

## House Price Shocks and Household Indebtedness in the United Kingdom

by

**Richard Disney<sup>†</sup>, Sarah Bridges\* and John Gathergood\***

### *Abstract*

We use household panel data to explore the link between changes in house prices and household indebtedness (both secured on housing assets and unsecured) in the United Kingdom. We show that households which are borrowing-constrained by a lack of housing equity as collateral make greater use of unsecured debt such as credit cards or personal loans. In response to rising house prices, which relax this constraint, such households are more likely to refinance and to increase their indebtedness relative to unconstrained households. However, for most households, house price movements appear to have little impact on indebtedness.

**Key words:** Housing wealth; collateral; unsecured debt; consumer spending

**JEL classification:** D12 D14 R21

---

\* University of Nottingham.

† University of Nottingham and Institute for Fiscal Studies, London.

*Corresponding author:* Disney, School of Economics, Sir Clive Granger Building, University of Nottingham, Nottingham, NG7 2RD Tel: (44) 1159 515619 Fax: (44) 1159 514159 email: richard.disney@nottingham.ac.uk

We would like to thank Experian Ltd for part-funding of this research, Andrew Henley of the University of Swansea for the constructed mortgage data described in the paper, and the ESRC Data Archive for providing the BHPS data. Helpful comments on successive drafts have been obtained from participants at a Finance and Consumption workshop on credit markets at EUI Florence, at the 2<sup>nd</sup> CSEF-IGIER symposium C6 in Capri, at a workshop on household debt at the University of Reading, the MMGD conference at the University of the Algarve, and at seminars at the Bank of England, the Czech National Bank, and the universities of Loughborough, Birmingham, University College, London, Nottingham and St Andrews, and from Andrew Benito and from John Muellbauer, two referees and an editor of this journal.

## INTRODUCTION

The role of housing wealth in underpinning household spending and borrowing decisions has been extensively discussed, particularly in the United Kingdom (UK) and the United States (US). In the UK, housing is a particularly important component of the household's wealth portfolio. Indeed, Banks, Blundell and Smith (2003), using comparable UK and US data sets, suggest that the value of home equity accounts for 60% of household financial wealth in the UK, almost twice the fraction for the US. Moreover, following the deregulation of the UK's mortgage lending market in the period 1980 to 1986 (on which, see Aoki *et al*, 2004; Aron and Muellbauer, 2006; Attanasio and Weber, 1994 and Muellbauer and Murphy, 1990), UK lending to households secured on housing wealth has grown rapidly.

In this paper, we examine the relationship between housing wealth and household indebtedness. We investigate a somewhat different 'route' by which gains in housing equity impact on household spending behaviour from those presented in existing studies. Unlike several studies which assume that households can only hold secured debt, we allow for the fact that most households can borrow unsecured through instruments such as credit cards as well as borrow secured on the value of their home. Our stylised model is described in Section One but can be very briefly summarised as follows.

Since debt secured on housing wealth is normally available on better terms to the household than unsecured debt, we can think of a natural ordering of borrowing in which the bulk of household indebtedness will be secured on the value of property. This finding accords with the evidence on aggregate household borrowing. However, households which are close to their limit on secured debt can borrow unsecured, albeit at higher interest rates. Exogenous increases in the value of housing equity thereby impact on households primarily by allowing them to refinance in order to substitute

cheaper secured debt for unsecured debt. This reduction in the price at which households can borrow on the margin may lead them to increase overall borrowing, and thereby to increase their spending on, for example, durable goods.

In Sections Two and Three we provide evidence consistent with our stylised ‘story’ using data from the British Household Panel Survey (BHPS). We first describe the data and identify those households that appear to have high levels of household borrowing relative to the value of their financial assets and housing wealth. We term households with high levels of secured debt relative to assets as ‘collateral constrained’ households, in the spirit of Aoki *et al* (2004) and Iacoviello (2004). We examine how rising house prices over the late 1990s and early 2000s have reduced the fraction of collateral-constrained households in the UK, and identify the characteristics of those households.

We then apply several statistical tests of our general hypotheses. We first examine whether households that are ‘collateral constrained’ by our definition are more likely to borrow unsecured than other households, and confirm this to be true. Since household indebtedness varies over the life cycle, we examine sub-groups of the sample by age to check that we are not simply picking up a life-cycle effect. Next, we exploit the panel element of the data to investigate whether households that experience increases in the value of their housing wealth use re-mortgaging to refinance unsecured debt. We show that this is also the case, instrumenting changes in house values to allow for their potential endogeneity to changes in indebtedness. Finally, we show that changes in household indebtedness over this period largely arise among the small sub-group of households that started the period with high levels of secured *and* unsecured debt relative to assets and who obtained gains in housing equity over the period, so allowing them to refinance their debt and reduce their borrowing costs. These findings differ in their implications from other models which

link increases in debt-financed spending to general increases in housing wealth across all households, and from those models which focus on ‘collateral-constrained’ households only but which assume that secured debt is the only available form of credit – a variant of the ‘financial accelerator’ model derived from Bernanke *et al.* (1999). The implications are briefly described in Section Four, which concludes the paper.

## I. PREVIOUS LITERATURE AND THEORETICAL CONSIDERATIONS

### *Models of housing wealth and debt-financed consumption*

There are several models in the literature concerning the manner in which changes in house prices impact on consumer spending and indebtedness. The ‘standard’ intertemporal model examines the role of housing equity accumulation and withdrawal in smoothing life cycle consumption on non-housing. Since a life-cycle optimising household will choose its consumption path of both housing and other consumption simultaneously (so that planned housing wealth is endogenous), a standard approach to modelling the impact of housing wealth on life-cycle consumption is to examine how ‘surprises’ to the value of housing wealth (or indeed to other financial assets) that shift the intertemporal budget constraint induce households to change their consumption. However, changing house prices have different implications for potential ‘downsizers’ and ‘upsizers’ among households over the life cycle and the net effect on overall spending of house price changes may be rather small.<sup>1</sup>

Evidence that *predictable* changes in housing wealth can affect household consumption is harder to sustain in such a framework. An alternative explanation in the housing-consumption literature arises from the supposition that households (as potential borrowers) and lenders have asymmetric information on default risk that

induces lenders to require the posting of collateral as a pre-requisite to lending money to homeowners (as in Bernanke *et al.*, 1999). Since housing wealth is the dominant source of collateral available to households, changes in housing wealth affect the borrowing capacity of consumers with high future expected income or discount rates (that is, households which have borrowed up to their ‘collateral constraint’). Excess sensitivity of debt-financed consumption to changes in house prices arises among such households because of the fixed nominal value of mortgage debt. Benito and Mumtaz (2006) find that 20-30% of households in the UK do not smooth their consumption fully in response to income shocks, and that housing equity improves a household’s ability to smooth spending. The process by which changes in housing wealth have a disproportionately large impact on consumption through tightening or relaxing collateral constraints is sometimes termed the ‘financial accelerator’ (Aoki *et al.*, 2004; Iacoviello, 2004) although in general equilibrium models with firms and households there may be both financial accelerators and ‘decelerators’ at work (Iacoviello, 2005).

Models in the existing literature which incorporate collateral constraints either assume that unsecured borrowing is prohibitively expensive, or that it acts as an adjunct to secured borrowing. An alternative, and smaller, literature focuses only on *unsecured* debt and household debt-financed consumption, as in Chatterjee *et al.* (2007). Here, the constraints on household borrowing stem from the supply side – that is, the threat of default risk limits the supply of credit to any household (see also Gross and Souleles, 2002). The unsecured debt literature models the sources of default risk and the optimal strategy of credit providers. It has been argued that a model in which there is simply a ceiling on the *supply* of credit to any household, rather than one specific to its structure of asset holding, provides more straightforward modelling and testable predictions (Kehoe and Levine, 2001). In contrast, the

introduction of default risk into the standard collateral constraint model of debt-financed consumption complicates the predictions of a financial accelerator (Elul, 2006). In general, a model in which access to unsecured debt is dependent on having some form of collateral but is not (positively) related to the *value* of that collateral seems to accord more closely with the facts of household indebtedness, as we illustrate below.

#### *Housing collateral effects with secured and unsecured debt*

Two rationales are generally given in the literature on credit constraints or, more specifically, collateral constraints for emphasising secured rather than unsecured debt in a household's balance sheet. First, that the value of secured debt far outweighs the value of unsecured debt, and second, that interest rates on unsecured debt are typically considerably higher than on secured debt.

Secured debt predominates in a household's overall debt portfolio, insofar as the largest debt-financed purchase that a household will make is likely to be its first and perhaps subsequent house purchases. Rising house prices have increased the ratio of secured debt to annual household disposable income in the UK in recent years: from Bank of England statistics, for example, this ratio rose from 0.75 in 1993 to 1.13 in 2005<sup>2</sup>. Nevertheless, much of the increase in secured debt does not reflect collateral effects of the type examined in this paper, but is instead due to turnover in the housing market (Benito and Power, 2004; Benito, 2007).

Unsecured debt has also grown in importance, however, with the ratio of unsecured debt to annual household disposable income also rising, from 0.04 to 0.06 over the same period. Moreover, whilst secured debt is generally most important in the *stock* of debt, households inevitably use unsecured borrowing far more frequently in their lifetime than secured borrowing to finance lumpy purchases, and the interest

rate differential between secured and unsecured debt has tended to diminish in the UK in recent years. The spread between secured lending rates and credit card rates has fallen from over 15 percentage points in 1995 to less than 10 percentage points in 2005.

In the standard collateral constraint model without unsecured debt, a household can borrow secured against some fraction of its housing wealth. The budget constraint has a cliff non-convexity where the collateral constraint ‘bites’: that is, the maximum that a household can consume in any period is its current income and cash-in-hand, plus the expected value (to the lender) of the value of its house, discounted at the rate of interest on a loan secured on the collateral. Hence a rise in the house price allows a highly leveraged household to increase its consumption up to (or within) the budget constraint augmented by the higher value of the collateral.

If we incorporate the availability of unsecured debt into this mechanism, the consumer now faces a non-linear budget constraint: cheaper secured debt can be supplemented by the use of more expensive unsecured credit. The unbinding of the collateral constraint when house prices rise with secured (mortgage) debt fixed in nominal terms allows the household to refinance its debt portfolio. In this setting, the wealth effect arising from the reduction in the average interest rate on the household’s borrowing allows it to increase its consumption spending so that the new equilibrium can involve no use of unsecured debt, or a higher proportion of secured debt in its portfolio. However, the net effect on household spending of a general rise in nominal asset values for a previously collateral-constrained household, whilst positive, is smaller than in the scenario without unsecured credit. Indeed where, as in practice, there are transactions costs involved in refinancing secured debt, there will be a discontinuity at the original kink point in the budget constraint and the household may not change its debt structure or debt level at all should the costs of refinancing

outweigh the gains to be had in reducing the average interest rate of its debt portfolio. Housing collateral effects, therefore, are weakened somewhat by the inclusion of unsecured debt.

## **II. COLLATERAL CONSTRAINTS AND UNSECURED DEBT: EMPIRICAL EVIDENCE**

### *Data description*

We utilise the British Household Panel Survey (BHPS), which is an annual panel survey of approximately 10,000 adults in around 5,000 households that has been running since 1991. We work at a household level in which we aggregate housing, debt and asset values of the respondent and his or her partner. Aside from standard questions concerning household demographics, health and economic status, the BHPS asks in detail about wealth and indebtedness in three of the fifteen waves available at the time of writing: 1995, 2000 and 2005. Respondents in those waves are asked to list the sources of household debt, access to unsecured debt instruments and the total value of unsecured debt. This data on the amount of unsecured financial debt is collected in two stages. In the first stage, individuals are asked to give a precise value for the total amount they owe. Individuals who say that they do not know how much that they owe are then asked to give a banded answer. In this analysis we assign the median for those households who report banded information.

In addition, the BHPS in every wave collects information on secured debt, on housing status and self-assessed house value. The survey obtains detailed information on mortgaging and remortgaging, as well as year-on-year self-reported house values. The mortgage data contains data on type of mortgage, original mortgage value, the regular value of mortgage payments, and the current estimated value of the mortgage. A key variable in our analysis is the household's *loan-to-value ratio (LTV)* since this is a direct indicator of whether the household is facing a collateral constraint.

There are intrinsic difficulties for respondents in constructing current mortgage values – whilst annual mortgage statements typically report this statistic; those without the information available may attempt to estimate a value from an imperfect understanding of how mortgages work. More fundamentally, we need to incorporate explicitly, given the arguments of the previous section, the fact that households may use rising house prices to remortgage. In consequence the measured change in the LTV ratio from 1995-2000 and 2000-2005 is not an exogenous variable. To deal with this, we also utilise additional constructed data which predicts current values of mortgages of BHPS respondents derived from the reported value of the original mortgage and from details on the terms of the mortgage (duration and type of mortgage) available from the UK Data Archive (calculated by Andrew Henley, utilised in Bridges *et al.*, 2006). This proxy variable takes out any change arising from remortgaging and nets out some of the measurement error arising from self-reporting. This predicted LTV is used in the analysis where relevant.<sup>3</sup>

Summary statistics for household indebtedness are provided in Table 1. The sample is limited to home-owning households who appear in at least two of the three waves. We use this sample throughout the analysis. Households reporting unsecured debt in excess of £30,000 or house values in excess of £1.5 million are excluded from the sample as outliers. This removes only 25 households. All financial variables are adjusted to 2000 prices using the Retail Prices Index minus mortgage interest payments. Financial variables are reported at the household level, defined as the head of household plus spouse / live-in partner. The financial variables are constructed as follows: household income is defined as household gross annual labour income plus annual pension income plus annual benefit income plus ‘non-labour income’; financial wealth is the sum of savings accounts, stock holdings, national savings bonds, national savings certificates, premium bonds and TESSA/PEP/ISA accounts<sup>4</sup>;

unsecured debts are the sum of credit card and store card balances (including outstanding balances not yet due), outstanding personal loans, bank account overdrafts, the value of hire purchase agreements and the value of catalogue and mail order purchase agreements; house value is in this case the self-reported value of first and additional homes owned by household members; secured debt is the sum of outstanding loans on all the property owned by the household.<sup>5</sup> The household LTV ratio is calculated by dividing the value of outstanding loans on first and additional properties by the total self-reported value of those properties.

< TABLE 1 HERE >

Demographic variables included in the summary statistics are the age of the household head, a dummy variable which takes a value of 1 if the household head is male, a dummy variable for whether the household head lives with his/her spouse or live-in partner and a dummy variable for whether at least one child under the age of 18 lives in the household. There is limited attrition in the sample size over the three waves. As the household panel sample ages so the mean age of the household head increases.

In the panel, approximately two-thirds of households have a male head. Nearly three-quarters of households are composed of a couple with around one-third of households including at least one child. Real household income grew at 3% per annum over the ten year period and mean financial wealth increased by 27% over ten years, but growth in household wealth is dominated by the value of housing, with the mean house value trebling over the ten year period from £73,000 to £217,000. This increase in house values is not matched to any great extent by the increase in secured debt which increases at the mean in the data by approximately £22,000. Consequently the mean loan-to-value (LTV) ratio fell by two-fifths over the ten year period with the

majority of the reduction occurring from 2000 to 2005, the period of greater house price inflation.

The average value of unsecured debt in the whole sample is small relative to secured debt - only one twentieth that of secured debt over the period. However, disaggregating households by LTV ratio reveals substantial variation in levels of unsecured debt: households with LTV ratios higher than 0.66 have on average between 2 to 3 times more unsecured debt than households with LTV ratios in the lowest band (though the ratio of secured to unsecured debt is still approximately one to twenty for both groups). The groups with higher LTV ratios are typically younger, more likely to be married and have children, have higher incomes and income growth, lower levels of financial wealth and housing equity and therefore, with higher LTV ratios, greater secured debt.<sup>6</sup>

< FIGURE 1 HERE >

In order to illustrate the distributions of financial wealth and housing wealth positions among households Figures 1 and 2 plot cumulative density functions for the LTV ratio and household 'net worth' in the three waves of data. In 1995 approximately one third of the sample of homeowners had no outstanding mortgage debt, hence a LTV ratio of 0. The distribution shifts upwards as ratios fall due to mortgage repayments and (in larger part) house price growth, but also becomes more concave by the latter wave of data, suggesting a concentration of households with high LTV ratios in 2005. A small number of households report LTV ratios in excess of 1 in the 1995 data.

< FIGURE 2 HERE >

Figure 2 illustrates the distribution of 'net worth' among households. Net worth is defined as financial wealth plus house value minus secured debt minus

unsecured debt, using the definitions of these variables described earlier; it does not include accrued pension rights. The first to 99<sup>th</sup> percentiles are plotted for 1995 (with censoring of outliers at £400,000, which removes 7 observations). As can be seen from the figure, net worth is concave past the 75<sup>th</sup> % point of the distribution. The sample includes a concentration of high net worth households. In the earlier waves, there is a significant minority of households with negative net worth (in 1995 5% of households report negative net worth by this measure, with the median of the bottom percentile at -£38,500. The median of the 99<sup>th</sup> percentile was £359,000). These observations may be explained by house prices being depressed in the early 1990s. Gains in house prices cause the distribution to shift rightwards over the three waves. Median net worth for the 80<sup>th</sup> percentile in 2005 exceeded median net worth for the 99<sup>th</sup> percentile in 1995, mainly due to real house price inflation.

*Which are the collateral constrained households?*

It is evident from the descriptive statistics in Table 1 that households with higher LTV ratios hold greater levels of unsecured debt than other households. Of course, this may be due to differing incomes, ages and access to credit across these groups rather than household collateral position *per se*. This is investigated in the next section. However, the distribution of LTV ratios and net worth in the sample provides some indication of the proportion of households which might be considered collateral constrained.

As discussed in the literature review, models of the behaviour of collaterally constrained households presume that the constraint is binding for a significant fraction of households. The fraction of households assumed to be ‘collateral constrained’ constitute 50% of households in Aoki *et al*, 2004; and 25% and 36% of households in Iacoviello 2004, 2005 respectively. These studies typically rely on external evidence

of the extent of credit constraints from studies of the US such as Jappelli (1990) rather than from estimates constructed by direct measurement of households' financial positions. Note however that such estimates for US households rarely put the proportion of credit constrained households at more than a quarter of the population, and rely on measures of self-reported credit refusals. Moreover, estimates for the United States of credit constraints based on self-reported refusals are actually much higher than for other countries, perhaps due to the increased frequency of *applications* for credit.<sup>7</sup>

The approach used here – to identify credit constraints in the form of collateral constraints by self-reported LTV ratios – relies on the validity of our indicators of institutional constraints. In the UK mortgage markets, lenders will generally allow borrowing up to a LTV ratio of 1, with additional constraints in income multiples (with a typical maximum loan value of four times the income of the highest earner on the mortgage or three and a half times the combined incomes of co-owners). However, lenders tend to impose premiums on borrowers with LTV ratios greater than 0.8. To benchmark an estimate of the appropriate level of LTV that defines the collateral constraints: according to the Halifax Bank (the largest UK mortgage lender), in 1995 its mortgage lending limit to households was 90% of the house value or 3.5 times household gross income (whichever value was lower). From 1999, however, the income multiples limit was abolished in favour of an affordability criterion. The Halifax reported an actual average LTV for first-time buyers in 1995 of 0.81.<sup>8</sup>

Taking this fraction as indicative of a collateral-constrained household, then the distribution of LTV ratios illustrated in Figure 1 show that 13% of homeownership households had LTVs greater than 0.9 in 1995 and nearly 25% exhibited LTVs over 0.8. Fewer than 40% of households have LTVs in this wave of data of greater than

0.65. By 2000 and 2005, these proportions were significantly lower. Hence the distribution of self-reported values would suggest a lower incidence of households facing collateral constraints than those used in simulations such as those of Aoki *et al* (2004) and Iacoviello. Even so, there are sufficient numbers of measured collateral-constrained households to warrant further investigation of our hypotheses, and to examine how sensitive are our results to the definition of ‘collateral constraint’.

### III RESULTS

#### *Collateral Constraints and Unsecured Debt: Cross-Section Evidence*

In this sub-section, we investigate whether collateral-constrained households utilise unsecured debt to a greater extent than unconstrained households, as hypothesised in Section 2.2. Simple descriptives suggest this to be the case (Table 1) but of course this correlation between household LTV ratios and levels of unsecured debt might be explained by age, incomes and demographic characteristics rather than household behaviour. Younger households tend to have more unsecured debt (and, if homeowners, higher LTV ratios) but this may arise for several reasons: such households may be more acquainted with newer forms of credit, with higher income growth they may make greater use of short-maturity debt, and their demographic characteristics may be linked to better credit scores granting them access to unsecured debt at cheaper interest rates and more favourable repayment terms.

To examine this further, we pool the information on unsecured debt for the three available waves of data. The total value of household unsecured debt is regressed against the self-reported LTV ratio together with quadratics in household income and financial assets, dummy variables for employment status, educational qualifications, and controls for household demographics (age, gender, marital status). In the absence of detailed information on pension wealth a dummy variable is

included for whether the household is a member of an occupational pension scheme. The regression also includes control variables for the number of benefits received by the household and the number of children in the household.

Results are reported in Table 2. Column 1 presents Tobit estimates for 5083 household-observations over the three waves of data; the mean frequency of household observations is 2.2. A random effects estimator is used to attempt to control for unobserved household-specific characteristics. The coefficients on the LTV ratio, household income and financial assets are all statistically significant at the 1% level, together with a range of demographic variables including household age and marital status, supporting our basic hypothesis. The marginal effect on the LTV ratio is 1.6 in the random effects specification and the coefficient on household income is 0.04. By way of interpretation, with mean household income at £26,000 and the mean LTV ratio of 0.34 in the pooled sample, a 0.1 increase in the LTV ratio increases unsecured debt in this simulation by £150, equivalent in effect to increasing household current income by approximately £5000.

< TABLE 2 HERE >

These estimates of the impact of household LTV ratios on the use of unsecured debt based on cross-section data rely on comparisons between low-LTV and high-LTV households controlling for other observed characteristics in the regression, and assuming unobserved household-specific characteristics are randomly distributed across households. However, observations of low-LTV ratios are principally among older households, with observations of high-LTV ratios principally found among younger households. These two groups are also likely to differ considerably in their demand for debt, usage of credit instruments and experience in credit markets.

To create more comparable groups, therefore, we re-estimate the random effects Tobit on sub-samples selected by age group. This approach to the cross-sectional regression exploits variation in LTV ratios and unsecured debt across households of a similar age / life-cycle position. We choose three age ranges: households aged 20-34, aged 35-49 and aged 50-65. Results are presented in Columns 2 – 4 of Table 2. The coefficient on the LTV ratio is again statistically significant at the 1% level in regressions for each age band comparison, with the marginal effect greatest for the middle aged group.

The estimates in Table 2 assume a linear relationship between the value of the LTV and the value of unsecured debt. The argument of the previous section implied that the relationship between household LTV ratios and holdings of unsecured debt should be non-linear because collateral constraints only ‘bind’ at higher LTV ratios. We would expect only households close to the ‘collateral constraint’ to accumulate greater levels of unsecured debt, *ceteris paribus*. However we do not know the exact value of the LTV ratio that reflects a ‘collateral constraint’ (though we gave some evidence from banking sources) and indeed the actual LTV ratio that acts as binding constraint may be specific to the household. So we therefore test the sensitivity of the relationship between unsecured debt and LTV ratio for different LTV ratio proxying ‘the’ collateral constraint by re-estimating the cross-section regressions with dummy variables for deciles of the LTV ratio rather than the continuous measure. The same method is also applied to the age variable in order to further control for non-linearities in the relationship between household age and indebtedness.

Estimates are presented in Table 3. Column 1 presents estimates for the whole sample. Coefficient estimates between the higher (0.6-0.7 through 0.9-1), middle-range (0.4-0.5, 0.5-0.6) and lower (0-0.1 through 0.3-0.4) LTV bands are statistically significantly different from each other at the 1% level with higher coefficients for the

middle and high LTV bands compared to the lower LTV bands, though it should be noted that the magnitude of the marginal effect weakens significantly past the 0.8-0.9 band. Columns 2 to 4 present estimates for sub-samples chosen by age, using the same age bands as in Table 2. For younger households (Column 2 and 2a) the marginal effects increase monotonically from the lowest to the highest LTV bands, exactly as our model would suggest. For middle-aged and older households, the marginal effects are greatest in the 0.6 to 0.8 range, although not surprisingly fewer households have high LTV ratios; indeed the estimates for older households in Column 4 omit the 0.8 to 0.9 and 0.9 to 1 dummies as we have no observations of households with LTV ratios at these levels for this age group. It is also notable that the coefficients on unsecured debt levels to LTV-bands are for the greater part larger for the older age groups. We illustrate this in Figure 3 by comparing coefficients for the young and middle age groups, with dashed lines for plus and minus one standard error. We have no obvious explanation as to why older households' unsecured debt may be more sensitive to their loan-to-value ratios; it may reflect differences in preferences or financial acumen on the one hand, or reflect how credit scorers treat holdings of debt (and assets) by age group on the other.

< TABLE 3 & FIGURE 3 HERE >

These results can be interpreted as illustrating a collateral constraint that limits further secured borrowing at higher levels of the LTV ratio (but below 1 for all but the youngest households) whereas increases in the LTV ratio from initially low levels have little impact of household holdings of unsecured debt given unused secured debt capacity. In summary, the LTV ratio is a key variable in explaining household holdings of unsecured debt, even after controlling for observed characteristics and random effects, and the relationship is non-linear, as we expect.

*Collateral Constraints and Household Refinancing Activity*

The previous section presented evidence that households with high loan-to-value (LTV) ratios also hold more unsecured debt after controlling for household characteristics, consistent with the hypothesis that unsecured debt is utilised as a substitute for secured debt by collateral-constrained households. This section therefore explores the implications for the refinancing activity of such households when positive house price ‘shocks’ unbind collateral constraints, using the panel aspect of the data.

The BHPS observes the remortgaging activity of households together with whether the household moved home as well as the value of new mortgages. Hence self-reported changes in LTV ratios, which we are treating as our measure of the potential collateral constraint, are endogenous to refinancing activity and we need an instrument for changes in self-reported LTV ratios over time. We therefore construct a *predicted* LTV ratio as follows: the numerator is obtained by modelling the value of the mortgage over time defined by the *original* mortgage contract of each household in order to construct a predicted value of the mortgage (i.e. abstracting from any re-mortgaging), while the denominator uses the change in the average county-level house value rather than the self-reported change to adjust the value of the home.<sup>9</sup> The dynamics of the ‘predicted LTV’ are driven by the amortisation schedule of the mortgage and movement in local-level house prices, excluding household refinancing activity.

In general terms, both the ‘collateral constraint’ model with secured debt only and the model where households can obtain unsecured debt as described in Section 2.2 predict a *negative* association between changes over time in a household’s underlying predicted LTV ratio and its probability of remortgaging, but with the effect most noticeable for households with high initial LTV ratios: i.e. as house prices rise,

the LTV ratio falls and high-LTV households can unbind any collateral constraint. In addition, the model incorporating unsecured debt predicts a *positive* association between the original value of unsecured debt and the probability of remortgaging, given the change in the predicted LTV ratio. This arises simply because the falling LTV ratio allows the household to substitute cheaper secured debt for its outstanding unsecured debt. Moreover, given our previous evidence that households unbind collateral constraints by using unsecured debt, it is expected that the households most likely to remortgage will be those with high LTV ratios *and* unsecured debt which they seek to refinance rather than those with high LTV ratios *per se* – our assumption being that the latter group are less likely to react to a relaxation of the constraint on increased borrowing given that they did not use the opportunity of unsecured debt to unbind their constraint in the earlier period.

To examine the impact of changes in the LTV ratio on household remortgaging, a probit model is estimated for household refinancing between 1995 and 2005. In addition to data on household assets and wealth available in the three waves used in the previous sub-section, data on remortgaging activity is available in every wave. Dummy variables are created for whether the household refinanced its mortgage between 1995 and 2000 and 2000 and 2005, and changes in the predicted LTV ratio over the two periods are also calculated. Hence for households present in all three waves we have two refinancing dummies and two predicted LTV changes. Pooling observations over the two periods, the dependent variable in the probit is the binary response to the question of whether the household refinanced, with the predicted change in the LTV ratio (in the absence of refinancing) as an explanatory variable along with the level of unsecured debt, changes in income, financial assets, employment status, marital status and the number of children in the household.

Column 1 of Table 4a is the baseline regression. It indicates no statistically significant relationship between changes in the predicted LTV ratio and the probability of household refinancing. Unbinding household collateral constraints *per se* appears to have no impact on the refinancing decision. The probability of refinancing increases with changes in household income, employment status and the number of children added to the household over the period. The probability of refinancing decreases with changes in financial assets.

< TABLE 4A HERE >

Column 2 presents results for interactions of the change in the LTV ratio with indicators of the level of the household's LTV in the previous period and holdings of unsecured debt in the previous period. The interaction terms are calculated by firstly creating dummy variables for whether households had a LTV ratio greater or lower than 0.8 in 1995/2000. Of the observations of household-years, 18% record LTV ratios in excess of 0.8. The interaction terms for unsecured debts over £1000 includes 30% of households. These interaction terms test between two models: if refinancing behaviour is wholly driven by relaxation of collateral constraints arising from high initial LTVs, then there should be a significant negative coefficient for the interaction on households with high LTV ratios compared to the interaction for households with low LTV ratios. If mortgage refinancing is instead driven by relaxing collateral constraints on households which also have high levels of unsecured debt then there should be a significant and negative coefficient on the interaction with higher levels of unsecured debt and *vice versa*.

Results in Column 2 suggest the latter explanation. The coefficients on the interactions for the household LTV ratio being higher or lower than 0.8 in the previous waves both attract positive and statistically insignificant coefficients. The

responses of households with high initial LTV ratios appear no different from those of households with low LTV ratios. However, this is not the case for the interaction terms in unsecured debt. Here, the coefficient on the interaction term for households with unsecured debts in excess of £1000 at  $t-1$  is negative and statistically significant at the 1% level. The negative coefficient on an increase in the LTV ratio implies a positive relationship between falling LTV ratios and refinancing probabilities. The marginal effect is calculated to be  $-0.15$ . The interpretation of the absolute value of the marginal effect on this interaction term is the increased probability of refinancing for a household which observes its LTV ratio to fall by 1 (i.e. from a LTV ratio of 100% to 0%) compared to a household which did not observe this change. The marginal effect is best interpreted against the interaction term in the next row for households with unsecured debts less than £1000, which attracts a positive and statistically insignificant coefficient. These interaction terms are statistically significantly different from one another at the 1% level.

Column 3 tests the sensitivity of these results to varying the cut-off level of ‘high’ unsecured debt to £1500, which lowers the proportion of households captured by the unsecured debt dummy to 21%. The coefficient on the unsecured debt interaction increases with this alternative specification, consistent with higher levels of unsecured debt providing a greater incentive for households to refinance for a given change in the LTV ratio.<sup>10</sup>

As with the whole-sample estimates in the previous section, the results in Table 4a rely on comparing the behaviour of households with initially high levels of LTV ratios (or unsecured debt) against the behaviour of the rest of the sample. The households exhibiting high LTV ratios and unsecured debt are predominantly younger. Older households with lower LTV ratios due to their life-cycle position might constitute a poor comparison group. Therefore Table 4b presents estimates of

the specification in Column 2 of Table 4a for sub-sets of the sample defined by age. The pattern in the coefficients found in the whole sample is shown to be the same for both the older and younger sub-samples. However, the higher coefficient estimates for our young and middle-aged households indicate that refinancing activity by these households is more sensitive to changes in house prices when they have relatively high levels of both secured and unsecured debt than the oldest age group. Note however from our earlier discussion of Table 3 and from the cell sizes described in the notes to Table 4B that few in the oldest age group have very high secured loan-to-value ratios and it may be that these lower levels of overall debt among the oldest age group in our analysis dampen their measured response to house price changes.

Table 4b also presents estimates in which the change in the LTV ratio is proxied by the change in the county level house price, using the Halifax county level house price series, in case the ‘predicted loan’ component of the predicted LTV ratio does not adequately omit the impact of mortgage refinancing. However, estimates using changes in county level house prices reveal a very similar pattern to those using changes in the predicted LTV ratio. As the estimates in Table 4b illustrate, a statistically significant relationship between house prices and remortgaging activity is only found for households with levels of unsecured debts in excess of £1000.

< TABLE 4B HERE >

These results suggest that refinancing activity among a sample of non-moving households is driven not purely by movements in collateral constraints, or even by movements in collateral constraints from initially high levels. Rather, households which have previously utilised unsecured debt appear more likely to refinance when collateral constraints unbind. Taken together, these results lend support to the

refinancing model, suggesting that the desire to substitute secured for unsecured debt is an important factor in explaining the incidence of re-mortgaging.

### *House Prices and Household Indebtedness*

We now consider the impact of relaxing LTV ratios on the *total* level of household debt. Our approach provides a direct test of the proposition that the relaxation of collateral constraints only has a significant impact on the indebtedness of constrained households with unsecured debt – and permits a quantification of that response. Given the remortgaging results in the previous section, we expect the strongest relationship between house price changes and total debt to be observed among constrained households with high levels of unsecured debt. So we again distinguish between constrained and unconstrained households on the basis of their self-reported LTV ratio. However, to obtain an exogenous measure of movements in house prices we use the Halifax county-level house price index utilised in Section 4.2.

In our analysis, the change in total household debt is chosen as the dependent variable. If the relaxation of collateral constraints causes households to refinance their debt portfolio, the net effect will depend upon the change in both secured and unsecured debt. Hence the change in *total* indebtedness is regressed against the change in the house price. However, a potential endogeneity problem suggests the use of an instrumental variable technique. Self-reported house prices may themselves be endogenous to change in total indebtedness if households borrow to fund home improvement activity. To avoid this, the self-reported change in the house price is instrumented by the county-level change in the house price. All standard errors are bootstrapped in the specifications.

A further issue is that there is a strong likelihood that moving is associated with changes in net financial assets arising from home improvement and moving

costs.<sup>11</sup> Consequently the analysis is restricted to non-moving homeowners. However, to correct for the non-random nature of non-movers a selection-correction is estimated on movers and non-movers using the standard Heckman method. The BHPS questions respondents on whether they prefer to move work, like their current neighbourhood and whether work commitments prevent the household from moving. These responses (using a lag of the preference for moving response) are used as exclusion restrictions in the first-stage regression for whether the household is a non-mover over the period. The likelihood of the household being a non-mover decreases with the household liking its neighbourhood (coefficient 0.10, s.e. 0.12), increases with the household preferring to move home (coefficient 0.39, s.e. 0.07) and decreases with the household having work commitments which prevent moving (coefficient -0.16, s.e. 0.09). The coefficients on the exclusion restrictions are jointly significant at the 5% level. For a comparison, we also present the results without the selectivity correction in the subsequent table.

Table 5a reports estimates of the effect of house price changes on (changes in) total debt for the whole sample of households used in Section 3. Column 1 is the baseline regression in which the change in total indebtedness is regressed against the change in house prices (using the change county level house price as an instrument for the self-reported change in the house price). Changes in household income, employment status, financial assets and the number of children in the households are included along with household characteristics at the beginning of the period. There are 3154 observations of household-changes with 660 mover-observations. Other regression diagnostics are reported in the table.

< TABLE 5A HERE >

In this specification there is no significant relationship between changes in house prices and changes in household indebtedness – a result which suggests that controlling for household characteristics and changes in income might explain much of the observed aggregate association between house prices and mortgage equity withdrawal. The coefficient on the change in household income is positive and significant at the 1% level, implying that a £1000 increase in household income increases household indebtedness over the five-year changes by £70. The growth in household debt is also negatively associated with age of head of household with a one-year increase in age associated with total debt falling by approximately £60 over the period. The positive coefficient on age squared suggests this relationship is non-linear.

Columns 2 and 3 investigate the strength of the relationship between house prices and indebtedness for households with high LTV ratios at the beginning of the period. In Column 2 dummy variables are created for whether the household LTV ratio is above or below 0.8 at the start of the period (in the years 1995 and 2000). 18% of sampled household-observations fall into this category. The observations of changes in house prices are interacted with these dummy variables for each household-observation. The results suggest that even for households very likely to be collateral-constrained there is no significant relationship between the change in the house price and the change in indebtedness. The coefficients on the interaction terms are both insignificant at the 10% level, though the coefficient on the higher LTV group is weakly positive compared to the lower LTV group. As in the previous subsection, this implies that households exhibiting initially high LTV ratios do not respond to rising house prices in a significantly different manner to households with lower LTV ratios. The result in Column 3 (with 26% of household-observations

exhibiting an LTV ratio in excess of 0.7) confirms the absence of a significant relationship for alternative choices of the ‘high-LTV’ threshold.

In order to explore the impact of the household’s initial holdings of unsecured debt on this relationship, Column 4 includes an additional set of interactions for whether the household held a significant level of unsecured debt at the beginning of the period. The threshold level of debt is initially set at £1000. Two interactions are included in the regression: an interaction term for households which have a high LTV ratio *and* over £1000 of unsecured debts at the beginning of the period (as before, this is investigated for a range of thresholds) and secondly an interaction for households with over £1000 of unsecured debts but which do not exhibit high beginning-of-period LTV ratios. This approach is adopted to distinguish between households which hold high levels of unsecured debts for transactions purposes (such as revolving credit card balances) and households which hold high levels of debt for borrowing purposes, who, from our earlier analysis, are more likely to be constrained households.

Column 4 presents results for a LTV threshold of 0.8. In the sample, 10% of household-observations record a LTV ratio above 0.8 and unsecured debt in excess of £1000. (This proportion rises to 17% for an LTV ratio of 0.7). The coefficient on the interaction of a high LTV ratio and high unsecured debt is positive and significant at the 1% level. The coefficient value of 0.31 implies that a household with these characteristics experiencing a £1000 increase in its (instrumented) house value over the period increased its total indebtedness by £310 more than a household experiencing a similar increase in house value but which is not characterised by the interaction terms on levels of unsecured debt and high LTV ratio. In addition, the interaction term in the fifth column suggests a positive relationship between house prices and indebtedness for households with £1000 or unsecured debt who fall below

the LTV threshold. However, as the results in Column 5 reveals, when the threshold value of LTV ratio is lowered the significance of this interaction term weakens.

Similarly, altering the value of unsecured debt used to distinguish ‘high’ and ‘low’ debt households at the beginning of the period alters the strength of the coefficient on the interaction term. In Column 6, the threshold unsecured debt threshold is increased to £1500, which increases the coefficient on the interaction term in the fourth row to 0.42 (standard error 0.06) with the number of households captured by the interaction term falling accordingly to 5%. A similar effect is shown in Column 7 for an LTV threshold of 0.7. Hence raising the debt threshold leads to a greater coefficient identified for a smaller subset of households; lowering the threshold has the opposite effect. Table 5b provides further estimates for age sub-groups, following the approach adopted in Table 4b. Selectivity–corrected estimates are presented alongside uncorrected estimates. In general, the selectivity-correction weakens the estimated coefficients. Results by age-group show the same pattern as that for the whole sample. In common with Table 4B, younger households captured in the LTV and unsecured debt interactions exhibit a stronger response to house price movements compared to older households.

< TABLE 5B HERE >

A pattern in the estimated coefficients is evident: households with greater values of unsecured debt together with higher LTV ratios have a stronger positive association between house price movements and indebtedness compared to the rest of the sample. It is apparent that the interaction terms, though capturing household status 5 years previously, are able to distinguish differential responses across households to rising house values.

#### IV. CONCLUSION

This paper has explored the mechanisms by which house price changes affect household indebtedness in models in which households may be subject to collateral constraints. We argue that collateral based models should take account of unsecured debt. On the margin, it is easier for households to adjust unsecured debt rather than secured debt, and to unbind collateral constraints by the use of unsecured debt. The relative price effect arising from changing asset values will indeed increase debt-financed consumption, but the magnitude of the effect is likely to be much smaller where there is unsecured debt than the ‘amplification’ of shocks implied by a model in which collateral constraints wholly bind household borrowing.

Our reasoning finds some support from qualitative data: the Survey of English Housing suggests that, after housing improvements, households report ‘paying off debt’ as the second most important rationale for utilising housing equity gains. This fits with our argument that exogenous housing wealth gains allow constrained households to substitute secured for unsecured debt. One possible alternative interpretation of our results is that persistently growing housing wealth over time allows households to de-accumulate previously built-up financial assets, so inducing the increase in indebtedness described in this paper. A simple test of this hypothesis is to use the panel component of our data to test what happens to the financial assets of households as house prices increase. If rising housing wealth allows financial asset de-accumulation, we might expect a *negative* correlation between household-specific changes in housing wealth and changes in financial assets controlling for age (lifecycle effects) and preferences (proxied by lagged value of financial assets). In fact we find no such effect: household financial asset levels in 2000 are strongly positively correlated with financial assets in 1995, significantly related to a quadratic

in age and *positively* (but insignificantly) associated with changes in house values between 1995 and 2000.

Our results show that collateral-constrained households (households with higher self-reported LTV ratios of around 0.7 or greater) do indeed have higher unsecured debt once we control for life cycle characteristics and for individual heterogeneity. We show that households exploit relaxing collateral constraints to refinance their debt portfolios, substituting secured for unsecured debt, and thereby test between the pure collateral effects and effects which transmit *via* unsecured debt. We show that remortgaging is not associated with high LTV ratios *per se*, but is associated with high levels of unsecured debt. We confirm this by a direct test of the impact of relaxing collateral constraints (due to rising house prices in our period) on the value of total debt among non-moving households (to abstract from the effect of moving itself on holding of financial assets and on consumption). Our results also show that total debt increases amongst households with housing equity gains that initially faced high LTV ratios *and* high levels of unsecured debt, providing further support for our general hypothesis.

Much of the period covered by our data is characterised by rising housing prices, a gradual increase in the secured-debt to household income ratio, and (despite the increase in credit card usage), a stable ratio of unsecured debt to household income (for evidence on these points, see Bridges *et al.* , 2006). These stylised facts accord with our general ‘story’. In the late 2000s, however, there is evidence that access to secured debt in the UK has been tightened up, and that the long boom in house prices may have come to a halt, at least temporarily. Whether this tightening of access to secured debt leads households to increase their *unsecured* debt holdings on the margin, as implied by our model, depend on several factors: changes in household

income expectations, a tightening of the terms on which unsecured debt is supplied, and so on. This can be an agenda for future research.

**Table 1**  
**Descriptive Statistics, BHPS Households 1995, 2000, 2005**

	1995				2000				2005			
	All sample	LTV <=0.33	0.33 <LTV<= 0.66	LTV >0.66	All sample	LTV <=0.33	0.33 <LTV<= 0.66	LTV >0.66	All Sample	LTV <=0.33	0.33 <LTV<= 0.66	LTV >0.66
<i>Financial Variables (Household)</i>												
Income	25,300	22,700	26,800	26,000	31,700	31,200	32,400	31,200	39,300	36,900	42,000	43,700
Financial Wealth	10,600	10,500	8,600	4,000	10,900	17,800	10,000	3,800	12,300	15,800	8,900	8,900
House Value	73,800	88,400	75,900	58,000	109,300	140,800	107,500	71,500	216,600	233,700	196,300	184,000
Unsecured Debt	1,500	1000	1,700	2,100	2,800	1,600	3,000	4,300	3,200	2,300	4,400	5,600
Secured Debt	34,600	19,000	36,700	46,600	49,600	32,400	53,400	53,600	56,600	44,000	64,000	128,400
Loan-to-Value Ratio	0.51	0.18	0.49	0.83	0.47	0.19	0.49	0.79	0.30	0.17	0.46	0.75
<i>Demographics (Household Head)</i>												
Age	45	54	45	36	47	54	45	40	50	54	46	40
Male	0.73	0.75	0.74	0.69	0.72	0.78	0.67	0.73	0.70	0.71	0.70	0.78
Children	0.35	0.32	0.39	0.49	0.34	0.32	0.38	0.48	0.36	0.31	0.42	0.47
Couple	0.83	0.84	0.84	0.82	0.82	0.82	0.81	0.83	0.81	0.81	0.83	0.72
N	1535	483	523	529	1496	484	640	372	1152	649	434	69

Sample: Households who appear in at least two consecutive waves of the BHPS sample used (either 1995 and 2000, or 2000 and 2005) who report LTV ratios no higher than 1, unsecured debts of less than £30,000 and house values less than £1.5m. All values are self-reported.

Figure 1  
Distribution of Loan-to-Value Ratio

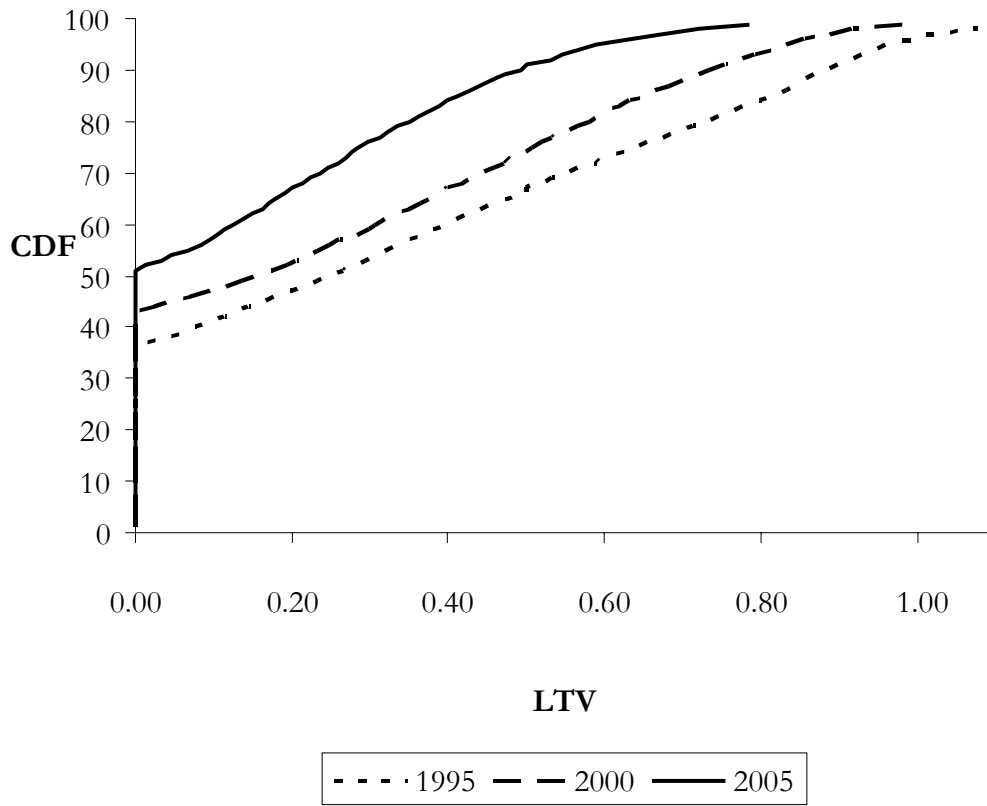
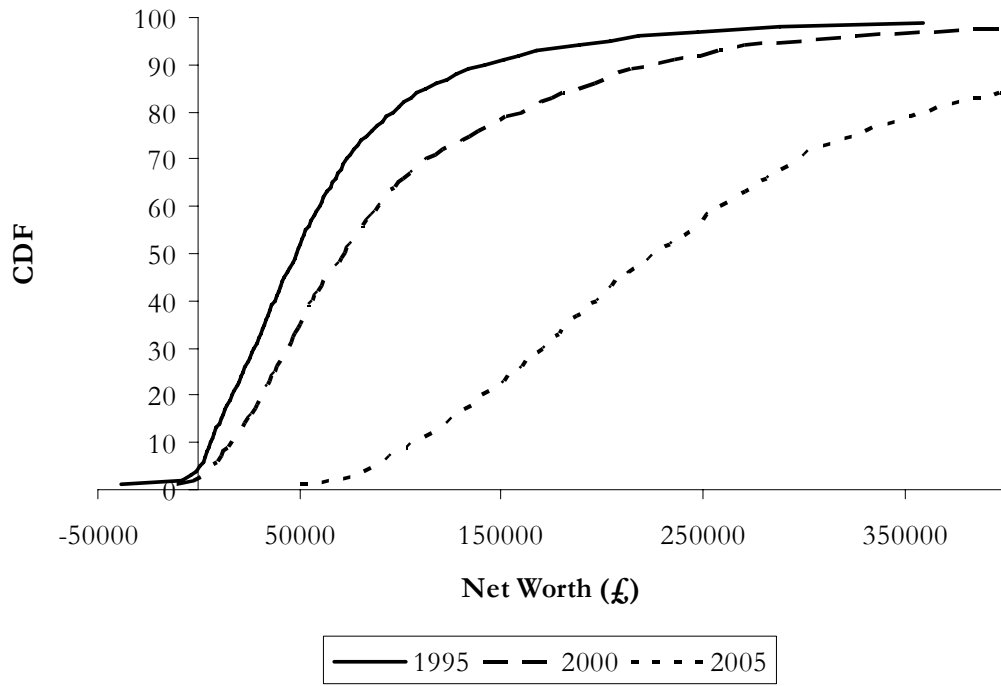


Figure 2  
Distribution of Net Worth



**Table 2**  
**Cross-Section Loan-to-Value Ratio and Value of Unsecured Debt**  
**Pooled Household-Observations BHPS 1995, 2000 and 2005**

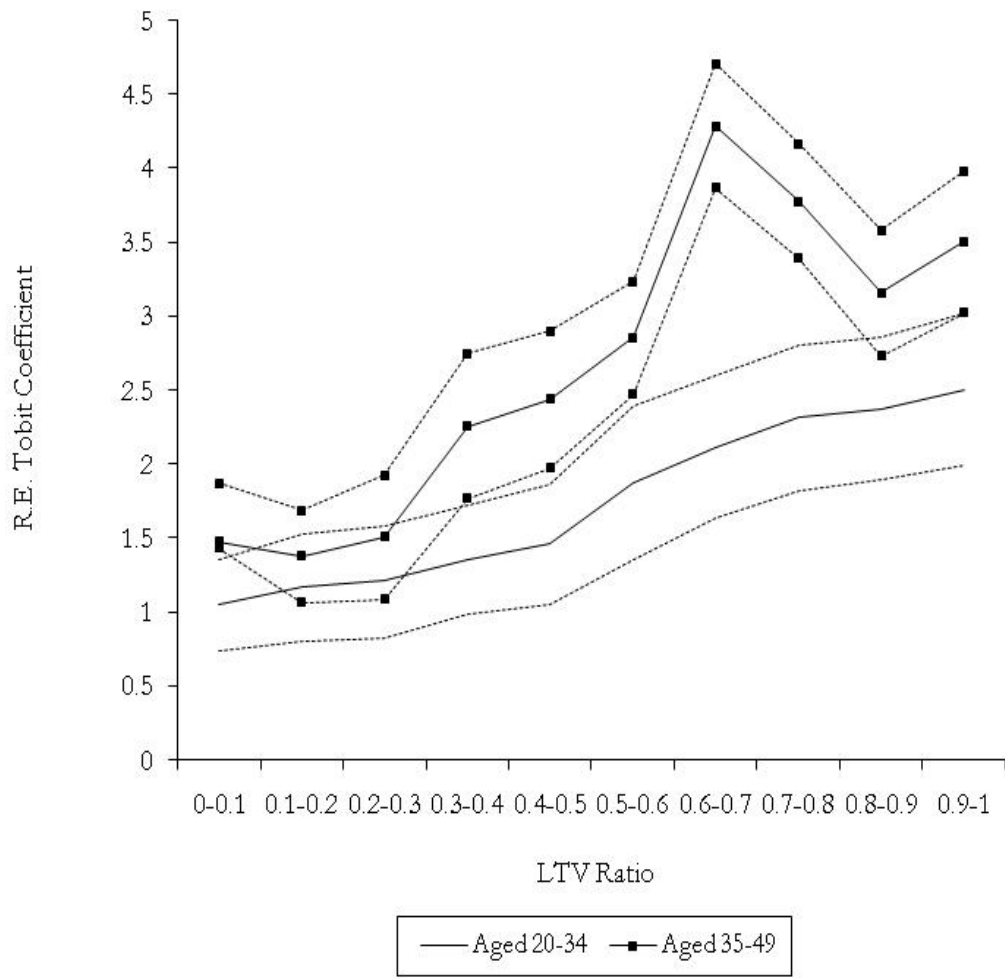
<i>Specification:</i> Random-Effects Tobit	(1) Whole Sample	(1a) Marginal Effects	(2) Aged 20-34	(2a) Marginal Effects	(3) Aged 35-49	(3a) Marginal Effects	(4) Aged 50-65	(4a) Marginal Effects
<i>LHS Variable:</i> Unsecured debt (£)								
loan-to-value ratio	4.14** (0.38)	1.6	3.41** (0.45)	1.9	4.84** (0.54)	2.42	6.28** (0.8)	1.91
income (£000s)	0.07** (0.008)	0.04	0.10** (0.01)	0.06	0.09** (0.01)	0.05	0.08** (0.02)	0.02
income <sup>2</sup> (£000s)	-0.0003** (0.00005)	-.00006	-0.0002** (0.00004)	-.00008	-0.0001* (.00004)	-.00006	-0.0003** (0.0001)	-.00009
financial assets (£000s)	-0.021** (0.006)	-0.07	-0.06** (0.009)	-0.03	-0.07** (0.01)	-0.03	-0.009 (0.01)	-0.03
financial assets <sup>2</sup> (£000s)	0.00002* (0.00001)	.000005	0.00008** (0.00002)	0.0004	0.0002 (0.0004)	.00009	-0.0004 (0.0006)	-0.0001
employed=1	1.68** (0.42)	0.52	1.29* (0.70)	0.66	1.55* (0.73)	0.7	1.37* (0.54)	0.39
age	-0.04* (0.011)	-0.08	0.18 (0.24)	0.1	0.2 (0.71)	0.1	0.77 (1.27)	0.24
age <sup>2</sup>	0.0007 (0.0008)	.0004	-0.03 (0.04)	-0.02	-0.02 (0.008)	-0.001	-0.01 (0.01)	-0.002
number of benefits	0.11 (0.07)	0.06	0.15 (0.15)	0.08	0.29 (0.16)	0.14	0.09 (0.15)	0.03
number of children	0.12 (0.07)	0.05	-0.03 (0.13)	-0.002	0.06 (0.13)	0.03	0.38 (0.32)	0.12
female household head=1	-0.03 (0.28)	-0.01	0.13 (0.26)	0.07	-0.11 (0.29)	-0.05	-0.62 (0.24)	-0.19
married=1	0.55 (0.26)	0.18	0.24 (0.31)	0.13	-0.09 (0.35)	-0.05	0.12 (0.37)	0.65
retired=1	-0.54 (0.31)	-0.6	-		-		-0.97* (0.47)	-0.28
saver=1	-0.34 (0.17)	-0.11	-0.44 (0.26)	-0.25	-0.17 (0.29)	-0.09	-0.26 (0.34)	-0.08
endowment=1	-0.26 (0.18)	-0.08	-0.18 (0.16)	-0.15	-0.28 (0.19)	-0.06	-0.34 (0.18)	-0.09
smoker=1	0.32* (0.21)	0.12	0.29 (0.26)	0.17	0.46 (0.30)	0.23	-0.15 (0.36)	-0.04
<i>N of obs</i>	5083		1174		2216		1093	
<i>Log L</i>	-12284.63		-6123.07		-5136.79		-2709.51	
<i>Wald/LR <math>\chi^2</math> (19)</i>	1210.76		347.61		339.19		281.94	
<i>Prob&gt;<math>\chi^2</math></i>	0.0000		0.0000		0.0000		0.0000	

*Notes:* Specifications also include constant term and dummies for highest educational qualifications (degree, O level, A level, HND) and whether the head of household is a member of an occupational pension scheme. White standard errors (clustered) in parentheses (for whole sample: 2216 groups (households), mean groups 2.2) are quoted. Marginal effects are conditional on being uncensored (for whole sample: 3,277 observations censored at 0, 1,806 uncensored observations). \*\*=1% level of significance; \*=5% level of significance.

**Table 3:**  
**Estimates For LTV Dummies (With and Age Dummies): Random Effects Model**

<i>Specification:</i> Random Effects Tobit <i>LHS Variable:</i> Unsecured Debt (£)	(1) Whole Sample Coefficients	(1a) Marginal Effects	(2) Aged 20-34 Coefficients	(2a) Marginal Effects	(3) Aged 35-49 Coefficients	(3a) Marginal Effects	(4) Aged 50-65 Coefficients	(4a) Marginal Effects
0<LTV<0.1	1.50** (0.38)	0.53	1.05** (0.31)	0.38	1.48** (0.39)	0.43	1.78** (0.38)	0.79
0.1<LTV<0.2	1.27** (0.33)	0.55	1.17** (0.36)	0.38	1.38** (0.31)	0.46	1.46** (0.31)	0.80
0.2<LTV<0.3	1.49** (0.32)	0.61	1.21** (0.38)	0.46	1.51** (0.42)	0.49	1.73** (0.36)	0.83
0.3<LTV<0.4	1.89** (0.33)	0.78	1.36** (0.37)	0.56	2.26** (0.49)	1.31	2.13** (0.38)	1.05
0.4<LTV<0.5	2.98** (0.32)	1.36	1.46** (0.41)	0.59	2.44** (0.46)	1.76	3.58** (0.41)	1.59
0.5<LTV<0.6	2.54** (0.36)	1.22	1.88** (0.52)	0.63	2.86** (0.38)	1.71	3.19** (0.48)	1.51
0.6<LTV<0.7	3.58** (0.37)	1.24	2.12** (0.48)	1.10	4.29** (0.42)	1.68	3.76** (0.43)	1.43
0.7<LTV<0.8	2.94** (0.41)	0.86	2.32** (0.49)	1.26	3.78** (0.39)	0.61	3.01** (0.49)	1.26
0.8<LTV<0.9	2.58** (0.42)	0.66	2.38** (0.48)	1.32	3.16** (0.42)	0.51	-	-
0.9<LTV<1	3.05** (0.49)	0.81	2.51** (0.51)	1.38	3.51** (0.48)	0.50	-	-
<i>N of obs</i>	5083		1174		2216		1093	
Log L	-12140.34		-5791.26		-5083.49		-2481.39	
Wald/LR $\chi^2$ (28)	1291.34		356.58		348.23		271.29	
Prob> $\chi^2$	0.0000		0.0000		0.0000		0.0000	

Figure 3  
 Estimated Coefficients for Young and Middle-Aged Households (from Table 3)



**Table 4a**  
**Collateral Constraints and Mortgage Refinancing**  
**Change in Self-Reported House Prices (£'000s)**

<i>Specification:</i> Probit	(1)		(2)		(3)	
	Coeff.	M.E.	Coeff.	M.E.	Coeff.	M.E.
<i>LHS Variable:</i> Whether remortgaged						
$\Delta$ LTV ratio	0.07 (0.06)	0.01	-	-	-	-
$\Delta$ LTV ratio* LTV>0.8 <sub>t-1</sub>	-	-	0.18 (0.14)	0.03	0.16 (0.15)	0.03
$\Delta$ LTV ratio* LTV<0.8 <sub>t-1</sub>	-	-	0.11 (0.14)	0.02	0.12 (0.11)	0.02
$\Delta$ LTV ratio* Un. Debt>1000 <sub>t-1</sub>	-	-	-0.46** (0.07)	-0.15	-	-
$\Delta$ LTV ratio* Un. Debt<1000 <sub>t-1</sub>	-	-	0.21 (0.17)	0.05	-	-
$\Delta$ LTV ratio* Un. Debt>1500 <sub>t-1</sub>	-	-	-	-	-0.53** (0.08)	-0.18
$\Delta$ LTV ratio* Un. Debt<1500 <sub>t-1</sub>	-	-	-	-	0.11 (0.08)	0.03
$\Delta$ income	0.01** (0.001)	0.002	0.01** (0.001)	0.002	0.01** (0.001)	0.002
$\Delta$ assets	-0.003** (0.001)	-0.0008	-0.003** (0.001)	-0.0008	-0.003** (0.001)	-0.0008
$\Delta$ employment	0.53** (0.14)	0.1	0.50** (0.13)	0.1	0.51** (0.14)	0.1
$\Delta$ partner	-0.06 (0.09)	-0.01	-0.07 (0.09)	-0.01	-0.08 (0.09)	-0.01
$\Delta$ no.children	0.14** (0.04)	0.03	0.15** (0.04)	0.03	0.16** (0.04)	0.03
<i>N of obs</i>	3154		3154		3154	
Log L	-1139.12		-1128.16		-1129.29	
<i>Wald/LR <math>\chi^2</math></i>	412.29		451.29		446.18	
<i>Prob&gt;<math>\chi^2</math></i>	0.0000		0.0000		0.0000	
<i>Pseudo R<sup>2</sup></i>	0.19		0.19		0.19	

*Notes:* Additional variables are beginning of period income, (income squared), assets (assets squared), employment status dummy, retired dummy, no. of benefits, educational qualification dummies, a quadratic in age, sex and a dummy variable for whether the head of household is a member of an occupational pension plan. White standard errors in parenthesis.

**Table 4b**  
**Collateral Constraints and Mortgage Refinancing**  
**Estimates for Age Sub-Groups and County-Level House Prices**

	$\Delta$ LTV ratio* LTV>0.8 <sub>t-1</sub>	$\Delta$ LTV ratio* LTV<0.8 <sub>t-1</sub>	$\Delta$ LTV ratio* Un.Debt>1000 <sub>t-1</sub>	$\Delta$ LTV ratio* Un.Debt<1000 <sub>t-1</sub>
Whole Sample	0.18 0.03 (0.14)	0.11 0.02 (0.14)	-0.46** -0.15 (0.07)	0.21 0.05 (0.17)
Aged 20-34	0.35 0.09 (0.20)	0.18 0.03 (0.12)	-0.85** -0.34 (0.35)	0.19 0.04 (0.11)
Aged 35-49	0.18 0.04 (0.16)	0.12 0.02 (0.10)	-0.64** -0.16 (0.25)	0.20 0.05 (0.13)
Aged =>49	0.06 0.01 (0.09)	0.07 0.01 (0.06)	-0.14* -0.07 (0.06)	0.22 0.06 (0.20)
	$\Delta$ county house price* LTV>0.8 <sub>t-1</sub>	$\Delta$ county house price * LTV<0.8 <sub>t-1</sub>	$\Delta$ county house price * Un.Debt>1000 <sub>t-1</sub>	$\Delta$ county house price* Un.Debt<1000 <sub>t-1</sub>
Whole Sample	0.19 0.006 (0.12)	0.006 0.002 (0.011)	-0.27* -0.16 (0.012)	0.015 0.007 (0.01)
Aged 20-34	0.04 0.001 (0.08)	0.08 0.01 (0.06)	-0.57** -0.24 (0.25)	0.08 0.01 (0.08)
Aged 35-49	0.16 0.009 (0.15)	0.01 0.005 (0.01)	-0.30** -0.14 (0.11)	0.05 0.008 (0.06)
Aged =>49	0.23 0.11 (0.15)	0.001 0.000 (0.002)	-0.11* -0.08 (0.05)	0.005 0.001 (0.007)

*Sample Sizes:*

Whole Sample: 3154 households.

Aged 20-34: 781. Aged 35-49: 1389. Aged =>49: 984.

*Cell Sizes as % of Sample:*

Whole Sample – LTV > 0.8<sub>t-1</sub> : 18%. Unsecured Debt > 1000<sub>t-1</sub> : 30%.

Aged 20-34 – LTV > 0.8<sub>t-1</sub> : 42%. Unsecured Debt > 1000<sub>t-1</sub> : 39%.

Aged 35-49 – LTV > 0.8<sub>t-1</sub> : 28%. Unsecured Debt > 1000<sub>t-1</sub> : 31%

Aged =>49 – LTV > 0.8<sub>t-1</sub> : 4%. Unsecured Debt > 1000<sub>t-1</sub> : 20%.

*Notes:* Rows present probit estimates using the specification in Column 2 of Table 4a for the whole sample and age sub-groups. Additional variables are beginning of period income, (income squared), assets (assets squared), employment status dummy, retired dummy, no. of benefits, educational qualification dummies, a quadratic in age, sex and a dummy variable for whether the head of household is a member of an occupational pension plan. White's standard errors in parentheses. A full set of estimates are available from the authors on request.

**Table 5a**  
**House Prices and Household Indebtedness**  
**Selectivity-Corrected Estimates**

<i>Specification:</i> Heckman	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>LHS Variable:</i> Change in total debt (unsecured plus secured)		LTV> 0.8 <sub>t-1</sub>	LTV> 0.7 <sub>t-1</sub>	LTV> 0.8 <sub>t-1</sub>	LTV> 0.7 <sub>t-1</sub>	LTV> 0.8 <sub>t-1</sub>	LTV> 0.7 <sub>t-1</sub>
$\Delta$ house price (£000s)	-0.01 (0.01)	-	-	-	-	-	-
$\Delta$ house price* LTV>0.X <sub>t-1</sub>	-	0.02 (0.02)	0.01 (0.02)	0.01 (0.01)	0.01 (0.01)	0.01 (0.02)	0.01 (0.02)
$\Delta$ house price* LTV<0.X <sub>t-1</sub>	-	-0.01 (0.01)	-0.02 (0.01)	-0.03 (0.02)	-0.03 (0.02)	-0.02 (0.02)	-0.03 (0.03)
$\Delta$ house price* LTV>0.X <sub>t-1</sub> Un. Debt>1000 <sub>t-1</sub>	-	-	-	0.31** (0.07)	0.20** (0.04)	-	-
$\Delta$ house price* LTV<0.X <sub>t-1</sub> Un. Debt>1000 <sub>t-1</sub>	-	-	-	0.05 (0.06)	0.01 (0.01)	-	-
$\Delta$ house price* LTV>0.X <sub>t-1</sub> Un. Debt>1500 <sub>t-1</sub>	-	-	-	-	-	0.42** (0.06)	0.30** (0.07)
$\Delta$ house price* LTV<0.X <sub>t-1</sub> Un. Debt>1500 <sub>t-1</sub>	-	-	-	-	-	0.04 (0.04)	0.02 (0.02)
$\Delta$ income (£000s)	0.07** (0.03)	0.09** (0.03)	0.06** (0.03)	0.05** (0.02)	0.06** (0.02)	0.05** (0.02)	0.07** (0.02)
$\Delta$ assets (£000s)	0.02 (0.04)	0.03 (0.04)	0.04 (0.05)	0.03 (0.05)	0.02 (0.05)	0.03 (0.05)	0.02 (0.05)
$\Delta$ employment	1.95 (1.27)	1.83 (1.23)	1.83 (1.24)	1.84 (1.20)	1.82 (1.26)	1.81 (1.25)	1.83 (1.24)
$\Delta$ partner	0.61 (0.41)	0.62 (0.40)	0.69 (0.41)	0.65 (0.38)	0.67 (0.41)	0.68 (0.42)	0.65 (0.43)
age	-0.57** (0.21)	-0.57** (0.20)	-0.57** (0.24)	-0.54** (0.22)	-0.55** (0.23)	-0.57** (0.22)	-0.56** (0.24)
age <sup>2</sup>	0.01** (0.002)	0.01** (0.004)	0.01** (0.003)	0.01** (0.005)	0.01** (0.004)	0.01** (0.005)	0.01** (0.005)
N	3154	3154	3154	3154	3154	3154	3154
Censored Obs.	660	660	660	660	660	660	660
Uncensored Obs.	2494	2494	2494	2494	2494	2494	2494
Wald/LR $\chi^2$	72.45	73.26	73.98	73.23	73.42	73.59	73.68
P> $\chi^2$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

*Notes:* Additional variables are beginning of period income, (income squared), assets (assets squared), employment status dummy, retired dummy, no. of benefits, educational dummies, sex, change in number of children and a dummy variable for whether the head of household is a member of an occupational pension plan. Coefficient (standard errors in parenthesis). \*\*=1% level of significance; \*=5% level of significance. Heckman specification with total 3154 observations (660 observations for moving households). Results reported are for non-movers.

**Table 5b**  
**House Prices and Household Indebtedness**  
**Selectivity-Corrected and Uncorrected Estimates for Age Sub-Groups**

<i>Selectivity – Corrected Estimates</i>				
	$\Delta$ house price* LTV>0.8 <sub>t-1</sub>	$\Delta$ house price* LTV<0.8 <sub>t-1</sub>	$\Delta$ house price* LTV>0.8 <sub>t-1</sub> * Un.Debt>1000 <sub>t-1</sub>	$\Delta$ house price* LTV<0.8 <sub>t-1</sub> * Un.Debt>1000 <sub>t-1</sub>
Whole Sample	0.01 (0.01)	-0.02 (0.02)	0.31** (0.07)	0.05 (0.06)
Aged 20-34	0.01 (0.01)	-0.02 (0.02)	0.47** (0.12)	0.06 (0.04)
Aged 35-49	0.01 (0.01)	-0.02 (0.02)	0.34** (0.08)	0.05 (0.05)
Aged =>49	0.01 (0.01)	-0.01 (0.02)	0.21** (0.06)	0.04 (0.06)
<i>Uncorrected Estimates</i>				
Whole Sample	0.01 (0.01)	-0.02 (0.02)	0.46** (0.11)	0.13* (0.06)
Aged 20-34	0.02 (0.02)	-0.02 (0.03)	0.52** (0.13)	0.14* (0.07)
Aged 35-49	0.01 (0.01)	-0.02 (0.02)	0.45** (0.10)	0.10* (0.06)
Aged => 49	0.01 (0.01)	-0.02 (0.02)	0.31** (0.06)	0.08 (0.07)

*Sample Sizes and Cell Sizes: as Table 4b.*

*Notes:* Rows present estimates using the specification in Column 4 of Table 5a the whole sample and age sub-groups. Additional variables are beginning of period income, (income squared), assets (assets squared), employment status dummy, retired dummy, no. of benefits, educational dummies, sex, change in number of children and a dummy variable for whether the head of household is a member of an occupational pension plan. Coefficients (standard errors in parentheses). \*\*=1% level of significance; \*=5% level of significance. Results reported are for non-movers. . A full set of estimates are available from the authors on request.

## References

- Aoki, K., Proudman, J. and Vlieghe, G. (2004) 'House prices, consumption, and monetary policy: a financial accelerator approach', *Journal of Financial Intermediation*, 13, 414-435.
- Aron, J. and Muellbauer, J. (2006) 'Housing wealth, credit conditions and consumption', *Centre for the Study of African Economics Working Paper 2006: No.8*.
- Attanasio, O. and Weber, G. (1994), "The UK consumption boom of the late 1980s: aggregate implications of microeconomic evidence", *Economic Journal*, 104: 1269-1302.
- Attanasio, O., Blow, L., Hamilton, R. and Leicester, A. (2005) 'Consumption, house prices and expectations', *forthcoming, Economica*.
- Banks, J., Blundell, R. and Smith, J.P. (2003) 'Understanding differences in household financial wealth between the United States and Great Britain', *Journal of Human Resources*, 38, 2, 241-279.
- Banks, J., Blundell, R., Oldfield, Z. and Smith, J. (2004) 'House price volatility and housing ownership over the life cycle', *Discussion Paper 04-09*, University College, London.
- Benito, A. (2007) 'Who withdraws housing equity and why?' *forthcoming, Economica*.
- Benito, A. and Mumtaz, H. (2006), 'Consumption Excess Sensitivity and the Collateral Role of Housing', *Bank of England Working Paper No. 306*.
- Benito, A. and Power, J. (2004), 'Housing Equity and Consumption: Insights from the Survey of English Housing.', *Bank of England Quarterly Bulletin*, Autumn.
- Bernanke, B., Gertler, M., and Gilchrist, S. (1999) 'The financial accelerator in a quantitative business cycle framework', 1341-1393 in Taylor, J.B. and Woodford, M. (eds) *Handbook of Macroeconomics*, Vol 1C, Amsterdam, Nld: Elsevier Science, North Holland.
- Bhatia, K. B. (1987), "Real estate assets and consumer behaviour", *Quarterly Journal of Economics*, 102: 437-443.
- Bridges, S. and Disney, R. (2004) 'Use of credit and arrears on debt among low-income families in the United Kingdom', *Fiscal Studies*, 25, March, 1-25.
- Bridges, S., Disney, R. and Henley, A. (2006) 'Housing wealth and the accumulation of financial debt: Evidence from UK households', 135-180 in Bertola, G., Disney, R. and Grant, C. (eds) *The Economics of Consumer Credit*, Cambridge, Mass: MIT Press.
- Campbell, J. Y. and Cocco, J. F. (2006) 'How do house prices affect consumption? Evidence from micro data', *Journal of Monetary Economics*, 54, 591-621.
- Case, K. (2000) 'Real estate and the macroeconomy', *Brookings Papers on Economic Activity*, 2, 119-162.
- Carroll, C. (2004) 'Housing wealth and consumption expenditure', mimeo, Department of Economics, Johns Hopkins University, Baltimore, Md.
- Chatterjee, S., Corbae, D., Nakajima, M. and Rios-Rull, J-V. (2007) 'A quantitative theory of unsecured consumer credit with risk of default', *Econometrica*, 75, November, 1525-1589.
- Disney, R., Gathergood, J. and Henley, A. (2007) 'House price shocks, negative equity and household consumption in the UK', *Working Paper 07-12*, Centre for Finance and Credit Markets, School of Economics, University of Nottingham.
- Duygan, B. and Grant, C. (2006) 'Household debt and arrears: what role do institutions play?', presented at Finance and Consumption workshop, EUI, May 2006.

- Elul, R. (2006) 'Collateral, credit history and the financial decelerator', *mimeo*, Federal Reserve Bank of Philadelphia.
- Engelhardt, G.V. (1996) 'House prices and home owner saving behaviour', *Regional Science and Urban Economics*, 26: 313-336.
- Gross, D. and Souleles, N. (2002) 'Do liquidity constraints and interest rates matter for consumer behavior? Evidence from credit card data', *Quarterly Journal of Economics*, 117, 2, 149-185.
- Iacoviello, M. (2004) 'Consumption, house prices, and collateral constraints: a structural econometric analysis', *Journal of Housing Economics*, 13, 304-320.
- Iacoviello, M. (2005) 'House prices, borrowing constraints, and monetary policy in the business cycle', *American Economic Review*, 95, 739-764.
- Jappelli, T. (1990) 'Who is credit constrained in the US economy?', *Quarterly Journal of Economics*, 105, 1, 219-234.
- Kehoe, T. and Levine, D. (2001) 'Liquidity constrained markets versus debt constrained markets', *Econometrica*, 69, 3, 575-598.
- Muellbauer, J. and Murphy, A. (1990), 'Is the UK balance of payments sustainable?', *Economic Policy*, 347-382.
- Skinner, J. (1989) 'Housing wealth and aggregate saving' *Regional Science and Urban Economics*, 19, 305-324.

## Footnotes

---

<sup>1</sup> For further explanation and representative empirical studies on housing wealth for the US using household data, see Bhatia, 1987; Case, 2000; Carroll, 2004; Engelhardt, 1996; Skinner, 1989; recent studies for the UK include Attanasio *et al*, 2005, Campbell and Cocco, 2006; Disney, Gathergood and Henley, 2007.

<sup>2</sup> The statistics in this and the next paragraph are drawn from the Bank of England Monetary and Financial Statistics available online at <http://www.bankofengland.co.uk>

<sup>3</sup> For households with an endowment mortgage we assume the mortgage balance is outstanding until the endowment is redeemed. We further assume the asset accumulates at a constant proportional return such as to pay-off the mortgage balance at redemption. This value is offset against the outstanding secured debt in order to calculate the current loan value.

<sup>4</sup> Personal Equity Plans (PEPs), Tax Exempt Special Savings Accounts (TESSAs) and Individual Savings Accounts (ISAs) are all untaxed personal savings accounts allowing holders to avoid income tax on investment returns, initially introduced to encourage stock market-related investments but later extended to unit / investment trusts and corporate bonds as well as cash deposits. TESSAs and PEPs were available for investment between 1987 and 1999 when they were replaced by less-generous ISAs with a lower limit on the value of tax-free investments.

<sup>5</sup> The exact form of the question asked is: “*Approximately how much is the total amount of your outstanding loans on all the property you (or your household) own, including your current home?*”

<sup>6</sup> It is notable that households hold both financial assets and unsecured debt (see also Banks, Blundell and Smith, 2003). The definition of financial assets includes less liquid classifications such as Individual Savings Accounts and National Savings which may involve transaction costs and fixed-term commitments

<sup>7</sup> See Duygan and Grant (2006). Lower self-reported credit constraints for other OECD countries may of course simply reflect a greater incidence of discouraged borrowers who do not expect to be offered credit, but this finding nevertheless suggests that caution should be exercised in using the self-reported incidence of credit constraints.

<sup>8</sup> Source: correspondence by the authors with the Halifax Bank Housing Research Unit. Average LTV evidence based on first-time buyer mortgage originations in the calendar year 1995.

<sup>9</sup> Changes in county-level house values are calculated using the Halifax Local House Price Index.

<sup>10</sup> We also the sensitivity of these results to varying the cut-off levels of a ‘high’ LTV ratio and ‘high’ unsecured debt to 0.7 and £1500 respectively, which raises the number of households captured by the LTV ratio dummy to 36% and lowering the proportion for the unsecured debt dummy to 21%. The estimates are consistent with the interpretation outlined above: there remains no significantly different response to changes in the LTV ratio for households with initial levels of the ratio above or below 0.7. The coefficient on the unsecured debt interaction increases with this alternative specification, consistent with higher levels of unsecured debt providing a greater incentive for households to refinance for a given change in the LTV ratio

<sup>11</sup> According to the Survey of English Housing, administered by the UK’s Department of Communities and Local Government for 2005-6, 56% of households reporting housing equity withdrawal reported that they used it to fund home improvements, 29% reported that they used it to reduce debt, and 15% reported that they used it directly to finance household purchases.