Household External Finance and Consumption

Timothy Besley
Bank of England and LSE

Neil Meads
Bank of England

Paolo Surico*
Bank of England

Draft: February 2008

Abstract

This paper uses mortgage data to construct a measure of terms on which households access to external finance, and relates it to consumption at both the aggregate and cohort levels. The Household External Finance (HEF) index is based on the spread paid by risky borrowers in the mortgage market. There is evidence that the terms of access to external finance matter more for the consumption of young cohorts in U.K. data. Results are robust to a wide variety of specifications.

JEL Classification: D10, E21, G21

Keywords: external finance, terms of access, household consumption, birth cohorts, pseudo panels.

*We are grateful to Charlie Bean and Richard Blundell for comments, and to Andrew Leicester and Emilio Fernandez-Corugedo for invaluable help with the FES and SML data respectively. The views expressed in this paper are those of the authors, and do not necessarily reflect those of the Bank of England or other members of the Monetary Policy Committee. Correspondence: External Monetary Policy Committee Unit, Bank of England, Threadneedle Street, London EC2R 8AH, United Kingdom. E-mail: tim.besley@bankofengland.co.uk, neil.meads@bankofengland.co.uk, paolo.surico@bankofengland.co.uk.

1 Introduction

The impact of credit availability on consumption behavior is a central issue in both theory and practice. The most stylized permanent income model assumes that households can use a combination of saving (internal finance) and borrowing (external finance) with consumption growth being governed by the real interest rate. A standard caveat to this prediction comes from the possibility that some households may face unfavorable conditions for accessing external finance – either because such finance is rationed or else because the terms are not attractive. However, even though the availability of external finance plays a central role in theoretical thinking about consumption, evidence for its empirical importance remains quite limited.

From a macro-economic point of view, access to credit may play an important role in the monetary transmission mechanism. The conventional financial accelerator model, as discussed in Bernanke, Gertler and Gilchrist (1999), tends to focus on how credit conditions affect the investment decisions of firms. This paper emphasizes similar issues in regard to consumption decisions. This is particularly relevant at present times given the turbulence in financial markets that has been experienced around the globe. A key question is how far these developments will lead to a slow down in consumption growth.

This paper explores the importance of external finance for consumption in the U.K. using a novel measure of the terms available for household external finance, which is constructed from mortgage data.[1] The measure that we used is constructed from the spread over the Bank of England's policy rate paid by the riskiest borrowers. We argue, using a simple model, that this spread should reflect lenders' perceptions of default risk, i.e. the risk/liquidity premium relative to Libor that lenders use to price mortgages, as well as competitive conditions in the mortgage market.

We make two main contributions to the literature on financial constraints and consumption. First, we construct an aggregate index of households' external cost of finance for the U.K. over the period 1975-2005 using mortgage data. Second, we use this index to measure the empirical relevance of financing conditions on consumption growth across household cohorts. Our measure of external financing is based on the spread between borrower-specific mortgage rate and a risk-free rate, and therefore captures the price

[1] The main idea of the paper takes off from earlier work by Fernandez-Corugedo and Muellbauer (2006), who first measured credit conditions using secured lending data from the Survey of Mortgage Lenders. However, we use a rather different procedure to extract our measure. We discuss the methodological differences further below.

of borrowing rather than simply the quantity of credit which consumers have access to.

An increase in households' cost of external financing due to a larger spread between the interest rate charged to borrowers and the policy rate, will tend to depress current consumption. This is because borrowing is less attractive to households.[2] Thus, we expect a negative correlation between our Households' External Financing (HEF) index and consumption growth. We show that this is indeed the case using data from the Family Expenditure Survey (FES). We find this both at the aggregate level and when we disaggregate the data by birth cohort, creating a pseudo panel. The latter exercise reveals that the consumption of the relatively younger cohorts has been the most responsive to our measure of access to external finance.

In Figure 1, the basic pattern that we uncover in the data is illustrated. In particular, we plot our HEF index against aggregate non-housing consumption growth as measured in the U.K. Family Expenditure Survey. Higher values of the HEF measure reflect a larger spread being charged to risky borrowers. The Figure suggests a negative correlation between the HEF index and consumption growth: the raw correlation is -0.41. We will explore these issues more carefully in what follows.

The next section reviews related theoretical and empirical literature. In section 3, we present a simple model of the credit market and derive our index of households' external costs of finance from the SML dataset. Section 4 shows how we use the HEF index in the micro data on household expenditure. In section 5, we present estimates of a consumption function using aggregate and disaggregate data from the FES to assess the impact of the external financing cost index on household expenditure across cohorts. The robustness of the main findings are assessed in section 6 which shows that the results are insensitive to alternative specifications, measures of consumption and level of disaggregation. In section 7, we explore links to housing more directly and section 8 concludes. A description of the data is detailed in the Appendix.

2 Related Literature

Our paper is related to the vast prior literature on the determinants of consumption beginning from the classic work of Friedman (1957) and his

[2] One might expect the conditions associated with higher spreads also to be associated with greater credit rationing, which also lowers current consumption compared to the past. Thus the empirical implications for consumption on either interpretation are similar.

statement of the permanent income hypothesis. In a seminal paper, Hall (1978) developed the implications of the model for aggregate consumption using the Euler equation.

The model has been augmented in a variety of directions. Deaton (1991) introduced precautionary savings motive for holding assets and so expanded income to a cash in hand term which covers consumer impatience to model how consumption relates to income given precautionary saving/liquidity constraints. Carroll (1997) also employs a buffer stock version of the permanent income hypothesis.

The implications of liquidity constraints were developed by Zeldes (1989) who emphasizes consumers would be expected to have faster consumption growth between time t and $t+1$ as constraints kept consumption at time t artificially low. Ludvigson (1999) develops a version of the model in which liquidity constraints are binding stochastically.

The link between liquidity constraints and consumption has been the subject of a vast empirical literature that is difficult to condense in a few paragraphs.[3] On macro data, Jappelli and Pagano (1989), Campbell and Mankiw (1989), and Attanasio and Weber (1993) establish the excess sensitivity of consumption to income, which they interpret as indirect evidence for the existence of liquidity constraints.

On international data, Ludvigson (1999), and Bacchetta and Gerlach (1997) provide evidence on the relationship between credit aggregates and aggregate consumption. Calza, Monacelli and Stracca (2007) show that the interest rate elasticity of consumption depends on the structure of a country mortgage market.

The most related contribution to this paper is the work by Aron and Muellbauer (2007). They use an error correction model on aggregate U.K. data from the Office for National Statistics (ONS) to investigate whether the credit conditions index constructed in Fernandez-Corugedo and Muellbauer (2006) affects consumption.

This paper builds on Fernandez-Corugedo and Muellbauer's idea of using data from mortgage lenders and construct a measure of households' access to external finance. Our measure is designed to capture changes in the terms on which external finance is available to households. A further contribution of our paper is to use micro data on households' expenditure aggregated at the birth cohort level to test for heterogeneity in the effects of external financing conditions on consumption.

The idea of using data on cohorts to study consumption was first ex-

[3] See Deaton (1992) and Browning and Lusardi (1996) for an overview.

ploited in Attanasio and Weber (1994 and 1995), and used also in Banks, Blundell and Tanner (1998) and Banks, Blundell and Brugiavini (2001). They report Euler equation estimates for the U.K. and the U.S. which are inconsistent with the permanent income hypothesis.

Using micro data, Hall and Mishkin (1982), Zeldes (1989) and Johnson, Parker and Souleles (2006) for the U.S., and Benito and Mumtaz (2006) for the U.K. develop methods to infer the proportion of liquidity constrained households from expenditure data. Their evidence, however, is indirect since no data from credit market conditions are used in the estimation.

To the best of our knowledge, only few studies have provided direct evidence on the link between consumption and liquidity constraints using micro data. In two event studies, Gross and Souleles (2002), and Agarwal, Liu and Souleles (2007) use credit card data to investigate the impact of credit card limits and the 2001 tax rebates on households' debt. Attanasio, Goldberg and Kyriazidou (2007) use data on car loans to explore the relationship between loan conditions and loan demand. In the study most closely related to our paper, Jappelli, Pischke and Souleles (1999) use the credit index in Jappelli (1990) to estimate a regime-switching Euler equation model on food expenditure. Furthermore, all these studies are for the U.S..

It is worth emphasizing that, unlike previous contributions on micro data, we construct a financing cost index for the whole economy by looking at the lending conditions offered to mortgagors.[4] Furthermore, our index is a time series describing the evolution of the household access to external finance in the U.K. over the last thirty years. This contrasts with the credit measure in Jappelli (1990) which is drawn from a single cross-section drawn from the 1983 Survey of Consumer Finance.

3 Measuring the cost of external finance

The centerpiece of our analysis is a measure of the terms on which riskier borrowers can access external finance. To motivate the exact measure that we use, we present a simple theoretical model of the pricing of mortgage loans. We then discuss how a regression of household borrowing rates on household characteristics allows us to estimate an index of household external finance access. We then discuss briefly how this relates to our specification of a consumption equation.

[4] According to the 2007 NMG Research survey, mortgagors hold the vast majority of UK unsecured debt (see Waldron and Young, 2007).

3.1 Theoretical Background

To motivate our measure of the terms on which households gain access to external finance, suppose that a mortgage can be viewed as a series of one period debt contracts and priced relative to a lender's (risk adjusted) opportunity cost of funds denoted by ρ_t. The assumption of a sequence of one period debt arrangements is reasonable for the U.K. market where few borrowers are locked into loan arrangements for significant periods.

Consider a borrower whose probability of repayment is $p(\theta_{it}, z_{it})$ where z_{it} are variables that are observable to the lender and θ_{it} are unobserved. We suppose that the latter is a scalar and that $\partial p / \partial \theta_{it} < 0$ so that higher θ_{it} is associated with lower default. The lender will be interested in the distribution of θ_{it} conditional on z_{it} which we denote by $F(\theta | z_{it}, \psi_t)$, where $\partial F(\theta | z_{it}, \psi_t) / \partial \psi < 0$ it induces a first order stochastically dominating shift in the distribution of θ. Let

$$\bar{p}(z_{it}, \psi_t) = E\{p(\theta_{it}, z_{it}) : z_{it}, \psi_t\}.$$

It is easy to see that $\partial \bar{p}(z_{it}, \psi_t) / \partial \psi < 0$.

Normalizing the size of the loan to be one, a competitively determined interest rate for borrower with characteristics (z_{it}) is:

$$\bar{p}(z_{it}, \psi_t)(1 + r(z_{it}, \psi_t)) + (1 - \bar{p}(z_{it}, \psi_t)) \max\{(v_{it} - k), 1 + r(z_{it}, \psi_t)\} = 1 + \rho_t.$$

where v_{it} is the expected value of housing owned by individual i at time t per unit of borrowing and k is the foreclosure cost. Solving for the equilibrium interest rate shows that this will vary for two kinds of borrowers depending on their housing collateral. If $v_{it} - k \geq 1 + r(z_{it}, \psi_t)$ then

$$r(z_{it}, \psi_t) = \rho_t.$$

These individuals are low risk borrowers whose housing collateral is sufficient to repay their loan and cover foreclosure costs in all states of the world. Their loan rate moves with the risk adjusted opportunity cost of funds. Thus, we would expect their borrowing rates to vary with changes in the degree of competition in the mortgage market and/or factors that change either risk or liquidity premia in the market for loanable funds.

If $v_t - k_{it} < 1 + r(z_{it}, \psi_t)$, then:

$$r(z_{it}, \psi_t) = \rho_t + \left[\frac{1 - \bar{p}(z_{it}, \psi_t)}{\bar{p}(z_{it}, \psi_t)}\right][1 + \rho_t - (v_{it} - k)]$$

where the second term on the right hand side represents an additional premium for riskier borrowers. This can be thought of as the households' counterpart of the firms' external finance premium in Bernanke, Gertler and Gilchrist (1999).

The household risk premium will change with the ψ_t factors that affect the subjective risk assessment and with expected house prices. In a world where v_{it} is increasing and/or ψ_t is decreasing, then interest rate premia charged to riskier borrowers will be greater.

Suppose that

$$\rho_t = \alpha_t \left[\rho_t^0 + \rho_t^1\right]$$

where ρ_t^0 is Bank Rate and ρ_t^1 is an unobserved risk/liquidity premium and α_t is a mark-up reflecting competition in the credit market. Then our measure of household external finance, HEF_{it}, is:

$$\begin{aligned} HEF_{it} &= r\left(z_{it}, \psi_t\right) - \rho_t^0 \qquad (1) \\ &= \begin{cases} (\alpha_t\text{-}1)\rho_t^0+\alpha_t\rho_t^1 & \text{if } v_{it}\text{-}k \geq 1+(\alpha_t\text{-}1)\rho_t^0+\alpha_t\rho_t^1 \\ (\alpha_t\text{-}1)\rho_t^0+\alpha_t\rho_t^1+(\frac{1-\bar{p}}{\bar{p}})[1+\rho_t\text{-}(v_{it}\text{-}k)] & \text{otherwise} \end{cases} \end{aligned}$$

where, for notational convenience, we have not written explicitly the arguments of the $\bar{p}(\cdot)$ function.

Suppose that we can observe in the data $\left(z_{it} \text{ and } \rho_t^0\right)$, then the expressions in (1) show that we should be able to extract information about changes over time in α_t and ρ_t^1 from all borrowers. However, for the riskiest borrowers we can extract information about the house price expectations and subjective estimate of ψ_t by looking at the spreads they paid. This is the empirical procedure that we follow.[5]

3.2 Empirical Implementation

In this section, we present the construction of our index of households' external financing costs based upon the SML dataset, whose full description is given in the Appendix. An average of 40,000 randomly selected borrowers has been surveyed each year over the period 1975-2005. The number of interviewees ranges from 35,000 in 1975 to 115,000 in 2005.

[5] In fact, α_t and ρ_t^1 affect the classification of a borrower as risky in our terms, and the dependence of the spread on these variables is different for riskier borrowers. This is consistent with the observation on U.K. data that the spread of mortgage rates over the Bank rate varies with the collateral position of each household (see Aoki, Proudman and Vlieghe 2004).

Following from the discussion in the previous section, our goal is to create a measure which captures the terms on which households can gain access to credit. Empirically, we will model equation (1) using micro data where we control for individual characteristics and macroeconomic conditions. The left hand side variable will be the spread between the rate individuals are charged on new mortgage lending and the 3 month Treasury Bill rate in the month that lending occurred.

We run a regression of the borrower-specific rate spread, x_i, on a number of explanatory variables expressed in logarithms. Year dummies control for aggregate economic effects. Our basic regression takes the following form:

$$x_i = \mu_t + \mu_r + \gamma z_i + \varphi hp_{rt} + \varepsilon_{it} \tag{2}$$

where μ_t is a vector of year dummy variables, μ_r is a vector of (Standard Statistical) region dummy variables and z_i includes the income, y_i, age, loan size, the value of the house, v_i, age interacted with loan value, house value and income for the individual i, and regional house price, hp_{rt}.

The estimates of a number of specifications based on equation (2) are reported in Table 1. In column 1, the matrix z_{it} only includes the loan to income (lti) ratio. This is positively and significantly associated with the spread as is its interaction with age. Higher loan to value (ltv) ratios in column 2 also imply significantly larger spreads. The point estimates are robust to including both lti and ltv as in column 3.

In the last three columns of Table 1, we relax the restrictions that loan and income, on the one hand, and loan and value, on the other hand, enter the interest rate spread regression with the same coefficients. In the most general specification in column 6, the variables loan, income and values have the expected signs. The regional house price index is negative and significant whereas the effects of age are statistically different from zero only in the interaction with income, y_{it}, although the coefficient is small in size.

The residuals, ϵ_{it}, reflect unobserved supply side components for each individual in our sample, and therefore give us some insight into how far some individuals are from the regression line based on the observables. As we saw above, we would expect riskier borrowers to be charged a rate that is higher conditional on z_{it} and this will show up as a residual far from the regression line.

We create our aggregate HEF index by taking the 90^{th} percentile of residuals within each year, and then combining into a time series. Our decision to exploit information on riskier borrowers classified this way is motivated by the idea (supported in the simple theoretical model above) that, on the margin, this may be the important group as their access to credit may be most driven by changes in structural conditions in the credit market due to securitization, competition and factors affecting default risk. The choice of the 90^{th} percentile reflects our desire to pick up what has been happening with riskier borrowers.

It is worth to notice that the six specifications in Table 1 lead to the very similar HEF indices.[6] Obviously, the choice of an exact cutoff in the interest rate spread distribution is somewhat arbitrary. In what follows, we will mainly focus on the 90^{th} percentile based on the estimates in column 6 but we will test the robustness of our finding against looking at the $75th$ percentile.

To investigate any possible variation across borrowers, we also construct group-specific indices by taking the 90^{th} percentile of the households' residuals within each cohort, including only the participant mortgagors who were born in the periods $1941-45, 46-50, 51-55, 56-60, 61-65, 66-70$. To the extent that our HEF index is a genuine measure of supply conditions, we should observe little variation across birth cohorts.

In Figure 2, we plot our HEF index against annual FES consumption growth for each cohort. High values of the HEF index represent an increase in the households' cost of external financing. We note that the contemporaneous correlations between cohort consumption and the HEF index is always negative with a peak for the households in the middle cohorts.[7] The HEF index, however, displays little variation across groups.[8]

Several previous studies have focused on the construction of an aggregate measure of UK credit conditions, with a view to capture the waves of financial liberalization occurred since the early 1980s. Fernandez-Corugedo and Muellbauer (2006), for instance, define their index as the principal component of a system of ten aggregate credit indicators. Their measure shows a steady pattern towards looser conditions moving from the early 1980s to the 2000s.

Our index shares with its predecessors a time trend toward more benign credit conditions. Being based on an interest rate spread rather than on

[6] The $90th$ percentile of the raw spread is significantly different from the $90th$ percentile of the residuals from a regression of the spread on year and region dummies only. Once we control for macroeconomic conditions, however, the addition of loan size, income, age and house value as explanatory variables has virtually no impact on the HEF index.

[7] In particular, the correlations are: -0.02 (1941-45), -0.25 (46-50), -0.53 (51-55), -0.44 (56-60), -0.26(61-65), -0.05 (66-70).

[8] We have carried out a similar exercise for (Standard Statistical) regions and found that the region-specific HEF indeces are very similar to each others.

loan to income and loan to value ratios, however, it seems better suited to capture the year on year movements in supply side constraints as reflected in movements in the price terms upon which individuals can access credit lines. As such, our measure may reflect information on the external financing costs encountered by households rather than pure institutional changes to the level of access to credit.

To the extent that the *terms* of access to credit markets -and not just the access- matter for consumption, the spread between Libor and the official policy rate should give us a sense for the ability of our index to capture changes in the credit availability for individuals with pre-existing access to the market. In Figure 3, we notice that the correlation between the Libor-policy spread and our HEF index is 0.6.

4 Consumption Growth and External Finance

This section discusses how we use the HEF index to study consumption and how this links back to underlying theories of consumption behavior based on the life-cycle permanent income model.

We expect the measure of external financial conditions that we have extracted from mortgage data to be reflecting how credit markets are pricing risk to riskier classes of borrowers. The theoretical relevance of this to estimating consumption is not immediately clear but can be motivated using the classical Euler equation for inter-temporal consumption employed in most modern empirical work on consumption.

Suppose that each household has a utility function, $u\left(C_{it};\gamma_{it}\right)$, which depends on their consumption, C_{it}, and household-specific characteristics, γ_{it}. In the most basic version of the model, consumers are price takers and optimize given a process for their income and other relevant stochastic variables. They also have access to credit markets to smooth their consumption over the life-cycle. This leads to the standard Euler condition:

$$u_c\left(C_{it},\gamma_{it}\right) = \delta E\left(r_{it+1}u_c\left(C_{it+1},\gamma_{it+1}\right)\right) \tag{3}$$

where $E\left(\cdot\right)$ is the expectations operator and r_{it+1} is the real interest rate between t and t+1 which can be specific to household i.[9] Under the assumption of constant relative risk aversion, we can take logs on both sides of (3) and solve for consumption growth. Accounting for excess sensitivity

[9] In one of the sensitivity analysis, we will use the household-budget shares to construct a divisia price index, and thus also the real interest rate will become household-specific.

to income yields the baseline equation that is typically estimated on macro and micro data.

In theory, augmenting the model to incorporate liquidity constraints is accomplished by specifying an additional constraint on the consumers' optimization problem (see, for example, Zeldes, 1989). This constraint reflects access to credit which binds for a given consumer in some time periods. Define λ_{it} as the extra utility stemming from relaxing the liquidity constraint at time t, then it makes most sense to think of our HEF_t measure as reflecting the aggregate factors which make it more or less likely that λ_{it} is positive, i.e. individuals are borrowing constrained.

An alternative interpretation of our interest rate spread measure is to suppose that there is a wedge between the borrowing and savings rates faced by households. The spread measure tells us something about the borrowing rates paid by riskier borrowers. This supposes that households can use flexible mortgage borrowing arrangements to manage their intertemporal consumption decision rather than the Treasury Bill rate, which is more likely to be relevant for saving. Obviously, this ignores the fact that unsecured credit (particularly credit card borrowing) is also used for consumption smoothing. To extent that the factors driving risk premia in mortgage lending are correlated with the determinants of risk premia in the credit market as a whole, however, we would expect HEF also to measure some aspects of access to all credit. In future work, it would be interesting to look at extracting information on spreads in unsecured credit to supplement the information extracted from mortgage contracts.

In light of these theoretical considerations, we will aggregate micro data to estimate the following consumption growth equation at the aggregate level:

$$\Delta c_t = \sigma_0 + \sigma_1 r_t + \sigma_2 \Delta y_t + \sigma_3 HEF_t + \sigma_4 \Delta hp_t + \zeta w_t + \eta_t \qquad (4)$$

where Δ represents the first difference operator and consumption, c_t, income, y_t, and house price, hp_t, are expressed in logarithms. The vector w_t includes age, age squared, family size and family size squared. As measurement errors in differentiated data and time aggregation may introduce MA components in the error term, standard errors are adjusted for serial correlation up to order three as well as heteroskedasticity.

We are particularly interested in whether σ_3 has any explanatory power in such an equation. If HEF_t is picking up the extent of credit access for households, we would expect it to enter (4) with a negative sign reflecting the fact that (the presence or the anticipation of) more cautious lending, as implied by a higher spread, reduces current consumption.

The FES covers a randomly selected sample of around 7000 British households per year. The full dataset consists of a time-series of repeated cross-sections, and therefore the method introduced by Deaton (1985) can be used to create a pseudo-panel. For each variable and year, we take geometric means and compute: *(i)* a single time-series on average data, including most households in the survey; *(ii)* six time-series on average cohort data, including only the participant households whose head was born in the intervals 1941-45, 46-50, 51-55, 56-60, 61-65, 66-70.[10]

At this disaggregated level, the core equation to be estimated is:

$$\Delta c_{bt} = \kappa_b + \kappa_1 r_t + \kappa_2 \Delta y_{bt} + \kappa_3 HEF_t + \kappa_4 \Delta hp_t + \xi x_{bt} + \eta_{bt} \qquad (5)$$

where a subscript b refers to a birth cohort and where κ_b is a vector of birth cohort dummies. To look for heterogeneity in the impact of the HEF measure we will augment (5) with a set of interaction terms between HEF_t and birth cohort. This will allows us to see how far different cohorts have responded to changes in the terms on which external finance is available.

5 Main Results

In this section, we present the main results of the paper based on the merge between synthetic annual data on households' external financing costs from the SML and synthetic annual data on household expenditure from the FES. The description of the data sets is provided in the Appendix.

5.1 Evidence from aggregate FES data

Our baseline measure of consumption is non-housing expenditure and services. The explanatory variables include the 3 month Treasury bill rate, demographic variables, disposable income, national house prices and the HEF index whose construction we discussed in the previous section. We deflate the data using the Retail Prices Index excluding mortgage interest payments (RPIX), normalize consumption and income by family size, and then take first differences of all variables except the interest rate and the HEF index. The sample covers the years between 1975 and 2005.

We use the time-series averaged over most participating households to

[10] We consider only cells with at least 120 observations per year. The birth bands were chosen so as to maximize the number of time-series observations available for each cohort.

investigate the link between consumption and HEF in the aggregate.[11] In Table 2, we report results using OLS.

In the first column of Table 2, we show the estimates of a baseline specification in which consumption displays the usual "excess sensitivity" to income. The results reported here are not statistically different from the estimates reported in Attanasio and Weber (1993). In the second column, we add our measure of households' external cost of financing, which is found to have a large and significant negative coefficient.

To get a feel for the magnitude of the effect predicted by these results, observe that a one standard deviation increase in the HEF index (corresponding to around a 20 basis point increase in the spread between Libor and the policy rate[12]) is associated with a fall in annual consumption growth a little above 1%. Thus the effect of credit conditions on consumption is certainly of economically significant.

The inclusion of house price inflation in the specification in the third column improves the fit further.[13] The estimated coefficient on Δhp_t is significant but smaller than the value found by Campbell and Cocco (2007) whose analysis is based on quarterly data and a shorter sample. The results imply that a 1% change in house prices is associated with around a 0.2% change in consumption growth.

The most general specification in the last column is associated with a remarkable R^2 of 0.81. The coefficient on the real interest rate is robust across models but the coefficient on income growth becomes insignificantly different from zero. Consumption growth is a positive function of age, though at a decreasing rate, and the rate of house price inflation remains significant. The HEF index confirms itself as a significant driver of consumption.

The inference based on the OLS estimates relies implicitly on three assumptions. First, current values of the real interest rate, income and consumption growth provide a reasonable approximation for their expected values. Second, measurement errors are averaged out by aggregating over households. Third, the explanatory variables, including inflation expectations and the nominal interest rate, are exogenous to consumption growth.

One way to assess the extent to which these assumptions affect our find-

[11] For consistency with the cohort analysis below, we report aggregate estimates based on (i) all households whose head is born between 1940 and 1970, and (ii) cells with a minimum of 120 observations.

[12] This number is obtained by projecting the HEF index on the Libor-policy rate spread assuming an autoregressive process for the spread.

[13] This could either be interpreted as a wealth effect or as a proxy for permanent income.

ings is to estimate the consumption function using instrumental variables, with lagged values of consumption growth, income growth, inflation and the nominal interest rate as instruments for their current values. In selecting the lag lengths of the instruments, it is important to bear in mind two issues which may introduce an MA(1) component in the error term. First, the data are at an annual frequency and hence are time averaged.[14] Second, the disturbance embodies an expectational error.[15] The first order serial correlation in the error term implies that the first lag of the instruments would lead to inconsistent estimates (as argued by Bean, 1986). We therefore experiment with using the second and third lags of consumption, income, inflation and the nominal interest rate as additional instruments. We also add the lag of house price inflation and the HEF index to the instrument list in an effort to capture expectations of future house prices.

In Table 4, we report the estimates of the aggregate consumption equation obtained with the Generalized Method of Moments (GMM) using an optimal weighting matrix that accounts for the possibility of heteroskedasticity and serial correlation in the error terms (see Hansen, 1982). In practice, we employ a three lag Newey-West estimate of the covariance matrix.

The GMM estimates confirm, by and large, the OLS results. The large negative coefficient on the HEF index is always significant, while income growth loses its explanatory power in the most general specifications on the right of Table 3. Age has a nonlinear effect on consumption and house price inflation has a small but significant positive correlation with consumption growth.

An alternative way to account for the measurement errors that may be associated with the FES data is to employ contemporaneous values of ONS consumption growth and ONS income growth as instruments for their FES counterparts, while keeping the second and third lags of inflation and the Treasury Bill rate as instruments for the real interest rate.

These results are reported in Table 4, and they are a useful check of the sensitivity of our results to using a smaller instrument set. The estimates in the first four columns are not statistically different from the values reported in Table 3, and thus they confirm the empirical relevance of the household terms of access to the credit market for consumption.

In the last column, we account for the fact that the HEF index is a generated regressor (see Pagan, 1984). When the generated regressor is a

[14] When the households' decision period is shorter than the data sampling interval, Christiano, Eichenbaum and Marshall (1991) show that the time-average of multiple decisions introduces a spurios first order serial correlation in consumption growth.

[15] The sum of two MA(1) processes is still a MA(1).

nonlinear function of the residuals and represents a measure of risk, Pagan and Ullah (1988) recommend to use its own lag as an instrument. Our results are also robust to Pagan and Ullah's estimation strategy.[16]

5.2 Evidence from disaggregated data by birth cohort

The evidence on aggregate FES data corroborates the idea that the costs of external financing is significantly correlated to consumption growth. In this section, we assess the extent to which the aggregate results are robust to splitting the FES sample according to birth cohorts. In so doing, we will also be able to explore the importance of heterogeneity in responses to changing household financing conditions across cohorts.

The results in Table 5 present evidence using OLS while including a cohort fixed effect and a separate linear time trend for each birth cohort. The coefficients in the first column are similar to those obtained in Attanasio and Weber (1993). Using a shorter time period, Banks, Blundell and Tanner (1998), and Banks, Blundell and Brugiavini (2001) also obtain estimates of the consumption sensitivity to the real interest rate which are not statistically different from ours.

The impact of the external financing cost on consumption is not statistically different from zero in columns 2 and 4. However, interacting the HEF index with birth cohort specific dummy variables in column 5, we find evidence in favor of an heterogeneous effect. In particular, the effect of our HEF measure on the consumption growth of the oldest cohorts is significantly smaller than the effect on the consumption growth of the youngest groups. The cohort with a household head born between 1956 and 1960 is associated with the "peak effect" of the HEF index.

The real interest rate and income growth both have explanatory power, with point estimates robust across specifications. House price inflation is also typically significant at a 5% level.

As for the GMM, we report results based on the two instrument sets discussed above. For all estimates, the null hypothesis of weak instruments is rejected on the basis of the Anderson's canonical correlation statistics while the null hypothesis of valid overidentifying restrictions is not rejected on the basis of the Hansen's J statistics.[17] All specifications include a dummy and a linear time trend for each birth cohort.

[16] More specifically, Pagan and Ullah (1988) analyse the use of the squared residuals as generated regressor.

[17] The results of the tests are not reported but available from the authors upon request.

Our finding of heterogeneous responses to the HEF index is robust to using GMM, as shown in Table 6. The standard errors are larger than in the OLS case, possibly reflecting the fact that the number of cohorts and instruments prevents us from using an optimal weighting matrix which is robust to inter- as well as intra-cluster correlation.

The point estimates of the coefficient on the real interest rate is systematically higher than in Table 5, suggesting that the OLS results may suffer from measurement errors and endogeneity. In contrast to the basic OLS fixed effect estimation, the parameter on income growth is not statistically different from zero in the most general specifications in columns 4 and 5. The attenuation and loss of significance of the income growth coefficient in columns 4 and 5 is consistent with the idea that income growth, in the baseline model of column 1, may be capturing the existence of (and/or the anticipation of future) unfavourable terms on which external finance can be accessed by households.

In Table 7, we note that using a smaller instrument set produces estimates very similar to those in Table 6. The coefficient on the HEF index is highly significant in both the more aggregative specifications in columns 1 to 4 and the heterogenous cohort specification in column 5, confirming that the younger cohorts are more likely to suffer from a deterioration of the terms of access to borrowing.

6 Robustness

In this section, we assess the sensitivity of our results to the choice of an alternative cutoff in the interest rate spread distribution, a further level of disaggregation by age (as well as cohort), the timing assumption on the HEF index and the measure of consumption expenditure used. The finding that young households are more influenced by credit conditions compared to older households is shown to be robust to each of these modifications.

In further sensitivity analyses, not reported but available upon request, we also find that (i) deflating all variables with a divisia price index rather than RPIX,[18] (ii) using the time deposit rate rather than the 3 month Treasury bill rate, and (iii) employing GMM or the estimation strategy of Pagan and Ullah (1988) for generated regressors do not affect our basic conclusions about the importance of access to external finance in affecting consumption

[18] For each household, the divisia price index is constructed as the average of the price indices of the categories of goods and services in the reported expenditure, weighted by the household-budget shares.

growth.

6.1 Percentile selection

In the baseline specification, we have constructed a HEF index using the 90^{th} percentile of the error terms from the SML interest rate spread regression. While motivated by the desire to capture the access to finance of riskier borrowers, the exact choice of the cutoff is not obvious. To assess the sensitivity of our results to the selection of different percentiles, we can look at different percentiles.

In Table 8, we present the finding for a HEF index based on the 75^{th} percentile of the residuals in equation (1). For expositional convenience, we also replicate columns 1 and 3 from Table 5. The estimates based on the alternative HEF index constructed in this section confirms the results based on the 90^{th} percentile: the impact of the external cost of financing on consumption growth for the young cohorts 56-60 and 66-70 is significantly larger than the impact on the three oldest cohorts.

As a further robustness check, we also compute an HEF index based on the 50^{th} percentile. To the extent that higher quantiles are needed to identify riskier borrowers, our findings should not withstand this modification. This is indeed the case. In results not reported here, but available upon request, reveal that the median of the interest rate spread residuals has no power in explaining consumption growth. We conclude that the choice of the exact cutoff point in the interest rate spread distribution is not crucial for our results as long as the HEF index captures information on riskier borrowers.

6.2 Age and birth cohorts

In interpreting the results above, we rely on the notion that the birth cohorts provide a reasonable approximation for the age cohorts. The cohort in which the head of household is born between 1940 and 1945, for instance, can be thought as the oldest consumers in our sample while the cohort in which the head of household is born between 1965 and 1970 can be thought as the youngest consumers.

We can further divide our sample by using information about age. The idea is that the consumption of a family whose head was born in 1942 and interviewed in, say, 1977 may be different from the consumption of a family whose head was born in 1942 but was interviewed in 2003. Data availability, however, limit the level of disaggregation. The FES is based on 7000 household interviews per year, and with the birth cohorts spanning the

1950s or the 1960s our constraint of 120 observations per cell easily becomes binding when splitting cells by age.

In an effort to maximize the number of households per cell and the number of time-series observations per cohort, we label as 'young' ('old') the households whose head is aged below or equal to (above) 43 at the time of the FES interview. This age threshold allows us to split further the birth cohorts between 1940 and 1955.

As for the birth cohorts between 1956 and 1970, there are insufficient observations to generate sufficiently large 'old consumers' sub-groups. Hence, for the last three cohorts, and only for these, we do not use any further division of the cohorts. It should also be noted that the later birth cohorts are dominated by young individuals in that most of the people born in the 1960s are still young, according to our definition, in 2005 when our sample ends.

The results on the age and birth cohorts are reported in Table 9 and confirm the significant heterogeneity in the effect of households' external cost of financing across groups. The consumption of the household whose head is born between 1941 and 1945 are not strongly affect by the HEF index, independent of whether the head is young or old. We find that the impact of our measure of access to external finance on the expenditure of the young born between 1946-1950 is significantly larger than its impact on the consumption of the old in the same birth group.

The coefficients on the HEF index in the young and old sub-groups within the birth cohort 1951-55 are significantly negative but not statistically different from each other. The last three birth cohorts are associated with impacts of financing costs which are significantly larger than the impacts on the oldest cohorts. In summary, we find further evidence in support of the notion that the young are more exposed to (current and future) changes in the terms on which they access the credit market than the old.

6.3 Timing assumption

The theoretical literature on liquidity constraints and consumption is built around the idea that a tightening of credit conditions at time t has a negative impact on the level of consumption at time t, either because consumers they face worse conditions for borrowing or because they save in an effort to prevent future constraints on borrowing binding (see Deaton, 1991, and Carroll, 2001).

As consumption at time $t-1$ is pre-determined, the theory then predicts a negative *contemporaneous* relationship between consumption growth and the HEF index (where high values of the index imply a deterioration of financing conditions). We have already shown that there is a negative and significant relationship between the HEF index and consumption growth.

The presence and/or the anticipation of future borrowing conditions prevents households smoothing consumption between time t and time $t+1$. As emphasized by Zeldes (1989), the relationship between the shadow price of the borrowing constraint at time t and the growth rate of consumption between t and $t+1$ should then be positive.[19] We investigate this prediction in Table 6 where we let the HEF index enter the consumption equation along with the $t-1$ index.[20]

In line with what we would expect, lagging the HEF index by one period does indeed switch the sign of the coefficient in Table 10. An increase in the external cost of financing at time t has a positive and significant relationship with consumption growth at time $t+1$ via the negative effect on the contemporaneous level of consumption. As with the core results, the effect is significantly larger for younger than older cohorts.

6.4 Non-durable consumption

Finally, we investigate the robustness of our results to using non-durable consumption and services rather than non-housing expenditure and services as dependent variable. The results are reported in Table 11. The significance and heterogeneity of the HEF index across cohorts are unaffected by the change in the left-hand side variable.

The OLS fixed effect estimates confirm that the younger groups are more vulnerable to changes in the HEF index than the older cohorts. The differences are significant. For the last four groups, a one standard deviation tightening in credit conditions is associated, on average, with a fall in annual consumption growth of around 2.3%. In columns 4 and 5, the coefficients on house price inflation are significant but smaller in magnitude.

7 Evidence on housing tenure status

A number of recent papers, Campbell and Cocco (2007), Attanasio et al. (2005) and Benito et al. (2006), investigate whether the main drivers of consumption growth vary with home tenure status. There are two possible interpretations of this relationship either viewing house price changes as a

[19] In our framework it would be the actual borrowing cost rather than the shadow price.

[20] Results are robust to using demographic variables at time t and lagged TB rate.

proxy for permanent income or as representing a wealth effect. In the spirit of these contributions, we interact our measure of household financing costs with the variable *owners*, which measures the proportion of homeowners in each cohort.

Although we use SML data based on new mortgage applications in the U.K., our measure of HEF is constructed so as to capture exogenous shifts in the supply of credit and therefore can be applied across cohorts and tenure status. In particular, we are interested in assessing the extent to which home ownership is associated with additional access to credit markets.

The impact of financing conditions does not seem to vary systematically with the tenure status. In Table 12, consumption growth depends positively on the proportion of homeowners within each cohort, but the effect is statistically different from zero only in the last column. The HEF index is negative and insignificant in columns 2 and 4. The inclusion of the variable *owners* in column 5 does not overturn the findings of heterogeneity across cohorts in the access to credit market.

In the last column, we interact the HEF index with the group-specific proportion of homeowners. We find little evidence of variation across tenure status, and the coefficient on the interaction of *owner* with the HEF index in the youngest cohorts is imprecisely estimated, possibly reflecting the fact that the average proportion of homeowners in these groups is between 10% and 25% smaller than in the other cohorts.

These results are broadly suggestive of the notion that house prices proxy for permanent income changes rather than affecting wealth.

8 Conclusions

This paper has investigated the link between consumption and the terms of access to external finance by households measured from interest rate spreads on mortgages. We have shown that the HEF index that we construct from mortgage data is robustly correlated with consumption growth between 1975 and 2005, with stronger effects in younger birth cohorts. These findings are robust to a wide variety of empirical specifications.

Taken together, the results support the claim that the terms on which households can access to external finance to smooth their consumption matter for consumption growth. The improved terms on which households can access credit can, according to our measure, account for a significant amount of the growth in consumption over the period of our study. A one standard deviation change in our HEF index corresponds, on average, to about 1%

annual change in aggregate consumption growth. In future work, we plan to relate our HEF index to production variables where the terms of external access to credit are important, in particular in starting up new businesses.

In a broader macro-economic context, our results complement existing work on the financial accelerator through changing access to credit for businesses as in Bernanke, Gertler and Gilchrist (1999). The literature to date has emphasized the link to business investment from changing credit conditions. The results reported here suggest that there is scope for a quantitatively significant direct channel from credit conditions onto household behavior through the way in which risk is priced in the markets for secured household debt.

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Data Appendix

This Appendix provides further details on the SML and FES data sets used for the estimation in the main text.

Survey of Mortgage Lenders

In order to construct our HEF index measure, we use mortgage origination data covering the period 1975 to 2005 from the Survey of Mortgage Lenders (SML) and its predecessor, the 5% Sample Survey of Building Society Mortgages (SBSM). These surveys are available in electronic format for the years 1975 to 2001 from the Data Archive at the University of Essex. Unfortunately, the year 1978 is missing, and so we have interpolated the 1978 data where relevant. Data covering the period 2002 to 2005 was obtained by the Bank of England from the Council of Mortgage Lenders (CML).

The switch between the SBSM and SML surveys reflected the changing nature of the mortgage market in the U.K.. Increased competition from Banks and other specialist lenders combined with the demutualisation of the Abbey National resulted in the creation of the CML in 1989, and eventual extension of the SBSM to accommodate all members of the CML in 1992. In 2003 the SML sample size was expanded, with most contributors providing a full sample of mortgage completions rather than a 5% random sample.

The surveys provide a range of information including data covering characteristics of the loan at origination (the loan size, purchase price, gross rate of interest, whether the interest charged is fixed or variable, repayment method, etc.) and individual borrower characteristics (sex and age of borrowers, income on which the mortgage is based, previous tenure, region etc). The surveys form a repeated cross-section and the method in Deaton (1985) can be used to construct a pseudo-panel.

To obtain estimates for our measure of the HEF index we supplement data from the SBSM/SML on loan size, property value, gross interest rate, age and income, with regional house price data from the Nationwide house price index. We also place the following restrictions upon the data and:

1. discard individuals over the age of 75 and under 21.

2. omit individuals buying a house with a price discount and who were previously local authority or housing association tenants.

3. exclude sitting tenants not-covered by restriction 2.

4. discard observations where lending is not for house purchase (further advances and remortgaging activity).

5. omit observations for individuals with outlying loan-to-income (LTI) and loan-to-value (LTV) ratios. The threshold levels chosen were LTI>=10, and LTV<0.2 or LTV>1.1.

6. discard observations with a gross interest rate below 0.5% per annum, or where the absolute value of the spread between the gross rate of interest and the 3 month Treasury Bill rate is greater than 10% of the Treasury Bill rate.

7. omit observations where relevant data are missing.

In Table 13, we provide descriptive statistics of the SML data we use.

Family Expenditure Survey

We use data on household consumption, disposable income,demographics and housing status from the Family Expenditure Survey available at http://www.data-archive.ac.uk/findingdata/festitles.asp. The sample spans the period 1975-2005, with the first observation associated with the beginning of our SML data set and the last observation marking the latest available data in July 2007 when the data were collected.

Our baseline measure of consumption is non-housing expenditure and services, defined as total expenditure minus expenditure for housing plus 'repair' and 'do it yourself' (diy). Non-durable consumption is the sum of two week reported expenditure on food, catering, alcohol, tobacco, fuel, household services, clothing, personal goods and services, fares, leisure services, consumables, pet care, repair, diy, motoring expenditure, recreational goods.

Nominal variables are deflated using the Retail Prices Index minus mortgage interest payments (RPIX). Consumption and income are divided by the size of the household, $fsize$. The variable age refers to the age of the head of household, defined on the basis of income. The variable $owner$ stands for the proportion of homeowners in each cohort.

To ensure the FES data are representative of the UK population, we plot in Figure 4 the aggregate per-capita non-housing real consumption growth from the FES and the corresponding ONS series. For the sake of comparability with the ONS data, in Figure 4, and only in Figure 4, the FES consumption growth is computed as the log difference of the average of all households in the FES panel, i.e. arithmetic mean.

In Tables 14 and 15, we report descriptive statistics for our FES dataset.

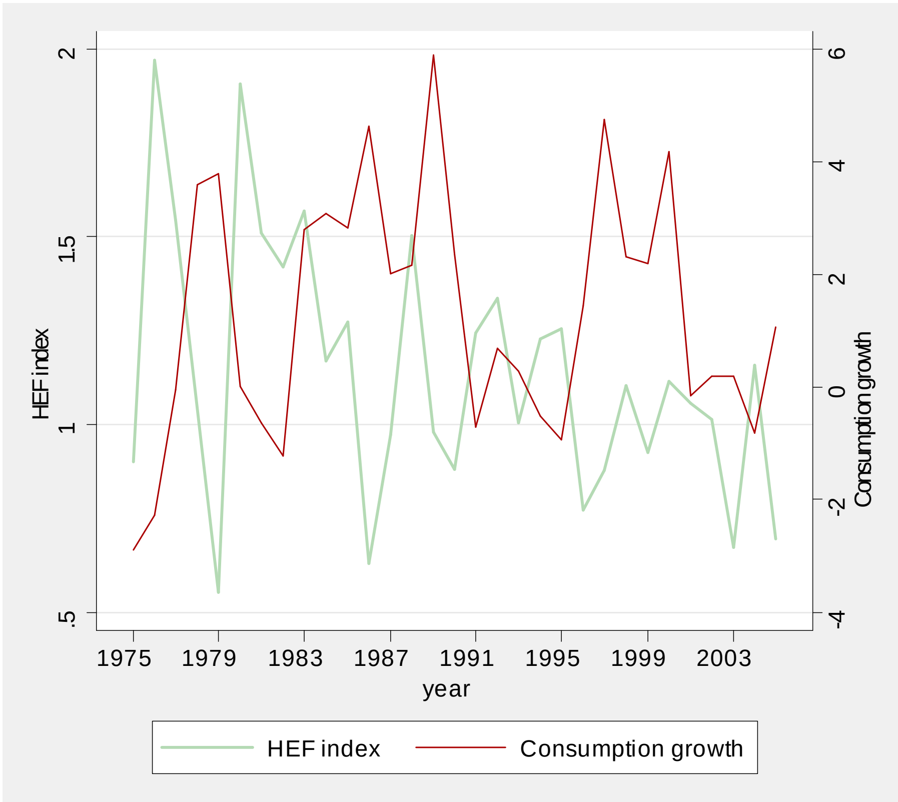

Figure 1: Aggregate FES consumption growth and HEF index

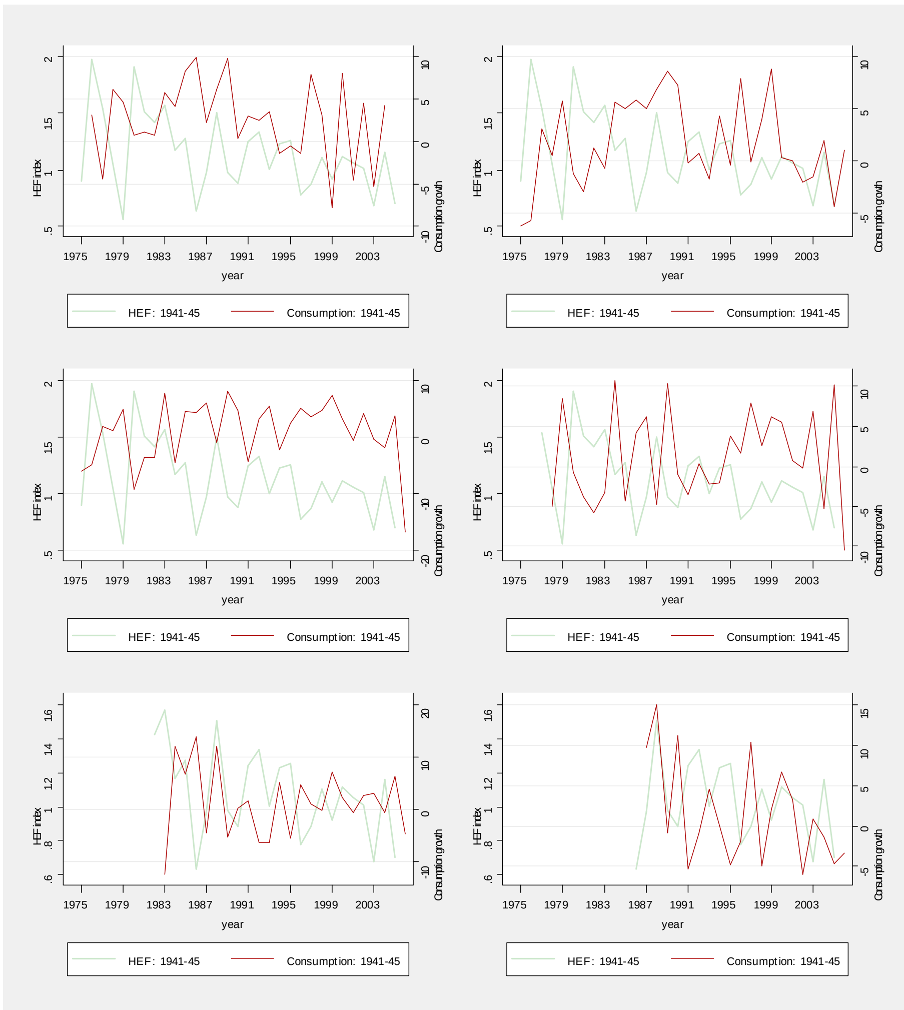

Figure 2: FES consumption growth and HEF index by birth cohort

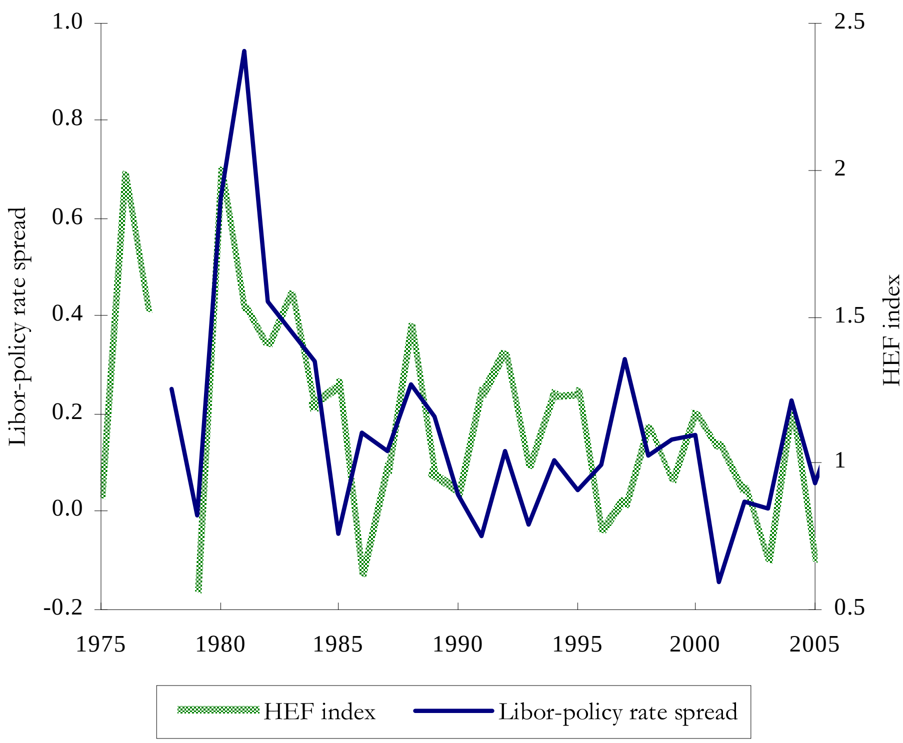

Figure 3: HEF index and Libor-policy rate spread

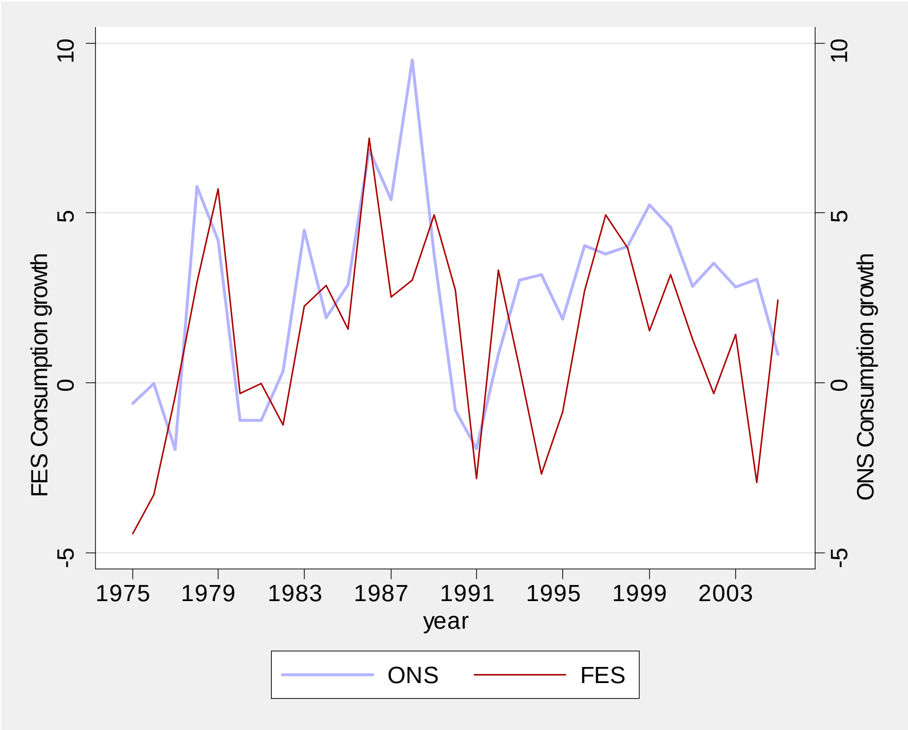

Figure 4: FES and ONS consumption growth, arithmetic averages

Table 1: Disaggregate interest rate spread, OLS

coeffs	(1) *lti*	(2) *ltv*	(3) *lti & ltv*	(4) *loan & y*	(5) *loan & v*	(6) *all*
lti_i	0.017***		0.014***			
	(0.005)		(0.005)			
ltv_i		0.002***	0.002***			
		(0.000)	(0.000)			
$loan_i$				0.033	0.077	0.148***
				(0.039)	(0.048)	(0.055)
y_i				-.071*		-.119***
				(0.042)		(0.043)
v_i					-0.107**	-0.083*
					(0.046)	(0.047)
age_i*lti_i	-.0002		-.0004***			
	(0.0001)		(0.0001)			
age_i*ltv_i		-0.00001	-0.00001			
		(0.00001)	(0.00001)			
age_i*$loan_i$				-0.002	0.005	-0.017
				(0.011)	(0.013)	(0.015)
age_i*y_i				0.019		0.037***
				(0.012)		(0.012)
age_i*v_i					0.005	-0.003
					(0.013)	(0.013)
hp_{rt}	-.028***	-.026***	-.026***	-.029***	-.027***	-.027***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
age_i	0.077***	0.142***	0.163***	-0.101	0.010	-0.037
	(0.011)	(0.017)	(0.019)	(0.062)	(0.061)	(0.063)
obs	588237	588237	588237	588237	588237	588237
R^2	0.44	0.44	0.44	0.44	0.44	0.44

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; lti (ltv) refers to the loan to income (value to income) ratio; all variables are logarithms except for lti and ltv ratios; coefficients on region and year dummy variables not reported.

Table 2: Aggregate FES consumption, OLS

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*
r_t	0.312***	0.315***	0.276***	0.269***
	(0.069)	(0.091)	(0.068)	(0.060)
Δy_t	0.401***	0.250***	0.212**	-0.077
	(0.108)	(0.079)	(0.083)	(0.125)
Δage_t	-0.012	0.070	0.108	0.271***
	(0.069)	(0.071)	(0.074)	(0.047)
Δage_t^2	-0.004	-0.089	-0.143*	-0.316***
	(0.070)	(0.070)	(0.078)	(0.054)
$\Delta fsize_t$	-1.011	-0.389	-3.733	-3.652
	(2.990)	(2.627)	(2.228)	(2.304)
$\Delta fsize_t^2$	0.596	0.119	1.745	1.384
	(1.448)	(1.301)	(1.090)	(1.109)
$HEF\ Index_t$		-3.260**		-4.959***
		(1.458)		(1.044)
Δhp_t			0.179***	0.236***
			(0.039)	(0.031)
obs	31	31	31	31
R^2	0.51	0.59	0.65	0.81

Heteroskedasticity & serial correlation adjusted s.e. in parentheses; ***p<.01, **p<.05, *p<.1

Table 3: Aggregate FES consumption, GMM

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*
r_t	0.326**	0.165	0.397***	0.313***
	(0.140)	(0.169)	(0.124)	(0.046)
Δy_t	0.424***	0.324***	0.314	-0.063
	(0.154)	(0.115)	(0.211)	(0.106)
Δage_t	-0.035	0.090*	0.017	0.237***
	(0.034)	(0.049)	(0.083)	(0.051)
Δage_t^2	0.020	-0.105**	-0.035	-0.275***
	(0.036)	(0.047)	(0.093)	(0.054)
$\Delta fsize_t$	0.173	1.164	-0.374	-1.947*
	(2.622)	(2.675)	(2.384)	(1.113)
$\Delta fsize_t^2$	-0.079	-0.789	0.147	0.533
	(1.243)	(1.370)	(1.072)	(0.512)
$HEF\ Index_t$		-4.470***		-5.351***
		(0.967)		(0.602)
Δhp_t			0.083	0.222***
			(0.098)	(0.037)
constant	1.034	4.708***	0.053	3.906***
	(1.261)	(1.545)	(1.247)	(0.731)
obs	28	28	28	28
R^2	0.47	0.58	0.59	0.84

Heteroskedasticity & serial correlation adjusted s.e. in parentheses; ***p<.01, **p<.05, *p<.1; instrument list: second and third lags of consumption growth, disposable income growth, RPIX inflation and 3m Treasury Bill rate, first lag of HEF index and house price inflation.

Table 4: Aggregate FES consumption, GMM

	(1)	(2)	(3)	(4)	(5)
	baseline	*HEF*	*hp*	*HEF & hp*	*Pagan-al.*
coefficient					
r_t	0.355***	0.316**	0.394***	0.375***	0.359***
	(0.125)	(0.124)	(0.114)	(0.067)	(0.068)
Δy_t	0.666***	0.575***	0.522***	0.127	0.007
	(0.149)	(0.106)	(0.157)	(0.127)	(0.121)
Δage_t	-0.056	0.037	0.022	0.192***	0.226***
	(0.057)	(0.064)	(0.052)	(0.034)	(0.055)
Δage_t^2	0.044	-0.053	-0.044	-0.222***	-0.260***
	(0.059)	(0.066)	(0.061)	(0.040)	(0.060)
$\Delta fsize_t$	1.701	0.381	-0.210	-1.078	-1.118
	(3.719)	(3.008)	(3.223)	(1.679)	(1.434)
$\Delta fsize_t^2$	-0.625	-0.129	0.194	0.272	0.209
	(1.717)	(1.443)	(1.447)	(0.784)	(0.669)
$HEF\ Index_t$		-3.417***		-5.095***	-5.938***
		(1.202)		(0.717)	(1.053)
Δhp_t			0.102**	0.193***	0.215***
			(0.046)	(0.028)	(0.020)
constant	0.928	3.550**	-0.078	3.628***	4.425***
	(1.553)	(1.472)	(1.067)	(0.979)	(0.930)
obs	28	28	28	28	28
R^2	0.42	0.53	0.56	0.83	0.83

Heteroskedasticity & serial correlation adjusted s.e. in parentheses; ***p<.01, **p<.05, *p<.1; instrument list: ONS consumption growth and disposable income growth, second and third lags of RPIX inflation and 3m Treasury Bill rate; first lag of HEF index in 'Pagan-al' column only.

Table 5: Disaggregated consumption, OLS fixed effect

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.355***	0.341***	0.291***	0.283***	0.275***
	(0.029)	(0.031)	(0.028)	(0.030)	(0.033)
$\Delta y_{c,t}$	0.475***	0.422***	0.418***	0.374***	0.392***
	(0.052)	(0.075)	(0.062)	(0.080)	(0.080)
$\Delta age_{c,t}$	-0.064	-0.042	-0.017	-0.001	-0.006
	(0.061)	(0.072)	(0.053)	(0.062)	(0.047)
$\Delta age^2_{c,t}$	0.007	-0.016	-0.037	-0.054	-0.055
	(0.105)	(0.123)	(0.089)	(0.107)	(0.094)
$\Delta fsize_{c,t}$	0.520	0.541	0.362	0.397	0.292
	(0.460)	(0.488)	(0.590)	(0.618)	(0.590)
$\Delta fsize^2_{c,t}$	-0.328	-0.384	-0.310	-0.363	-0.304
	(0.209)	(0.198)	(0.266)	(0.256)	(0.256)
$HEF\ Index_t$		-3.352		-3.127	0.467
		(2.123)		(2.056)	(0.411)
Δhp_t			0.107**	0.097**	0.093**
			(0.029)	(0.027)	(0.030)
HEF_t**coh*46-50					-1.278***
					(0.248)
HEF_t**coh*51-55					-3.169***
					(0.387)
HEF_t**coh*56-60					-10.909***
					(0.399)
HEF_t**coh*61-65					-2.235***
					(0.275)
HEF_t**coh*66-70					-9.189***
					(0.157)
obs	159	159	159	159	159
R^2	0.50	0.54	0.53	0.56	0.60

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; coh*xx-yy* is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported.

Table 6: Disaggregated consumption, GMM fixed effect

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.381***	0.403***	0.416**	0.594***	0.437***
	(0.146)	(0.153)	(0.172)	(0.146)	(0.162)
$\Delta y_{c,t}$	0.504***	0.378***	0.404*	0.175	0.254
	(0.120)	(0.104)	(0.212)	(0.143)	(0.163)
$\Delta age_{c,t}$	0.130	0.155	0.183	0.222	0.118
	(0.135)	(0.137)	(0.155)	(0.146)	(0.154)
$\Delta age^2_{c,t}$	-0.201	-0.232	-0.254	-0.297*	-0.203
	(0.150)	(0.163)	(0.172)	(0.174)	(0.177)
$\Delta fsize_{c,t}$	0.577	0.764	0.533	-0.012	0.524
	(0.608)	(0.686)	(0.706)	(0.757)	(0.817)
$\Delta fsize^2_{c,t}$	-0.335	-0.491	-0.377	-0.234	-0.460
	(0.309)	(0.333)	(0.334)	(0.354)	(0.364)
$HEF\ Index_t$		-3.759***		-3.365***	-0.921
		(1.072)		(1.015)	(1.518)
Δhp_t			0.043	0.121***	0.054
			(0.066)	(0.038)	(0.057)
HEF_t*coh46-50					-0.654
					(2.206)
HEF_t*coh51-55					-4.045*
					(2.186)
HEF_t*coh56-60					-9.050**
					(4.189)
HEF_t*coh61-65					-1.402
					(5.412)
HEF_t*coh66-70					-8.356**
					(3.502)
obs	141	141	141	141	141
R^2	0.50	0.53	0.52	0.53	0.57

Heteroskedasticity & serial correlation adjusted s.e. in parentheses;***p<.01,**p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported; instrument list: see Table 3.

Table 7: Disaggregated consumption, GMM fixed effect

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.460***	0.548***	0.505***	0.683***	0.724***
	(0.168)	(0.165)	(0.166)	(0.178)	(0.173)
$\Delta y_{c,t}$	0.682***	0.423***	0.477***	0.075	0.008
	(0.106)	(0.119)	(0.170)	(0.186)	(0.186)
$\Delta age_{c,t}$	0.050	0.119	0.197	0.270*	0.182
	(0.126)	(0.121)	(0.134)	(0.158)	(0.168)
$\Delta age^2_{c,t}$	-0.108	-0.189	-0.249*	-0.336*	-0.249
	(0.135)	(0.138)	(0.148)	(0.190)	(0.197)
$\Delta fsize_{c,t}$	0.178	0.336	0.172	-0.029	-0.289
	(0.598)	(0.687)	(0.708)	(0.983)	(0.940)
$\Delta fsize^2_{c,t}$	-0.043	-0.217	-0.169	-0.259	-0.182
	(0.296)	(0.331)	(0.337)	(0.448)	(0.434)
$HEF\ Index_t$		-4.473***		-4.581***	-0.819
		(1.204)		(1.167)	(1.627)
Δhp_t			0.078	0.136***	0.163***
			(0.048)	(0.047)	(0.045)
HEF_t*coh46-50					-1.400
					(2.214)
HEF_t*coh51-55					-5.182**
					(2.218)
HEF_t*coh56-60					-9.081*
					(4.668)
HEF_t*coh61-65					-1.802
					(6.396)
HEF_t*coh66-70					-9.269**
					(3.813)
obs	141	141	141	141	141
R^2	0.46	0.53	0.52	0.49	0.50

Heteroskedasticity & serial correlation adjusted s.e. in parentheses;***p<.01,**p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported; instrument list: see Table 4.

Table 8: Disaggregate consumption, OLS fixed effect - 75^{th} percentile

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.355***	0.327***	0.291***	0.276***	0.280***
	(0.029)	(0.022)	(0.028)	(0.021)	(0.029)
$\Delta y_{c,t}$	0.475***	0.445***	0.418***	0.402***	0.397***
	(0.052)	(0.064)	(0.062)	(0.070)	(0.077)
$\Delta age_{c,t}$	-0.064	-0.051	-0.017	-0.011	-0.003
	(0.061)	(0.060)	(0.053)	(0.053)	(0.048)
$\Delta age^2_{c,t}$	0.007	-0.007	-0.037	-0.044	-0.055
	(0.105)	(0.104)	(0.089)	(0.089)	(0.088)
$\Delta fsize_{c,t}$	0.520	0.476	0.362	0.343	0.335
	(0.460)	(0.459)	(0.590)	(0.588)	(0.588)
$\Delta fsize^2_{c,t}$	-0.328	-0.328	-0.310	-0.311	-0.318
	(0.209)	(0.197)	(0.266)	(0.257)	(0.256)
$HEF\ Index_{75,t}$		-2.383		-1.645	1.369**
		(1.872)		(1.820)	(0.532)
Δhp_t			0.107**	0.100**	0.099**
			(0.029)	(0.027)	(0.028)
$HEF_{75,t}$*coh46-50					-3.230***
					(0.316)
$HEF_{75,t}$*coh51-55					-1.244***
					(0.207)
$HEF_{75,t}$*coh56-60					-8.624***
					(0.520)
$HEF_{75,t}$*coh61-65					-0.206
					(0.411)
$HEF_{75,t}$*coh66-70					-9.325***
					(0.849)
obs	159	159	159	159	159
R^2	0.50	0.51	0.53	0.53	0.55

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy and cohort time trend not reported

Table 9: Disaggregate consumption, OLS fixed effect - interaction with age

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.415***	0.402***	0.227***	0.234***	0.203***
	(0.035)	(0.042)	(0.057)	(0.057)	(0.060)
$\Delta y_{c,t}$	0.491***	0.440***	0.434***	0.393***	0.416***
	(0.076)	(0.097)	(0.094)	(0.109)	(0.115)
$\Delta age_{c,t}$	-0.122	-0.101	-0.072	-0.058	-0.062
	(0.082)	(0.093)	(0.075)	(0.084)	(0.074)
$\Delta age^2_{c,t}$	0.144	0.123	0.096	0.082	0.083
	(0.115)	(0.133)	(0.099)	(0.116)	(0.106)
$\Delta fsize_{c,t}$	0.347	0.394	0.038	0.112	-0.085
	(0.522)	(0.531)	(0.670)	(0.682)	(0.729)
$\Delta fsize^2_{c,t}$	-0.214	-0.285	-0.108	-0.183	-0.072
	(0.219)	(0.205)	(0.274)	(0.264)	(0.297)
$HEF\ Index_t$		-3.392*		-3.091	1.016
		(1.761)		(1.736)	(0.734)
Δhp_t			0.130***	0.117***	0.116***
			(0.030)	(0.030)	(0.034)
HEF$_t$*coh40-45$_{\text{old}}$					-1.833*
					(0.967)
HEF$_t$*coh46-50$_{\text{young}}$					-3.009***
					(0.461)
HEF$_t$*coh46-50$_{\text{old}}$					0.361
					(0.694)
HEF$_t$*coh51-55$_{\text{young}}$					-3.241***
					(0.477)
HEF$_t$*coh51-55$_{\text{old}}$					-5.389**
					(1.868)
HEF$_t$*coh56-60					-11.206***
					(0.655)
HEF$_t$*coh61-65					-2.722***
					(0.570)
HEF$_t$*coh66-70					-9.348***
					(0.862)
obs	168	168	168	168	168
R^2	0.48	0.5140	0.50	0.53	0.58

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; cohxx-yy is a dummy equal to one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported; young are people below 43.

Table 10: Disaggregate consumption, OLS fixed effect - alternative timing

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.335**	0.346**	0.311**	0.320**	0.284**
	(0.112)	(0.101)	(0.109)	(0.096)	(0.095)
$\Delta y_{c,t}$	0.503***	0.533***	0.479***	0.509***	0.528***
	(0.057)	(0.052)	(0.056)	(0.051)	(0.049)
$\Delta age_{c,t\text{-}1}$	-0.133	-0.132	-0.125	-0.123	-0.105
	(0.125)	(0.117)	(0.113)	(0.102)	(0.105)
$\Delta age^2_{c,t\text{-}1}$	0.225	0.221	0.213	0.208	0.193
	(0.133)	(0.128)	(0.121)	(0.115)	(0.115)
$\Delta fsize_{c,t\text{-}1}$	0.682	0.610	0.849	0.791	0.891
	(0.743)	(0.729)	(0.784)	(0.777)	(0.770)
$\Delta fsize^2_{c,t\text{-}1}$	-0.372	-0.329	-0.465	-0.429	-0.488
	(0.344)	(0.336)	(0.363)	(0.359)	(0.356)
$HEF\ Index_{t\text{-}1}$		2.591*		2.832*	0.374
		(1.231)		(1.283)	(0.278)
Δhp_t			0.080**	0.090**	0.090**
			(0.024)	(0.026)	(0.027)
HEF$_{t\text{-}1}$*coh46-50					-0.250
					(0.387)
HEF$_{t\text{-}1}$*coh51-55					4.662***
					(0.359)
HEF$_{t\text{-}1}$*coh56-60					5.257***
					(0.982)
HEF$_{t\text{-}1}$*coh61-65					5.314***
					(0.856)
HEF$_{t\text{-}1}$*coh66-70					2.891**
					(1.007)
obs	153	153	153	153	153
R^2	0.51	0.53	0.53	0.55	0.58

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported.

Table 11: Disaggregate consumption, OLS fixed effect - non-durables

coefficient	(1) *baseline*	(2) *HEF*	(3) *hp*	(4) *HEF & hp*	(5) *interaction*
r_t	0.350***	0.341***	0.306***	0.301***	0.292***
	(0.05104)	(0.04872)	(0.05682)	(0.05721)	(0.06110)
$\Delta y_{c,t}$	0.441***	0.407***	0.403***	0.375***	0.388***
	(0.04216)	(0.06100)	(0.04482)	(0.06061)	(0.06259)
$\Delta age_{c,t}$	-0.130**	-0.116*	-0.098*	-0.088	-0.083
	(0.04974)	(0.05138)	(0.04594)	(0.04731)	(0.04252)
$\Delta age^2_{c,t}$	0.101	0.086	0.071	0.060	0.050
	(0.08307)	(0.08970)	(0.07675)	(0.08366)	(0.07496)
$\Delta fsize_{c,t}$	0.570	0.584	0.463	0.485	0.400
	(0.4712)	(0.5007)	(0.5453)	(0.5688)	(0.5772)
$\Delta fsize^2_{c,t}$	-0.363	-0.399	-0.351	-0.385	-0.339
	(0.2102)	(0.2096)	(0.2459)	(0.2419)	(0.2639)
$HEF\ Index_t$		-2.152		-1.997	1.096*
		(1.6768)		(1.6465)	(0.4273)
Δhp_t			0.073**	0.067**	0.065**
			(0.02139)	(0.02217)	(0.02524)
HEF_t*coh46-50					-0.870*
					(0.3748)
HEF_t*coh51-55					-3.158***
					(0.4756)
HEF_t*coh56-60					-8.557***
					(0.4068)
HEF_t*coh61-65					-2.158***
					(0.3421)
HEF_t*coh66-70					-9.977***
					(0.2446)
obs	159	159	159	159	159
R^2	0.52	0.53	0.53	0.54	0.58

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trends not reported.

Table 12: Disaggregate consumption, OLS fixed effect- housing tenure status

	(1)	(2)	(3)	(4)	(5)	(6)
	base	*HEF*	*hp*	*HEF-hp*	*birth*	*age*
coefficient						
r_t	.251***	.248***	.214***	.215***	.301***	.121
	(.034)	(.036)	(.025)	(.024)	(.052)	(.115)
$\Delta y_{c,t}$	.482***	.429***	.425***	.382***	.403***	.393***
	(.046)	(.064)	(.051)	(.066)	(.066)	(.072)
$\Delta age_{c,t}$	-.034	-.006	-.005	.017	-.003	.043
	(.028)	(.033)	(.032)	(.035)	(.027)	(.051)
$\Delta age^2_{c,t}$	-.034	-.06***	-.07***	-.09***	-.07***	-.116**
	(.019)	(.012)	(.013)	(.009)	(.016)	(.037)
$\Delta fsize_{c,t}$	.746	.759	.605	.632	.381	.290
	(.432)	(.444)	(.519)	(.532)	(.548)	(.571)
$\Delta fsize^2_{c,t}$	-.461*	-.510**	-.446	-.493*	-.336	-.305
	(.191)	(.183)	(.236)	(.225)	(.254)	(.252)
$owner_{c,t}$	.058	.047	.062	.052	.100	.205**
	(.046)	(.046)	(.037)	(.038)	(.067)	(.074)
HEF Index_t		-3.370		-3.115	6.298	1.812
		(2.049)		(2.014)	(4.278)	(4.511)
Δhp_t			.105***	.094**	.084**	.106**
			(.024)	(.025)	(.028)	(.040)
HEF_t*owner					-8.136	-1.694
					(5.840)	(6.110)
HEF_t*46-50					-1.478**	-3.240
					(.486)	(1.626)
HEF_t*51-55					-4.44***	.002
					(.994)	(3.484)
HEF_t*56-60					-11.7***	-2.308
					(1.185)	(4.792)
HEF_t*61-65					-3.02***	9.790
					(.714)	(7.232)
HEF_t*66-70					-8.50***	5.229
					(.829)	(8.482)
- - -						- - -

Table 12: housing tenure status - continued

coefficient	(1) *base*	(2) *HEF*	(3) *hp*	(4) *HEF-hp*	(5) *birth*	(6) *age*
- - -						- - -
HEF_t*46-50*owner						3.348
						(2.047)
HEF_t*51-55*owner						-5.922
						(4.650)
HEF_t*56-60*owner						-15.629*
						(6.646)
HEF_t*61-65*owner						-19.726
						(10.502)
HEF_t*66-70*owner						-23.547
						(14.457)
obs	163	163	163	163	163	163
R^2	0.49	0.53	0.52	0.55	0.60	0.61

Clusters in birth cohort-adjusted standard errors in parentheses; ***p<.01, **p<.05, *p<.1; cohxx-yy is a dummy taking value one if the birth year is between xx and yy, and zero otherwise; coefficients on cohort dummy variables and cohort specific time trend not reported; owner is the proportion of owners in cohort c.

Table 13: SML data - descriptive statistics

variable	*mean*	*min*	*max*	*st dev*
spread	1.213	-1.469	13.375	1.223
loan	10.375	6.551	13.777	0.779
value	10.674	7.090	13.815	0.816
income	9.626	6.215	13.815	0.712
age	3.454	2.890	4.554	0.277

All variables, except *spread*, are in logarithms

Table 14: FES data - cohort definition and cell size

cohort	*birth*	*age in 1975*	*age in 2005*	*cell size minimum*	*cell size maximum*	*cell mean*	*# years*
1	1940-44	31-35	61-65	141	702	573	31
2	1945-49	26-30	56-60	169	848	700	31
3	1950-54	21-25	51-55	156	715	626	31
4	1955-59	16-20	46-50	145	739	635	28
5	1960-64	11-15	41-45	168	817	686	23
6	1965-69	6-10	36-40	177	785	635	18

Table 15: FES data - descriptive statistics

variable	*mean*	*min*	*max*	*st dev*
$\Delta c_{i,t}$	1.64	-8.36	13.46	4.60
$\Delta y_{i,t}$	2.27	-15.20	20.29	5.57
r_t	3.03	-11.81	8.01	3.31
Δhp_t	3.17	-14.55	15.87	8.88

All variables are in log differences (except r_t) times 100