A2. The FSA also provide other information, including the flow of new arrears cases. The FSA data on possessions include data from all regulated lenders, including second charge possessions, and so tend to be higher than CML possessions data, at least for non- Buy-to-Let mortgages, see section A2.

[35] Table A1 increases the relevant information relative to the Ministry of Justice table (MoJ, Jan 2009). The MoJ court actions data are national statistics and the FSA MLAR data are official statistics. 'National Statistics' are a subset of official statistics which have been certified by the UK Statistics Authority as compliant with its Code of Practice for Official Statistics. The Statistics and Registration Service Act 2007 defines 'official statistics' as all those statistical outputs produced by the UK Statistics Authority's executive office (the Office for National Statistics), by central Government departments and agencies, by the devolved administrations in Northern Ireland, Scotland and Wales, and by other Crown bodies.

[36] Table A1 shows that CML has collected quarterly figures on arrears and possessions since 1997, provided to data contributors and government and used for internal purposes, and they have been published on a quarterly basis since 2008.

In addition, there are data from the Ministry of Justice, for possessions only. The MoJ data on court actions for mortgage possession in England and Wales begin in 1986, and are quarterly from 1987. These data have the advantage of being available at the regional and sub-regional level, unlike all the other sources, but do not include 'voluntary' possessions cases[37].

A2. Comparing and contrasting the data from the different providers

Apart from their differing availability of historical data, the FSA and CML's published data on arrears and possessions employ different definitions, and are compiled from different sets of borrowers. Thus, these data are not directly comparable, and trends may differ.

According to the CML, their data refer only to *CML members*, who they believe account for 98 percent of the outstanding stock of first mortgages secured on UK residential housing.[38] The CML currently has 136 members (banks, building societies and other mortgage lenders) and 72 associates (related businesses that have an interest in the mortgage market). Their data are sometimes revised, with resubmission of earlier figures from lenders, new lenders reporting, and when they get "better information about rates of growth and performance in different parts of the market". A measurement issue thus arises. One of the bigger recent revisions concerned 2007 possessions and arrears data. Missing data from some smaller members were grossed up to obtain an estimate for all members and it was discovered that default and delinquency rates for these lenders in niche markets tended to be somewhat higher. As a result, the sample representation was extended to give a more complete picture, resulting in upward revision of default and delinquency rates. Thus, in the arrears data, CML cautions that "care should be taken when looking at changes over time as lenders newly reporting figures may distort comparisons".

The FSA data cover all *regulated firms*, and also take account of *multiple loans* concerning a single property. Many mortgages are split into multiple accounts (for example one account for an interest-only segment, another for a repayment section for a part-and-part mortgage). The FSA figures involve a degree of 'double counting' in that a borrower can have arrears both on the first loan and on the second loan. As a fraction of the total number of accounts, however, the FSA count of cases in arrears or flowing into possession can be lower or higher than the CML figures, depending on whether arrears or possessions rates are higher or lower on second loans. Table A2 illustrates this. The CML count of first mortgages outstanding was 11.7m at the end of 2008, while the FSA count of the number of loan accounts was 15.4m. In terms of *proportions* of loans, the two sets of arrears figures are reasonably close, though CML estimates a higher proportion are 10 percent or more in arrears. However, the CML arrears proportions in the 2.5 to 5 percent range have shown a more rapid rise in 2008.

For the proportion of possessions, the FSA figures are lower than the CML's but show a more rapid rate of increase in 2008, possibly because possessions rates are rising among second and third loans because the households taking out such loans are more heavily indebted and so

[37] Instances where a property is surrendered after a claim is made by the lender or a court order is granted but before such an order is enforced are categorised as voluntary possessions by some lenders and will be included in MoJ mortgage possession court statistics.

[38] This has not always been so. In the late 1980s and early 1990s, when CML membership covered a smaller fraction of the industry, it is believed that CML estimates of possessions made an allowance for non-CML members. To the extent that CML used a simple grossing up factor, not taking into account the higher possessions rates for non-members, it is likely that CML possessions estimates for the early 1990s may have understated the true incidence of possessions at that time. As of May 2010, after the drafting of this paper, the CML began to publish estimates grossed up to be representative of the entire first charge mortgage market, and revised their arrears and possessions series accordingly back to Q1 2009.

more likely to default on their loans. It is also possible that the small fraction of lenders not covered by CML data have experienced a higher rate of repossessions than CML members. This could be because these lenders specialise in non-prime lending.

A recent view from the FSA[39] is that the main reason for the recent gap between CML and FSA-MLAR possession statistics is due to the different treatment of Buy-to-Let Receiver of Rent cases. FSA data differ from the CML data through coverage only of loans made by regulated firms and coverage of second charge loans, but the CML data also exclude Buy-to-Let mortgages for which a receiver of rent (RoR) has been appointed, whereas the FSA includes these cases. Analysis by the FSA of the possessions data produced since 2007 by the Finance and Leasing Association (FLA) supports this view. Moreover, analysis by the FSA suggests that the majority of possessions in the unregulated market arise from Buy-to-Let loans (including RoR) rather than second charge loans.

The FSA further disaggregates loan data and contrasts default and delinquency rates on securitised and non-securitised loans, Table A3, adding considerably to previously available information. Except for the highest levels of arrears (over 10 percent of the loan), it shows that arrears rates for securitised loans are more than double those for non-securitised loans. It also shows more rapid rates of increase of default and deliquency rates among securitised loans.

The FSA also produces very useful information on distributions of loan to value ratios, see Table A4. CML no longer put data of this kind into the public domain. These show dramatic falls between mid 2007 and mid-2009 in the proportions of more exposed loans, with LTVs over 90 percent and over 95 percent respectively. Their cross-tabulation of loan proportions with high LTVs and high loan to income ratios also shows a sharp decline. These declines reflect a mix of 'credit crunch' effects and of greater caution by lenders in view of falling house prices and rising unemployment.

A3. Gaps in coverage of the available data on mortgage possessions and arrears

Gaps in coverage should be considered from two points of view. One is from the short-run perspective of tracking the detail of what is happening both to understand the forces at work and to have some hope of finding evidence on the effects of policy interventions. The other is from the perspective of long-run comparisons and modelling. The latter is important since analysis of the previous crisis and the subsequent recovery can offer important guidance on what might be expected in the future, controlling for different economic circumstances.

1. The most obvious gap in the data is the *absence of sub-national estimates*, except for county court actions and orders. There is no fundamental reason why mortgage lenders should not be able to classify arrears and possessions cases by region or sub-region. House prices, incomes, and unemployment and their changes differ considerably by location so that the evolution of arrears and possessions cases is likely to differ considerably by location, see Chart 1, on the regional distribution of court claims for possessions in 2010, quarter 1. The FSA view is that: 'All regulatory reporting by authorised firms is covered by the FSA Handbook. Any changes to reporting are subject to formal appraisal, and public consultation with affected firms, and cost benefit analysis.' However, ideally, the FSA could additionally classify arrears and possessions cases by post code groupings or sub-regions. Not only is this of significance for local government, but such variations will illuminate the relative importance of the drivers of payment difficulties. This may help to disentangle the relative contributions of interest rates, policy interventions and changes over time in the quality of lending.

[39] We are grateful to John Longbottom of the FSA for drawing our attention to these details.

2. A second important gap is the absence of information on the year in which the mortgage was first issued (the *vintage of the mortgage*). The year of origination of the mortgage is used by some lenders who classify their own data in this way; but it would be useful if all lenders could supply their data to the FSA or CML in this form. The proportion of mortgages of a given year's vintage going into possession gives important clues on the quality of lending in that year, and tends to give more stable models and better predictability. A good example of what might be done is shown in Chart 2. This shows 90+ days arrears on UK non-conforming residential mortgage-backed securities, by vintage. Jonathan Livingstone of Moodys.com has constructed estimates of possessions rates on UK residential mortgages by year of origination of the loan using vintage data for a subset of UK lenders. Livingstone (2006) covers possessions data for the years 1985 to 2003, and demonstrates the strong association between original loan to value and subsequent possessions rates. Reliable and timely data of this type covering the full set of lenders reporting to the FSA would be of great value in understanding variations in possessions rates and producing forecast scenarios. This should make it possible to better link data on distributions of loan to value from the Survey of Regulated Mortgages with subsequent possessions rates.

3. Compared to the US, where *micro data tracking individual mortgages* from origination to subsequent non-performance or performance are widely available for analysis, see Section 2.2 and Gerrardi et al. (2008), few comparable data have been released in the UK[40]. Given the government stake in major UK mortgage lenders, it would be useful to extract such data for analysis, and this would also be a valuable check on analyses with aggregated data.

4. Better information on *market shares by types of mortgages issued* would be an advantage for analysis with aggregate or micro data. For example, FSA data show that default rates for securitised loans are substantially higher than for non-securitised loans and there are Bank of England estimates of the market share of securitized mortgages.[41] Additional historical data on the market shares both for new mortgages and for the stock of outstanding mortgages classified by several categories would be helpful before the 2007Q1 date at which the FSA published data begin. The categories might also include regulated and unregulated, whether to borrowers with impaired credit histories or not, whether interest only, whether self-certified or not, and whether low initial 'teaser rates' were on offer. These all serve as partial indicators of 'quality of lending'.

5. Other important indicators of 'quality of lending' are distributions of loan to value and loan to income or debt service ratios. The FSA have produced tabulations back to 2007Q1 of LTV distributions. In principle, these can be connected with tabulations from the Regulated Mortgage Survey (RMS) back to mid 2005, and further back to tabulations from the Survey of Mortgage Lenders and its predecessor. Comparability problems of the different surveys were discussed in Section 3.3. Further research on matching data from the RMS and SML beyond the start made by Tatch (2006) would be helpful.

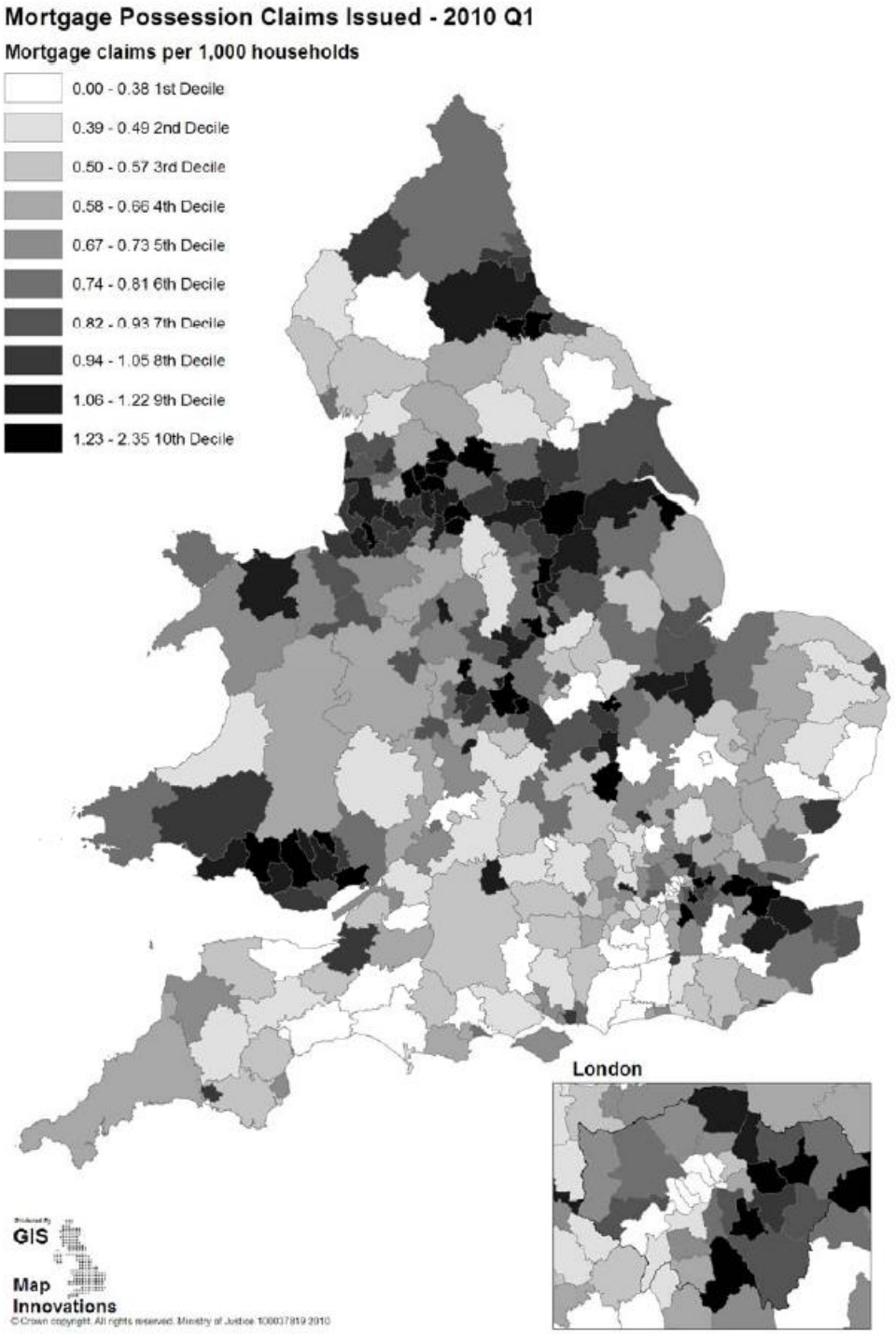
6. The range of mortgage interest rates now published, for example on the Bank of England website, has expanded greatly. What is missing, however, from official data bases is a long historical record of a broadly representative rate based on an average of actual payments, both for new and existing customers, and including special offers and their discontinuation, when relevant. ONS used to publish the average of building society rates on outstanding mortgages under the code AJNL. From 1998, the average for banks and building societies was published but appears to have been discontinued. The FSA now produce excellent information on

[40] Citadel Capital Advisors have analysed a subset of the non-prime market using micro data in the public domain from the Trustees of several mortgage backed securities originators including RMAC, Lehman Bros, Bear Stearns, Merrill Lynch.

[41] Also see the Crosby Report for information on the growth of mortgage backed securities in the UK and other countries.

interest rates, see Table A5. It shows distributions of spreads above base rate and average rates both on existing loans and paid by new borrowers. Such information taken back in time would provide useful material for modelers and others attempting to understand the dynamics of mortgage defaults. Of course, the monthly payment is not the only cost borne by mortgage holders, (there could be setting up costs, penalty costs, and insurance indemnity premia, for example), and the interest element and the repayment element of a typical monthly payment need to be treated separately. Historical data on average setting up costs appear not to be available.

Chart 1: Possession orders by district

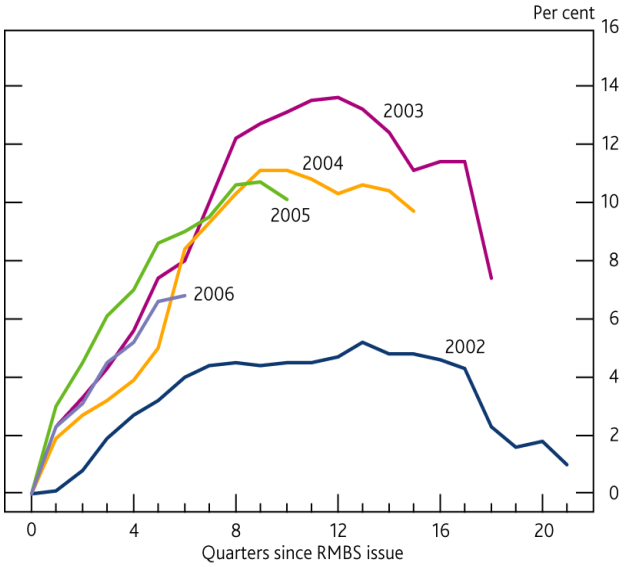


Notes:
1. The number of mortgage possession claims per 1,000 households (including mortgaged and rented) are based on 2006 household estimates for England, published by the Department of Communities and Local Government, and 2004 estimates for Wales, published by the Welsh Assembly.
2. Each decile includes 10% of local authorities (based on the number of mortgage claims) in ascending order from the lowest number per 1,000 households (the 1st decile) to the highest (the 10th decile).

Source: Ministry of Justice, http://www.justice.gov.uk/publications/docs/stats-mort-land-q1-2010.pdf

Chart 2: Quality of lending

Chart 1.20 90+ days arrears on UK non-conforming residential mortgage-backed securities, by vintage



Source: Lehman Brothers.

Source: Financial Stability Review, BOE, October, 2007.

Table A1: Typology of Published Estimates on Mortgage Arrears and Possessions

Source	***Category***	***Frequency and historical samples***			***Units and seasonal adjustment***	***Definition of coverage***
		Annual	***Quarterly***	***Bi-annual***		
LOANS DATA						
CML	Mortgages outstanding	1969 onward	*Published:* 2008q1 onward *Unpublished:* 1999q1-2007q4	1981:h2 onward	Reported as number at end period	For BTL only, CML estimates lending figures where these are not reported, see below.
CML	BTL properties: mortgages outstanding	1998 onward	2008q1 onward	2005:h2 onward		
FSA	Number of loan accounts	2007 onward	2007q1 onward	2008q1 onward	Reported as number at end period	
ARREARS DATA						
CML data: no. of households more than x months in arrears and no. of households whose arrears total x% or more of the total outstanding balance on their mortgage						
CML	Arrears >6-12 months	1969 onward	*Published:* 2008q1 onward *Unpublished:* 1999q1-2007q4	1981:h2 onward	Reported as number at end period *and* as % of all loans end period. Arrears figures are rounded to the nearest 100. Figures are not seasonally adjusted.	*Definition*: All first charge loans held by CML members, both regulated and unregulated, are included. This includes Buy-to-Let (BTL). Non-CML members are excluded Other secured lending is also excluded. Properties in possession are not counted as arrears. BTL mortgages when a receiver or rent has been appointed are not counted as arrears. *Sample*: Estimates from a sample of CML members, "grossed up" to represent the membership as a whole. Not clear how representative this sample is or how it changes over time. For BTL only, CML estimates lending figures where these are not reported. *Members*: Drawn from Scotland, Wales and England. Not clear on whether the coverage is
CML	Arrears >12 months	1982 onward		1982:h1 onward		
CML	Arrears >3-6 months	1994 onward		1994:h2 onward		
CML	Arrears >3 months	1994 onward		1994:h2 onward		
CML	Arrears 2.5%<5%	1994 onward		1994:h2 onward		
CML	Arrears 5%<7.5%	1993 onward		1993:h1 onward		
CML	Arrears 7.5%<10%	1993 onward		1993:h1 onward		
CML	Arrears >=10%	1993 onward		1993:h1 onward		
CML	BTL properties: arrears >3months	1998 onward	2006q3 onward	1998:h2 onward		

Source	*Category*	*Frequency and historical samples*			*Units and seasonal adjustment*	*Definition of coverage*
CML	BTL properties in arrears with ROR newly appointed, in period	2006 onward	2006q3 onward	2005:h2 onward		equally good in each region and over time.
CML	BTL properties in arrears with ROR acting on lender's behalf, end period	2005 onward	2006q3 onward	2005:h2 onward		
FSA data: number of individual loan accounts in arrears						
FSA	New cases in quarter		2007q1 onward	-	Reported as number of loan accounts, amount in £m, balance outstanding in £m, or new cases as % total stock Figures are not seasonally adjusted.	*Disaggregation*: all FSA data for residential loans to individuals in the column 2 are separately presented in six different categories: A. Securitised loans 1. Regulated + Non-regulated 2. Non-regulated 3. Regulated B. Unsecuritised and securitised loans 4. Regulated + Non-regulated 5. Non-regulated 6. Regulated *Definition*: All first charge loans, both regulated and unregulated, held by firms regulated by the FSA, are included. Firms not regulated by the FSA, are excluded. Second and subsequent charge loans are also included (i.e. any loan secured on a property for which a separate first charge loan already exists). Hence, Buy-to-Let mortgages (BTL) are covered, but not if extended by unregulated firms (many second charge lenders are not regulated). Some further advance loans are also included from first charge lenders. Properties in possession are counted as arrears, see previous column.
FSA	End of quarter arrears		2007q1 onward	-		
FSA	1.5<2% in arrears [1]		2007q1 onward	-	Reported as number in arrears, % all loans, balance in arrears, or % total loan balance Figures are not seasonally adjusted. Total includes cases in possession	
FSA	2.5<5% in arrears		2007q1 onward	-		
FSA	5<7.5% in arrears		2007q1 onward	-		
FSA	7.5<10% in arrears		2007q1 onward	-		
FSA	>10% in arrears		2007q1 onward	-		
FSA	Total in arrears		2007q1 onward	-		

Source	*Category*	*Frequency and historical samples*			*Units and seasonal adjustment*	*Definition of coverage*
						Note [1] lower threshold than for CML. Note: contrasts with the CML data which refers to no. of borrowers in arrears: here it is no. of loan accounts in arrears. *Sample*: 100% of regulated firms. *Regulated firms*: UK-wide.
POSSESSIONS DATA						
CML data: number of possessions						
CML	Properties taken into possession in period	1970 onward	*Published:* 2008q1 onward *Unpublished:* 1999q1-2007q4	1982:h1 onward	Reported as number at end period *and* as % all loans end period. Rounded possessions figures to the nearest 100. Figures are not seasonally adjusted.	*Definition*: All first charge loans held by CML members, both regulated and unregulated, are included. This includes Buy-to-Let (BTL). Non-CML members are excluded Other secured lending is also excluded. Voluntary repossessions are included, and defined as cases in which the borrower decides to give up the property before legal action for possession has been completed (CML, Nov.2009), as well as cases that had not gone to court. *Sample*: Estimates from a sample of CML members, "grossed up" to represent the membership as a whole. Not clear how representative this sample is or how it changes over time. For BTL only, CML estimates lending figures where these are not reported. . In May 2010, the CML produced estimates grossed up to be representative of the entire first charge mortgage market and revised their data series back to Q1 2009. *Members*: Drawn from Scotland, Wales and
CML	Properties in possession at end period	1990-onward		1990:h2 onward		
CML	Voluntary possessions	1994 onward		1994h1 onward		
CML	Possessed properties sold in period	1997 onward		1997:h1 onward	Number	
CML	BTL Properties taken into possession in period	2006 onward	2006q3 onward	2005:h2 onward	Reported as number at end period or % all loans	
CML	BTL Properties in possession at end period	2005 onward	2006q3 onward	2005:h2 onward		

Source	*Category*	*Frequency and historical samples*			*Units and seasonal adjustment*	*Definition of coverage*
						England. Not clear on whether the coverage is equally good in each region and over time.
MoJ data: possession claims issued or orders made in the county courts						
Possession actions England and Wales						
MoJ	Actions entered (number of possession claim issued in the county courts) There are also data on: No. of Landlord possession claims	1987 onward	1989q2 onward See below for new disaggregated category.	-	Both seasonally adjusted and non-seasonally adjusted figures are given (adjustment using X12 ARIMA). Data are disaggregated into court regions back to 1987. Comparability over time is affected by new court jurisdictions being incorporated.	Mortgage data include all types of lenders whether local authority or private (e.g. banks and building societies). Landlord data include all types of landlord whether social or private sector, and cover actions made using both the standard and accelerated possession procedures. Voluntary repossessions are not included, except insofar that the property is surrendered after a claim is made by the lender or a court order is granted. Note: The mortgage possession figures do not indicate how many houses have actually been repossessed through the courts. Repossessions can occur without a court order being made while not all court orders result in repossession.
MoJ	Number of possession orders made (incl. suspended orders) There are also data on: No. of Landlord possession orders made (incl. suspended orders)	1987-2008 See below for change of definition.	1990q1-2009q2 See below for definitional change and new disaggregated category.	-		
MoJ	Orders suspended	1990 onward	1990q1 onward	-		
MoJ	Charging orders applications made	2001 onward		-		
MoJ	Charging orders granted	2001 onward		-		
Possession actions Northern Ireland						
NI Court Service	Writs and summonses	1991-2007	1991q1-2007q4	-		
Definitional differences in MoJ data introduced from August 2009						
MoJ	Number of possession orders made (mortgage and landlord)	1999 onward	2004q1 onward published; 1999q1 onward on request	-	New, additional local authority level breakdown for the 'orders' and 'claims'	Redefinition to: Number of possession claims that lead to an order.

Source	*Category*	*Frequency and historical samples*			*Units and seasonal adjustment*	*Definition of coverage*
					series, with the disaggregation based on the physical location of the property which is the subject of the possession action.	This will eliminate all instances of multiple orders on the same claim. It will not eliminate all instances of multiple orders on a single household: a homeowner in arrears on more than one mortgage loan account could be subject to more than one claim (though this is likely to be a very small proportion).
MoJ	Actions entered (number of possession claims issued in the county courts)	1987 onward	1987q1 onward			No definitional change.
FSA: number of individual loan accounts in possession						
FSA	New possessions in quarter		2007q1 onward	-	Number. Figures are not seasonally adjusted.	*Definition*: All first charge loans, both regulated and unregulated, held by firms regulated by the FSA, are included. Firms not regulated by the FSA, are excluded. Second and subsequent charge loans are also included. Hence, Buy-to-Let mortgages (BTL) are covered, but not if extended by unregulated firms (many second charge lenders are not regulated). Voluntary repossessions are included. *Sample*: 100% of regulated firms. *Regulated firms*: UK-wide. Note: contrasts with the CML data which refers to no. of borrowers subject to possession: here it is no. of loan accounts in possession
FSA	Possessions cases sold in quarter		2007q1 onward	-		
FSA	Stock at end- quarter		2007q1 onward	-		

Table A2: Comparison of FSA and CML data on arrears and possession, 2007Q1-2008Q4

	2007-Q1[1]	2007-Q2[1]	2007-Q3	2007-Q4	2008-Q1	2008-Q2	2008-Q3	2008-Q4
FSA *All FSA-regulated members: for securitized+non-securitised, regulated+non-regulated*								
	% of number of loan accounts							
1.5 < 2.5% in arrears	0.59	0.59	0.59	0.62	0.63	0.64	0.69	0.75
2.5 < 5 in arrears	0.57	0.58	0.59	0.61	0.63	0.65	0.71	0.80
5 < 7.5 in arrears	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.31
7.5 < 10 in arrears	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.13
Over 10 in arrears	0.19	0.18	0.19	0.20	0.20	0.21	0.22	0.25
TOTAL arrears	1.64	1.65	1.68	1.76	1.8	1.86	2	2.24
New possessions in Q[2]	0.043	0.042	0.044	0.052	0.059	0.071	0.086	0.084
Number of loan accounts	15,046,772	15,473,936	15,475,000	15,505,441	15,614,450	15,607,195	15,643,767	15,536,598
CML *Data from sample of CML members ("grossed up")*								
	% of mortgages outstanding							
2.5 < 5 in arrears	0.59	0.59	0.61	0.61	0.63	0.68	0.75	0.91
5 < 7.5 in arrears	0.63	0.20	0.22	0.22	0.21	0.24	0.25	0.32
s7.5 < 10 in arrears	0.21	0.09	0.09	0.09	0.09	0.10	0.11	0.13
Over 10 in arrears	0.09	0.16	0.16	0.16	0.15	0.16	0.17	0.21
TOTAL arrears	1.52	1.04	1.08	1.08	1.08	1.18	1.28	1.57
Possessions in period	0.053	0.055	0.051	0.059	0.072	0.085	0.095	0.089
Number of mortgages outstanding	11,793,400	11,841,000	11,846,500	11,852,000	11,787,000	11,763,000	11,718,000	11,667,000

Sources: As above. CML data quarternalised through interpolation by ourselves.

Notes:

[1] The 2007Q1 FSA figure is taken from the published October statistics, and the 2007Q 2 figure from the published January statistics. The later figures are from the published March, 2009 statistics. The earlier figures may since have been revised but are not publicly available.

[2] Note this is different from FSA reporting. They report the stock at end quarter as a percentage of number of loan accounts. We report the ***flow*** of new possessions in the quarter as a percentage of number of loan accounts**.** Note that the totals figure reported by FSA including possessions (defined as end of quarter stocks) can be misleading. This is because the stock of possessions depends on the speed with which mortgage lenders sell those properties. This is not closely connected with the default rate.

Table A3: Analysis of FSA arrears data for categories of securitised and of non-securitised loans

	2007-Q1[1]	2007-Q2 [1]	2007-Q3	2007-Q4	2008-Q1	2008-Q2	2008-Q3	2008-Q4
FSA *All FSA-regulated members: **non-securitised**, regulated+non-regulated*								
	% of number of loans							
1.5 < 2.5 in arrears	0.48	0.48	0.50	0.50	0.51	0.51	0.55	0.61
2.5 < 5 in arrears	0.46	0.46	0.47	0.49	0.50	0.51	0.55	0.63
5 < 7.5 in arrears	0.17	0.17	0.18	0.19	0.19	0.20	0.21	0.24
7.5 < 10 in arrears	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.11
Over 10 in arrears	0.19	0.18	0.19	0.19	0.19	0.20	0.21	0.24
TOTAL arrears	1.38	1.37	1.42	1.45	1.47	1.51	1.61	1.83
New possessions in Q[2]	0.028	0.027	0.029	0.033	0.038	0.045	0.054	0.054
Number of loan accounts	12,883,218	13,127,061	13,054,664	13,256,525	13,434,808	13,332,125	13,380,386	13,137,190
FSA *All FSA members: **for securitized**, regulated+non-regulated*								
	% of number of loans							
1.5 < 2.5 in arrears	1.25	1.19	1.13	1.31	1.33	1.36	1.49	1.51
2.5 < 5 in arrears	1.26	1.23	1.20	1.36	1.44	1.47	1.68	1.77
5 < 7.5 in arrears	0.40	0.4	0.43	0.47	0.51	0.53	0.62	0.67
7.5 < 10 in arrears	0.14	0.15	0.16	0.19	0.20	0.21	0.25	0.26
Over 10 in arrears	0.16	0.17	0.20	0.23	0.26	0.26	0.30	0.29
TOTAL arrears	3.21	3.14	3.12	3.56	3.74	3.83	4.34	4.5
New possessions in Q[2]	0.131	0.124	0.126	0.167	0.186	0.222	0.276	0.246
Number of loan accounts	2,163,554	2,346,875	2,420,336	2,248,916	2,179,642	2,275,070	2,263,383	2,399,408

Sources: As above.

Notes: [1]The 2007Q1 FSA figure is taken from the published October statistics, and the 2007Q 2 figure from the published January statistics. The later figures are from the published March, 2009 statistics. The earlier figures may since have been revised but are not publicly available.

[2] Note this is different from FSA reporting. They report the stock at end quarter as a percentage of number of loan accounts.

We report the ***flow*** of new possessions in the quarter as a percentage of number of loan accounts.

Table A4: Loan to value ratios, FSA data

	2007-Q1[1]	2007-Q2[1]	2007-Q3	2007-Q4	2008-Q1	2008-Q2	2008-Q3	2008-Q4
FSA *All FSA-regulated members: for non-securitized, regulated+non-regulated*								
	% of value of loans							
LTV								
< = 75	48.62	47.59	48.62	49.54	55.17	55.91	64.37	65.21
Over 75 < = 90	37.24	37.65	37.05	37.14	34.33	33.70	29.10	28.76
Over 90 < = 95	8.52	9.29	8.27	7.78	6.25	7.20	5.06	4.56
Over 95	5.62	5.47	6.06	5.54	4.24	3.19	1.47	1.47
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
High LTV and High Income multiple (All over 90)								
Single: 3.50 x or more	3.11	3.17	3.06	2.83	2.27	2.09	1.23	1.11
Joint : 2.75 x or more	5.67	6.04	5.79	5.65	4.66	4.98	2.99	2.60
Total HIM	8.78	9.20	8.85	8.48	6.92	7.07	4.22	3.71

Source: FSA.

Notes:

[1] The 2007Q1 FSA figure is taken from the published October statistics, and the 2007Q 2 figure from the published January statistics. The later figures are from the published March, 2009 statistics. The earlier figures may since have been revised but are not publicly available.

Table A5: Interest rates, FSA data

	2007-Q1[1]	2007-Q2[1]	2007-Q3	2007-Q4	2008-Q1	2008-Q2	2008-Q3	2008-Q4
FSA *All FSA-regulated members: for non-securitised, regulated+non-regulated*								
Percent of business at fixed rates								
Gross advances	64.79	67.45	67.11	57.04	45.88	56.37	52.69	43.75
Balances outstanding	47.71	50.51	52.78	53.05	51.43	51.07	50.83	48.13
Percent of business above BBR								
Gross advances								
Less than 2 above	96.95	97.04	96.85	95.66	95.13	94.92	92.44	44.48
2 < 3 above	2.20	2.29	2.41	3.27	3.52	3.93	6.40	19.67
3 < 4 above	0.30	0.17	0.24	0.55	0.67	0.65	0.73	18.70
4 or more above	0.55	0.51	0.50	0.51	0.68	0.49	0.43	17.15
Balances outstanding								
Less than 2 above	91.96	92.34	92.61	92.11	91.73	90.55	89.61	36.17
2 < 3 above	7.37	7.00	6.56	7.09	7.45	8.65	9.58	28.48
3 < 4 above	0.34	0.33	0.37	0.43	0.39	0.43	0.44	25.60
4 or more above	0.34	0.33	0.47	0.38	0.43	0.37	0.37	9.75
Overall weighted average interest rates								
Gross advances								
Fixed rate loans	5.35	5.54	5.77	6.01	5.92	5.82	6.12	6.05
Variable rate loans	5.88	6.05	6.25	6.14	5.87	5.83	6.11	4.33
All loans	5.53	5.71	5.93	6.07	5.90	5.83	6.11	5.08
Balances outstanding								
Fixed rate loans	5.23	5.20	5.30	5.42	5.52	5.59	5.70	5.71
Variable rate loans	6.23	6.43	6.64	6.55	6.15	5.95	6.03	4.12
All loans	5.75	5.81	5.93	5.95	5.83	5.77	5.86	4.89

Sources: FSA, data[1] from particular years as in above tables.

ANNEX 2: Forecast scenarios: underlying assumptions 2009q4-2013q4

	SCEN1	SCEN2	SCEN3	SCEN4	SCEN5	SCEN6	SCEN1	SCEN2	SCEN3	SCEN4	SCEN5	SCEN6
	Unemployment rate						House price					
Date	UPBASE	UPHG	UPLG	UPBASEALT	UPXPOS	UPXNEG	PHBASE	PHHG	PHLG	PHBASEALT	PHXPOS	PHXNEG
Dec-09	8.3	8.3	8.4	8.6	8.4	9.2	166.1	166.1	166.0	166.0	166.0	166.0
Mar-10	8.5	8.4	8.6	9.0	8.7	9.9	164.4	166.1	164.4	166.0	166.0	161.6
Jun-10	8.6	8.4	8.7	9.3	9.0	10.6	163.2	166.1	162.7	166.0	169.0	157.2
Sep-10	8.6	8.4	8.8	9.5	9.3	11.1	163.2	167.8	161.9	166.0	172.0	152.8
Dec-10	8.6	8.3	9.0	9.5	9.3	11.4	163.3	169.5	161.9	168.1	175.0	152.8
Mar-11	8.5	8.2	9.0	9.5	9.3	11.4	163.4	171.1	161.9	170.2	177.9	152.8
Jun-11	8.5	8.2	9.0	9.5	9.0	11.4	163.7	172.9	162.1	172.3	180.9	152.8
Sep-11	8.4	8.1	8.9	9.5	8.6	11.4	164.0	174.8	162.3	174.3	183.9	152.8
Dec-11	8.2	7.9	8.7	9.5	8.2	11.4	164.5	176.9	162.6	176.4	186.8	152.8
Mar-12	8.0	7.7	8.6	9.3	7.6	11.0	165.1	179.0	163.1	178.5	189.8	152.8
Jun-12	7.9	7.4	8.5	9.0	7.0	10.7	166.1	181.3	163.7	180.5	192.8	154.7
Sep-12	7.6	7.1	8.3	8.3	6.4	10.3	167.4	183.8	164.7	182.6	195.7	156.6
Dec-12	7.5	7.0	8.2	7.6	5.8	9.9	169.1	186.6	166.0	184.7	198.7	158.5
Mar-13	7.3	6.8	8.0	6.9	5.2	9.6	171.1	189.6	167.3	186.8	201.7	160.3
Jun-13	7.1	6.6	7.8	6.4	4.8	9.2	173.3	192.6	168.9	188.8	204.7	162.2
Sep-13	7.0	6.5	7.7	6.0	4.75	8.9	175.8	195.7	170.4	190.9	207.6	164.1
Dec-13	6.9	6.4	7.6	5.6	4.75	8.5	178.2	198.8	171.9	193.0	210.6	166.0

SCEN1	SCEN2	SCEN3	SCEN4	SCEN5	SCEN6	SCEN1	SCEN2	SCEN3	SCEN4	SCEN5	SCEN6
Real income						Mortgage interest rate					
PEDYBASE	PEDYHG	PEDYLG	PEDYBASEALT	PEDYXPOS	PEDYXNEG	ARBMBASE	ARBMHG	ARBMLG	ARBMBASEALT	ARBMXPOS	ARBMXNEG
213862	213862	213648	213969	214290	213456	3.81	3.81	3.81	4.00	4.00	4.00
214076	214290	213434	214375	215683	213050	3.81	4.00	3.81	4.40	4.00	4.86
214504	214933	213434	214783	217085	212645	3.81	4.10	3.81	4.60	4.00	5.20
215148	215792	213648	215191	218496	212645	3.81	4.20	3.81	4.80	4.00	5.55
216008	216871	214075	215600	219916	212645	3.81	4.50	3.81	5.00	4.00	5.90
216980	218064	214610	216893	221895	212645	3.91	4.60	3.81	5.20	4.19	6.25
218065	219372	215254	218195	223892	212858	4.11	4.80	3.90	5.40	4.37	6.60
219373	220908	216115	219504	225907	213071	4.21	4.90	4.00	5.60	4.56	6.66
220799	222454	217196	220821	227940	213284	4.41	5.10	4.10	5.80	4.74	6.72
222345	224012	218390	222146	229992	213817	4.61	5.30	4.30	6.00	4.93	6.78
223901	225692	219592	223479	232062	214352	4.71	5.40	4.40	6.20	5.11	6.84
225524	227497	220909	224820	234150	214888	4.91	5.60	4.60	6.25	5.30	6.90
227553	229545	222235	226168	236258	215425	5.11	5.70	4.80	6.30	5.30	6.96
229602	231611	223568	227525	238384	215963	5.21	5.80	4.90	6.35	5.30	7.02
231668	233695	224909	228891	240529	216503	5.41	6.00	5.10	6.40	5.30	7.08
233753	235915	226259	230264	242694	217044	5.61	6.10	5.30	6.45	5.30	7.14
235915	238156	227616	231646	244878	217587	5.71	6.20	5.40	6.50	5.30	7.20

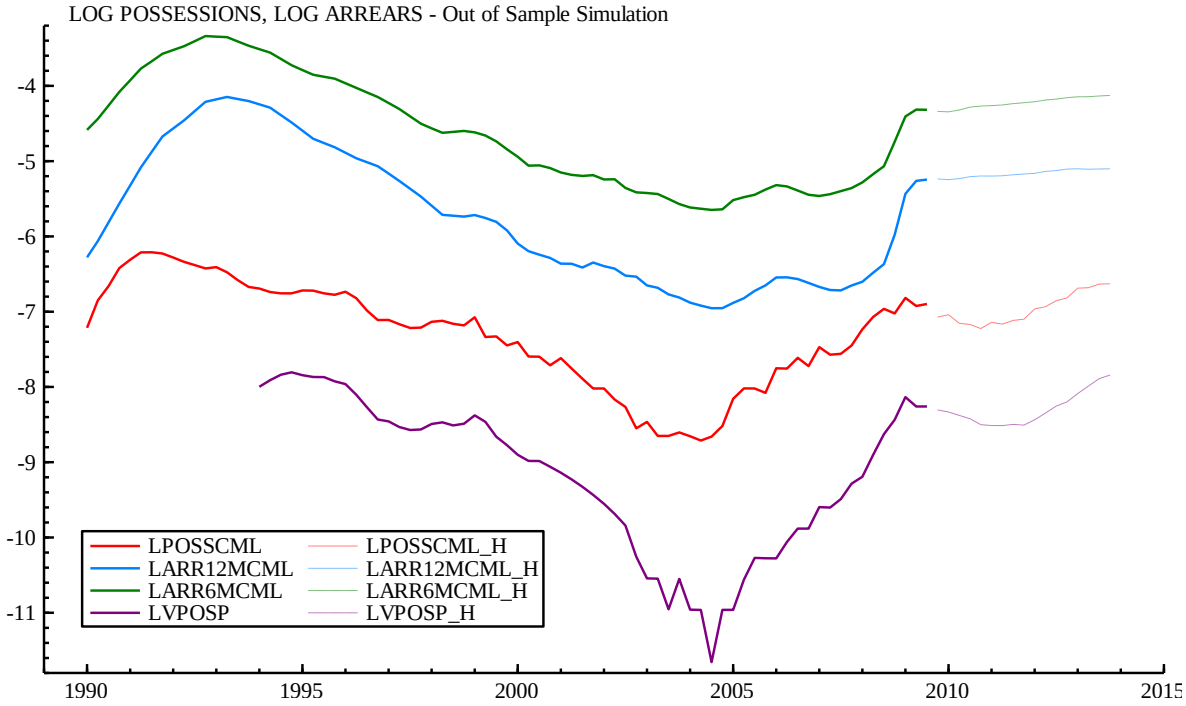
SCEN1	SCEN2	SCEN3	SCEN4/5/6	SCEN1	SCEN2	SCEN3	SCEN4	SCEN5	SCEN6
Price level				Mortgage lending stock					
PCBASE	PCHG	PCLG	PCALT	AMWTBASE	AMWTHG	AMWTLG	AMWTALT	AMWTPOS	AMWTNEG
1.095	1.097	1.095	1.099	1228872	1228872	1228872	1228872	1229994	1233993
1.101	1.103	1.097	1.104	1232437	1233664	1229978	1232437	1237190	1241403
1.099	1.107	1.097	1.110	1237133	1239586	1232192	1237133	1246097	1248858
1.101	1.111	1.099	1.115	1242578	1246280	1235149	1242578	1256191	1256357
1.103	1.116	1.101	1.121	1248814	1253757	1238854	1248814	1267497	1263902
1.105	1.121	1.103	1.127	1255972	1262158	1243438	1255972	1280235	1271491
1.108	1.127	1.106	1.132	1264304	1271750	1249158	1264304	1294830	1279127
1.111	1.133	1.109	1.138	1273797	1282560	1256028	1273797	1311339	1286808
1.114	1.140	1.112	1.144	1284469	1294103	1264821	1284469	1329042	1294535
1.118	1.147	1.116	1.149	1296263	1307044	1274307	1296263	1348977	1302309
1.124	1.154	1.121	1.155	1309160	1321421	1284501	1309160	1371235	1310129
1.130	1.161	1.126	1.161	1323128	1336618	1296062	1323128	1394889	1317996
1.137	1.168	1.131	1.167	1338123	1352657	1310318	1338123	1419997	1325911
1.144	1.175	1.137	1.173	1353772	1369565	1324732	1353772	1446622	1333873
1.151	1.182	1.143	1.178	1369788	1387370	1339304	1369788	1474831	1341883
1.158	1.189	1.148	1.184	1386022	1405406	1354706	1386022	1503591	1349941
1.165	1.196	1.154	1.190	1402473	1423676	1370285	1402473	1532911	1358047

SCEN1/2/3	SCEN4/5/6	SCEN1/2/3	SCEN4/5/6
Population level		Number of outstanding mortgages	
POPWR	POPWRALT	MORTINT	MORTINT
38297	38304	11592592	11592592
38333	38342	11604185	11604185
38368	38380	11615789	11615789
38432	38419	11627405	11627405
38496	38457	11639032	11639032
38560	38496	11650671	11650671
38624	38534	11662322	11662322
38671	38573	11673984	11673984
38719	38611	11685658	11685658
38766	38650	11697344	11697344
38814	38689	11709041	11709041
38860	38727	11720750	11720750
38908	38766	11732471	11732471
38955	38805	11744203	11744203
39001	38844	11755947	11755947
39052	38882	11767703	11767703
39102	38921	11779471	11779471

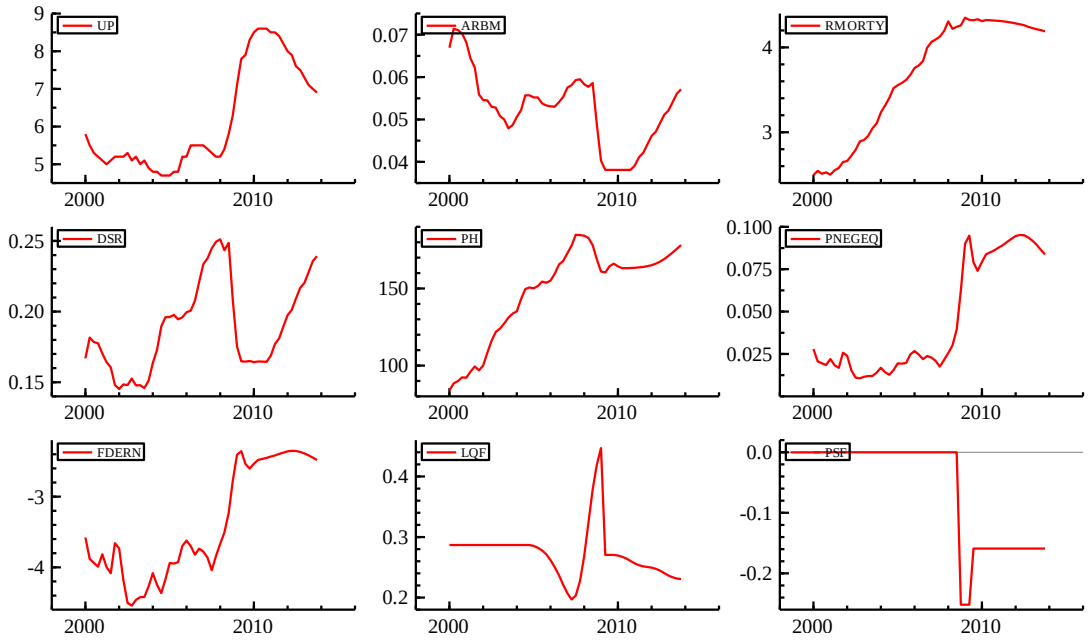
ANNEX 3: Forecast scenarios and underlying assumptions for repossessions and arrears

The different scenarios are summarized in Table 5, using underlying data in Annex 2.

SCENARIO 1: Base scenario

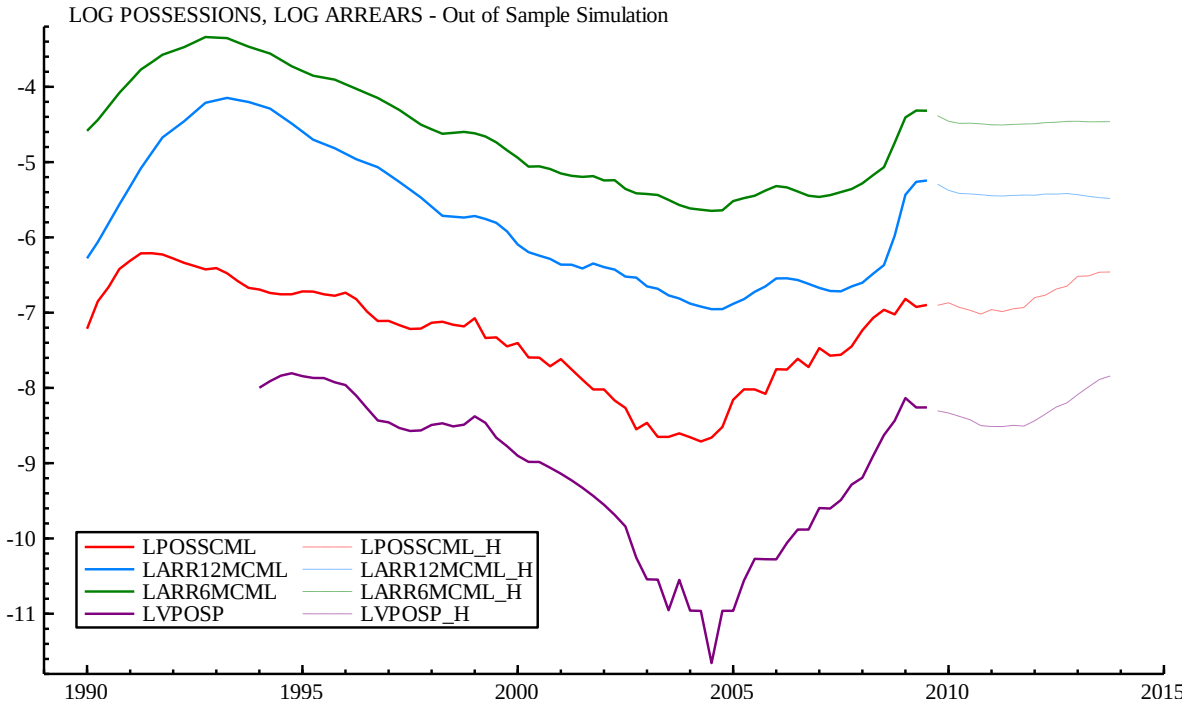


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP



UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 1A: Base scenario with policy switched off



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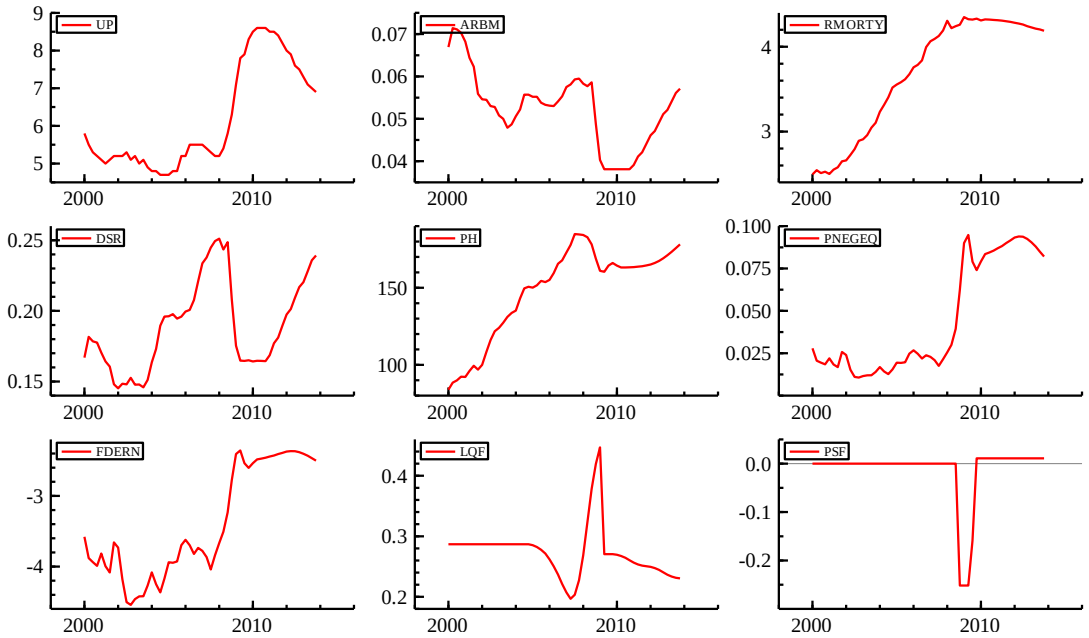
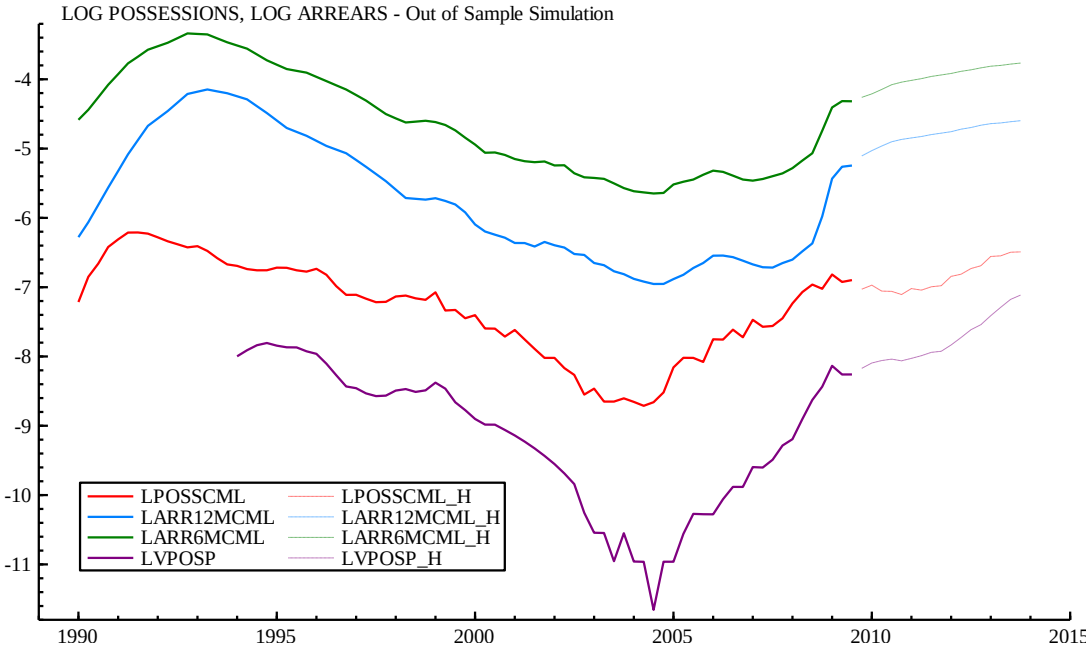
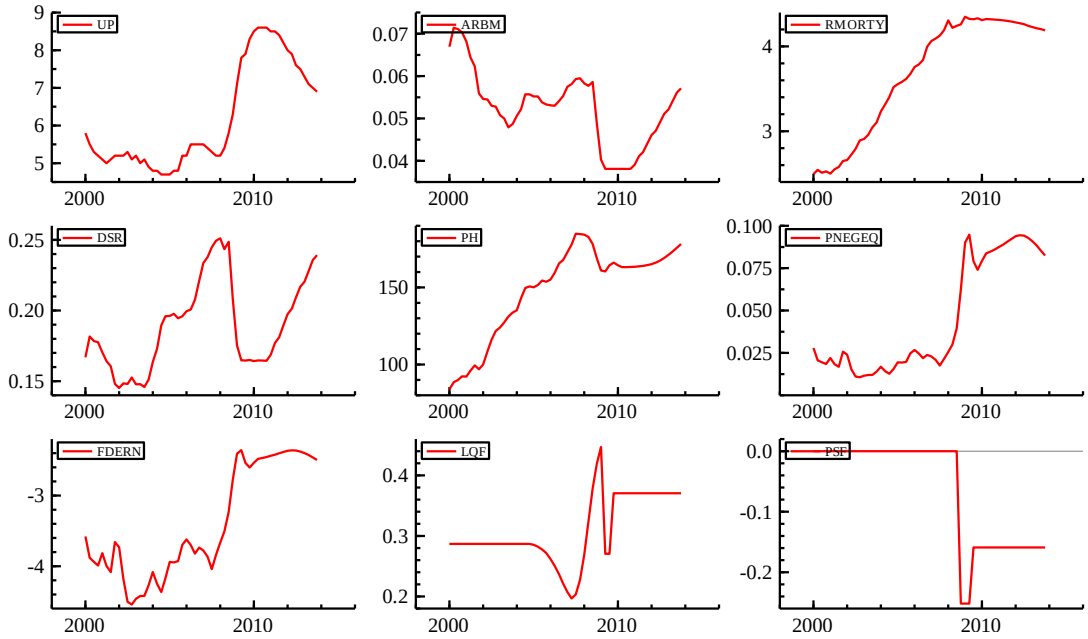


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 1B: Base scenario with sensitivity testing of the lending quality function

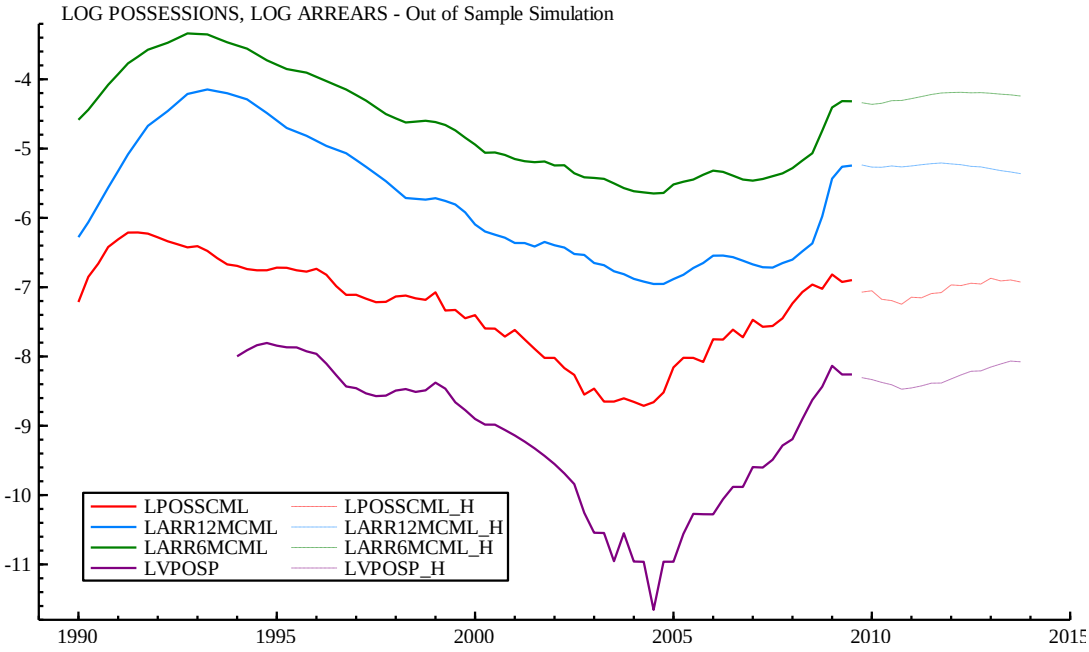


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP

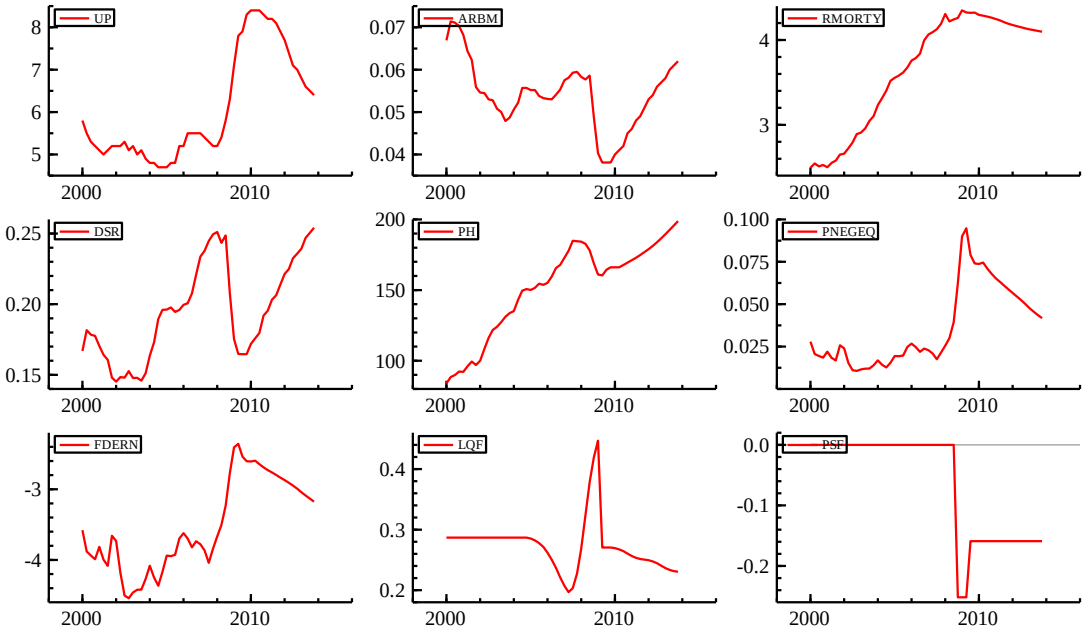


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 2: High growth scenario

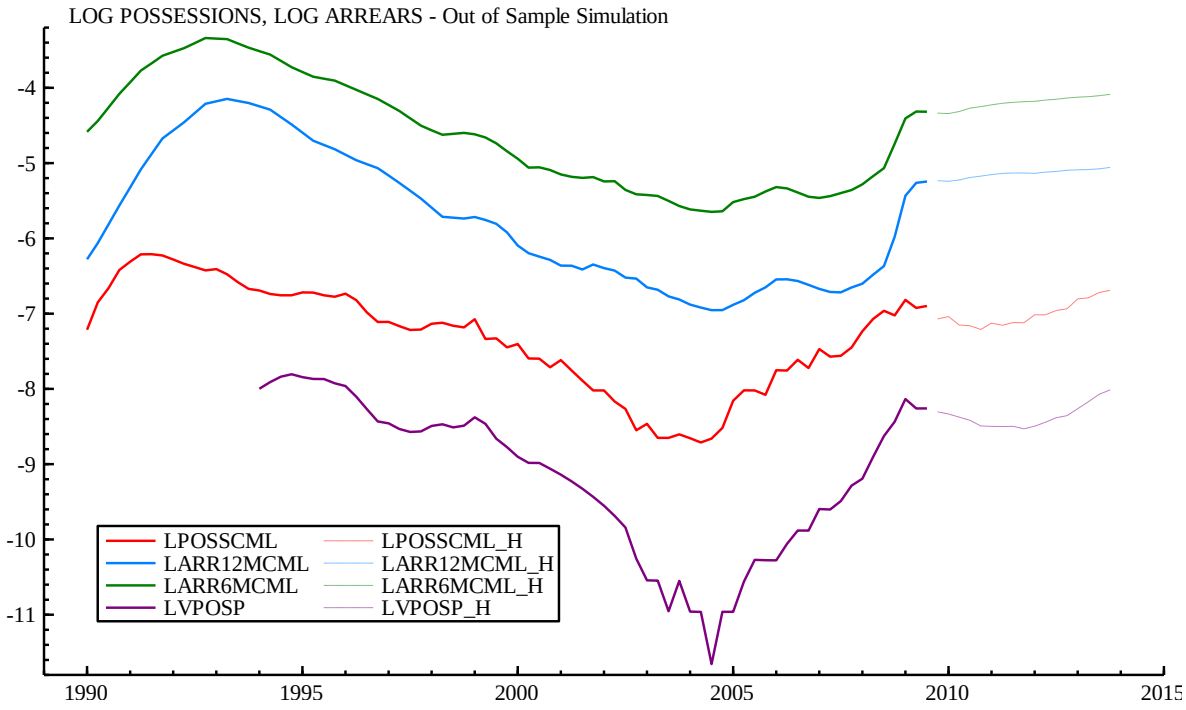


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP

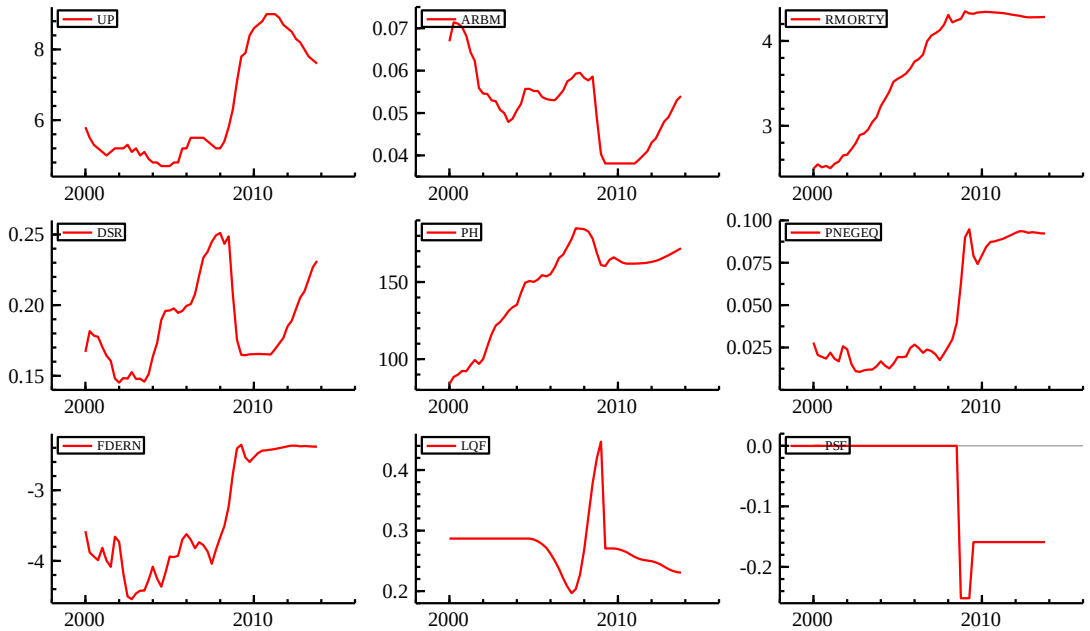


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 3: Low growth scenario

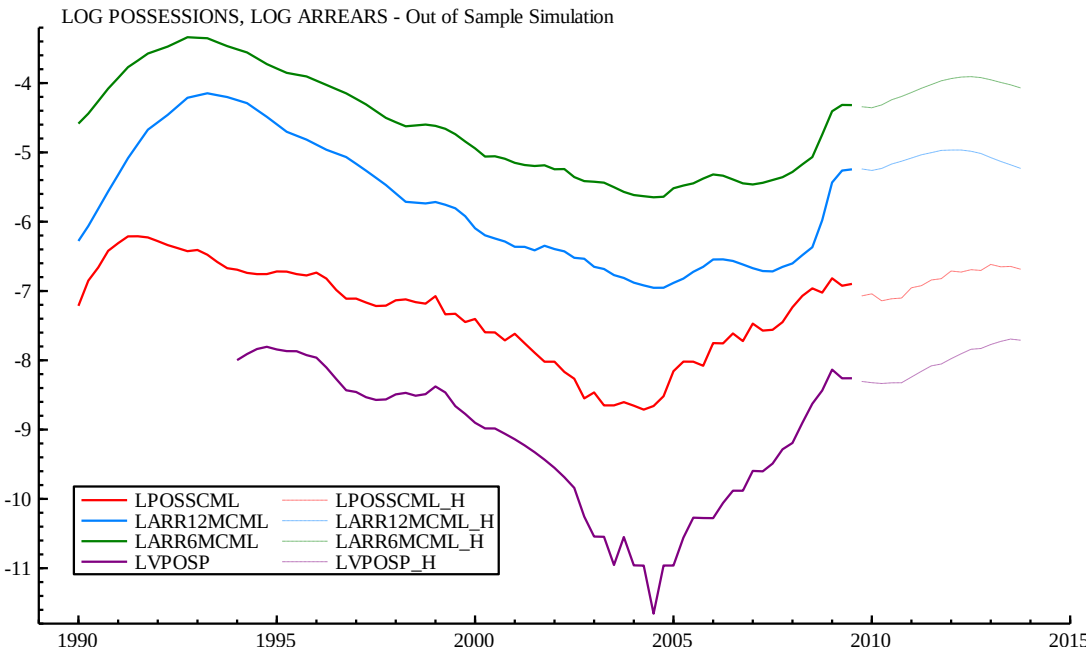


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP

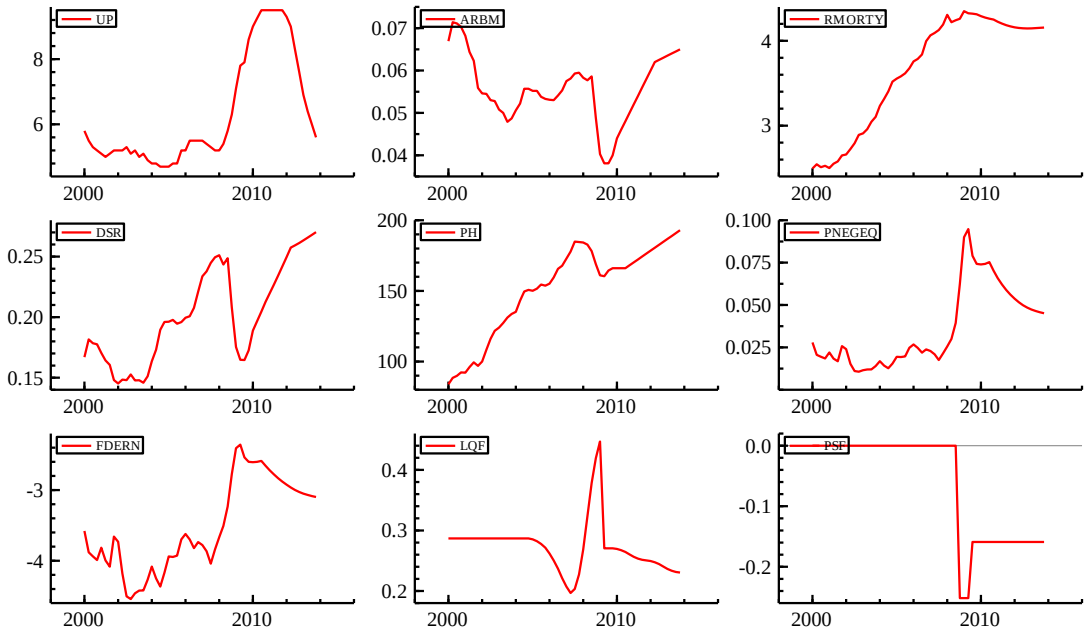


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 4: Base with alternative assumption on interest rates

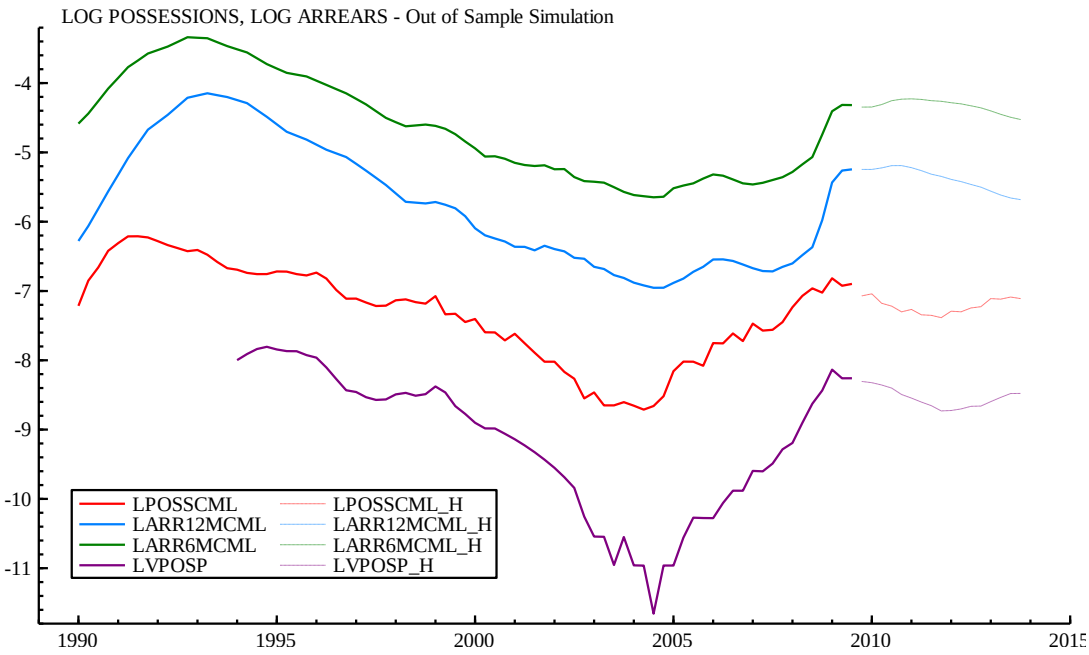


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP

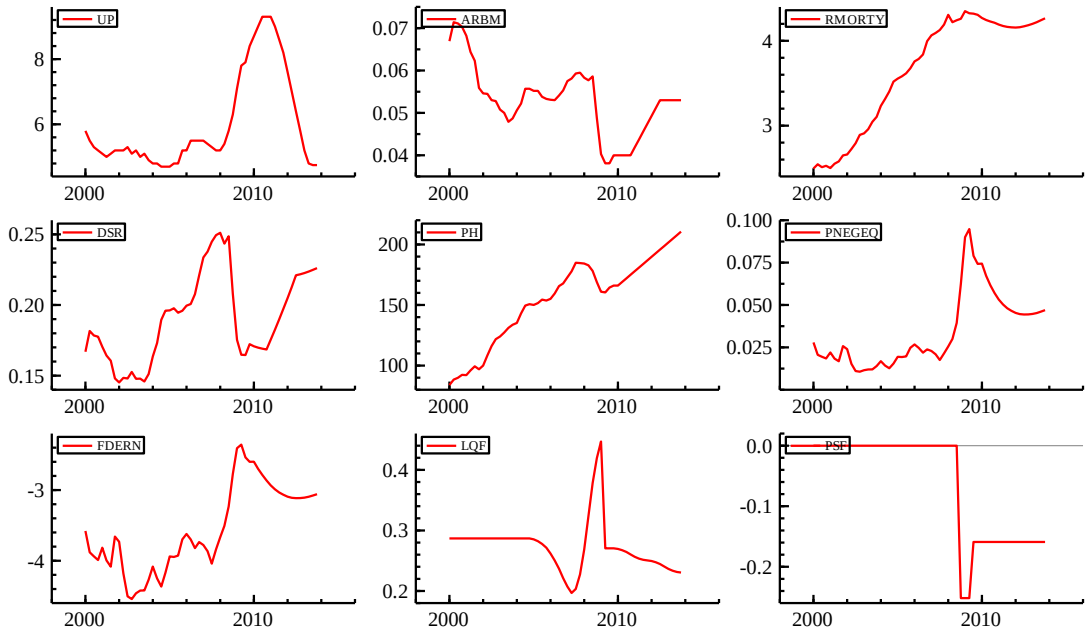


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 5: Extreme positive

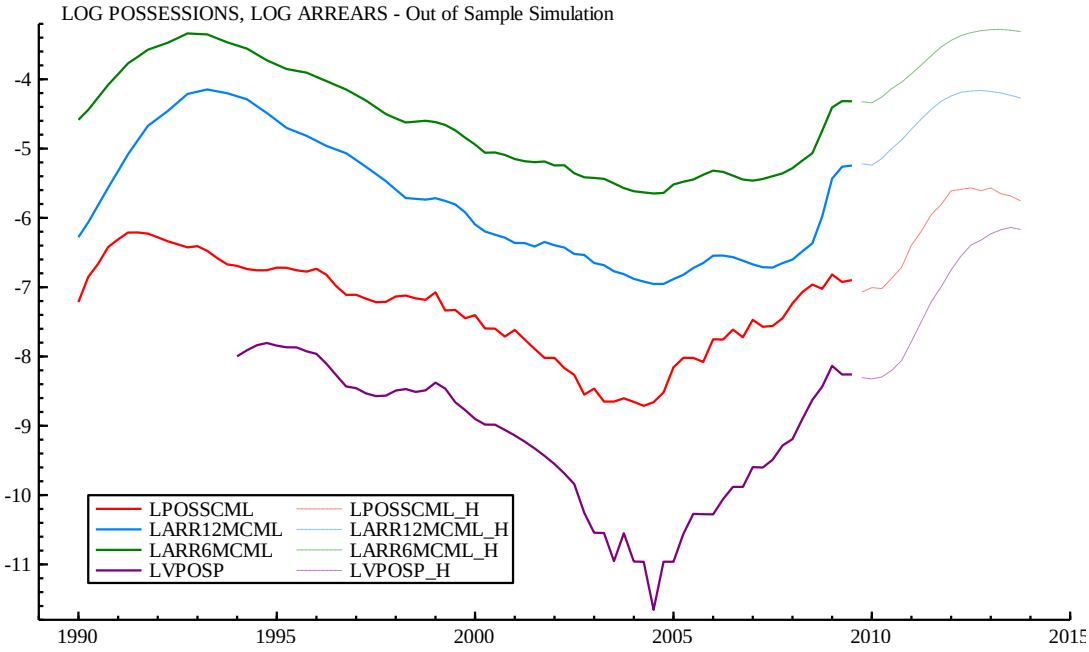


KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP

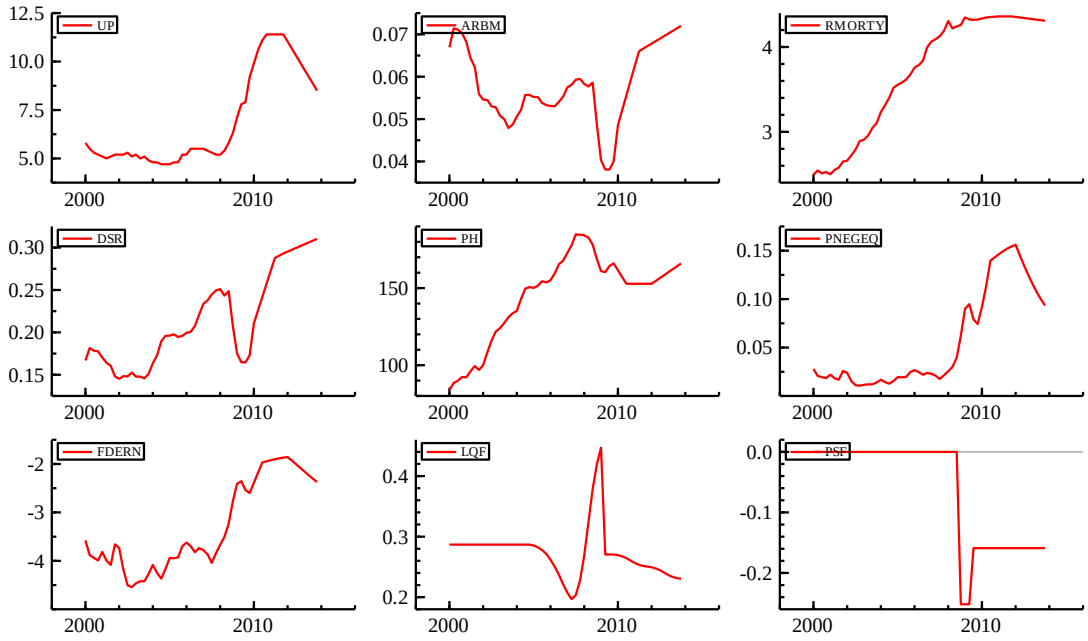


UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

SCENARIO 6: Extreme negative



KEY: Order of coloured lines: highest to lowest: LARR6MCML, LARR12MCML, LPOSSCML, LVPOSP



UP=unemployment, ARBM=mortgage rate; RMORTY=average mortgage over average income; DSR= debt service ratio; PH=house prices; PNEGEQ=proportion in negative equity; FDERN=log(pnegeq); LQF=lending conditions; PS=policy function.

ANNEX 4: A further selection of forecast results 2009q4-2013q4

SCENARIO 3 Forecast quarter	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9847	61834	151635
2010q1	10179	61411	150963
2010q2	9101	62520	155324
2010q3	9023	64743	162599
2010q4	8599	65949	166113
2011q1	9371	67368	170212
2011q2	9118	68587	173925
2011q3	9457	68987	176414
2011q4	9433	69025	177874
2012q1	10493	68790	178976
2012q2	10514	69940	182188
2012q3	11148	70620	184422
2012q4	11401	71873	187649
2013q1	13012	72303	189876
2013q2	13236	72688	191503
2013q3	14205	73482	194159
2013q4	14645	74933	197770

SCENARIO 4 Forecast quarter	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9847	61478	150941
2010q1	10155	60218	148755
2010q2	9194	62059	155188
2010q3	9484	66242	167423
2010q4	9584	69050	175643
2011q1	11120	72303	186243
2011q2	11480	75853	198177
2011q3	12468	78319	209056
2011q4	12731	80989	220935
2012q1	14231	81492	228534
2012q2	14027	81623	233903
2012q3	14536	80310	235347
2012q4	14396	77748	232519
2013q1	15714	73422	225524
2013q2	15190	69494	217445
2013q3	15298	66227	210082
2013q4	14705	63005	201085

SCENARIO 5 Forecast quarter	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	9847	61054	150125
2010q1	10162	61138	150491
2010q2	8877	62555	156057
2010q3	8522	64678	165012
2010q4	7854	64775	169037
2011q1	8147	62962	169848
2011q2	7542	60345	168726
2011q3	7492	57418	165908
2011q4	7253	55696	164567
2012q1	7969	53371	161409
2012q2	7905	51754	158833
2012q3	8363	49710	154708
2012q4	8534	47865	150254
2013q1	9592	45205	143962
2013q2	9526	42800	137143
2013q3	9839	41061	131636
2013q4	9620	40140	127491

SCENARIO 1a Forecast quarter	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	11667	58217	144520
2010q1	12056	53734	134393
2010q2	11366	51617	130884
2010q3	10936	51345	131458
2010q4	10411	50850	130225
2011q1	11070	50190	128830
2011q2	10774	50078	128562
2011q3	11202	50494	129796
2011q4	11400	50825	130584
2012q1	13036	50774	131240
2012q2	13470	51605	133336
2012q3	14620	51604	134108
2012q4	15212	52067	135834
2013q1	17349	51300	136076
2013q2	17466	50249	135322
2013q3	18357	49482	135524
2013q4	18439	48920	135798

SCENARIO 1b Forecast quarter	*Properties taken into possession in period/no.*	*Loans in arrears ≥12 months/no.*	*Loans in arrears ≥6 months/no.*
2009q1	12700	50600	141400
2009q2	11400	60100	154900
2009q3	11700	61100	154400
2009q4	10280	70286	163521
2010q1	10892	75891	171956
2010q2	10006	81162	183541
2010q3	9977	86417	196773
2010q4	9550	89430	204392
2011q1	10408	91493	209969
2011q2	10186	93564	215511
2011q3	10699	96294	222509
2011q4	10888	98375	227671
2012q1	12476	100540	232971
2012q2	12874	104332	240446
2012q3	13990	106932	245941
2012q4	14575	110717	253366
2013q1	16679	113351	259479
2013q2	16845	114611	262837
2013q3	17763	116789	268091
2013q4	17884	118591	272439

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