

Consumption, household portfolios and the housing market in France

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Abstract: Not all co-movements between consumption and wealth are wealth effects. Some result from common factors: shifts in credit conditions, interest rates, income expectations or demographics. Unravelling these is necessary for modelling linkages between households and finance. The findings for France from a 6-equation model for consumption and the main elements of household portfolios are that marginal propensities to consume financial wealth are comparable to those in the US or the UK, but housing wealth effects are far weaker, and aggregate consumption falls with higher house prices relative to income. This is interpreted as the need for younger households in France then to save more if they wish to become homeowners, while other tenants can expect rents to increase in the future, saving more in consequence. The estimates suggest that during the French house price boom between 1996 and 2008, offsets from the negative effect of higher house prices and higher debt neutralized the positive effects of higher housing wealth and easier credit on consumption, avoiding the amplifying feedbacks, via consumption, of the US boom.

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Introduction

The US sub-prime crisis, which triggered the global financial crisis, began with a major over-valuation of asset prices, especially of housing. The consequence of overvaluation, eventually, is falling house prices, triggering the down-phase of a financial accelerator. Falling house prices reduce residential investment and lower consumer spending in countries where housing collateral is an important driver of consumption, such as the US and the UK. Falling house prices increase bad loans and lower the capital of financial firms. This impairs the ability of banks to extend credit. The credit-crunch feeds back further on residential investment and household spending, increasing unemployment and reducing GDP, which further reduces the demand for housing and the capital of financial firms.

Macro-evidence has accumulated for the role of leverage and of real estate connected financial instability (Cerutti *et al.* (2017) and Mian *et al.* (2017)). Mian and Sufi (2014, 2018) have provided extensive microeconomic evidence for the role of credit shifts in the US sub-prime crisis and the constraining effect of high household debt levels. Gertler and Gilchrist (2018) highlight the role of credit shocks and household balance sheets in the way the financial accelerator played out in the US during the financial crisis. Jordà *et al.* (2016) have drawn attention to the increasing role of real estate collateral in bank lending in most advanced countries and in financial crises. The IMF's October 2017 Financial Stability Report provides further evidence, highlighting the critical role of mortgage debt and nonlinear effects, finding more pronounced effects at high debt ratios, and larger effects in countries with open capital accounts and fixed exchange rate regimes.

Beyer *et al.* (2017) note the importance of wealth effects and heterogeneity, including across countries, a focus for the ECB's multi-country model, under construction, for the five largest members of the Eurozone. This is in the class of macro-econometric models, newly popular with central banks, which do not impose the rational, representative agent micro of New Keynesian DSGE models and give more scope to empirical evidence. However, most versions of such models impose a net worth constraint on the effect on consumption function of wealth, and ignore shifting credit conditions. The multi-equation personal sector model here estimated for France evaluates whether those assumptions are valid.

Does France resemble the Anglo-Saxon economies where changes in house or financial asset prices translate into changes in consumption, an amplifying mechanism in the financial accelerator, and part of monetary policy transmission? Its institutional background is very different: in particular, home equity withdrawal opportunities are much rarer, the retirement system relies mostly on a pay-as-you-go system and stock-market participation is lower. Current literature reviewed in online complement C1 generally accepts lower wealth effects in France. However, the macroeconomic estimates of the marginal propensity to consume (MPC) for net worth cover a wide range -from 0.4 cent per additional

euro of net worth to 4.6- largely the result of specification problems such as omitting controls for permanent income (i.e. expectations of income growth) and credit conditions (whose large change are documented in online complement C3). On microeconomic data, Arrondel *et al.* (2014) report a MPC for financial wealth which is at the lower end of the range, with 0.5 cent per euro and a large disparity between households and types of wealth.

Since household spending, saving and portfolio decisions are related and driven by common shocks and shifts in the economic and demographic environment, it is important to model these decisions jointly in a sub-system of equations when using a macroeconomic approach. In the present article, we follow Aron *et al.* (2012) with a ‘credit-augmented’ permanent income form of the consumption function. This encompasses the textbook permanent income model as a special case but captures shifts in credit availability and balance sheet heterogeneity. As no direct measure of time-varying access to credit is available, we use a latent variable method to measure credit conditions in a six-equation system for France for consumption, housing loans, consumer credit, liquid assets, house prices and permanent income estimated from 1981Q2 to 2016Q4. This can be seen as the translation into macro-time series modelling of what Mian and Sufi (2018) call the ‘credit-driven household demand channel’.

The outline of the article is as follows. Section 2 focuses on the theoretical background for the econometric specification of consumption equation. Section 3 sets out the specification of the empirical models and discusses the estimation results. Section 4 concludes. An appendix and online complements give respectively details on the data used and further literature background.

Macro theory, the consumption function and the modelling framework

Blanchard (2018) argues that in contrast to dynamic stochastic general equilibrium models, “Partial equilibrium modelling and estimation are essential to understanding the particular mechanisms of relevance to macroeconomics”. In particular, Hendry and Muellbauer (2018) criticize the representative agent New Keynesian DSGE models for being insufficiently stochastic – trivializing the role of uncertainty and heterogeneity, insufficiently dynamic – missing key lags in relationships, insufficiently general equilibrium – ignoring important feed-back loops, seen for example in the global financial crisis, and insufficiently Keynesian - missing co-ordination failures in labour and financial markets.

Consumption function

Households actually face idiosyncratic and uninsurable income uncertainty, and uncertainty interacts with credit or liquidity constraints. The asymmetric information revolution in economics in the 1970s for which Akerlof, Spence and Stiglitz shared the Nobel prize explains this economic environment. Research by Deaton (1991,1992), Carroll (1992, 2000, 2001, 2014), and a new generation of

heterogeneous agent models imply that household horizons then tend to be both heterogeneous and shorter – with ‘hand-to-mouth’ behaviour even by quite wealthy households (Kaplan *et al.*, 2014). Kaplan *et al.* (2018) have incorporated these insights into a DSGE model, though without endogenising housing, and Hedlund *et al.* (2017) into a DSGE model with a frictional housing market. Kaplan and Violante (2018) spell out further implications of heterogeneous agent models, the limitations of extant models and unresolved research questions, for example on asset pricing and labour market income risk. They acknowledge that current versions of the heterogeneous agent New Keynesian model “miss the potentially large wealth effects on consumption for wealthy households that can arise from changes in asset prices”, an issue on which the present paper provides empirical evidence. There is mounting empirical evidence on the cash-flow channel of monetary policy transmission, consistent with heterogeneity and liquidity constraints (La Cava *et al.* (2016) for micro-evidence on Australia, Aron *et al.* (2012) for macro-evidence for the UK).

Contributions to behavioural economics by Thaler and on financial illiteracy (Clark *et al.*, 2017 as an example) reject the hypothesis of a shared rational behavior. Alternative expectations mechanisms, radical uncertainty and structural breaks, such as shifts in credit market architecture in particular, have not, so far, been incorporated in DSGE models useful for central bank policy making. They do however, feature in the quantitative partial equilibrium model of the household sector estimated on aggregate data presented below. To obtain general equilibrium results, this module would have to be inserted into a larger macro-econometric model, including specifications of policy feedback rules.

The simplest textbook permanent income form of the consumption function is as follows, using the log-linear approximation as in Muellbauer and Lattimore (1995):

$$\ln(c_t/y_t) = \alpha_0 + \ln(y_t^p/y_t) + \gamma A_{t-1}/y_t \quad (1)$$

where c is consumption, y is non-property income, y^p is permanent non-property income, and A is net worth. The marginal propensity to spend out of net worth is γ .

If real interest rates are variable, standard consumption theory suggests that the real interest rate r_t enters the model with the usual interpretation of inter-temporal substitution and income effects. Extending the model further to include probabilistic income expectations suggests the introduction of a measure of income uncertainty. With income uncertainty, the discount factor, δ , in expected income growth as measured by $\ln(y_t^p/y_t)$ should incorporate a risk premium, allowing the possibility that households may discount the future more heavily than by the real rate of interest.

Furthermore, different types of assets may imply different marginal propensities to consume. One reason is that owner-occupied housing wealth differs fundamentally from financial assets since a roof

over one's head gives shelter (has utility value) as well as having an asset value, see Buiter (2010) and Aron *et al.* (2012). The second reason is that, with credit constraints, housing wealth has a collateral role (see Muellbauer (2007) or Aron *et al.* (2012) for further discussion). A third reason is that illiquid financial assets as well as housing are subject to asset price volatility and/or trading costs or restrictions (see Kaplan *et al.* 2014; Kaplan *et al.* 2018).

Finally, the Friedman-Ando-Modigliani model suggests that the consumption to income ratio for adults varies with age, which is indeed the case in France (Fesseau *et al.*, 2009). Thus, demography may have an impact on consumption behavior.

The long-run version¹ of the credit-augmented generalized aggregate consumption function is:

$$\ln(c_t/y_t) = \alpha_{0t} + \alpha_{1t}r_t + \alpha_{2t}rl_t + \alpha_{3t}\ln(y_t^p/y_t) + \gamma_1NLA_{t-1}/y_t + \gamma_2IFA_{t-1}/y_t + \gamma_{3t}HA_{t-1}/y_t + \gamma_{4t}\ln(hp_{t-1}/y_{t-1}) + \gamma_5demog_t \quad (2)$$

Here r is a real interest rate for borrowing and rl a real interest rate on liquid assets. Net worth, A , is replaced by a tripartite division into liquid assets minus debt² NLA , illiquid financial assets IFA , gross housing wealth HA , with different marginal propensities. hp is an index of house prices, and $demog$ captures the effect of the proportion of adults in the pre-retirement age group on consumption. With numerical indicators such as credit conditions indices ($CCIs$) for the mortgage market ($MCCI$) and for consumer credit loans ($CRCCI$), it is possible to make each potentially time-varying parameter a linear function of the $CCIs$ and test hypotheses about time variation.

The intercept α_{0t} increases with greater availability of non-housing loans and of mortgages, as the need to save for a down-payment is reduced or as the lengthening of mortgage maturities improves short to medium term net cash-flows. The coefficient measuring the sensitivity of down-payment requirements to house prices relative to income, γ_{4t} , should become less negative if the down-payment constraint becomes less binding. However, a relaxation of the debt-service ratio constraint could increase the fraction of households subject to the down-payment constraint. If access to home equity loans increases, the coefficient, γ_{3t} , measuring the marginal propensity to spend out of housing wealth, should increase. Expectations of future income growth, captured in α_{3t} , should have a larger effect on consumption when credit constraints ease, while greater income insecurity should have the opposite effect. It is also

¹ The dynamic version includes partial adjustment, and changes in the unemployment rate -an income uncertainty proxy-, and changes in income and interest rates. Models of this type have been estimated for the UK, US and Japan in Aron *et al.* (2012), Canada in Muellbauer *et al.* (2015), South Africa in Aron and Muellbauer (2013), and Germany in Geiger *et al.* (2015).

²It is possible to disaggregate net worth into four main elements, with a separate coefficient on debt. However, netting debt off liquid assets is supported by the evidence, while netting debt off gross housing wealth, a restriction sometimes found in the literature, is strongly rejected.

possible that α_{1t} , the sensitivity of consumption to the real interest rate on borrowing might be affected by credit conditions.

Consumption equation (2) satisfies long-run homogeneity in income and assets: doubling both, doubles consumption. The long run coefficient on $\ln y$ is set to 1. This means that the income endogeneity issues raised by Hall (1978) are not of concern for the measurement of the long-run income and asset effects.

The modelling philosophy follows an encompassing approach. Bontemps and Mizon (2008), given uncertainty about which of several competing models is correct, recommend constructing an encompassing model, which generates each of the competing models under particular testable parameter restrictions. For example, equation (1) is a special case of equation (2) under a number of restrictions. As presented in the empirical section, the data strongly reject these restrictions.

Modelling framework for household portfolios

Household portfolios are key determinants for consumption. The house price index as well as mortgage and consumer debt and liquid assets are endogenised in the model. They are determined by current and permanent income (with a positive coefficient, +), credit conditions (+ for debt and house prices, - for liquid assets), uncertainty (-), and characteristics of the age composition of population. They are also determined by arbitrage opportunities, represented here by their corresponding interest rates, real or nominal (- for debt and house prices, + for liquid assets) and the evolution of other assets (the impact of which is ambiguous, whether assets are complements or substitutes).³ House price and mortgage debt equations also include housing user and transaction costs (-). The modelling framework for the house price index and the mortgage debt are detailed further here, see online complement C5 for consumer debt and liquid assets equations.

The theory background for the house price equation is an inverted log-linear demand function, where real house prices, $rh p_t$, are determined by household demand, conditional on the lagged housing stock.

$$\ln rh p_t = h_{0t} + h_{1t} \ln nmr_t + h_{2t} \ln user_t + h_3 (\ln(y_t/hs_{t-1}) + h_{4t} E_t \ln(y_t^p/y_t)) + h_5 demog_t + h_6 LA_{t-1}/y_t + h_7 IFA_{t-1}/y_t + h_8 spillover_{t-1} + h_9 trans_t \quad (3)$$

Here h_{0t} should increase with mortgage credit conditions. The nominal mortgage rate is nmr , and user cost, measuring interest rates minus expected appreciation, is $user$. The parameter h_3 measures minus

³ Avouy-Dovi *et al.* (2014) show how financial assets may be complements or substitutes with a model for French households' portfolio detailed in 6 categories. Liquid assets are substitute for other assets, but not for insurance and pension funds.

the inverse of the price elasticity of demand for housing, and is attached to the log ratio of income to the housing stock, which imposes the constraint that the income elasticity of demand for housing is one. The coefficient h_{4t} captures the relative effect of permanent to current income, analogously to a similar term in the consumption function. The remaining terms respectively represent the effects of demography, liquid and illiquid financial assets, spillover effects from other housing markets, transactions costs and income uncertainty.

Mortgage and consumer debt are driven by the purpose of the debt, i.e. house prices and the long-run solution from the consumption function in equation (2) respectively. Higher house prices should increase the demand for mortgages because for a given level of housing demand, higher house prices require greater levels of debt.

$$\begin{aligned} \ln(mdebt_t/y_t) = & m_{0t} + m_{1t} \ln nmr_t + m_{2t} \ln user_t \\ & + m_{3t} E_t \ln(y_t^p/y_t) + m_{4t} \ln(hp_{t-1}/y_{t-1}) + m_{5t} demog_t + m_{6t} \ln(LA_{t-1}/y_t) \\ & + m_{7t} \ln(IFA_{t-1}/y_t) + m_{9t} trans_t \end{aligned}$$

(4)

Credit market liberalisation should impact in several ways on these long-run relationships, broadly corresponding to effects described on consumption. A direct, positive effect on debt should result from the different facets of credit liberalization, which included relaxation of the down-payment and debt-service constraints in the 80s and longer duration for housing credits in the 2000s, which also reduced debt-service cash-flows. Thus, m_{0t} should increase with *MCCI*, though housing equity loans to existing owners remained marginal in France. Real interest rates may matter more with liberalization, making m_{2t} more negative for example, while nominal ones perhaps matter less, making m_{1t} less negative. Income expectations may matter more after liberalization, shifting m_{3t} . Higher house prices relative to income should increase demand for mortgages but this might well be more pronounced if liberalisation relaxes the down-payment constraint, shifting m_{4t} . Demography, asset to income ratios and transactions costs are represented in the next four terms in (4). To the extent that bank funding is less constrained by household deposits in a more liberal regime, there may be time variation in m_{6t} .

Empirical findings

Six equations are estimated jointly by maximum likelihood methods for French quarterly data from 1981 to 2016, for consumption, house prices, mortgage loans, consumer credit, and liquid assets⁴,

⁴ For the estimations of the consumer credit and liquid assets equations, see online complement C5.

permanent income (see Box), with credit conditions for both consumer credit and mortgage loans estimated as latent variables⁵. They entail potentially important, highly non-stationary demographic effects. Empirical identification of the latent variables relative to demography is not a trivial exercise. Fortunately, there is institutional and other information on the nature and timing of credit market liberalisation and there are priors on the direction of interest rate and income effects on house prices and household balance sheets. Micro information on holdings of debt and liquid assets by age of household and on household saving rates (hence consumption to income ratios) by age is also used to impose sign restrictions and upper bounds on potential demographic effects.

Estimates for the two credit conditions indices

There are no data to measure credit conditions directly in France before 2003. This article adopts a “latent variable approach”, where credit conditions indicators for housing and non-housing loans are proxied by spline functions guided by institutional information on credit market liberalization. Both indices are specified as a linear combination of ogive dummies, which make a smooth transition from zero to one over eight quarters, and lagged inflation rates, relevant for consumer credit. When inflation risk, proxied by the lagged annual inflation rate, is high, lenders are less likely to extend credit for fear of negative returns. The disinflation that really took hold in 1984 would therefore have been likely to ease credit constraints. In all, 13 dummies (resp. 6) are used to describe the shape of the mortgage credit conditions index *MCCI* (resp. *CRCCI*) shown in Figure 1a (cf. online complement C2).

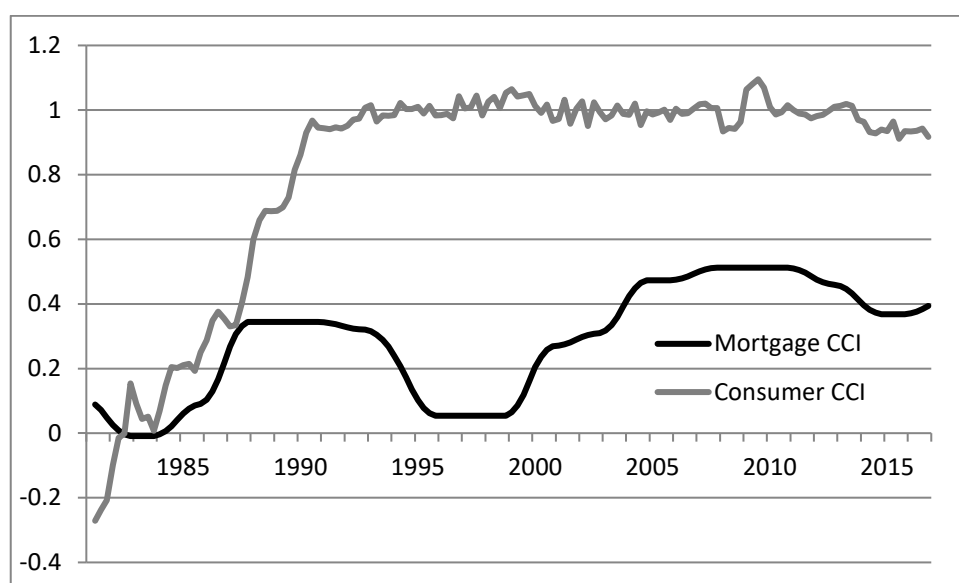
Since the stock of consumer credit rises from extremely low levels in 1981, unlike consumption and liquid assets, potentially influenced by *CRCCI*, it is implausible to use the same linear form in each equation. Hence while *CRCCI* enters the other equations linearly, in the consumer credit equation it enters as: $\ln(0.5 + CRCCI_t)$. For log consumer debt, the marginal effect of *CRCCI* then declines as *CRCCI* rises, while for the other (log) variables, the marginal effect is constant.

Though unsecured consumer debt was already rising dramatically before, credit controls were relaxed in 1984, when *MCCI* begins to rise strongly, and further deregulation took place later in the 1980s, when both indices rise. In the early 1990s, in common with many other countries, some French banks were in trouble with bad loans partly due to excess lending to real estate developers in the late 1980s, due to households’ nominal income deceleration following disinflationary monetary policy, and partly due to the stresses caused by interest rate rises resulting from German unification. There is a close negative correlation from 1991 to 2016 between the ratio of non-performing loans to total loans to the

⁵Duca and Muellbauer (2013) name this type of equation system a *Latent Interactive Variable Equation System* (LIVES).

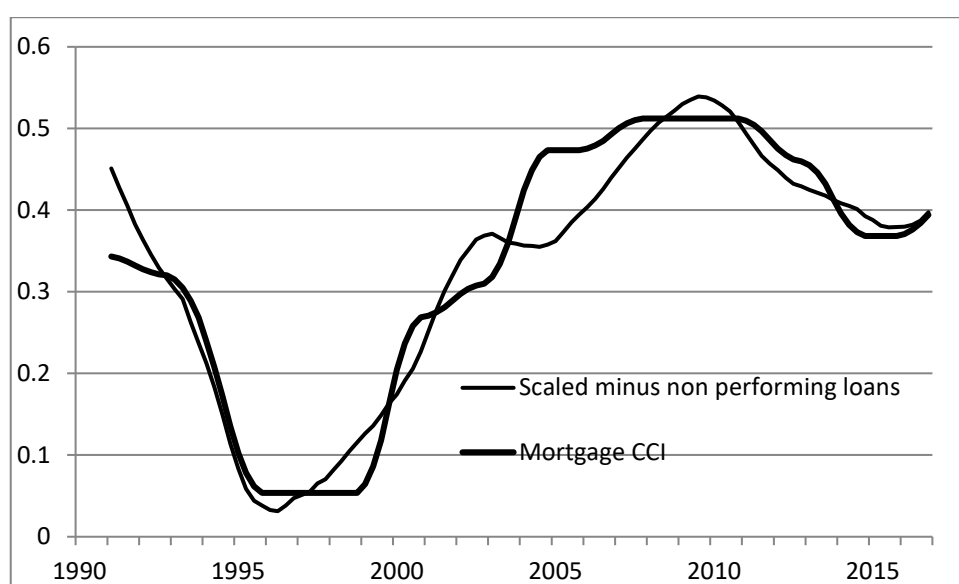
private sector, lagged one year and our estimated *MCCI* (Figure Ib). The relation is particularly close when credit conditions tighten in 1991-96 and 2010-14.

Towards the end of the 1990s, as banks recovered, credit flows improved, competition in credit markets increased with the expected arrival of the common currency and, as discussed in online complement C3 and C4 conditions on securitisation of loans loosened, while terms of housing loans were extended from an average of 11.8 years in 1989 to 14.3 years in 1999 and 18.4 years in 2009. Given the maximum



Sources: INSEE ; authors' calculations (cf. online complement C2)

Figure 1a: Estimated mortgage and consumer credit conditions indices.



Sources: INSEE, Banque de France; authors' calculations (cf. online complement C2).

Figure 1b: Scaled negative non-performing loan ratio (8-quarter moving average, lagged 2 quarters) and estimated mortgage credit conditions index.

debt burden of loans allowed by banks to households, the level of interest rates and of income, this meant an increase of nearly 20% in the borrowing capacity of households. In the *MCCI* graph, this shows up as a considerable liberalisation on housing loans before declining once more after 2010 as the bad loans ratio rose. There seems to have been little change in credit availability for non-housing consumer credit since about 1990.

BOX – The permanent income forecasting equation: modelling and estimates

Following Campbell (1987), **expected income growth** is defined as follows as the log ratio of permanent income to current income:

$$\ln(y_t^p / y_t) = \left(\sum_{s=1}^k \delta^{s-1} E_t \ln y_{t+s} \right) / \left(\sum_{s=1}^k \delta^{s-1} \right) - \ln y_t$$

The quarterly discount factor is set at $\delta = 0.95$, corresponding to a quarterly discount *rate* of 5%.

Forecast permanent income follows linear trends, allowing for an unanticipated negative shift after the global financial crisis, economic variables and demography. This is a reduced form representation of the forecast effects of the capital stock and of total factor productivity and of cyclical deviations around capacity on future incomes. The expected signs of coefficients are indicated in parentheses: the economic variables include changes in nominal and levels of real interest rates (-), current real per capita income (-) because of reversion to trend, changes in log real per capita income, possibly indicating some growth momentum (+), household survey expectations of future living standards (+), the unemployment rate (-) (e.g. because it weakens the power of workers in wage negotiations), the log stock market index in real terms (+) (it indicates expectations of productivity growth and is one of the drivers of capital investment which expands future capacity), log real oil prices (-) and the log real exchange rate (-), indicating worsening competitiveness, and finally the ratio of the working age population divided by the total population (+).

The relevant variables were chosen by first carrying out a model selection exercise for data from 1972 to 2016 for forecasting income over 1, 4 and 8-quarter horizons, incorporating a split trend around 2009. This exercise suggested the relevance of longer lags than normally considered in econometric forecasting. Since permanent income is a moving average of future income, it is plausible that moving averages of the drivers would also be relevant and many of the variables enter in that form. The parameter estimates are shown in Table A below and the fit is visualised in Figure A. The long lags shown for many variables are consistent with a slowly evolving capital stock, reacting to economic influences on investment. Given the overlapping nature of the dependent variable, the residuals are highly auto-correlated, though the model does seem to capture reasonably well cyclical fluctuations. Goodness of fit, however, is not necessarily an unmixed blessing since households are bound to make serious forecast errors: rather the aim is to capture what their views might have been, given information to which households would have ready access. In contrast to the unforecastable financial crisis, the effects of repeated variations in interest rates, equity prices, oil prices, exchange rates and unemployment might have been sensibly evaluated. They could have operated through the medium of professional forecasters, business economists, central banks and organisations such as the IMF and the OECD.

Two alternative assumptions on income growth beyond the end of the sample in 2016 were considered. One uses forecasts from OxfordEconomics.com in which future trend growth is of the order of 1.2%; the other assumes linear trend growth of real per capita income ranging from 0.6% to 1% per annum. The results are robust to alternative assumptions, and 0.8% growth is assumed.

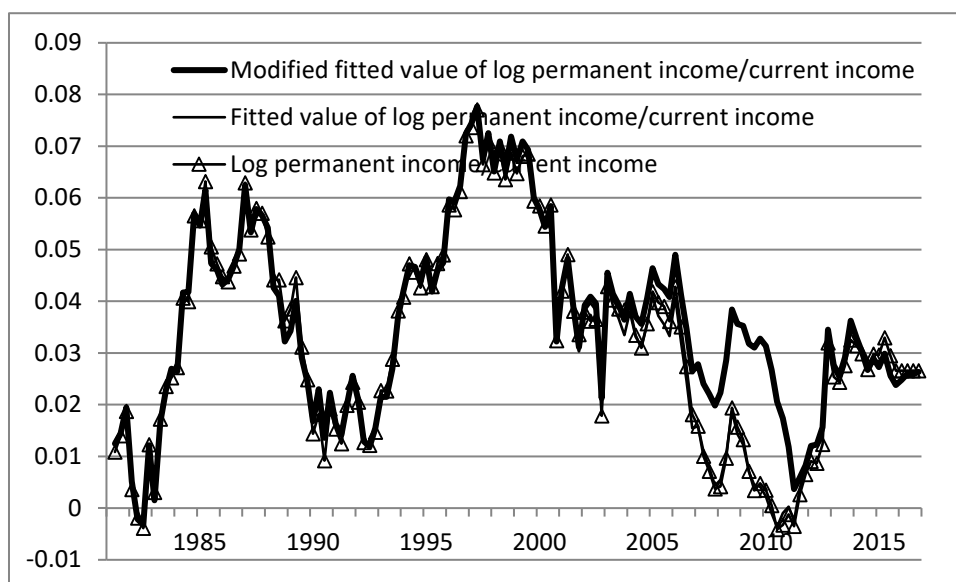
If the downturn in economic growth after the global financial crisis, implying a shift in the trend, had been fully anticipated, then, given the 10-year horizon, already in 2000, household expectations would have been beginning to build in the shift in trend that began at the end of 2009. To fit the data, the permanent income model therefore incorporates the present discounted value of the shift in trend that began at the end of 2009. However, households could not have had this information, so that generated permanent income up to 2009Q3 omits this component of the econometric model. We then assume that households' expectations gradually incorporated the downward revision of trend growth over the next 8 quarters so that from 2011Q4 they have fully adjusted. The effect of the adjustment is that households have increasingly a too optimistic view of permanent income before 2009. This is shown in Figure A, suggesting households over-estimated permanent income by around 3 percent in 2009.

Table A: Estimates for the income growth forecasting model

Dependent Variable = log (permanent income/current income)	1981Q2-2016Q4		1981Q2-2008Q3	
	<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>
Variables				
Constant	1.74	37.3***	1.68	18.7***

Time trend	0.00318	34.1***	0.00299	21.8***
Split trend from 2009Q4, discounted present value	-0.00200	-22.3***	-0.00231	-5.4***
Log (real per capita income)	-1.10	-42.4***	-1.02	-39.5***
4-quarter change in log (real per capita income)	0.17	6.0***	0.11	3.2***
Log working age pop/total population	0.59	fix	0.59	fix
Survey expectations of future conditions	0.0052	3.8***	0.0040	1.1
Real interest rate ma4 (t-1)	-0.08	fix	-0.08	fix
Real interest rate ma4 (t-5)	-0.19	-6.3***	-0.18	-7.1***
Real interest rate ma4 (t-9)	-0.19	-7.1***	-0.18	-7.9***
4-quarter change in T-bill rate	-0.073	-9.2***	-0.027	-1.6*
4-quarter change in T-bill rate (t-4)	-0.041	-6.7***	-0.016	-1.2
log real stock market index ma4 (t-1)	0.015	7.3***	0.013	5.9***
unemployment rate ma4 (t-1)	-0.0034	-5.5***	-0.0020	-2.2**
unemployment rate ma4 (t-5)	-0.0022	-4.3***	-0.0014	-3.4***
log real oil price ma4 (t-1)	-0.0071	-5.5***	-0.0044	-2.5**
log real oil price ma4 (t-5)	-0.0059	-4.2***	-0.0058	-3.7***
Log real exchange rate ma4 (t-1)	-0.038	-4.5***	-0.032	2.2**
Log real exchange rate ma4 (t-5)	-0.033	-3.0***	-0.045	-3.5***
Diagnostics				
Equation standard error	0.00184		0.00161	
DW	0.54		0.42	
R-squared	0.992		0.993	

Note: t-ratios are corrected for heteroscedasticity and autocorrelation. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and *** respectively. ma4: moving average on 4 quarters. Maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals
Sources: INSEE, Banque de France, authors' calculations.



Sources: INSEE, Banque de France; authors' calculations. The modified fitted value applies a time-varying weight to the discounted present value of the split trend beginning in 2009Q4. The weight is zero up to 2009q4, one from 2011Q4 and gradually shifts from zero to one between 2009Q4 and 2011Q4.

Figure A: Plots of actual values of log ratio of permanent to current income against fitted values and modified fitted values used in the consumption equation

Consumption

The general form of the consumption equation was set out in equation (2). The estimated speed of adjustment at 0.56 is high, indicating a strong reaction of consumption to the long run determinants (table 1.a). The main difference with US and UK estimates comes from effects of house prices and housing wealth.

The real interest rate enters as a weighted average of the real interest rate on unsecured debt and mortgage debt, weighted by the lagged debt to income ratios. It has a strongly significant negative effect. The coefficient on the ratio of permanent to current income is a little over one half, substantially below the ‘text-book’ permanent income hypothesis of one, despite the fact that permanent income, by its construction already embodies a far shorter horizon. The coefficient on net liquid assets is substantially larger than that on illiquid financial wealth, the latter containing a large saving for retirement element.⁶ The restriction that the debt coefficient is minus that on liquid assets is easily accepted. The apparently small size of the illiquid financial wealth effect with a marginal propensity to consume (MPC) of 0.022 is partly due to the inclusion of the control for permanent income, which is strongly affected by the stock market.⁷ These results are consistent with those based on micro data for France. Using the French Wealth Survey and the Household Budget Survey, Arrondel *et al.* (2014) report a MPC for financial wealth ranging from 0 for the wealthiest owning mostly illiquid assets to 0.11 for the less wealthy owning mostly liquid assets.

Housing wealth/income has a positive effect, but with an MPC (0.013) smaller than that for illiquid financial assets, and with a strong offsetting negative effect from log house prices/income. The two measures are quite correlated, so that their separate coefficients are not very accurately estimated. If the negative house price/income effect is omitted, housing wealth/income becomes insignificant, with a t-ratio below 1 but other coefficients are little affected. This answers the question of whether there is an aggregate housing wealth effect on consumption in France: the simplest interpretation is that there is such an effect for owners, but that it is offset, when housing becomes less affordable, by lower consumption of tenants, including those saving for a housing deposit. Such a hypothesis is confirmed by Arrondel *et al.* (2014), who find a MPC for housing wealth ranging from 0.007 to 0.011 for homeowners on microdata.

⁶ The estimated coefficient is 0.14. However, the ratio to income of net liquid assets has a strong downward trend. Introducing a small trend effect, for example, from increased life expectancy for those aged 60 or more, which should also reduce the consumption to income ratio, it is easy to accept a coefficient of 0.12, close to US and UK estimates. Fortunately, such a modification has little effect on other estimates.

⁷ This is consistent with Poterba (2000), who argues that so-called wealth effects in consumption functions, excluding controls for expected income, are a mix of genuine wealth effects and expectations.

An interaction between mortgage credit conditions and log house prices/income proved *negative* and on the margin of significance. This result indicates the importance of distinguishing the down-payment from other constraints on borrowers. Easing only the former would entail a *positive* coefficient on the interaction. Easing only the latter is likely to drive larger fractions of potential first-time buyers to save more for a given down-payment ratio, resulting in a *negative* interaction effect. However, the overall implications for consumption from this more complex specification are almost the same as those discussed below for the 1996 to 2008 period.

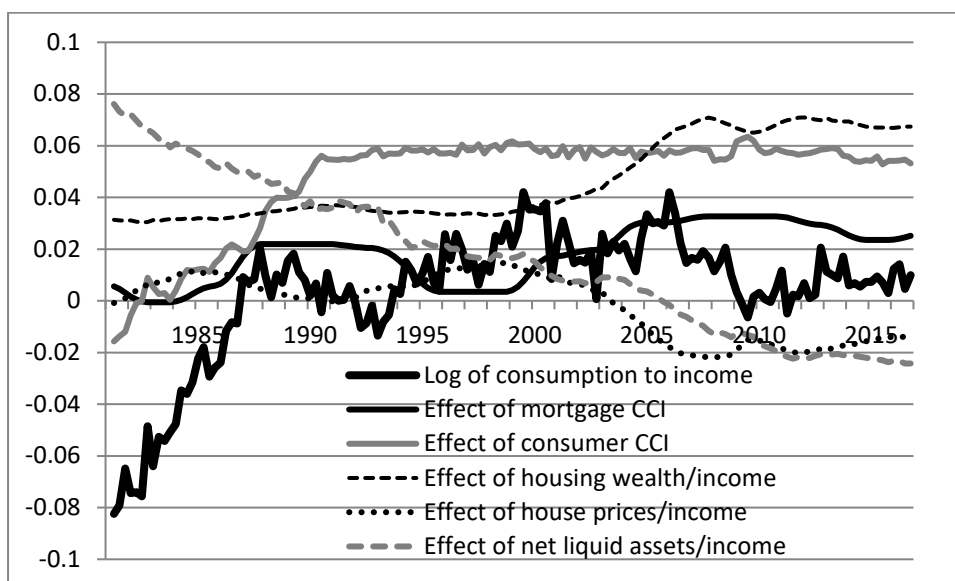
Estimating demographic effects on consumption, given the other controls, of which balance sheets are themselves likely to be influenced by demography, potentially runs into a ‘spurious regression’ problem as most demographic variables are integrated of order 2.⁸ Cross-section studies tend to find the highest saving rates for households in the pre-retirement age bracket. This suggests using the proportion of adults in this age group, defined as the proportion of those aged 40 to 59 plus 0.4 of those aged 60-64, since the retirement age was 60 over most of our sample. The coefficient on this variable approximately represents minus the difference between the saving rate of this group of adults, about 40% of adults, compared to the remainder of adults. It seems hard to believe that this could be more than 0.4, an upper bound⁹. Between 1981 and 2016, the 3% increase in this proportion would then imply a 1.2% decline in the consumption to income ratio. The freely estimated coefficient is within one standard error of -0.4 and we therefore calibrate the coefficient to this value.

The coefficient on the mortgage credit conditions index is normalised at 1 in the house price equation. When the *MCCI* has an impact of +1 % on house prices, then its estimated impact on consumption is +0.06%, everything else being equal. In the consumer loans equation, the term $\ln(0.5 + CRCCI_t)$ has a coefficient normalised to 1. For high values of *CRCCI*, a rise with a 1% impact on consumer credit implies an impact on consumption of around 0.08%, other things being equal. The quantitative long-run contributions to the log-ratio of consumption to income of the two credit conditions indices are shown in Figure IIa.

From 1983 to 1990 increasing access to consumer credit is estimated to have increased the consumption to income ratio by around 6%, with another 2.5% or so from increased access to mortgages. However, the negative offset from the rise in the overall debt to income ratio, as reflected in the decline in the ratio of liquid assets minus debt, accounted for around 3% over that period.

⁸ Requiring twice differencing to make them stationary.

⁹ Cross-section evidence shows more moderate differences in saving rates out of income by age. Such evidence is only a rough guide since gross differences in saving rates by age are attenuated by wealth differences.



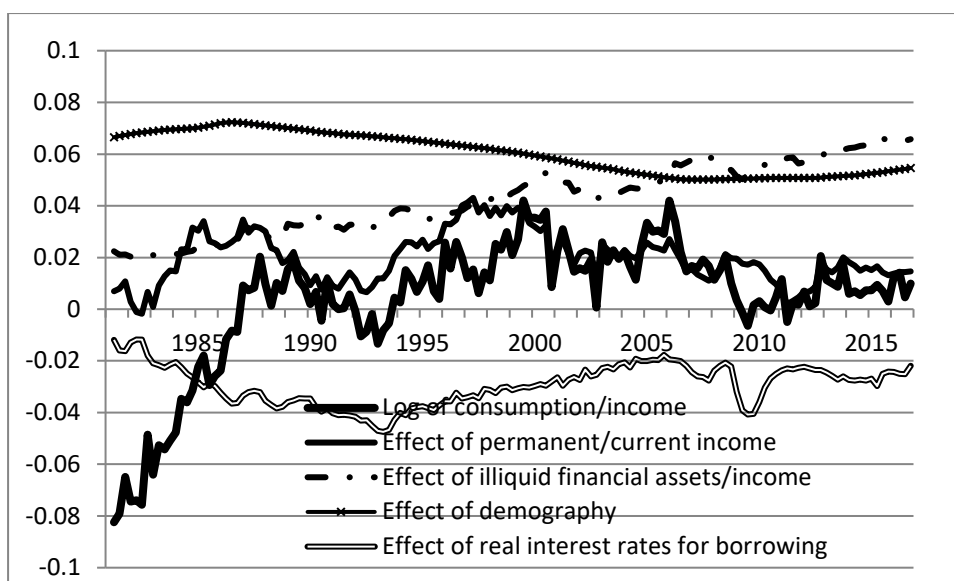
Sources: Banque de France, INSEE, OECD, INSEE, authors' calculations.

Figure IIa: Long-run effects on log consumption/income

From the 1996 trough to the 2008 peak in the housing market and mortgage credit availability, the increase in mortgage credit availability accounts for a direct increase in the log consumption to income ratio of about 2.5% and an indirect increase via housing wealth of 3.5%. But this is almost exactly balanced by a 3.5% negative effect from higher house prices relative to income and a 2.5% negative effect of lower net liquid assets relative to income, mainly driven by higher household debt.

The UK and the US also experienced mortgage credit liberalisation and a large rise in housing wealth from 1996 to 2007. Falls in the ratio of liquid assets minus debt to income also occurred in the US and the UK with similar negative effects on consumption to those in France, see Duca and Muellbauer (2013) and Hendry and Muellbauer (2018). But with far smaller down-payment requirements and easy access to home equity withdrawal, the net consumption effects, unlike in France, were large and positive in the US and the UK.

Figure IIb illustrates the notable contributions of ratios to current income of permanent income and illiquid financial wealth, and of real interest rates, which rose in the 1980s and fell after the mid-1990s. The increasing share of adults in the pre-retirement age-group is reflected in the demographic trend.



Sources: Banque de France, INSEE, authors' calculations.

Figure IIB: Long-run effects on log consumption/income.

The propensity to consume might depend on the type of income. It is accounted for in the form of a weighted average of log conventional household disposable income (HDI) and log non-property income, with weights ω and $1 - \omega$. The estimated weight on log HDI is 0.5. Since HDI contains non-property income, the implied weight on the property component of income is around 0.33 with 0.67 on the non-property component.¹⁰

The short-run dynamics include five economic variables: the quarterly change in log real income enters with a negative coefficient, suggesting that a mix of current and last quarter's income is relevant for consumption. The change over four quarters in the unemployment rate has a significant negative effect, paralleling results for other countries, see Aron *et al.* (2012). Inflation over the two previous years has a negative effect.¹¹ A measure of the car scrapping scheme subsidy is strongly significant, with a positive effect, offset by a negative effect in the quarter after the subsidy ends.¹² The annual change in the housing transaction tax rate has a significant negative effect on consumption. The specification also

¹⁰ If income is measured just by non-property income, all the wealth coefficients rise. This is not surprising since the omitted property income is clearly linked with asset ownership. The negative effect of the log house price to income ratio increases.

¹¹ It is unlikely that this could be a real balance effect since that is already strongly represented through the net liquid asset/income term. It could be another indicator of uncertainty about real income or indirectly picking up a small role for nominal interest rates, given the strong real interest rate effects in the equation.

¹² The scheme operated for parts of the periods 1994-98 and 2009-13 and had the purpose of stimulating the car industry by offering a premium for scrapping of older models when purchasing a new one.

included three impulse dummies for outliers¹³, which may represent other shocks, e.g. due to major strikes or floods. The results are robust to the exclusion of the impulse dummies though illiquid wealth is a little less significant. Parameter stability tests, for example estimating from 1986Q1 instead of 1981Q2, and estimating to 2008Q3, omitting the global financial crisis, support the reported estimates. The second column reports estimates to 2008Q3¹⁴.

The last column of Table 1a shows estimates for the consumption function obtained when the two credit conditions indicators are excluded. The speed of adjustment falls from 0.55 to 0.2 and the R-squared falls from 0.71 to 0.57. The coefficient on the log house price to income ratio switches from negative to positive, while that on the housing wealth to income ratio switches from positive to negative, though neither is significant. The marginal propensities to spend out of net liquid and illiquid financial assets both rise and are far less well determined. The direction of these biases can all be interpreted in terms of correlations with the omitted credit conditions. Forcing wealth effects to enter in a single net worth to income ratio and omitting the log house price to income ratio fares even worse, with the marginal propensity net worth to income ratio estimated to be negative. No wonder previous estimates of aggregate French consumption functions find unstable wealth effects (Chauvin & Damette, 2011). As argued in Hendry and Muellbauer (2018), the net worth constraint and the omission of shifts in credit conditions is a gross misspecification, particularly for economies where large shifts have occurred in credit architecture.

Comparable estimates of long-run credit conditions and wealth effects for Germany, the UK and the US, are shown in Table 1b. They show no housing wealth or collateral effect in Germany but a comparable negative effect of log house prices/income as in France. Also, the small variation in credit conditions entail smaller effects than in France. In the UK and the US the interaction of mortgage credit conditions and housing wealth/income is crucial, suggesting no housing wealth or collateral effect before mortgage credit liberalisation.

¹³For 1984Q4, 1993Q1 and 1995Q2.

¹⁴ Since estimation of demographic effects needs long samples, the coefficients on the proportion of adults in the pre-retirement age group in the consumption equation and that on the log working age population in the permanent income equation are set to the full sample values.

Table 1a: Estimates of the long-run solution of the French consumption function

Dependent Variable = $\Delta \ln c_t$	Symbol	1981Q2-2016Q4		1981Q2-2008Q3		1981Q2-2016Q4 Excluding CCIs(a)	
		<i>coefficient</i>	<i>t- ratio</i>	<i>coefficient</i>	<i>t-ratio</i>	<i>t- ratio</i>	<i>t- ratio</i>
Speed of adjustment	λ	0.56***	11.1	0.63***	10.3	0.20***	5.0
Long-run coefficients for log c/y							
Constant	α_0	0.08*	1.7	0.12**	2.2	-0.11	-0.9
Mortgage credit conditions index: <i>MCCI</i>	α_{0c}	0.064***	5.3	0.078***	4.8	0	Fix
Consumer credit CCI: <i>CRCCI</i>	α_{00c}	0.058***	5.4	0.066***	4.9	0	Fix
Real interest rate i_t , weighted by debt/income	α_1	-0.72***	-7.5	-0.65***	-4.8	-1.17***	-4.0
Forecast future income growth: $E \ln(yperm / y)_t$	α_3	0.55***	9.9	0.59***	11.3	0.48***	3.1
Net liquid assets $_{t-1} / y_t$	γ_1	0.14***	4.4	0.13***	4.3	0.18**	2.0
Illiquid financial assets $_{t-1} / y_t$	γ_2	0.022***	3.3	0.017***	3.4	0.040**	2.3
Housing wealth $_{t-1} / income_{t-1}$	γ_3	0.013**	2.2	0.015***	2.7	-0.013	-0.9
log house prices $_{t-1} / income_{t-1}$	γ_4	-0.062**	-2.5	-0.081***	-3.1	0.070	1.2
ratio of pre-retirement age group/adults	γ_5	-0.4	fix	-0.4	fix	-0.4	Fix
Weight on <i>HDI</i>	ω	0.5	fix	0.5	fix	0.5	Fix
Diagnostics							
Equation standard error		0.00324		0.00306		0.0390	
DW		1.93		1.86		1.85	
R-squared		0.705		0.760		0.573	

(a) excluding the two credit conditions indicators.

Include stars beside each coefficient for significance

Note: Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and *** respectively.

Maximum likelihood estimation of 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals.

Sources: Banque de France, INSEE, OECD, authors' calculations.

Table 1b: Estimates of the long-run credit conditions and wealth effects for Germany, UK and US.

		German estimate 1981:3- 2012:4	t-ratio	UK estimate 1967:1 – 2005:4	t-ratio	US estimate 1971:4 – 2011:1	t-ratio
Mortgage credit conditions index: <i>MCCI</i>	α_{0c}	0.073	5.8	0.050	3.6	-	-
Consumer credit CCI: <i>CRCCI</i>	α_{00c}	0.024	1.0	-	-	0.089	7.7
Net liquid assets _{t-1} / y_t	γ_1	0.09	4.1	0.11	8.0	0.10	7.6
Illiquid financial assets _{t-1} / y_t	γ_2	0.016	2.5	0.022	8.0	0.017	8.6
Housing wealth _{t-1} / income _{t-1}	γ_3	0.001	0.1	-	-	-	-
MCCI*Housing wealth _{t-1} /income _{t-1}	γ_{3c}			0.043	10.3	0.055	5.4
log house prices _{t-1} / income _{t-1}	γ_4	-0.069	-3.2	-	-	-	-

Notes: German estimate from a special version of the equation in Geiger *et al.* (2016); UK estimate from Aron *et al.* (2012); US estimate from Duca and Muellbauer (2013).

Sources: cited papers.

House prices

In the house price equation, the intercept effect of the credit conditions indicator for housing loans is normalised at one, in order to identify MCCI estimation. The estimated quarterly speed of adjustment is 0.12, similar to that found for Germany in Geiger *et al.* (2016) (Table A2-1). The elasticity of house prices w.r.t. to the nominal mortgage rate is -0.38 (t=-11.5). There is also an interest rate effect buried in the user cost measure, which turns out to interact with mortgage credit conditions. When MCCI is zero, there is no significant user cost effect. This finding is consistent with the large user cost effect found by Duca *et al.* (2011, 2016) for US house prices, given higher levels of leverage there.

The user cost variable is described in appendix 1. It incorporates large transaction costs which are motivated by weak mobility in France and expectations of further large increase in house prices, after a buoyant period, that would have led to negative user cost otherwise. Lagged house price appreciation relative to other countries was also explored but found insignificant.

The effect of income relative to the net housing stock is strongly significant and in line with Meen (2001) “central estimates”. Indeed, the log of this measure has a freely estimated coefficient close to 2 and we impose this restriction, implying that the price elasticity of aggregate demand for housing in France is -1/2.. It is a little less elastic than UK estimates, see Cameron *et al.* (2006), and substantially

less elastic than German estimates, see Geiger *et al.* (2016)¹⁵. The hypothesis of an equal and opposite coefficient on log income and log housing stock, implying an income elasticity of demand for housing of one, is accepted by data, as is usually the case in this approach.¹⁶ The relative weight of log permanent to current income of 0.52 is close to the 0.55 found in the consumption function.

The last elements in the long run solution are two demographic variables also found relevant in the mortgage equation: the ratio of children to adults and the proportion of adults in the pre-retirement age group. On the one hand, a high ratio of children to adults suggests both higher rates of family formation, increasing housing demand. On the other hand, cross-section data in Arrondel *et al.* (2016) show the highest incidence of mortgages by 10-year age brackets in the 40-49 and 50-59 brackets. To avoid the risk of spuriously large demographic effects, the size of the coefficient for the ratio of children to adults (resp. for the proportion of 40 to 60-64s) is limited to 2 (resp. 3). Those values are within one standard error of the freely estimated coefficient.

Short term effects include the acceleration of the proportion of those aged 25 to 40 as well as that of unemployment rate over two quarters. Note that those variables are also in the short term dynamics of mortgage equation, but by considering their change rather than their acceleration.

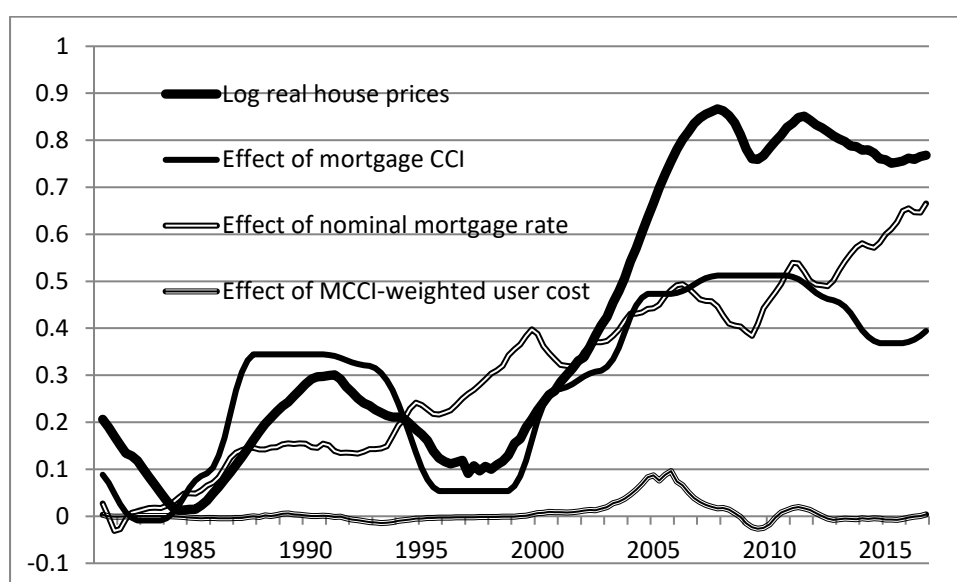
Since persistence in house price appreciation is already incorporated in the user cost, further short term house price dynamics are checked using lagged acceleration in log nominal house. Short-run dynamics also include the annual change in transactions costs – the level is not significant- and some impulse dummies. These capture the three quarters after the collapse of Lehman Bros.

Figure IIIa shows that the combination of lower nominal interest rates and liberalisation of credit market conditions explains a good deal of the upward trend since 1985 in real house prices, with credit crunches explaining most of the fall from 1990 to 1996 and after 2010. Demography, see Figure IIIb, in the form of the fall in the ratio of children to adults, together with rising housing supply relative to income and population explains the fall in real house prices in the early 1980s, despite falling interest rates. Demography explains about half of the rise after 1995, when the increasing share of adults in the pre-retirement age group is more than compensating for the continued, but more moderate, decline in the child/adult ratio.

¹⁵ This is probably due to the Paris-dominated structure of the French economy in contrast to the far more decentralised German economy with multiple metropolitan centres, thus offering greater locational substitution possibilities.

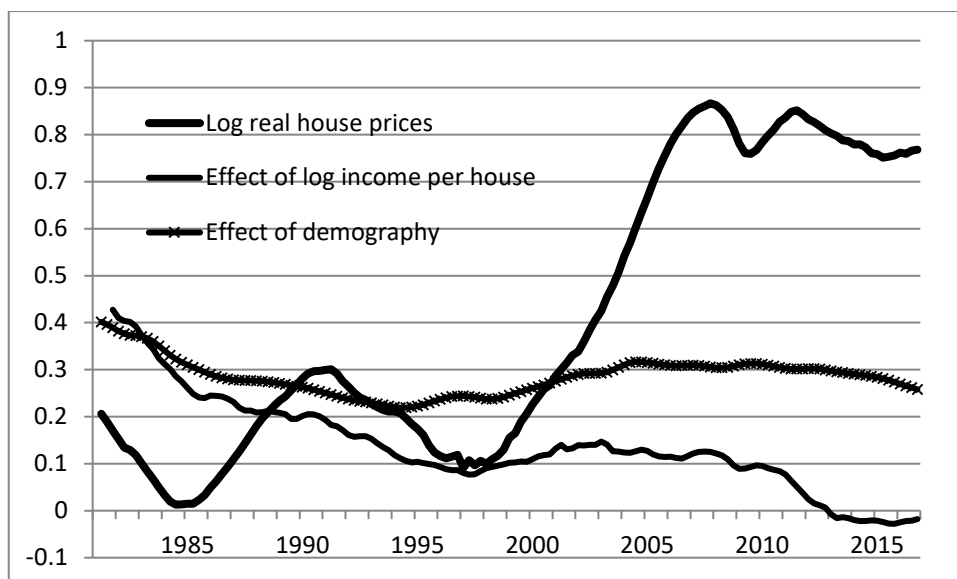
¹⁶ Note that this model cannot estimate the elasticity of housing supply with respect to prices because the stock of houses is considered as given..

Excluding the *MCCI* term in the house price equation, leads to a collapse in the speed of adjustment from 0.12 to 0.026, and a dramatic worsening in the fit and in autocorrelation of the residuals. Without restrictions, many of the estimated long-run effects would be absurd. To help define a sensible long-run solution, key coefficients are calibrated as shown in the table and demographic effects are generalised by including the proportion of adults aged 25 to 44. The evidence is consistent with that of the studies surveyed in online complement C1 excluding credit conditions, which reveal extreme fragility of estimated parameters, and in many cases magnitudes of elasticities far from economically plausible values. Even with calibrated demographics and interest rate effects, the freely estimated coefficient on log income per house would rise from a value of 2 to the absurd level of 12 (and a very low price elasticity of demand), while the speed of adjustment falls further.



Sources: Banque de France, INSEE, OECD, authors' calculations.

Figure IIIa: Long-run effects on log real house prices.



Sources: Banque de France, INSEE, OECD, authors' calculations.

Figure IIIb: Long-run effects on log real house prices in France.

Mortgage stock

Miles (1992) and Brueckner (1994) discuss the borrowing and saving decisions for housing and portfolio investment motives and discuss the consequences of the relaxation of mortgage rationing for the mortgage stock. However, little systematic econometric work exists on household debt, see the reviews in Fernandez-Corugedo and Muellbauer (2006) and in Meen (1990). In France as well as most developed economies, mortgage debt accounts for the major proportion, often 70 to 80 percent of total household debt.

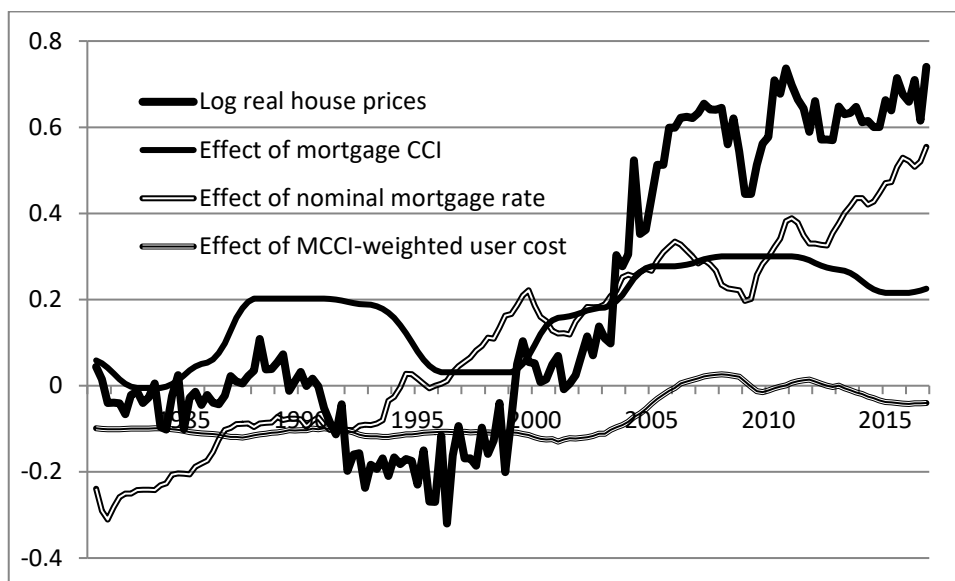
Given the long duration of mortgage contracts, the mortgage stock adjusts quite slowly to the long-run drivers, with a quarterly speed of adjustment of 0.077 ($t=15.8$), see Table A2-2. This is not far from estimates of around 0.065 found for the UK in Fernandez-Corugedo and Muellbauer (2006). In the long-run solution for the mortgage stock equation, the log of the nominal mortgage interest rates has a highly significant coefficient of -0.46 ($t=-16.6$). Such a strong effect is consistent with banks using the debt service ratio as a key lending criterion (online complement C4). In the extreme case of every borrower at the maximum allowed by the ceiling on the debt service ratio, the coefficient on the nominal interest rate would be -1. Neither the real interest rate nor a measure of the user cost of housing proved significant, though user cost has an indirect influence via its impact on house prices. Not surprisingly, mortgage credit conditions have a highly significant intercept effect, with a coefficient of 0.59. The effect of the log house price to income ratio varies strongly with mortgage credit conditions, a highly significant interaction effect.

No effects could be detected of liquid or illiquid financial wealth or of permanent income on the stock of mortgages, and an income elasticity of one is accepted. The housing transactions cost has a clear

negative effect on the level of mortgages. Demography has important effects, as suggested by recent international evidence on rates of housing investment by Monnet and Wolf (2016) interpreted as demand for housing. The ratio of children to adults and the ratio of adults in the pre-retirement age group (defined as above) both have strong positive effects, somewhat amplified from their role in the house price equation. The effect is calibrated at 1.5 of the effect in the house price equation, an acceptable restriction, below the freely estimated value. In the short-term dynamics, the change (but not the level) in the proportion in the age group 25 to 44 has a highly significant positive effect, $t=12.4$. Short run dynamics include a negative effect from the change in the unemployment rate over the two previous quarters, $t=-3.2$.

Figure IVa, which decomposes part of the long-run solution, show that the loosening of housing loans conditions, the fall in nominal mortgage rates, the interaction of credit liberalisation with house price to income ratios and demography are the key to understanding the rise in the mortgage stock to income ratio. Figure IVb plots the remainder of the long-run effects. There is a modest positive effect from the decline in transactions cost and a notable effect from demography, in particular from the decline in the child to adult ratio, offset somewhat by the increasing proportion of adults in the pre-retirement age group.

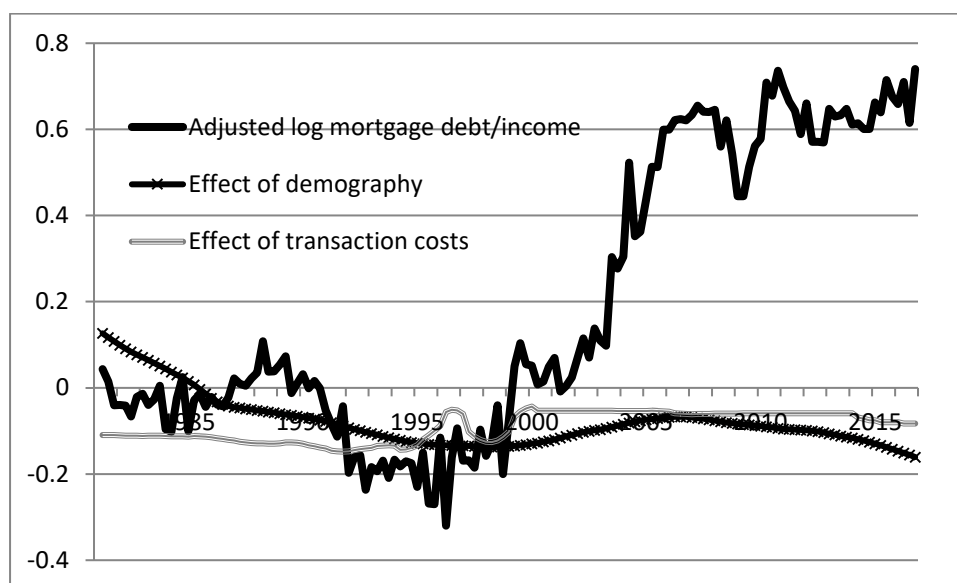
When the mortgage credit conditions index is omitted from the housing loan stock equation, the speed of adjustment falls, but only modestly, and the equation standard error rises. The equation is now dominated by log ratio of house prices to income, clearly a proxy for the omitted credit conditions effect, though the log of the nominal mortgage rate remains highly significant.



Note : Given the slow speed of adjustment, the dependent variable in the figures is $\ln(debt_{t-1}/income_{t-1}) + \Delta \ln debt_t / \pi$ where π is the speed of adjustment. Without the second term, the visualisation would show a strong lag between the long run drivers and the dependent variable.

Source: Banque de France, INSEE, authors' calculations

Figure IVa: Long-run effects on log mortgage stock/income in France.



Note : Given the slow speed of adjustment, the dependent variable in the figures is $\ln(debt_{t-1}/income_{t-1}) + \Delta \ln debt_t / \pi$ Without the second term, the visualisation would show a strong lag between the long run drivers and the dependent variable.

Source: Banque de France, INSEE, authors' calculations

Figure IVb: Long-run effects on log mortgage stock/ income in France.

Conclusions

The consumption functions of current central bank non-DSGE econometric policy models typically summarise household portfolios in a single net worth measure and neglect shifts in credit conditions. These assumptions greatly restrict the interactions of the household and financial sectors. The empirical evidence of this article for French quarterly data from 1981 to 2016 strongly rejects these assumptions. Not all co-movements between consumption and wealth are wealth effects. Some result from common factors including shifts in credit conditions, interest rates, income expectations or demographics. These controls are essential to estimate well-identified wealth effects and to illuminate direct and indirect monetary policy transmission on consumption. To distinguish common factors driving consumption and household portfolios from causal relationships, it is necessary to model the main components of household portfolios. This includes modelling house prices, which derive from housing demand, given the housing stock. The model therefore included equations for consumption, house prices, mortgage debt, consumer credit, liquid assets, and permanent income. Controls included credit conditions both for housing and non-housing consumer credit, estimated as latent variables common to multiple equations, interest rates, income expectations and demographics.

Previous macro-econometric models excluding the two credit conditions indicators perform badly, particularly as far as consumption, house prices and consumer credit are concerned. The interpretation of the two latent variables in the system as credit availability indicators is a strong one. Financial liberalization relaxed French mortgage credit conditions from 1984. Subsequent variations are strongly inversely correlated with banks' non-performing loans. Permanent income matters for consumption but, consistent with undiversifiable income uncertainty and liquidity constraints, far less than under the strict permanent income hypothesis. For France, the marginal propensities to consume from financial wealth are comparable to those in the US, the UK and Germany, with a marginal propensity to consume out of liquid assets minus debt far greater than for illiquid financial assets. But, as in Germany, housing wealth or collateral effects in France are much weaker in aggregate, given the absence of home equity loans, than in the US or the UK. ECB (2009) points to this as a major factor in the high levels of heterogeneity across countries in housing wealth or collateral effects on consumption. Arrondel *et al.* (2014) support the evidence for small housing wealth effects for French homeowners, using microdata. Moreover, there is evidence of a negative effect on aggregate consumption of higher house prices. This can be interpreted as follows: with relatively strict financial regulation in France, higher house prices relative to income require younger households to save more if they wish to become homeowners, while other tenants can expect rent rises and so save more also.

During the French house price boom between 1996 and 2008, a small positive housing wealth effect on consumption and looser mortgage credit conditions, were thus offset by the negative effect of higher house prices and higher debt. France is therefore very different from the Anglo-Saxon economies where home equity loans produced large collateral effects of housing wealth on consumption. As a result, despite higher house prices, France did not experience an Anglo-Saxon-style consumption boom in which the financial accelerator via home equity loans proved powerful and destabilising. Another element in the US house price boom was an overshooting of house prices due to extrapolative expectations, likely to have been enhanced by high levels of gearing. The empirical evidence is that overshooting of French house prices due to extrapolative expectations has been on a relatively limited scale, consistent with relatively strict regulations, which limit gearing by French households. This suggests only a small potential risk factor for financial stability from this source.

House prices are quite sensitive to interest rates and, of course, to income and the supply of houses. Moreover, both consumption and household income are quite sensitive to interest rates making interest rates and income potential sources of fragility for the French housing and housing loans markets. However, with lower levels of illiquid financial asset holdings in France than in the US or the UK, this mechanism for monetary transmission is likely to be weaker. These findings suggest that, incorporated

in a larger econometric model, in which different scenarios could be simulated, this household sector model is useful for examining monetary policy issues, including financial stability.

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Appendix 1: data: definitions and sources

C: Consumption is total consumption excluding financial services at constant prices (source: National accounts, INSEE (National Institute of Statistics and Economics)).

Y: Income is a geometric average of disposable non-property income and conventional disposable income of households (source: National accounts, INSEE).

LA: Liquid assets include cash (coins and notes), current deposits, liquid saving accounts, short term debt securities and short term mutual funds (source: Financial national accounts, Banque de France).

NLA: Liquid assets net of debt (source: Financial national accounts, Banque de France).

IFA: Illiquid financial assets include all financial assets with the exception of liquid assets as defined above (source: Financial national accounts, Banque de France).

HA: Gross housing asset is available as annual data since 1978. It includes housing and land under building (source: National accounts, INSEE).

Mdebt: The term “Mortgage debt” has been used in this article in place of housing loans (source: Banque de France). A long time series has been built by Wilhelm (2005). Mortgage loans in the strictly legal sense are a minority in housing loans in France and is not measured as such regularly in France. Most housing loans are indeed guaranteed by a specialized organisation that mutualizes risks on incomes (62 % of new loans in 2011 according to the French Supervisory Authority for banks and insurance companies, ACPR). Thus, housing properties are not the guarantee for most loans, but households’ income. However when a housing loan is not repaid, households might be obliged to sell their home. Thus the impact on the housing market might not differ from that of a mortgage loan.

Cdebt: Consumer credit extends over any credit card debt, personal loans or overdrafts and loans for the purchase of durable goods other than housing (source: Banque de France).

Hp and rhp: house price and real house price (source: OECD): There has been an official house price index for all France, corrected for quality effects, only since 1996 from the notaries data (Gourieroux and LaFerrere, 2009). Before, the only *official* index is a Parisian index since 1980 built by INSEE. OECD publishes an index which is based on an annual index constructed by Friggit (2010) based on repeat sales information. Before 1997, actual annual log real house price changes at t-1 are replaced by

their fitted values from a regression on growth in mortgage debt, interest rates, inflation and income and the 4-quarter lag of the annual log real house price change.

Rdepr: Returns on liquid assets is measured by a weighted average of real interest rate on regulated saving accounts (source: Banque de France), zero for non-interest bearing deposits (which is the rule in France) and the after tax interest rate on money market funds- such funds for households developed earlier in France than in most other European countries due to fiscal advantages (source: Bernard & Berthet, 2015).

Ncr and *rcr*: nominal/real interest rates on consumer loans. Interest rates on consumer loans are the equally weighted average of rates on overdraft and proper consumer loans measured by the MIR (Monetary Financial Institution Interest Rates) survey harmonized over the euro zone level since 2003 (source: Banque de France). They were backcast by the average of minimum and maximum rates beforehand.

Nmr: nominal interest rates for mortgage loans adjusted for tax relief on mortgage interests paid. Interest rates on housing loans are those of new loans agreed by banks with fixed rate, according to the survey on the cost of credit (source: Banque de France). Before 1980, they were backcast with information on minimum and maximum rates beforehand. Tax relief is taken from the National accounts for housing (source: Ministry for Housing).

User: The user cost measure is defined as the real after-tax mortgage interest rate minus expected real appreciation plus assumed annualised transactions costs of 4.5%¹⁷ of the value and a time varying risk premium.. The time-varying risk premium is defined by the volatility of annual real house price changes in the last four years, with declining weights going back in time: $(ad4lrhp + 0.7 * ad4lrhp(-4) + (0.7^{**2}) * ad4lrhp(-8) + (0.7^{**3}) * ad4lrhp(-12)) / (1 + 0.7 + (0.7^{**2}) + (0.7^{**3}))$ where *ad4lrhp* is the absolute value of the annual change in log real house prices.

Demog: Demographic data are annual data each 1st January (source: INSEE). They were interpolated and lagged accordingly. In the permanent income model, demography affects the ratio of the working age population for all ages, measured as an 8-quarter moving average, to the total population.

H: The housing stock has been recursively computed on the principal of perpetual inventory using data from the housing stock in constant prices (source: national accounts, INSEE). The level is set by the value of stock in 2010. Gross fixed capital formation is housing GFC in volume and the deterioration rate is that of national accounts.

θ : Income uncertainty is proxied by the 4-quarter change in the unemployment rate in the consumption equation, and 2-quarter changes in the other equations.

Trans: Transaction costs come from “valeur-immobilier-france” (source: Ministry of Housing).

The impact of car scrapping subsidies is computed following Adda and Cooper (2000) for the first wave and extrapolated according to the link with car registration for the second wave.

Appendix 2: estimates for house prices and mortgage stock equations

Table A2-1: Estimates of long-run solution for French house price equation

Dependent Variable = $\Delta \ln hp_t$	Symbol	1981Q2-2016Q4		1981Q2-2008Q3		1981Q2-2016Q4 Excluding <i>MCCI</i>	
		<i>coefficient</i>	<i>t- ratio</i>	<i>coefficient</i>	<i>t- ratio</i>	<i>coefficient</i>	<i>t- ratio</i>
Speed of adjustment		0.123***	12.6	0.126	10.3	0.026	10.8
Long-run coefficients							
Constant	h_0	-5.95***	-51.8	-14.0***	-38.9	-8.8***	-25.9

¹⁷ For any one transaction, costs, including costs of moving, are much higher. The discounted present value spread out over a few years of ownership could plausibly be of the order of 4.5%. This is consistent with low levels of mobility in France.

Credit conditions index: <i>MCCI</i>	h_{0c}	1	fix	1	fix	0	fix
Log nominal mortgage rate	h_1	-0.38***	-12.4	-0.39***	-9.1	-0.38	fix
Log user cost* <i>MCCI</i>	h_2	-0.07***	-2.8	-0.14*	-1.8	-0.87*** ¹	-8.4
Coefficient on risk premium in user cost	h_{2a}	0.63***	12.0	0.72***	10.2	0.96***	16.5
Log (real income/house)	h_3	2	fix	2	fix	2	fix
Permanent/current income	h_4	0.52***	3.8	0.41***	2.7	0.52	fix
Children/adults	h_{5a}	2	fix	2	fix	3	fix
Pre-retirement adults/total adults	h_{5b}	3	fix	3	fix	4	fix
Adults 25-44/total adults		0	fix	0	fix	2.2***	3.2
Diagnostics							
Equation standard error		0.00234		0.00235		0.00482	
DW		1.83		1.72		0.84	
R-squared		0.973		0.969		0.887	

¹Not interacted with *MCCI*.

Note: Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and *** respectively. Maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals.

Sources: Banque de France, INSEE, authors' calculations.

Table A2-2: Estimates of the long-run solution for the mortgage stock equation

Dependent Variable= $\Delta \ln mdebt_t$	Symbol	1981Q2-2016Q4		1981Q2-2008Q3		1981Q2-2016Q4 Excluding <i>MCCI</i>	
		<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>
Speed of adjustment	π	0.077***	15.8	0.088***	3.3	0.057***	10.8
Long-run coefficients for log (real mdebt /y)							
Constant	m_0	-2.7***	-27.9	-2.9***	-25.5	-7.1***	-4.7
Credit conditions index: <i>MCCI</i>	m_{0c}	0.59***	12.2	0.55***	10.5	0	-
Log nominal mortgage rate	m_1	-0.46***	-16.6	-0.38***	-10.4	-0.59***	-12.3
log(house prices/y)	m_4	0	-	0	-	0.97	14.9
<i>MCCI</i> x log(house prices/y)	m_{4c}	0.70***	5.6	0.86***	5.4	0	-
Composite demographic effect from the house price equation	m_5	1.5	fix	1.5	fix	1.5	fix
Transactions cost	m_9	-2.9***	-4.2	-3.9***	-2.7	-5.1***	-4.4
Diagnostics							
Equation standard error		0.00322		0.00327		0.00374	
DW		2.10		2.21		1.77	
R-squared		0.902		0.906		0.870	

Note: Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and *** respectively. Maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals.

Sources: Banque de France, INSEE, OECD, authors' calculations.

Complements for Chauvin and Muellbauer ‘Consumption, household portfolios and the housing market in France’.

Online complement C1: Models for consumption and housing prices in France

Consumption function

In the mid-90s, many papers were written on French household consumption behaviour. The traditional Keynesian consumption function conditioned consumption on income and inflation, so as to capture the real money balance effects: when inflation is higher, households need to save more if they have an objective in terms of purchasing power of wealth. This Keynesian consumption function fitted French data fairly well before about 1990, supported by the fact that most households held regulated savings accounts at that time in France: current accounts and savings accounts had accounted for 63 % of households total assets at the end of 1977 when the pension system was nearly 100 % pay as you go, as it is still today. As state pension rights are difficult to evaluate, they are never taken into account, although they are not negligible. The median pension rights amounted to 149 300 euros whereas the median financial wealth amounted to 32 610 euros in 2004 (Buffard & Girardot, 2010). Pension rights are much less unequally distributed than financial wealth.

Ostry and Levy (1995) used the Campbell forward looking model of “saving for a rainy day”, augmented by the volatility of income, to test the permanent income hypothesis and found it was still accepted by French data. Cadiou (1995) and Ostry and Levy (1995) find an increase in the impact of the interest rates on consumption following the financial deregulation after 1984. Bonnet and Dubois (1995) do not find any stable wealth effects but do find a significant impact of the change in unemployment rate, as does Cadiou (1995). Finally, a number of these papers and Sicsic and Villette (1995) test the impact of financial deregulation measured as the change in the ratio of consumer credit to disposable income over 1986-1990 and find it significant. Sicsic and Villette (1995) especially show that a simple model with financial deregulation performs as well as other models with the change in unemployment for example. Although the change in the ratio of consumer credit over income was the best indicator for the impact of financial deregulation at that time, it is not satisfactory because the endogeneity of consumer credits is not correctly treated.

For more recent evidence, consumption functions are published in the papers presenting the three macro-econometric models that are currently used by French institutions to forecast or analyse economic evolutions. In the Banque de France model (Baghli *et al.*, 2003), the consumption function is estimated over a long time span and is very close to that of Sicsic and Villette (1995), the long term saving rate depends on an indicator of deregulation and real money balance effects. In the OFCE model (Chauvin *et al.*, 2002), the saving rate depends on an indicator of deregulation and change in real income growth. The model of INSEE and the Ministry of finance (Bardaji *et al.*, 2017) is very similar. It also includes the effect of the change in unemployment rate, in short term interest rate and car-scrappping schemes.

Wealth effects

Empirical work on wealth effects in France came after the first previously cited strand of literature. They are not incorporated in macro-econometric models on the grounds that they suffer from unstable coefficients, and were not seen as major determinants of consumption in France. They have been estimated on macro-data, because there was no common survey of micro-data on household consumption, income and wealth, until recently. The estimates for the long-term impact are presented in table 1. The various methodologies used across studies, as well as the sample chosen, may impact the results and are pointed out below.

Table C1-1 Long term impact of wealth on consumption in France

	Sample	MPC (as a percentage)			Elasticity (as a percentage)		
		Total	Financial	Housing	Total	Financial	Housing
Wealth							
Arrondel <i>et al.</i> (2014)		0.5	0*	0.7	2.9	0	2.1
De Bonis & Silvestrini (2012)			1.4			3.0	*
Chauvin & Damette (2010)	1987q1-2008q4	1.0	4.0	2.0	10.0	10.0	6.0
Aviat <i>et al.</i> (2007)	1985q1-2006q1	0.4			2.3		
Barrell & Davis (2007)	1980q1-2001q4	3.1			17.8		
Barrell & Davis (2007)	1980q1-2001q4	3.6			20.8		
Slacalek (2009)	1970q2-2003q2	3.2	2.6	2.0*	18.5	5.5	7.3
Slacalek (2009)	1970q2-2003q2	4.6*	2.9	2.3*	26.6	6.1	8.4
Catte <i>et al.</i> (2004)	1979q2-2002q1		1.4	0.0		3.0	0.0
IMF country report (2004)	1982q1-2003q4		2.5	0.5		5.3	1.9
Fraisse (2004)	1971q4-2003q2	1.6			9.2		
Beffy and Monfort (2003)	1978q1-2000q4	2.5			14.0		
Byrne and Davis (2003)	1972q2-1998q4		3*			16.3	
Bertaut (2002)	1978q1-1998q4		4.7			10.0	
Boone <i>et al.</i> (2001)	1970q1-1996q2	2.5	6.8	4.2	12.3	12.0	13.1

Notes:

i. According to Aviat *et al.* (2007), an increase in wealth by 100% implies an increase in consumption by 2.4%. Taking into account the average ratio of wealth over consumption during 1995-2005, this means that an increase by 1 euro of financial wealth induces an increase by 0.4 cent in annual consumption.

ii. Estimation results directly computed by the authors are in bold. The other results are derived, using elasticity = (MPC)x(wealth to consumption ratio). * indicates that estimates are *not* significant.

Sources: Cited papers.

Many papers estimated wealth effects for France in a context of international comparison by estimating a consumption function for each country separately, without taking into account the cross-country dispersion, which differs from intertemporal one. To our knowledge, Boone *et al.* (2001) were among the first ones. However, they estimated the co-integration vector between consumption, wealth and income without taking into account the potential endogeneity of the variables, which was also the case of Fraisse (2004). Bertaut (2002), Beffy and Monfort (2003), IMF (2004), Catte *et al.* (2004), Slacalek (2009) and Aviat *et al.* (2007) took this problem into account by using dynamic ordinary least squares (DOLS). Barrell and Davis (2007) and Byrne and Davis (2003) used unrestricted Error Correction Models (ECM) estimated via non-linear least squares. In most cases, authors used total consumption

and total disposable income, the exceptions being IMF (2004) which used non-durable consumption; Aviat *et al.* (2007) and IMF (2004) used non-property income, and Slacalek (2009) and Catte *et al.* (2004) used labour income (respectively before or after tax). Authors estimated either marginal propensity to consume or elasticities (figures in bold in table 1), or semi-elasticities for Boone *et al.* (2001). Estimation in elasticities might be mis-specified if the sum of the elasticities to income and to wealth is not equal to 1. The condition was usually imposed, but not in Bertaut (2002). Barrell and Davis (2007) used dummy variables to account for the impact of financial liberalisation. However, if they did consider the increasing outstanding amount of credit in the second half of the eighties, they did not take into account the reversal that came in 1991-1992, when banks restricted housing credits when bad loans increased too much. Byrne and Davis also test the impact of illiquid versus liquid wealth (elasticity of 2.5 %, significantly different from 0, for illiquid wealth and 2.6 %, not significantly different from 0, for liquid wealth). All these studies estimated only the impact of a permanent change in wealth on consumption. Most authors found a significant impact of wealth on consumption in France, albeit smaller than in the United States. The lack of robustness of the results is highlighted in Bertaut (2002) and Byrne and Davis (2003). Omitting the difference in assets and the impact of financial deregulation was certainly one reason for this, as shown by the present paper.

Using the French Wealth Survey and the Household Budget Survey, Arrondel *et al.* (2014) report relatively low MPCs for financial wealth but find large disparities between households. Taking into account these disparities, the average MPC of the households for financial wealth would be around 2 cents per euro (as in the estimate by Chauvin and Muellbauer). The MPCs indeed range from 0 for the almost wealthiest (percentiles 90 to 99 in net wealth), whose illiquid assets represent up to 78% of their financial wealth, to 11 cents per euro for the less wealthy (under median net wealth), whose liquid assets represent over 60% of their financial wealth. This indeed suggests differentiating the effects of liquid from illiquid financial assets because they differ in terms of nature but also in terms of ownership.

The MPC for housing wealth proves to be less heterogeneous between households, ranging from 0.007 to 0.011 for homeowners on microdata. This effect is a pure wealth effect for home owners. Micro data cannot account directly for the impact on non-owners of an increase in house price, as in macro estimates. This may take the form of a need to build a larger down payment in order to buy housing, so that an increase in house price may actually decrease consumption for this category of people. One hint at the micro level is that, independent of their position in the income distribution, young households (i.e. households whose head is up to 34 years old) are more likely renters compared to older households (Fatica & Prammer, 2017).

Housing prices

Information showing the complexity of the French housing market is available on Friggit (2018). Indeed, modelling French housing prices has been a daunting task recently. Bessone *et al.* (2005) and Antipa and Lecat (2013) use, among others, a structural approach broadly comparable to that used in this paper. House prices are explained by housing stock in volume, a proxy for households' income and user cost, and in addition by population or number of households in Antipa and Lecat. Antipa and Lecat find a break in 2002 in the co-integrating vector, which may be due, according to them, to financial changes and housing policies. In particular, the birth of the euro changed competition rules in the financing sector. In France, the duration of housing loans increased significantly, from 11.8 years in 1989 to 14.3 years in 1999 and 20 years in 2008 according of the Observatory of real estate and Banque de France. When they introduce the borrowing capacity of households in the co-integrating vector, the break in 2002 does not disappear but housing prices appear to be much nearer their equilibrium level in

2011. Both papers highlight the fragility of the results, because of measurement problems and omitted variables. More recently, Avouyi-Dovi *et al.* (2017) cannot fully account for the recent evolution of French house prices, even by taking into account potential instability.

Table C1-2: Long-term elasticities of different variables on house prices

	Bessone <i>et al.</i> (2005)	Antipa & Lecat (2013)	Antipa & Lecat (2013)	Antipa & Lecat (2013)	Antipa & Lecat (2013)	Antipa & Lecat (2013)
Sample	1986-2005	1992-2002	1992-2002 ⁱ	1992-2002	1992-2002	1992-2002
Housing stock	-3.57	-5.04	-4.98	-7.51	-6.30	
Households' income ⁱⁱ	8.26	1.02	1.68	1.24		
Borrowing capacity ⁱⁱⁱ					1.14	1.12
User cost	-0.07	-0.71	-0.45	-0.52		
Population		17.86	15.1		21.59	
Number of households				10.51		13.64

Notes:

i. User cost takes into account the anticipation of downturn, revealed by the stock of unsold new houses.

ii. The proxy for household income is consumption of non-durables for Bessone *et al.* (2005).

iii. Borrowing capacity is the maximum amount households can borrow, knowing that the housing debt service cannot exceed one third of the income in France and taking into account the duration of the loans actually observed.

Sources: cited papers.

Online complement C2: Estimates for the credit conditions indices.

There are no available data to measure credit conditions directly in France before 2003. This paper adopts a “latent variable approach”, where credit conditions indicators for housing and non-housing loans are proxied by spline functions guided by institutional information on credit market liberalization. Ogive (or smooth transition) dummies (OD) take the values 0.05, 0.15, 0.3, 0.5, 0.7, 0.85, 0.95, 1 over an 8-quarter interval beginning in the first quarter of year *i*.

Table C2-1: Estimates for the consumer credit conditions index

Sample	1981Q2-2016Q4		1981Q2-2008Q3	
	<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>
Variables				
OD1981	0.47	4.9	0.44	5.0
OD1982	-0.20	-3.4	-0.17	-3.3
OD1983	0.14	2.8	0.12	2.6
OD1987	0.39	5.5	0.35	5.6
OD1989	0.27	5.7	0.29	5.9
OD2013	-0.11	-3.8	-	-
annual inflation _{t-1}	-3.03	-18.4	-2.99	-18.0
inflation acceleration (4-quarter moving average) _{t-1}	-19.0	-3.3	-16.8	-3.2

Notes: The coefficient estimate for the Ogive Dummy starting in 1981Q1 is 0.47 over the sample 1981Q1-2016Q4, 0.44 over the sample 1981Q1-2008Q3. All coefficients are significant at the 1% level. The estimates are based on maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1.

Sources: INSEE, authors' calculations.

Table C2-2: Estimates for the mortgage credit conditions index

Sample	1981Q2-2016Q4		1981Q2-2008Q3	
	<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>
Variables				
D_1981	-0.11	-4.1	-0.13	-4.0
D_1984	0.10	6.0	0.11	5.5
D_1986	0.25	19.0	0.25	14.3
D_1991	-0.02	-1.6	-0.03	-1.5
D_1993	-0.10	-4.9	-0.10	-4.5
D_1994	-0.16	-5.6	-0.15	-4.7
D_1999	0.22	13.3	0.20	10.7
D_2001	0.04	3.3	0.04	3.1
D_2003	0.16	9.1	0.13	5.7
D_2006	0.04	1.9	0.05	2.1
D_2011	-0.05	-3.3	-	-
D_2013	-0.09	-7.1	-	-
D_2016	0.05	1.5	-	-

Notes: The coefficient estimate for the Ogive Dummy starting in 1981Q1 is -0.11 over the sample 1981Q1-2016Q4, -0.13 over the sample 1981Q1-2008Q3. All coefficients are significant at the 1% level, except those for 1991, 2006 and 2016. The estimates are based on maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1.

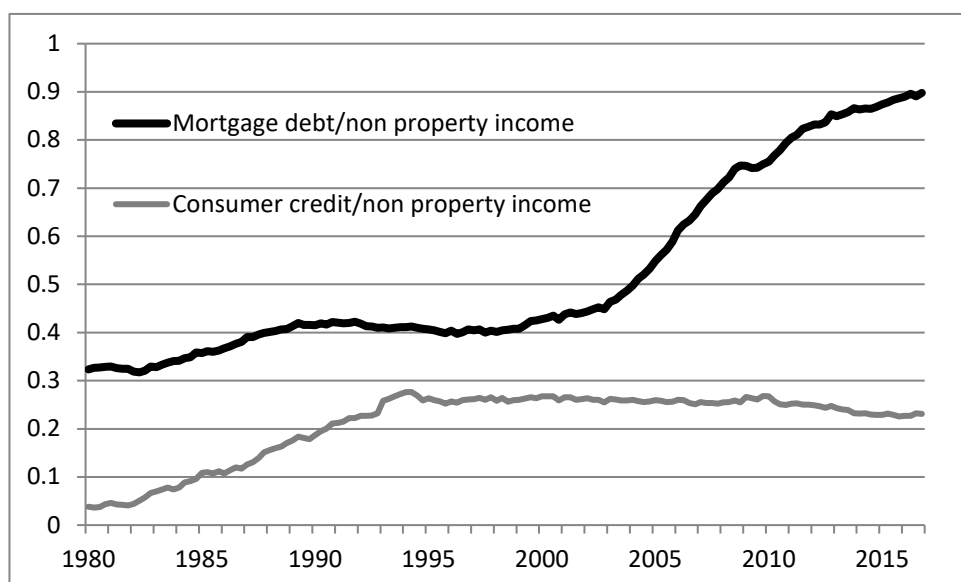
Sources: INSEE, authors' calculations

Online complement C3: Financial innovation and its impact on consumer and housing loans in France

In the aftermath of the World War II in France, loans were mostly allocated to productive investment and housing because of the reconstruction effort. Thus, consumer credit was probably even more rationed than housing loans in this post-war phase of credit controls. Financial innovation arrived in two steps in France, from 1984 on and at the end of the 1990s.

In the mid-1980s, the French financial system changed from a very strict monitoring of new loans by the government to a free determination by banks of the loans they provide (Melitz, 1990, Icard & Drumetz, 1994). At the same time, non-financial firms were allowed to finance themselves directly on stock and bond markets. Thus, at the end of the deregulation process in 1987, banks had more resources to be dedicated to households, whether as consumer or housing loans. Deregulation also impacted the way interest rates for consumer and housing loans were settled, as loans to households were mostly granted by institutions that were under the control of the government or via loans that were subject to a contract with the State (so-called “prets conventionnes”). In this paper, this is taken into account in the interest rates in housing and consumer loans.

During this first step of financial deregulation, the ratio of the stock of consumer credit over income doubled from 7 % in 1983 to 14 % in 1987, admittedly from a low level, and never returned to its pre-deregulation level. In percentage rates of growth, the stock of housing loans grew more slowly than consumer credit in the 1980s. Since consumer credits have far shorter average durations than housing loans, rapid growth in new consumer credits translates into rapid growth in the stock (figure C3-1).



Sources: Banque de France, INSEE.

Figure C3-1: Ratios of housing loans and consumer credit to annualised non-property income

Box: timetable for financial deregulation (ECB, 2009)

1982: Liquid saving accounts benefitting from tax rebates can be opened in any bank.

1984: Bank specialisation requirements reduced.

1987: Elimination of credit controls.

1999: Reform of securitisation of housing loans.

1999: Reduced early repayment fees for housing loans.

2008: Modernised framework for securitisation

The second step of financial innovation occurred in the late 1990s through a change in securitisation. The legal framework for securitisation was introduced in France by Act 88-1201 of 23 December 1988 that created the FCC (fonds communs de créances– a French equivalent to US ‘special purpose vehicles’). However, it was modernised by the Order of 13 June 2008 which extended its purpose and legal forms (Birouk & Cassan, 2012). The new legal framework diversified the types of assets eligible for securitisation from bank loans only to trade receivables, insurance risks, debt securities, etc. It also broadened the scope of the eligible securitisation techniques (replenishment of vehicles, broader credit enhancement methods, active management of portfolios and resale of acquired assets) and the types of securities that securitisation vehicles can issue (in addition to units in FCCs – which are due to be

phased out, units in securitisation funds, short-term debt securities such as commercial paper or other short-term securities, etc.). From the end of 2009 to June 2012, the stock of residential mortgage backed securities (RMBS) increased by 18.4 billion euros (i.e. 1.4 % of households' disposable income). Over the same period, the stock of securitised consumer loans decreased by 12.4 billion euros.

Online complement C4: The housing market in France

In France in 2010, owner-occupiers represent 55 % of households, which is close to the euro area where they represent 60%, between Germany where they represent only 44 % of the population and Spain or Italy where they represent respectively 83 % and 69 % (Arrondel *et al.*, 2016).

Housing loans are largely fixed rate loans and the self-discipline of banks to approve housing loans is tight in France. The average debt-service ratio, the monthly repayments on loans (interest payments + capital reimbursement) relative to current income reached its peak, 32%, in 2009. The proportion of debt-service ratios in excess of 35% reached a peak of around 29% in 2008-10, but has hovered around 22-23% since 2013, despite lower nominal interest rates. The upward trend from the late 1990s, and partial reversal, in both measures is likely to have been related to the increase in the average duration of housing loans from 13 years in 1999 to 17.4 years in 2005, and 20 years in 2008, dropping back a little thereafter.

Fatica and Prammer (2017) show that the income gradient of ownership is very steep both in Germany and France, where high-income households are three times more likely to own their residence than households in the first income quintile. Independent of their position in the income distribution, young households (i.e. households whose head is up to 34 years old) are more likely to be renters compared to older households. This arguably reflects both the typical hump-shape of age-income profiles and the fact that down-payment requirements reduce housing affordability for people at the initial stages of wealth accumulation.

The average loan to value ratio for new housing loans since 2001 has averaged at around 80% at the lower end of the range in the euro area. Around half of loans have been at 85% or above and about one third at 95% or above in this period. These high values are likely to be related to the fact that separate financial guarantees and insurances cover the majority of mortgages, enhancing the ability of the bank to recover its losses from the borrower (Avouyi *et al.*, 2014).

Early repayments and renegotiation were very rare before 2000 because of fees due by owners when renegotiating their loans with their bank, by law. As noted above, the fees were cut in 1999. Finally, equity release is forbidden and housing is hardly ever used as a guarantee for consumer credit. Thus, housing prices affect loans essentially through purchases of housing rather than through refinancing existing homes. More information on the French mortgage market can be found in Laferrere and Le Blanc (2012).

Online complement C5: equations for consumer credit and liquid assets

Consumer credit

The stock of consumer credit would be expected to have similar drivers to those for consumption, and interest rate effects would be expected, given controls for increased credit supply. We propose the following long-run formulation for the log of consumer debt:

$$\ln(cdebt_t/y_t) = u_{0t} + u_{1t} \ln ncr_t + u_{2t} rcr_t + u_{3t} E_t \ln \left(\frac{y_t^p}{y_t} \right) + u_{4t} \ln(hp_{t-1}/y_{t-1}) + u_5 demog_t + u_6 (long - run solution for \ln c/y).$$

Here, the intercept is time-varying and increases with *CRCCI*, the credit conditions indicator applying to consumer credit. The nominal interest rate on consumer credit, *ncr* and/or the real rate *rcr_t* is expected to have a negative sign and could have coefficients time-varying with *CRCCI*. Income growth expectations are included. A potentially important reason for unsecured borrowing is to supplement mortgage borrowing. Thus, one would expect the house price to income ratio to have a similar effect on unsecured borrowing as on mortgage borrowing.

Since a major reason for consumer credit is to finance consumption, especially of durables, the long-run solution from the consumption function in equation (2) is included. The parameter u_6 should be expected to be at least 1.

The estimated long-run solution shown in Table C5-1. The speed of adjustment of 0.24, is far higher than for mortgages, as befits short duration loans. The effect of consumer credit conditions is normalised and the quantitative effect is large. The real interest rate for consumer loans has a significant negative effect but the nominal rate does not and nor does permanent/current income. Demography again matters for the long-run solution, with a negative coefficient for the proportion of adults over retirement age. The effect is calibrated at -2.5, close to the freely estimated value. This implies that the level of consumer debt for this age group is around one third of that of remaining adults, which is consistent with cross-section data. The long-run solution from the consumption function is calibrated to have a coefficient of 1 in the consumer credit equation. Freely estimated, the coefficient is around 1.2 with a standard error of 0.7, so that the plausible value of 1 is statistically acceptable. Other coefficients in the system are hardly affected by the calibration.

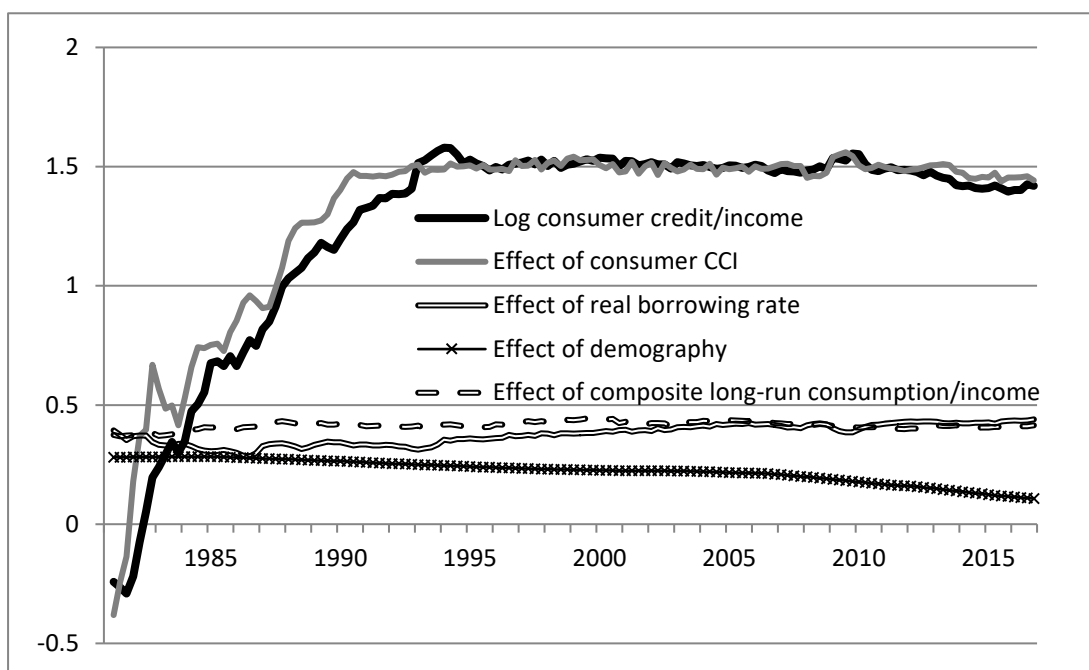
In the short-run dynamics, the annual change in the unemployment rate has a significant positive effect, paralleling results for Germany in Geiger *et al.* (2016). In other words, consumer debt appears to be used to help consumers maintain spending during periods of higher unemployment. An impulse dummy is also included for 1985Q1, and for 1993Q1, the latter possibly connected with short-term shocks associated with the ERM crisis of late 1992.

The decompositions of the long-run solutions into the different components shown in Figures C5-1 reveal the dominant effect of the consumer credit conditions index, particularly in the 1980s and 90s. Omitting the credit conditions index for consumer credit has drastic consequences for the consumer credit equation. The speed of adjustment collapses from 0.24 to 0.06, the fit deteriorates sharply and the long-run solution makes little economic sense, with a positive effect for the interest rate. It is incontrovertible that there was a significant consumer credit liberalisation in the 1980s, which needs to be taken into account in modelling the stock of non-housing consumer credit.

Table C5-1: Estimates of the long-run solution for the consumer credit stock equation for France

Dependent Variable = $\Delta \ln cdebt_t$	Symbol	1981Q2-2016Q4		1981Q2-2008Q3		1981Q2-2016Q4 Excluding <i>CRCCI</i>	
		<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>	<i>coefficient</i>	<i>t-ratio</i>
Speed of adjustment	μ	0.24	9.9	0.26	10.2	0.06	5.5
Long-run coefficients for log (real cdebt/y)							
Constant	u_0	-1.74	-14.0	-1.70	-13.6	-0.62	-4.9
Credit conditions index: <i>CRCCI</i>	u_{0c}	1	-	1	-	0	-
Real interest rate for consumer credit	u_1	-1.2	-4.8	-1.3	-4.2	0.2	0.2
Composite wealth and house price effect from consumption equation	u_6	1	-	1	-	1	-
Post-retirement adults/total adults	u_5	-2.5	-	-2.5	-	-2.5	-
Diagnostics							
Equation standard error		0.0167		0.0175		0.0243	
DW		1.84		1.84		1.88	
R-squared		0.786		0.792		0.545	

Sources: Banque de France, INSEE, authors' calculations. All coefficients are significant at the 1% level except when omitting the credit conditions index. Maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals



Sources: Banque de France, Insee, authors' calculations.

Figure C5-1: Long-run effects of consumer credit conditions, interest rates, composite long-run log consumption/income and demography on log consumer credit stock/ income in France

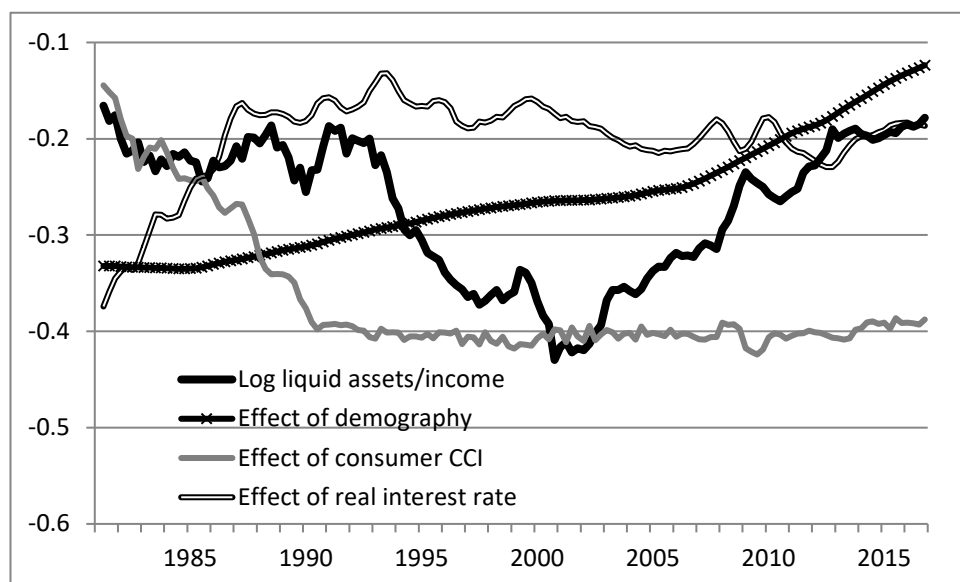
Liquid assets

There is an extensive literature on the demand for money, including household demand for broad money, i.e. liquid assets. The literature discusses three aspects of the demand for broad money. The first is the transactions demand and hence the need for a scale variable such as income. The second focuses on portfolio influences introducing other wealth components and opportunity costs. The third is a buffer stock view of money, introducing uncertainty and a precautionary motive. Since unsecured debt can also serve a buffer stock role in maintaining consumption under temporary declines in income, one would expect increased access to unsecured credit to *reduce* the demand for liquid assets. However, higher real returns on liquid assets should increase demand for them. Recent inflation and losses in illiquid financial assets should lead households to wish to save more in liquid form. Further, as one motive for saving in the form of liquid assets is to build up a deposit for an envisaged housing down-payment, house price developments can be expected to have the reverse of the implications for this component of liquid assets as for mortgage demand: higher house prices relative to income should increase demand for liquid assets, but mortgage credit liberalization should offset this.

In the equation below, s_{0t} is the time-varying intercept, expected to decline as access to credit increases. Since money market funds have once been popular with French households thanks to a specific tax policy, an average of the real interest rate on regulated deposits and the money market rate is included. The following four terms are the potentially time-varying impacts of the log ratio of permanent to current income and the log house price to income ratio, demography, and the log illiquid financial asset to income ratio.

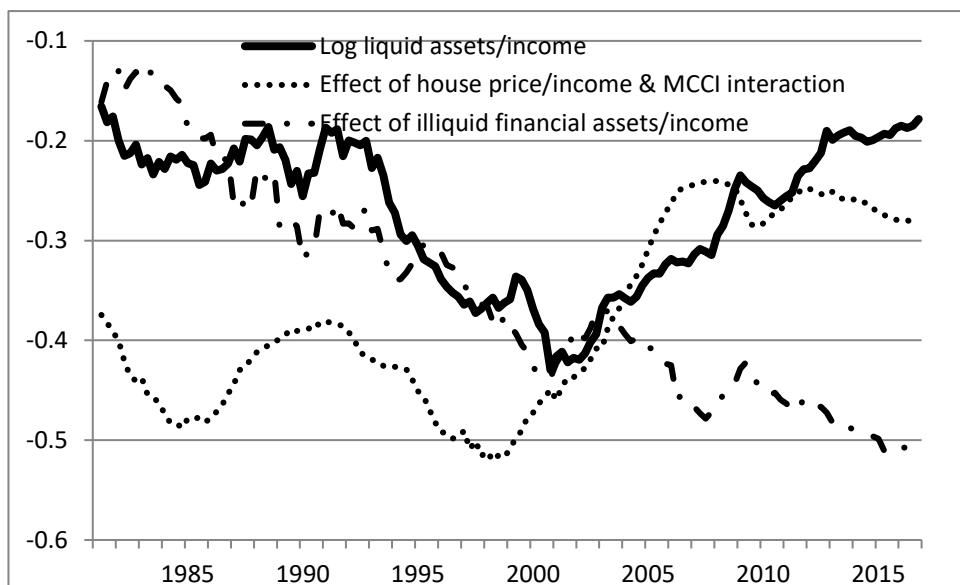
$$\ln(LA_t/y_t) = s_{0t} + s_1 rdepr_{t-1} + s_{3t} E_t \ln\left(\frac{y_t^p}{y_t}\right) + s_{4t} \ln(hp_{t-1}/y_{t-1}) + s_5 demog_t + s_6 \ln(IFA_{t-1}/y_t)$$

Empirically, the negative effect of increased access to consumer credit, which limits the demand for liquid assets as a buffer stock, is offset by the positive effect of higher real returns on liquid assets (Figure C5-2a). The coefficient on log permanent/ current income is not significant, though negative. Liquid assets indeed rise with house prices, but rise less when mortgage credit conditions ease. This might be an evidence for the need to build up a down-payment for housing purchase. The demographic specification for the long-run solution reverses that for consumer debt: adults over the retirement age tend to hold far higher levels of liquid assets than do younger adults. The coefficient is calibrated at 3, slightly below the freely estimated value. The negative effect of illiquid financial asset accumulation on liquid assets might reflect the rise in long term insurance policies in household portfolios, partly due to fiscal incentives, indirectly a kind of substitution effect (Figure C5-2b). The coefficients are remarkably stable for the sample ending in 2008Q3.



Sources: Banque de France, Insee, authors' calculations.

Figure C5-2a: Long-run effects of consumer credit conditions, real interest rates and demography on the log ratio of liquid assets to income.



Sources: Banque de France, Insee, authors' calculations.

Figure C5-2b: Long-run effects of the composite log house price to income ratio and the log ratio to income of illiquid financial assets.

Short run dynamics include the lagged rate of change of liquid assets and the two-quarter change in log real per capita income. This suggests that a temporary fall in income is met by running down liquid assets to buffer consumption. This parallels a similar finding for Germany.

The effect of excluding credit conditions from the liquid assets equation is to reduce the speed of adjustment by a quarter and to reduce the significance of the real interest rate. However, unlike the consumer debt equation, the long-run solution still makes economic sense.

Table C5-2: Estimates of the long-run solution for the stock of liquid assets equation for France

Dependent Variable= $\Delta \ln LA_t$	Symbol	1981Q2-2016Q4		1981Q2-2008Q3		1981Q2-2016Q4 Excluding CRCCI, MCCI	
		coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio
Speed of adjustment	ρ	0.12	5.8	0.13	4.5	0.09	4.5
Long-run coefficients for log (real LA/y)							
Constant	s_0	-2.3	-6.7	-2.3	-5.7	-2.1	-2.3
Credit conditions index: CCI	s_{0c}	-0.20	-3.9	-0.22	-3.4	0	-
Real rate of return	s_1	2.5	4.1	3.0	4.6	0.8	1.3
Log house prices/y	s_4	0.59	4.8	0.59	4.0	0.49	6.2
MCCI x log(house prices/y)	s_{4c}	-0.36	-1.4	-0.42	-1.4	0	-

ratio of post-retirement age group/adults	s ₅	3	fix	3	fix	3	fix
log illiquid assets/income	s ₆	-0.32	-7.3	-0.33	-5.9	-0.48	-9.4
Diagnostics							
Equation standard error		0.00874		0.00948		0.00886	
DW		1.74		1.81		2.02	
R-squared		0.385		0.400		0.370	

Source: Banque de France, INSEE, authors' calculations. For specifications including credit conditions indices, all coefficients are significant at the 1% level, except for the interaction of mortgage credit conditions and log house prices/income. Maximum likelihood estimation of the 6-equation system in TSP (Time Series Processor) 5.1. Equation standard errors are RMSEs of the residuals

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