Household decisions, credit markets and the macro economy: implications for the design of central bank models

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Eighth BIS Annual Conference 2009

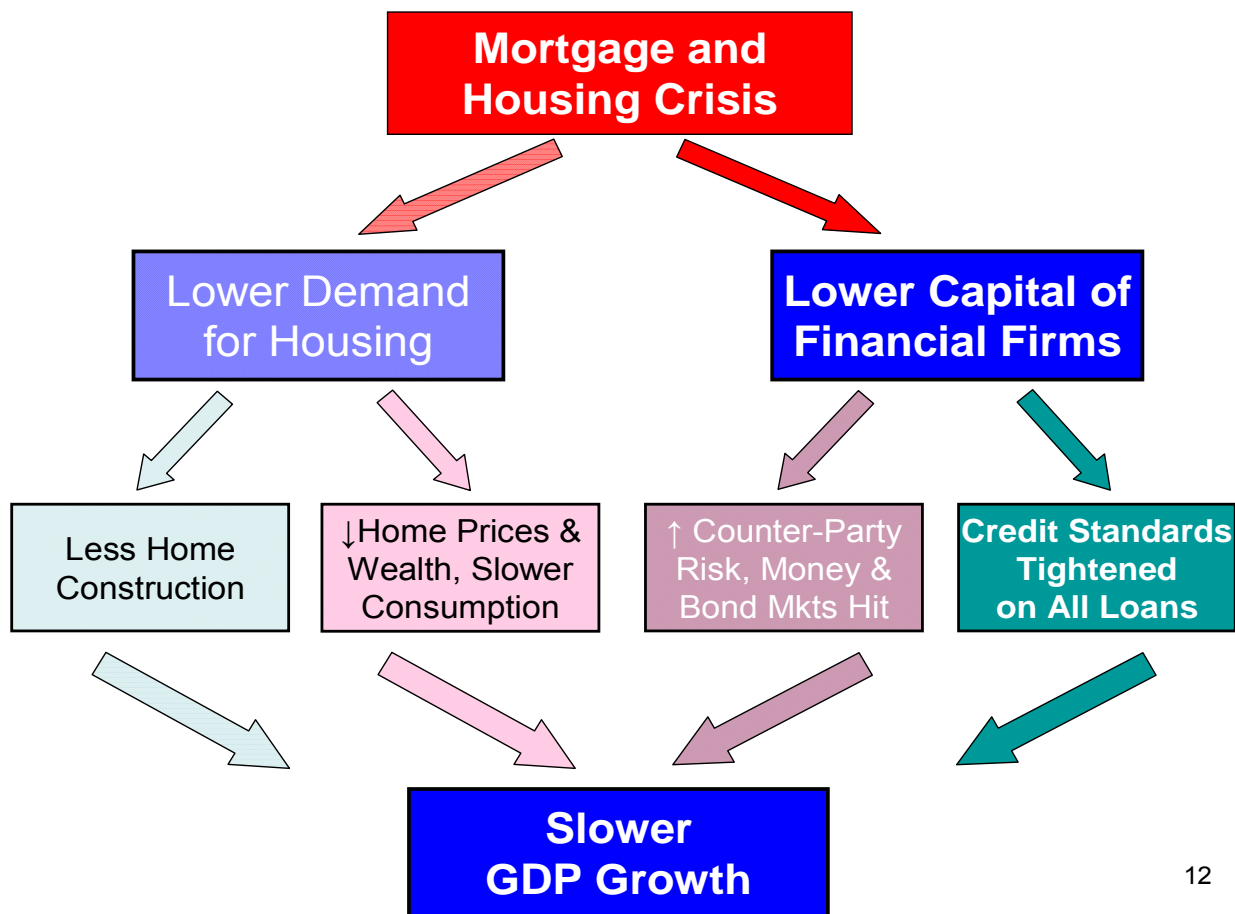*Financial System and Macro-economic Resilience: revisited*

Don Kohn, Fed VC Nov 2008

- "*The recent experience indicates that we did not fully appreciate how* *financial innovation interacted with the channels of credit to affect real economic activity-*-*both as credit and activity expanded and as they have contracted. In this regard,* *the macroeconomic models* *that have been used by central banks to inform their monetary policy decisions* *are clearly inadequate*".

Kohn cont'd

- "*These models incorporate few, if any, complex relationships among financial institutions or the financial-accelerator effects and other credit interactions that are now causing stresses in financial markets to spill over to the real economy. Rather, these models abstract from institutional arrangements and focus on a few simple asset-arbitrage relationships, leaving them incapable of explaining recent developments in both credit volumes and risk premiums*".

The Channels of Transmission of the Mortgage and Housing Crisis (Graphic by John Duca, Dallas Fed.)

Mortgage and Housing Crisis

Lower Demand for Housing

Lower Capital of Financial Firms

Less Home Construction

↓Home Prices & Wealth, Slower Consumption

↑ Counter-Party Risk, Money & Bond Mkts Hit

**Credit Standards Tightened on All Loans**

Slower GDP Growth

12

2. Income growth expectations as the driver of consumption vs. credit, asset prices, uncertainty etc.

- King, Pagano 1990 vs Muellbauer-Murphy 1990
- What caused the fall in the UK personal saving ratio in the 1980s?
- Take perfect foresight view. Define permanent non-prop income over 10 year horizon. (assume historical growth rate continues beyond 2007).
- Plot log c/y against log yperm/y….
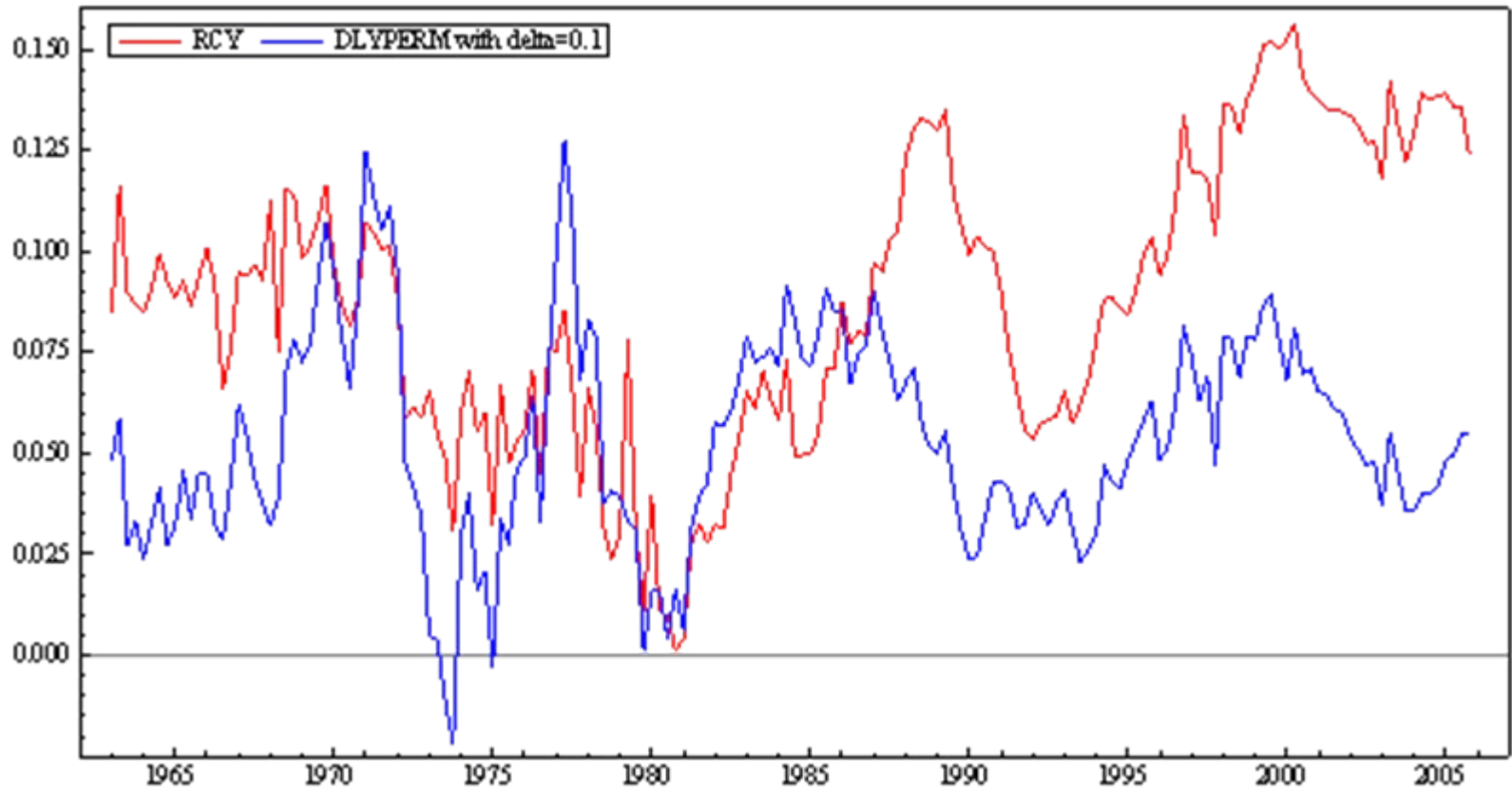- Cannot account for 1984/5 to 1988/9 rise in c/y

Log (c/y) vs. log (yperm/y) with discount rate 1.25% per quart.
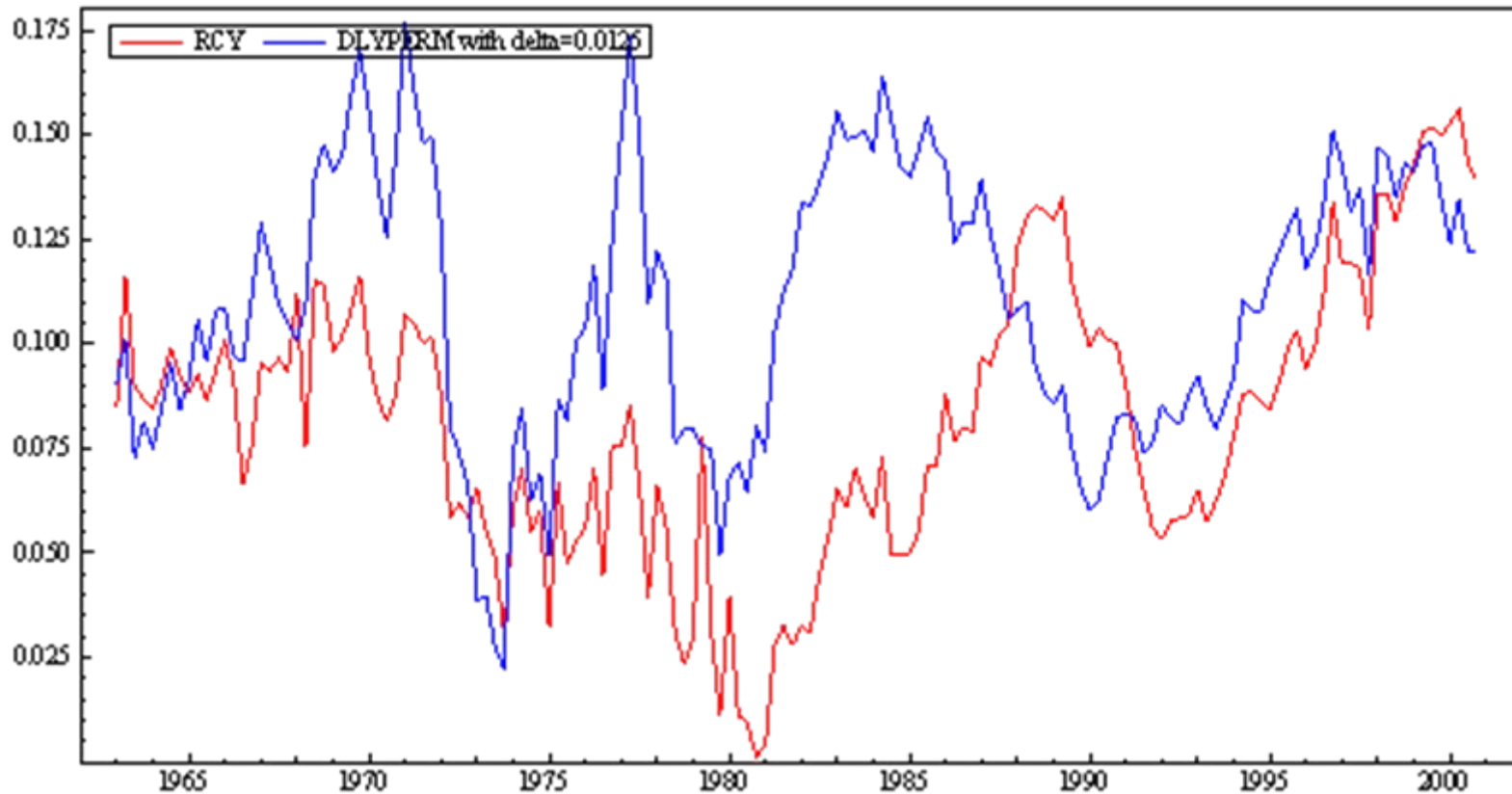
Log (yperm/y) is close to fitted trend – log y, hence easy to predict
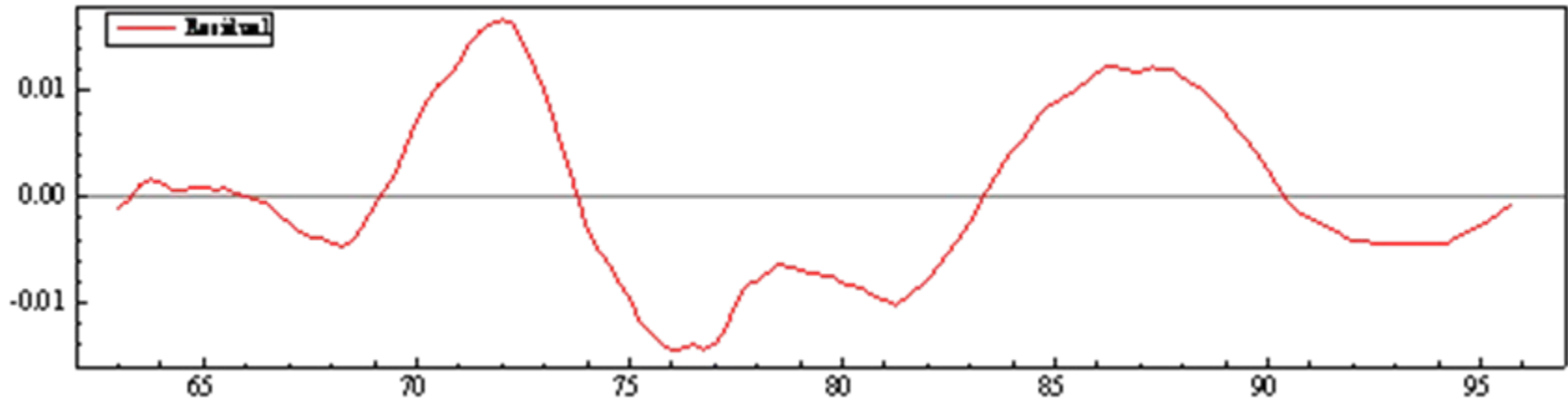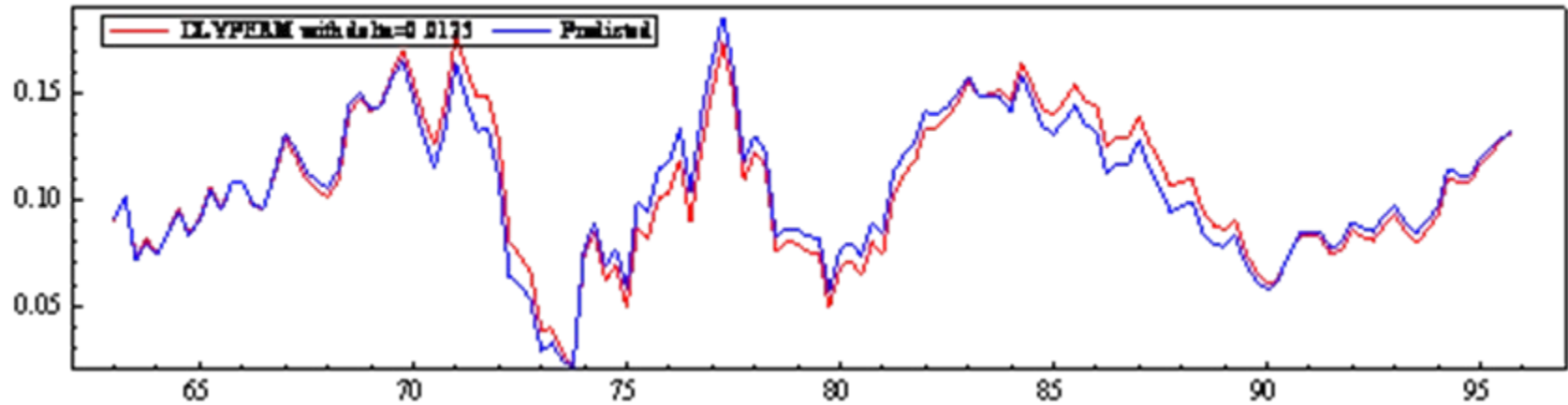
Log (c/y) vs. log (yperm/y) with discount rate 10% per quart.

Perfect foresight version of income growth expectations cannot explain log consumption/income

- Regression of log change in consumption on lagged log c/y and income growth expectations finds latter effect is not significant, 1967-2005

- But including lagged A/y, as implied by Ando-Modigliani (1963) solved out consumption function, gives sensible long run relationship.

- Strong evidence against DSGE view that asset prices are JUST proxy for expected future growth. Frictions, inefficiencies, non-RE matter.

But Friedman-Ando-Modigliani model needs modification for housing and credit

- Modern theory implies MPC out of housing wealth is different from financial wealth MPC e.g. King 1990, Muellbauer 2007.

- The credit channel is crucial to explain a positive impact of house prices on consumption via 2 mechanisms:

  - Down-payment constraint affecting mainly consumption/income.

  - Ability to borrow against home equity, affecting MPC out of housing collateral.

The credit channel features through:

- the different MPCs for net liquid assets, illiquid financial assets (larger for net liquid, Otsuka, 2006) and for housing;

- through the cash flow effect for borrowers Jackman and Sutton(1982);

- by the possibility of parameter shifts with credit market liberalisation, index CCI.

- CCI comes from MIMIC model of 10 credit indicators with rich controls, Fernandez-Corugedo and Muellbauer (BOE, wp 2006)

Credit market liberalisation should raise:

- the intercept, implying a higher level of log(c/y)
- the real interest rate coefficient.
- the impact of expected income growth.
- the MPC for housing collateral.
- But **reduce** the negative cash flow impact of a rise in the nominal interest rate.

UK income forecasting equation

- We use 3 info sets: simplest has trend reversion, change in short term interest rate, and log real house price x post Thatcher dummy.

(incl. real hp avoids charge that housing collateral effect on consumption is omitted income expectations).

Sophisticated model also includes tax rate, government deficit/GDPxPostThatcher dummy, stock market, union density, credit growth, real oil prices.

Life-cycle theory restrictions on role of log (yperm/y) in long-run

- Theory suggests log (c/y) = (1-discount rate)*log (yperm/y) + wealth effects etc.
- Evidence for perfect foresight, rational expectations and 'learning' models suggests:
- *either* high discount rate e.g.10% discount rate/quarter- as in Carroll(2001) buffer stock theory;
- *or* far lower role for permanent than current income.
- What does account for rise in c/y in late 1980s?

Figure 2: Long-run contributions to log consumption/income of the credit conditions index and its interaction with housing wealth/income.
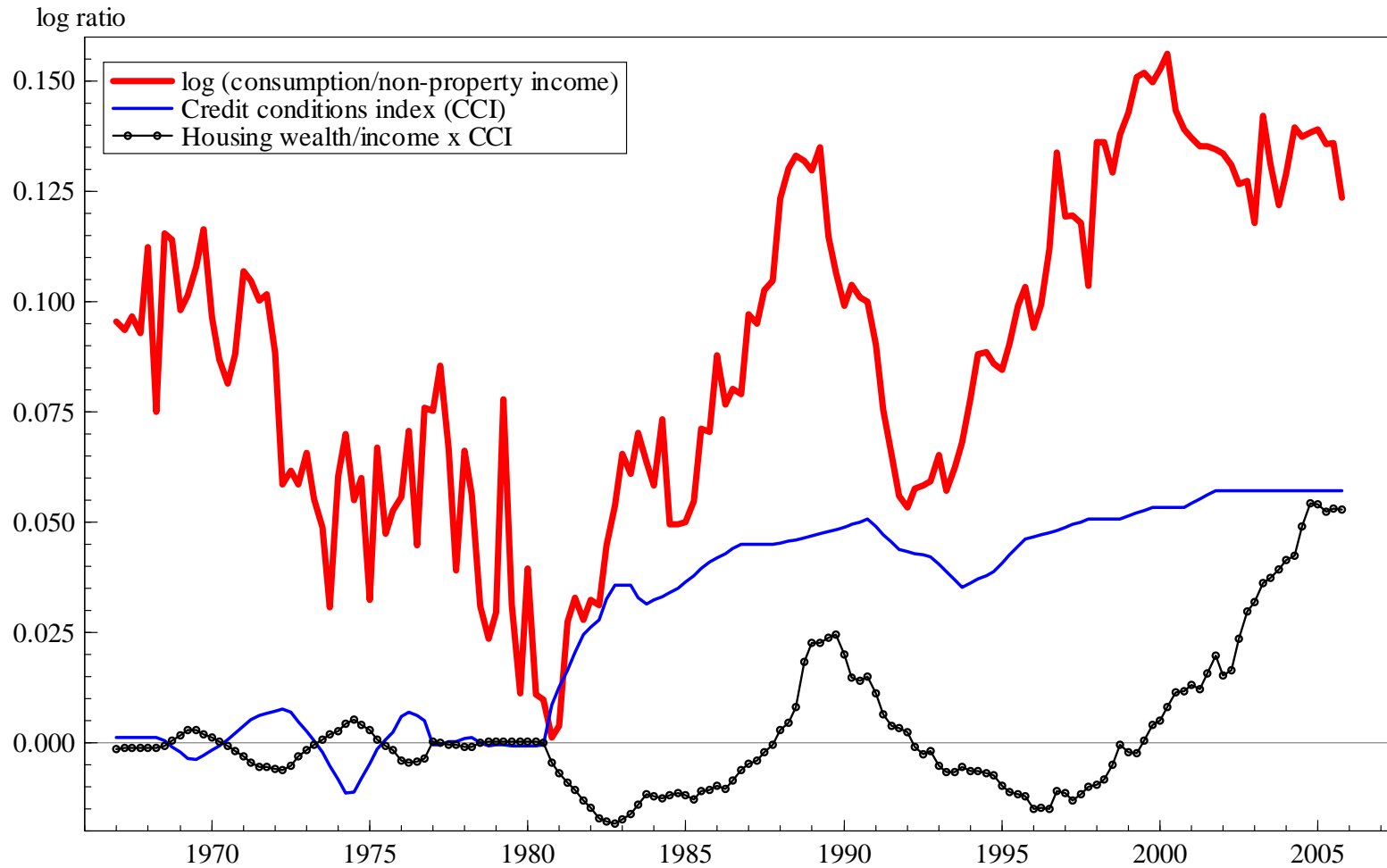
Figure 3: Long-run contributions to log consumption/income of net liquid assets/income and illiquid financial assets/income.
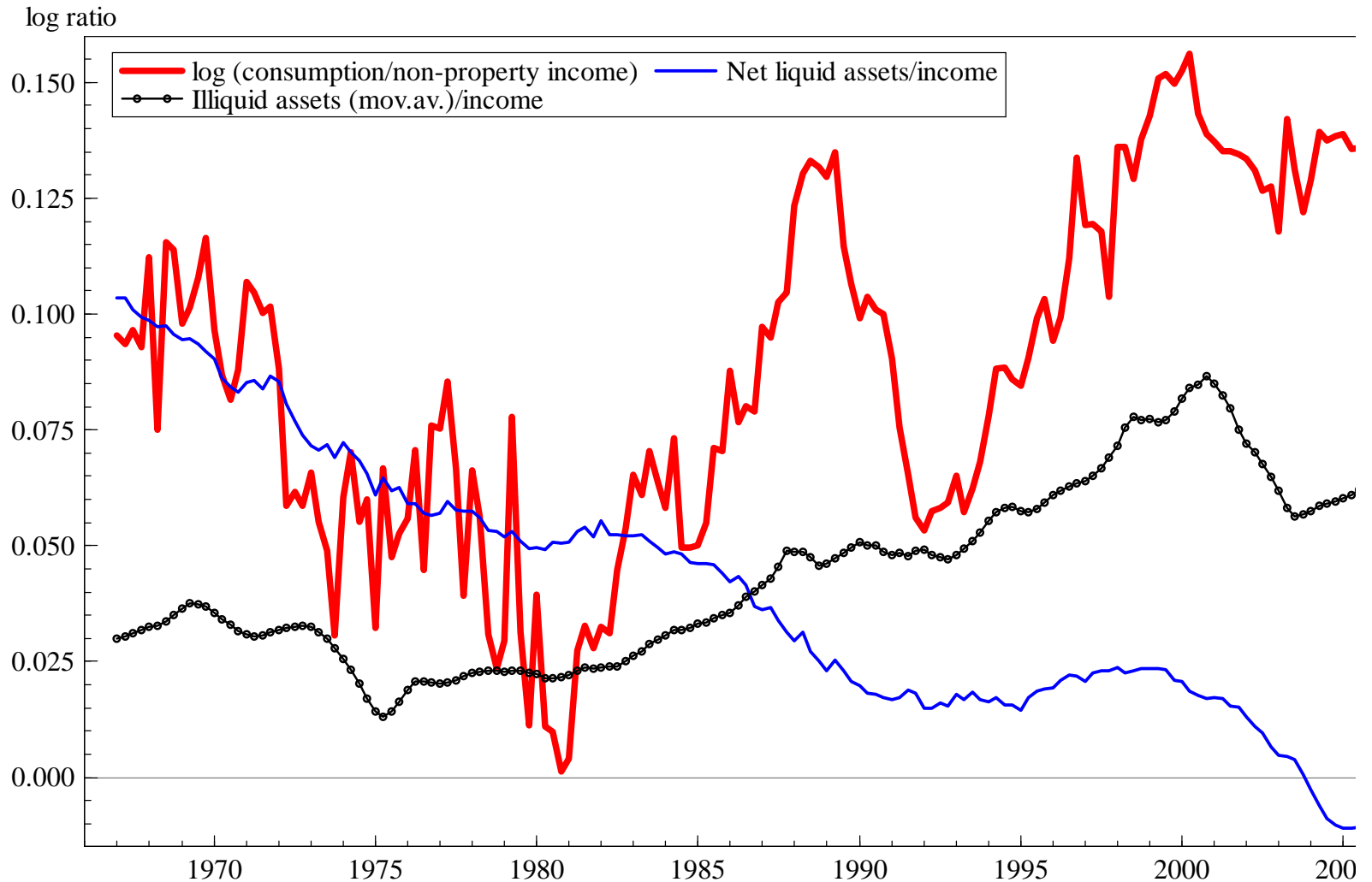
Model is very useful for policy

- Model gives 3 times larger weight to debt than to housing wealth so *net* housing wealth is wrong concept for consumption fn. (see Fig 3).

- When asset prices and income collapse, debt is heavy constraint on spending.

- Credit crunch has direct and interaction effects.

- Model made coming UK recession in 2008H2 obvious in summer 2008, but explain how lower interest rates have helped consumption.

- Strong policy implications of paper with Murata on Japan: quite different monetary transmission.

Section 3

- Centrepiece of all DSGE models is consumption Euler equation.

- Hall (1978) established that consumption growth should be unforecastable.

- Most DSGE literature ignores inconvenient truth: Campbell and Mankiw (1989, 1991) multi-country evidence on 'excess sensitivity' i.e. forecastability, of consumption growth.

- New evidence for UK, US and Japan of dramatic rejection of Hall hypothesis, consistent with failure of simple RE.

- Supports less restrictive consumption model of Section 2.

Section 4

- Attanasio et al (2009) claim UK micro evidence for expectations view and no 'housing wealth effect'.

- They regress consumption residuals by age on log hp or Δlog hp, arguing that lack of rise in correlation with age contradicts wealth effect.

- I regress their young, middle and old hh consumption residuals on UK macro data, finding results consistent with Aron et al (2008) i.e. role for housing collateral, income, income uncertainty, cash flow role of interest rate changes, and relaxation of credit.

Section 5

- Iacoviello (2005) and Iacoviello and Neri (2008) introduce housing sector and a financial friction into a DSGE model.

- I discuss 9 major omissions/failings of the model incl. contradiction with observed MEW, lack of amplification, contradiction of empirical evidence on house price determination, no saving for down-payment.

- Discuss other DSGE literature with housing.

6. What models should central banks use?

- "up the creek without a paddle (model)" is current predicament of some, since NK-DSGE models "have little to say about the current crisis". (ECB's suite of models was sensible).

- One way forward is to adapt older type income-expenditure models: FRB-US is a good example with systematic treatment of expectations.

- Improve credit channel transmission in consumption, hp and investment equations, with more focus on structural change and non-linearities.

Add default, bad loan, spreads feedbacks via banks and credit markets

- Empirical literature on defaults necessarily implies non-linear or asymmetric responses to asset prices, e.g. Aron and Muellbauer (2009) on UK mortgage defaults.

- Link defaults to asset base of banks, as in BOE RAMSI.

- Bernanke (1983), Brunnermeier (2008), Von Peter (2009) and papers by Duffie, Shin, Tirole, and Rajan all about aspects of this amplification.

Sources of amplification via household sector

- Extrapolative expectations or momentum trading.

- Log-linear house price model implies a type of 'frenzy' effect.

- Downside risk or fear induced by defaults can amplify downside.

- Linearity of budget constraint implies elasticity of consumption w.r.t. asset prices is higher with higher asset prices.

'Neoclassical' demand for durables theory defines 'user cost'
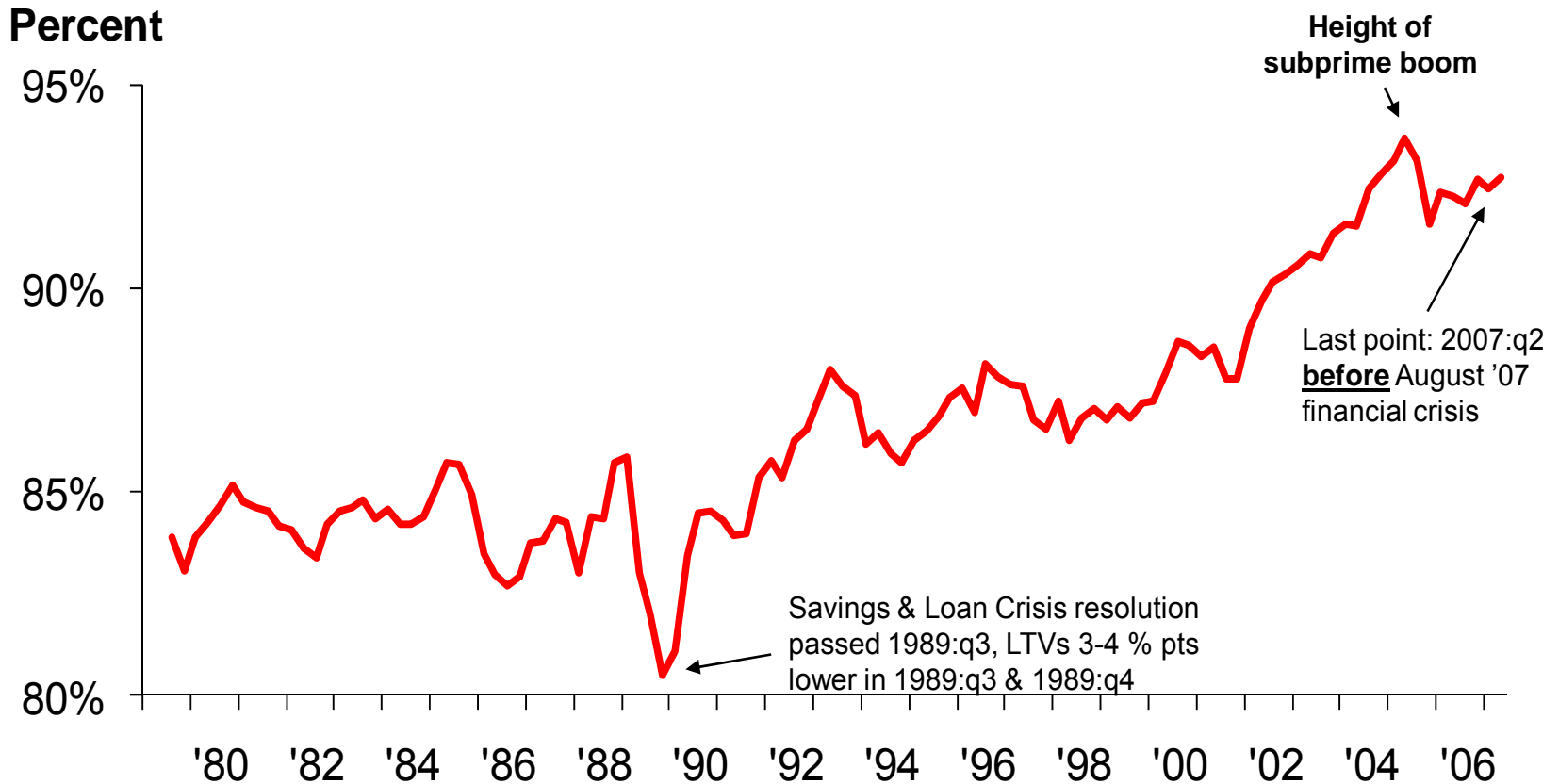
- Real user cost is (uch)(real house price index).

- Uch is real interest rate + (rate of tax, transactions cost, risk premium) – expected rate of appreciation of real house prices.

- Extrapolative expectations amplifies and propagates shocks.
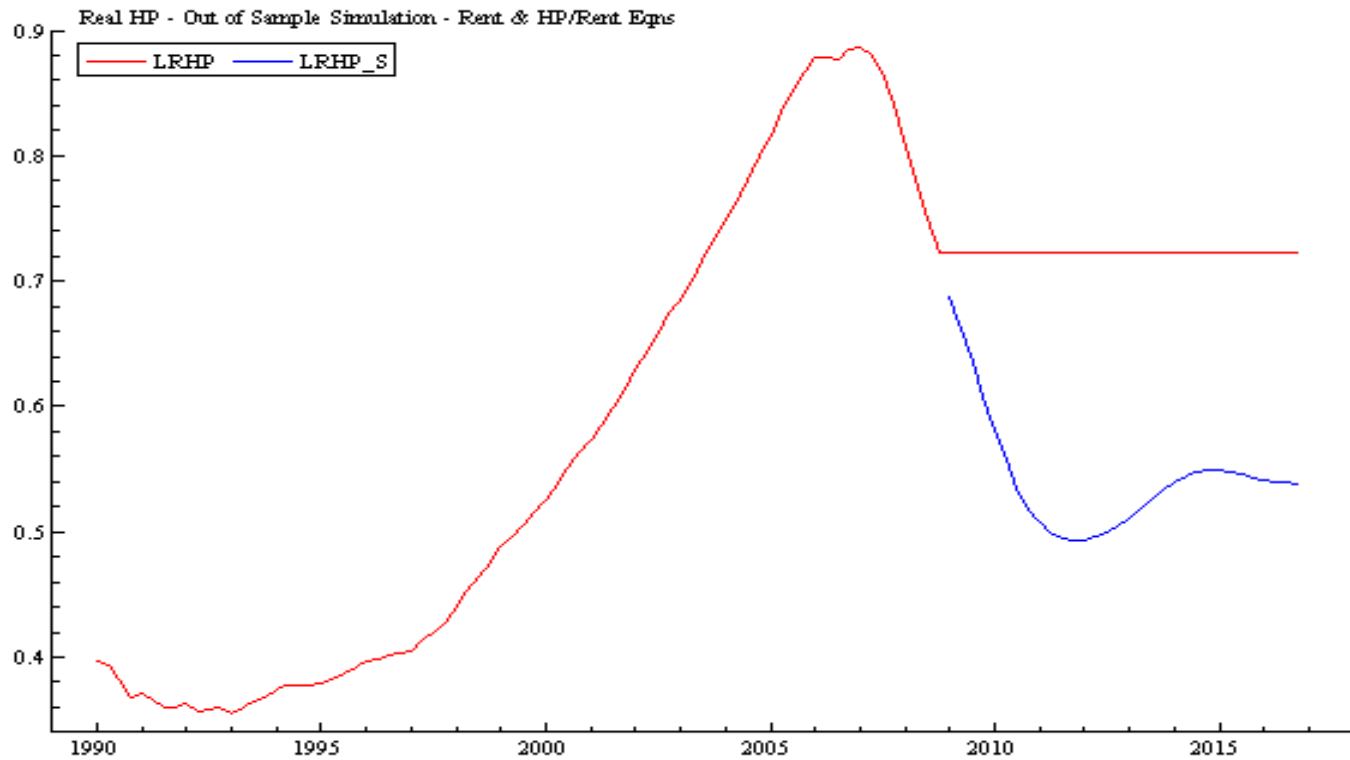
Amplification via expectations

- Much evidence for extrapolative element in expectations,or momentum trading, Piazzesi and Schneider (2008).

- Hence a sequence of positive shocks, e.g. sub-prime explosion – fall in LTVs for first time buyers and lower interest rates, can drive up appreciation, generating more demand and further appreciation.

- Important element in overshooting of US house prices, we show in Duca et al (2009).

- Our evidence is for 3-4 year memory of US hp appreciation.

Average LTVs for First-Time Home-Buyers Using Non-Gov't Mortgages

Percent

Height of subprime boom

Last point: 2007:q2 **before** August '07 financial crisis

Savings & Loan Crisis resolution passed 1989:q3, LTVs 3-4 % pts lower in 1989:q3 & 1989:q4

95%

90%

85%

80%

'80 '82 '84 '86 '88 '90 '92 '94 '96 '98 '00 '02 '04 '06

Source: American Housing Survey, calculations from Duca, Johnson, and Muellbauer (2008, in process). Non-gov't mortgages exclude FHA & VA insured mortgages and other gov't insured or direct mortgage loans that are generally limited in their individual size. 3-quarter moving average.

Real House Price Simulation Based on House Price-to-Rent and Rent Equ's (LTVs Revert to 1999 Q4 Level by 2008 Q4)

Amplification via non-linearity in user cost

- Log-linear version of model implies that log uch should have coeff. close to -1 in long-run.

- Log function amplifies movements when uch falls to low levels.

- With extrapolative expectations uch could even be negative during a house price boom, unless transactions costs, risk premia large enough.

- Hence 'frenzy' comes out of the theory.

- US data support log vs. linear form of uch.

Leamer (2007) 'Housing **is** the Business Cycle' points to size and volatility of residential investment

- Contradictory literature on residential supply reviewed in Muellbauer and Murphy (OXREP 2008).

- Mayer and Somerville (2000): residential construction responds not to level of real house prices but to rate of appreciation.

- could be part of reason for great instability of estimates of the supply elasticity.

- User cost incl. int.rate as well as rate of apprec.

Fitted contribution of log uch to log growth rate of US housing stock/head
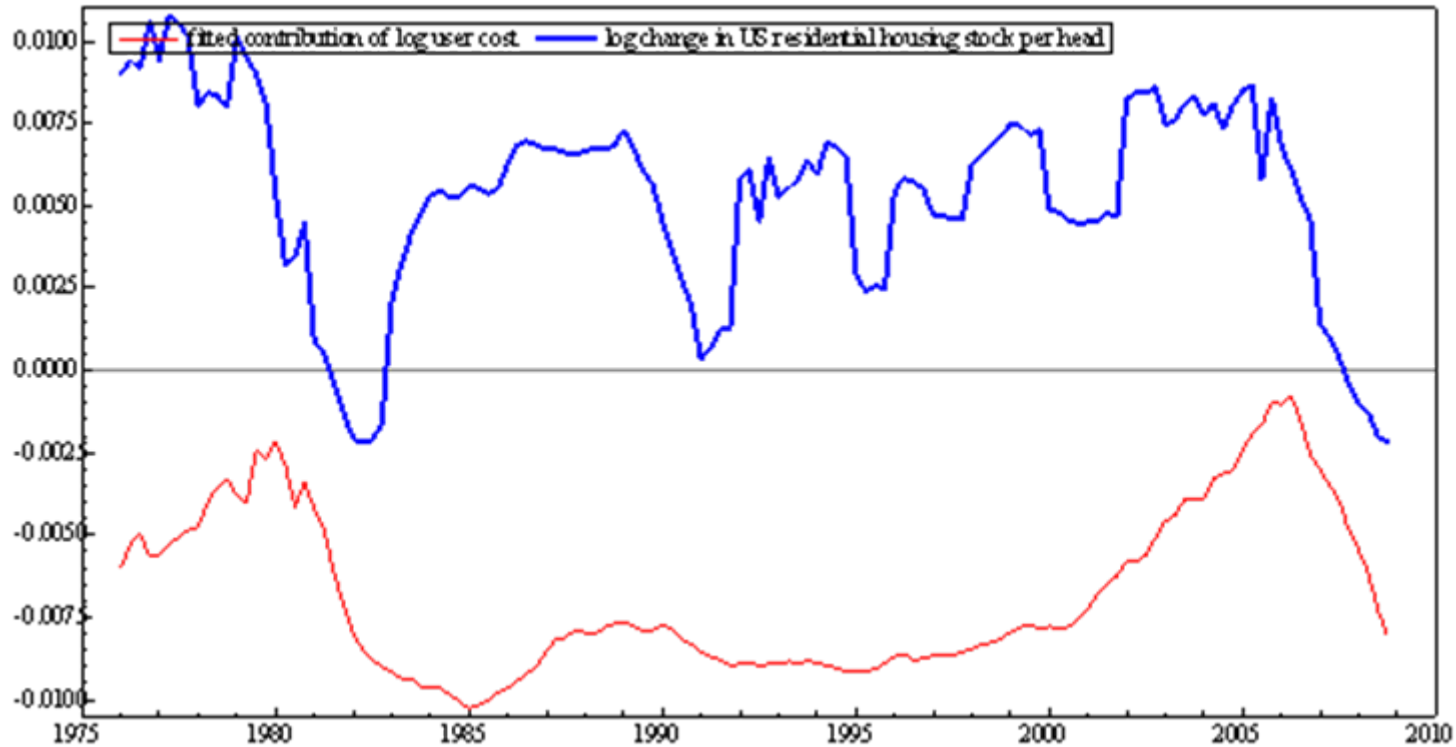
Remarkable US result

- For US model for log change in housing capital/head we find main driver is exactly same log user cost term (t=8) which drives our house price equation (i.e. capital gains and int. rate)

- Hence same double scope for amplification as for house prices: momentum trading and non-linearity.

- If Spain and Ireland are similar, would help explain res. construction boom and bust – hugely important for current collapse of GDP in those countries.

Econometric methodology

- Sims (1980) 'macroeconomics and reality' was suboptimal response to Lucas (1976) critique of macro-econometric models.

- VARs are just as prone to structural shifts and impose their own 'incredible restrictions' – to deal with curse of dimensionality, set of relevant variables and lags is often very restrictive.

Constructive response

- Work hard to handle structural change – shifts in credit market architecture and in fiscal and monetary policy rules.

- Expectations is key mechanism linking different variables, so conditioning on expectations, as in our consumption function, should produce more parsimonious structural equations.

- Automatic model selection (PCGets, Autometrics) is powerful tool for specification search.

Use MIMIC-type methods to extract information on credit shifts

- Joreskog-Goldberger (1975) multiple indicator-multiple cause idea used in Fernandez-Corugedo and Muellbauer (2006) to extract CCI as common factor from 10 jointly estimated equations for credit indicators, with complete set of economic controls.

- Current EC project on early warning indicators of housing stress is attempting same in multi-country setting.

- Sub-system estimation with cross-equation restrictions.

Allowing for possibility of longer lags

- In our work on forecasting US inflation on monthly data Aron and Muellbauer (2008), we use flexible lags up to 3 months, then $\Delta_3 x_{t-3}$,

    $\Delta_6 x_{t-6}$, $\Delta_{12} x_{t-12}$.

- Thus 24 monthly lag coefficients are replaced by 6: example of "parsimonious longer lags", PLL.

- Standard use of information criteria to select VAR lag length throws away key information relevant for forecasting inflation. PLL does much better.

Conclusion

- Evidence based macro research needs to replace faith based models.

- Theory needs to be used in less heavy handed manner and data used to discriminate.

- Nest alternative theories in encompassing model and test.

- Though we've learnt a lot from good micro panel data, there is huge information content in macro data and quality of micro data is sometimes worse.

Inform policy

- We need systems to model the main feedbacks – the essence of dynamic, stochastic general equilibrium/disequilibrium.

- Dynamic simulation of shocks can be used to explore alternative scenarios, risks and policy options.

reserve slides follow

Encompassing Friedman-Ando-Modigliani Consumption Function and Credit Channel

- Many studies of housing wealth effects suffer from poor controls, but not this one:

$$\Delta \log c_t \approx \beta(\alpha_{0t} - \alpha_{1t} r_t - \alpha_{2t} \theta_t + \alpha_{3t}(E_t \log y_t^p - \log y_t)$$

$$+ \gamma_1 NLA_{t-1} / Y_t + \gamma_2 IFA_{t-1} / Y_t$$

$$+ \gamma_{3t} HA_{t-1} / Y_t + \log y_t - \log c_{t-1})$$

$$+ \beta_{1t} \Delta \log y_t - \beta_{2t} \Delta nr_t (DB_{t-1} / Y_t) + \varepsilon_t$$

3. 'Simple asset-arbitrage relationships': the Euler equation

- The consumption Euler equation comes from optimal asset allocation over time and is centre-piece of standard DSGE.

- Hall (1978) showed (under 'usual' ass'ns) that it implies that consumption growth should be unpredictable, given previous period's information.

- Campbell-Mankiw (1989,91) showed it fails for every OECD country in their data set.

# Using better instruments, striking failure for UK, US, and Japan

- As in Campbell-Mankiw, strong evidence of 'excess sensitivity': forecastable income growth has strong effects on consumption growth.

- 'Habits' cannot rescue the model and rejection seems not just because of credit constraints.

- Supports modern solved out consumption function – discussed earlier, consistent with more realistic view of household behaviour.

4. Attanasio et al (ABHL 2009), previously BOE w.p.

- Use (non-panel) micro data from FES. 1975-2001.

- Use information on regional house prices to measure impact of house price changes and levels on hhs by age and tenure.

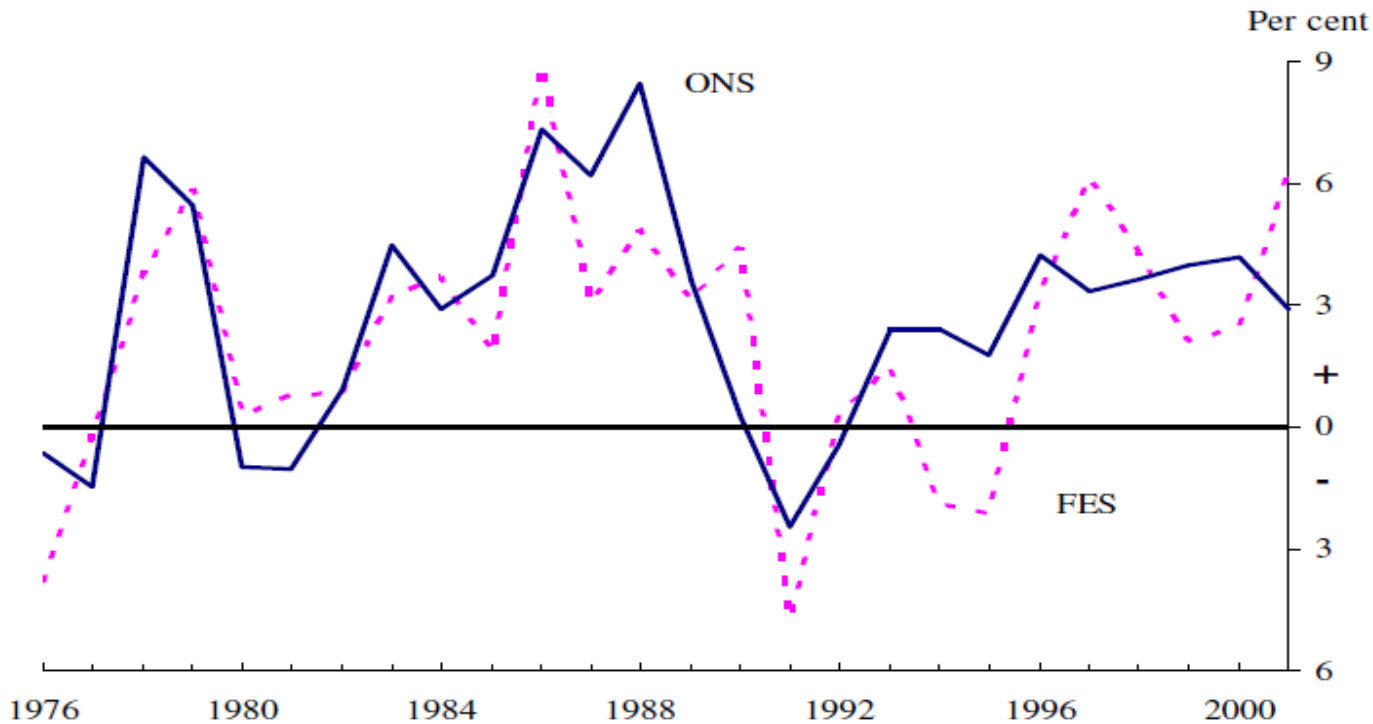- Expect to find bigger effects on older hhs and owner-occupiers if housing wealth hypothesis holds.

Gap between actual and predicted levels of consumption, by age group
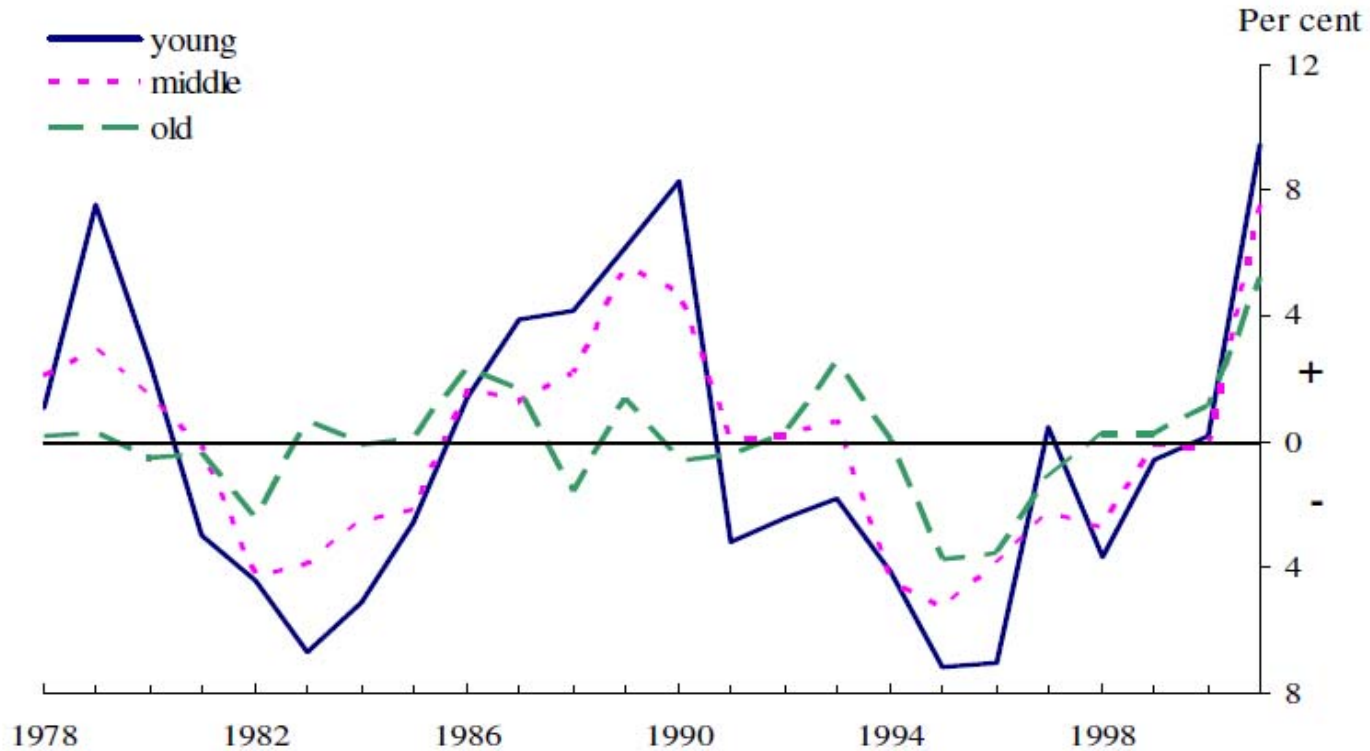
FES micro data quality: FES vs. ONS agg. consumption data. FES income data worse.

Aggregate consumption growth:
FES and ONS 1975-2001

ABHL omit obvious controls

- Current income, change in interest rate, change in unemployment rate, liquid asset and debts, other financial wealth.

- Hence correlation of consumption with hp biased by correlation of hp with omitted controls.

- Theory and evidence of our aggregate consumption function also has predictions for differences by age.

Consumption differences by age

- The young are most affected by changes in the unemployment rate: have higher unemployment rates, less secure labour market attachment.
- The young (21-34) and even more mid-aged (35-59) have biggest mortgages, so more affected by changes in mortgage rate.
- Young and mid-aged should show biggest response to current non-property income.

We regress ABHL's consumption residuals on agg. UK data

- Deviation from trend of log income
- Change in interest rate.
- Change in rate of unemployment.
- Forecast growth rate of income
- Net liquid assets/income
- CCIxHousing wealth/income
- CCI
- Meas. error proxy: FES minus agg. cons.

Findings

- Current income DOES matter – a lot, even though instrumented with previous year's data.

- Sensitivity to current income correlated with age, as predicted.

- Evidence for meas. error hypothesis, for young and mid-aged.

- CCI effect largest for young (previously most credit constrained).

Findings cont'd

- big differences by age in response to interest rate and unemployment rate changes- young biggest for unemployment, mid for interest rate.

- Some support for income expectations hypothesis.

- Support for housing collateral hypothesis, but NOT housing wealth hypothesis, exactly consistent with AMM UK paper or ADMMM AEA paper. Agree with ABHL on lack of classical wealth effect.

5. DSGE models with housing

- Iacoviello (2005, AER)

- Iacoviello and Neri (2008) w.p. extends earlier model to endogenize housing supply side in 2-sector model and updates estimates to 2006.

- Very influential approach – e.g. European Commission using similar model.

- Calza, Monacelli and Stracca (2008) 'Mortgage Markets, Collateral Constraints and Monetary Policy' add variable rate/fixed rate mortgages

The Model

Two Sectors: goods and housing

- Two Types of Households
- Patient Households work, consume, buy homes, rent capital and land to firms and lend to impatient households
- Impatient/Credit Constrained Households work, consume, buy homes and borrow against the value of their home

(Preferences set up so that the borrowing constraint is binding)

Comments 1-3

1. Closed economy so one group of hhs lends to the rest and to firms – misses 7% US current account deficit – lending from ROW via financial services industry. Thus cannot account for large positive, volatile levels of US MEW.

2. Misses amplification from financial sector.

3. Credit rationing driven by exog. taste difference and unexplained LTV limit – no asymmetric info.

Comments 4-7

4. Fixed fraction of credit constr. hhs omits time-varying expectations of income, capital appreciation and uncertainty.

5. Also omits life-cycle: young households need to borrow but have to save first for initial housing deposit. Their saving should depend on both LTV constraint and level of real hp.

6. Precautionary saving is missing.

7. No default risk – mortgage foreclosures in US now at record levels.

Comments 8-9

8. Incredible housing preference shocks play major role in explaining real hp and housing investment.

9. No role for extrapolative expectations of hp appreciation or other market inefficiencies. So ignores large literature on housing market inefficiency.

Other DSGE work with housing

- Recent literature by Favilukis et al (2009), Kiyotaki et al (2008), Rios-Rull and Sanchez (2008) and others has expanded the framework in a number of directions, but how to endogenize the banking system, and its shock-amplifying role remains a large open question.

- Favilukis et al (2009) introduce foreign creditors and model rise in LTV as reduction in risk premium.

- Rios-Rull and Sanchez admit it's hard for a RE DSGE model to obtain realistic volatility and persistence of hp and investment.